
CAD/CAM Industry Service Electronic Design Automation Applications

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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.

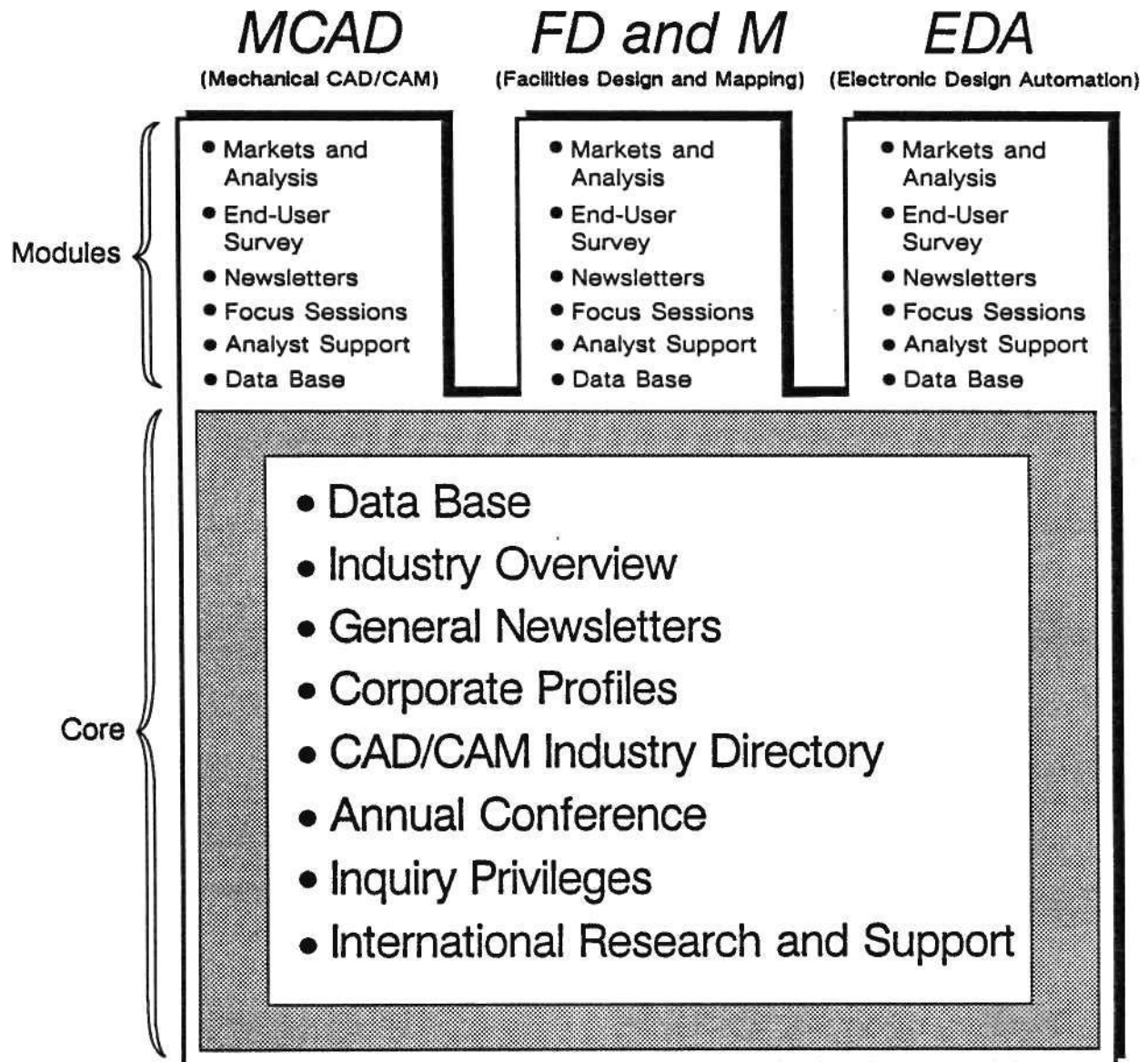
Core Service

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*

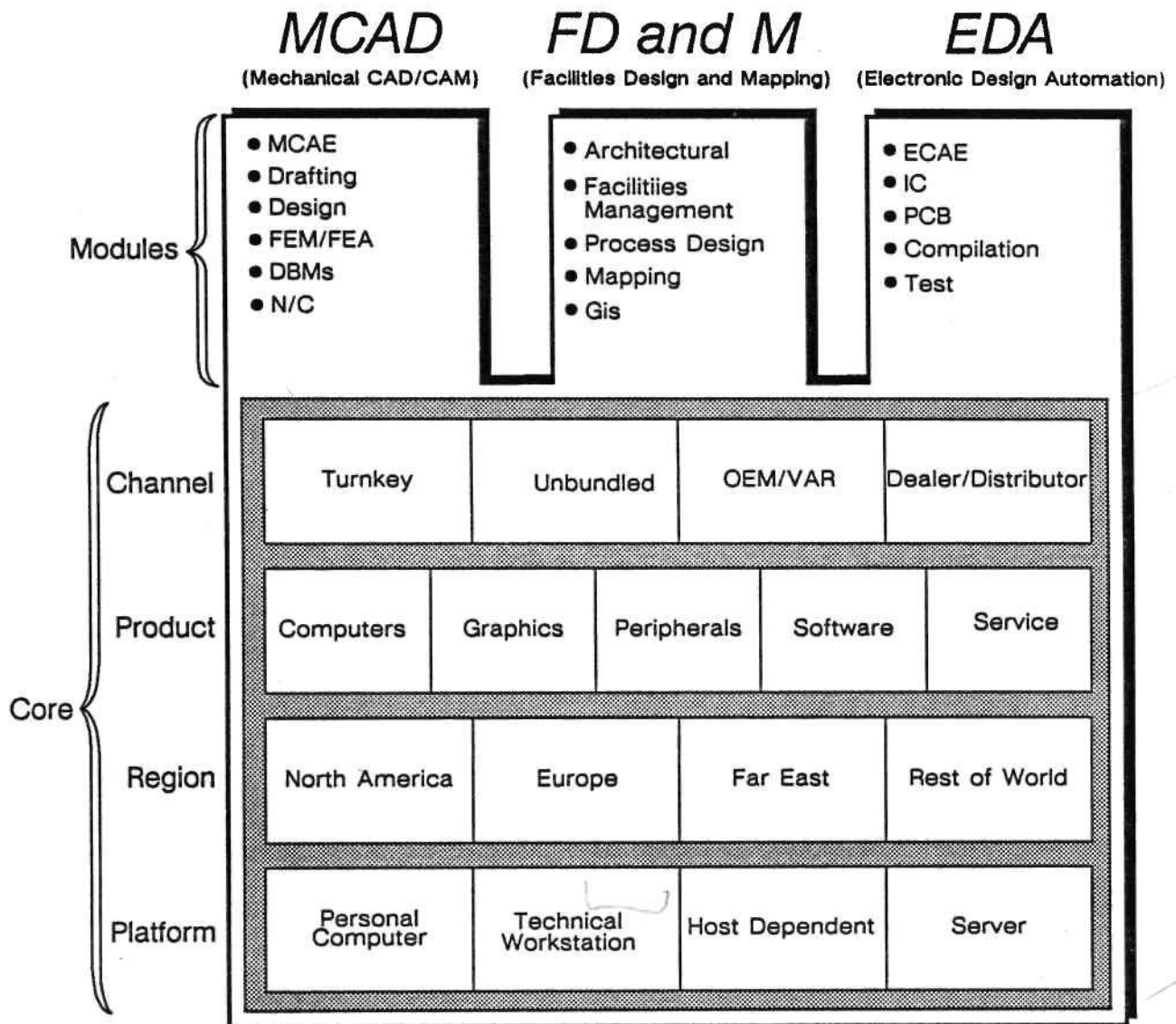
Each application module contains information and analyses particular to the specific application, including newsletters and other event-driven publications, market overview, market shares and forecasts, and specialized research and surveys. Each application module is supported by a staff of CCIS analysts 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 | • Control Data |
| • Applicon | • Daisy |
| • Auto-Trol | • Digital |
| • Autodesk | • Exapt |
| • CISI | • Ferranti |
| • Cadnetix | • Fujitsu |
| • Calay | • Futurenet |
| • Calcomp | • Gerber Systems |
| • Calma | • Graftek |
| • Cimlinc | • Hewlett-Packard |
| • Computervision | • Hitachi |

- | | |
|-----------------------|---------------------------|
| • Hitachi Zosen | • Robo Systems |
| • Holguin | • SDRC |
| • IBM | • Scientific Calculations |
| • Intergraph | • Seiko I&E |
| • MacNeal-Schwendler | • Sharp System Products |
| • Matra Datavision | • Siemens |
| • McDonnell Douglas | • Silvar-Lisco |
| • Mentor | • Sun |
| • Mitsubishi Electric | • Synercom |
| • Mutoh Industries | • Syscan |
| • NEC | • Tektronix |
| • Norsk | • Telesis |
| • Otsukashokai | • Toshiba |
| • Pafec | • Valid |
| • Prime | • Zuken |
| • Racal-Redac | • 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 | • Automated Systems |
| • ACDS | • Cadam |
| • Accugraph | • Caeco |
| • Advanced Geographic Systems | • Cascade Graphics |
| • Aptos | • 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
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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.

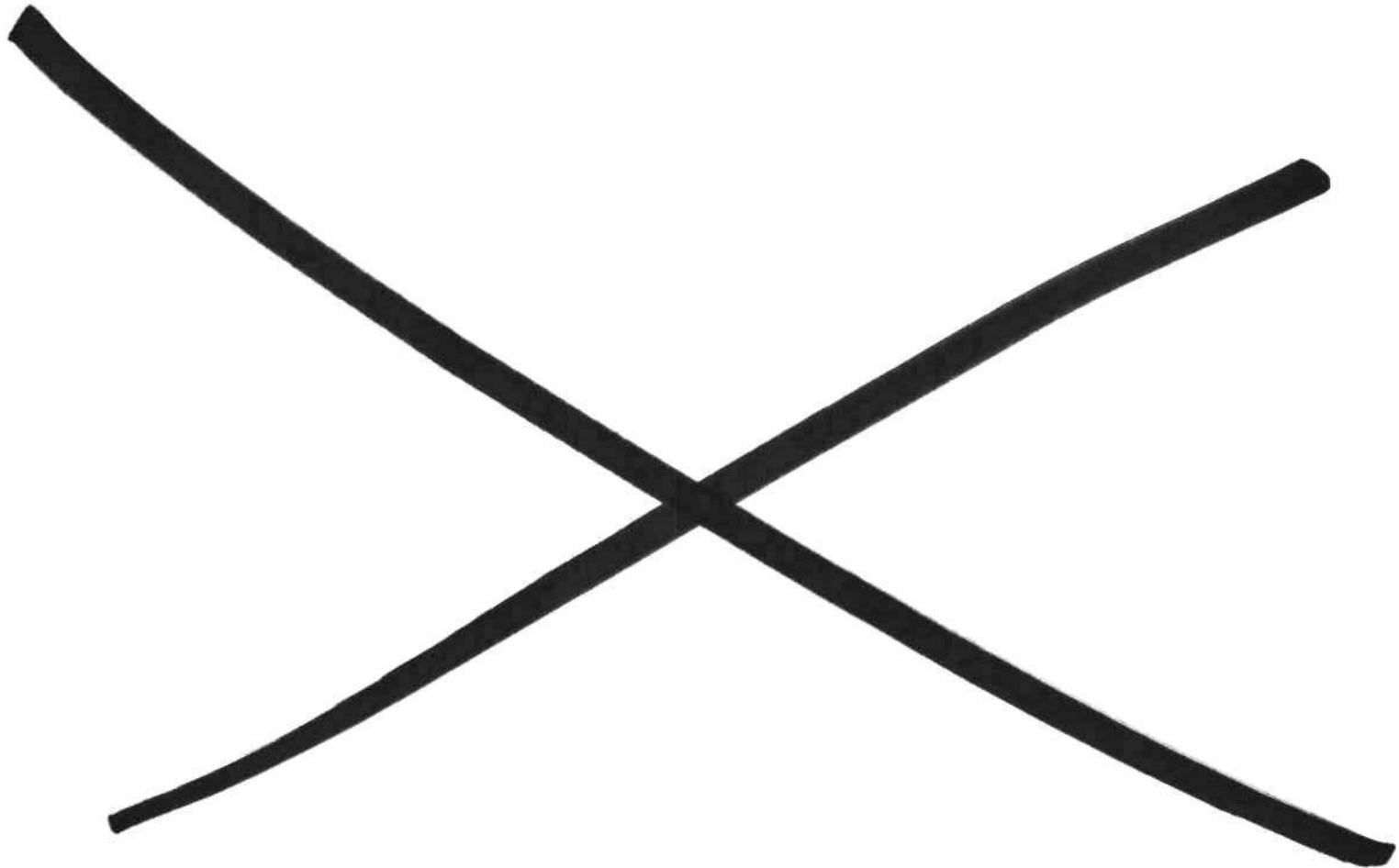
Dataquest's revenue and shipment estimates are based on the following sources:

- 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.



1.1 EDA Definitions

The electronic segment encompasses design automation products that are typically used to support the design and manufacture of electronics products. Their primary users are engineers, designers, and draftspeople involved in the design, documentation, and engineering process. This section defines the major electronic design automation (EDA) product areas: electronic computer-aided engineering (ECAE), printed circuit board (PCB) layout, and integrated circuit (IC) layout. It is followed by a general discussion of the history, trends, and opportunities in the EDA market. Other sections in this binder contain detailed discussions of each individual product area.

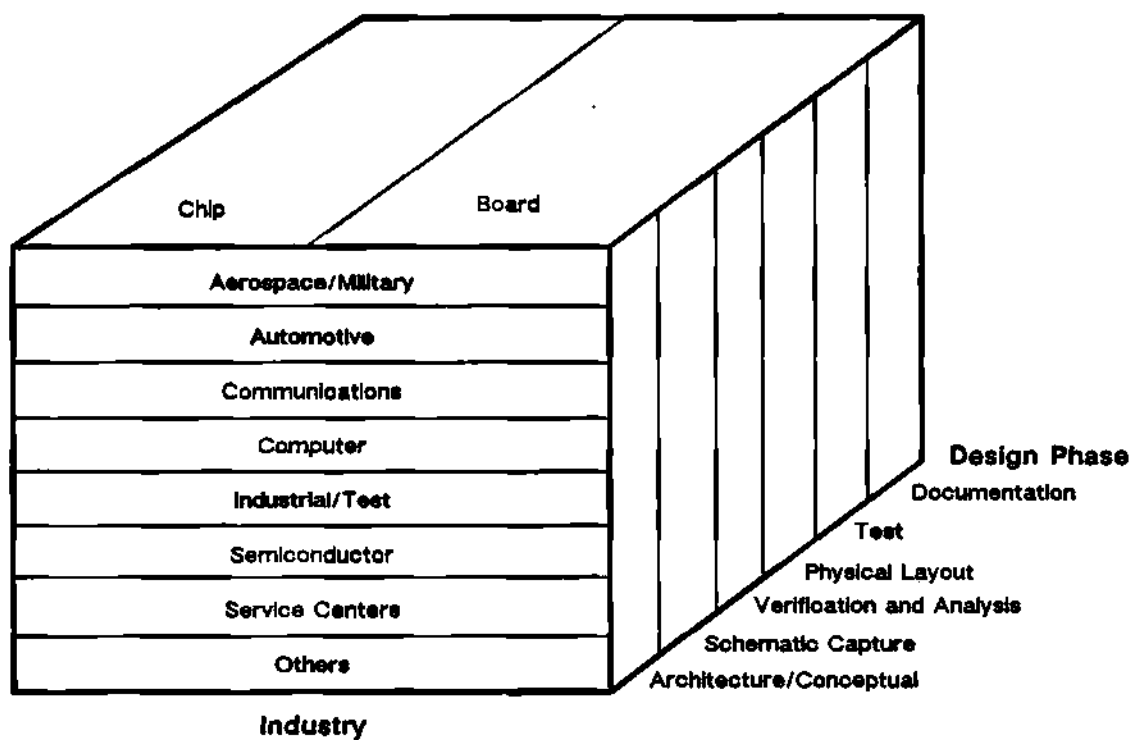
Dataquest would like to provide one further note of explanation of our use of the term EDA. Dataquest now uses EDA rather than the term ECAD to describe the entire electronic CAD market. The term ECAE (rather than EDA, which was used formerly) is used to distinguish tools used up front in the electronics engineering process. We made these changes in order to keep pace with industry-standard terms and practices.

DEFINITION OF THE EDA MARKET

Dataquest has defined the EDA market in terms of major applications, users, and technology. Figure 1.1-1 illustrates the basic model used in our analysis.

Figure 1.1-1

Electronic Design Automation
Application Model



Source: Dataquest
July 1988

Definition by Technology

Dataquest distinguishes between two major technology applications: IC design and PCB design. Integrated circuits include standard components, such as TTL and ECL; very large scale integrated (VLSI) circuits such as the Intel 80386 or the Motorola 68030; and application-specific integrated circuits (ASICs), such as gate arrays, standard cells, and PLDs. PCBs cover the complete range of board design, including single-board systems, multiboard computers, or embedded hardware for real-time operations.

Definition by Application

The EDA market applications are organized by major design phase, from the initial conceptual design of the product to layout, test, and release to manufacturing. For purposes of forecasting, we group together three major classes of application: ECAE, IC layout and PCB layout.

ECAE applications are used in the up-front part of the design process for the engineering and documentation of the product. ECAE includes the following design stages and applications:

- Architectural design tools that specify and evaluate the general concept of the design, and logic design automation tools that facilitate this process
- Schematic capture tools that create detailed implementations and documentation drawings of the design
- Verification and analysis tools that debug the design's logical and timing behavior and check conformity to electrical rules, thermal behavior, and other key characteristics
- Test tools that generate and create the patterns used in the manufacture of the product
- Documentation tools
- Data base management tools that link applications, manage design data, and track libraries

IC layout tools are used during the physical design phase to create and validate the geometric patterns that will be used in the manufacture of the IC (e.g., mask data or e-beam information). Applications that are tracked in the IC layout market include:

- Polygon editing systems that create mask geometries manually
- Automated place-and-route systems for gate arrays, standard cells, and cell-based designs

- Silicon compilation systems that generate IC structures automatically
- Layout verification that performs electrical rule checks (opens, shorts), design rule checks (design rule spacing), and net-list versus layout comparison on the final geometries

PCB layout tools are used during the physical design phase to create and validate the data that will be used to manufacture boards (e.g., solder masks, board outline, and drill data). Applications that are tracked in the PCB layout market include:

- Layout editing systems that place-and-route board designs manually
- Automated routers and routing accelerators
- Layout verification tools that check design rule spacing
- Thermal and reliability analysis packages that evaluate the layout's cross talk, noise, and stability under varying conditions
- Software interfaces to manufacturing systems (numeric control output and Gerber and photoplot information)

Dataquest established this differentiation between ECAE, IC layout, and PCB layout by distinguishing between the primary output of each system. Layout systems primarily generate manufacturing information (mask sets, numeric control data, etc.). ECAE systems primarily generate net-list data used to drive physical layout systems (though other major ECAE output includes test patterns and schematic documentation).

Definition by User

We also characterize the market in terms of eight major classes of user. Dataquest user surveys examine attitudes, needs, levels of penetration, and spending plans in each category. This data is the basis of our overall forecasts and underlies our analyses of major technology trends.

Aerospace/Military

The aerospace/military segment is among the early adopters of all EDA technologies, and, while not the largest segment, has continued to assume the role of technology leadership. Military/aerospace companies are driven by the need to provide very sophisticated real-time systems in increasingly compact spaces. The military also sets very rigid standards for reliability and documentation. As such, they have been aggressive users of ASICs, surface-mount technology, simulation, and special-purpose hardware, such as logic accelerators. The pending navy purchase of millions of dollars worth of EDA equipment ensures that the military will be a significant factor in the EDA market for years to come.

Automotive

With the growing amount of electronics in today's cars (fuel systems, brakes, repair monitors, etc.), the automotive segment uses EDA technology aggressively. The automobile industry's use of ASIC components and surface-mount board designs is behind this market's increasing use of advanced ECAE and PCB systems.

Communications

EDA is used in most communications companies wherever possible (e.g., digital switches), but in some cases the design automation tools have not equaled the design problem (e.g., microwave design). In addition, major communications companies, particularly AT&T, have extensive amounts of internally developed software and IC design capability (full custom and standard cell). This in-house design and manufacturing capacity has tended to slow the acquisition of commercially available tools at these user sites.

Computer

As is the case in communications, EDA plays an important role in computer design, but many organizations have internally developed capabilities that augment commercially purchased tools. The heavy use of ASICs and microprocessors tends to encourage the use of EDA technology. As tools have emerged that can support the rigors of very large digital systems design, such as mixed hardware and software development, penetration into computer companies has steadily increased.

Industrial/Test

This segment is among the slowest of EDA adopters and has only begun to enter the market. The heavy analog component of the designs in this segment (e.g., controllers) has tended to limit the applicability of the available tools. This factor, coupled with conservative design practices, has tended to slow the rate of penetration.

Semiconductor

Semiconductor companies are among the heaviest users of EDA. The absolute need for EDA technology in order to design and manufacture ICs has forced semiconductor companies to make substantial investments in design automation. In the case of ASIC, EDA tools are required just to deliver the technology to the end user. In spite of the high levels of penetration in this segment, competitive pressures (more complex chips developed in less time) are pushing these companies to continue to purchase more equipment and more advanced technology, such as silicon compilation, as it comes onto the market.

Service Centers

Service centers are perhaps the heaviest of users of EDA, if only because they depend on it for their business. PCB layout shops, ASIC design centers, and custom software businesses all need EDA in order to be competitive. While not the largest market segment, these end users are the most quality conscious. A company in the CAD system business cannot afford downtime on a CAD system.

Other

This segment includes several important areas of EDA users, most notably consumer and education. The consumer electronics market is dominated by Japan and the newly industrialized countries. While the semiconductor arms of these companies (e.g., Matsushita, Samsung, and Hitachi) are heavy users of EDA, the consumer divisions themselves have been slower to adopt EDA. Universities, on the other hand, have been eager adopters of EDA and suppliers of public domain software. The advent of PC-based packages saw a steady influx of design capabilities to engineering schools, and universities like Berkeley have established an excellent reputation for supplying state-of-the-art design packages like SPICE or UNIX.

1.2 EDA Executive Summary

This summary highlights the key points and analyses presented in this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the electronic design automation (EDA) segment. Highlights include the following:

- The EDA market was \$1.98 billion in 1987; it is forecast to grow to \$2.56 billion in 1992, at a compound annual growth rate (CAGR) of 5 percent.
- The EDA market is expected to grow to \$2.17 billion in 1988, representing a 9.5 percent increase, but overall growth is slowing as the EDA market matures.
- Dataquest expects workstation unit shipments to remain relatively strong.
 - Between 1987 and 1992, we expect workstation shipments to grow at a 12 percent CAGR from 50,369 in 1987 to 89,210 in 1992.
 - In 1988, shipments are expected to surge 21 percent to 60,800.
- Dataquest believes, however, that strong workstation shipments will be offset by a declining average price per seat. The average price per seat is forecast to decline at 9.9 percent CAGR from \$25,400 in 1987 to \$15,100 in 1992.
- Regionally, the Far East and Europe accounted for 27 percent and 28 percent, respectively, of 1987 EDA revenue.
 - Europe will remain the strongest EDA growth region through 1988.
 - North American revenue, while representing 44 percent of the 1987 market, is growing at only 3 percent CAGR.
 - Far Eastern revenue was essentially flat in 1987, when corrected for yen appreciation.
- In our opinion, the decline in revenue growth rates indicates that the EDA market is maturing and that 1987 was a pivotal, positioning year. We believe that the following events and trends point toward market maturation:
 - Among key EDA vendors, a race for second place in the market (after Mentor Graphics) is developing.
 - Daisy and Valid Logic, having recovered from relatively weak 1986 performances, are riding both 386 and Sun waves.
 - These two vendors in turn have been joined at the \$100 million annual revenue mark by Cadnetix after its HHB acquisition, with several other contenders such as Racal-Redac not far behind, as the rate of strategic mergers and consolidations in this market continues to accelerate.
 - EDA end users are much more experienced at this point, with increasingly sophisticated and conservative buying behaviors. This situation both increases the sales cycle and puts increasing pressure on vendors to hold prices down.

1.3 EDA Market Overview

HISTORY

Over the past 20 years, the electronic design automation (EDA) industry has been transformed from a handful of start-up companies to a \$1.98 billion market in 1987. In the process, it has evolved from serving the needs of a few design specialists to serving the entire electronics community. Indeed, the EDA industry has been a highly competitive, explosive market that has permanently changed the nature of electronics design.

The EDA market's evolution can roughly be characterized by four major phases: automated drafting, automated design, computer-aided engineering, and, now, automated engineering. Each of these phases has seen the EDA market expand dramatically. New tools from new companies on lower-cost platforms addressed the needs of an exponentially increasing audience and generated the dynamics between customers, technology, price, and suppliers that has fueled the market's growth.

The first wave of EDA products in the early 1970s was drafting tools for printed circuit board (PCB) and integrated circuit (IC) designers. Provided by companies such as Calma and Computervision, these tools replaced the error-prone and tedious technique of mylar and tape for generating the mask sets, numerical control data, and other information used in IC/PCB manufacturing. The automated drafting tools were all host-based systems connected to graphics terminals. This made these systems high in price, and initially limited them to the larger companies that could afford them.

In the next phase, companies such as Genrad, Silvar Lisco, and Teradyne began to supply automated design tools. These tools—logic simulators, circuit simulators, and placement-and-routing—provided truly automated solutions to tasks that had theretofore been done manually. However, the use of such tools was limited to sophisticated engineers doing VLSI and large-system design. Although these products, like the drafting systems, were host-based, the automated tools were primarily batch programs with textual input and output, as opposed to interactive graphics.

The third wave, CAE, began in 1981 and saw the EDA market extend to include the general engineering community. Companies like Cadnetix, Daisy, Hewlett-Packard, Mentor, and Valid took the EDA technologies invented in the 1970s, made them more user-friendly, and integrated them on technical workstations and PCs. Initially focused on engineering tasks such as schematic entry and simulation, these companies were quick to expand into automated PCB and IC drafting and design, becoming full-line EDA suppliers. Bringing EDA tools to the average electrical engineer made it possible to apply them to problems such as application-specific IC (ASIC) design or system verification. In addition, the shift to technical workstations and PCs made it much less expensive to purchase and support systems. Rather than a mainframe that was cost-effective only with a large number of users, companies could now acquire systems on an incremental, per engineer basis—and at a much lower price per engineering seat.

The fourth generation of companies is focused on automating engineering in the truest sense of the word. These new suppliers—Cadence, EDA Systems, Gateway, Silc,

Silicon Compilers, and Synopsys—are providing tools that help design and layout engineers to improve the quality and efficiency of their work. In the past, EDA tools largely sought to emulate, not to automate. A gate-level simulator substituted for a pattern generator and logic analyzer, and a schematic-capture system replaced a drafting board. These tools did not add to the individual's skills. The fourth-generation tools, however, are literally beginning to perform work for the engineer by automatically optimizing a design or generating layouts. In the process, such tools are fundamentally changing the methodologies by which electronics products are created.

Today, EDA is an integral part of most companies' electronics manufacturing and development plans. Electronics firms are looking to design automation to provide them with a strategic advantage in the marketplace, not just as a labor-saving device. We are quickly approaching the day when a workstation will be on every engineer's desk complete with a rich set of design and management application tools. This network of design stations will be the central path by which new products are created and brought to market.

1987—A YEAR OF POSITIONING AND CONSOLIDATION

After a fairly difficult transitional year in 1986, the EDA industry underwent significant consolidation in 1987 and into 1988. This consolidation reflected conscious efforts by individual suppliers to position themselves for long-term growth and stability. The result of this activity is that although total market growth remained only 11 percent, the industry appears to be much healthier. Profitability for individual firms is up sharply, and revenue growth is following, although at a slower pace.

From January 1987 to June 1988, the industry has averaged approximately one merger, acquisition, or major investment (more than 25 percent equity purchase) per month. The value of these mergers and acquisitions is more than \$200 million. Table 1.3-1 highlights these transactions and their cash value.

The specific motivation behind these mergers and acquisitions varies. In some cases, two players combined to more effectively address a specific niche, for example, SCI/SDL, SDA/ECAD, and Zycad/Silicon Solutions. In other cases, large, full-line vendors, such as Mentor/Cadent and HHB/Simucad, were moving to control a key technology. In still other cases, this activity reflected the need to increase market share in order to compete, as with Cadnetix/HHB and Valid/Calma IC.

Yet, regardless of the rationale behind each decision, the objective of these companies was to reposition themselves to become more effective competitors. Economies of R&D, sales/distribution, and greater market presence all make for a better company if the merger can be properly effected.

Table 1.3-1

Major EDA Mergers and Acquisitions

Date	Description	Valuation (\$ Millions)
1983 September	Mentor Graphics Corp. acquires California Automated Design Inc. (CADI)	N/D
1984 November	Data I/O Corp. acquires FutureNet Corp.	\$27.0
December	Daisy Systems Corp. acquires Vulcan Software Inc.	\$ 2.3
1985 January	Tektronix, Inc. acquires CAE Systems, Inc.	\$75.0
September	Hewlett-Packard Co. acquires Cerikor Inc.	\$20.0 (est.)
1986 July	Shiva Multisystems acquires SimuCad, Inc.	N/D
August	Harris Corp. acquires Scientific Calculations	N/D
November	Zycad Corporation acquires Silicon Solutions Corp.	\$16.0
1987 February	Valid Logic Systems Inc. acquires Telesis Systems Corp.	\$18.5
March	Silicon Compilers Incorporated (SCI) and Silicon Design Labs (SDL) merge	N/A
April	European Silicon Structures (ES2) acquires Lattice Logic Ltd.	\$ 1.0 (est.)
June	Caeco Inc. acquires DeNies Resources, Inc.	N/D
	Data I/O-FutureNet acquires Endot Inc.	\$ 5.0
	Mentor Graphics Corp. acquires Caedent Corp.	\$ 0.5*
October	Valid Logic Systems Inc. acquires a minority equity position in Epic Design Technology	N/A
November	Teradyne Inc. purchases AIDA Corp.	\$34.0
	ECAD Inc. acquires the printed circuit product line from Omnicad Corp.	N/D
	Teradyne Inc. purchases CASE Technology	\$20.0
1988 February	ECAD merges with SDA to form Cadence	\$72.0
	Intergraph acquires additional interest in Tangent, now holds 80 percent	\$ 2.0
March	Tektronix sells CAE operations to Mentor Graphics	\$ 5.0
April	Valid acquires GE-Calma IC layout operations	N/D
	HHB Softron acquires Simucad	\$ 3.8
May	Zycad acquires Endot from Data I/O	N/A
June	Cadnetix acquires HHB Softron	\$77.0

N/D = Not Disclosed

N/A = Not Applicable

*Initial payment; additional payment includes royalties based on 5-year sales activity

Source: Dataquest
July 1988

The decisions made by Cadnetix, Daisy, and Valid to move to the Sun Microsystems workstations are really part of this same repositioning trend. Making the transition to standard hardware and the unbundling of hardware/software are part of the general efforts of each player to more effectively compete with the market leaders, most notably, Mentor Graphics. New management at companies such as Daisy and Valid are very anxious to get into the chase for the number one position and improve their long-term viability. Having already improved the profitability of their companies dramatically, the pressing need is to execute their strategies for continued revenue growth and earnings.

The net result of these individual firms' decisions has been substantial market consolidation. Prior to these mergers and acquisitions, three companies dominated the market in terms of revenue—Mentor Graphics with \$211 million, Daisy with \$104 million, and Racal-Redac with \$90 million—and then revenue dropped off. After consolidation, four firms clustered near \$100 million—Cadnetix, Daisy, Racal-Redac, and Valid. Clearly, the rules of the game have changed.

The outcome of this repositioning in the market will depend on the performance of the individual companies. As a rule, mergers and acquisitions are less than a 50-50 success/failure proposition, but in all of these instances, the players know one another's businesses quite well. There are no outsiders coming in, as was the case with GE-Calma or Schlumberger/Applicon. The challenges are mostly at the culture and management level. If the new firms can succeed, then the outlook is for a much healthier industry for the long term.

A SLOW BUT STEADY MARKET

Although individual firms managed to increase their revenue and market shares in 1987, partially through consolidation, the overall EDA market's performance was not particularly spectacular. Total market revenue growth was only 11 percent, down from 21 percent in 1986.

Three major factors checked EDA market growth in 1987:

- Slow growth in the Far East and North America
- Continuing price erosion
- Sharply declining host-dependent system revenue

Yet these downward trends mask several important areas of vitality and reasons for optimism. The following forces point toward renewed vigor in the market:

- Strong technical workstation and personal computer revenue growth
- Improved performances of individual firms

Dataquest believes that these areas of strength in the market will continue to provide sources of revenue and profitability growth for the next several years.

Slow Growth in the Far Eastern and North American Markets

The first major factor that slowed down the EDA marketplace was sluggish revenue growth in the Far Eastern and North American markets, which experienced 13 percent and 2 percent, respectively. When the Far Eastern market's revenue was adjusted for currency changes, real revenue growth was actually a negative 3 percent.

The slow growth of the North American market reflected a continuation of the 1986 slowdown into the first two quarters of 1987. However, most vendors reported that North American orders were up in the second half of 1987 and that this trend has continued into 1988. Indeed, our survey of North American buyers shows that 1988 budgets are up more than 20 percent over last year's actual spending.

The Far Eastern market slowdown reflects the cutbacks in purchases by Japanese companies because of concerns about the yen, trade barriers, and the global economy. A Dataquest survey of Japanese EDA buyers shows that 1988 budgets were down 20 percent in terms of yen from 1987 spending. The Japanese market may still recover later in the year, particularly given the windfall Japanese semiconductor firms have received from the DRAM market.

Price Erosion

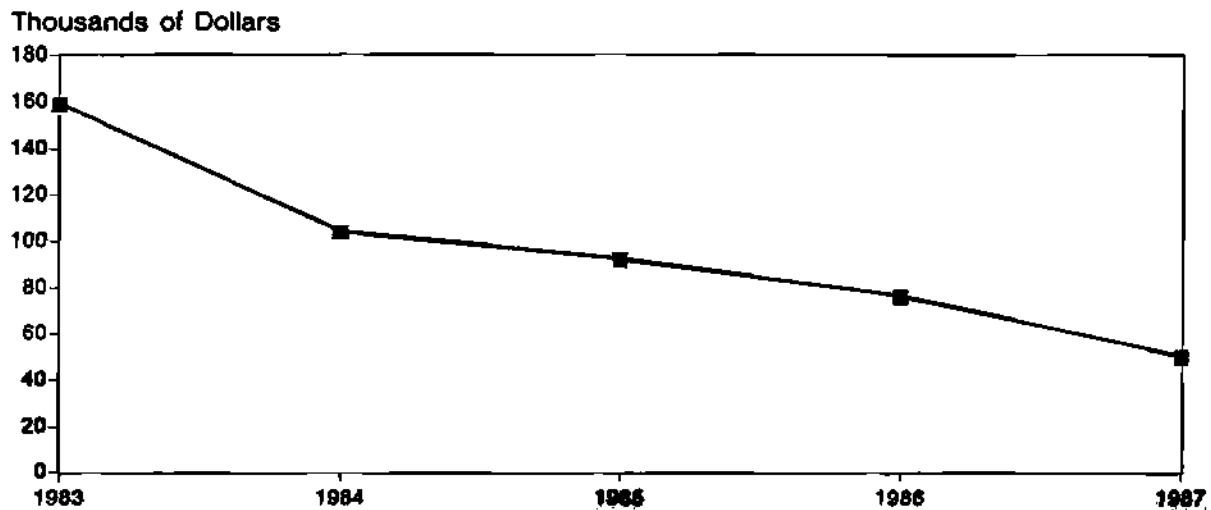
Continuing price erosion is the second major factor holding back revenue growth.

The average price per turnkey seat (APPS) fell 34 percent from 1986 to 1987, continuing the steady downward trend shown in Figure 1.3-1. This heavily offset increases in unit shipments of 34 percent in 1987, as illustrated in Figure 1.3-2. Many EDA vendors this year felt the frustration of selling significantly more units, but with frequent declines in profits and total revenue.

Dataquest believes that this trend of declining prices will continue into the future, particularly since it occurred on both the hardware and software side. On the hardware side, both technical workstations and PCs fell in price due to stiff competition. The APPS of technical workstations, for example, is forecast to drop at a 10.6 percent compound annual growth rate (CAGR) through 1992. On the software side, applications such as schematic capture, which listed for \$15,000 or more in 1984, are now selling for well under \$1,000. Indeed, low-cost \$100 schematic capture packages now threaten to turn this application into a commodity.

Figure 1.3-1

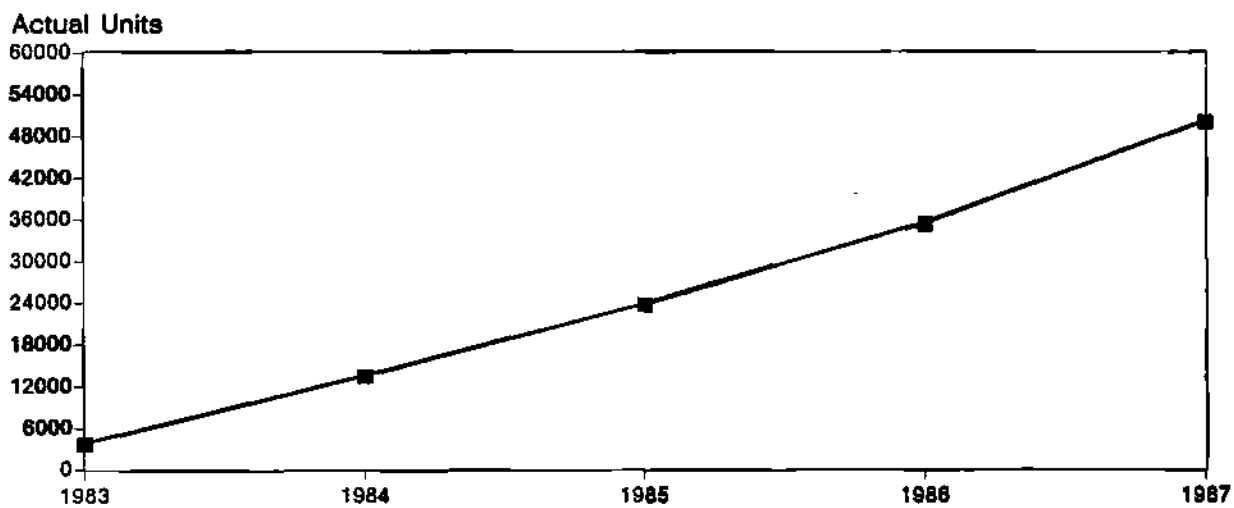
Electronic Design Automation
Average Price per Turnkey Seat



Source: Dataquest
July 1988

Figure 1.3-2

Electronic Design Automation
Worldwide Workstation Shipments



Source: Dataquest
July 1988

The unbundling of hardware and software is likely to exacerbate price erosion over the coming years. As large customers make more and more of a commitment to workstations across their corporations for CASE, manufacturing, document production, accounting, as well as EDA applications, they are increasingly buying their stations directly from the hardware vendor and purchasing software separately. In 1987, turnkey EDA revenue fell 11 percent, from \$315 million to \$280 million, while unbundled software grew from \$235 million to \$444 million, an increase of 89 percent. These large-volume hardware purchase agreements directly drive down prices per station. Software prices follow in kind—first, because software is also being purchased in volume, and second, because the separation of software from hardware exposes the value of each.

The Decline of Host-Dependent System Revenue

The third major factor that figured in the slowing of 1987 market growth was the sharp drop in host-dependent system revenue. Although host-based systems still play a role in electronics design automation, revenue is dropping off sharply. Only in Japan do these systems continue to enjoy reasonable revenue growth.

Worldwide, host-dependent revenue fell to \$542 million in 1987, or only 27 percent of the market. System shipments declined to 1,636 units. Dataquest believes that the host will still play a role for computationally intensive tasks, data management, and network services, but that its role in graphics-oriented problems will disappear. We expect host-dependent sales to be only 9 percent of the market in 1992.

Reasons for Optimism

In spite of the negative appearances given by the slow growth of the EDA market, there are two important reasons for optimism. The first reason is the very strong revenue and shipment growth displayed by technical workstations and personal computers. The second reason is the new-found prosperity of the vendors that specialize in these markets.

Both technical workstation and personal computer revenue continued to grow impressively. In 1987, technical workstation revenue grew 25 percent to \$1.118 billion, or 56 percent of the total market, while personal computer revenue rose to \$322 million, or 16 percent of the total market. Technical workstation shipments actually reached 19,328 systems, and personal computer shipments increased to 27,735 units. *no significant change in 1987*

Equally importantly, the vendors in the EDA market that focus on these segments are starting to perform quite well. These vendors include Apollo, Cadnetix, Daisy, Hewlett-Packard, Mentor, Racal-Redac, Sun, and Valid. Vendors that used to be focused on the mainframe side, such as Digital Equipment, are discovering new strength in the workstation side of the business.

The prosperity of these vendors bodes well for the industry. Healthy vendors make for confident customers. These customers, which know that their investments will be safe, are willing to make large system purchases. If, in fact, EDA users' faith in their suppliers has been restored, especially after the jolt it received in 1986, then the market will perform well. Dataquest anticipates a period of renewed growth in the industry.

EDA BUYERS

Dataquest believes that another major factor in the overall transformation of the market is the shift in buyer attitudes. Many companies have already invested tens of millions of dollars in EDA technology and are planning to match those expenditures over the next two to three years. These investments reflect EDA users' desires to use tools and automation to their best strategic advantage. However, as investments rise, users are increasingly concerned about making the right choices and controlling their own design environments.

Table 1.3-2 illustrates the average level of investment and planned spending from Dataquest's 1987 survey of North American users. As this table clearly shows, the average investment is quite substantial, reaching \$2.5 million per site in the military aerospace segment. Moreover, 1988 annual budgets are almost double 1987 spending. Users are making major commitments to design automation.

Table 1.3-2

North American Average CAD Investment by Industry

	Investment to Date	1987 Purchases	1988 Budget
Aerospace/Military Electronics	2,525,714	394,358	667,153
Automotive	425,000	7,500	22,500
Communications	1,899,453	377,350	332,170
Computers	1,823,220	517,136	596,386
Consumer Electronics	548,077	204,091	192,909
Education	651,040	477,679	750,556
Government	1,642,857	719,286	1,988,813
Medical	1,363,267	329,200	1,078,964
Semiconductor	2,939,252	589,126	788,670
Service Bureau	1,629,455	609,485	531,183
Test/Instrumentation	783,386	172,436	472,395
Other	1,022,340	217,840	238,196

Source: Dataquest
July 1988

Buying Criteria

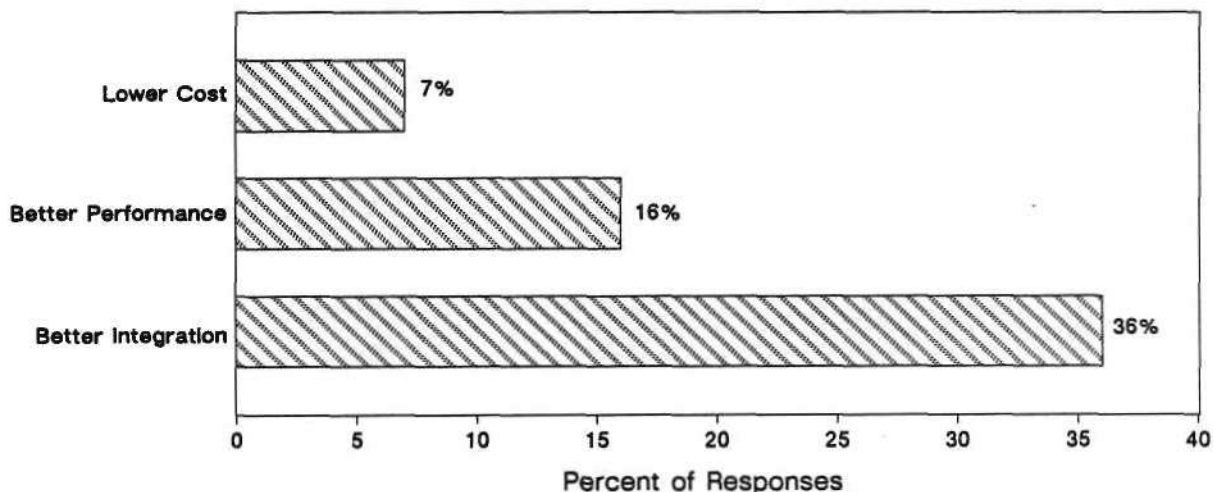
The first major point of change is in end-user buying criteria—the major items a buyer looks for in a supplier and the supplier's products when making a purchase. Today's EDA buyers place much more emphasis on the vendor as a company, on reliable and robust core applications, on hardware and software integration, and, last but not least, on service, support, and training. Potential buyers are looking for demonstrated success and strategic directions—not unproven promises.

Dataquest believes that the transition in buyers' criteria is driven by the buyers' past experiences with EDA and demand for productivity, not just by technology. Early adopters of EDA, most recently ECAE, made purchases on the basis of either technology leadership through advanced R&D or a technology imperative. For example, EDA tools are an absolute necessity in ASIC design. In contrast, current buyers are now attempting to integrate EDA tools into their entire design and manufacturing process—even when there is no technology imperative. *who says?*

The end user's objective is to be more competitive through shorter times to market and better products. Figure 1.3-3, from Dataquest's 1987 EDA user survey, illustrates this buyer need. When asked what they would change in their CAD system, current EDA users asked for two things: better integration and faster performance. This clearly indicates that users' interests lie with productivity, not technology. Users want the products they originally purchased to work as promised. They are far less interested in the next round of products or technologies.

Figure 1.3-3

What EDA Users Would Change in
Their EDA Systems



Source: Dataquest
July 1988

End-User Purchasing Practices

*will
15. (this
conclusion
5-12-88)*

The second major area of change is in purchasing practices. As opposed to spot purchases made by separate engineering teams or divisions, the major users are now making decisions at the corporate level. These corporations are making long-term agreements involving large purchases that may be spread out over several years. While this presents significant opportunities for vendors, it also slows the decision process considerably. Lengthy and time-consuming benchmarks are required, and vendors are closely scrutinized.

Buyer-Vendor Relations

The final major shift is occurring in the relationship between buyers and vendors. As the dollar volume of purchases and the level of user penetration increases, buyers are seeking ways to control their commitment to specific hardware and software suppliers. Many buyers no longer purchase turnkey stations with bundled hardware and software. Instead, they purchase hardware and software separately from the respective manufacturers to obtain the best prices. Buyers are aggressively negotiating volume purchase or site-licensing agreements with their vendors.

BUSINESS STRATEGIES

Dataquest believes that vendors' success in the maturing EDA market will be determined by their development and execution of their business strategies. In the growth phase of the market, many suppliers were pulled upward by the demand for their technologies in the marketplace. However, in the maturing market, vendors' profits and revenue are pulled down by declining prices and rigorous competition. Only suppliers able to deliver on their promises and to demonstrate that they are well managed companies will be able to push their revenue and profits up, and, with luck, gain market share.

We believe that there are two major viable strategies in the marketplace today: full line and niche. A full-line supplier is a company that markets and distributes a complete set of EDA products to end users (e.g., Daisy, HP, Mentor Graphics, and Valid). A niche supplier is a company that develops and sells individual products or services that meet specific needs in the EDA market (e.g., CADENCE, IKOS, and Trimeter).

Dataquest feels that it is possible to pursue one or the other of these two strategies, but not both. In the early days of the EDAE market, companies simultaneously pursued niche strategies, such as developing state-of-the-art simulation, and full-line strategies, by offering integrated EDAE and layout. Several companies, most notably Daisy and Valid, went so far as to develop both software and proprietary hardware. In the early stages of the EDAE market, these companies enjoyed the best operating margins and profitability.

Handwritten notes:
 1. Niche suppliers will be successful if they do either of the following:
 a) Develop a highly unique product
 b) Pursue the OEM channel (e.g. defense, code line, etc., Colson/Alcalá?)

However, as the number of individual applications multiplied and general-purpose hardware suppliers (Apollo and Digital) surpassed proprietary solutions, it was no longer possible for one company to be all things to all people. Niche players began to focus on developing the best IC simulator or schematic capture package. Former full-line suppliers that attempted to maintain a lead in each individual software application and still be fully integrated found that their resources were badly diffused. Companies that integrated other vendors' hardware or software packages along with their own core applications have remained both focused and profitable.

Full-Line Strategies

The full-line supplier has the most to gain and lose in this transitional market. As a full-line supplier, a company can control key distribution and marketing channels through its relationship with end users. This, in turn, allows the full-line supplier to capture important revenue in the final value-added chain by integrating its own applications with products from niche suppliers.

From a practical standpoint, Dataquest identifies three ways that full-line suppliers can increase their revenue:

- Option 1—Sell more of the same applications they offer today
- Option 2—Develop and sell or OEM new products
- Option 3—Grow a service/support business based on an effective combination of the first and second strategies

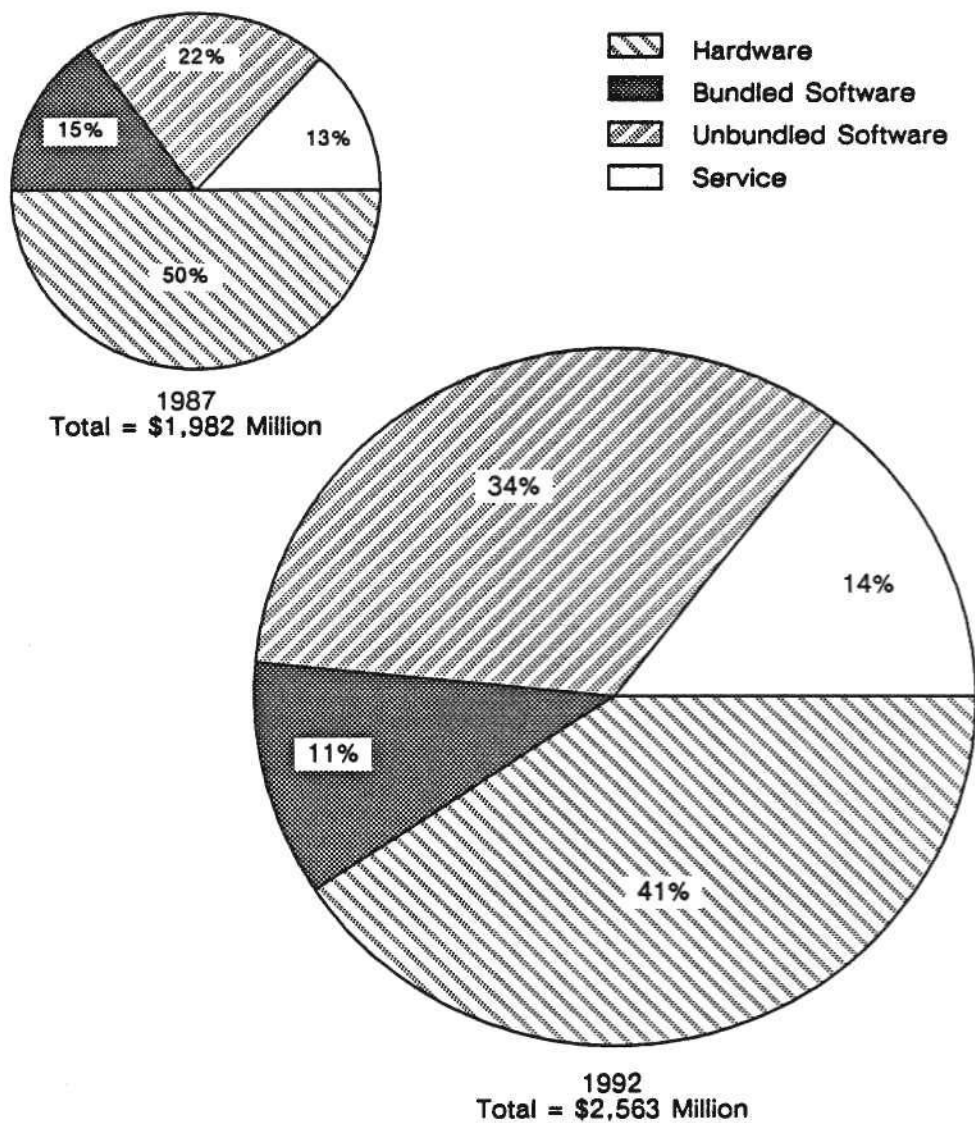
Figure 1.3-4 shows Dataquest's forecast for the mix of products in 1992 relative to 1987. As this figure indicates, unbundled software is the fastest-growing segment. Hardware and bundled software revenue, on the other hand, are each forecast to decrease as a percentage of total revenue.

Given this forecast, as well as our expectations of continued price erosion for applications, options 1 and 2 alone are clearly not viable. Price erosion and the separation of hardware and software sales make option 1 (sell more of the same products) untenable; current products are becoming commodities. The second option, market or OEM new products, holds equal perils. Developing new products stretches resources. OEM has low margins. And the more products a vendor has to sell, the less focused a sales force can be. Only the third option, which is based on service, support, and integration, holds promise.

Handwritten notes:
 But the problem here is one of dependence on a supplier of a tool that can be superseded by a competitor—e.g., Cadet. What is the solution?

Figure 1.3-4

**EDA Revenue Sources
Actual and Estimated**



Source: Dataquest
July 1988

The following are what Dataquest believes to be the critical success factors for the third full-line supplier option:

- Provide robust core applications or platforms
- Integrate products from multiple suppliers
- Manage, service, and support the installed base
- Market, sell, and distribute

These are the key factors that can transform a company from an application vendor into a solution provider—and a profitable one.

However, it is important to remember that full-line suppliers can effectively differentiate themselves across several dimensions—otherwise, all such vendors would look the same. Three of the key dimensions are as follows:

- Target customer
- Channel of distribution
- Product mix

First, each full-line vendor must be very conscious as to its target customers, for example, small firms, large corporations, defense contractors, and semiconductor firms. Second, the best channels of distribution to reach those customers should be selected; these channels include direct, dealer rep, and distributor. Third, the right product mix—including applications, integration tools, and hardware platforms—must be present. PCAD, through its dealer rep network, is a full-line supplier to small firms that specialize in PCB design, just as Mentor Graphics is positioning itself as a full-line supplier to large corporations.

The definition of full-line supplier is not fixed. Simply having a broad product line and a direct sales force is not sufficient. Indeed, too broad a product line can be a liability if it overloads the channel of distribution or if it runs contrary to customer expectations. Rather, the customer's requirements define the full-line supplier's role. Although some customers may wish to purchase all products from one full-line source, almost half of the current customers now believe that their EDA needs can be served best by purchasing from many suppliers, any one of which might still be considered a full-line supplier in its arena (for example, a full-line hardware vendor).

Is this still true?

Niche Strategies

The alternative to a full-line strategy is a niche strategy—specialized hardware or software designed to satisfy focused EDA requirements, such as emitter-coupled logic (ECL) board routers, simulation accelerators, and logic synthesis. Dataquest believes that, as the market expands, opportunities will be created to develop many specialized applications or bridges between applications. These areas will be beyond the reach of full-line suppliers but of great interest to end users. A \$30 million or \$40 million niche opportunity can make for very profitable businesses but may still be too small for a full-line supplier to pursue.

Niche opportunities are essentially user-driven. They are created as users adopt primary EDA technologies but find that the core technologies are insufficient, too costly, or only partial solutions. These opportunities roughly fall into three major categories:

- Low-cost products
- Leading-edge technologies
- Technology and service bridges

In each of these categories, there are focused user demands that go outside of the bounds of the full-line suppliers' application capabilities.

Low-cost products, such as \$500 schematic capture and PCB layout, have already had a significant impact on the market. Large companies that are anxious to put EDA tools on every engineer's desk and small companies that cannot afford large systems have both eagerly evaluated—and purchased—these low-cost products. Companies that could not justify buying a \$40,000 EDA workstation for an engineer have been able to justify spending \$5,000 or \$10,000 per engineer. Provided that the products are tools and not toys, large-volume, low-cost products present a sizable dollar opportunity.

Leading-edge technologies represent an equally important area of opportunity. Although full-line suppliers answer the requirements of the mainstream market, many companies and R&D groups continue to need advanced products as they pursue increasingly complex design problems. Examples of such problems are very large scale ASIC design (20,000 gates and up), 300 package surface-mount board designs, and mixed analog/digital designs. These problems can be solved only with new EDA technologies, and users who need them will pay for them.

The final major opportunity lies in bridging technologies—products that fill key gaps in full-line supplier applications. Examples of such products include libraries, simulation/test integration packages, and specialized netlisters. Often these products may seem like very simple concepts, but actually they require much attention to detail

and accuracy. Bridging technologies make usable the mainstream products (capture, simulation, and layout) and integrate discrete applications. These products are of immediate interest to an end user since they can make existing EDA investments that much more productive. Most companies spend an extra dollar on integration and bridging problems for each dollar invested in EDA tools, which underscores the size of the total opportunity in this area.

*where
is this
supported?*

As is the case with full-line suppliers, there are several fundamental success factors for all niche suppliers, no matter what their product may be:

- Strong marketing/distribution programs
- Close linkages with full-line suppliers
- Special relationships with key users/major accounts

These factors enable niche players to create barriers to entry that can keep out other niche players. Technology alone is not sufficient. If all a company has is technology, then a new competitor with a better technology can always displace it. Only niche players that build barriers to entry on top of their technology—unique product positioning, contractual relationships with large users, or integration into full-line supplier products—can succeed.

Dataquest believes that the next three years will put the niche companies to the test. As the full-line suppliers' core product lines slow down in terms of growth, the suppliers will increasingly look to various niches as potential sources of revenue. Some full-line suppliers will seek partnerships with the small companies, or perhaps acquisitions, but if history is any guide, some of the full-line suppliers will attempt to bring out their own products. The niche player's ability to defend its turf through strategic positioning will then determine its success.

PRODUCT OPPORTUNITIES

Given these basic business strategies—and in spite of the maturation of the market—a significant number of important product opportunities exist. Even as market growth slows down, user needs are continuing to evolve and change. Productivity-driven customers want solutions.

Major product opportunities can be mapped back to the primary business strategies described earlier: full line and niche. Full-line strategies require core products that both meet basic user needs and integrate the design environment. Niche products correspond to the different niche strategies—low cost, leading edge, and bridge—and segment further by application—ECAE, IC layout, and PCB layout.

Full-Line Product Opportunities

While nothing excludes full-line suppliers from selectively pursuing niche opportunities, there are specific product opportunities that can directly support their strategies. Given the objective of selling to large mainstream users, full-line suppliers must meet user demands for a stable, integrated design environment. In other words, they must go back to basics.

Basics, in this case, begin with robust core applications. For example, even schematic-capture packages have failed to meet customer expectations. Users were promised, and expect, capture packages that can be used for documentation (e.g., the drawings need page numbers), netlist generation (flat or hierarchical) and back-annotation from a layout. Thus, the first major product opportunity for full-line suppliers is to deliver the products they originally claimed would ship.

Looking forward, the next major opportunity is to effectively integrate the basic applications around a common data management system. Ideally, this system would allow the user or the full-line supplier to integrate other elements into the same environment. These elements could include tools from other vendors, in-house tools, or linkages to other automated systems (e.g., manufacturing or mechanical design). Such a data management system would provide for the following facilities:

- Design and library management
- Design documentation
- Third-party tool integration
- System management utilities
- Project management
- Technology-independent design
- Mixed-methodology design

This management product would provide users with the flexibility and structure to effectively control the design process, accommodate special user needs, and be open to future technology developments.

The major product opportunity for full-line suppliers is to develop the product integration tools to sustain their market positions, rather than pursue more niche applications. Integration products enable them to focus on stabilizing their original application set while allowing them the opportunity to work with the niche suppliers. Moreover, offering well-integrated products coupled with data management tools enables full-line suppliers to command higher prices per application—even in the face of low-cost competition.

Niche Product Opportunities

In contrast with full-line product opportunities, niche opportunities cover a wider expanse of technologies. Although a complete list is not possible, the following outline examines low-cost, leading-edge, and bridge technologies allocated by application:

- **Low-cost technologies**
 - **ECAE:**
 - Schematic capture
 - Technical documentation
 - Pattern editors
 - Board verification
 - **PCB layout:**
 - Symbolic editors
 - Single-board routing accelerators
 - **IC layout:**
 - Low-cost ASIC design tools
- **Leading-edge technologies**
 - **ECAE:**
 - Architectural design tools
 - Logic design automation and synthesis
 - Specialized ASIC simulators
 - Mixed analog/digital design
 - Behavioral simulation
 - Test pattern generation
 - **PCB layout:**
 - Manufacturability analysis
 - Reliability analysis

- SMT routing
- Thermal analysis
- Electromagnetic analysis
- IC layout:
 - Performance-driven layout
 - Very large gate-array design
 - Very high speed IC layout
 - Linear chip compilation
- Bridge technologies
 - ECAE:
 - Libraries
 - Logic design to test linkages
 - Mixed software/hardware design

HARDWARE PLATFORMS

The preceding discussion on strategies and product opportunities is as applicable to hardware platforms as it is to applications. Distinct market positions are available for full-line and niche hardware vendors. Full-line hardware vendors are the suppliers of core platforms and integrated development and operating environments. Niche vendors, on the other hand, offer specialized systems that meet specific user needs for leading-edge CPU or graphics performance, low-cost entry stations, or linking hardware technologies.

Nonetheless, within the general framework of platforms, there are certain unique issues and trends. The balance between personal computers, technical workstations, host-computers, and special-purpose hardware is shifting. This is partly driven by improvements and changes in technology and dropping prices, but it also reflects the changes in user base described above. Pressures from users to put a station on every engineer's desk are operating at the low end, while increasing user familiarity and experimentation with EDA applications are driving the midrange to high end.

Technical Workstations

Dataquest believes that the technical workstation will be at the center of EDA shipment and revenue growth. The technical workstation has the right mix of capabilities and is in the right location—the desk top—to provide the hardware platform for EDA. We believe that the technical workstation will take on this role for the following reasons:

- Low incremental cost per user
- Steady improvements in price/performance
 - Given fixed performance, price dropping 30 percent per year
 - Given fixed price, mips doubling each year
- 32-bit processing needed for most EDA applications
- Computational alignment with each user's requirements
- Wide range of computation/graphics capabilities
 - Supertechnical workstations at the high end
 - Diskless stations at the low end

The technical workstation has all of the key elements. First, it has the computing capabilities required for most EDA applications (32-bit CPU, virtual addressing, and nonsegmented memory), and the horsepower available is steadily improving both in terms of graphics and processing power. Second, the cost per seat is dropping steadily. The result is that the technical workstation is able to displace the personal computer at the low end and is starting to rival superminicomputers at the high end. Indeed, the proliferation of capabilities among technical workstation suppliers is rapidly causing the distinctions between PCs, mainframes, and workstations to blur.

Personal Computers

Dataquest believes that, while the PC will continue to be the system of choice for the engineer's desk and represent the bulk of unit shipments in the near future, it will eventually give way to the technical workstation. The PC's primary advantage today is its price, but rapid declines in technical workstation prices are eliminating this distinction. It is important to note that, by Dataquest's definition, an 80386-based system running OS/2 in 80286 mode is a personal computer. The same hardware running UNIX in true 80386 mode is a technical workstation. However, the fact that this hardware is now being marketed for, and can be used for, significantly larger applications is extremely important. This "simple" shift in operating system increases the memory space. It can

also eliminate memory segmentation (or make the segments so large as not to be an issue), increase application speed (if only through simpler memory management schemes), and make the process of porting software from other workstations much easier.

Dataquest believes that the PC will remain important for the following reasons:

- Low cost per seat will continue to make PCs attractive.
- PC-based application prices have dropped significantly.
- OS/2 and IBM's Personal System/2 will extend the PC's life.
- The 80386 PC AT clones will increase performance even as prices fall.

Dataquest believes that PCs will eventually decline in popularity for the following reasons:

- Applications are limited by the 16-bit operation.
- Technical workstation prices will meet those of the PC.
- Rising user needs will drive users to 32-bit stations.

Again, the distinction between PCs and technical workstations is a fine but important one. User needs for increasing performance will force the transition in both operating systems and platform type.

Host-Dependent Computing

Dataquest sees the role of the host computer as declining but still important. With most graphics applications migrating to the technical workstation and the personal computer, the host computer emerges as a computational engine and a network server. As a computational engine, the host computer still can be a shared resource for large batch processes that are still too large for technical workstations. As a network server, it serves the need for data base management and archival and other shared resources such as printers, plotters, big disks, and tapes.

Dataquest views the following factors as dominating the future of host computers as an EDA platform:

- The rising computing capabilities of technical workstations
- The constantly expanding need for very large computing
- The existence of resources that will always be best shared on a network

Again, part of the reason for the decline in the role of host computing is definitional. The difference between a supertechnical workstation and a supermini-computer will eventually come down to the graphics tube: a headless station is a host, a station with a tube is a workstation. This is as fine a distinction as the one between personal computers and technical workstations, but it is important for understanding the basic makeup of the users hardware environment.

Special-Purpose Hardware

Dataquest believes that special-purpose hardware will still have an important niche role in EDA, particularly in the areas of hardware modeling and application-specific accelerators. Both of these hardware options have capabilities that cannot be easily matched by general-purpose platforms and have demonstrated their usefulness in real design environments.

Hardware modeling began as a substitute for software models of complicated VLSI chips during system simulation. Yet even though software behavioral models now exist for 68020s or Ethernet controllers, hardware modeling has taken on many other roles. Users continue to surprise simulation vendors with the applications they find for hardware modeling. For example, one company plugged a microwave dish into its physical modeler and used real responses from this system to drive its simulation of several ASIC designs. Hardware modeling is a quick and simple window that bridges the real world and the software world, and, as such, will always have a place in the EDA design environment.

Application-specific accelerators for routing, simulation, and fault grading pose a different problem. On the one hand, it is possible to imagine general-purpose hardware catching up with today's accelerators. Reduced-instruction-set computing (RISC) architectures and high-performance workstations suggest the possibility of general-purpose accelerators displacing application-specific accelerators. On the other hand, the same technologies that promise speedups in general-purpose hardware (ASICs, faster SRAMs, and 25 plus MHz CPUs) can also be applied to keep application-specific accelerators ahead in the game. As a result, Dataquest believes that application-specific accelerators can remain an important factor in EDA environments.

1.4 EDA Forecasts

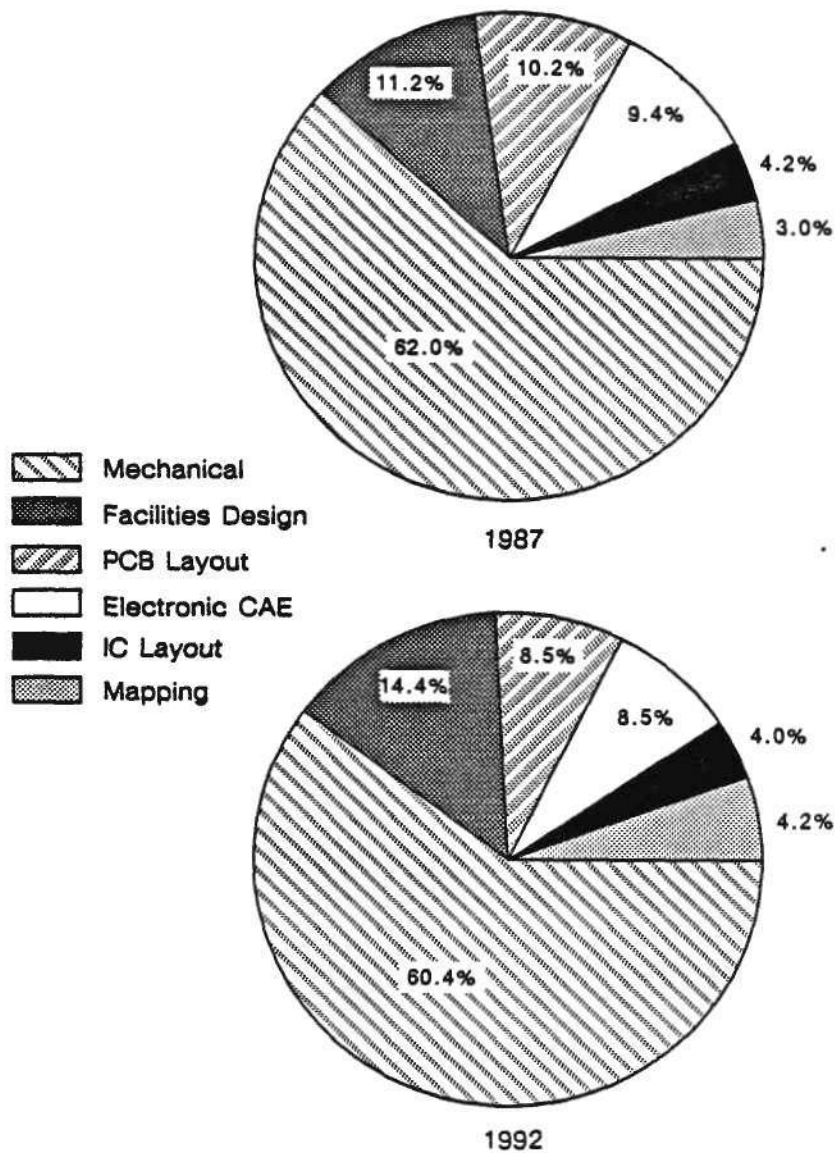
TOTAL ELECTRONIC DESIGN AUTOMATION MARKET

This section presents Dataquest's forecast and analysis for the total electronic design automation (EDA) market for all regions and platforms as illustrated in Figures 1.4-1 and 1.4-2 and Table 1.4-1. These data are summarized as follows:

- The EDA market was an estimated \$1.982 billion in 1987 and is forecast to grow to \$2.563 billion in 1992, a 5.3 percent compound annual growth rate (CAGR).
- Dataquest forecasts that the market will grow to \$2.170 billion in 1988, a growth rate of only 9 percent.
- Workstation shipments in 1987 were 50,369 and are forecast to grow to 60,800 in 1988, an increase of 21 percent; the CAGR through 1992 is expected to be 12.1 percent, with shipments rising to 89,210.

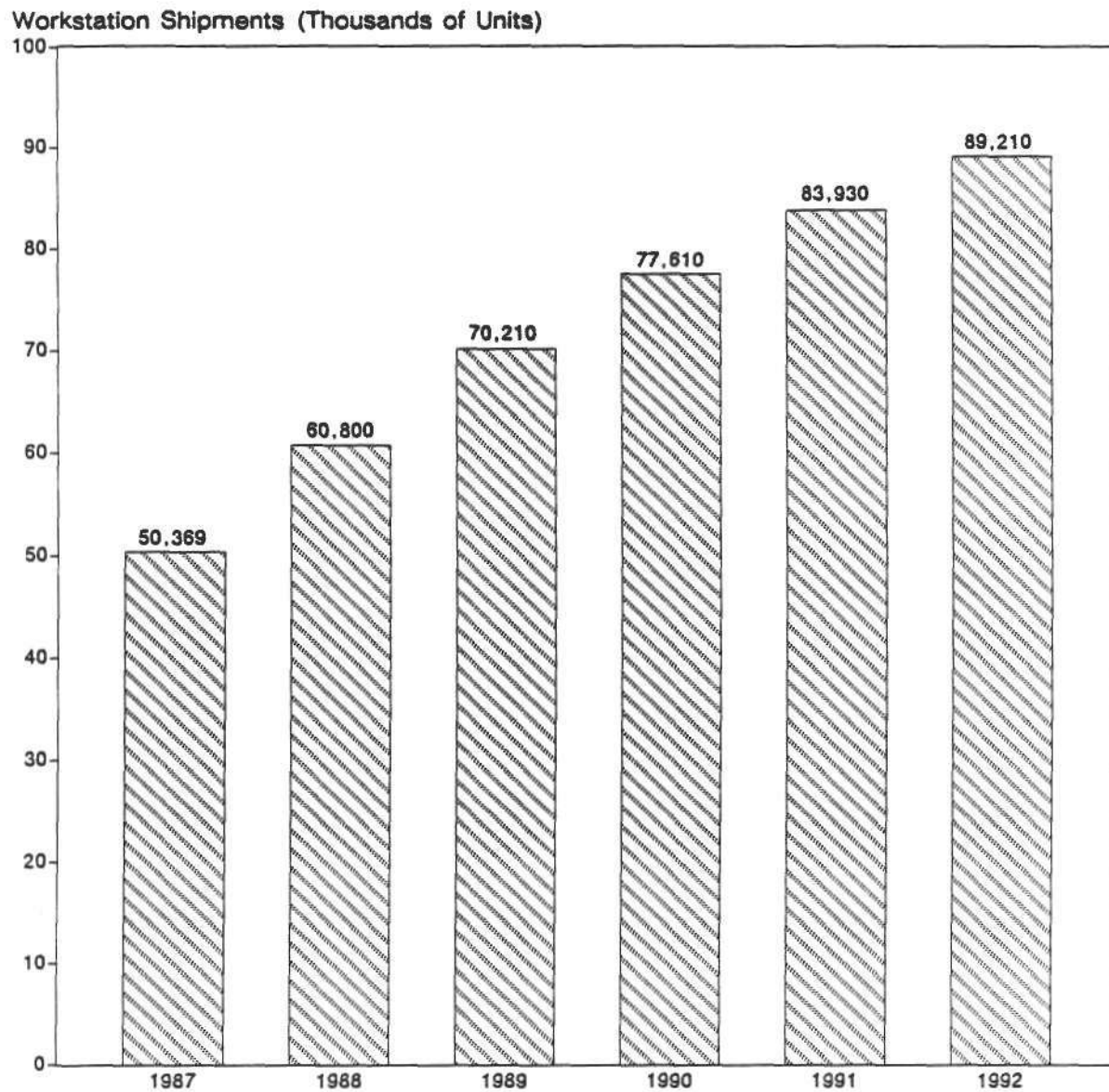
Figure 1.4-1

EDA Worldwide Forecast
Revenue



Source: Dataquest
July 1988

Figure 1.4-2
EDA Worldwide Forecast
Shipments



Source: Dataquest
July 1988

1.4 EDA Forecasts

Table 1.4-1

EDA Worldwide Forecast
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Revenue	1,982	2,170	2,322	2,450	2,521	2,563	5.3%
Systems	48,339	59,400	69,170	76,860	83,320	88,780	12.9%
Workstations	50,369	60,800	70,210	77,610	83,930	89,210	12.1%

Source: Dataquest
July 1988

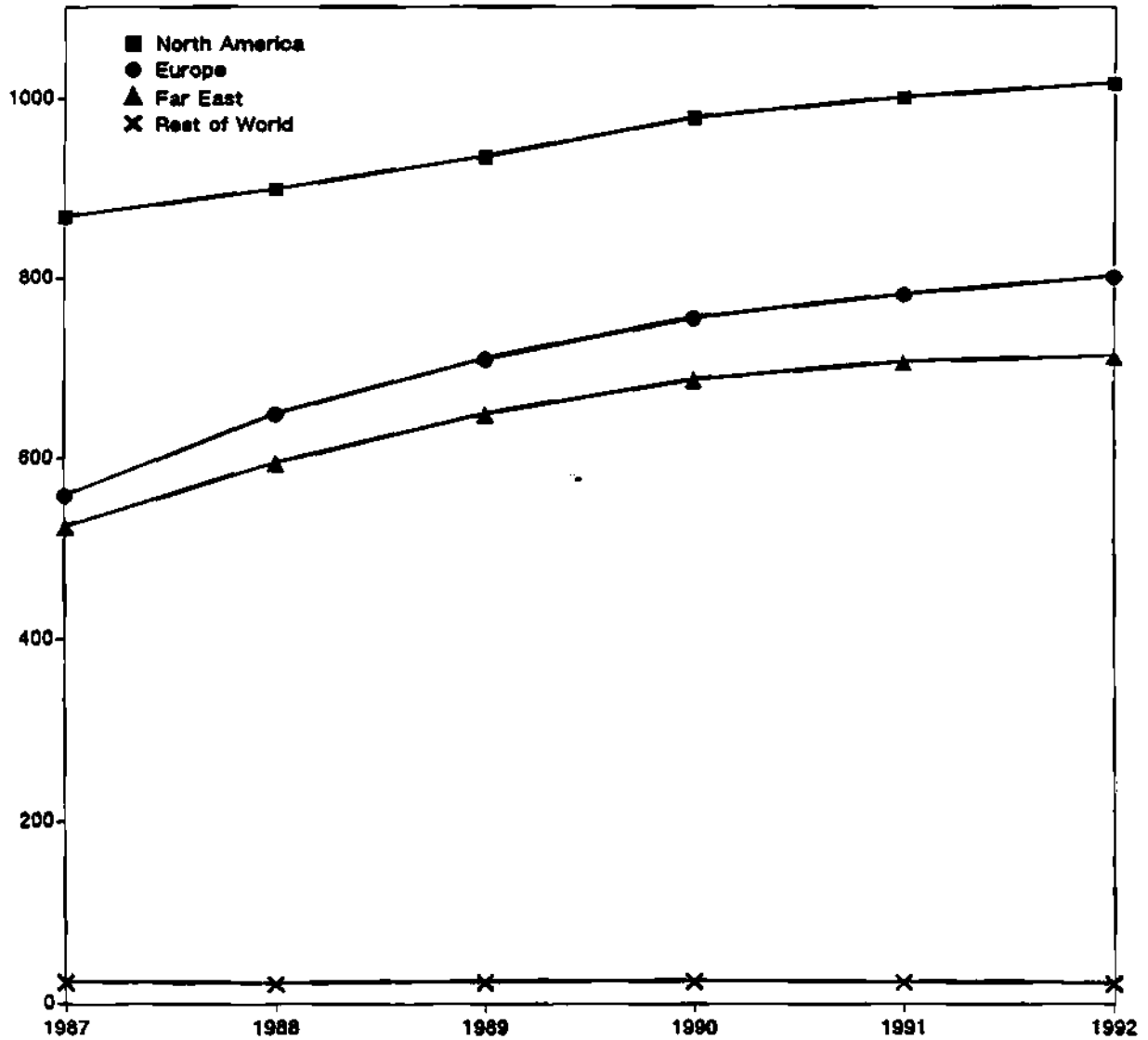
REGIONS

This section presents Dataquest's forecast and analysis of the EDA market, segmented by region as illustrated in Figures 1.4-3 and 1.4-4 and Tables 1.4-2 and 1.4-3. These data are summarized as follows:

- North American revenue was \$870 million in 1987 and is expected to grow at only a 3.2 percent CAGR to \$1,019 million in 1992, the slowest growth rate of any region.
- North American revenue is forecast to grow to \$901 million in 1988, up only 4 percent.
- North America represents 44 percent of the EDA market, but will decline to 40 percent as a result of its relatively slow growth.
- European revenue was 28 percent of the total worldwide revenue in 1987 at \$560 million. It is forecast to grow at a 7.5 percent CAGR to \$804 million in 1992, representing 31 percent of the total market.
- Dataquest forecasts that European revenue will rise 16 percent in 1988 to \$650 million, continuing the strong growth it experienced in 1987.
- Dataquest expects the Far East to be one of the two strongest growth markets. Revenue in 1987 was \$526 million, 27 percent of the total, and is expected to rise to \$715 million in 1992, a 6.3 percent CAGR and 28 percent of total revenue. In 1988, revenue is expected to grow 13 percent.
- The rest of the world (ROW) accounted for 1 percent of total revenue at \$25 million and is expected to decline at a negative 0.8 percent CAGR through 1992.
- Dataquest believes that as the Far East and European markets rise as a percentage of the total market and the United States declines, EDA vendors will have to take on a balanced sales strategy, as well as meet the buying criteria of an international customer base. Corporate stability and reputation and service and support are as important as product content.

Figure 1.4-3
EDA Regional Forecast
Revenue

Millions of Dollars



Source: Dataquest
July 1988

Figure 1.4-4

EDA Regional Forecast
Shipments

Workstation Shipments (Thousands of Units)

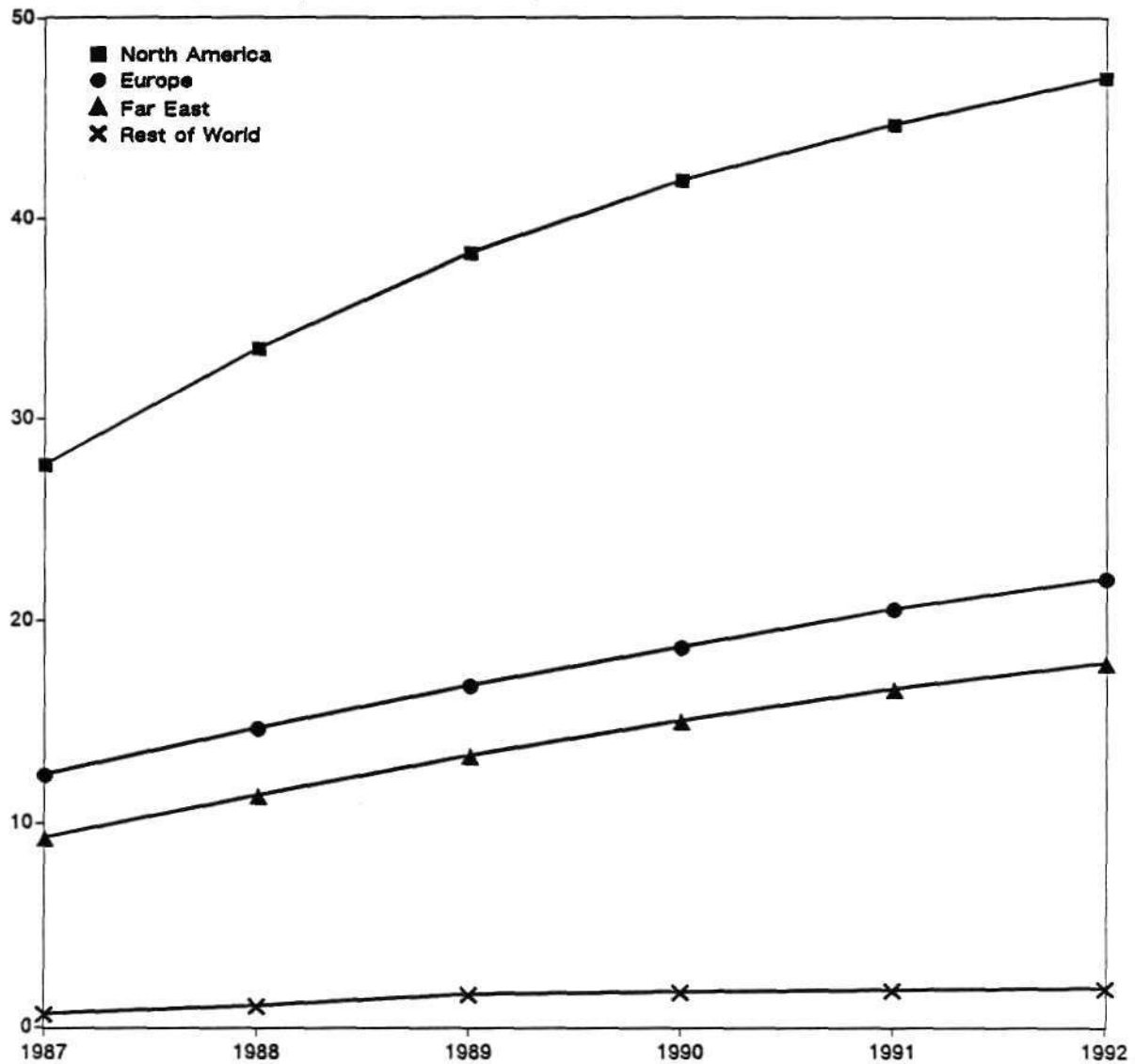
Source: Dataquest
July 1988

Table 1.4-2

EDA Regional Forecast
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	***	***	***	***	***	***	***
Total Market							
Revenue	1,982	2,170	2,322	2,450	2,521	2,563	5.3%
Systems	48,339	59,400	69,170	76,860	83,320	88,780	12.9%
Workstations	50,369	60,800	70,210	77,610	83,930	89,210	12.1%
North America							
Revenue	870	901	937	980	1,003	1,019	3.2%
Systems	27,280	33,380	38,250	41,960	44,740	47,100	11.5%
Workstations	27,816	33,540	38,320	41,960	44,740	47,100	11.1%
Europe							
Revenue	560	650	711	757	784	804	7.5%
Systems	11,983	14,470	16,740	18,740	20,630	22,150	13.1%
Workstations	12,456	14,720	16,830	18,750	20,640	22,160	12.2%
Far East							
Revenue	526	596	650	688	708	715	6.3%
Systems	8,376	10,470	12,510	14,370	16,070	17,550	15.9%
Workstations	9,364	11,430	13,380	15,120	16,670	17,980	13.9%
Rest of World							
Revenue	25	23	25	26	25	24	-.8%
Systems	700	1,090	1,660	1,780	1,880	1,980	23.1%
Workstations	733	1,110	1,670	1,780	1,880	1,980	22.0%

Source: Dataquest
July 1988

Table 1.4-3

**EDA Regional Forecast
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
North America						
Revenue	44%	42%	40%	40%	40%	40%
Systems	56%	56%	55%	55%	54%	53%
Workstations	55%	55%	55%	54%	53%	53%
Europe						
Revenue	28%	30%	31%	31%	31%	31%
Systems	25%	24%	24%	24%	25%	25%
Workstations	25%	24%	24%	24%	25%	25%
Far East						
Revenue	27%	27%	28%	28%	28%	28%
Systems	17%	18%	18%	19%	19%	20%
Workstations	19%	19%	19%	19%	20%	20%
Rest of World						
Revenue	1%	1%	1%	1%	1%	1%
Systems	1%	2%	2%	2%	2%	2%
Workstations	1%	2%	2%	2%	2%	2%

Source: Dataquest
July 1988

PLATFORMS

This section presents Dataquest's forecast and analysis of the EDA market segmented by platform as illustrated in Figures 1.4-5 and 1.4-6 and Tables 1.4-4 and 1.4-5. These data are summarized as follows:

- In 1987, workstation shipments were 50,369 units. They are forecast to grow at a 12.1 percent CAGR to 89,210 units in 1992.
- Technical workstation shipments were 19,328 units, representing 38 percent of total unit shipments. However, technical workstation revenue was \$1,118 million, representing 56 percent of the total EDA market.
- Technical workstation revenue and shipments are expected to have the highest growth rates for all platform types. Unit shipments are forecast to grow at a 20.5 percent CAGR to 49,190 units in 1992. Revenue is expected to grow at a 12.4 percent CAGR to \$2,010 million in 1992. Technical workstations in 1992 will represent 78 percent of total revenue and 55 percent of total shipments.
- Host-dependent workstation shipments were 3,666 units in 1987, representing 7 percent of total unit shipments. However, host-dependent revenue was \$542 million, representing 27 percent of the total EDA market in 1987.
- Host-dependent revenue and shipments are expected to have the slowest growth rates for all platform types. Unit shipments are forecast to wane at 16 percent CAGR to 1,530 units in 1992. Revenue is expected to dwindle at 15.8 percent CAGR to \$229 million in 1992. Host-dependent systems in 1992 will represent 9 percent of total revenue and 2 percent of total shipments.
- Personal computer shipments were 27,375 units, representing 54 percent of total unit shipments. Revenue was only \$322 million, representing 16 percent of the total EDA market.
- Personal computer revenue and shipments are expected to have moderate growth rates. Unit shipments are forecast to grow at a 7.1 percent CAGR to 38,490 units in 1992. While revenue is only expected to grow at a 0.1 percent CAGR to \$324 million in 1992, personal computers in 1992 will represent 13 percent of total revenue and 43 percent of total shipments.
- Dataquest believes that this shift toward the technical workstation and away from the personal computer and host-dependent system reflects the following major trends:
 - The increasing CPU power of the technical workstation
 - The demand for 32-bit applications over 16-bit tools
 - The declining price of technical workstations

Taken together, these factors tend to limit personal computers to documentation and design entry tasks, and host-dependent systems to network server roles.

Figure 1.4-5

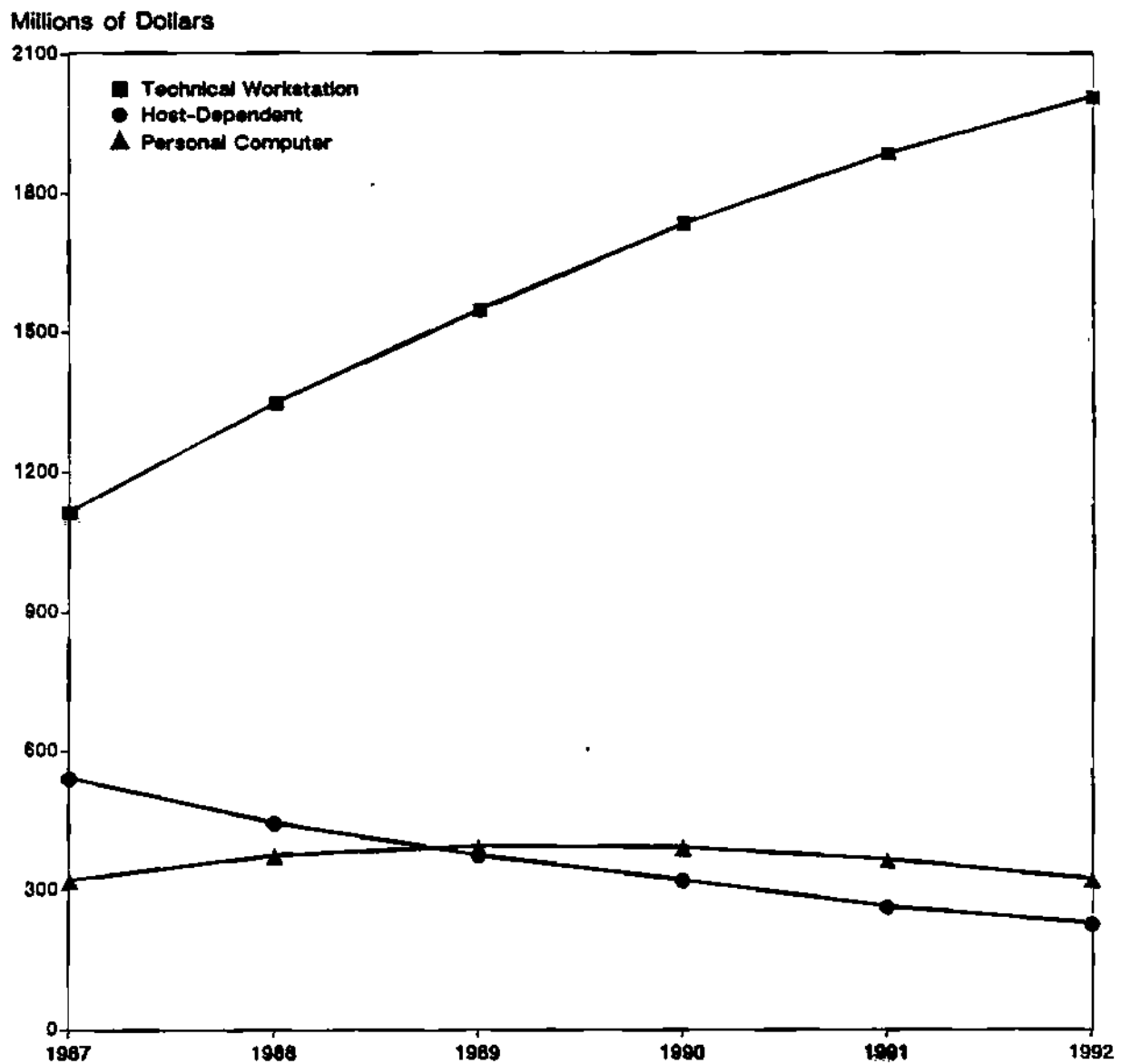
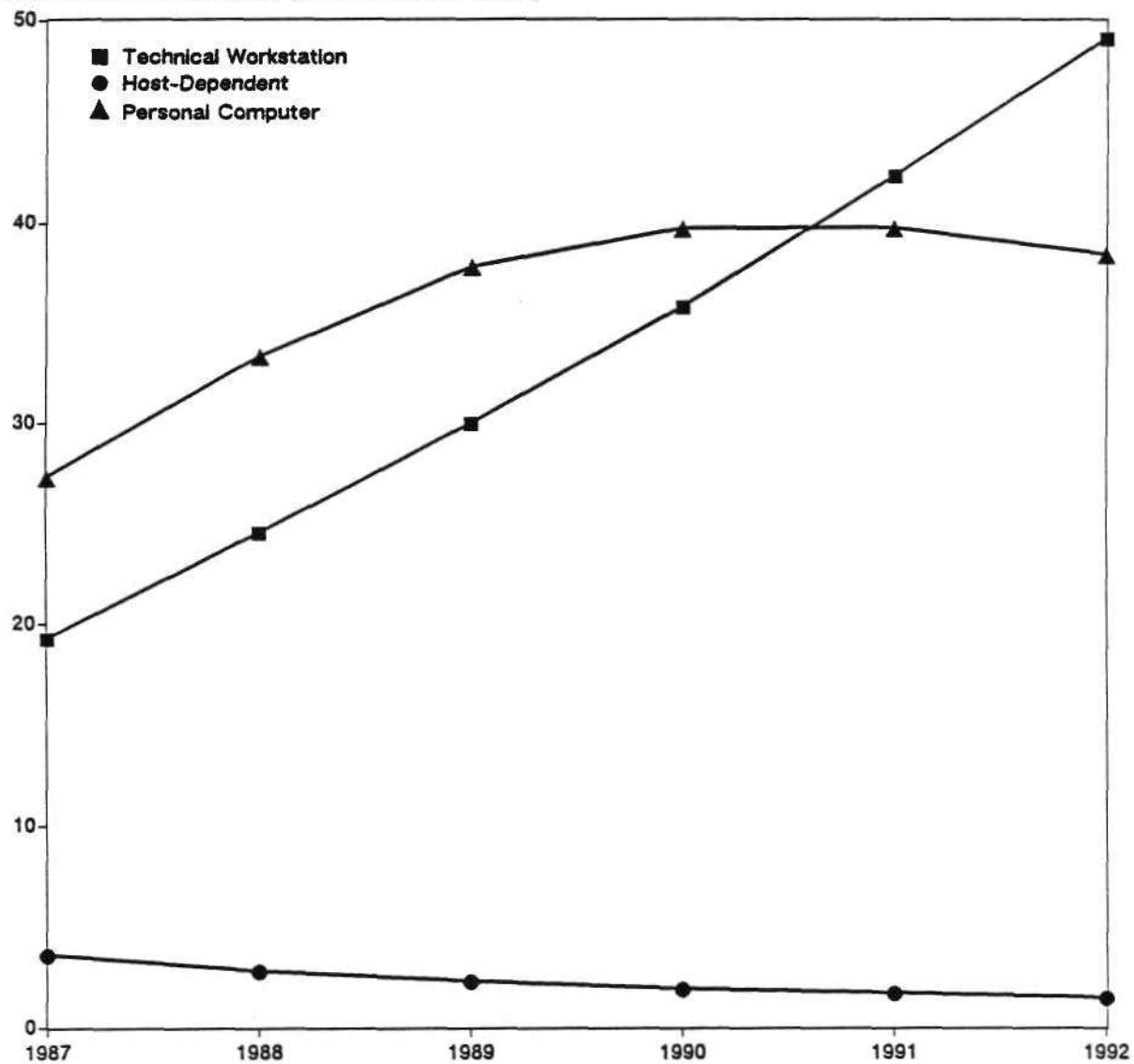
EDA Worldwide Forecast by Platform
RevenueSource: Dataquest
July 1988

Figure 1.4-6

EDA Worldwide Forecast by Platform
Shipments

Workstation Shipments (Thousands of Units)



Source: Dataquest
July 1988

Table 1.4-4

**EDA Worldwide Forecast by Platform
(Millions of Dollars, Actual Units)**

	1987	1988	1989	1990	1991	1992	CAGR
	-----	-----	-----	-----	-----	-----	-----
Total Market							
Revenue	1,982	2,170	2,322	2,450	2,521	2,563	5.3%
Systems	48,339	59,400	69,170	76,860	83,320	88,780	12.9%
Workstations	50,369	60,800	70,210	77,610	83,930	89,210	12.1%
Technical Workstation							
Revenue	1,118	1,350	1,551	1,736	1,888	2,010	12.4%
Systems	19,328	24,580	30,030	35,860	42,370	49,190	20.5%
Workstations	19,328	24,580	30,030	35,860	42,370	49,190	20.5%
Host-Dependent							
Revenue	542	445	375	322	265	229	-15.8%
Systems	1,636	1,460	1,300	1,230	1,150	1,100	-7.6%
Workstations	3,666	2,860	2,350	1,980	1,750	1,530	-16.0%
Personal Computer							
Revenue	322	375	395	393	367	324	.1%
Systems	27,375	33,350	37,840	39,770	39,810	38,490	7.1%
Workstations	27,375	33,350	37,840	39,770	39,810	38,490	7.1%

Source: Dataquest
July 1988

Table 1.4-5

EDA Worldwide Forecast by Platform
(Percentage of Total)

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
Technical Workstation						
Revenue	56%	62%	67%	71%	75%	78%
Systems	40%	41%	43%	47%	51%	55%
Workstations	38%	40%	43%	46%	50%	55%
Host-Dependent						
Revenue	27%	21%	16%	13%	11%	9%
Systems	3%	2%	2%	2%	1%	1%
Workstations	7%	5%	3%	3%	2%	2%
Personal Computer						
Revenue	16%	17%	17%	16%	15%	13%
Systems	57%	56%	55%	52%	48%	43%
Workstations	54%	55%	54%	51%	47%	43%

Source: Dataquest
July 1988

AVERAGE PRICE PER SEAT

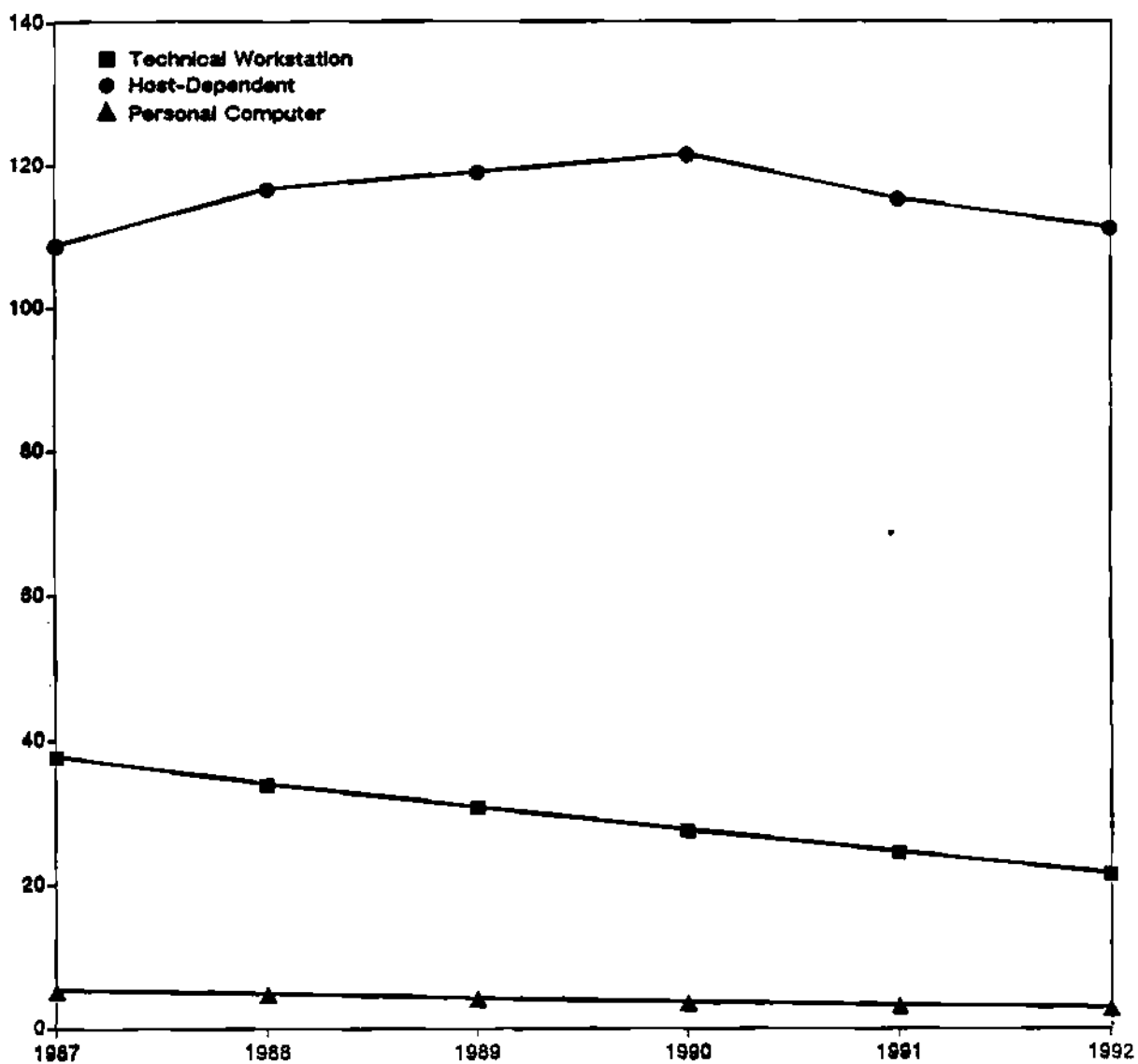
This section presents Dataquest's forecast and analysis of the average price per seat by platform for the EDA market as illustrated in Figure 1.4-7 and Table 1.4-6. These data are summarized as follows:

- For all EDA product types worldwide, the average price per seat (APPS) was \$25,400 in 1987. It is forecast to decline at a 9.9 percent CAGR to \$15,100 in 1992. In 1988, the APPS is expected to be \$22,000, a decrease of 13 percent.
- The technical workstation APPS was \$37,900 in 1987. It is forecast to decline at a negative 10.6 percent CAGR to \$21,700 in 1992. In 1988, the APPS is expected to be \$34,200, a decrease of 10 percent.
- The host-dependent APPS was \$108,900 in 1987. It is forecast to stay at roughly the same level through 1992.
- The personal computer APPS was \$5,400 in 1987 and is forecast to have the steepest decline at a negative 11.1 percent CAGR to \$3,000 in 1992. The APPS in 1988 is expected to be \$4,900.
- Dataquest believes that these declines in prices will be driven by steady price erosion in both hardware and software. Basic applications, such as schematic capture, have already dropped below the \$1,000 price point, and, given fixed functionality, prices can only continue to fall. Current prices can be maintained only by increases in product functionality or performance.

Figure 1.4-7

EDA Worldwide Average Price per Seat by Platform

Thousands of Dollars



Source: Dataquest
July 1988

Table 1.4-6

**EDA Worldwide Average Price per Seat by Platform
(Thousands of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
Turnkey & Hardware-Only							
Technical Workstation	37.9	34.2	30.9	27.8	24.7	21.7	-10.6%
Host-Dependent	108.9	116.9	119.2	121.7	115.5	111.5	.5%
Personal Computer	5.4	4.9	4.3	3.8	3.4	3.0	-11.1%
All Platforms	25.4	22.0	19.5	17.9	16.5	15.1	-9.9%
Turnkey							
Technical Workstation	47.1	43.6	40.7	37.9	35.3	32.7	-7.0%
Host-Dependent	86.3	92.7	92.7	89.5	91.1	94.9	1.9%
Personal Computer	14.4	13.6	12.6	12.7	14.2	14.8	.5%
All Platforms	46.2	42.7	40.0	37.8	36.1	33.7	-6.1%
Hardware-Only							
Technical Workstation	22.8	20.6	18.7	16.7	14.8	13.0	-10.6%
Host-Dependent	144.9	149.7	152.5	163.3	144.5	127.1	-2.6%
Personal Computer	4.3	3.9	3.6	3.3	2.9	2.6	-9.6%
All Platforms	14.4	12.3	10.9	9.9	9.1	8.5	-10.0%

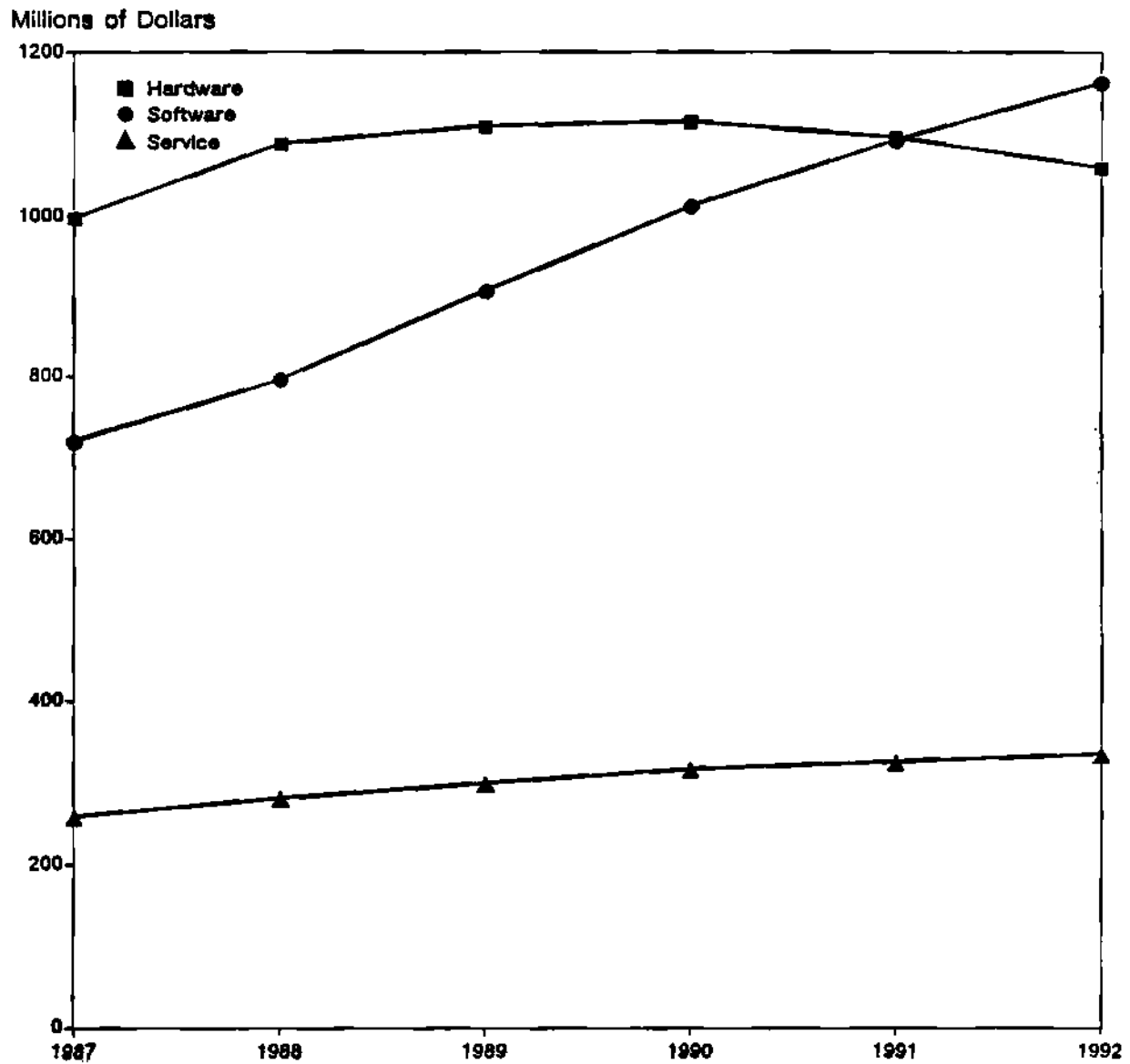
Source: Dataquest
July 1988

REVENUE SOURCES

This section presents Dataquest's forecast and analysis of the EDA market segmented by revenue source for each platform as illustrated in Figure 1.4-8 and Tables 1.4-7 and 1.4-8. These data are summarized as follows:

- Hardware revenue was approximately \$1,000 million in 1987, or roughly 50 percent of total EDA revenue. Hardware revenue overall will grow at only a 1.2 percent CAGR through 1992 to \$1,061 million, or only 41 percent of total 1992 revenue.
- Software and service revenue is forecast to have the strongest growth. In 1987, revenue for software and service was \$721 million and \$260 million, respectively. Software revenue is expected to grow at a 10.1 percent CAGR to \$1,165 million in 1992, while service revenue will grow at a 5.3 percent CAGR to \$336 million.
- Dataquest believes that the growth of service and software revenue reflects the steady maturation of the EDA market. Not only are hardware prices falling, but large installed customer bases are also requiring increasing levels of support, training, and service. Moreover, as penetration increases, the demand for more hardware declines while the demand to add more software to the same system starts to rise.

Figure 1.4-8
EDA Worldwide Revenue Sources



Source: Dataquest
July 1988

Table 1.4-7

EDA Worldwide Revenue Sources by Platform
(Millions of Dollars)

	1987	1988	1989	1990	1991	1992	CAGR
	***	***	***	***	***	***	***
All Platforms							
Hardware	1,000	1,091	1,112	1,118	1,098	1,061	1.2%
Software	721	797	909	1,014	1,095	1,165	10.1%
Service	260	282	301	318	327	336	5.3%
Total	1,982	2,170	2,322	2,450	2,521	2,563	5.3%
Technical Workstation							
Hardware	511	641	709	760	793	802	9.4%
Software	449	514	620	728	829	929	15.6%
Service	158	194	223	248	267	279	12.0%
Total	1,118	1,350	1,551	1,736	1,888	2,010	12.4%
Host-Dependent							
Hardware	360	307	256	219	181	152	-15.9%
Software	103	79	71	62	52	45	-15.4%
Service	78	60	49	40	33	33	-16.1%
Total	542	445	375	322	265	229	-15.8%
Personal Computer							
Hardware	129	143	148	140	125	108	-3.6%
Software	169	204	218	224	215	192	2.6%
Service	24	28	29	29	28	25	.6%
Total	322	375	395	393	367	324	.1%

Source: Dataquest
July 1988

Table 1.4-8

**EDA Worldwide Revenue Sources by Platform
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
All Platforms						
Hardware	50%	50%	48%	46%	44%	41%
Software	36%	37%	39%	41%	43%	45%
Service	13%	13%	13%	13%	13%	13%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	46%	48%	46%	44%	42%	40%
Software	40%	38%	40%	42%	44%	46%
Service	14%	14%	14%	14%	14%	14%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	66%	69%	68%	68%	68%	66%
Software	19%	18%	19%	19%	20%	20%
Service	14%	13%	13%	13%	12%	14%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	40%	38%	37%	36%	34%	33%
Software	52%	54%	55%	57%	58%	59%
Service	7%	7%	7%	7%	8%	8%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

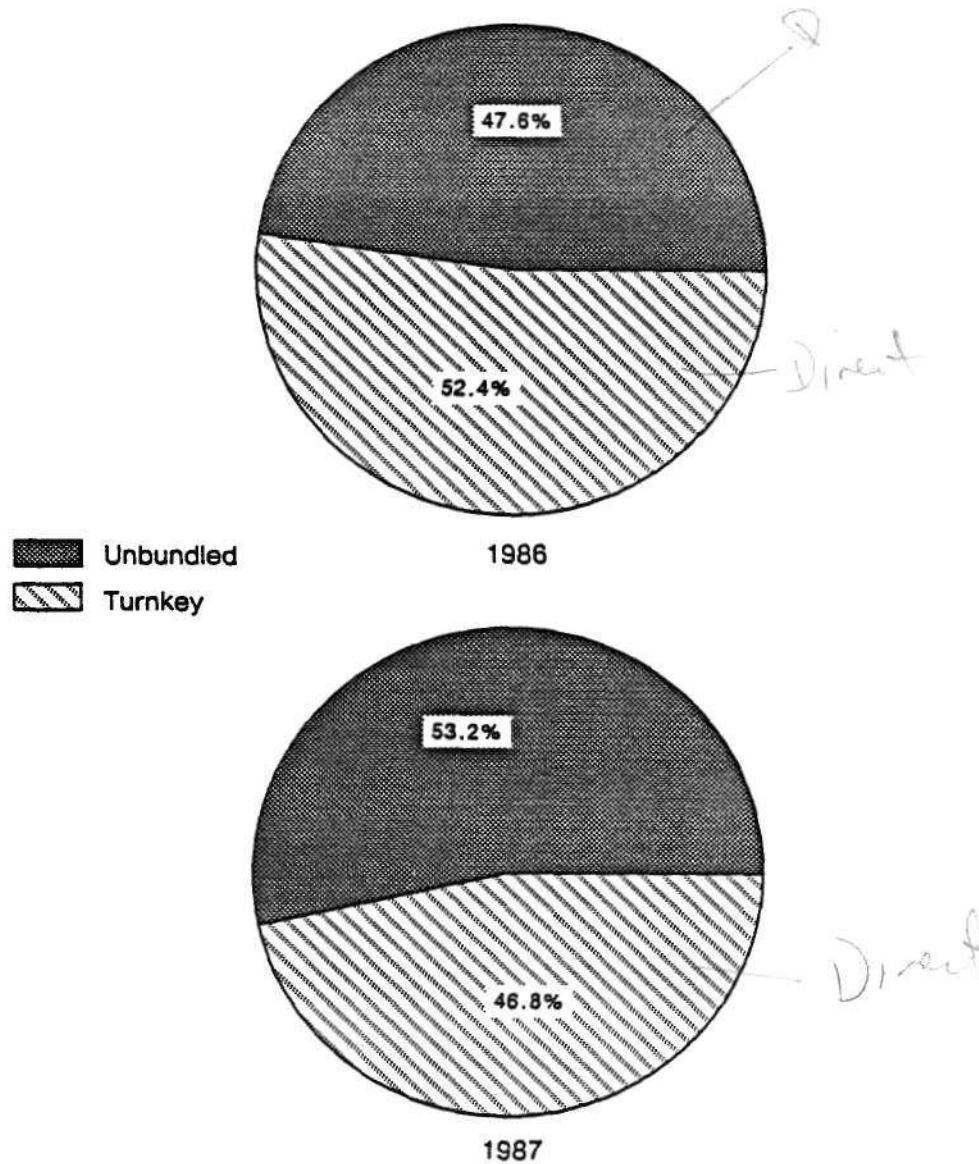
DISTRIBUTION CHANNELS

This section presents Dataquest's forecast and analysis for turnkey and unbundled sales for the EDA market as illustrated in Figure 1.4-9 and Tables 1.4-9 and 1.4-10. These data can be summarized as follows:

- Turnkey hardware the software revenue is forecast to decline from \$805 million in 1987 to \$798 million in 1992, dropping from 47 percent of the total market to 36 percent.
- Unbundled hardware and software revenue is forecast to grow at a 9.3 percent CAGR, from \$916 million in 1987 to \$1,429 million in 1992. It will grow from 53 percent of total revenue to 64 percent.
- Dataquest believes that this shift reflects a fundamental change in the buying practices of all customers, large and small. Hardware is increasingly purchased separately from software. For large corporations, this means purchasing workstations directly from the manufacturer and then assembling a software solution. For the small company, it means purchasing a personal computer and then buying software through a discount chain or by mail order.

Figure 1.4-9

**Electronic Design Automation
Turnkey versus Unbundled
(Percentage of Revenue)**



Source: Dataquest
July 1988

Table 1.4-9

**Electronic Design Automation
Turnkey versus Unbundled
(Millions of Dollars, Actual Units)**

	1987	1988	1989	1990	1991	1992	CAGR
	****	****	****	****	****	****	****
Total Hardware and Software Revenue							
Turnkey	805	827	835	838	828	798	-.2%
Unbundled	916	1,061	1,186	1,294	1,365	1,429	9.3%
Total	1,721	1,888	2,021	2,132	2,193	2,227	5.3%
Hardware Revenue							
Turnkey	525	582	578	568	546	506	-.7%
Unbundled	475	509	534	551	553	556	3.2%
Total	1,000	1,091	1,112	1,118	1,098	1,061	1.2%
Software Revenue							
Turnkey	280	245	257	270	283	292	.9%
Unbundled	442	552	652	743	812	873	14.6%
Total	721	797	909	1,014	1,095	1,165	10.1%
Workstation Shipments							
Turnkey	17,398	19,340	20,880	22,180	22,920	23,670	6.4%
Unbundled	32,971	41,450	49,330	55,430	61,010	65,540	14.7%
Total	50,369	60,800	70,210	77,610	83,930	89,210	12.1%

Source: Dataquest
July 1988

Table 1.4-10

**Electronic Design Automation
Turnkey versus Unbundled
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
Total Hardware and Software Revenue	----	----	----	----	----	----
Turnkey	47%	44%	41%	39%	38%	36%
Unbundled	53%	56%	59%	61%	62%	64%
Total	100%	100%	100%	100%	100%	100%
Hardware Revenue						
Turnkey	53%	53%	52%	51%	50%	48%
Unbundled	47%	47%	48%	49%	50%	52%
Total	100%	100%	100%	100%	100%	100%
Software Revenue						
Turnkey	39%	31%	28%	27%	26%	25%
Unbundled	61%	69%	72%	73%	74%	75%
Total	100%	100%	100%	100%	100%	100%
Workstation Shipments						
Turnkey	35%	32%	30%	29%	27%	27%
Unbundled	65%	68%	70%	71%	73%	73%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

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1.5 EDA Market Shares

This section presents Dataquest's analysis of EDA market shares in terms of total revenue, hardware and software revenue, and workstation shipments, as illustrated in Figures 1.5-1 through 1.5-4 and Table 1.5-1. These data are summarized as follows:

- Mentor Graphics was the number one player in the 1987 EDA market in total revenue, with \$210.7 million and a 10.6 percent market share. The company was also the number one software supplier, with \$79.8 million and an 11.1 percent market share. Mentor Graphics is a leading turnkey system supplier and a textbook company. It has enjoyed steady growth in revenue, shipments, and profitability.
- Digital Equipment is the leading hardware supplier in the market with \$149.5 million in hardware sales and an 8.8 percent share of total market. Its strength is still at the mainframe and host level, but it is gaining ground in workstations.
- Daisy remained at number three in 1987 as the second largest turnkey supplier in the market. Its total revenue was \$103.5 million and its market share was 5.2 percent. After a very difficult year in 1986 and several changes in management, Daisy appears to have recovered. The new president and CEO, Dr. Norman Friedman, has set the company on a new course. Daisy has adopted Sun UNIX and is now porting to the Sun Microsystems 386i platform.
- Racal-Redac, the only European supplier, emerged as the number four vendor in the market, with \$89.8 million in sales and a 4.5 percent market share. It is also the number two software supplier in the market today, with a 9.3 percent market share. Racal-Redac is the only one of the old-line CAD companies to have held and gained ground. Because of its strength in Europe, which is the fastest-growing market in EDA, and its continued innovation in PCB layout, Racal-Redac is a company to be reckoned with.
- The next three positions are occupied by hardware suppliers Apollo, IBM, and Sun, in order of rank. Apollo is the fifth largest vendor, with revenue of \$82.6 million and a 4.2 percent share, and its product remains the preferred technical workstation. IBM, through its personal computer strength, is number six, with \$80.2 million in revenue and a 4.0 percent share. Sun gained more market share than any other vendor in 1987, and rose to the number seven spot with \$68.5 million and 3.5 percent share.

- Valid Logic, Hewlett-Packard, and Cadnetix are the eighth, ninth, and tenth largest suppliers, respectively. Valid Logic is on the mend and, like Cadnetix, ported to the Sun platform in 1987. Both companies also made significant mergers in early 1988, Cadnetix buying HHB Systems and Valid acquiring GE Calma's IC layout division. These mergers have put both Cadnetix and Valid Logic into contention with Daisy and Racal-Redac for the number two turnkey/solution supplier position. HP gained market share in 1987 and continues to grow at a steady pace, but now it must catch up once again with other hardware, software, and turnkey suppliers.
- Scientific Calculations, Computervision, and Calma are the eleventh, twelfth, and thirteenth vendors in the market, respectively. These three original CAD companies have been squeezed out of the top ten by newer vendors. Indeed, this will be the last year that Computervision and Calma appear on this list—Computervision because of its acquisition by Prime, and Calma because its IC layout operations were sold to Valid Logic and its PCB layout operations were reduced to a minimum.
- Zuken is the highest-ranked Japanese vendor on this list as the fourteenth largest supplier, with \$41.7 million in sales. Zuken's sales are up from last year, but the company has been under heavy pressure from other entrants into the Japanese market, such as Racal-Redac and Mentor Graphics.

Figure 1.5-1

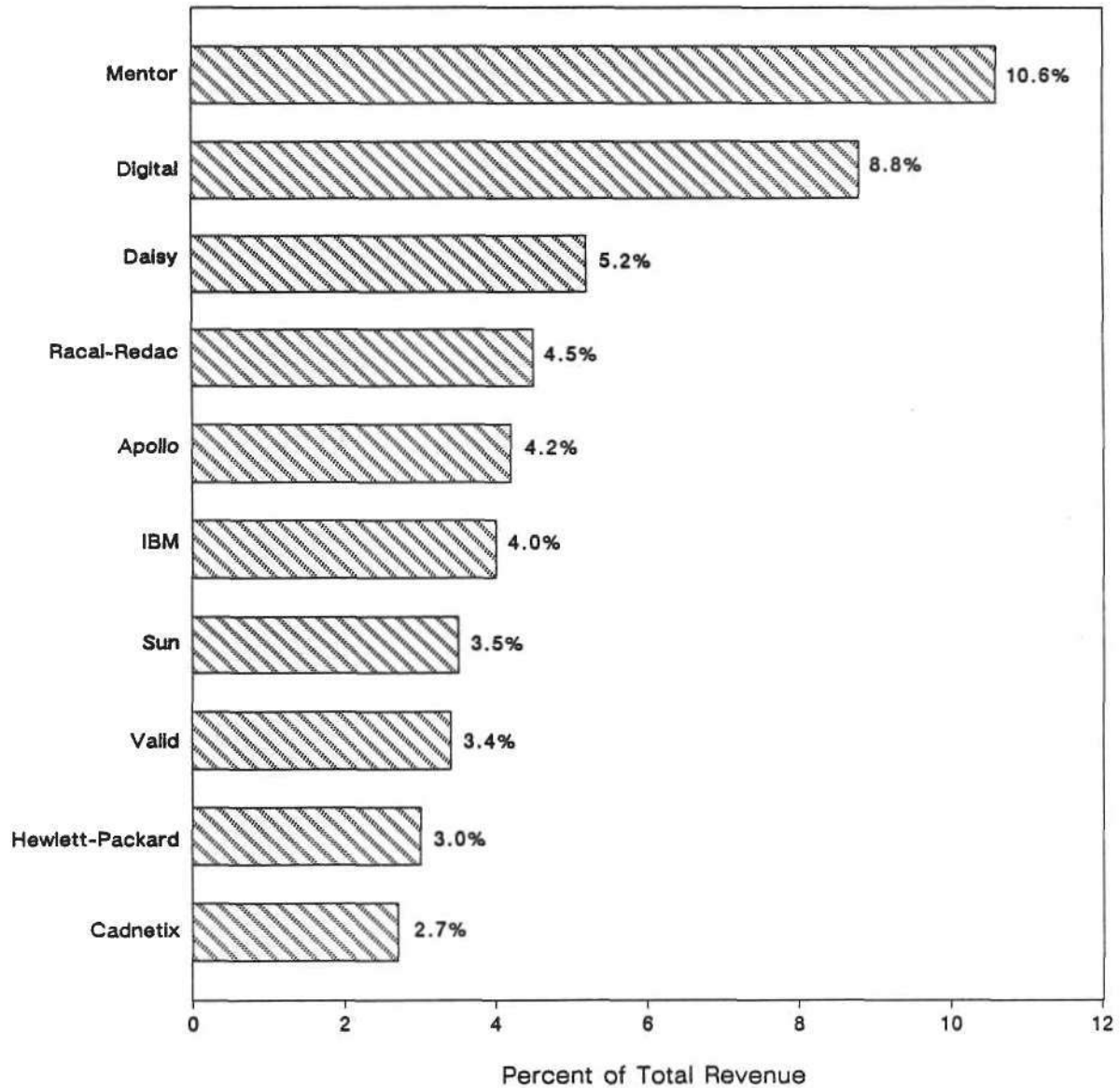
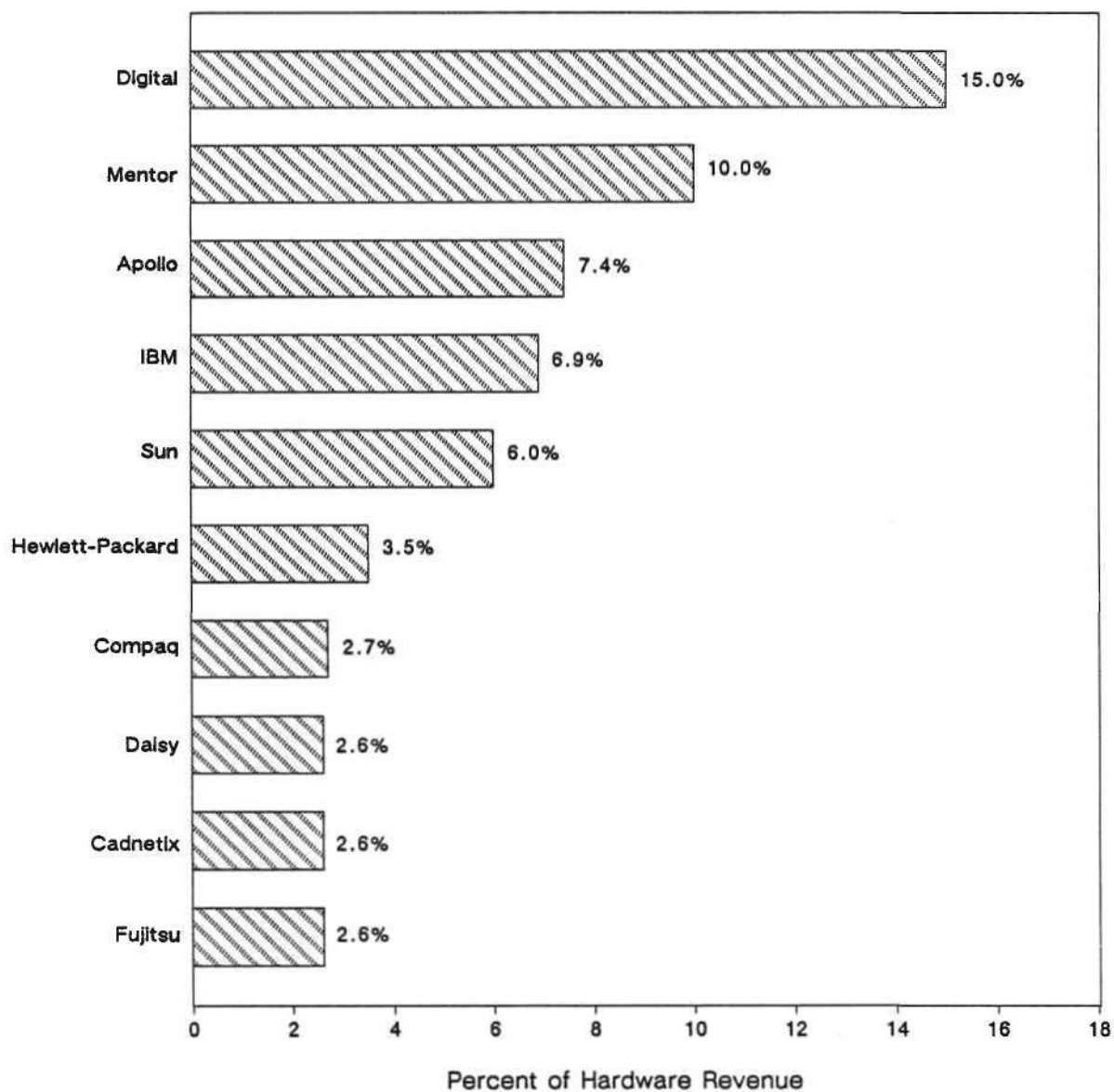
**EDA 1987 Market Share
(Total Revenue)**Source: Dataquest
July 1988

Figure 1.5-2

EDA 1987 Market Share
(Hardware Revenue)



Source: Dataquest
July 1988

Figure 1.5-3

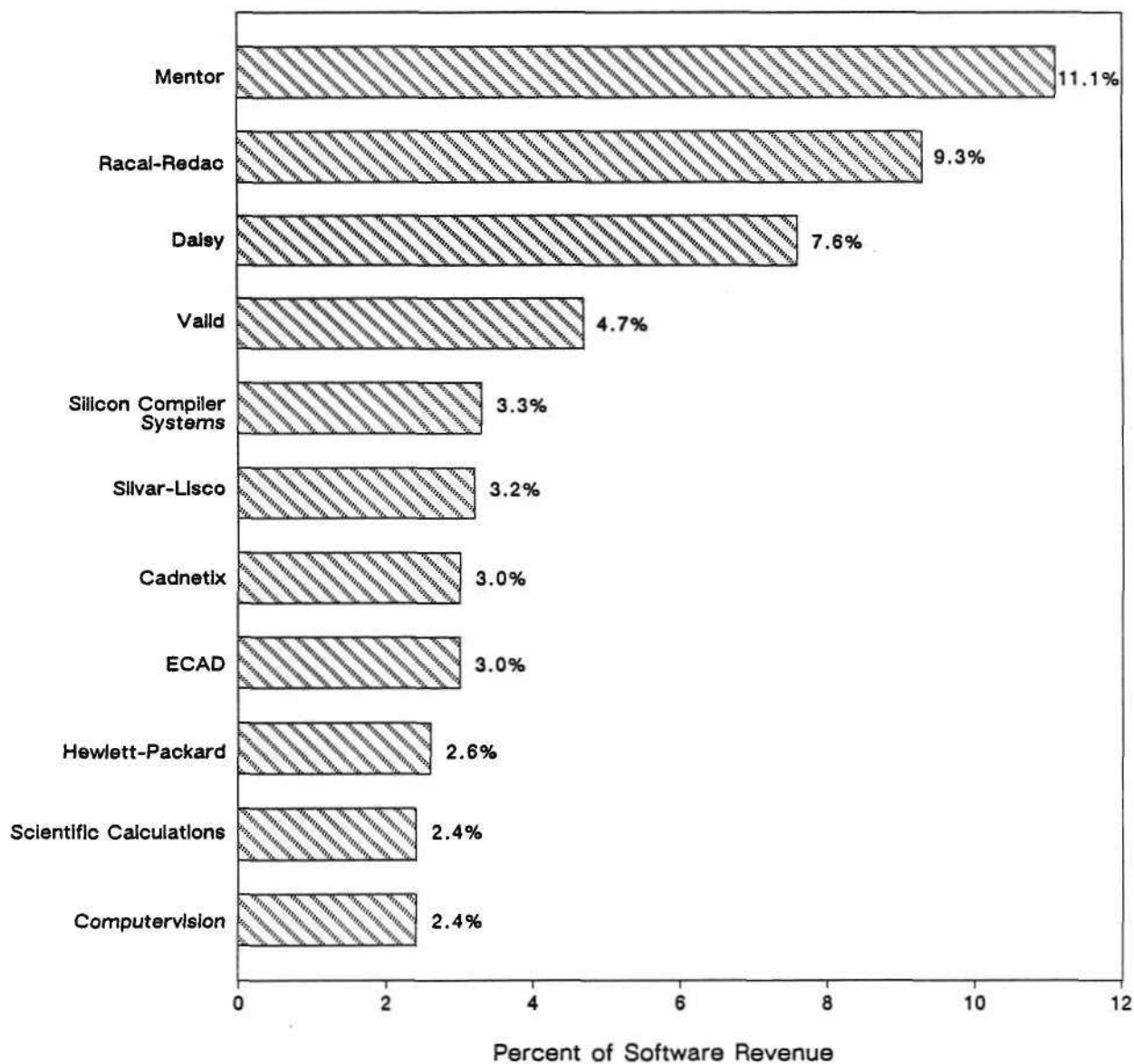
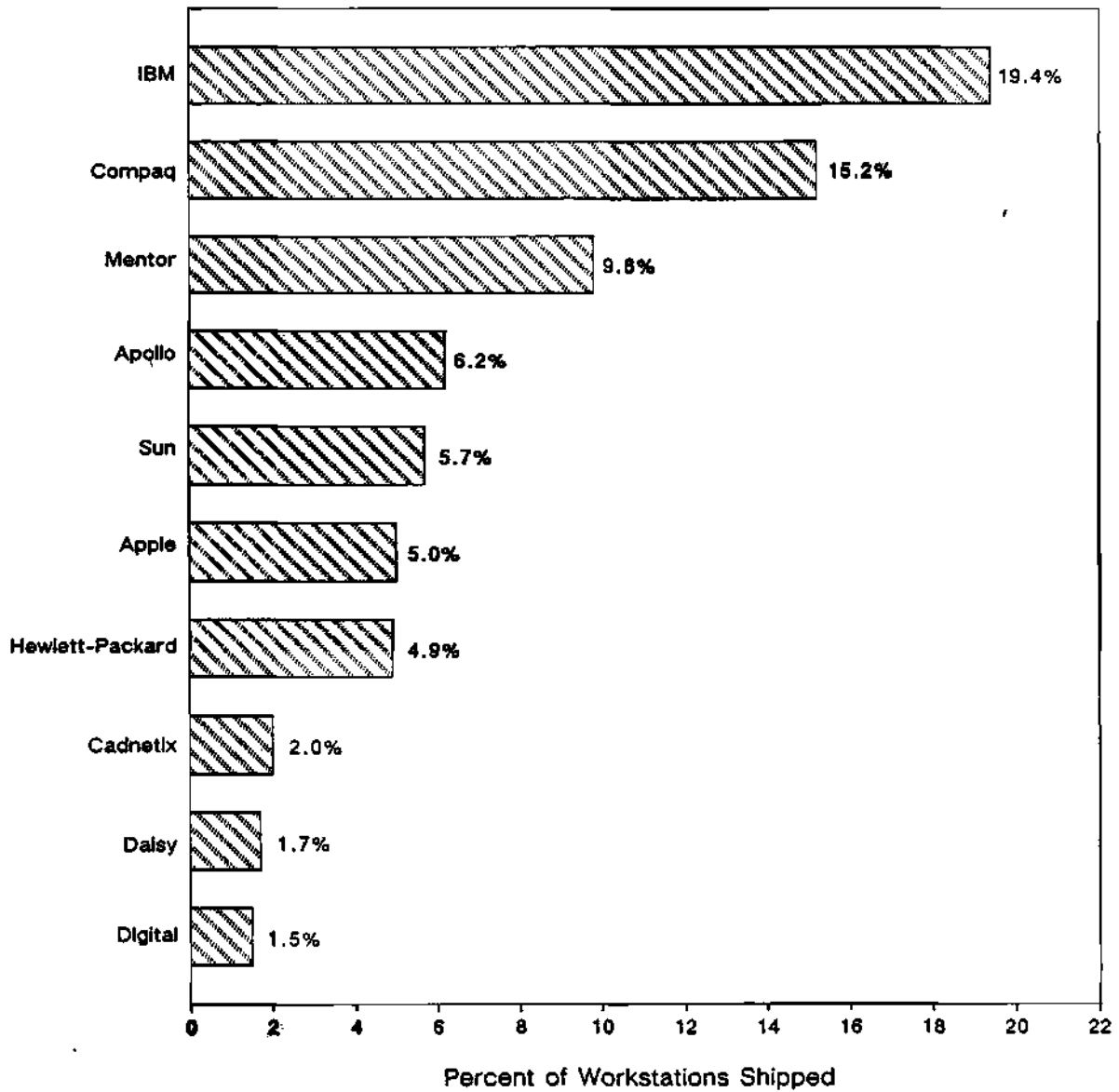
EDA 1987 Market Share
(Software Revenue)Source: Dataquest
July 1988

Figure 1.5-4

EDA 1987 Market Share
(Workstation Revenue)



Source: Dataquest
July 1988

Table 1.5-1

EDA 1987 Market Share
(Millions of Dollars, Actual Units)

As per Atsuko Namours
1/30/89
(Also 1987 - 174 H/W new loaders
115 H/W models
221 upgrades)

Company	Market Share				Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Mentor	210.7	99.9	79.8	4,936	10.6%	10.0%	11.1%	9.8%
Digital	174.1	149.5	.0	779	8.8%	15.0%	.0%	1.5%
Daisy	103.5	26.2	55.2	831	5.2%	2.6%	7.6%	1.7%
Racal-Redac	89.8	10.0	67.3	199	4.5%	1.0%	9.3%	.4%
Apollo	82.6	74.0	.0	3,115	4.2%	7.4%	.0%	6.2%
IBM	80.2	68.8	4.9	9,775	4.0%	6.9%	.7%	19.4%
Sun	68.5	60.5	.0	2,886	3.5%	6.0%	.0%	5.7%
Valid	67.3	19.3	33.6	688	3.4%	1.9%	4.7%	1.4%
Hewlett-Packard	58.7	34.7	18.9	2,466	3.0%	3.5%	2.6%	4.9%
Cadnetix	53.9	25.6	22.0	990	2.7%	2.6%	3.0%	2.0%
Scientific Calculations	51.5	16.8	17.3	154	2.6%	1.7%	2.4%	.3%
Computervision	47.5	17.0	17.3	424	2.4%	1.7%	2.4%	.8%
Calma	43.5	23.2	12.4	359	2.2%	2.3%	1.7%	.7%
Zuken	41.7	21.9	14.4	346	2.1%	2.2%	2.0%	.7%
Fujitsu	37.9	26.1	8.1	508	1.9%	2.6%	1.1%	1.0%
Seiko Instruments (No OEM)	35.0	18.1	13.4	200	1.8%	1.8%	1.9%	.4%
NEC	34.3	17.8	13.0	639	1.7%	1.8%	1.8%	1.3%
Calay	27.2	17.1	8.1	230	1.4%	1.7%	1.1%	.5%
Compaq	27.2	27.2	.0	7,640	1.4%	2.7%	.0%	15.2%
Zycad	27.1	23.9	.0	53	1.4%	2.4%	.0%	.1%
Silicon Compiler Systems	27.0	.0	23.8	0	1.4%	.0%	3.3%	.0%
Silver-Lisco	25.3	.0	23.0	0	1.3%	.0%	3.2%	.0%
Intergraph	24.5	13.5	5.8	222	1.2%	1.3%	.8%	.4%
Control Data	21.8	14.2	2.6	374	1.1%	1.4%	.4%	.7%
ECAD	21.4	.0	21.4	0	1.1%	.0%	3.0%	.0%
Futurenet	17.9	.0	15.7	0	.9%	.0%	2.2%	.0%
SDA	16.5	.4	15.4	10	.8%	.0%	2.1%	.0%
Sharp System Products	16.3	6.8	7.9	85	.8%	.7%	1.1%	.2%
Personal CAD Systems	15.9	.0	13.9	0	.8%	.0%	1.9%	.0%
Autodesk	15.0	.0	15.0	0	.8%	.0%	2.1%	.0%
Hitachi	13.7	9.3	3.3	245	.7%	.9%	.5%	.5%
Asahi Optical (No OEM)	10.0	7.4	1.6	55	.5%	.7%	.2%	.1%
Applicon	9.5	3.9	2.7	200	.5%	.4%	.4%	.4%
Tektronix	7.5	3.5	3.1	95	.4%	.3%	.4%	.2%

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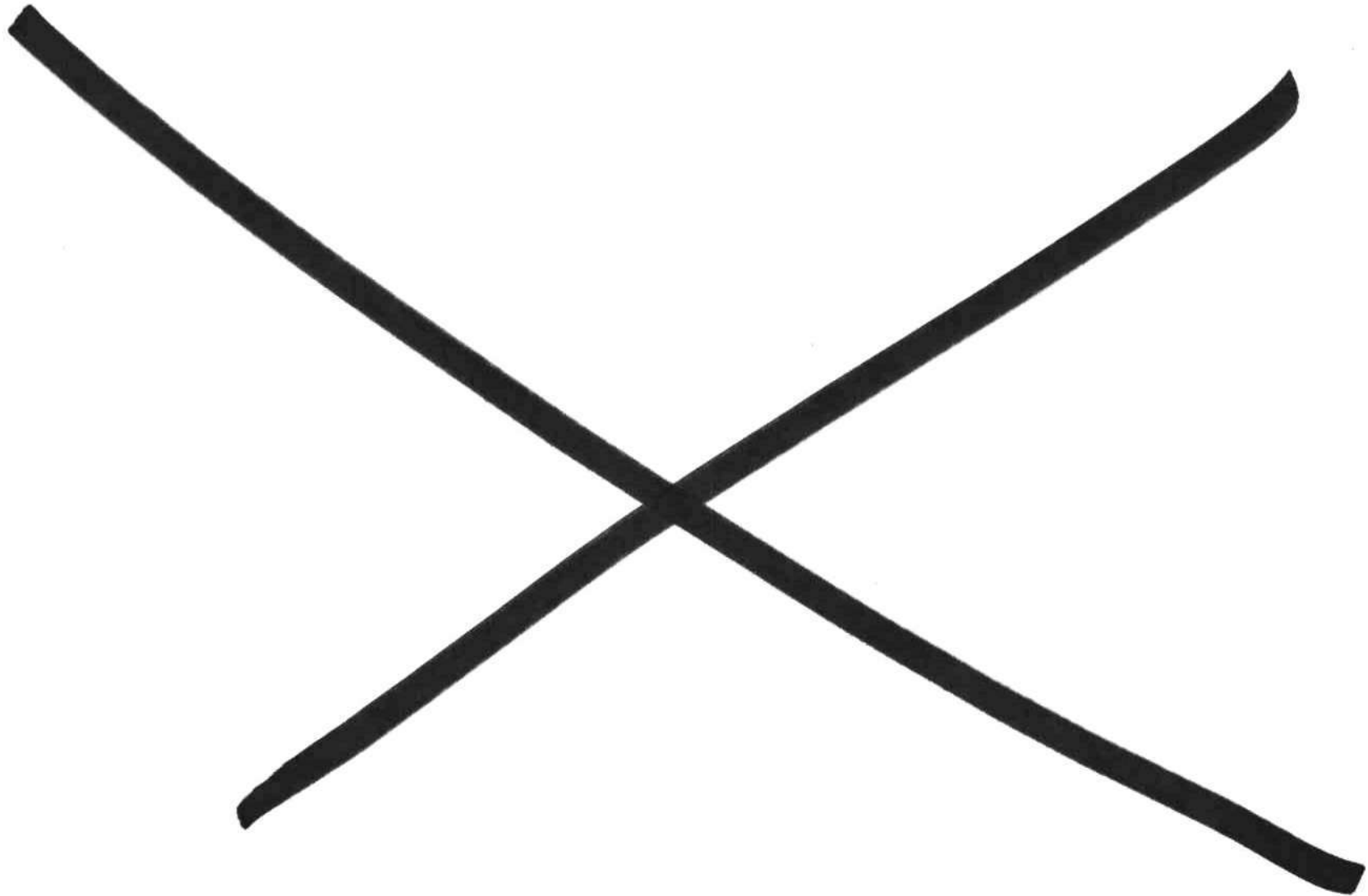
(Continued)

Table 1.5-1 (Continued)

EDA 1987 Market Share
(Millions of Dollars, Actual Units)

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Toshiba (No OEM)	7.2	5.5	1.0	84	.4%	.6%	.1%	.2%
Apple Computer	7.0	7.1	.0	2,527	.4%	.7%	.0%	5.0%
Hitachi Zosen	4.4	1.6	2.4	29	.2%	.2%	.3%	.1%
CADAM	4.2	.0	3.8	0	.2%	.0%	.5%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	.2%	.2%	.1%	.1%
Tokyo Electron (No OEM)	.8	.0	.7	0	.0%	.0%	.1%	.0%
ICL	.8	.6	.2	19	.0%	.1%	.0%	.0%
Other Companies	349.2	146.4	171.7	9,160	17.6%	14.6%	23.8%	18.2%
All Companies	1,981.9	999.6	721.4	50,369	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	1,540.0	807.2	521.6	45,293	77.7%	80.7%	72.3%	89.9%
All Asian-Based Companies	265.2	143.9	93.7	3,629	13.4%	14.4%	13.0%	7.2%
All European-Based Companies	176.8	48.6	106.1	1,447	8.9%	4.9%	14.7%	2.9%
All Hardware Companies	527.3	474.7	.6	32,971	26.6%	47.5%	.1%	65.5%
All Turnkey & SW Companies	1,454.6	525.0	720.8	17,398	73.4%	52.5%	99.9%	34.5%

Source: Dataquest
July 1988



2.1 ECAE Definitions

The electronic computer-aided engineering (ECAE) segment refers to CAD/CAM hardware and software products that are typically used in the engineering or design phase of electronic products (as opposed to the physical layout phase). ECAE applications address design creation, verification and analysis, test, documentation, and data base management tasks. ECAE products are generally used by electrical engineers. Because of significant differences between the marketing and product strategies for ECAE, IC layout, and PCB layout, Dataquest continues to differentiate and segment the electronic CAD/CAM market in this manner. Therefore, ECAE by definition does not include layout.

A netlist serves to connect ECAE to layout applications; a netlist is a logical or functional description of an integrated circuit (IC), printed circuit board (PCB), electronic system, or product. This type of output is used to analyze the performance or functionality of the circuit and is also used in another product design phase to manually or automatically create the physical layout. A netlist is not the only output of an ECAE system. For example, other critical ECAE output can consist of test patterns, bonding diagrams, and design documentation.

ECAE DESIGN PHASES AND TASKS

ECAE products address the following design phases and tasks, and they may include the functionalities listed and defined below.

Architectural/Conceptual

The architectural/conceptual phase includes the following:

- *Architectural/conceptual*—During the architectural/conceptual stage, an electronic product requirement is translated from a concept into a functional specification. During schematic capture, this specification becomes a circuit design. This circuit design can then be verified, simulated, tested, documented, and stored in a data base. The finished design can be implemented as either an IC or a PCB during the layout or physical design stage.
- *Logic design automation/synthesis*—These tools are used to automate the process of design specification and creation. This includes behavioral/architectural tools, logic minimization, technology conversion, and automatic schematic synthesis/generation.

Schematic Capture

The schematic capture phase includes the following:

- *Schematic capture*—During the entry stage of the design process, a functional description becomes an actual logic diagram or design. The most frequently used tool for design entry on ECAE workstations is schematic capture.
- *Capture or schematic capture*—This is an automated graphic design entry method that allows a designer to define the logic of a circuit and to create a schematic drawing or design. After creating the schematic, detailed design documentation can be produced in either graphic or netlist form. The process of netlist production is known as *netlist extraction (NLE)*.
- *PLD programmers*—These are ECAE systems used to define the logic of a programmable logic device (PLD), a type of semicustom application-specific integrated circuit (ASIC).

Verification and Analysis

The verification and analysis phase includes the following:

- *Verification and analysis*—ECAE includes an entire class of tools that are used, after design creation, to evaluate the electronic behavioral characteristics of a design.
- *Behavioral simulation*—This is the simulation of ICs or systems that are based on high-level models, as opposed to gate, transistor, or switch-level models. Behavioral models may be of an entire section of the IC or system (e.g., I/O management) or of a specific complex component (e.g., a microprocessor or register).
- *Circuit simulation*—This is the simulation of an IC at the switch, transistor, or device level and is the most accurate form of IC verification. The best known of the circuit simulators is *SPICE*, invented at the University of California at Berkeley, and now available in the public domain or in enhanced forms from several commercial suppliers.
- *Electrical rule checking (ERC) or logic design rule checking (LDRC)*—This is making sure that the logic design conforms to known process limitations (e.g., maximum fanout from a component).
- *Hardware modelers*—This is special-purpose peripheral hardware that enables a new circuit design to incorporate existing, real-world circuitry in its simulation.

- *Logic simulation*—This ECAE software is used to verify the logic and timing behavior of a digital electronic design.
- *Mixed-level simulation*—This simulation is performed simultaneously at the behavioral, device, and physical model level.
- *Mixed-mode simulation*—This is the simulation of an electronic design that contains both analog and digital circuits.
- *Simulation accelerators*—These special-purpose computers are used to perform logic or fault simulation at speeds unattainable on workstations.
- *Timing analysis or verification*—This is behavioral evaluation of a circuit design that examines signal delays and determines if signals arrive at predicted times.

Test

The test phase includes the following:

- *Test*—These ECAE software applications are used to create the test patterns that will be used to test the actual product during manufacture. Electronic test products include pattern editing, pattern generation, and fault grading or simulation.
- *Automatic test pattern generation (ATPG)*—These are tools that automatically produce fault tests from a specific circuit description.
- *Fault grading/simulation*—This is used to evaluate or grade the quality of a test pattern relative to a design. Quality is determined by the measure of the coverage of the test vectors (i.e., what percentage of time will the patterns identify potential errors in a given circuit).
- *Test pattern editing and generation*—These tools are used to manually create and edit the test vectors used by fault tests.
- *Testability analysis*—These are tools used to evaluate the quality of a design in terms of its ultimate testability.

Documentation

An integral part of ECAE is the graphic and textual documentation of designs. ECAE includes the class of special-purpose software used to document electronic designs.

Design Data Base Management

The design data base management class of products underlies all the stages of the ECAE design process. For example, these tools are used to provide revision controls on design files or to maintain standard symbol or parts libraries to be used by all designers on a project. Design support tools, such as design libraries, are included also.

2.2 ECAE Executive Summary

This summary highlights the key points and analyses discussed throughout this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the ECAE applications segment. Highlights include the following:

- Dataquest estimates the ECAE market at \$942 million in 1987, up 9 percent from \$868 million in 1986.
- The ECAE market is forecast to grow 8 percent in 1988 to more than \$1 billion, but long-term growth is slowing as ECAE tools are increasingly absorbed into the engineering workplace.
- The ECAE market is forecast to grow to \$1.2 billion in 1992, representing a 5 percent compound annual growth rate (CAGR).
- Dataquest estimates that 29,850 ECAE workstations were shipped in 1987.
 - ECAE workstation shipments will grow 21 percent to 36,020 in 1988.
 - They are expected to reach 52,960 units in 1992, growing at 12 percent CAGR.
- The average selling price per ECAE seat across all platform types is expected to decline at 10.2 percent CAGR, from \$21,000 in 1987 to \$12,300 in 1992.
- In 1987, the personal computer continued its impact on the ECAE market, accounting for 59 percent of ECAE workstation shipments but for only 18 percent of overall ECAE revenue.
- Technical workstations, which accounted for 56 percent of all ECAE revenue and 37 percent of all workstations shipped in 1987, are forecast to represent 77 percent of all ECAE revenue in 1992 and 47 percent of workstation shipments.
- Dataquest anticipates continued consolidation and retrenching among ECAE vendors, with company roles and product offerings being redefined to adapt to the high number of vendors.

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2.3 ECAE Market Overview

HISTORY

Overview

One of the major trends in the entire CAD/CAM market is toward providing computer-aided engineering (CAE) applications. CAE is used by engineers of all disciplines to automate the engineering and analysis phase of any product's design cycle. For instance, mechanical engineers apply CAE to their design tasks using applications such as stress analysis, kinematics, and finite element analysis.

Vendors addressing the needs of electrical engineers have made such a significant impact on the way in which electronic products are designed, as well as on CAD products themselves, that we differentiate CAE for electrical engineers from all other CAE applications. Therefore, Dataquest uses the term ECAE to refer to electronic computer-aided engineering applications.

Because ECAE and physical layout functions can be highly integrated, especially with automatic layout dependent on ECAE data, it is impossible to completely separate the two applications. Electronic product design does not end with logic design. Therefore, it is important to note the following regarding Dataquest's ECAE segmentation:

- The ECAE estimates and forecasts are for systems with ECAE applications only.
- The ECAE section refers to functionality, as opposed to the design's ultimate implementation as either an integrated circuit or a printed circuit board. ECAE products can be used to front-end either IC or PCB design.

The Evolution of the Market

The focus of electronic CAD/CAM vendors prior to 1981 was primarily physical layout applications for both ICs and PCBs. The ECAE segment of the CAD/CAM industry began with the introduction of the first commercially available ECAE products from Daisy Systems, Mentor Graphics, and Valid Logic in 1981—products that automate the engineering design process for engineers.

The original product lines of the early ECAE vendors consisted of basic schematic capture, i.e., the ability to draw the electrical schematics, or logic diagram, of an electronic product primarily for documentation purposes. Shortly after its introduction, schematic capture grew to encompass logic design, with various forms of analysis, simulation, and verification.

Dataquest defines logic design as schematic capture combined with the ability to associate electrical parameters with graphic schematic symbols, thus driving analysis and simulation. Logic design is the more comprehensive of the two applications because it maintains electrical information such as power, timing, and performance.

The electronic CAD/CAM market evolved to encompass ECAE. Companies with physical layout products as their original entry into the EDA market have also expanded their product functionality to include logic design. Engineers have accepted automated logic design as a productivity tool.

The continuing need of electrical engineers to increase productivity—to make the design cycle more efficient while at the same time shortening it—continued to be addressed by the 1987 ECAE market in products that extended logic design to include other productivity tools, such as test and logic design automation. Recently, in order to meet the challenge of more full-line suppliers, many ECAE vendors have extended or plan to extend their product functionality to include the physical design of ICs and PCBs integrated with ECAE functionality. Dataquest believes that product lines of leading ECAE companies will grow further to address the demands of the larger system-engineering market for integrated IC/PCB design.

1987: POSITIONING AND CONSOLIDATION

The ECAE market in 1987 enjoyed steady revenue growth of 9 percent from \$894 million to \$940 million. Some segments, such as technical workstation-based systems, with 1987 revenue at \$529 million, enjoyed revenue growth of 21 percent.

The major ECAE vendors took advantage of this situation to recover after the market slowdown of 1986 and to focus on improving and consolidating their positions in the market. For a few vendors, such as Mentor Graphics, "steady as she goes" was the watchword. For other vendors, such as Data I/O and Tektronix, there were cutbacks in the efforts in the market. But for vendors such as Cadnetix, Daisy, Teradyne, and Valid, this was an opportune time to push ahead, with some changes in course.

First, a number of major mergers and acquisitions occurred as vendors strove to solidify their market share and gain technology. The Teradyne/Case/Aida, Cadnetix/HHB, and Simucad mergers highlighted this activity, but there were numerous other moves including Mentor Graphics' purchase of Caedent and Valid's investment in Epic.

Second, the decisions to port to the Sun Microsystems workstations by Cadnetix, Daisy, and Valid Logic represent another major effort to reposition these companies. The switch to the Sun workstation moved these vendors away from proprietary hardware, and set them against the Mentor Graphics/Apollo alliance. Cadnetix, Daisy, and Valid are now ready to fight for the number two market spot and eventually challenge Mentor Graphics for industry leadership.

Third, many companies forged new alliances to improve their market position. Analogy set up working relationships with Cadnetix, Racal-Redac, and HHB, while Logic Automation closed a number of important library deals. EDA Systems formed its synergy partner program as part of its role as an integration supplier. ASIC suppliers such as VTI also set up stronger working relations with key ECAE suppliers such as Daisy and Valid Logic.

The result of these mergers, acquisitions, alliances, exits, and ports is a more consolidated and stronger market. The remaining vendors are larger, healthier, and more profitable, which is a much better situation than we had at the end of 1986.

In retrospect, this market consolidation and vendor positioning is really a continuation of the market maturation that began in 1986. We began 1986 with too many vendors, excessive price competition, and extreme uncertainty. This situation had cut into profits, growth, and buyer confidence.

Now, with a restructured market and vendors, the market is in a position to enjoy renewed growth, but with very different rules. The days of the single-source, turnkey, homogeneous environment are coming to a close. We are moving into a world of sophisticated users who demand integration and service from their suppliers but also are prepared to work with a highly heterogeneous design environment. The market will expand, but it will do so on the users' terms rather than the vendors'.

THE NEW BUYER SOPHISTICATION

The repositioning and consolidation on the vendor side has been mirrored by new sophistication on the buyer side. Frustrated by unfulfilled promises from "solution suppliers" and their inability to control their own design environments, users have struck out on a new course themselves.

Users now understand that no one vendor can supply a totally integrated and complete solution for all their design problems. Users no longer want to hear about integration; they now require it. Because of the lack of integrated solutions, users have come to regard standard hardware as the integrative base to which they can add third-party software and solve their own design problems. This move toward platform standardization is particularly evident in purchases by larger, corporate CAD/CAM end users seeking to centralize design activity within their organizations.

For an increasing number of companies, CAD/CAM/CIM (computer-integrated manufacturing) represents a strategic, corporate-level commitment in which much more emphasis is placed on overall design process integration and productivity than on isolated design solutions for individual personnel. Typically, in larger organizations, development is divided between engineering and CAD groups for product design and physical layout, respectively. The design product needs of these two sets of end users varies accordingly.

System engineering, because it needs to manage a complex design process that involves many different types of engineering (e.g., software design, hardware design, and I/O design), tends to regard choice of design tools more as a management problem than a performance-driven issue. On the other hand, CAD departments primarily concentrate on performance in the sense of getting jobs done quickly. CAD departments were the first CAD users, purchasing large proprietary systems that supported physical design well but had little connectivity with other design tasks such as logic design, analysis, and documentation.

System engineers have shown more concern with design methodology and, consequently, favor tools supporting company-wide design standards and practices. Specific demands of system engineers are as follows:

- To own their own design data, complete with revision control and full documentation, so that they can leverage previous design experiences on whichever system is ultimately used and despite possible changes in design personnel
- To share resources and data across applications, particularly in the case of large corporate engineering groups that support multiple users requiring design, layout, test, analysis, manufacturing, documentation, and project management functions
- To integrate state-of-the-art solutions on their own systems as soon as these become available
- To use off-the-shelf, standard (as opposed to proprietary) hardware so as not to preclude interactive, on-line software engineering tasks
- To negotiate directly with hardware manufacturers so as to obtain optimal volume purchase and service discounts

Corporate-wide design automation plans demand shared resources. The new corporate CAD/CAM/CIM consciousness is directly responsible for 1987's continuing shift away from proprietary design systems and toward applications on standard, general-purpose hardware platforms. Dataquest believes that, for all these reasons, engineering rather than CAD departments will increasingly dominate corporate purchase decisions. Conservative corporate purchase criteria tend to favor the well-managed full-line or niche supplier.

STRATEGIC ISSUES

Not only does the maturing ECAE market consist of full-line and ASIC reseller niche players, but it also consists of standard hardware platform vendors who are applying strong competitive pressure from the market's high end. These classes of ECAE vendor are briefly described as follows:

- Full-line application suppliers consist of companies such as Cadnetix, Daisy, Mentor, PCAD, and Valid that market and support a complete range of EDA products to end users.
- In contrast, niche players develop and market individual products that address limited applications. These are suppliers, such as IKOS, Trimeter, and Zycad, seeking to expand their product base.
- Standard hardware vendors supply the workstations and systems on which either or both niche and full-line suppliers' products may run. These are systems suppliers, such as Apollo, Digital Equipment Corporation, Hewlett-Packard (HP), IBM, and Sun. These companies are coming into the market with unclear strategies relative to the end user.
- Also included are certain ASIC suppliers who both develop their own tools and resell other ECAE vendors' products.

Faced with a maturing ECAE market, each class of vendor is examining some degree of strategic realignment in order to deal with the competition.

Full-Line ECAE Strategies

Severe price pressure and competition on full-line suppliers in the ECAE market, for example, is now coming from both the high and low ends of the market spectrum, i.e., from the large corporate players (Digital, HP, and IBM) entering the marketplace and from low-cost, PC-based software. In light of this wide-ranging competition, full-line suppliers may need to reposition themselves strategically, meaning the following:

- Porting from proprietary to standard hardware, operating systems, and data formats
- Returning to more of a core business focus
- Concentrating on customer service and support activities
- Delivering on promises
- Forming alliances with niche and hardware suppliers, as opposed to pursuing strategies based on either niche or hardware product development

Hardware Vendor Strategies

The CAD/CAM strategies of large system companies such as Digital, HP, and IBM are just not clear at this time. These vendors have the choice of remaining hardware suppliers (i.e., integration paradigms for a number of third-party solutions) or of attempting to become full-line suppliers themselves. In the latter case, the challenge for these companies would be to manage a complex juggling act of hardware and application sales and support with state-of-the-art solutions development. In addition to remaining competitive in the workstation market, they would need to supply everything to everybody on an ongoing basis. However, the trend in corporate CAD/CAM purchasing toward industry-standard hardware is fueling the ambitions of this class of company.

At this time, HP is perhaps more of a full-line supplier through its Ceracor acquisition and DesignCenter products than either IBM or Digital. IBM does offer a limited amount of EDA software through its CIEDS program. Digital, however, with its large number of trading partners and other third-party agreements, directly sells no EDA products. The names Digital and IBM are more widespread in this marketplace. In this market, these companies seemingly could choose to play any role at any moment.

The presence of these large computer manufacturers both in the market and in the installed base itself threaten the key account strategies of the full-line ECAE suppliers. The large system houses already have the experience of dealing with several major EDA end users and can leverage these relationships to supply workstations and, in some cases, applications.

The popularity of the IBM PC in the ECAE market and direct sales to end users by workstation vendors like Apollo, Digital, and Sun resulted in price erosion and forced full-line ECAE companies to unbundle products and readjust their marketing strategies. Cooperative marketing, comarketing, and referenced sales agreements have now proliferated between full-line suppliers and workstation vendors. The lower-priced, high-performance 386 and 68020-based workstations also forced down the price of proprietary hardware.

This situation caused many ECAE vendors to either reevaluate or totally abandon product strategies based solely on hardware. Solutions vendors simply do not possess the resources to compete against systems houses. Dataquest believes, however, that there is a corollary to this rule: workstation vendors may possess the resources, but they lack the solutions focus necessary to support the end users' application needs.

Niche Companies' Strategies

On the other hand, niche company products often compete head-to-head with offerings from full-line suppliers; for instance, Gateway Design's Vertog Simulator competes with Mentor Graphics Quicksim product.

Niche companies typically address a narrower range of products and technologies than full-line suppliers. The following are product development areas that typically fall outside full-line suppliers' application capabilities and therefore may be best addressed by niche companies:

- Low-cost products
- Leading-edge technologies
- Products that bridge technology and service

To survive in a market overcrowded with vendors and look-alike products, niche companies need to broaden their product bases by offering related, supporting products; by moving into other niche areas; or by becoming more full line.

Two examples of niche strategies are Vantage Analysis and the logic design automation companies Silc and Synopsys. Vantage Analysis has focused on the behavioral simulation market, but with a unique strength—VHDL, the military standard hardware description language. As the first vendor to market with a complete VHDL solution, as well as excellent simulation capabilities, Vantage has carved out a special niche for itself. Silc and Synopsys have entered the market with new logic design automation products with very sophisticated engineering functionality. Full-line vendors are simply not capable of duplicating this functionality and will have to partner with these two start-ups.

ASIC Suppliers

The fourth strategy in the market belongs to the ASIC suppliers. ASIC was one of the first, and remains one of the most important, ECAE applications. Some estimates suggest that more than 40 percent of the ECAE technical workstations sold are used for ASIC design some of the time.

The ASIC suppliers have been in the interesting position of user, developer, and reseller of ECAE tools. From the beginning of the ECAE market, two distinct initial strategies emerged from the ASIC suppliers: proprietary and commercial. Neither of these strategies worked out, and we are now witnessing vendors develop a hybrid of these two positions.

The first strategy was an internally developed, proprietary solution marketed directly to end users on mainframes and workstations. LSI Logic's LDS system is a prime example, and it gave LSI Logic the advantage of a highly reliable design path for customers, which could be in the market before any commercial solutions. The major drawback was that it worked for only one ASIC vendor, LSI Logic itself. Many ASIC users did not want to be "locked in" to one ASIC supplier, and also wanted tools that could be used for system design.

The second strategy was to rely on Daisy, Mentor, and Valid workstations and tools. Almost every ASIC vendor in the market developed "design kits" for use with these workstations. The advantage here was that less investment in tools was required, and customers perceived them as generalized design stations, both for multiple vendors and for system design. The major drawback was that the ASIC vendor did not control this critical design path. Customers were at the mercy of the workstation vendor when software updates occurred, particularly in regard to how reliably the tools handled their ASIC families. More often than not, the tools were not sufficiently accurate, and the cost of handling updates was exorbitant. The result was that ASIC suppliers were not able to offer customers as reliable a design path as the proprietary solution.

A new strategy has now emerged that combines these two earlier options. The ASIC vendor creates and sells a preferred design system, also using commercial tools and some proprietary content. These tool systems can be linked to ECAE workstations at the schematic and simulation level. Examples of vendors pursuing this new strategy are Motorola, National, and NCR. In principal, this new strategy should enable the ASIC vendor to control the design and service portion of the business, but without forcing the customer to drop his own design tools. The design path can be both specific and general at the same time, and the ASIC vendor's tool investment can also be controlled. Is this the best of all possible worlds?

OPPORTUNITIES

Given the strategic business differences between ECAE vendors, there are new product directions that best support each strategy; there are also company types that can best pursue particular product opportunities. However, we believe that the overall theme of application trends is not focused on product features but on increased scope. ECAE products are becoming an integrated set of design management tools that incorporate not only more design tasks but also better analysis capabilities. The result is a design management system—one that meets the needs of a project with many aspects and requirements.

Full-Line Product Opportunities

Given the differing strategies between niche and full-line suppliers, full-line suppliers are best able to distribute and support the design environment. We believe that data management and design environment support products such as documentation are best addressed by full-line vendors, although we can envision a niche company providing a bridged, multivendor design environment. The opportunities and requirements for next-generation full-line vendors are as follows:

- Integrative design data base with both hierarchical and full design, library, documentation, and project management
- Links to back-end layout

- Integration and interactivity between every phase of design
- Easy user integration of third-party tools
- Easy-to-use simulation integrated with both logic libraries and schematic capture
- Rule-based systems
- Integration of alternative design approaches, perhaps including some from niche suppliers
- Migration path to full system design
- Higher-level design entry (e.g., logic synthesis) with links to analysis tools
- Design floor planning tool

Whatever product strategy a full-line supplier pursues, the products must form part of a well-integrated base—a stable and manageable design environment still open to adding the special applications where niche companies excel.

Niche Product Opportunities

Dataquest believes that development efforts for niche suppliers in the ECAE market are directed in general toward low-cost products, leading-edge technologies, and products that bridge technology and service—ECAE products such as the following:

- Design libraries
- Application accelerators
- Hardware modelers
- Low-cost schematic capture
- Low-cost pattern editing
- Architectural-level design tools
- Test-pattern generators
- Links between design entry and test

HARDWARE

ECAE emerged out of a need for products that solved electrical engineers' design problems. However, this need could be met only with the emergence of microprocessor-based technical workstations.

The availability of technical workstations revolutionized the entire EDA market, including its design solutions and existing price and profit structures. Had pioneering companies such as Apollo, Daisy, Sun, and Valid not developed the hardware vehicle, the ECAE revolution might have been delayed for another three years—until the arrival of the IBM PC.

Dataquest distinguishes between hardware and application issues of the market. It is the application products that meet user needs; the hardware products are the vehicle by which these applications are delivered. Users buy neither hardware nor software: They buy solutions to design problems. These solutions are combinations of hardware and software.

However, hardware technology is changing underlying applications strategies. The major cause of this is the PC. The major effect is a dramatic shift in computational alignment—aligning the particular application requirements with the capabilities of the computer. This shift has brought about yet another layer of hardware to the ECAE environment—the application accelerator, which decreases the time involved to complete one or more applications.

The hardware platforms on which ECAE software run are radically changing the availability and feasibility of design automation for the mass end-user market. Listed below are the major causes of this change:

- Personal computers and coprocessors
- Application accelerators
- Decreasing technical workstation prices
- High-end technical workstation systems

In all cases, price and performance are paramount. The trend, however, is toward the division of labor between the networked system resources and the personal or desktop design system. To manage this change, we believe that a very flexible and profit-oriented management style is required for the following reasons:

- Downward-revised revenue goals due to lower average selling prices
- Higher unit volumes required to meet revenue goals
- Revised distribution strategies due to higher volumes

- Revised support strategies due to larger installed bases and lower average selling prices
- Increased competition due to less formidable barriers to entry

Three years ago, personal computers were barely considered a design automation alternative. Today, they threaten the very existence of the original ECAE platform—the technical workstation. We do not believe that technical workstations will be made obsolete by PCs (with or without coprocessors). We believe that what is occurring is just natural evolution.

It is a simple lesson of supply-and-demand economics. Dataquest believes that the end-user market will continue to force prices down across the board, especially where higher prices are unwarranted. End users will also continue to force increased performance at a fair price and only when applications require increased performance.

The PC is not capable of being a shared corporate resource. Networked or not, it remains an underutilized and, for certain implementations, an underpowered resource. While the PC can boost the productivity of an individual engineer, it remains an isolated member of a design team. Because Dataquest believes that design automation decisions increasingly are being made at higher corporate levels than the individual engineer's level, and because of inherent data storage and handling limitations of the 16- or 32-bit PC running DOS, we believe that users will choose the technical workstation if prices are relatively even.

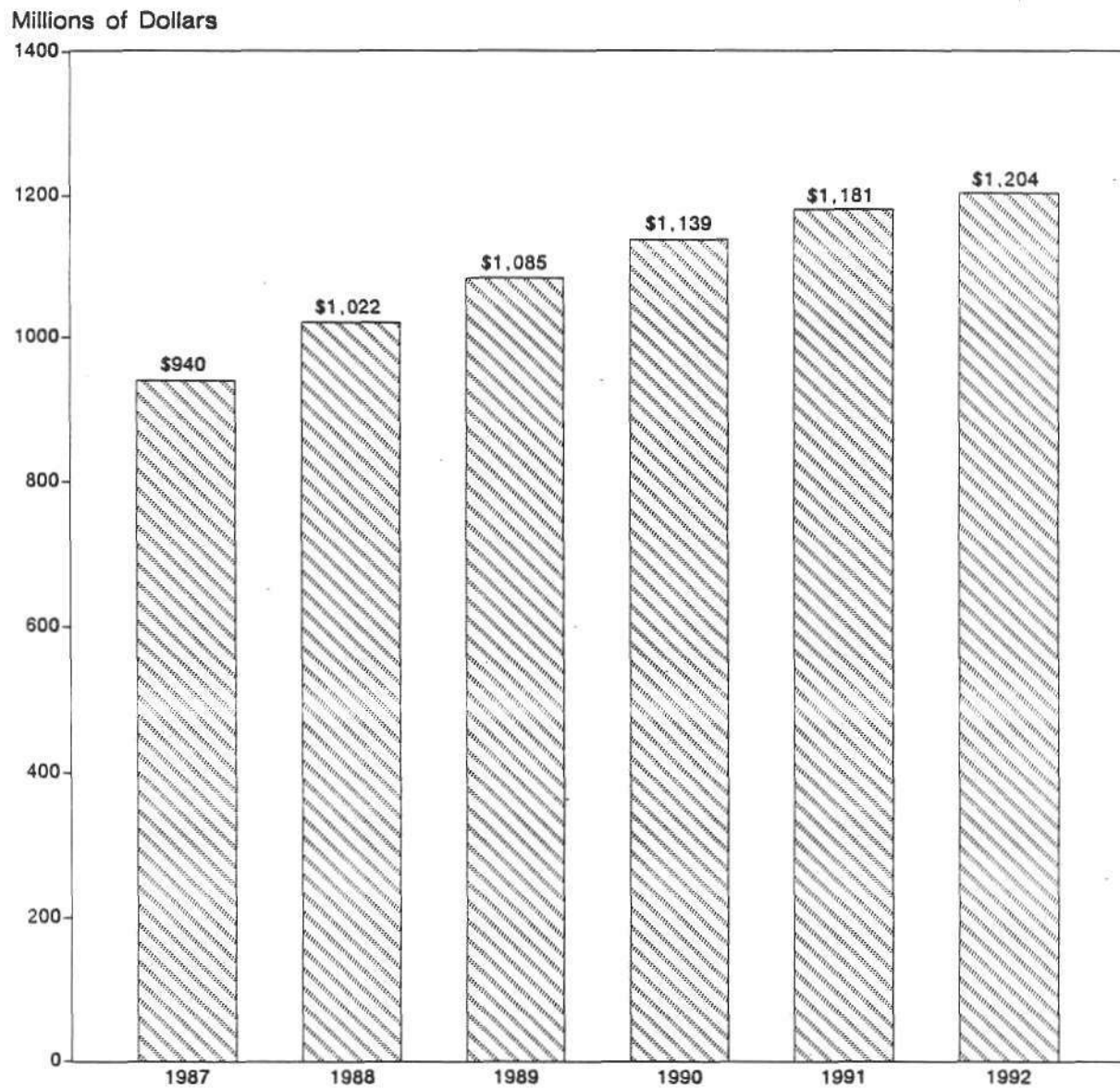
2.4 ECAE Forecasts

TOTAL ECAE MARKET

This section presents Dataquest's forecast and analysis for the total electronic CAE (ECAE) market for all regions and platforms, as illustrated in Figures 2.4-1 and 2.4-2 and Table 2.4-1. These data are summarized as follows:

- The ECAE market segment, worth an estimated \$940 million in 1987, is forecast to grow to \$1.204 billion in 1992, a compound annual growth rate (CAGR) of 5.1 percent.
- Dataquest estimates that ECAE revenue will increase 9 percent in 1988, topping \$1 billion.
- An estimated 29,850 ECAE workstations were shipped in 1987. Shipments are expected to reach 52,960 units in 1992, growing at a 12.2 percent CAGR.
- ECAE workstation shipments will grow to 36,020 in 1988, representing a 21 percent increase over 1987.

Figure 2.4-1
ECAE Worldwide Forecast
Revenue

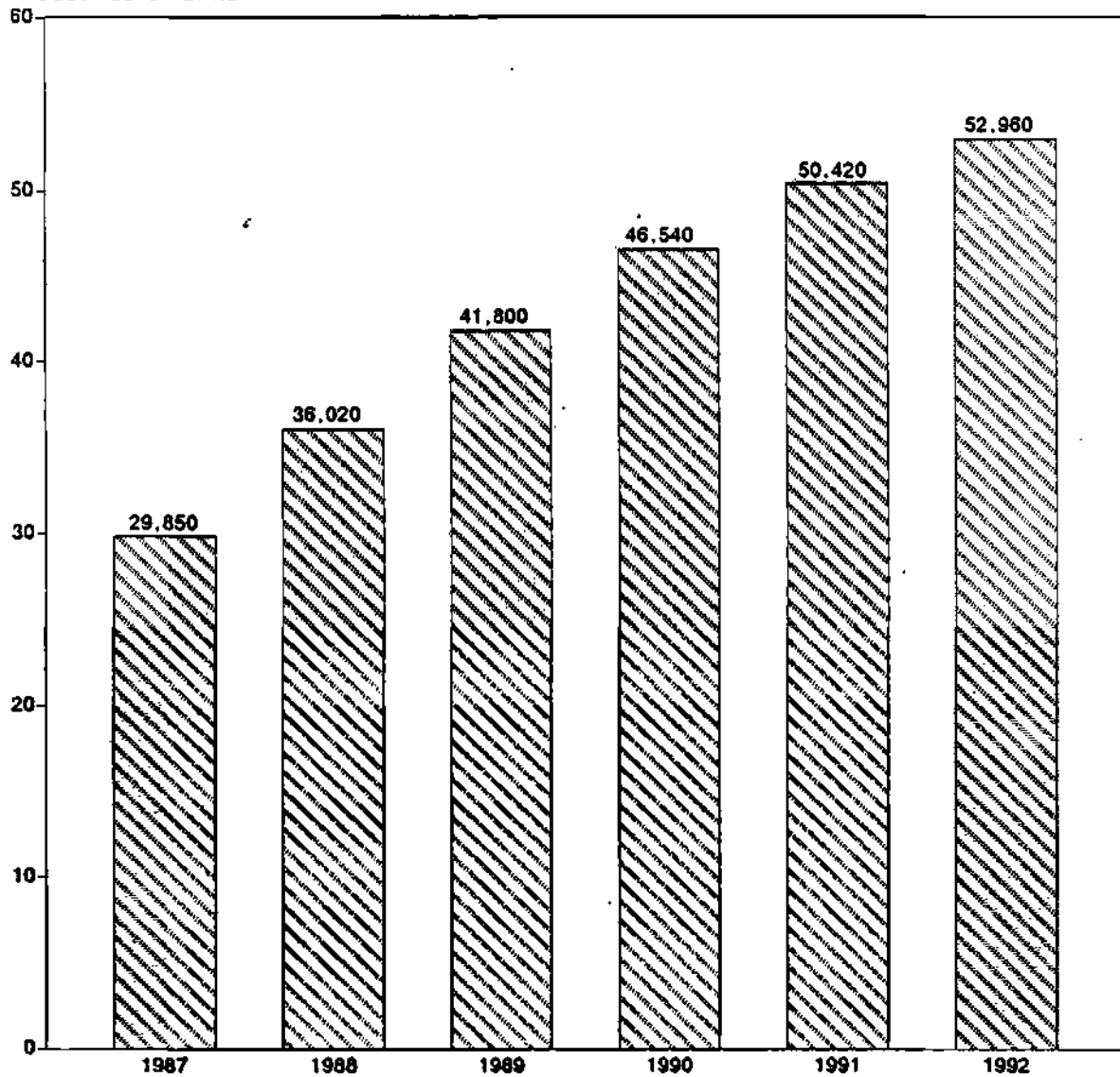


Source: Dataquest
July 1988

Figure 2.4-2

ECAE Worldwide Forecast
Shipments

Thousands of Units

Source: Dataquest
July 1988

2.4 ECAE Forecasts

Table 2.4-1

ECAE Worldwide Forecast
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Revenue	940	1,022	1,085	1,139	1,181	1,204	5.1%
Systems	29,415	35,710	41,550	46,300	50,190	52,760	12.4%
Workstations	29,850	36,020	41,800	46,540	50,420	52,960	12.2%

Source: Dataquest
July 1988

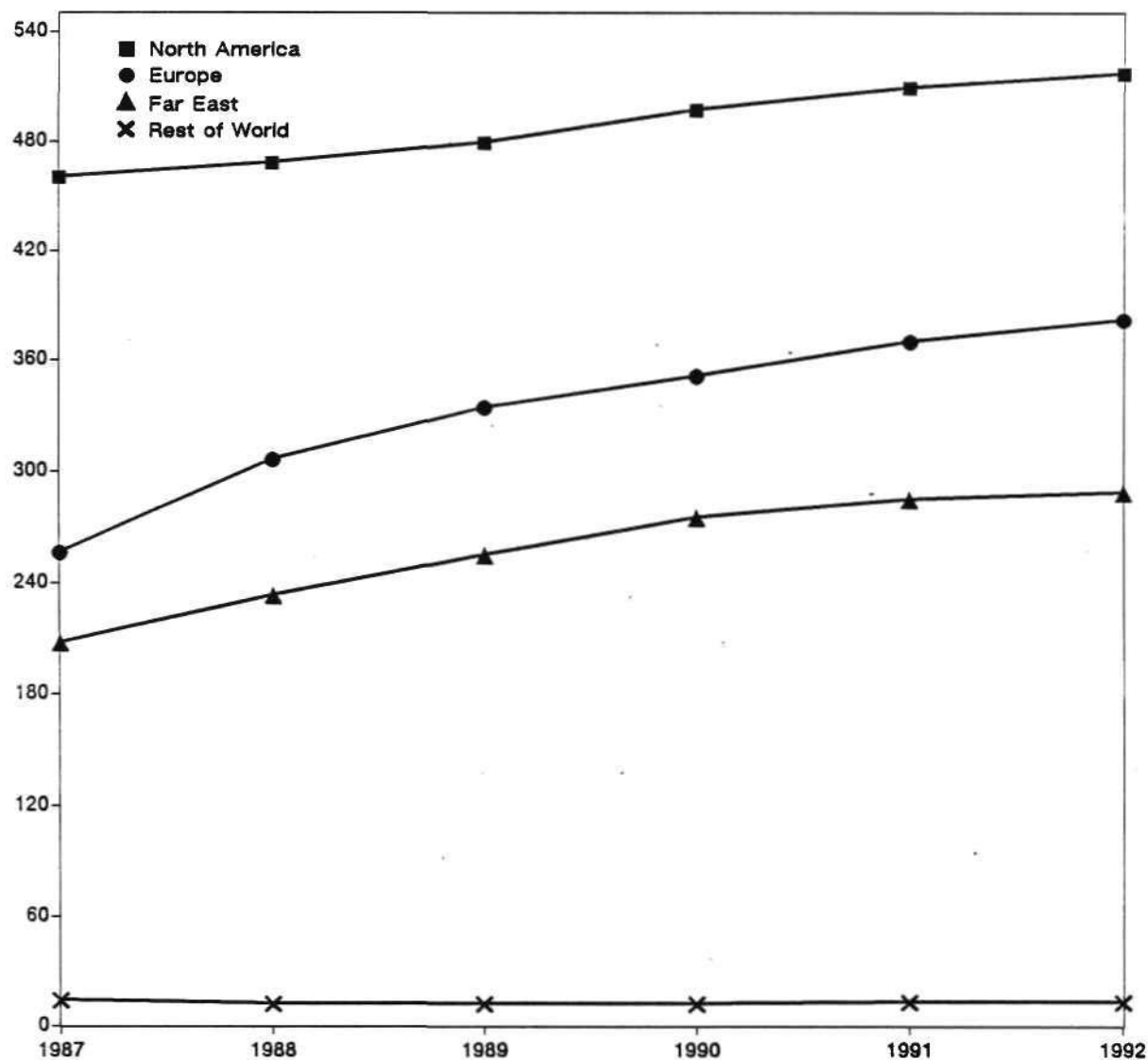
REGIONS

This section presents Dataquest's forecast and analysis of the ECAE market, segmented by region, as illustrated in Figures 2.4-3 and 2.4-4 and Tables 2.4-2 and 2.4-3. These data are summarized as follows:

- North America is expected to continue its lead in regional ECAE consumption through 1992, although the growth of this market is exhibiting signs of slowing due to increased penetration.
- We estimate that 1987 North American revenue was \$461 million and that it will grow to \$518 million in 1992, a 2.3 percent CAGR. Significantly, North American revenue in 1988 will reach \$469 million, representing only a 2.0 percent increase.
- European revenue was \$257 million in 1987 and is forecast to reach \$383 million in 1992, growing at an 8.3 percent CAGR. European revenue is forecast at \$307 million in 1988, representing a 19.0 percent increase.
- The Far Eastern ECAE segment represented \$208 million in 1987 and is forecast to grow at a 6.9 percent CAGR, to reach \$290 million in 1992.
- The rest of the world (ROW) accounted for \$15 million in 1987, 2 percent of that year's ECAE revenue.
- We believe that North America, with 49 percent of the total ECAE market, will be declining as the largest consumer of ECAE products for of the following two reasons:
 - An increasing market penetration of design automation tools in general, and specifically of design entry tools
 - A general economic slowdown in the U.S. electronics markets

Figure 2.4-3
ECAE Regional Forecast
Revenue

Millions of Dollars



Source: Dataquest
July 1988

Figure 2.4-4

ECAE Regional Forecast
Shipments

Workstation Shipments (in Thousands)

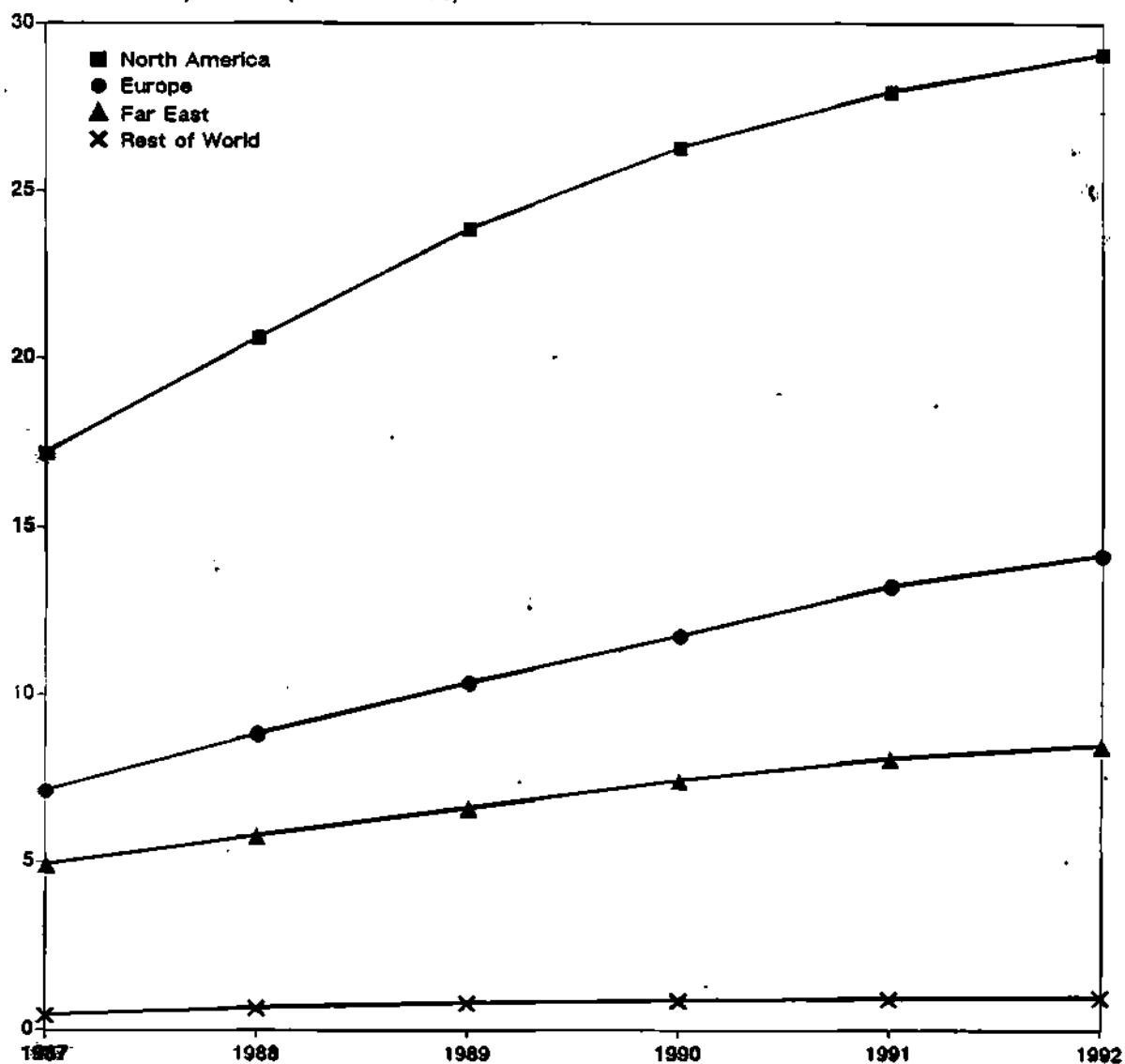
Source: Dataquest
July 1988

Table 2.4-2

ECAE Regional Forecast
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	****	****	****	****	****	****	****
Total Market							
Revenue	940	1,022	1,085	1,139	1,181	1,204	5.1%
Systems	29,415	35,710	41,550	46,300	50,190	52,760	12.4%
Workstations	29,850	36,020	41,800	46,540	50,420	52,960	12.2%
North America							
Revenue	461	469	480	498	510	518	2.3%
Systems	17,192	20,640	23,900	26,330	28,000	29,130	11.1%
Workstations	17,246	20,650	23,910	26,330	28,000	29,130	11.1%
Europe							
Revenue	257	307	335	352	371	383	8.3%
Systems	7,032	8,800	10,390	11,820	13,320	14,270	15.2%
Workstations	7,176	8,860	10,400	11,820	13,320	14,270	14.7%
Far East							
Revenue	208	234	256	276	286	290	6.9%
Systems	4,729	5,600	6,440	7,260	7,930	8,360	12.1%
Workstations	4,963	5,830	6,670	7,500	8,150	8,570	11.5%
Rest of World							
Revenue	15	13	13	13	14	14	-1.0%
Systems	462	670	820	900	950	1,000	16.7%
Workstations	465	680	820	900	950	1,000	16.6%

Source: Dataquest
July 1988

Table 2.4-3

**ECAE Regional Forecast
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	****	****	****	****	****	****
North America						
Revenue	49%	46%	44%	44%	43%	43%
Systems	58%	58%	58%	57%	56%	55%
Workstations	58%	57%	57%	57%	56%	55%
Europe						
Revenue	27%	30%	31%	31%	31%	32%
Systems	24%	25%	25%	26%	27%	27%
Workstations	24%	25%	25%	25%	26%	27%
Far East						
Revenue	22%	23%	24%	24%	24%	24%
Systems	16%	16%	15%	16%	16%	16%
Workstations	17%	16%	16%	16%	16%	16%
Rest of World						
Revenue	2%	1%	1%	1%	1%	1%
Systems	2%	2%	2%	2%	2%	2%
Workstations	2%	2%	2%	2%	2%	2%

Source: Dataquest
July 1988

PLATFORMS

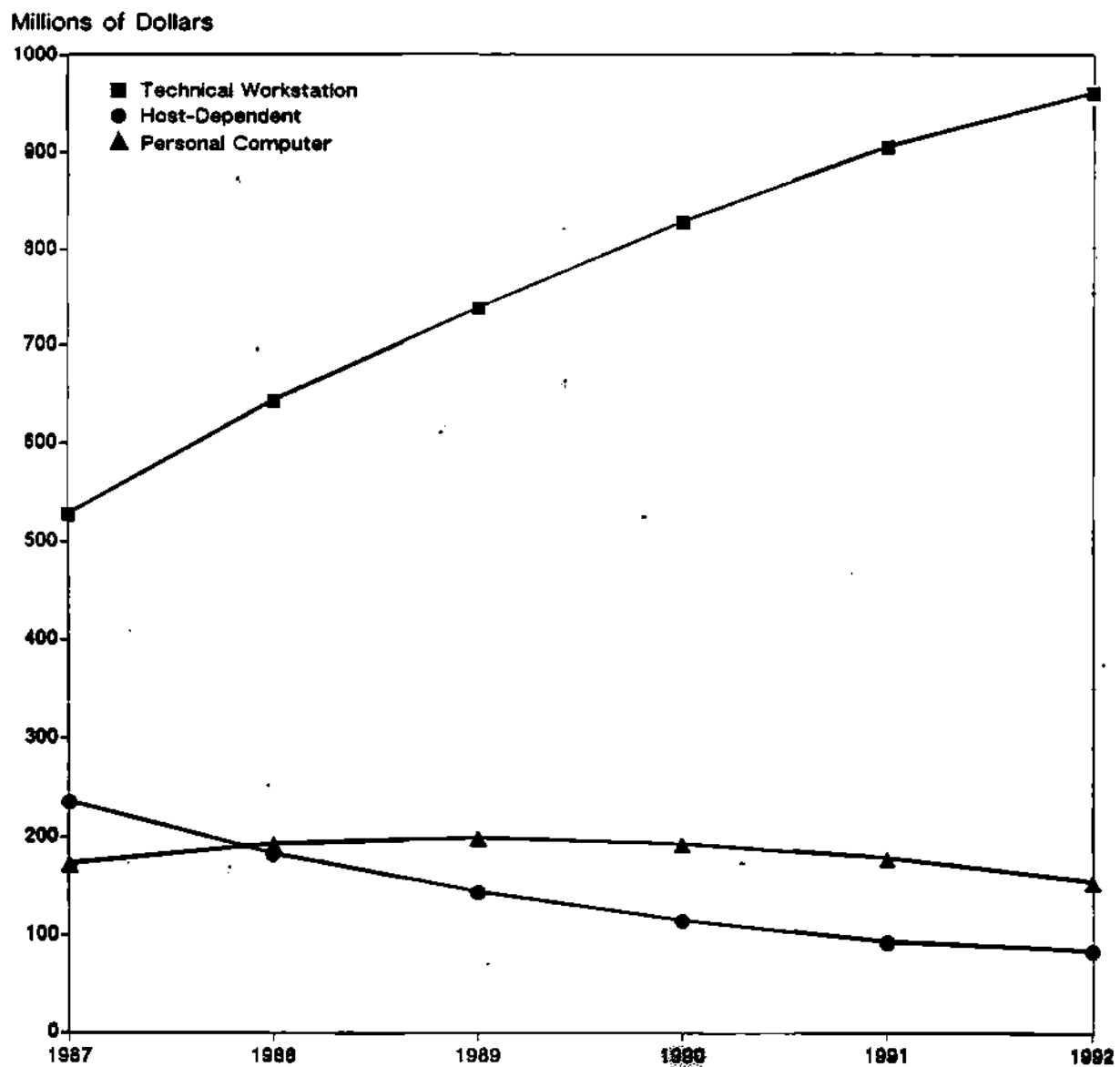
This section presents Dataquest's forecast and analysis of the ECAE market segmented by platforms, as illustrated in Figures 2.4-5 and 2.4-6 and Tables 2.4-4 and 2.4-5. These data are summarized as follows:

- Approximately 29,850 ECAE workstation units were shipped in 1987. We estimate that shipments will grow at a 12.2 percent CAGR to 52,960 workstations in 1992.
- Technical workstation revenue in 1987 was \$529 million and will grow at an estimated 12.7 percent CAGR, to reach \$963 million in 1992.
- Technical workstation shipments totaled 11,023 units in 1987 and are forecast to reach 27,520 units in 1992, growing at a CAGR of 20.1 percent.
- Revenue from host-dependent systems was \$237 million in 1987 and is forecast to decline to \$85 million in 1992, decreasing at a CAGR of 18.5 percent.
- Host-dependent workstation shipments totaled 1,277 units in 1987 and are forecast to decrease at a 12.9 percent CAGR to 640 units in 1992.
- PC revenue in 1987 was \$174 million, which is expected to drop to \$156 million in 1992, a CAGR of negative 2.2 percent.
- PC shipments totaled 17,550 units in 1987 and are forecast to grow at a 7.2 percent CAGR to reach 24,810 units in 1992.
- Host-dependent products play a limited role in the ECAE segment for two reasons:
 - Price sensitivity and price elasticity market requirements
 - Distributed processing requirements demanding equal performance for all users
- The primary ECAE role of the PC will be in schematics entry products, with limited local analysis capabilities.
- PCs with application-specific hardware add-ons (i.e., coprocessors) will be capable of assuming more computationally intensive tasks.
- Networking, communications, and design data base management are key issues with the large number of distributed systems.

- We believe that the growth of technical workstation systems will continually increase as a result of continuing improvements in price/performance ratios, i.e., a decrease in average selling prices (ASPs).
- Host-dependent systems will be used for batch analysis jobs and relieved of interactive graphics applications.

Figure 2.4-5

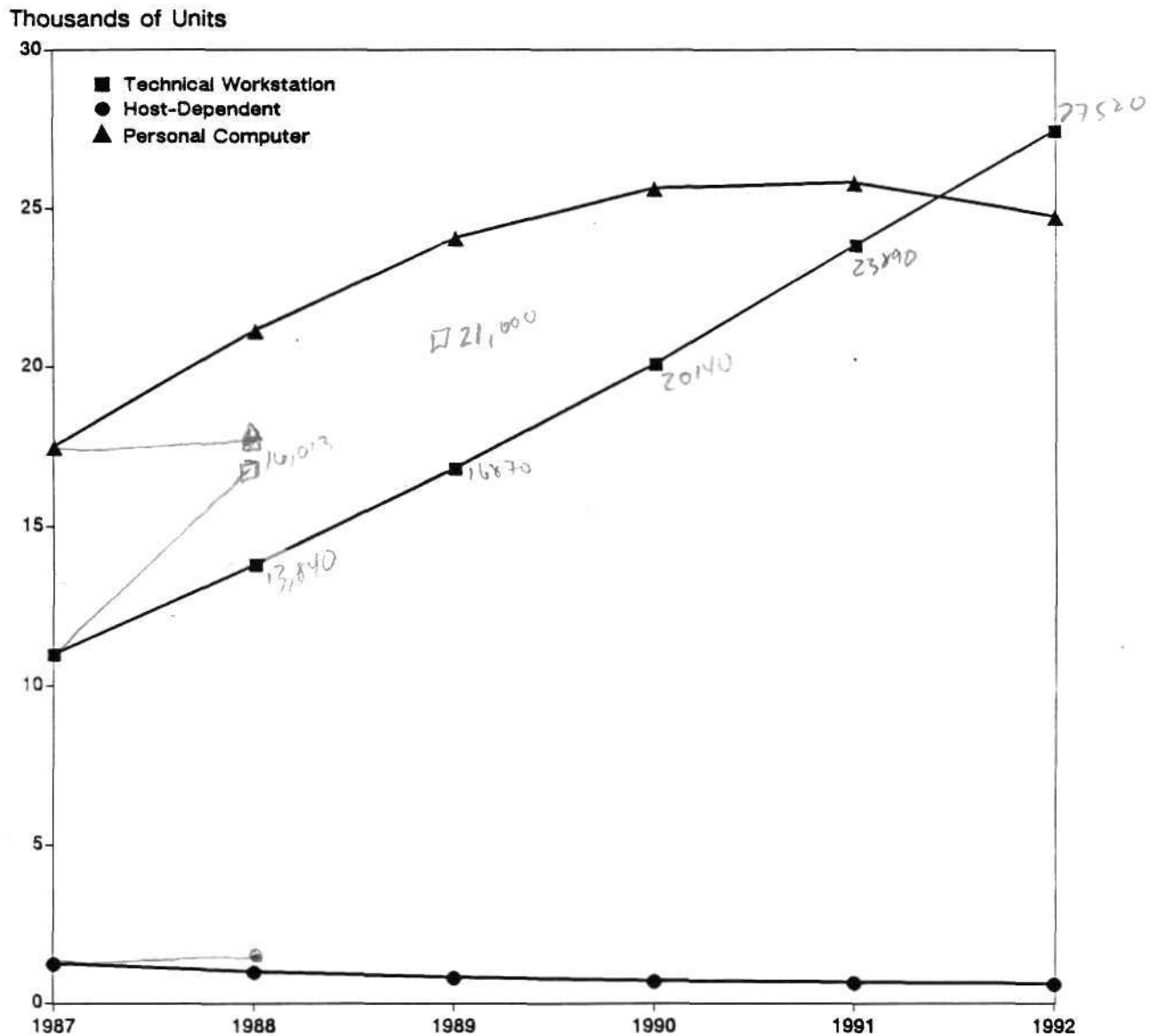
ECAE Worldwide Forecast by Platform
Revenue



Source: Dataquest
July 1988

Figure 2.4-6

ECAE Worldwide Forecast by Platform Shipments

Source: Dataquest
July 1988

2.4 ECAE Forecasts

Table 2.4-4

ECAE Worldwide Forecast by Platform (Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	940	1,022	1,085	1,139	1,181	1,204	5.1%
Systems	29,415	35,710	41,550	46,300	50,190	52,760	12.4%
Workstations	29,850	36,020	41,800	46,540	50,420	52,960	12.2%
Technical Workstation							
Revenue	529	645	740	830	907	963	12.7%
Systems	11,023	13,840	16,870	20,140	23,890	27,520	20.1%
Workstations	11,023	13,840	16,870	20,140	23,890	27,520	20.1%
Host-Dependent							
Revenue	237	184	145	116	94	85	-18.5%
Systems	842	700	570	480	440	430	-12.6%
Workstations	1,277	1,010	820	720	670	640	-12.9%
Personal Computer							
Revenue	174	194	200	194	180	156	-2.2%
Systems	17,550	21,180	24,110	25,680	25,860	24,810	7.2%
Workstations	17,550	21,180	24,110	25,680	25,860	24,810	7.2%

Source: Dataquest
July 1988

Schematic capture:
Tech. w.s. \Rightarrow all
PC \Rightarrow all
Host dependent \Rightarrow all

Table 2.4-5

**ECAE Worldwide Forecast by Platform
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
Technical Workstation						
Revenue	56%	63%	68%	73%	77%	80%
Systems	37%	39%	41%	43%	48%	52%
Workstations	37%	38%	40%	43%	47%	52%
Host-Dependent						
Revenue	25%	18%	13%	10%	8%	7%
Systems	3%	2%	1%	1%	1%	1%
Workstations	4%	3%	2%	2%	1%	1%
Personal Computer						
Revenue	18%	19%	18%	17%	15%	13%
Systems	60%	59%	58%	55%	52%	47%
Workstations	59%	59%	58%	55%	51%	47%

Source: Dataquest
July 1988

AVERAGE PRICE PER SEAT

This section presents Dataquest's forecast and analysis of the average price per seat by platform for the ECAE market, as illustrated in Figure 2.4-7 and Table 2.4-6. These data are summarized as follows:

- We expect the ASP per seat for all platform types to decline from \$21,000 in 1987 to \$12,300 in 1992, decreasing at a 10.2 percent CAGR as a result of both the large number of vendors offering ECAE capability and the industry-wide shift toward lower-cost workstations.
- We expect a 10.3 percent decrease in the ASP per technical workstation seat, from \$32,700 in 1987 to \$19,000 in 1992. We believe that this will be a consequence of the introduction of lower-cost technical workstations, as well as of a sharp decline in the price of design entry software, which we believe has become almost a commodity item in the ECAE market.
- Consistent with this shift, the ASP per seat for host-dependent systems will decline at a CAGR of 8.2 percent, from \$136,700 in 1987 to \$89,400 in 1992, according to our estimates. We also believe that the price/performance advantages of technical workstations and the popularity of personal computers are eroding the market for, and the price of, host-dependent ECAE workstations.
- We expect a 12.3 percent decline in the ASP per seat for personal computers, from \$5,200 to \$2,700 in 1992. This will be the slowest decline for all platform types and will be a result of the unique design data management, computational, and communications requirements this application imposes on the personal computer.

Figure 2.4-7

ECAE Worldwide Average Price Per Seat by Platform

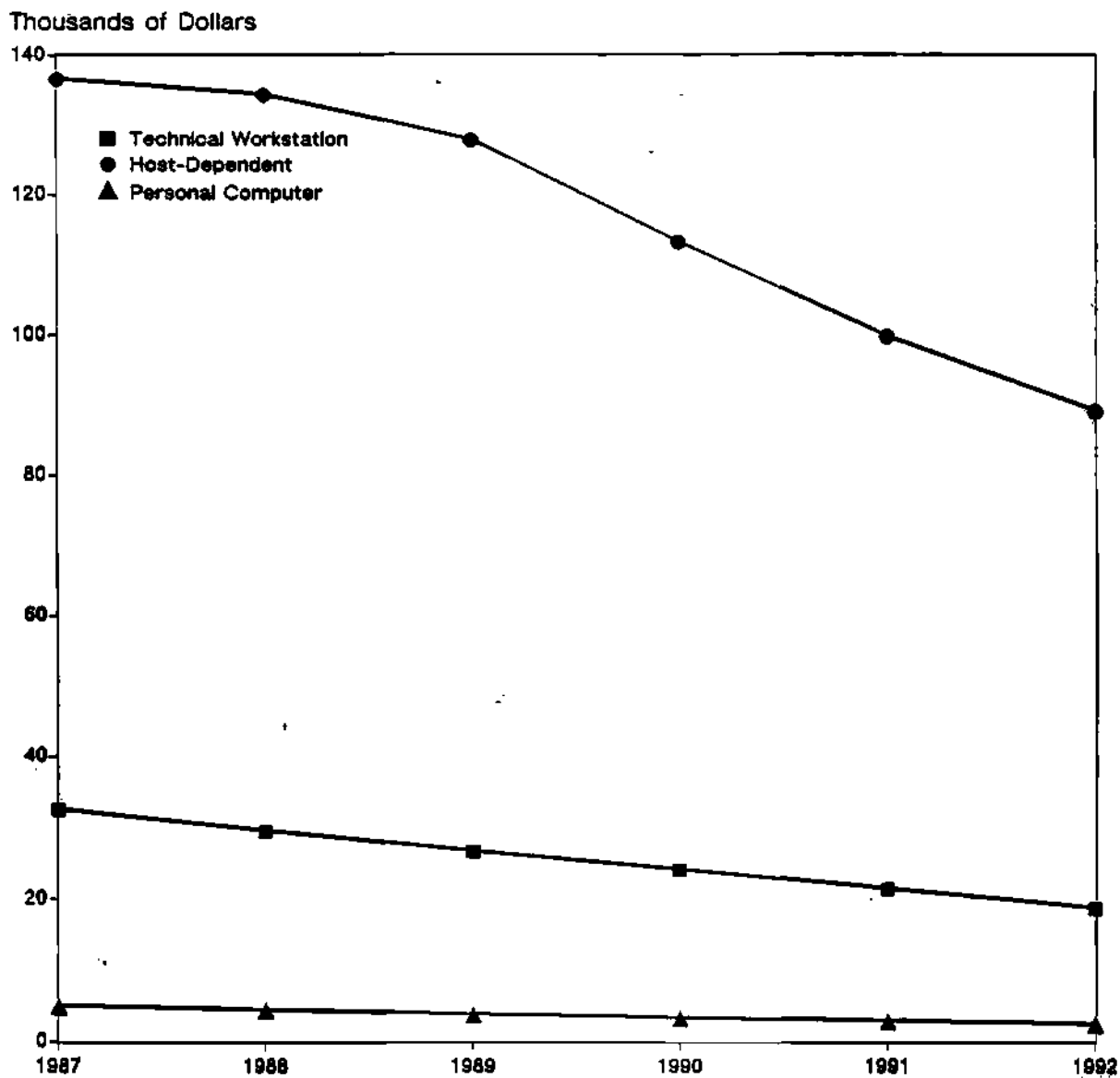
Source: Dataquest
July 1988

Table 2.4-6

**ECAE Worldwide Average Price Per Seat
Forecast by Platform
(Thousands of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Turnkey & Hardware-Only							
Technical Workstation	32.7	29.7	26.9	24.3	21.6	19.0	-10.3%
Host-Dependent	136.7	134.5	128.0	113.4	100.0	89.4	-8.2%
Personal Computer	5.2	4.6	4.0	3.5	3.1	2.7	-12.3%
All Platforms	21.0	17.8	15.7	14.2	13.1	12.3	-10.2%
Turnkey							
Technical Workstation	38.7	35.8	33.1	30.8	28.6	26.2	-7.5%
Host-Dependent	84.7	91.3	92.2	81.4	77.3	69.5	-3.9%
Personal Computer	13.1	11.8	9.3	9.2	10.5	23.9	12.8%
All Platforms	38.0	35.4	33.3	31.3	29.7	27.3	-6.4%
Hardware-Only							
Technical Workstation	23.2	21.0	19.0	17.0	15.0	13.2	-10.7%
Host-Dependent	198.8	177.3	160.0	143.4	124.6	108.7	-11.4%
Personal Computer	4.5	4.1	3.8	3.4	3.0	2.7	-9.7%
All Platforms	13.7	11.2	9.6	8.6	7.9	7.5	-11.4%

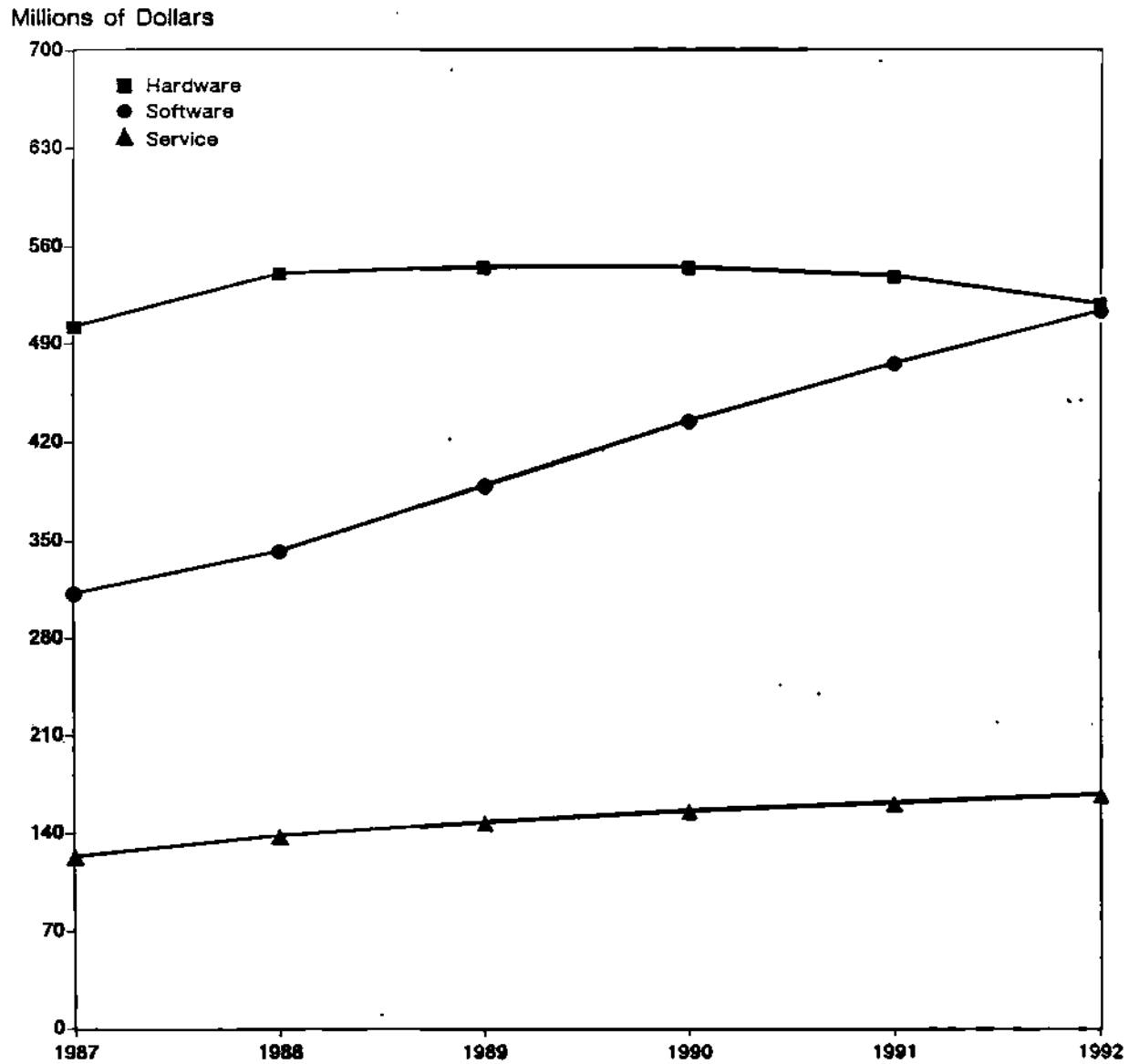
Source: Dataquest
July 1988

REVENUE SOURCES

This section presents Dataquest's forecast and analysis of the ECAE market segmented by revenue source for each platform, as illustrated in Figure 2.4-8 and Tables 2.4-7 and 2.4-8. These data are summarized as follows:

- Dataquest estimates that 1987 hardware revenue for all platform types was \$503 million and forecasts it to grow to \$520 million in 1992, at a 0.7 percent CAGR. In terms of total ECAE revenue, we expect hardware revenue to decline from 54 percent in 1987 to 46 percent in 1992.
- Software revenue accounted for \$313 million in 1987, which represented 33 percent of total ECAE revenue. By 1992, Dataquest estimates that software revenue will grow to \$515 million, at a 10.5 percent CAGR. Software will represent 43 percent of total ECAE revenue in 1992. We believe that this shift reflects increased emphasis on applications and data base management issues rather than on hardware platforms, which are becoming standardized.
- We expect ECAE service revenue to grow from \$124 million in 1987 to \$169 million in 1992, a 6.4 percent CAGR. Service revenue in 1987 represented 13 percent of total ECAE revenue, and we estimate that in 1992, it will constitute 13 percent of total ECAE revenue. We believe that this growth in service revenue reflects response to strong user demand for increased application and integration support.

Figure 2.4-8
ECAE Worldwide Revenue Sources



Source: Dataquest
July 1988

Table 2.4-7

**ECAE Worldwide Forecast by Revenue Source
(Millions of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
All Platforms							
Hardware	503	541	546	546	540	520	.7%
Software	313	343	390	436	477	515	10.5%
Service	124	139	149	157	163	169	6.4%
Total	940	1,022	1,085	1,139	1,181	1,204	5.1%
Technical Workstation							
Hardware	253	318	352	378	397	398	9.5%
Software	197	226	272	322	372	423	16.5%
Service	79	100	115	129	138	142	12.4%
Total	529	645	740	830	907	963	12.7%
Host-Dependent							
Hardware	168	133	103	79	64	54	-20.4%
Software	36	25	23	21	17	15	-16.4%
Service	32	25	20	16	13	17	-12.6%
Total	237	184	145	116	94	85	-18.5%
Personal Computer							
Hardware	82	89	92	88	79	67	-3.8%
Software	80	91	95	94	89	78	-.5%
Service	12	13	14	13	12	11	-3.4%
Total	174	194	200	194	180	156	-2.2%

Source: Dataquest
July 1988

Table 2.4-8

**ECAE Worldwide Forecast by Revenue Source
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	=====	=====	=====	=====	=====	=====
All Platforms						
Hardware	54%	53%	50%	48%	46%	43%
Software	33%	34%	36%	38%	40%	43%
Service	13%	14%	14%	14%	14%	14%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	48%	49%	48%	46%	44%	41%
Software	37%	35%	37%	39%	41%	44%
Service	15%	16%	16%	16%	15%	15%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	71%	73%	70%	69%	68%	63%
Software	15%	14%	16%	18%	18%	17%
Service	14%	14%	14%	14%	14%	19%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	47%	46%	46%	45%	44%	43%
Software	46%	47%	47%	48%	49%	50%
Service	7%	7%	7%	7%	7%	7%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

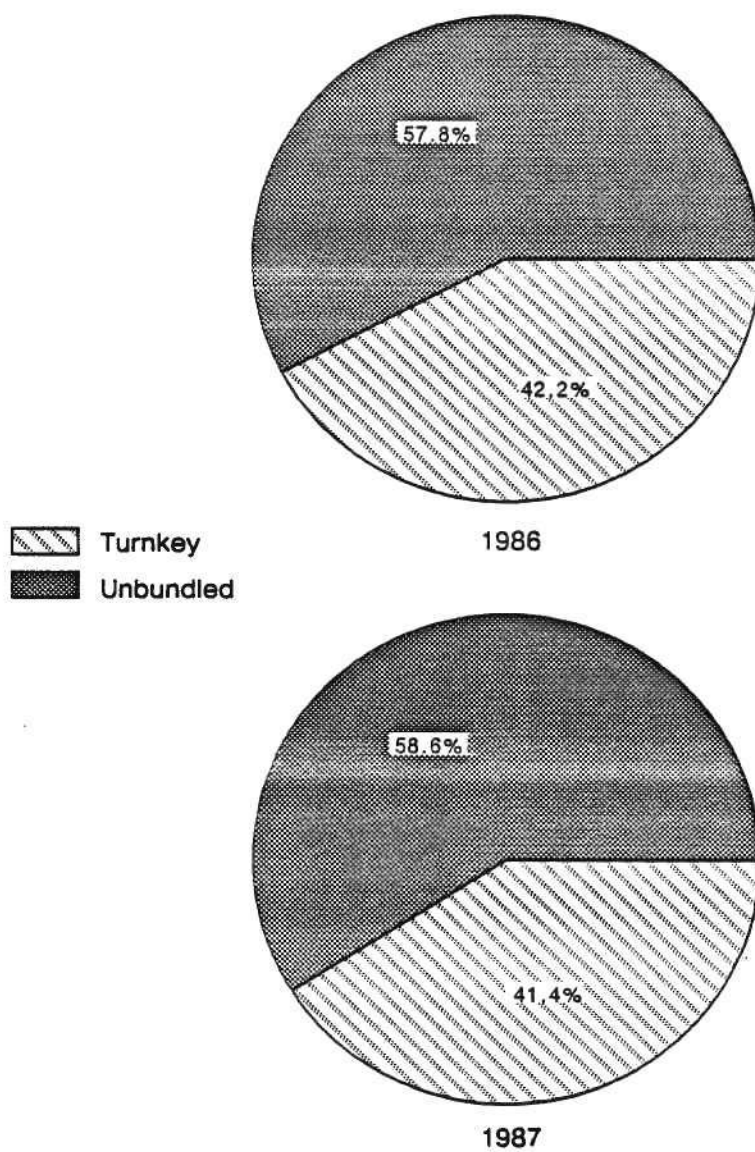
DISTRIBUTION CHANNELS

This section presents Dataquest's forecast and analysis for turnkey versus unbundled sales for the ECAE market, as illustrated in Figure 2.4-9 and Tables 2.4-9 and 2.4-10. These data are summarized as follows:

- Turnkey hardware and software revenue is forecast to increase slightly from \$338 million in 1987 to \$344 million in 1992, but it will drop from 41 percent of the total market to 33 percent of the market by 1992.
- Unbundled hardware and software revenue is forecast to grow at a 7.7 percent CAGR, from \$478 million in 1987 to \$692 million in 1992. It will grow from 59 percent of total revenue to 67 percent.
- Dataquest believes that this shift reflects a fundamental change in the buying practices of all customers, large and small. Hardware is increasingly purchased separately from software. For large corporations, this means purchasing workstations directly from the manufacturer and then assembling a software solution. For the small company, it means purchasing a personal computer and then buying software through a discount chain or mail order company.

Figure 2.4-9

ECAE—Turnkey versus Unbundled
(Percentage of Revenue)



Source: Dataquest
July 1988

Table 2.4-9

**ECAE Worldwide Forecast
Turnkey versus Unbundled
(Millions of Dollars, Actual Units)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Hardware and Software Revenue							
Turnkey	338	352	358	361	360	344	.3%
Unbundled	478	531	578	621	657	692	7.7%
Total	816	883	936	982	1,018	1,035	4.9%
Hardware Revenue							
Turnkey	216	249	250	246	237	215	-.1%
Unbundled	287	291	297	300	303	304	1.2%
Total	503	541	546	546	540	520	.7%
Software Revenue							
Turnkey	122	103	109	116	123	128	1.0%
Unbundled	191	240	281	321	354	387	15.2%
Total	313	343	390	436	477	515	10.5%
Workstation Shipments							
Turnkey	8,919	9,950	10,770	11,560	12,130	12,580	7.1%
Unbundled	20,931	26,070	31,030	34,980	38,290	40,380	14.0%
Total	29,850	36,020	41,800	46,540	50,420	52,960	12.2%

Source: Dataquest
July 1988

Table 2.4-10

**ECAE Worldwide Forecast
Turnkey versus Unbundled
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
Total Hardware and Software Revenue	41%	40%	38%	37%	35%	33%
Turnkey	59%	60%	62%	63%	65%	67%
Unbundled	100%	100%	100%	100%	100%	100%
Total						
Hardware Revenue	43%	46%	46%	45%	44%	41%
Turnkey	57%	54%	54%	55%	56%	59%
Unbundled	100%	100%	100%	100%	100%	100%
Total						
Software Revenue	39%	30%	28%	27%	26%	25%
Turnkey	61%	70%	72%	73%	74%	75%
Unbundled	100%	100%	100%	100%	100%	100%
Total						
Workstation Shipments	30%	28%	26%	25%	24%	24%
Turnkey	70%	72%	74%	75%	76%	76%
Unbundled	100%	100%	100%	100%	100%	100%
Total						

Source: Dataquest
July 1988

2.5 ECAE Market Shares

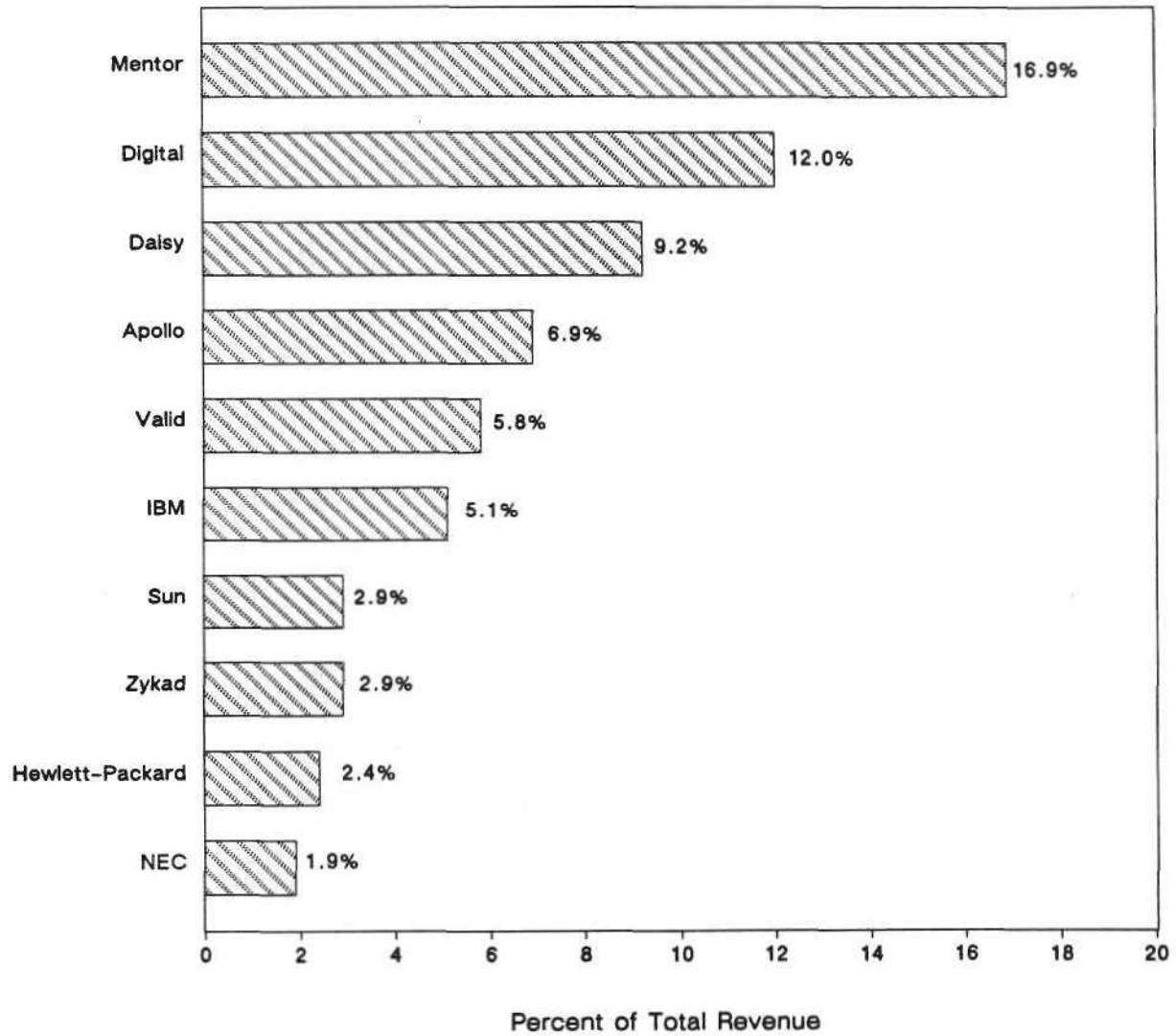
Figures 2.5-1 through 2.5-4, and Table 2.5-1 present Dataquest's analysis of the ECAE market share measure in total revenue, hardware and software revenue, and workstation shipments, as follows:

- Mentor Graphics was number one in the market in total revenue for 1987, with \$158.7 million and 16.9 percent market share.
 - Mentor Graphics was also the number one software supplier, with \$60 million and 19.2 percent market share.
 - ECAE remains Mentor Graphics' central strength in the market, accounting for close to 75 percent of the company's total sales.
- Digital Equipment Corporation is the leading hardware supplier in the market, with \$96.6 million in hardware sales and 19.2 percent market share. Its strength is still at the mainframe and host level, but Digital is gaining ground in workstations.
- Daisy Systems Corporation remained at number three for 1987, as the second largest turnkey supplier in the market.
 - Daisy's total revenue was \$86.4 million, and its market share was 9.2 percent.
 - ECAE is Daisy's foothold in the market, and the company remains well entrenched at many accounts, especially for ASIC design.
- Apollo Computer was the fourth largest vendor in the ECAE market overall, at \$65 million, and third in hardware sales behind Digital and Mentor.
 - Moreover, when Apollo's sales are added to those of Mentor Graphics, the combined companies become the number one hardware supplier.
 - Apollo's strength as a seller of unbundled hardware comes through its relationships with several key users, such as Boeing, Siemens, and TI.
- Valid Logic remains the third largest solution supplier in ECAE and the sixth largest company overall, with revenue of \$54.4 million and 5.8 percent market share. Valid's position in ECAE has been greatly strengthened by its relationships with Digital and Sun.
- IBM, because of its strength in personal computers, is the sixth largest vendor and fourth in hardware. IBM still maintains some strength in mainframes, but it has not enjoyed much success in software sales or in technical workstations.

- Sun Microsystems is a surprising seventh in the market this year, with \$27.3 million in sales. Along with its new partners Cadnetix, Daisy, and Valid, Sun will definitely challenge Apollo for leadership in ECAE technical workstations over the next year.
- Zycad, the simulation accelerator company, enjoyed the eighth position in the market. This company is, in a sense, the largest niche player in ECAE at this time; it has been both profitable and growing within its sector of the market.
- Hewlett-Packard is the ninth largest vendor in the market, at \$22.7 million and 2.9 percent market share. HP continues to make a concerted effort to be a solution supplier in the market, and it is the fourth largest supplier in this category behind Daisy, Mentor, and Valid.

In spite of the slow total market growth, Dataquest still sees reasons for optimism in key sectors of the market—most importantly, in technical workstations and personal computer-based systems. These two market segments, and the vendors within them, continue to enjoy strong revenue growth.

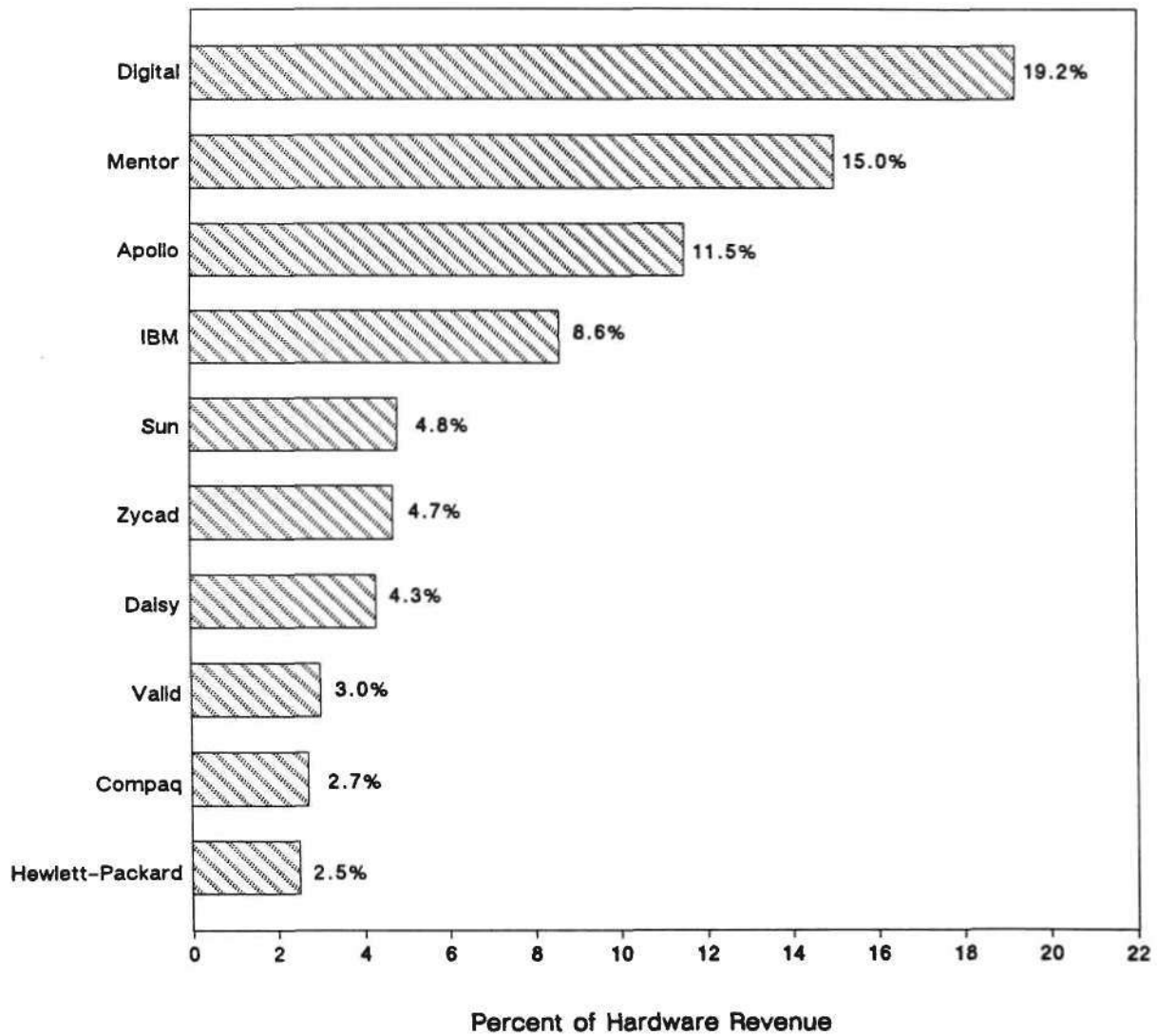
Figure 2.5-1

**ECAE-1987 Worldwide Market Share
Total Revenue**

Source: Dataquest
July 1988

Figure 2.5-2

ECAE—1987 Worldwide Market Share
Hardware Revenue



Source: Dataquest
July 1988

Figure 2.5-3

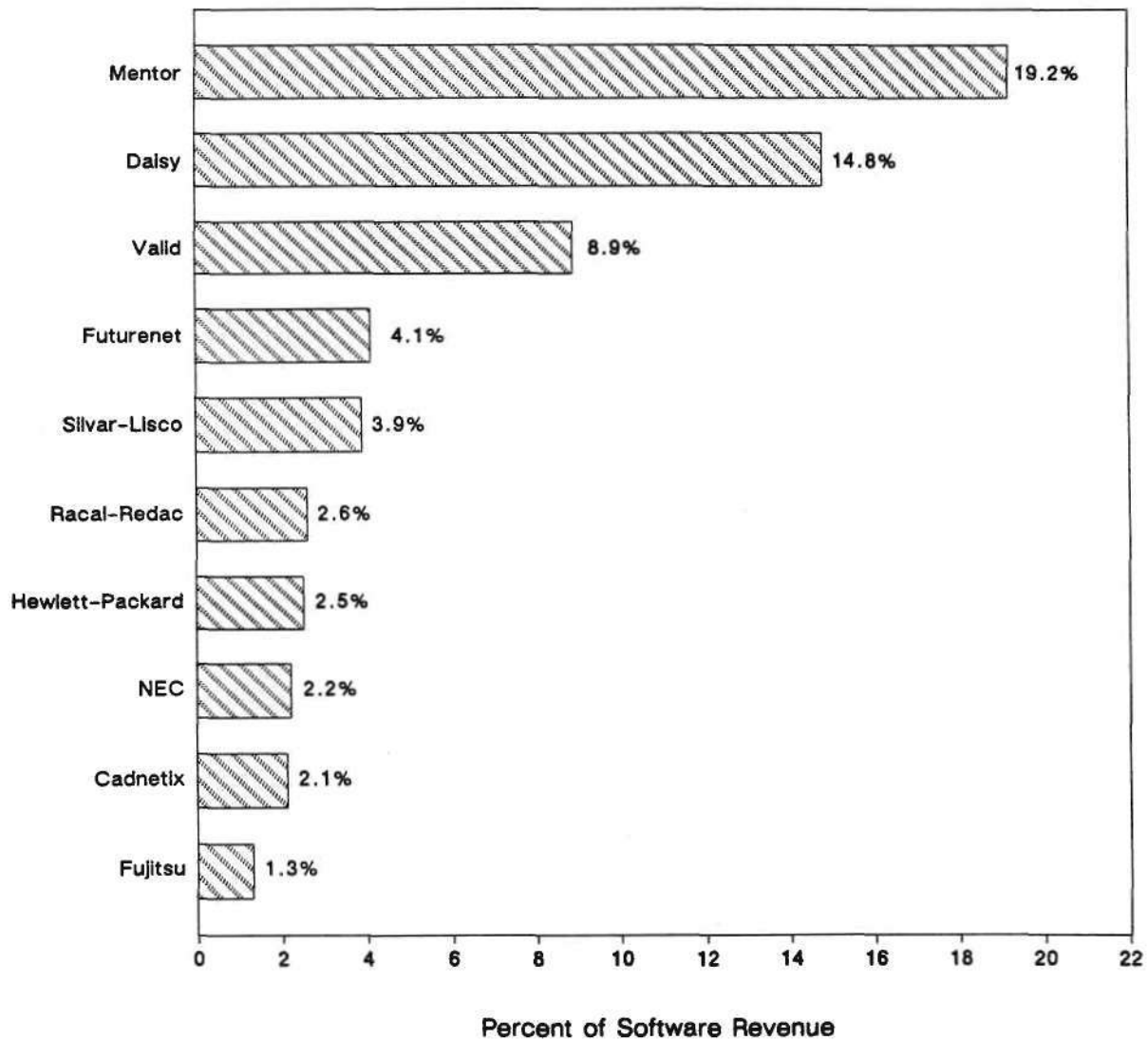
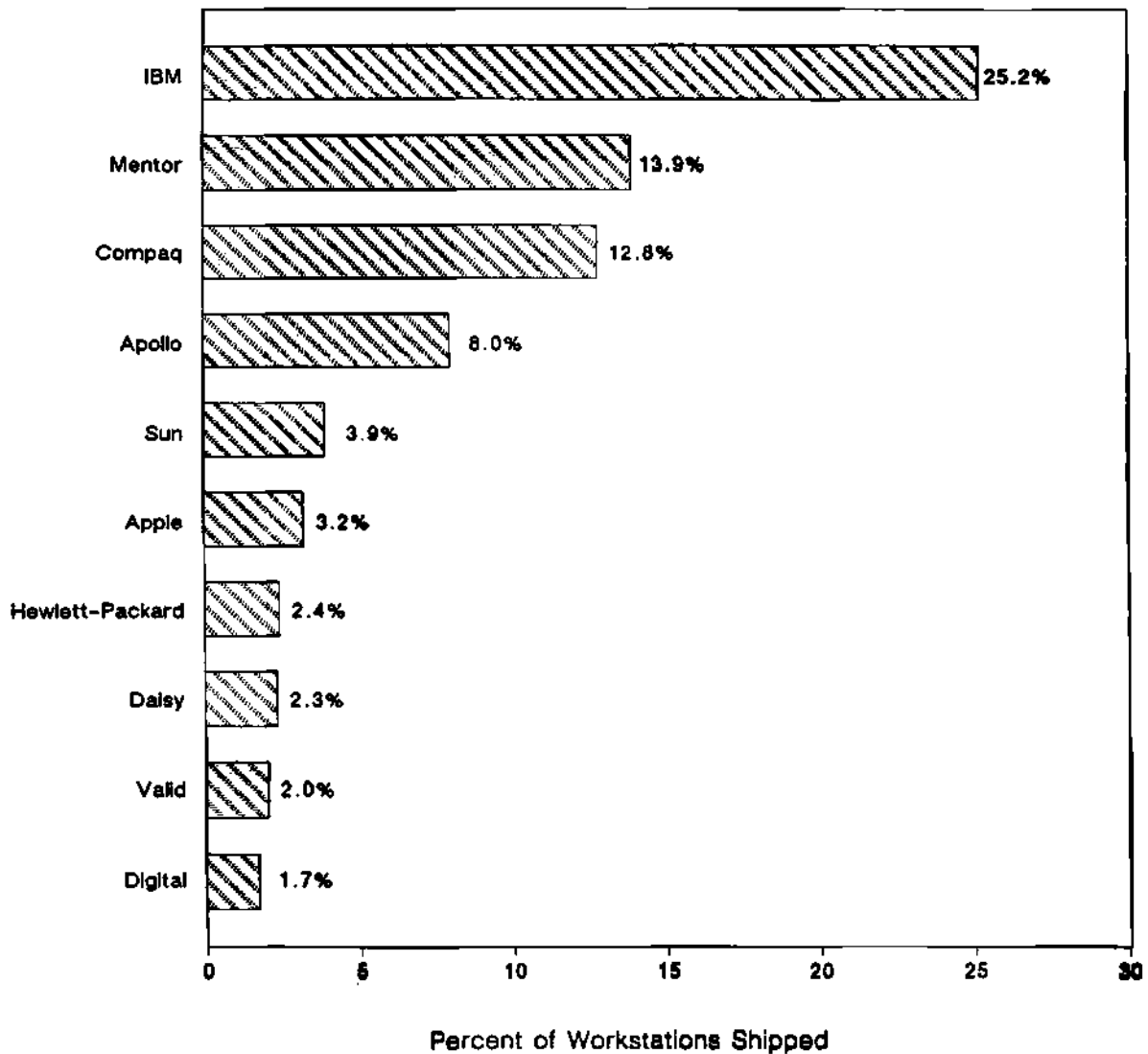
ECAE-1987 Worldwide Market Share
Software RevenueSource: Dataquest
July 1988

Figure 2.5-4

**ECAE—1987 Worldwide Market Share
Workstation Shipments**



Source: Dataquest
July 1988

Table 2.5-1

ECAE 1987 Worldwide Market Share
(Millions of Dollars, Actual Units)

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Mentor	158.7	75.5	60.0	4,157	16.9%	15.0%	19.2%	13.9%
Digital	112.5	96.6	.0	503	12.0%	19.2%	.0%	1.7%
Daisy	86.4	21.5	46.2	694	9.2%	4.3%	14.8%	2.3%
Apollo	65.0	57.7	.0	2,394	6.9%	11.5%	.0%	8.0%
Valid	54.4	15.0	27.8	589	5.8%	3.0%	8.9%	2.0%
IBM	48.1	43.5	1.6	7,530	5.1%	8.6%	.5%	25.2%
Sun	27.3	24.0	.0	1,153	2.9%	4.8%	.0%	3.9%
Zycad	27.1	23.9	.0	53	2.9%	4.7%	.0%	.2%
Hewlett-Packard	22.7	12.8	7.8	716	2.4%	2.5%	2.5%	2.4%
NEC	18.1	9.4	6.8	449	1.9%	1.9%	2.2%	1.5%
Cadnetix	16.2	7.7	6.6	345	1.7%	1.5%	2.1%	1.2%
Fujitsu	15.8	10.1	4.1	197	1.7%	2.0%	1.3%	.7%
Futurenet	14.8	.0	13.0	0	1.6%	.0%	4.1%	.0%
Compaq	13.6	13.6	.0	3,820	1.4%	2.7%	.0%	12.8%
Silvar-Lisco	13.3	.0	12.3	0	1.4%	.0%	3.9%	.0%
Control Data	12.0	7.8	1.5	4	1.3%	1.5%	.5%	.0%
Intergraph	11.7	6.1	2.7	123	1.2%	1.2%	.8%	.4%
Racal-Redac	11.6	1.8	8.2	31	1.2%	.4%	2.6%	.1%
Computervision	10.5	3.4	4.0	98	1.1%	.7%	1.3%	.3%
Seiko Instruments (No OEM)	7.0	3.1	3.2	30	.7%	.6%	1.0%	.1%
Zuken	5.5	2.9	1.9	59	.6%	.6%	.6%	.2%
Calma	5.3	2.8	1.7	84	.6%	.5%	.5%	.3%
Apple Computer	2.6	2.7	.0	948	.3%	.5%	.0%	3.2%
Autodesk	1.6	.0	1.6	0	.2%	.0%	.5%	.0%
Tektronix	1.5	.7	.6	28	.2%	.1%	.2%	.1%
Tokyo Electron (No OEM)	.8	.0	.7	0	.1%	.0%	.2%	.0%
Hitachi	.7	.7	.0	13	.1%	.1%	.0%	.0%
Personal CAD Systems	.3	.0	.3	0	.0%	.0%	.1%	.0%
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	175.3	60.0	100.1	5,830	18.6%	11.9%	32.0%	19.5%
All Companies	940.3	503.0	312.6	29,850	100.0%	100.0%	100.0%	100.0%

Gateway: \$5 million

(Continued)

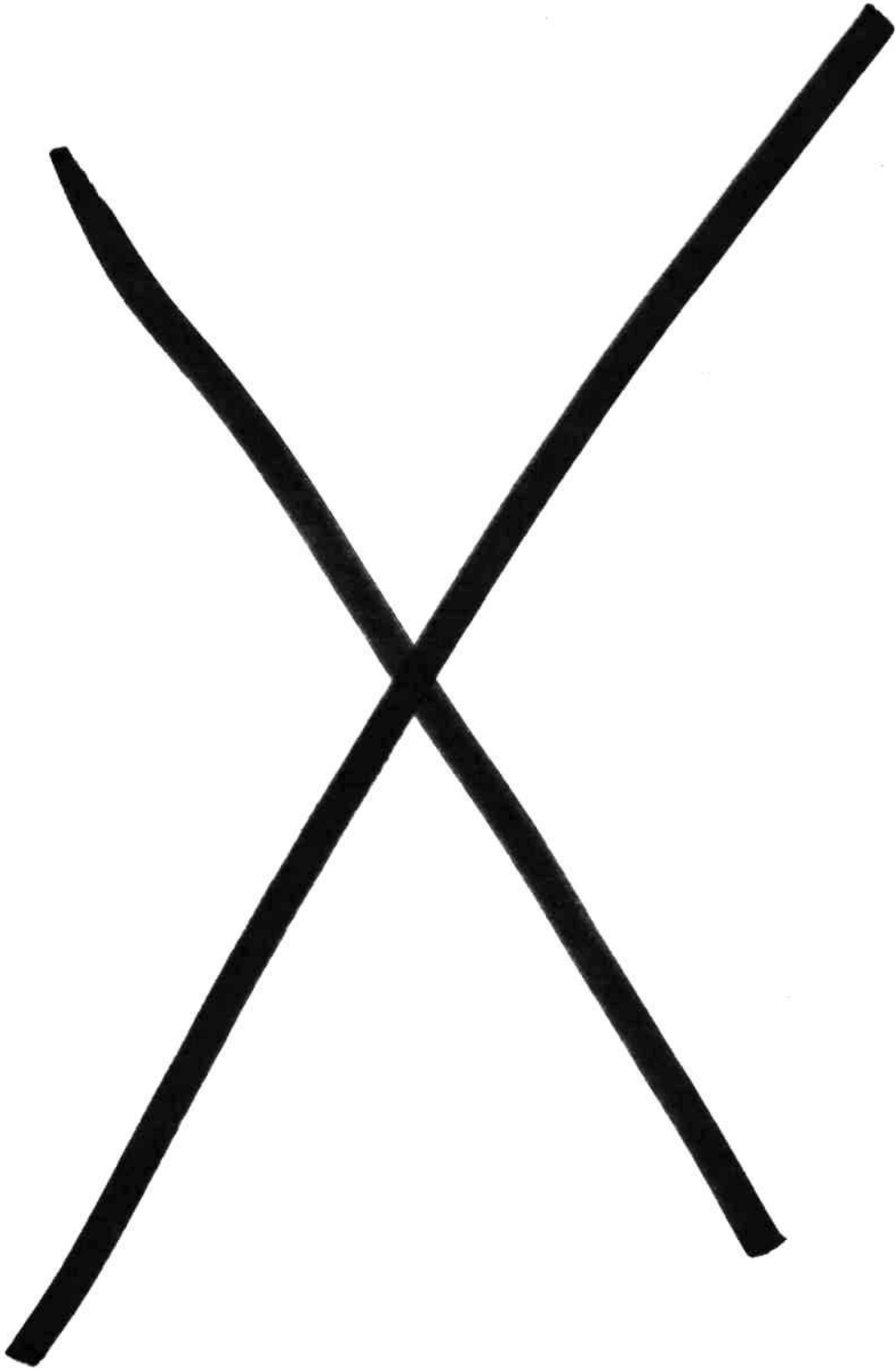
2.5 ECAE Market Shares

Table 2.5-1 (Continued)

ECAE 1986 Worldwide Market Share
(Millions of Dollars, Actual Units)

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
All U.S.-Based Companies	850.8	466.1	270.5	28,100	90.5%	92.7%	86.5%	94.1%
All Asian-Based Companies	66.3	32.4	27.5	1,251	7.1%	6.4%	8.8%	4.2%
All European-Based Companies	23.2	4.5	14.7	499	2.5%	.9%	4.7%	1.7%
All Hardware Companies	320.2	287.0	.2	20,931	34.1%	57.1%	.1%	70.1%
All Turnkey & SW Companies	620.1	216.0	312.4	8,919	65.9%	42.9%	99.9%	29.9%

Source: Dataquest
July 1988



3.1 IC Layout Definitions

The integrated circuit (IC) layout market segment consists of products used during the physical design phase to create and validate physical implementations of integrated circuits. IC layout tools include polygon editors for the creation of geometric data, symbolic editors, placement and routing (gate array, cell, and block), and DRC/ERC (design rule checking/electrical rule checking) verification tools. By definition, an IC CAD system's output is the physical description of an IC design that is used to create the necessary fabrication mask for manufacturing.

Dataquest references two distinct classes of IC layout design methodology: handcrafted and automatic. Handcrafted IC design methodologies are used for products on which a layout designer manually creates the physical description of the circuit. Handcrafted design methodologies require extensive graphics editing capabilities, regardless of whether the transistor representations used during layout are symbolic or geometric.

By contrast, automatic IC design methodologies are used for products that automatically create mask data, without the manual intervention of a layout designer. This subsegment includes gate array or cell-based place-and-route products, silicon compilers, and programmable logic array (PLA) compilers. The feature that distinguishes handcrafted IC design methodologies from automatic ones is the integration and close coupling of the logical and physical circuit descriptions. The scope of the IC layout segment includes the design tasks, products, and methodologies listed and defined as follows:

- *Automated IC design* refers to an IC design methodology in which all or portions of a chip are automatically generated.
- *Back-annotation* is a postlayout process in which the actual wire-length data derived from the completed layout replaces the statistically estimated delay information used during prelayout simulation.
- *Block placement and routing* is an IC design methodology for the interconnection of large blocks in a design. The blocks can be made up of compiled cells or handcrafted custom blocks. A special placer positions the blocks to minimize the routing distances and to optimize the IC performance. These are then connected by a router or routers that can support the block topology.
- *Cell-based placement and routing* is an IC design methodology that allows the creation of ICs or blocks within ICs from predefined cells that are placed and then routed together to create a logic function.
- *Composite chip design* is an automated IC layout methodology that allows users to combine different layout techniques on a single chip. A floor plan of different blocks is defined, and different types of blocks are then combined to create a composite chip. The blocks might contain standard cells, a compiled cell, or a handcrafted polygon layout.

- *Gate array placement and routing* is a type of application-specific integrated circuit (ASIC) design methodology or product that assembles and then interconnects predefined gates and other primitive elements, manually or automatically, by interconnecting the transistors using one or more layers of metal. The gate array itself is a predefined pattern of transistors that the semiconductor supplier prefabricates on wafers.
- *Layout verification* includes *design rule checking (DRC)*, *electrical rule checking (ERC)*, and *netlist comparison*.
 - *Design rule checking (DRC)* is a design task for verifying that an IC (or board) layout meets known fabrication tolerances, or spacing checks (e.g., trace-to-trace spacing, via adjacency, or trace-to-via spacing).
 - *Electrical rule checking (ERC)* is the verification of known electrical rules for the technology and identification of violations (e.g., opens, shorts, and floating nodes).
 - *Netlist comparison* means verifying that the final layout corresponds to the original design prior to layout (also known as *netlist* versus *layout*).
- *Manual polygon-level geometry creation and editing* is a type of handcrafted layout IC design methodology or product in which elements are graphically described, positioned, and interconnected one by one, according to specific manufacturing rules.
- *Programmable logic array (PLA) compilation* is a product or design methodology that automatically generates the layout data of a PLA.
- *Silicon compilation* is an automated IC design technique that automatically creates, assembles, simulates, and routes cells. A compiler generator system first generates the contents of circuit cells or modules and then automatically places and routes these cells to create a unique IC layout.
- *Spacing and compaction* is an automated process of optimizing the silicon surface utilization of a given IC design. Given a specific set of design rules, such objects as transistors, vias, and metal interconnects, are compacted as closely together as the rules will allow.
- *Symbolic layout and editing* is an automated IC layout methodology in which meaningful symbols of transistors, inverters, and other objects are used instead of geometric shapes such as polygons. In symbolic editing, the design itself is understood such that the layout must correspond to the original schematics. Symbolic editing has the further advantage of being design rule independent. Design rules are enforced automatically after the layout using spacing and compaction tools.

Dataquest differentiates electronic design automation (EDA) products based on a system's output: either logical/functional netlists or physical descriptions. With the development and acceptance of automatic IC layout products (and these by definition include close coupling and integration of logical or functional descriptions with physical descriptions), IC layout products may include ECAE functionality. Depending on the nature of the product and the degree of integration, an automatic IC layout product may also include the ability to describe the chip's functionality. This description may consist of gate, functional, architectural, or language level representation.

3.2 IC Layout Executive Summary

This summary highlights the key points and analyses presented in this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the ECAE applications segment. Highlights include the following:

- Dataquest estimates the 1987 IC layout market at \$319 million, up 16 percent from \$275 million in 1986.
- IC layout revenue are forecast to grow 11 percent in 1988, to \$353 million.
- Dataquest anticipates that the IC layout market segment will grow to \$429 million between 1987 and 1992, at a 6 percent compound annual growth rate (CAGR).
- IC layout workstation shipments were 4,204 units in 1987. Annual unit shipments are expected to reach 8,460 in 1992, representing a 15 percent CAGR.
- We expect the average selling price per seat for an IC design system to decrease by a negative 12 percent CAGR from \$41,500 to \$21,900 between the years 1987 and 1992, the impact of lower-priced technical workstations being offset by the need for increasingly sophisticated applications.
- Top IC layout vendors and their 1987 shares of total market were Calma (10 percent), followed by Seiko Instruments, Mentor Graphics, Sun Microsystems, and Silicon Compiler Systems (in order of share, all at approximately 9 percent).
- Top IC software vendors and their 1987 share of market were Silicon Compiler Systems (16 percent), ECAD (14 percent), and SDA (10 percent). Had the ECAD and SDA merger occurred in 1987 instead of 1988, the resulting entity, Cadence Corporation, would have had a 24 percent share of the 1987 IC layout software market.
- Top IC hardware vendors were Digital Equipment Corporation, first in IC hardware revenue (18 percent), and Apollo, first in number of workstations shipped (15 percent).
- Dataquest believes that the trend in the IC layout market toward unbundling of both software and hardware is continuing and that unbundled system sales have in fact surpassed turnkey sales.
 - Unbundled IC software revenue is growing at a 12 percent CAGR between 1987 and 1992, and unbundled IC design hardware revenue is growing at a 4 percent CAGR in the same period.
 - By contrast, turnkey IC revenue is declining by a 1 percent CAGR through 1992.

3.3 IC Layout Market Overview

HISTORY

Overview

Unlike any other CAD/CAM application, IC layout is required for integrated circuit product design. Very large scale integrated (VLSI) circuits cannot be designed without the use of some form of electronic design automation. The sophistication, complexity, and capabilities of IC design tools have developed and evolved in response to changes in the nature and complexity of integrated circuits themselves.

IC layout systems evolved from the relatively simple digitizing systems of the early 1970s to the "polygon-pushers" (with full manual geometric editing functionality) of the late 1970s and early 1980s. Although these products are still in use, they increasingly compete with and are being replaced by highly sophisticated and automated IC design products. Newer design methodologies for application-specific integrated circuits (ASICs) today are driving both semiconductor and IC layout markets. User demand for increased design automation and a reduced time to market is illustrated by the fact that both silicon compilers and automatic placement and routing have entered and are impacting this market.

Evolution of the Market

The first wave of IC layout products was initially dominated by product offerings from Applicon, Calma, and Computervision with their "polygon-pushing" manual editing systems, and later from Silvar-Lisco with batch placement and routing software. This set of vendors dominated the IC layout market and focused primarily on enhancements to manual editing or mask geometries instead of extending product functionality to front-end design tasks.

Second-wave design automation companies were specifically formed to address electronic CAE applications. By providing integrated front-end CAE solutions on lower-priced technical workstations, the new CAE companies were able to take advantage of the pricing umbrella created by the high system prices of traditional vendors and to chip away at their customer bases. This situation began eroding the traditional IC layout vendors' market share.

The high degree of expertise and knowledge required to develop ASIC design and layout tools brought another wave of semiconductor companies and other IC layout vendors into the IC layout segment. These third-wave vendors include companies such as Cadence, Silicon Compilers Systems, and VLSI Technology, Incorporated (VTI). They provide highly automated systems based on alternative IC design methods, particularly for gate-array and cell-based design. These systems incorporate automatic placement and routing with higher-level, cell-based, and silicon-compilation design techniques; collectively, they present a formidable challenge to traditional IC layout software.

1987: CONSOLIDATION AND POSITIONING

The IC layout market exemplified the consolidation and positioning of the EDA industry in 1987. IC layout always has been the most fragmented and smallest of the EDA niches (at \$319 million in 1987) and nowhere was the need for consolidation more evident. The consolidation in the market, coupled with changes in technology, also has changed the fundamental positioning of the remaining IC layout vendors.

The year 1987 began with more than 25 suppliers in IC layout. This crowded marketplace resulted in the following:

- Intense price competition
- Slower revenue growth despite strong unit shipments
- Small vendor size

In other words, everyone cut prices to get market share, but nobody was winning in the end. Total revenue growth was 16 percent in 1987, although unit shipments were up 58 percent to 4,204 workstations. At the beginning of 1987, there were no companies that had software revenue of more than \$25 million.

Consolidation

All of this changed with a series of mergers in 1987 and early 1988. First, Silicon Compilers merged with Silicon Design Labs to create Silicon Compiler Systems for approximately \$24 million in combined software revenue for 1987. Next, SDA and ECAD merged to form Cadence for a combined revenue of nearly \$40 million in IC layout. Finally, Valid Logic acquired the GE Calma IC Layout Division for a combined IC layout revenue of \$35 million. In addition, Tektronix sold its CAE and VR operations to Mentor Graphics, and Applicon significantly reduced its efforts in IC layout.

Today's market landscape is completely different. The new-generation companies that began in 1982 through 1984 now dominate the marketplace, displacing the older CAD companies. Instead of 20 companies dividing a \$147.7 million software market between them, now there are 6 companies with more than \$25 million per year in annual revenue. These suppliers will have the sales, research and development (R&D), and financial resources to compete over the long term. Customers are more likely to make purchases from vendors if they are perceived to be stable, particularly after the previous confusion in the market.

The New Positioning

The other major outcome of the restructuring of the IC layout market has been a significant change in the positioning of these companies. In the past, each supplier tended to specialize in one application area such as place and route (Silvar-Lisco, Tangent), polygon editing (Calma), or post-processing (ECAD), and the market could be segmented accordingly. Success was defined by how well a company dominated each individual niche.

These distinctions have been blurred after the mergers and acquisitions. The specialist still remain, but the main participants all offer IC layout solutions that cover the entire breadth of layout tasks. For example, VTI offers a complete IC layout solution for ASIC engineers as does SCS with its Genesil package. With its combined ECAD/SDA tools, Cadence offers a complete full-custom design package (with ASIC capabilities for a foundry), similar to SCS the GDT system offering.

The solution suppliers, such as Cadence, SCS, Valid/Calma, and VTI, are positioned by their methodology and target end users, not by whether or not they offer a specific software package. At the methodology level, vendors distinguish themselves by how their tools actually accomplish the complete layout cycle through different variants of symbolic editing, compilation, cell generation, and verification. From an end-user standpoint, vendors are distinguished by the degree to which they focus on ASIC or VLSI component layout, and the level of chip complexity their tools support.

END USERS

The domination of the IC layout market by relatively young companies with highly sophisticated, methodology-based tool solutions is a reflection of the demands imposed by the major user—the semiconductor industry—on its suppliers. The semiconductor companies, because of the competition within their own industry, have always put tool suppliers under constant pressure to deliver extremely reliable and advanced systems. Because of the intricacies of semiconductor manufacture, many users have required that the tools be customized to meet their own unique needs.

The two semiconductor segments that have exerted the most pressure on the tool vendors are ASIC and VLSI. More so than any other vendors, ASIC and VLSI suppliers depend on their IC layout tools for a competitive advantage in the market. These two classes of end users have defined the technology requirements for automated IC tools and vendors.

ASICs

The ASIC market and automated IC layout have always been inextricably linked together. Automated layout is the fundamental technology that enables ASIC suppliers to combine predefined functions into a unique chip for a customer. Cell-based, gate-array, and silicon-compiled ASICs are as much different approaches to the layout problem as they are distinct fabrication methods.

While basic gate array and standard cell tools have been in existence since the mid-1970s, customer requirements and competitive pressures have forced ASIC suppliers to look for new layout tools, even for low-complexity designs. The four pressures that have been driving this demand are as follows:

- **Fast turnaround for customers**—This means that the final layout must be performed quickly and still meet the customer's performance requirements; all critical path times have to be met by the layout system automatically.
- **Price competition**—ASIC price competition forces vendors to cut costs, and the first way to control costs is to shrink die sizes. This has meant using layout systems that pack the most gates into the smallest possible area and switching to denser layout structures such as sea-of-gates arrays and three-layer metal routing.
- **Reliable production**—This, in turn, means testable production, and many ASIC suppliers have switched to scan test. Once again, the layout tools must be capable of automatically placing and routing scan test structures.
- **Higher functionality and performance requirements**—Layout tools will be able to handle large microprocessor cores, customized RAMs and ROMs, and analog components, as well as such arcane features as double rows of pads, stray capacitance from high-speed signals, and stacked vias.

In short, pressures on ASIC suppliers to do "more, faster, and cheaper" have forced them to look for next-generation IC layout solutions. Much as on the ECAE side of ASIC design (see Section "2.3 ECAE Market Overview"), two different strategies have emerged.

Some vendors, notably LSI Logic and VTI, have decided that layout is simply too critical a technology to leave to third parties. They have chosen to develop their own tools in order to get to market on time and to be able to service their customers. Vendors with internally developed systems have tended to be the first to market, especially with high-complexity ASICs. However, they have also had to maintain large and expensive software development teams.

On the other hand, tool vendors such as SDA (Cadence), Silicon Compiler Systems, Silvar-Lisco, and Tangent have all brought out new systems that also have addressed these requirements. The performance of these commercial tools always meets and often exceeds the proprietary tools. The majority of the ASIC suppliers have relied upon IC layout vendors to deliver superior solutions, but with a penalty in time to market.

As long as the ASIC market exhibits its current intense competition, the pressures will remain for excellence in layout. It is difficult to anticipate a point where ASIC suppliers will say that their design needs have been completely fulfilled. New process and customer demands will push the ASIC layout suppliers to deliver a steady stream of innovative products.

VLSI

In contrast, the VLSI layout designer has been slower than ASIC end users to adopt automated tools. VLSI design had long been the bastion of manual layout methods. The argument always has been that large production chips require small die sizes that can be accomplished only through the use of handcrafting one polygon at a time. Even with CAD polygon editing systems, VLSI layout designers simply were substituting for their original method of handcrafting chips, mylar, and tape. The CAD station had replaced the drafting table, but it had not changed the way designs were accomplished.

However, exponentially rising chip complexity and the need to protect investment in chip layouts during process changes have forced VLSI designers to reconsider their methodologies and to look to new layout tools. With 200,000 transistor designs becoming commonplace, the first need has been to eliminate the gulf between schematic and layout. Too many errors are introduced as schematics are converted into polygons. Second, when a process change occurs or design rules are modified, polygon layouts must be completely redone by hand; this process can take months to accomplish. As a result, users have demanded a new generation of tools that link schematics, layout, and design rules without sacrificing chip performance or density. Users have demanded the following:

- Comparable chip densities to handcrafted layouts
- Correct-by-construction or layout = schematic
- Design rule independence
- Quick feedback between layout and simulation

In other words, they want the densities of handcrafted layout, without its tedious errors, and with the added productivity created by automated cell generators, compactors, and symbolic editors.

A range of IC layout vendors have stepped in with automated layout solutions to address these requirements. New companies such as Cadence, Caeco, and Silicon Compilers Systems offered different systems for creating and validating IC layout systems. Older line vendors such as Calma (Valid) and Mentor Graphics also added functionality to their systems for automation of the layout process. Subtle distinctions in methodology still separate these suppliers and make for very interesting competition.

A new generation of chips is now entering production based upon these new design approaches. For example, the Motorola 88000 RISC microprocessor chip set was designed entirely with Silicon Compiler Systems' GDT tool set. Not only does Motorola report impressive gains in productivity and very short design times through the use of these tools, but a number of other benefits have come out. These benefits include the following:

- The chips can be easily shrunk to fit new design rules.
- The chips can be easily converted to new processes.
- Customized versions of the chips can be created in days.
- The chips can be rapidly turned into ASIC cores.

Other semiconductor manufacturers and tools vendors are reporting similar results. Productivity in layout has been improved by orders of magnitude. Chip manufacturers are receiving unprecedented gains in productivity and manufacturing flexibility. Dataquest believes that all VLSI will be laid out using automated methodologies.

STRATEGIES

While IC layout now boasts some of the most sophisticated design tools found in any industry, the fortunes of the IC layout suppliers are tied to those of the semiconductor industry; these can vary greatly from year to year. In addition, the IC layout market's size is still quite small and probably not large enough to support all of the current participants.

Stable strategies in this market, which is fundamentally a niche market, are difficult to accomplish. A successful company must simultaneously be the leader in technology, price, sales, service, and support. Apart from a few very distinct subniches such as gate-array layout or silicon compilation, the only market position is that of complete automated solution supplier.

Dataquest believes that the only viable market strategy in IC layout is domination. Solution suppliers can differentiate themselves by methodology and target market, but within those segments, there will be one, at best two, suppliers. Very few prizes will be given out for third place.

Solution vendors can focus on high-complexity ASIC layout or composite VLSI chip design. Semiconductor layout problems are sufficiently distinct to warrant more than one methodology. A low-volume cell design does not need the same tools as a high-volume VLSI microprocessor. There is no right answer as to the correct methodology.

However, a supplier must be the leader in whatever segment it targets. The size of the supplier also will be determined by the size of the niche market. If an IC layout vendor chooses to attack a particular segment, it must be positive that its resources will be large enough to fund the ongoing R&D, sales, and support that will invariably follow. IC layout is not an easy business.

OPPORTUNITIES

As advanced as these new layout systems are, and even as they are now entering heavy production use, it is possible to envision a new set of emerging problems. Customer demands will not subside, nor will competitive pressures. Analog compilation, increased use of macrocells, three-layer metal cell designs, and submicron feature sizes are all on their way.

IC layout tool suppliers should be able to identify and capitalize on these opportunities. Although many of the new solution vendors are in the process of digesting their mergers and completing their tool sets, several new areas merit attention, such as the following:

- Very fast mask creation and design-rule checks
- Next-generation routers for high-performance chips
- Specialized compilers for analog or other chip types
- Close coupling with logic synthesis tool sets
- Project management and integration

Specific tool sets can be extended in all of these areas as well as many others. This situation further differentiates the supplier and demonstrates the robustness of a particular system for a wide range of layout problems. In the final analysis, the ability of an automated layout methodology to comprehend the broadest possible spectrum of chip designs will strongly determine the success of those tools—and the vendor—in the market.

HARDWARE PLATFORMS

Hardware platforms have begun to play an important role in penetrating the end-user market. As recently as three years ago, almost 100 percent of IC layout systems shipments were based on host-dependent architectures. (Please refer to Section 3.4.1 for Dataquest forecasts and an analysis of the IC layout segment by product type.)

Technical Workstations

The introduction of technical workstations for IC applications brought the following inherent benefits:

- Lower incremental cost, hence more affordability
- Distributed processing, thus maintaining constant performance levels regardless of the number of users (except in the case of large file transfers)
- Computational alignment, thus delegating design responsibilities according to system performance capabilities

Nearly all of the functionality challengers offer technical workstation product architectures, as do most semiconductor challengers. In response to competition, Calma and Computervision now offer technical workstations in addition to their traditional host-dependent systems.

Dataquest believes that technical workstations will continue to play an increasing role in IC layout applications; however, we recognize that they are not without the following limitations:

- Technical workstations are inadequate for batch-oriented tasks such as placement and routing or design-rule checking/electrical-rule checking (DRC/ERC) of large circuits.
- Technical workstations are slow when transferring large design files between engineers and layout designers.

Host-Dependent Systems

Although host-dependent systems will continue to be used for IC design, Dataquest estimates that by 1992 they will account for only 13 percent of all IC layout systems shipped, representing a decline from 26 percent in 1987. We believe that host-dependent products will be used mainly as computational engines, especially for automatic layout applications. With the introduction of high-performance technical workstations from Apollo, Digital, IBM, and Sun, however, Dataquest believes that there remain very few host-dependent alternatives except for IBM and its 4300 and 308X series.

Personal Computers

Dataquest believes that due to 32-bit IC-design bases with extensive graphics and storage requirements, personal computers will not play a major role in the IC layout segment. Furthermore, due to the design process itself, it is difficult to partition the design into sizes small enough to be managed by personal computers.

We believe that the present role of the personal computer is limited to the design or compilation of programmable logic arrays (PLAs). This is because these devices are typically small enough to be handled by a personal computer.

There are undoubtedly isolated cases where it is possible to efficiently run IC layout programs on a PC. However, because the value of the software disproportionately exceeds the value of the hardware, we do not believe that vendors will be able to receive an adequate return on their R&D, support, marketing, and sales investments to justify pursuing the PC as a viable hardware alternative.

Although Dataquest recognizes that there will always be exceptions, we believe that the majority of ICs will not be physically designed on a PC, even though their logic design could be on this platform.

3.4 IC Layout Forecasts

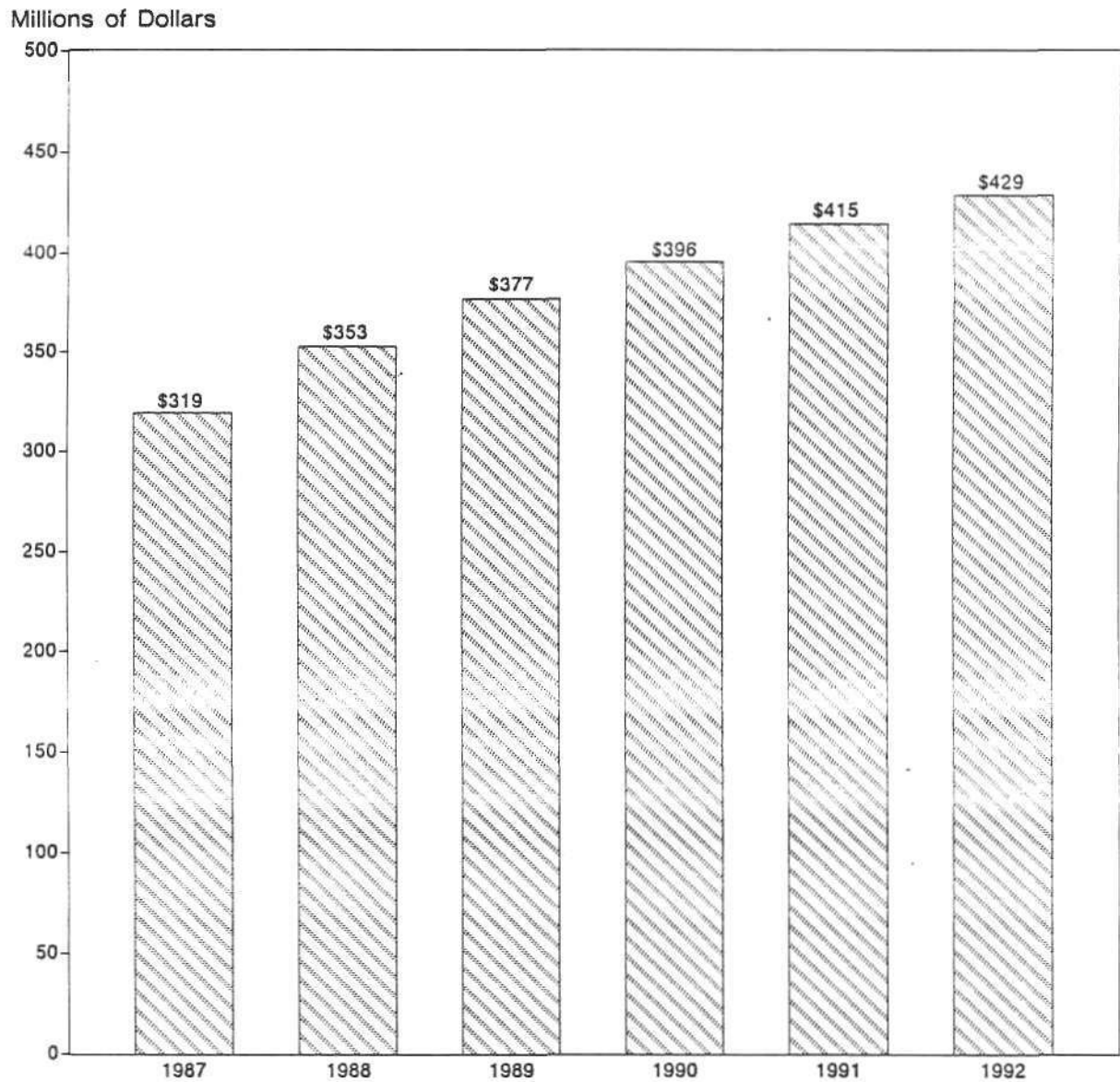
TOTAL IC LAYOUT MARKET

This section presents Dataquest's forecast and analysis for the total IC layout market for all regions and platforms, as illustrated in Figures 3.4-1 and 3.4-2 and Table 3.4-1. These data are summarized as follows:

- Dataquest estimates the 1987 IC layout market at \$319 million and forecasts it to grow to \$429 million by 1992, a 6.1 percent compound annual growth rate (CAGR).
- IC layout revenue is expected to grow 11 percent in 1988, to reach \$353 million.
- IC layout workstation shipments in 1987 were 4,204 units; annual shipments are expected to reach 8,460 units in 1992, growing at a 15 percent CAGR.

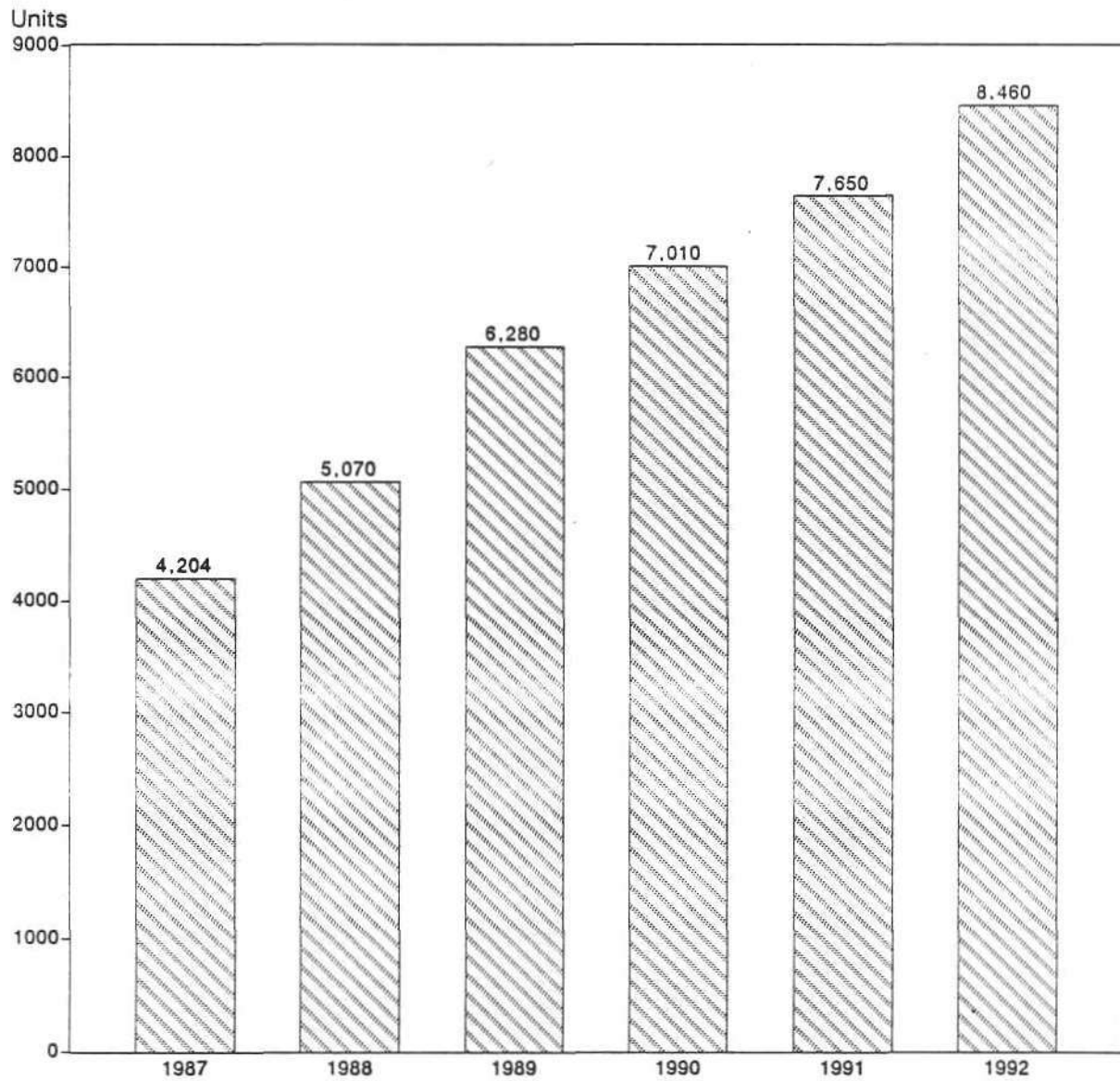
Figure 3.4-1

IC Layout Worldwide Forecast
Revenue



Source: Dataquest
July 1988

Figure 3.4-2

IC Layout Worldwide Forecast
ShipmentsSource: Dataquest
July 1988

3.4 IC Layout Forecasts

Table 3.4-1

IC Layout Worldwide Forecast
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Revenue	319	353	377	396	415	429	6.1%
Systems	3,985	4,950	6,170	6,930	7,600	8,460	16.3%
Workstations	4,204	5,070	6,280	7,010	7,650	8,460	15.0%

Source: Dataquest
July 1988

15% sold with schematic capture

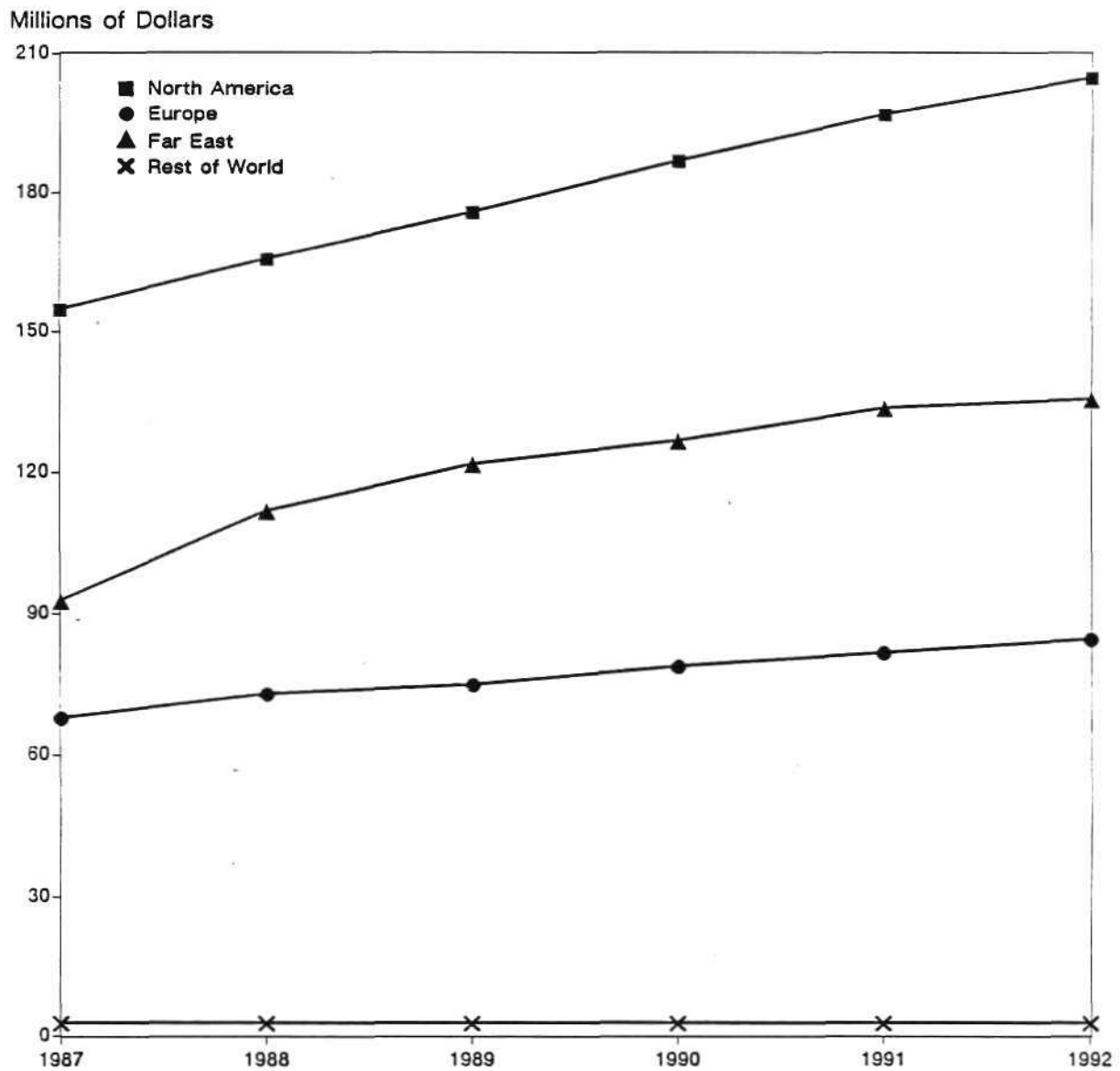
REGIONS

This section presents Dataquest's forecast and analysis of the IC layout market segmented by region, as illustrated in Figures 3.4-3 and 3.4-4 and Tables 3.4-2 and 3.4-3. These data are summarized as follows:

- North American IC layout revenue was \$155 million in 1987 and is forecast to grow to \$205 million in 1992, at a 5.7 percent CAGR. North American workstation consumption was 2,024 units, or 48 percent of the total workstations shipped in 1987. We estimate that North American workstation shipments are growing at a 14.3 percent CAGR and will reach 3,950 units, or 47 percent of the total IC layout workstations shipped in 1992.
- In 1987, European IC layout revenue was \$68 million and, growing at a CAGR of 4.6 percent, is expected to reach \$85 million in 1992. European workstation consumption was 1,069 units, or 25 percent of the workstations shipped in 1987. We estimate that workstation shipments are growing at a 6.4 percent CAGR and will reach 1,460 units or 17 percent of the total IC layout workstations shipped in 1992.
- The Far East continues to be the fastest-growing region for IC layout. Far East IC layout revenue was \$93 million in 1987 and is forecast to grow to \$136 million in 1992, at a 7.9 percent CAGR. The Far East consumed 1,066 workstations or 25 percent of those shipped in 1987. We estimate that workstation shipments are growing at an 18.5 percent CAGR, to reach 2,490 units, or 29 percent of the total IC layout workstations shipped in 1992.
- Dataquest believes that North America will continue to dominate consumption of IC layout systems through 1992, with an average of 48 percent of worldwide shipments.
- Far East workstation consumption, with 25 percent of worldwide shipments, is forecast to increase at the greatest rate, partly in reaction to the high price of domestic workstations in Japan. As U.S.-based suppliers penetrate the Japanese market with lower-cost solutions, Japanese average selling prices should decline and IC layout sales should increase.
- Although the majority of vendors are actively establishing non-U.S. marketing organizations if they have not already done so, Dataquest does not anticipate any major shifts in current worldwide consumption of IC layout systems, basically due to the distribution of IC manufacturers and consumption of ICs.
- We expect Europe to maintain a fairly constant 20 percent of worldwide shipments and consumption.

Figure 3.4-3

IC Layout Regional Forecast
Revenue



Source: Dataquest
July 1988

Figure 3.4-4

IC Layout Regional Forecast
Shipments

Workstation Shipments

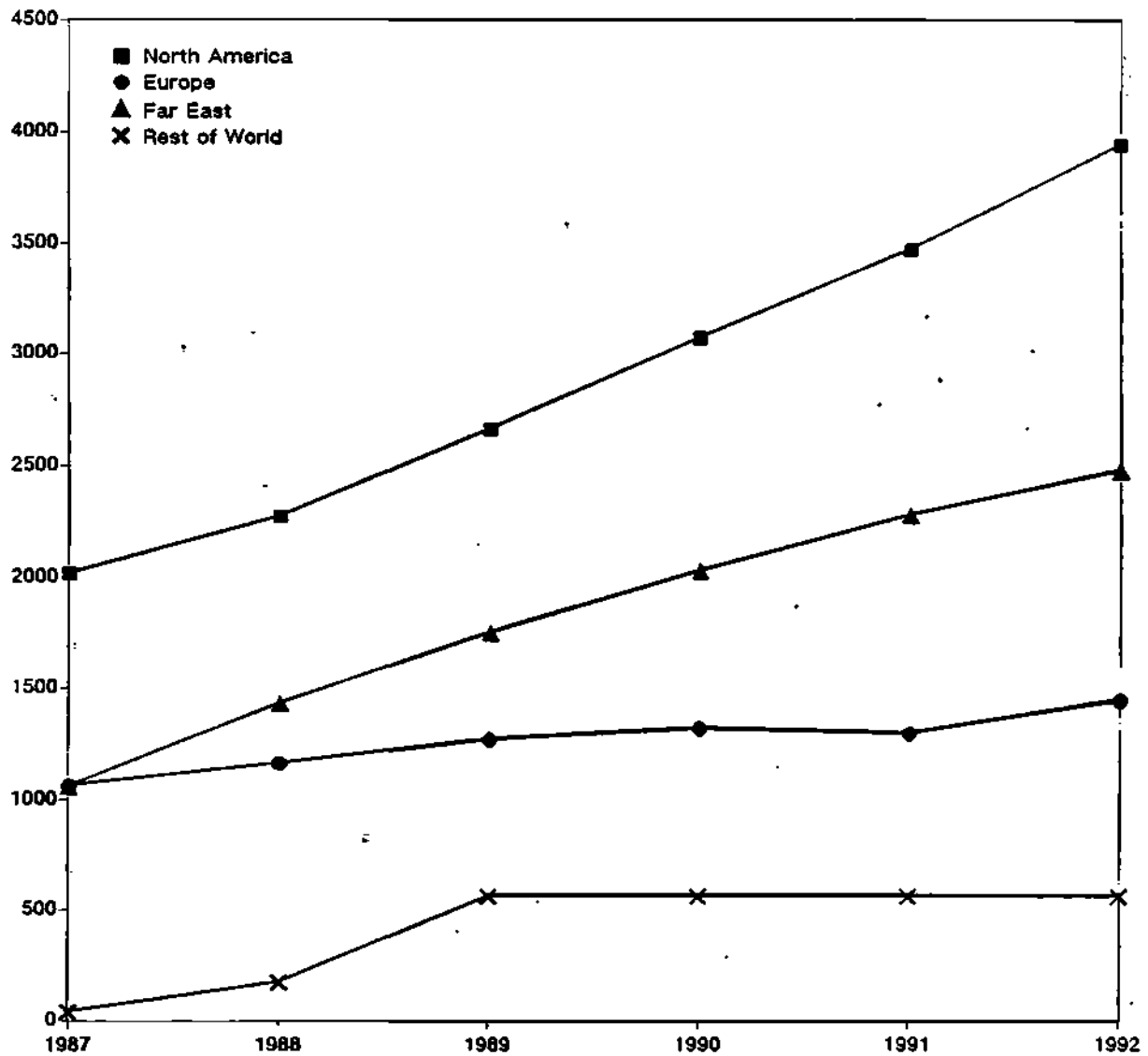
Source: Dataquest
July 1988

Table 3.4-2

IC Layout Regional Forecast
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Market							
Revenue	319	353	377	396	415	429	6.1%
Systems	3,985	4,950	6,170	6,930	7,600	8,460	16.3%
Workstations	4,204	5,070	6,280	7,010	7,650	8,460	15.0%
North America							
Revenue	155	166	176	187	197	205	5.7%
Systems	1,963	2,280	2,670	3,080	3,480	3,950	15.0%
Workstations	2,024	2,280	2,670	3,080	3,480	3,950	14.3%
Europe							
Revenue	68	73	75	79	82	85	4.6%
Systems	1,038	1,170	1,280	1,330	1,310	1,460	7.1%
Workstations	1,069	1,170	1,280	1,330	1,310	1,460	6.4%
Far East							
Revenue	93	112	122	127	134	136	7.9%
Systems	937	1,320	1,650	1,950	2,240	2,490	21.6%
Workstations	1,066	1,440	1,760	2,040	2,290	2,490	18.5%
Rest of World							
Revenue	3	3	3	3	3	3	-3.3%
Systems	46	180	570	570	570	570	65.4%
Workstations	46	180	570	570	570	570	65.7%

Source: Dataquest
July 1988

Table 3.4-3
IC Layout Regional Forecast
(Percentage of Total)

	1987	1988	1989	1990	1991	1992
	****	****	****	****	****	****
North America						
Revenue	49%	47%	47%	47%	47%	48%
Systems	49%	46%	43%	44%	46%	47%
Workstations	48%	45%	43%	44%	45%	47%
Europe						
Revenue	21%	21%	20%	20%	20%	20%
Systems	26%	24%	21%	19%	17%	17%
Workstations	25%	23%	20%	19%	17%	17%
Far East						
Revenue	29%	32%	32%	32%	32%	32%
Systems	24%	27%	27%	28%	29%	29%
Workstations	25%	28%	28%	29%	30%	29%
Rest of World						
Revenue	1%	1%	1%	1%	1%	1%
Systems	1%	4%	9%	8%	8%	7%
Workstations	1%	4%	9%	8%	7%	7%

Source: Dataquest
 July 1988

PLATFORMS

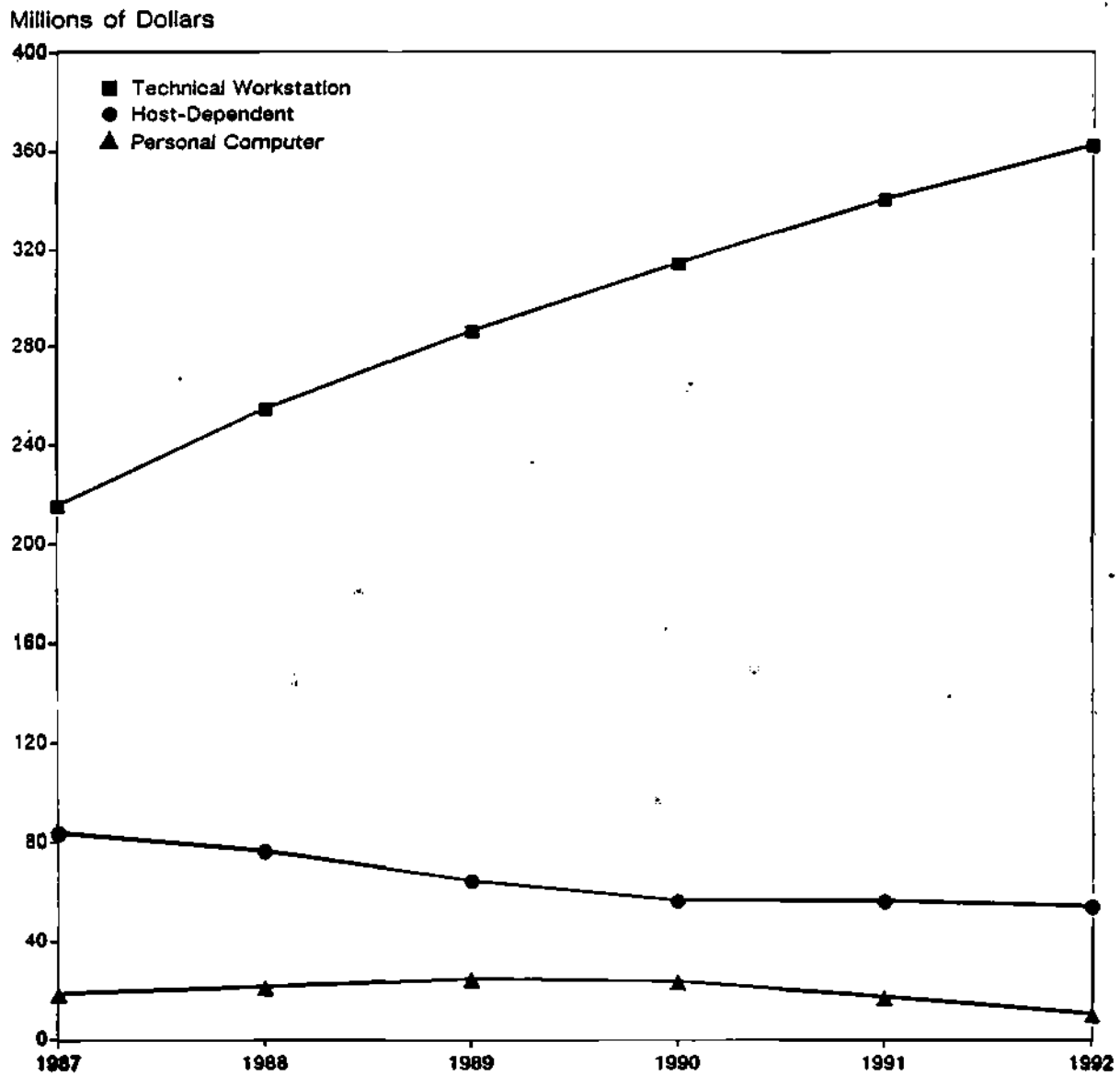
This section presents Dataquest's forecast and analysis of the IC layout market segmented by platform, as illustrated in Figures 3.4-5 and 3.4-6 and Tables 3.4-4 and 3.4-5. These data are summarized as follows:

- Approximately 4,204 IC layout workstation units were shipped in 1987 and, with growth at a 15 percent CAGR, we estimate that 8,460 workstations will be shipped in 1992.
- Technical workstation revenue was \$216 million in 1987 and is forecast to reach \$363 million in 1992, growing at a 10.9 percent CAGR.
- Approximately 2,734 technical workstations were shipped in 1987. The forecast is for 7,130 workstations to ship in 1992, a 21.1 percent CAGR.
- Host-dependent revenue was \$84 million in 1987, which is forecast to decrease at an 8 percent CAGR through 1992, declining to \$55 million.
- Host-dependent workstation shipments were 421 in 1987 and are forecast to decrease at a 16.6 percent CAGR to 170 units shipped in 1992.
- Personal computer revenue was \$19 million in 1987 and, declining at an 11 percent CAGR, is forecast at \$11 million in 1992.
- An estimated 1,049 personal computers for IC layout were shipped in 1987. This figure is expected to reach 1,150 units in 1992, growing at a 1.9 percent CAGR.
- Technical workstation shipments have surpassed host-dependent systems for the past two years due to lower costs per seat and less CPU degradation when performing graphics-intensive tasks.
- Host-dependent systems will continue to be used due to large, computation-intensive processing requirements.
- Host-dependent systems' primary application will be design programs and methodologies that do not require extensive interactivity and that can run in background mode.
- Personal computers will not be a major factor because of the inherent computation-intensive design tasks and large data bases. Dataquest believes that in IC design, the role of the PC will be limited to compilation of PLAs.

- For the foreseeable future, personal computers will be used to serve as front-end (ECAE) logic design entry systems for ICs, not for actual physical layout.
- Workstation performance and, specifically, CPU and graphics performance remain critical issues. Available disk drive and memory space are a prerequisite of IC design because of the large libraries and data bases involved. IC design graphics requirements, although not as intensive as the high-resolution graphics required by mechanical or solids modeling applications, still need near to real-time display and response speeds.

Figure 3.4-5

IC Layout Worldwide Forecast by Platform
Revenue

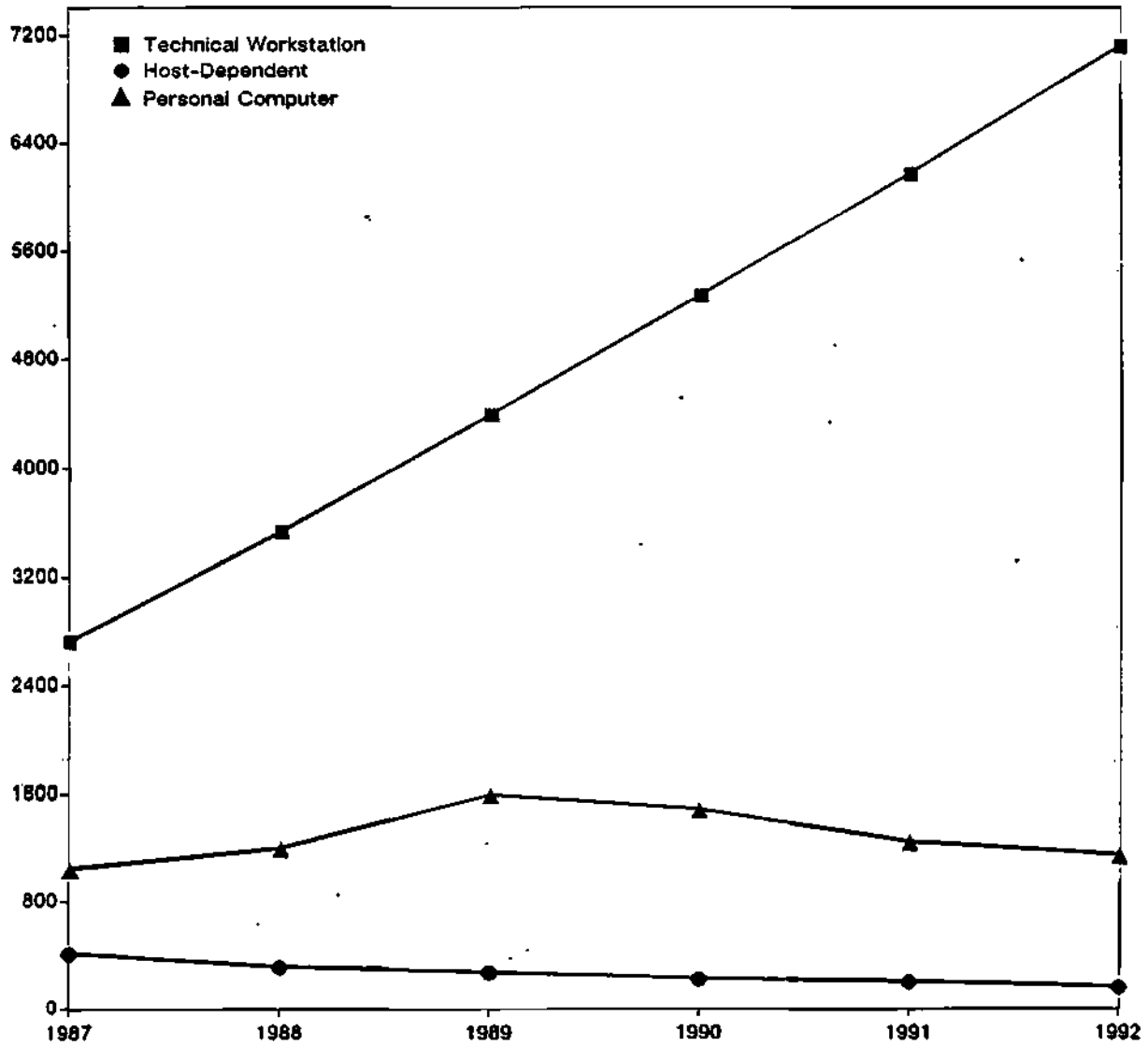


Source: Dataquest
July 1988

Figure 3.4-6

IC Layout Worldwide Forecast by Platform
Shipments

Workstation Shipments

Source: Dataquest
July 1988

3.4 IC Layout Forecasts

Table 3.4-4

IC Layout Worldwide Forecast by Platform (Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Market							
Revenue	319	353	377	396	415	429	6.1%
Systems	3,985	4,950	6,170	6,930	7,600	8,460	16.3%
Workstations	4,204	5,070	6,280	7,010	7,650	8,460	15.0%
Technical Workstation							
Revenue	216	255	287	315	341	363	10.9%
Systems	2,734	3,540	4,400	5,280	6,180	7,130	21.1%
Workstations	2,734	3,540	4,400	5,280	6,180	7,130	21.1%
Host-Dependent							
Revenue	84	77	65	57	57	55	-8.0%
Systems	201	210	170	150	160	170	-3.3%
Workstations	421	320	280	230	210	170	-16.6%
Personal Computer							
Revenue	19	22	25	24	18	11	-11.0%
Systems	1,049	1,200	1,600	1,490	1,250	1,150	1.9%
Workstations	1,049	1,200	1,600	1,490	1,250	1,150	1.9%

Schematic Capture
All platforms x 15%

Source: Dataquest
July 1988

Table 3.4-5

**IC Layout Worldwide Forecast by Platform
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
Technical Workstation						
Revenue	68%	72%	76%	79%	82%	85%
Systems	69%	72%	71%	76%	81%	84%
Workstations	65%	70%	70%	75%	81%	84%
Host-Dependent						
Revenue	26%	22%	17%	14%	14%	13%
Systems	5%	4%	3%	2%	2%	2%
Workstations	10%	6%	4%	3%	3%	2%
Personal Computer						
Revenue	6%	6%	7%	6%	4%	2%
Systems	26%	24%	26%	22%	16%	14%
Workstations	25%	24%	25%	21%	16%	14%

Source: Dataquest
July 1988

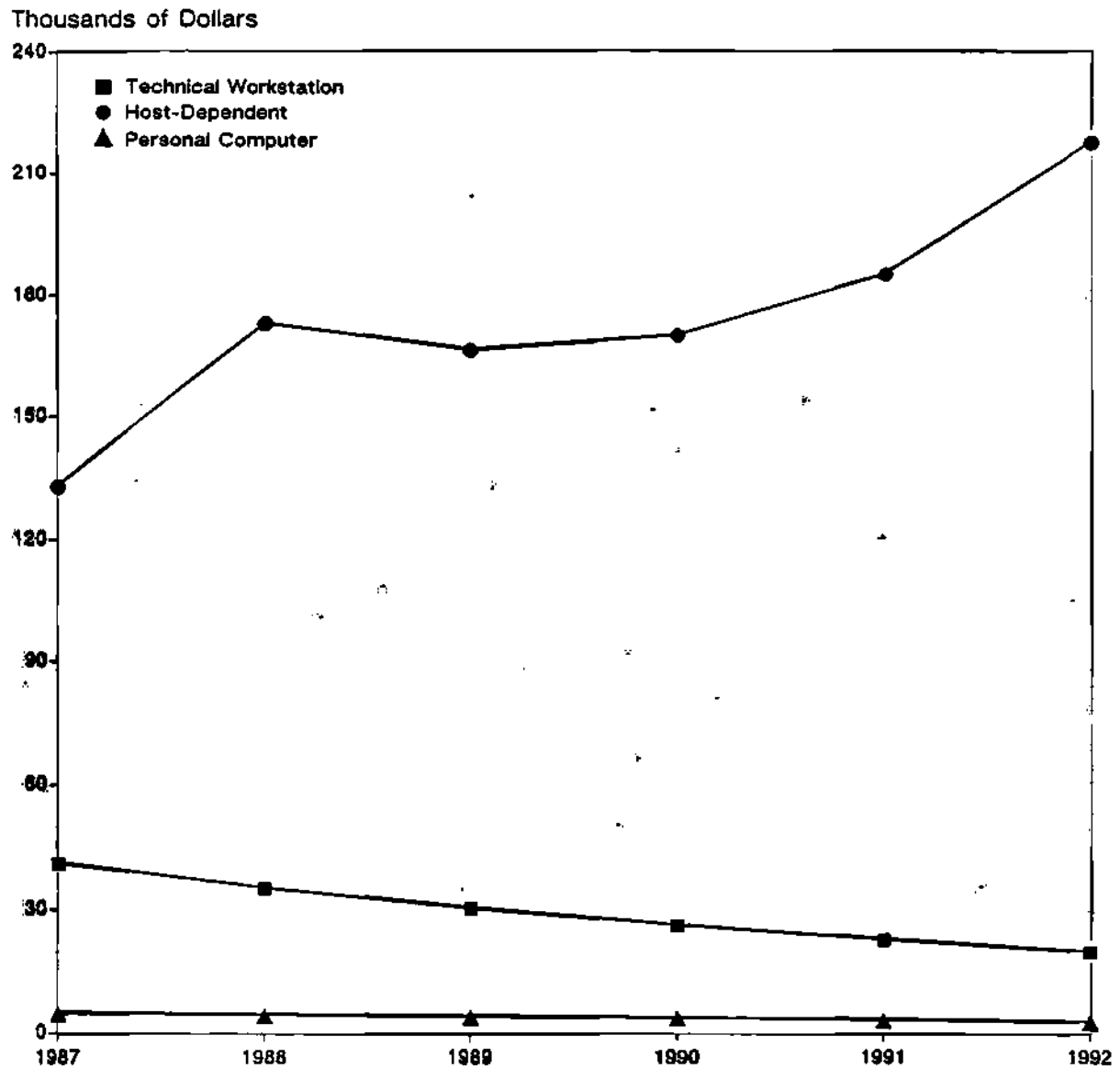
AVERAGE PRICE PER SEAT

This section presents Dataquest's forecast and analysis of the average price per seat by platform for the IC layout market, as illustrated in Figure 3.4-7 and Table 3.4-6. These data are summarized as follows:

- The average price per seat (APPS) for all IC layout platform types is expected to decline from \$41,500 to \$21,900 at a 12 percent CAGR between 1987 and 1992. This decline reflects, in part, the sophisticated and complex nature of IC design software and its high component cost balanced by the steep price erosion occurring in hardware.
- The 10.3 percent increase in APPS for host-dependent systems is actually largest in absolute dollars, from \$133,400 in 1987 to a predicted \$218,000 in 1992. This increase reflects the role of the host as a server and higher prices in the Japanese market.
- The decline in APPS is expected to be at a 13.4 percent CAGR for technical workstations, decreasing between 1987 and 1992 from an average of \$41,400 in 1987 to \$20,200 in 1992.
- The expected 9.8 percent decline in APPS for personal computer systems, from \$5,200 in 1987 to \$3,100 in 1992, reflects this platform's limited applicability in IC design.

Figure 3.4-7

IC Layout Worldwide Average Price per Seat by Platform



Source: Dataquest
July 1988

Table 3.4-6

**IC Layout Worldwide Average Price Per Seat by Platform
(Thousands of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
	***	***	***	***	***	***	***
Turnkey & Hardware-Only							
Technical Workstation	41.4	35.3	30.5	26.5	23.2	20.2	-13.4%
Host-Dependent	133.4	173.3	166.7	170.5	185.5	218.0	10.3%
Personal Computer	5.2	4.8	4.3	4.1	3.7	3.1	-9.8%
All Platforms	41.5	36.8	29.9	26.5	24.5	21.9	-12.0%
Turnkey							
Technical Workstation	72.4	69.2	65.4	61.7	57.9	53.9	-5.7%
Host-Dependent	112.9	157.9	161.9	174.2	204.2	271.3	19.2%
Personal Computer	5.6	5.5	5.1	5.7	11.9	.0	-100.0%
All Platforms	63.2	66.0	63.4	64.5	71.1	70.1	2.1%
Hardware-Only							
Technical Workstation	21.7	19.8	17.9	16.0	14.2	12.5	-10.4%
Host-Dependent	157.8	195.6	174.7	162.0	145.6	130.8	-3.7%
Personal Computer	5.0	4.6	4.1	3.8	3.4	3.1	-9.1%
All Platforms	27.4	22.7	17.6	15.1	13.5	12.0	-15.2%

Source: Dataquest
July 1988

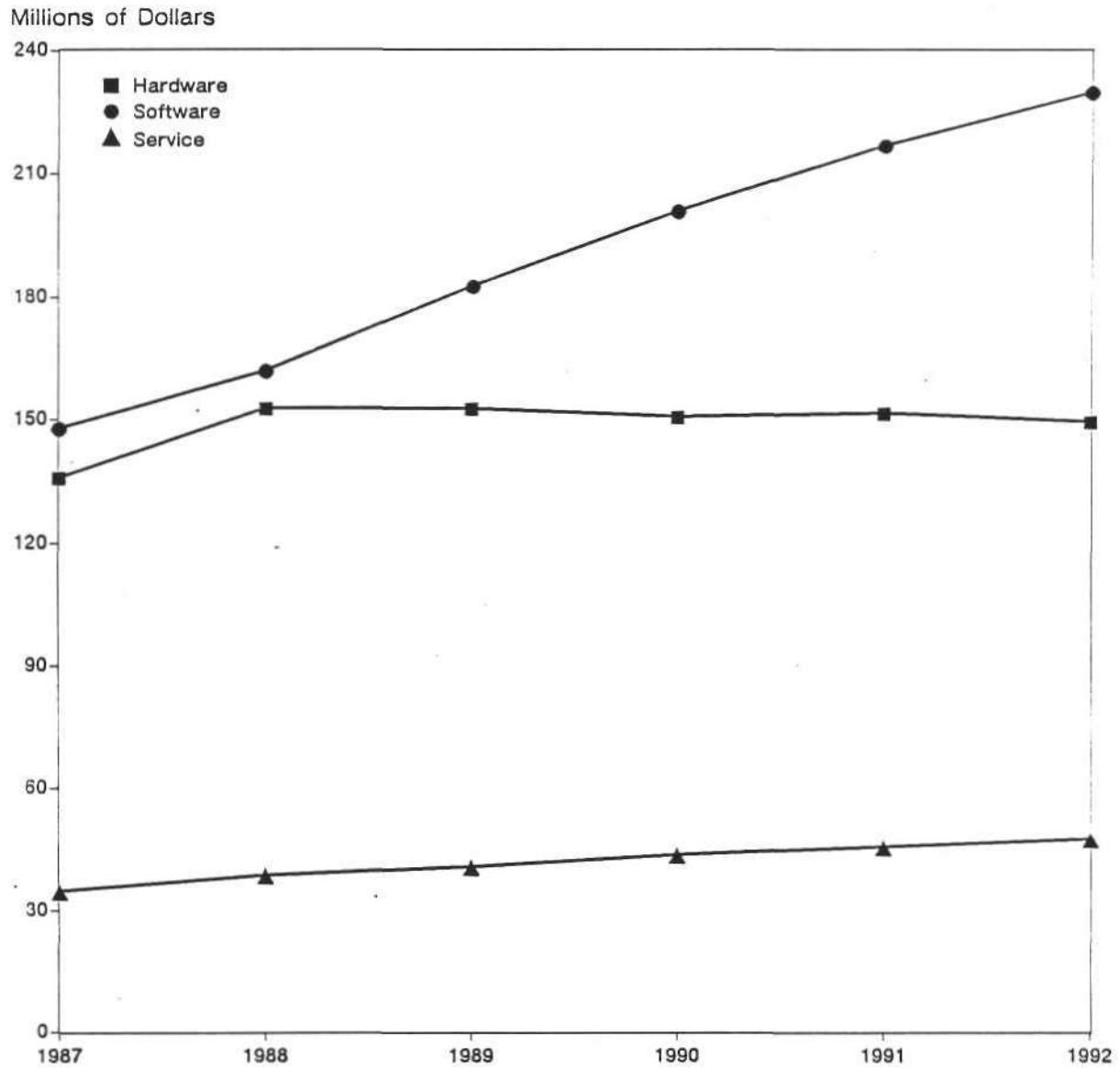
REVENUE SOURCES

This section presents Dataquest's forecast and analysis of the IC layout market segmented by revenue source for each platform, as illustrated in Figure 3.4-8 and Tables 3.4-7 and 3.4-8. These data are summarized as follows:

- Dataquest forecasts that hardware revenue, which accounted for \$136 million, or 43 percent of total revenue in 1987, will rise at a 2 percent CAGR to \$150 million, or 35 percent of total IC layout revenue in 1992.
- We expect software revenue, which was \$148 million, or 46 percent of total IC layout revenue, in 1987, to grow at a 9.3 percent CAGR to \$230 million, or 54 percent of 1992's total revenue. Dataquest believes that this shift reflects the need for additional applications and functionality continuing well beyond the saturation point in terms of IC layout seats.
- We believe that, growing at a 6.4 percent CAGR, IC layout service revenue will increase from \$35 million to \$48 million from 1987 to 1992.

Figure 3.4-8

IC Layout Worldwide Revenue Sources



Source: Dataquest
July 1988

Table 3.4-7

**IC Layout Worldwide Revenue Sources by Platform
(Millions of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
All Platforms							
Hardware	136	153	153	151	152	150	2.0%
Software	148	162	183	201	217	230	9.3%
Service	35	39	41	44	46	48	6.4%
Total	319	353	377	396	415	429	6.1%
Technical Workstation							
Hardware	80	101	110	116	120	121	8.5%
Software	111	124	144	162	182	201	12.5%
Service	25	29	33	36	39	42	10.8%
Total	216	255	287	315	341	363	10.9%
Host-Dependent							
Hardware	51	45	36	29	28	26	-12.9%
Software	23	23	22	22	23	23	.3%
Service	9	9	7	6	6	6	-8.8%
Total	84	77	65	57	57	55	-8.0%
Personal Computer							
Hardware	5	6	7	6	5	4	-4.5%
Software	13	15	17	17	12	7	-13.4%
Service	1	1	2	1	1	1	-13.4%
Total	19	22	25	24	18	11	-11.0%

Source: Dataquest
July 1988

Table 3.4-8

**IC Layout Worldwide Revenue Sources by Platform
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	****	****	****	****	****	****
All Platforms						
Hardware	43%	43%	41%	38%	37%	35%
Software	46%	46%	48%	51%	52%	54%
Service	11%	11%	11%	11%	11%	11%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	37%	40%	38%	37%	35%	33%
Software	51%	49%	50%	52%	53%	55%
Service	12%	11%	11%	11%	11%	12%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	61%	59%	55%	50%	49%	47%
Software	28%	30%	34%	39%	41%	43%
Service	11%	11%	11%	11%	11%	11%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	24%	26%	28%	25%	26%	34%
Software	70%	68%	66%	69%	68%	61%
Service	6%	6%	6%	6%	6%	5%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

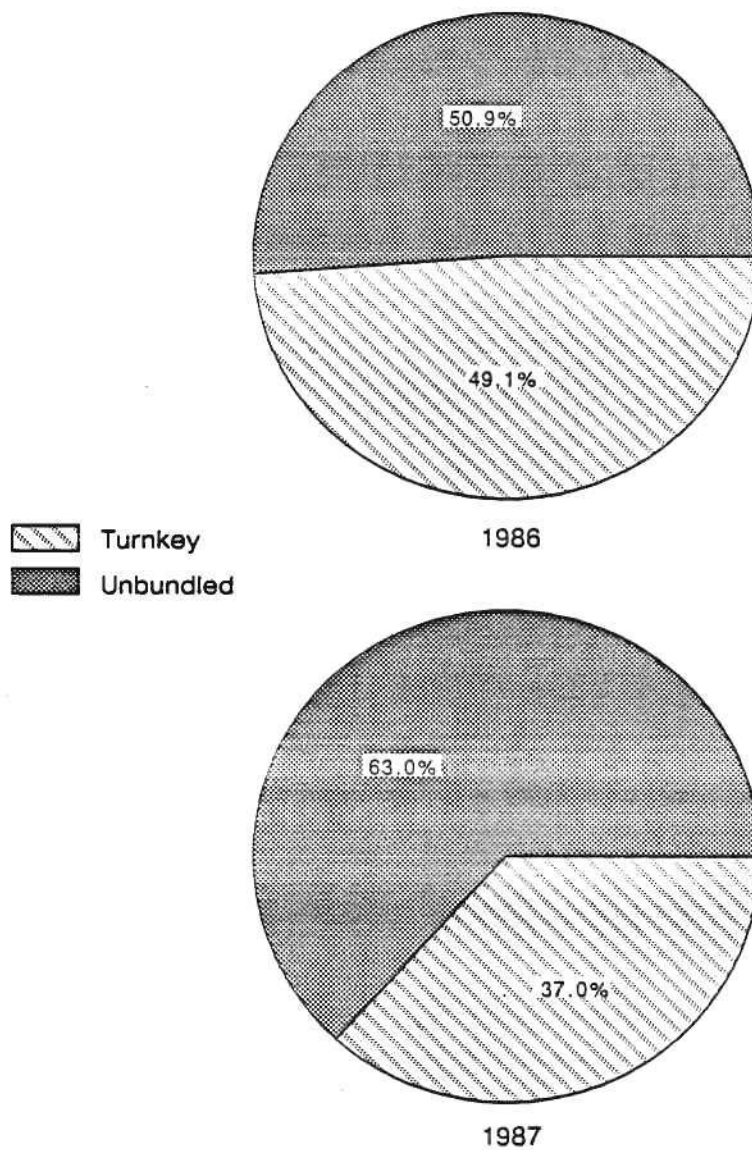
DISTRIBUTION CHANNELS

This section presents Dataquest's forecast and analysis for turnkey versus unbundled sales for the IC market, as illustrated in Figure 3.4-9 and Tables 3.4-9 and 3.4-10. These data are summarized as follows:

- Turnkey hardware and software revenue is forecast to stay flat, from \$105 million in 1987 to \$101 million in 1992, and is expected to drop from 37 percent of the total market to 27 percent of the market.
- Unbundled hardware and software revenue is forecast to grow at a 9.3 percent CAGR, from \$179 million in 1987 to \$279 million in 1992. It will grow from 63 percent of total revenue to 73 percent.
- Dataquest believes that this shift reflects a fundamental change in the buying practices of all customers, large and small. Hardware is increasingly purchased separately from software. For large corporations, this means purchasing workstations directly from the manufacturer and then assembling a software solution. For the small company, it means purchasing a personal computer and then buying software through a discount chain or mail order company.

Figure 3.4-9

IC Layout—Turnkey versus Unbundled
(Percentage of Revenue)



Source: Dataquest
July 1988

Table 3.4-9

IC Layout—Turnkey versus Unbundled
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Hardware and Software Revenue							
Turnkey	105	109	106	105	104	101	-1.7%
Unbundled	179	205	229	248	265	279	9.3%
Total	284	314	336	353	369	380	6.0%
Hardware Revenue							
Turnkey	66	75	72	70	68	66	-1.2%
Unbundled	70	78	81	81	84	84	3.9%
Total	136	153	153	151	152	150	2.0%
Software Revenue							
Turnkey	39	34	34	35	36	36	-1.6%
Unbundled	109	127	148	167	182	195	12.3%
Total	148	162	183	201	217	230	9.3%
Workstation Shipments							
Turnkey	1,657	1,650	1,680	1,620	1,460	1,440	-2.7%
Unbundled	2,548	3,420	4,600	5,390	6,180	7,020	22.5%
Total	4,204	5,070	6,280	7,010	7,650	8,460	15.0%

Source: Dataquest
July 1988

Table 3.4-10

IC Layout—Turnkey versus Unbundled
(Percentage of Total)

	1987	1988	1989	1990	1991	1992
Total Hardware and Software Revenue	***	***	***	***	***	***
Turnkey	37%	35%	32%	30%	28%	27%
Unbundled	63%	65%	68%	70%	72%	73%
Total	100%	100%	100%	100%	100%	100%
Hardware Revenue						
Turnkey	49%	49%	47%	46%	45%	44%
Unbundled	51%	51%	53%	54%	55%	56%
Total	100%	100%	100%	100%	100%	100%
Software Revenue						
Turnkey	26%	21%	19%	17%	16%	15%
Unbundled	74%	79%	81%	83%	84%	85%
Total	100%	100%	100%	100%	100%	100%
Workstation Shipments						
Turnkey	39%	33%	27%	23%	19%	17%
Unbundled	61%	67%	73%	77%	81%	83%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

3.5 IC Layout Market Shares

Figures 3.5-1 through 3.5-4 and Table 3.5-1 present Dataquest's analysis of the IC layout market share measure in total revenue, hardware and software revenue, and workstation shipments, as follows:

- The fundamental positioning of the companies described in these tables has changed as a result of recent mergers and acquisitions. Table 3.5-1 shows a market where the top eight vendors are tightly clustered with revenue ranging from \$30.7 million to \$16.5 million. However, as of this writing (July 1988), the market looks quite different.
- The leading vendor is now Cadence, created by the merger of ECAD and SDA.
 - Separately, these two vendors were the seventh and eighth largest vendors in the market; now their combined revenue is \$37.6 million, with overall market share of 11.8 percent.
 - Cadence is also by far the largest software supplier, with \$36.5 million in revenue and 24.7 percent market share.
- The second largest supplier is Valid/Calma, with \$34.8 million in total sales and 10.9 percent market share. It will be very interesting to observe how Calma IC, as a part of Valid, performs over the next year; and we look for a revival of this market leader.
- Seiko I&E, with its strength in the Japanese market, is the third largest vendor; Seiko continues to maintain its position in spite of strong competition from new challengers such as Cadence.
- Mentor Graphics was fourth in the market in total revenue for 1987, with \$27.8 million and 8.7 percent market share. Mentor remains committed to this market, but the company does not dominate the market the way it does ECAE.
- Sun Microsystems is a surprising fifth in the market this year, with \$27.1 million in sales.
 - Sun is now the largest supplier of hardware to the market, with 17.6 percent market share.
 - Sun's strength in hardware is partly due to its relationships with software leaders Cadence and SCS and partly due to its success in several key accounts.

- Silicon Compiler Systems is the second largest software supplier in the market, with \$27.0 million in total sales.
 - The Silicon Compiler merger with SDL appears to have gone quite well, and this company dominates the compilation segment.
 - It is starting to make a very strong showing in full-custom design also.
- Digital Equipment Corporation is the second largest hardware supplier in the market, with \$22 million in sales and 6.9 percent market share; its strength is still at the mainframe and host level, however.

Figure 3.5-1

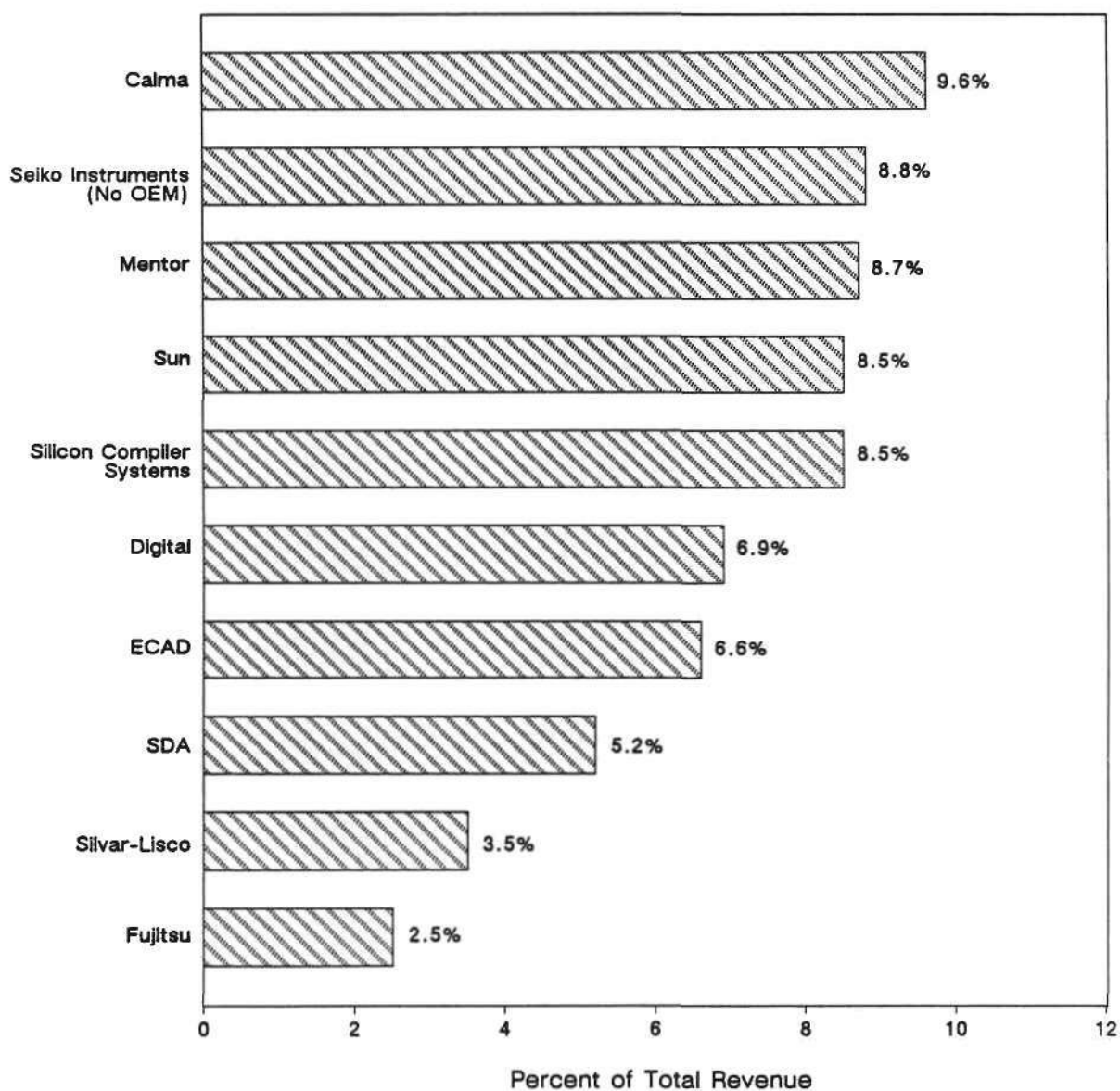
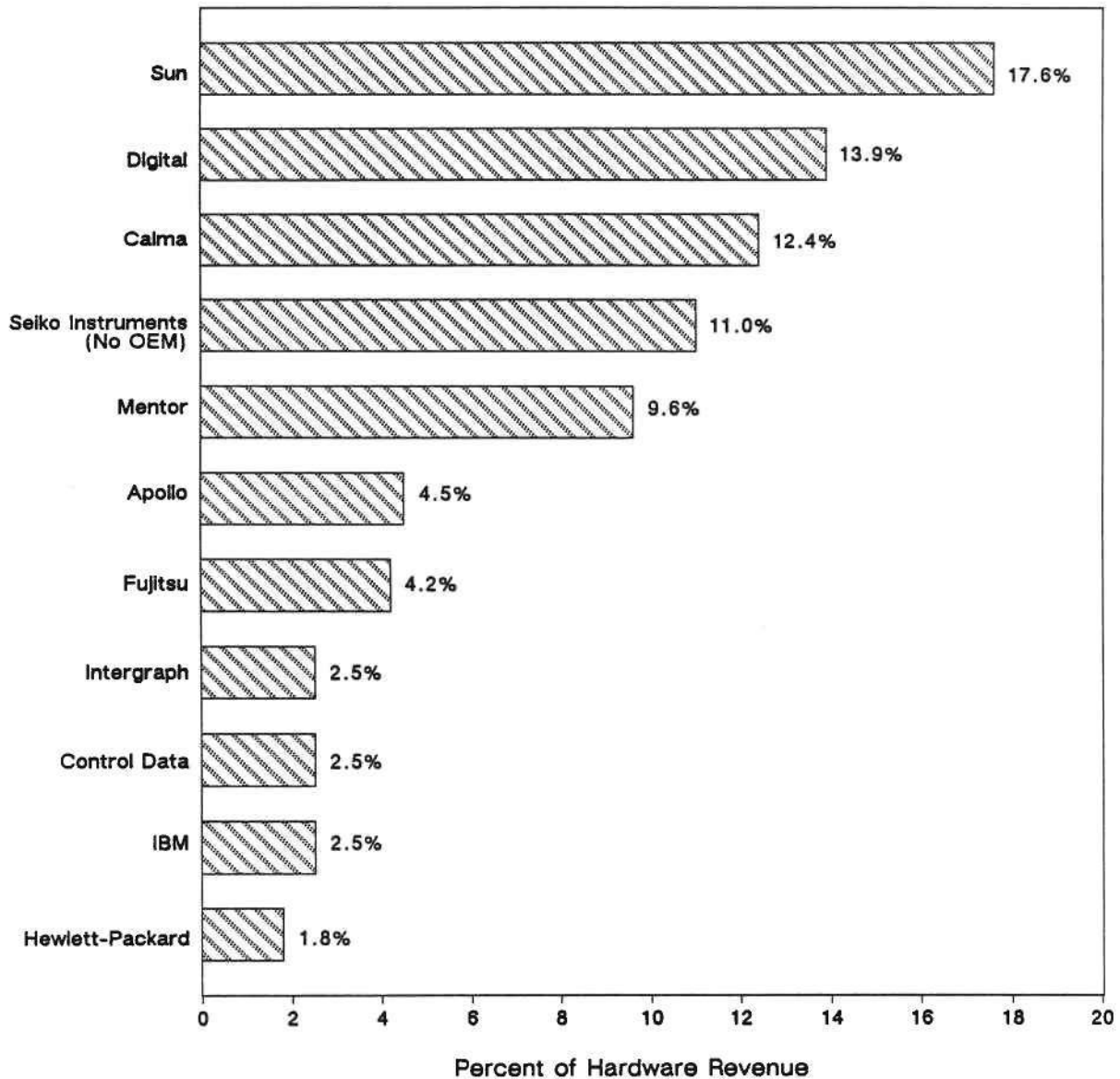
**IC Layout 1987 Worldwide Market Share
Total Revenue**Source: Dataquest
July 1988

Figure 3.5-2

IC Layout 1987 Worldwide Market Share
Hardware Revenue



Source: Dataquest
July 1988

Figure 3.5-3

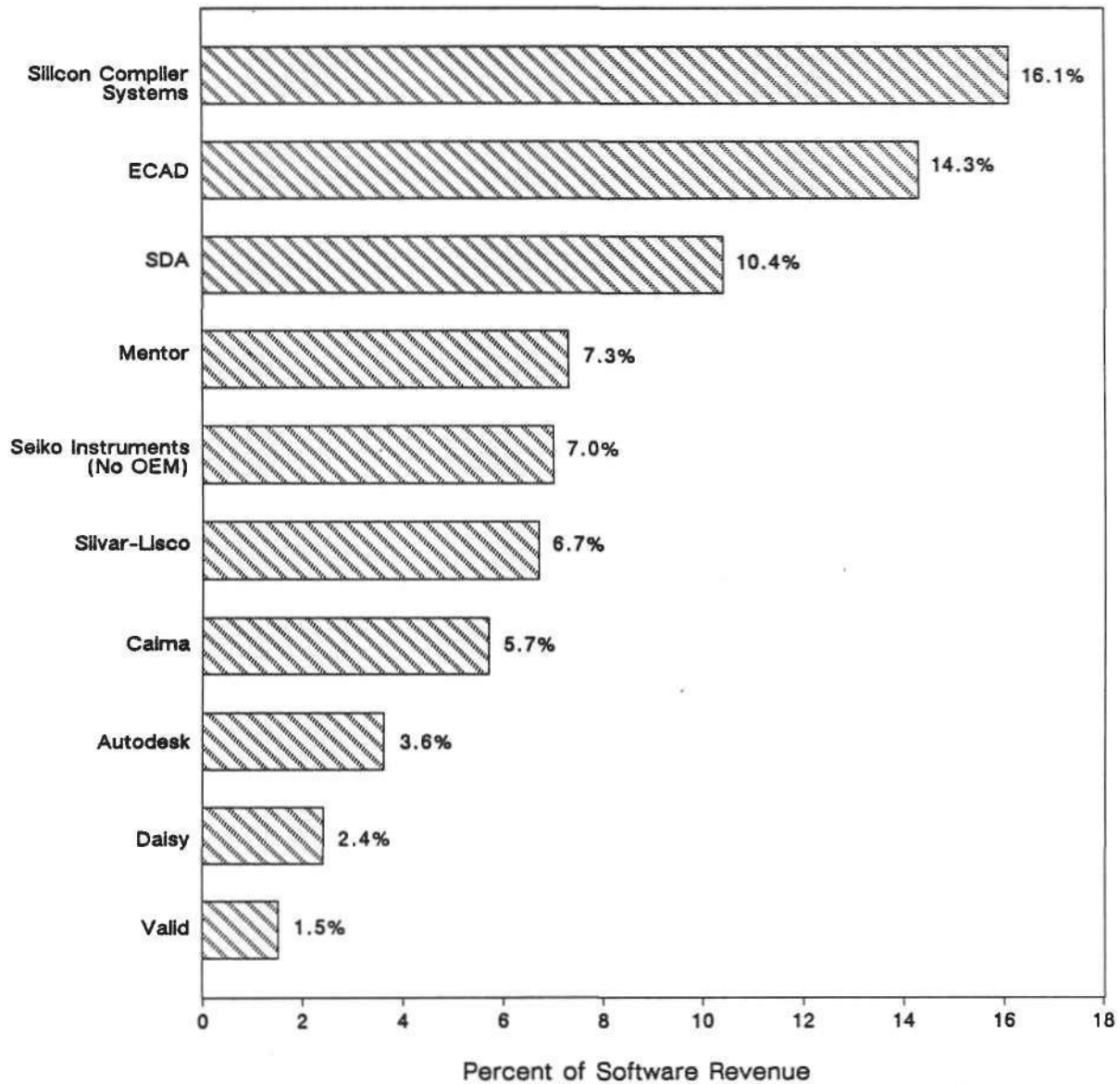
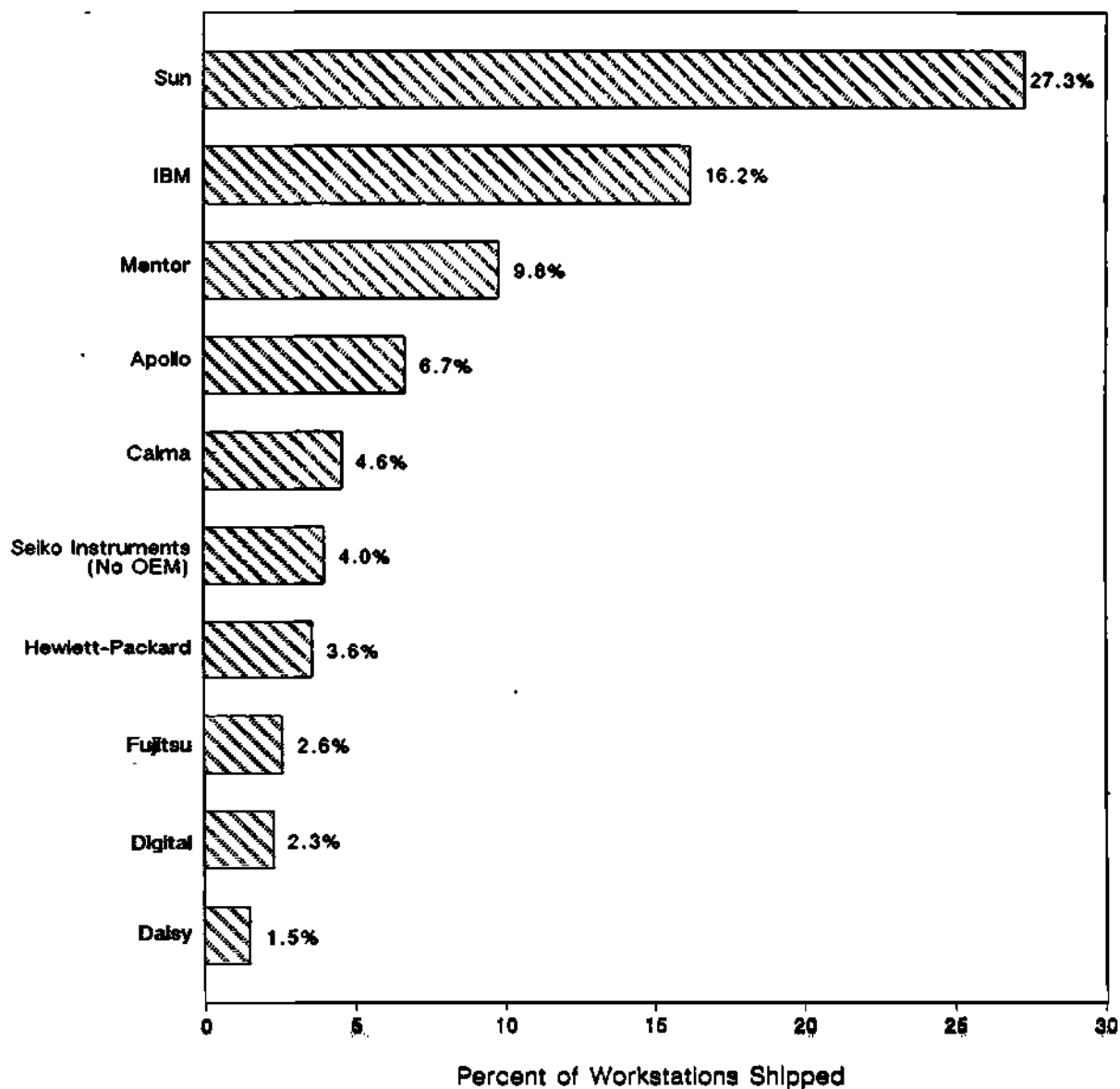
IC Layout 1987 Worldwide Market Share
Software RevenueSource: Dataquest
July 1988

Figure 3.5-4

IC Layout 1987 Worldwide Market Share
Workstation Shipments



Source: Dataquest
July 1988

Table 3.5-1

IC Layout 1987 Worldwide Market Share
(Millions of Dollars, Actual Units)

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Calma	30.7	16.8	8.5	194	9.6%	12.4%	5.7%	4.6%
Seiko Instruments (No OEM)	28.0	14.9	10.3	170	8.8%	11.0%	7.0%	4.0%
Mentor	27.8	13.1	10.8	412	8.7%	9.6%	7.3%	9.8%
Sun	27.1	23.9	.0	1,148	8.5%	17.6%	.0%	27.3%
Silicon Compiler Systems	27.0	.0	23.8	0	8.5%	.0%	16.1%	.0%
Digital	22.0	18.9	.0	98	6.9%	13.9%	.0%	2.3%
ECAD	21.1	.0	21.1	0	6.6%	.0%	14.3%	.0%
SDA	16.5	.4	15.4	10	5.2%	.3%	10.4%	.2%
Silvar-Lisco	11.1	.0	9.9	0	3.5%	.0%	6.7%	.0%
Fujitsu	7.9	5.7	1.4	111	2.5%	4.2%	1.0%	2.6%
Daisy	6.9	2.2	3.5	61	2.2%	1.6%	2.4%	1.5%
Intergraph	6.4	3.4	1.9	44	2.0%	2.5%	1.3%	1.0%
Apollo	6.4	6.1	.0	281	2.0%	4.5%	.0%	6.7%
Autodesk	5.4	.0	5.4	0	1.7%	.0%	3.6%	.0%
Control Data	4.5	3.5	.0	0	1.4%	2.5%	.0%	.0%
Tektronix	4.5	2.1	1.9	47	1.4%	1.5%	1.3%	1.1%
Hewlett-Packard	4.1	2.4	1.3	153	1.3%	1.8%	.9%	3.6%
Valid	4.1	1.1	2.2	23	1.3%	.8%	1.5%	.5%
IBM	3.4	3.4	.0	682	1.1%	2.5%	.0%	16.2%
Racal-Redac	1.8	.2	1.3	2	.6%	.1%	.9%	.0%
NEC	.8	.7	.0	30	.3%	.5%	.0%	.7%
Hitachi	.6	.6	.0	11	.2%	.4%	.0%	.3%
Other Companies	51.0	16.6	29.1	727	16.0%	12.2%	19.7%	17.3%
All Companies	319.1	135.9	147.7	4,204	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	260.8	109.6	121.3	3,424	81.7%	80.6%	82.1%	81.4%
All Asian-Based Companies	44.8	24.5	16.1	484	14.0%	18.0%	10.9%	11.5%
All European-Based Companies	13.4	1.9	10.3	296	4.2%	1.4%	7.0%	7.0%
All Hardware Companies	78.2	69.8	.2	2,548	24.5%	51.3%	.2%	60.6%
All Turnkey & SW Companies	240.9	66.2	147.5	1,657	75.5%	48.7%	99.8%	39.4%

Source: Dataquest
July 1988

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Figure 3.5-1

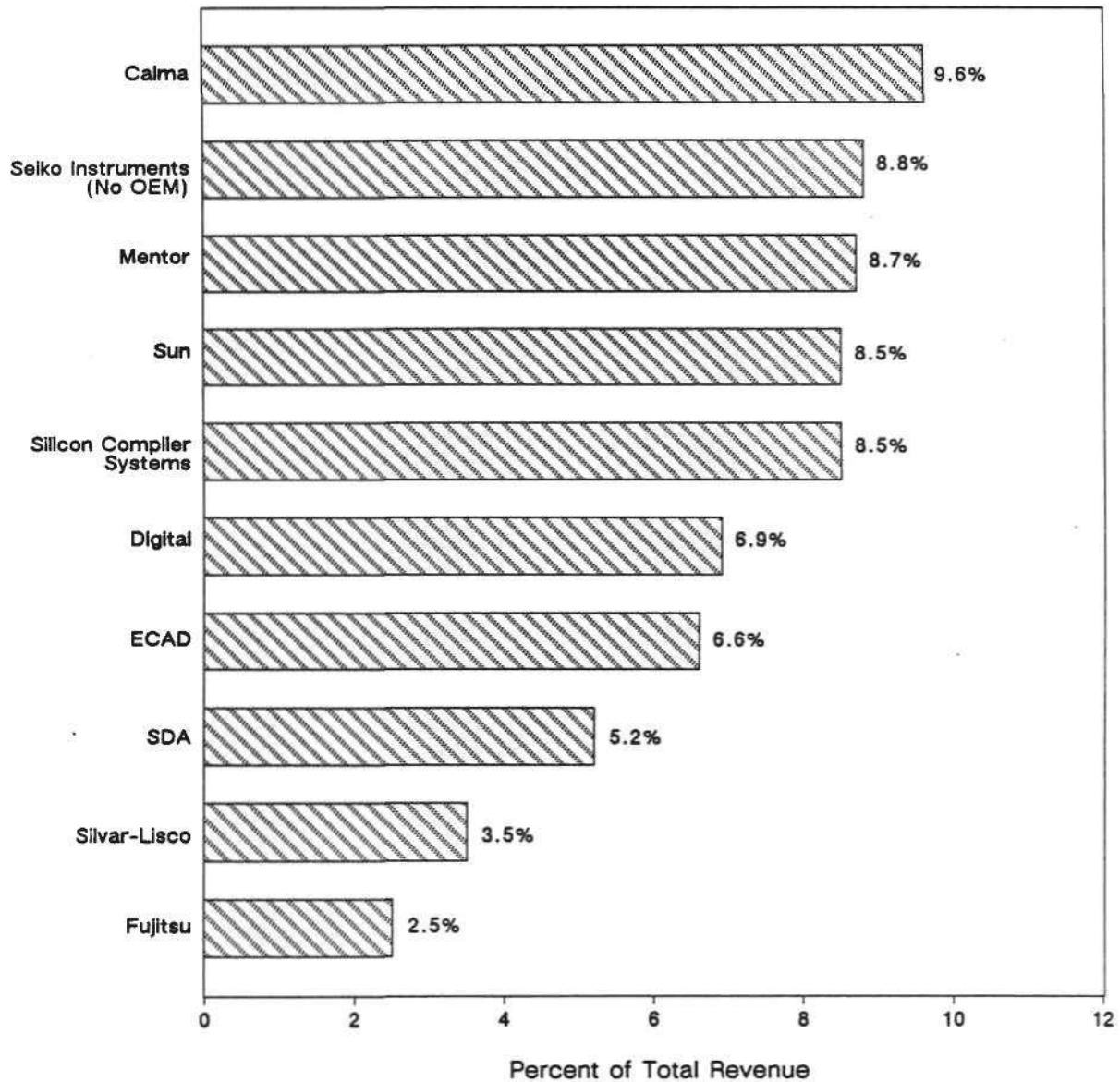
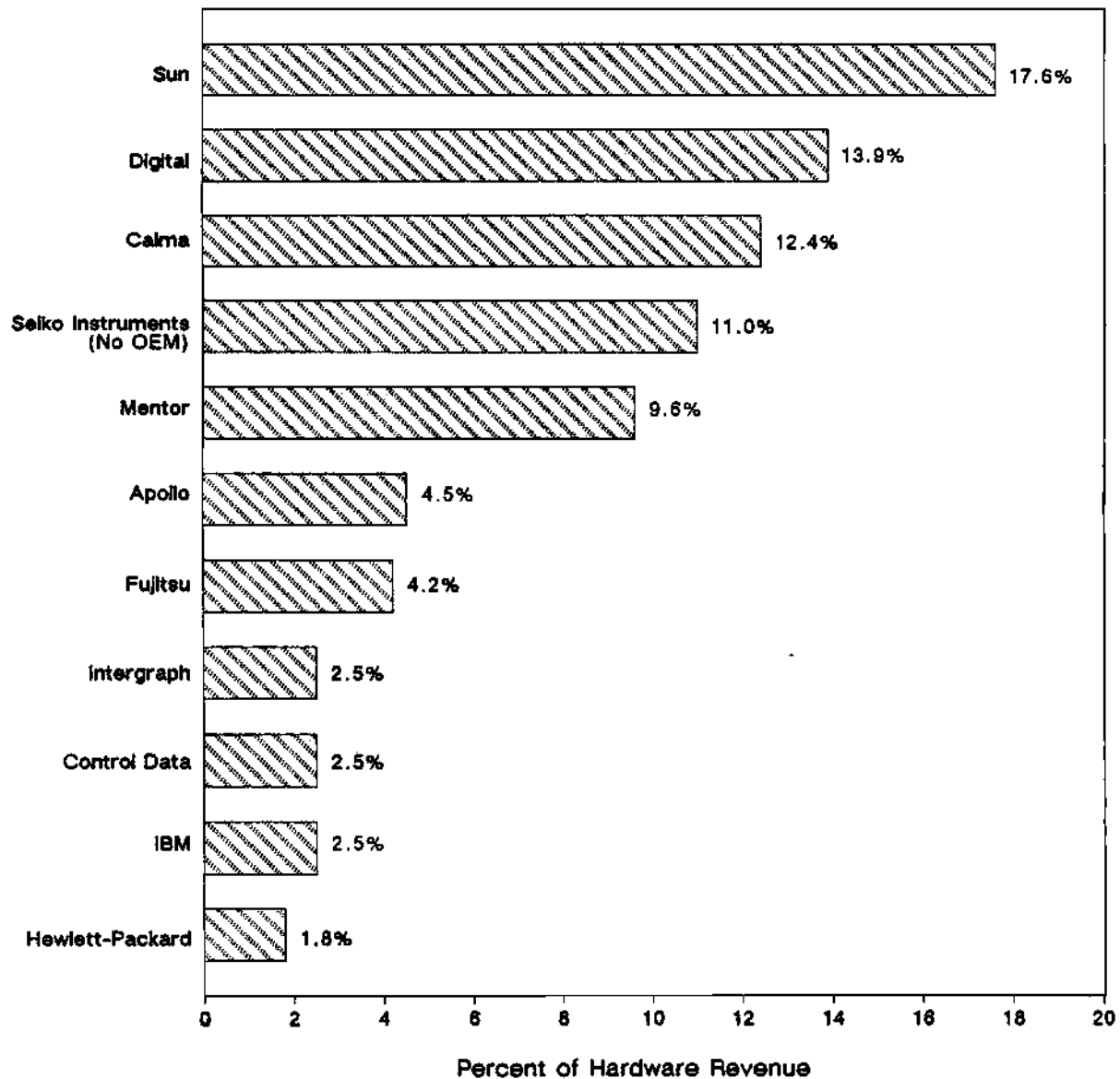
**IC Layout 1987 Worldwide Market Share
Total Revenue**Source: Dataquest
July 1988

Figure 3.5-2

IC Layout 1987 Worldwide Market Share
Hardware Revenue



Source: Dataquest
July 1988

Figure 3.5-3

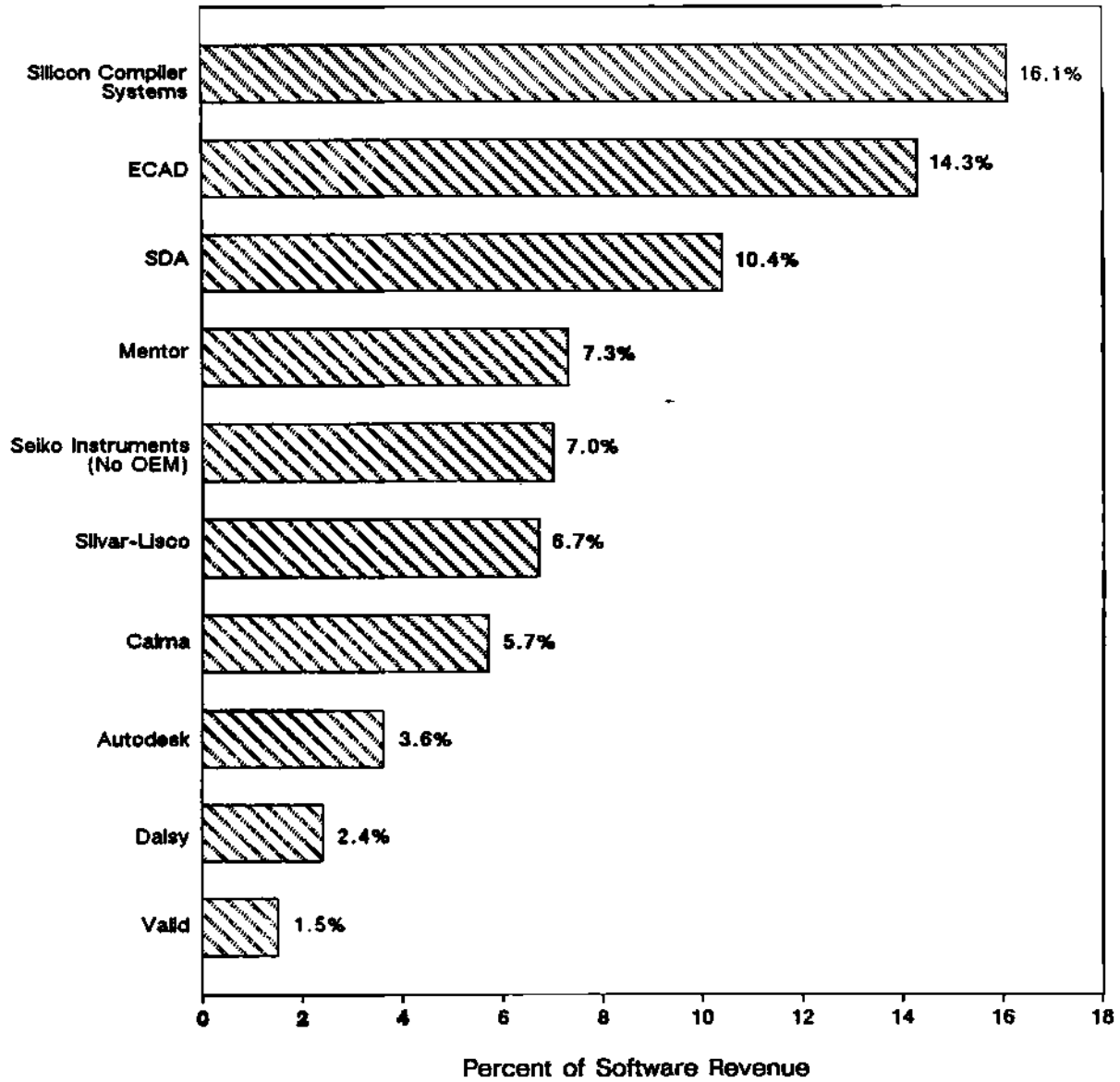
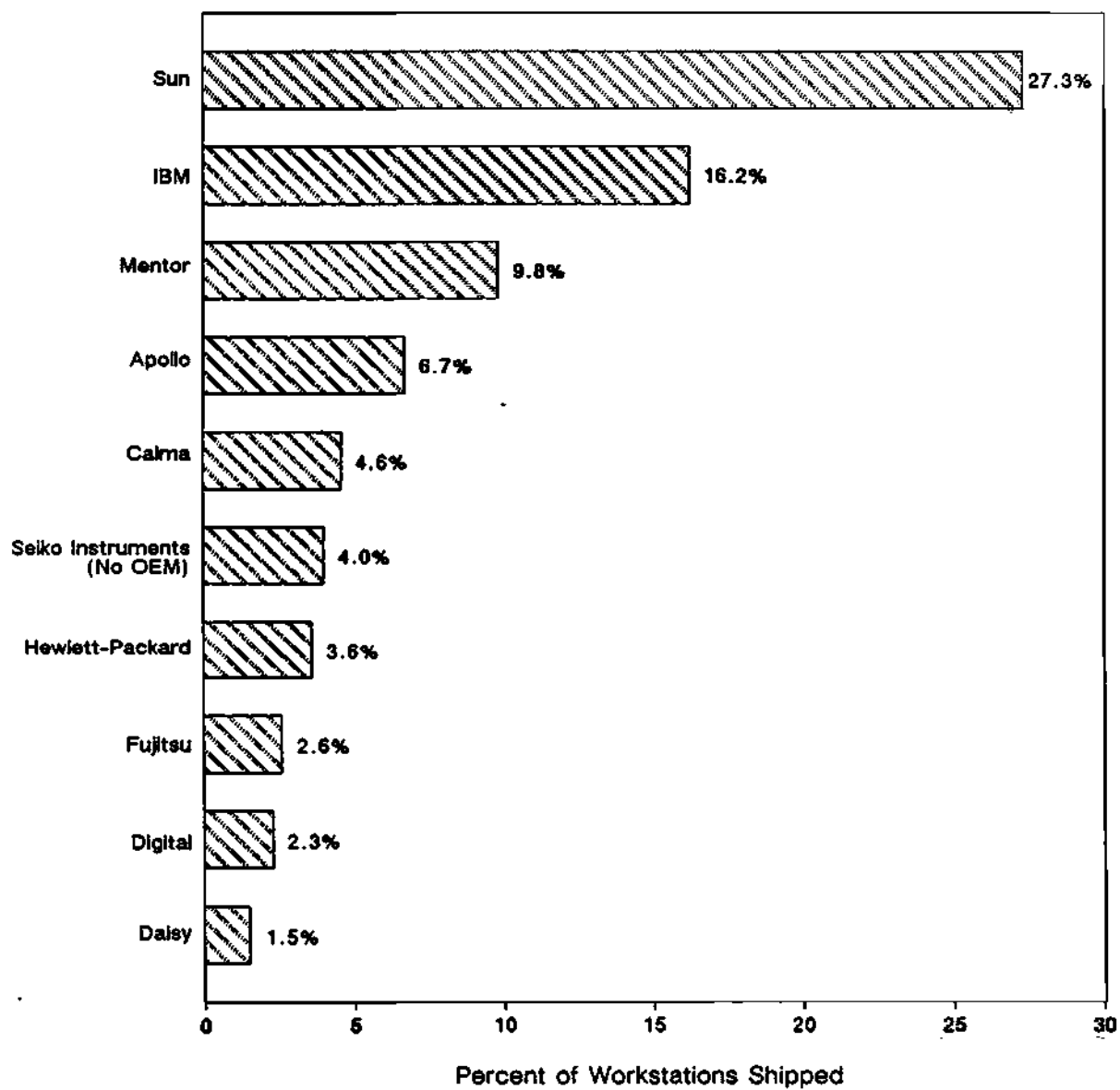
**IC Layout 1987 Worldwide Market Share
Software Revenue**Source: Dataquest
July 1988

Figure 3.5-4

IC Layout 1987 Worldwide Market Share
Workstation Shipments



Source: Dataquest
July 1988

Table 3.5-1

IC Layout 1987 Worldwide Market Share
(Millions of Dollars, Actual Units)

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Mentor	27.8	13.1	10.8	412	8.7%	9.6%	7.3%	9.8%
Sun	27.1	23.9	.0	1,148	8.5%	17.6%	.0%	27.3%
Silicon Compiler Systems	27.0	.0	23.8	0	8.5%	.0%	16.1%	.0%
Digital	22.0	18.9	.0	98	6.9%	13.9%	.0%	2.3%
ECAD	21.1	.0	21.1	0	6.6%	.0%	14.3%	.0%
SDA	16.5	.4	15.4	10	5.2%	.3%	10.4%	.2%
Silvar-Lisco	11.1	.0	9.9	0	3.5%	.0%	6.7%	.0%
Fujitsu	7.9	5.7	1.4	111	2.5%	4.2%	1.0%	2.6%
Daisy	6.9	2.2	3.5	61	2.2%	1.6%	2.4%	1.5%
Intergraph	6.4	3.4	1.9	44	2.0%	2.5%	1.3%	1.0%
Apollo	6.4	6.1	.0	281	2.0%	4.5%	.0%	6.7%
Autodesk	5.4	.0	5.4	0	1.7%	.0%	3.6%	.0%
Control Data	4.5	3.5	.0	0	1.4%	2.5%	.0%	.0%
Tektronix	4.5	2.1	1.9	47	1.4%	1.5%	1.3%	1.1%
Hewlett-Packard	4.1	2.4	1.3	153	1.3%	1.8%	.9%	3.6%
Valid	4.1	1.1	2.2	23	1.3%	.8%	1.5%	.5%
IBM	3.4	3.4	.0	682	1.1%	2.5%	.0%	16.2%
Racal-Redec	1.8	.2	1.3	2	.6%	.1%	.9%	.0%
NEC	.8	.7	.0	30	.3%	.5%	.0%	.7%
Hitachi	.6	.6	.0	11	.2%	.4%	.0%	.3%
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All U.S.-Based Companies	260.8	109.6	121.3	3,424	81.7%	80.6%	82.1%	81.4%
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All Hardware Companies	78.2	69.8	.2	2,548	24.5%	51.3%	.2%	60.6%
All Turnkey & SW Companies	240.9	66.2	147.5	1,657	75.5%	48.7%	99.8%	39.4%

Source: Dataquest
July 1988



4.1 PCB Layout Definitions

The printed circuit board (PCB) layout market encompasses tools that are used during the physical design phase to create and validate the data that will be used to manufacture the printed circuit board. PCB layout systems are primarily used by drafts-persons or engineers. By definition, the primary output of a PCB layout system is CAM data, such as photoplotter tapes, numeric control tapes, or solder mask information.

However, many board layout systems are now bundled within electronic CAE (ECAE) applications used in the engineering process. These applications include schematic capture, simulation, and fault grading. For forecasting purposes, PCB layout revenue includes any dollars associated with ECAE applications that are sold as part of a bundled PCB layout and design station.

PCB layout applications that are tracked include the following:

- *Manual layout and editing*—This includes tools that are used for drafting and editing tasks, such as drawing the board outline, placement of components and routing of nets by hand, and creation of component libraries.
- *Automatic routers*—These are tools that interconnect the nets on a board without human intervention. Specialized routers, such as emitter-coupled logic (ECL) or microwave routers, are included in this category.
- *Design rule checking (DRC)*—DRC packages are used to postprocess the final layout of a board to make sure that it conforms to known manufacturing tolerances, such as trace-to-trace spacing.
- *Automatic placement*—These tools position components on the board by optimizing them according to specific predefined objectives. Such objectives can include minimization of routing interconnection, routability, or critical paths.
- *Routing accelerators*—These are special-purpose types of hardware that are used to speed up the routing process.
- *Analysis packages*—These include software applications used to analyze board layouts for specific characteristics, such as electromagnetic properties (cross talk, noise, or ringing), thermal patterns, or reliability.
- *CAM interfaces*—These are tools used to transfer data from the layout system to manufacturing systems (numeric control output and Gerber and photoplotter tapes).
- *Surface-mount technology and devices (SMT and SMD)*—This is a board-manufacturing and IC-packaging methodology where the pins of the package are connected to the surface of the board, as opposed to through-hole methodologies where the component's pins are inserted into holes that have been drilled into the board.

4.2 PCB Layout Executive Summary

This executive summary highlights the key points discussed throughout this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the PCB layout applications segment. Highlights include the following:

- The PCB layout market was \$722 million in 1987, up 11 percent over 1986, and is forecast to grow to \$930 million in 1992, representing a compound annual growth rate (CAGR) of 5.2 percent.
- The PCB layout market is expected to grow to \$795 million in 1988, representing a 10 percent increase. This figure reflects a slowing growth rate, considering the 25 percent growth experienced in 1986 and 35 percent growth in 1985.
- Dataquest expects PCB design workstation unit shipments to continue to be relatively strong.
 - Between 1987 and 1992, we expect workstation shipments to grow at an 11 percent CAGR, from 16,315 in 1987 to 27,790 in 1992.
 - Shipments are expected to rise 21 percent in 1988, to 19,700.
- However, Dataquest believes that strong PCB workstation shipments will be offset by the declining average price per seat, which was \$29,400 in 1987 and is forecast to decline at a negative CAGR of 8.6 percent to \$18,700 in 1992.
- Regionally, the Far East and Europe will remain the strongest areas for PCB design systems, with a combined 64 percent market share of 1987 revenue.
 - The North American PCB market, while accounting for 35 percent revenue share in 1987, is growing at a slower rate than either Europe or Japan.
 - Europe will surpass North America in revenue in 1988.
- In our opinion, the decline in revenue growth rates indicates that the PCB layout market is mature and that 1987 was a key transitional year. We believe that the following events and trends point toward the maturation of the market:
 - Penetration at existing user sites is very high.
 - The opportunities for major technological innovations are small.
 - The opportunities for new entrants are very limited.
- These three factors, along with steady price erosion, point toward a mature, replacement market rather than a growth, expansion market.

4.3 PCB Layout Market Overview

1987—A YEAR OF CONSOLIDATION AND POSITIONING

The PCB layout market continued along much the same path in 1987 as in 1986. Steady 11 percent growth resulted in \$722 million at the revenue level, and workstation shipments grew to 16,315. Despite the fact that PCB layout is one of the oldest EDA markets, it continues to show surprising vigor.

As the oldest and most mature of the EDA markets, it is not surprising that PCB layout felt the impact of consolidation and positioning as well. It is also not surprising, however, that the fundamental structure of the market remains more or less intact. Market participants have far less room to maneuver in a well-established market.

Dataquest believes that the maturity of the PCB layout market can be characterized by four major factors:

- Positioning and consolidation by existing vendors
- Very clearly defined technology trends
- Declining prices combined with slow revenue growth
- Limited opportunities for new entrants

When taken together, these four factors define a mature market that is expanding very slowly, primarily among existing users. It is most decidedly not an expanding, growth opportunity. In such a market, competition between suppliers is likely to be extremely intense as they fight for the available market shares.

Positioning and Consolidation

Positioning, more so than consolidation, has been the first major contributor to the maturing of the PCB layout market in 1987. Vendors focused on establishing clear and defensible positions in the market. Not that there were not some mergers (such as Valid/Telesis) and some exits (such as Tektronix and Calma), but positioning was the essential ingredient for long-term survival in the market.

For example, in the technical workstation market, Racal-Redac, Cadnetix, and Mentor Graphics led the race for the high-end PCB layout customer. These vendors fought for leadership in the sales of premium tools that offered state-of-the-art place-and-route, ease-of-use, and next-generation analysis packages. Key elements in this battle were the following:

- Benchmarking
- Hardware platform

- Software/hardware unbundling
- Integration with other applications

First, every vendor strove to achieve parity, if not superiority, in benchmarking capability, in terms of both layout functionality and ease of use. Without this, vendors simply were not able to compete.

Second, standard hardware became an absolute necessity in 1987. Cadnetix and Calay made the shift to Sun Microsystems, as did Racal-Redac; Daisy had a major porting effort under way. Vendors that were still mainframe oriented at the beginning of the year, such as Scientific Calculations, were workstation driven by the end.

Third, vendors began to move away from being exclusively turnkey suppliers. In an effort to gain an edge in the market, some vendors, notably Valid and Racal-Redac, sold their software on an unbundled basis. This enabled them to reduce prices, protect margins, and win at large accounts that were purchasing hardware separately from software.

Fourth, suppliers tried to leverage their ability to link with other key applications—the full-line approach. Tight coupling with ECAE and mechanical packaging started to emerge as competitive points. Mentor Graphics actually entered the electromechanical market in order to capitalize on this opportunity. Other vendors have begun to seek partners.

Similar jockeying for position occurred in the personal computer-based market. PCAD, for example, has successfully gained a very strong position as the leading supplier of high-performance, PC-based tools through dealer representative channels. Nonetheless, PCAD faces competition from low-end suppliers such as OrCAD and Ovation, which have used direct mail and other low-cost channels to reach a similar customer base.

In other words, vendors are focused on achieving sustainable differentiation and profitability through products, customers, and channels of distribution. In a market where the total size is essentially fixed, the percentage that each vendor controls will determine its revenue and success.

Technology Trends

The technology trends for PCB layout are well known. They point toward integration, enhancements, and revisions of current products rather than major innovation. Successful products may not necessarily be the most advanced, but rather the most robust and stable.

Dataquest has identified the following three major technology trends driving PCB layout systems:

- Surface-mount design
- ASIC
- Design automation and manufacturing systems

PCB layout systems must have functionality across the entire system to handle these technologies. In other words, manual editing, libraries, routers, and CAM interfaces must all be capable of handling a given technology (e.g., SMT).

Surface Mount

Surface-mount design is the most significant trend in PCB layout systems today. An increasing number of users are doing multilayer, surface-mount design. As Table 4.3-1 shows, according to Dataquest 1986 and 1987 user surveys, surface-mount technology (SMT) use continues to increase.

Table 4.3-1

Percentage of Boards with SMT

	Percentage SMT	
	1986	1987
Aerospace	31%	39%
Automotive	26%	98%
Communications	26%	33%
Computer	33%	35%
Semiconductor	15%	49%
Service Centers	15%	25%

Source: Dataquest
July 1988

Surface-mount technology and associated fine-line etching techniques impose a range of requirements on a PCB layout system. The manual editing system must easily support component placement on both sides of the board, blind and buried vias, swapping between pin and SMT versions of a component, and insertion/editing of test points. Routers must be able to space traces on a much tighter grid or be gridless. Specialized CAM interfaces may be required, particularly in the case of proprietary SMT processes. Last but not least, the physical data base must be able to support SMT design without exceeding the memory capacity of the hardware.

ASIC Components

The next major shift in technology that will have an impact on PCB layout is ASIC (application-specific integrated circuit) components. Dataquest believes that designers will use ASICs to reduce the total component and board count of a system, rather than that of a given board. However, the number of large pin-count packages on a board, such as microprocessors or ASICs, will increase. In other words, the old view of a board, with rows of 64K DRAMs, TTL components, and an occasional microprocessor, is rapidly vanishing. Instead, the typical board of the future will have a few rows of 4MB DRAMs, several off-the-shelf VLSI components, and a few ASICs.

This change in the profile of the typical board will have several effects. First, it will require enhancements to placement-and-routing tools to account efficiently for the increase in large pin-count packages on a board. In principle, this should be similar to the block placement-and-routing tools now found in IC layout systems. Second, mechanisms should be in place to make it simple and efficient for users to create special libraries for their ASIC components. For example, while the package may be the same as for other VLSI, the pin and component names vary from design to design and must be assigned according to the semicustom vendor's bonding and naming conventions.

Design and Manufacturing Automation

The final major technology that must be factored into PCB layout system design is the automation of the electronic engineering process and manufacturing. Not only must PCB layout systems be closely integrated with other automation systems (e.g., shared logic and layout data bases), but the actual board layout tools must produce designs that fit the other systems' capabilities (e.g., board placements that are easily handled by pick-and-place robots).

At the integration level, the increasing use of automation in all aspects of electronics product design and manufacture necessitates close links between PCB layout and the other tools and systems employed. On the front end, a growing percentage of board designers uses some form of ECAE, such as schematic capture and simulation. Linkages between ECAE and PCB layout that are now required include netlist in, back-annotation to schematics and simulation, and engineering change capabilities (incremental netlist). On the back end, reliable and open CAM interfaces to a range of potential systems, including Gerber, photoplot, and numeric control, are an absolute requirement.

At the layout level, the increasing sophistication and complexity of the manufacturing process demands PCB layouts that are "manufacturable." It is no longer sufficient just to meet known design rules. The final layout should anticipate and accommodate problems such as optimal solder shapes, pick-and-place tools, SMD test, or preferred methods for etching traces. This implies that vendors should supply tools that analyze boards for manufacturability and enforce manufacturing rules during placement-and-routing, along with special editors to improve a board's layout prior to manufacture.

Declining Prices and Slow Revenue Growth

The third major factor contributing to the maturity of the PCB layout market is the steady decline of prices and revenue growth. With the advent of technical workstation-based systems and the proliferation of low-cost but usable personal computer-based systems, the average price per seat has dropped significantly. This in turn has slowed the rate of revenue growth.

Figures 4.3-1 and 4.3-2 show the average price per seat and total PCB layout revenue, respectively. As Figure 4.3-1 shows, the average price per seat has dropped by more than 60 percent from 1983 to 1987. Revenue, on the other hand, enjoyed a minor growth spurt in 1984-1985, principally due to the personal computer and technical workstation, but it has since slowed down considerably.

Dataquest forecasts that this trend of slowing revenue growth and declining prices will continue into the future. From 1987 to 1992, Dataquest is forecasting only a 5.2 percent CAGR from the current revenue base of \$722 million. In sum, the PCB layout market is not growing dynamically in terms of total revenue.

Figure 4.3-1

PCB Layout Average Price per Turnkey Seat

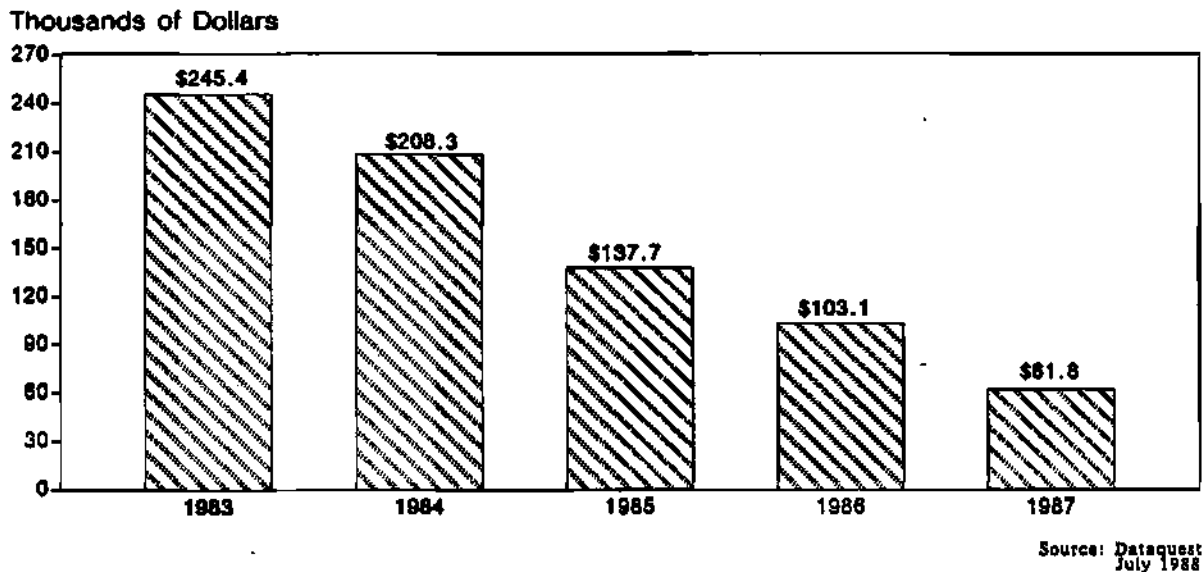
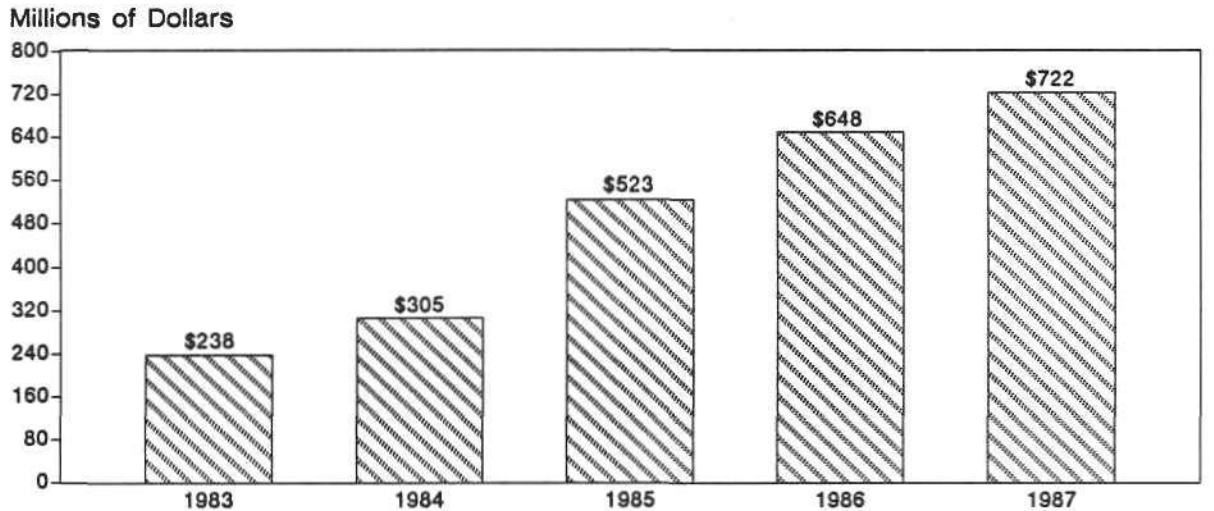


Figure 4.3-2

Physical Layout Revenue



Source: Dataquest
July 1988

Limited Opportunities for New Entrants

As of this writing, there are more than 75 suppliers of PCB layout systems, according to Dataquest's estimates. Of these companies, only 10 actually make more than \$20 million directly from this segment. Finally, as was noted in the previous discussion, penetration of the total potential market is very high, the total market's size is not growing rapidly, and the demand for major technological innovations is not great.

Under these conditions, Dataquest believes that it would be very difficult for a new entrant to establish itself and gain market share. Even the vendors that came into the market three years ago, such as Daisy and Mentor, have found it to be fairly slow going, as their products have had to mature enough to be competitive.

The more likely scenario is that already-established suppliers will dominate the market in its maturing years. Younger entrants (such as Cadnetix, Daisy, and Mentor) will compete with older organizations (such as Computervision, Racal-Redac, and Scientific Calculations) for market share. On the one hand, the older companies may be able to tap customer loyalty in their installed bases to protect their market share. On the other hand, the newer companies may be able to offer some performance or technology advantage to gain share.

In either case, all the present suppliers will find operation in a mature market to be very competitive. While it is not a zero-sum game (i.e., a market where one company gains only at another's expense), it does not have the expansive growth to allow all participants to increase their revenue. In a mature market, revenue gains and profitability are rare commodities.

PRODUCT OPPORTUNITIES

Mature markets generally do not lend themselves to major product opportunities, though this is not to say that opportunities do not exist. While in the main, the rule for PCB layout is "back to basics," there are continuing needs for new tools that provide additional productivity gains.

As is the case in the EDA market at large, Dataquest segments PCB layout opportunities into full-line and niche products. Full-line products are complete PCB layout stations. Niche products are specialized tools that are usually provided by smaller companies selling that class of product exclusively, or, in some cases, by the complete station companies.

Full-Line Product Opportunities

For suppliers of complete PCB design stations, the major opportunity is to deliver the products that were originally promised, and to deliver them in working order. As was noted before, the technology needs of the PCB market are well defined. The primary task for companies that want to participate in this market is to deliver the tools, market and sell them, and provide strong service and support.

Nonetheless, certain areas of product development merit special consideration for full-line suppliers. Two primary areas of note are integration and manufacturing. Integration products include data base management tools, user interfaces, and design management tools that enable users to tailor a PCB layout station to their own needs. This could involve adding a specialized router or analysis package, or creating special CAM links. Manufacturing products are specialized stations that help transfer designs from the layout department to the manufacturing organizations. This could involve specialized editors or additional CPU power to perform post-processing tasks. However, even integration and manufacturing product opportunities are really only extensions of the current generation of PCB design tools.

Niche Product Opportunities

Outside of the mainstream PCB design stations, several exciting areas for product development are now emerging. Two major areas are layout analysis and next-generation automatic placement-and-routing.

In the area of analysis, users are very interested in packages that help them evaluate their boards prior to release to manufacturing. Types of analysis that are currently being explored include thermal (heat distribution), manufacturability (fit with robot requirements), electromagnetic (cross talk, noise, and ringing), and reliability (probability of component failure). All these types of analysis can help the user determine the viability of a board before it actually goes into field testing.

In the area of automatic placement-and-routing, there is constant room for improvement. Today's measure of routing quality is level of completion. However, completion rates only start to measure the quality of a route in terms of overall board or individual net performance. Users' lack of satisfaction with their current routers suggests that there is ample room for improvement. The realm of PCB placement holds equal potential, particularly in the area of rule-based placement. Most automatic placement algorithms today optimize only wire length. Not only is total wire length a poor measure of routability, but optimizing wire length may also result in a board that cannot be manufactured. Next-generation placers that anticipate the thermal and electromagnetic characteristics, manufacturability, and reliability of a board represent another opportunity in the market.

HARDWARE PLATFORMS

Developments in hardware platforms have contributed significantly to the evolution of the PCB layout market. The advent of personal computers and technical workstations reduced the average price of a system significantly, but it may also have set in motion permanent price erosion in the value of PCB layout applications.

Dataquest believes that the technical workstation will be the platform of choice for PCB layout over the long term. Technical workstations have the performance at the graphics and processing level to meet the major needs of most users. Given current trends in terms of price and performance, technical workstations are likely to retain these advantages for some time to come.

Personal computers will still be important in terms of total unit sales, but due to limits in terms of memory management (e.g., 16-bit and segmented memory), customers will tend to switch to low-cost technical workstations. As data base complexity rises, the personal computer's limitations will become increasingly apparent. Complicated SMD boards and next-generation placement-and-routing will require 32-bit processing capabilities.

The host computer will remain an important part of the PCB layout environment. CPU-intensive tasks such as post-processing, routing, and network services (such as archival printing and plotting) will all be deferred to the host. However, the host's role as an editing station may indeed have come to an end.

Dataquest believes that special-purpose hardware such as routing accelerators will remain very important in the near term. Routing nodes clearly have a price/performance edge over host-based systems. However, in the long term, high-performance workstations with 10- to 20-mips processing capability may displace special-purpose hardware. While it is possible to imagine that accelerators will also improve in performance, the general-purpose functionality of a high-performance workstation should make it very attractive to the typical user.

4.4 PCB Layout Forecasts

TOTAL PCB LAYOUT MARKET

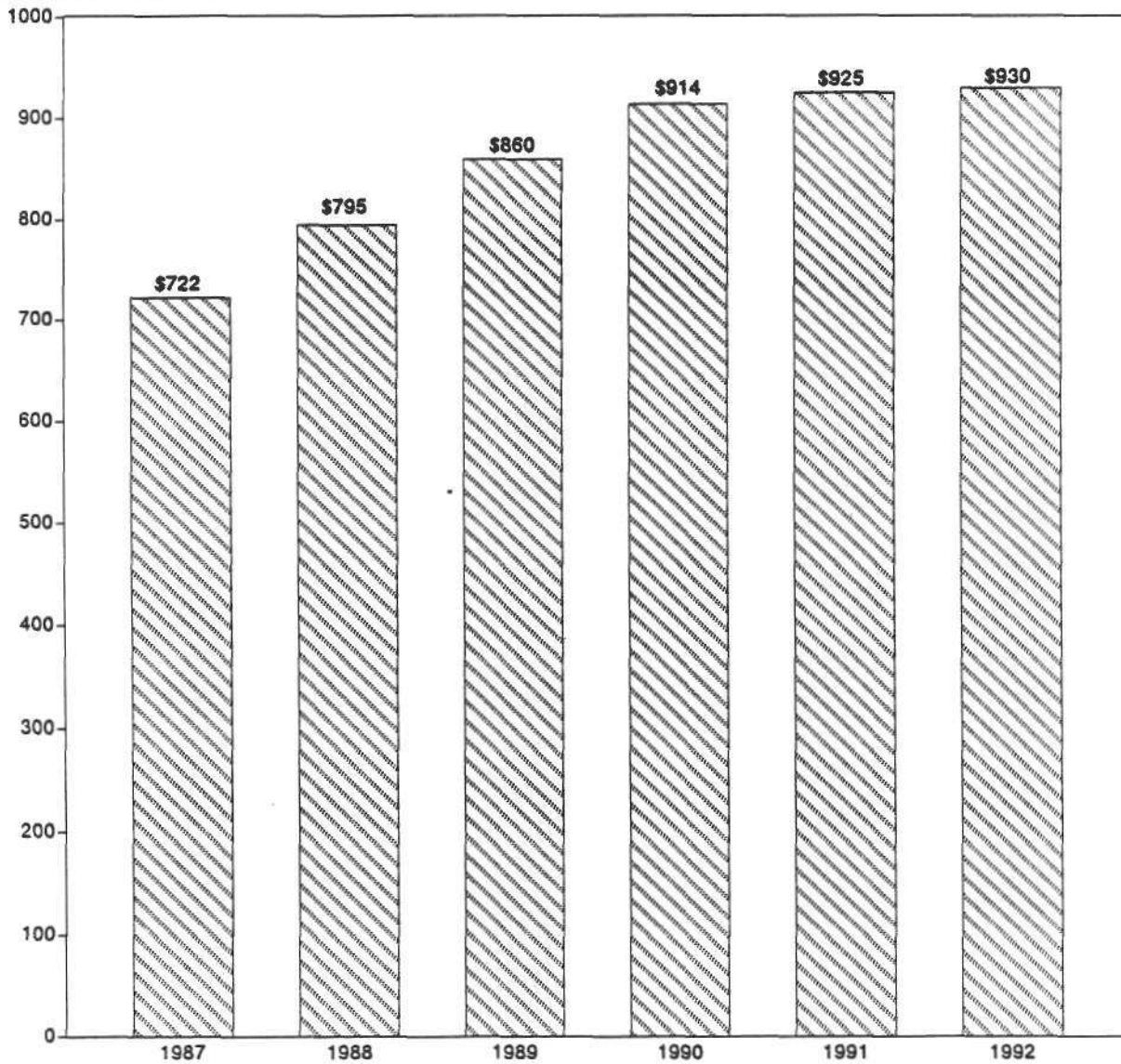
This section presents Dataquest's forecast and analysis for the total PCB layout market for all regions and platforms, as illustrated in Figures 4.4-1 and 4.4-2 and Table 4.4-1. These data are summarized as follows:

- The PCB layout market was an estimated \$722 million in 1987 and is forecast to grow to \$930 million in 1992, a 5.2 percent compound annual growth rate (CAGR).
- Dataquest forecasts that the market will grow to \$795 million in 1988, a growth rate of 10.0 percent.
- Workstation shipments were 16,315 in 1987 and are forecast to grow to 19,700 in 1988, an increase of 21.0 percent. The CAGR through 1992 is expected to be 11.2 percent, with shipments rising to 27,790.

Figure 4.4-1

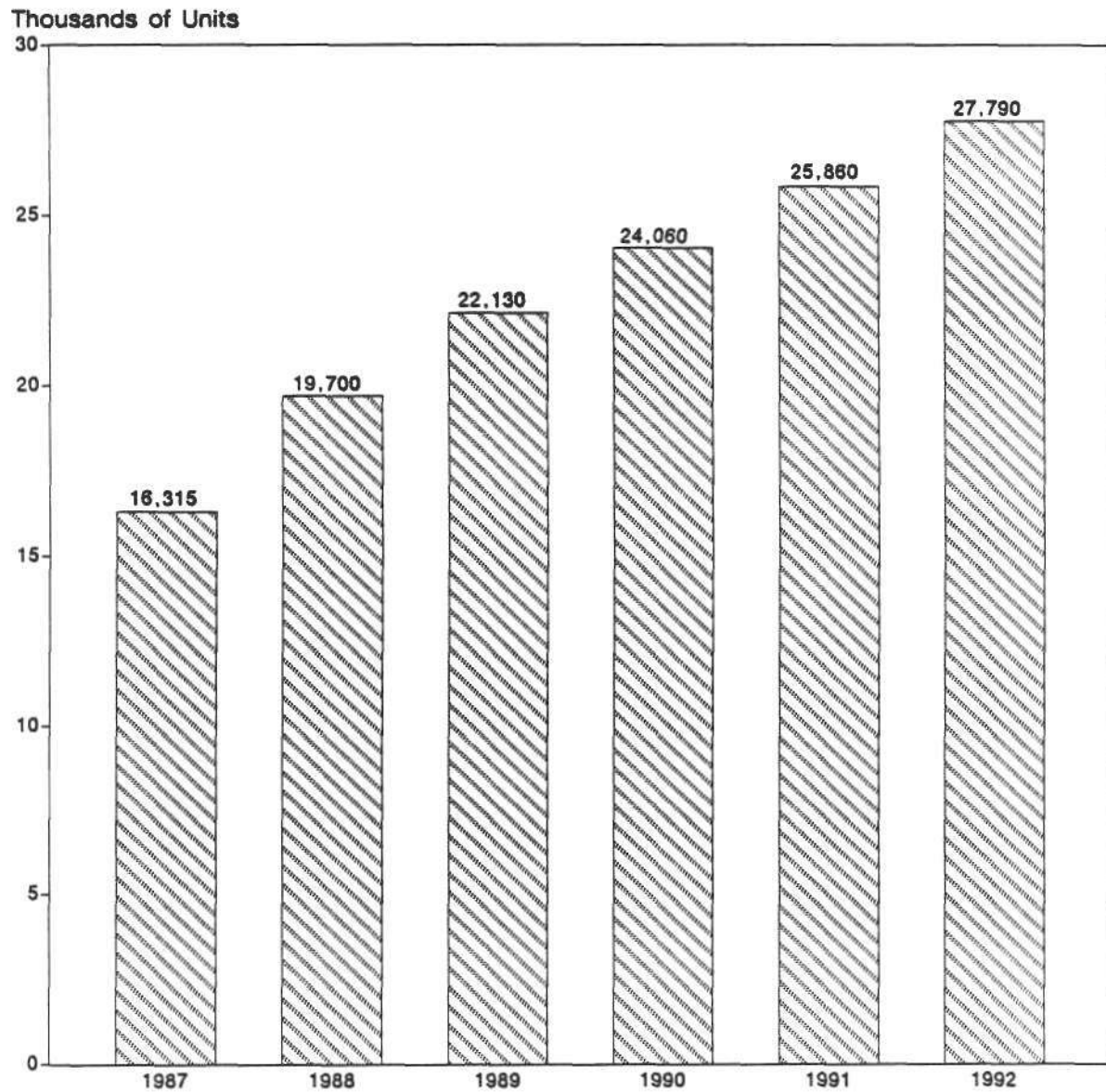
PCB Layout Worldwide Forecast
Revenue

Millions of Dollars



Source: Dataquest
July 1988

Figure 4.4-2

**PCB Layout Worldwide Forecast
Shipments**

Source: Dataquest
July 1988

4.4 PCB Layout Forecasts

Table 4.4-1

**PCB Layout Worldwide Forecast
(Millions of Dollars, Actual Units)**

	1987	1988	1989	1990	1991	1992	CAGR
	***	***	***	***	***	***	***
Revenue	722	795	860	914	925	930	5.2%
Systems	14,940	18,740	21,450	23,630	25,530	27,360	13.0%
Workstations	16,315	19,700	22,130	24,060	25,840	27,790	11.2%

Source: Dataquest
July 1988

REGIONS

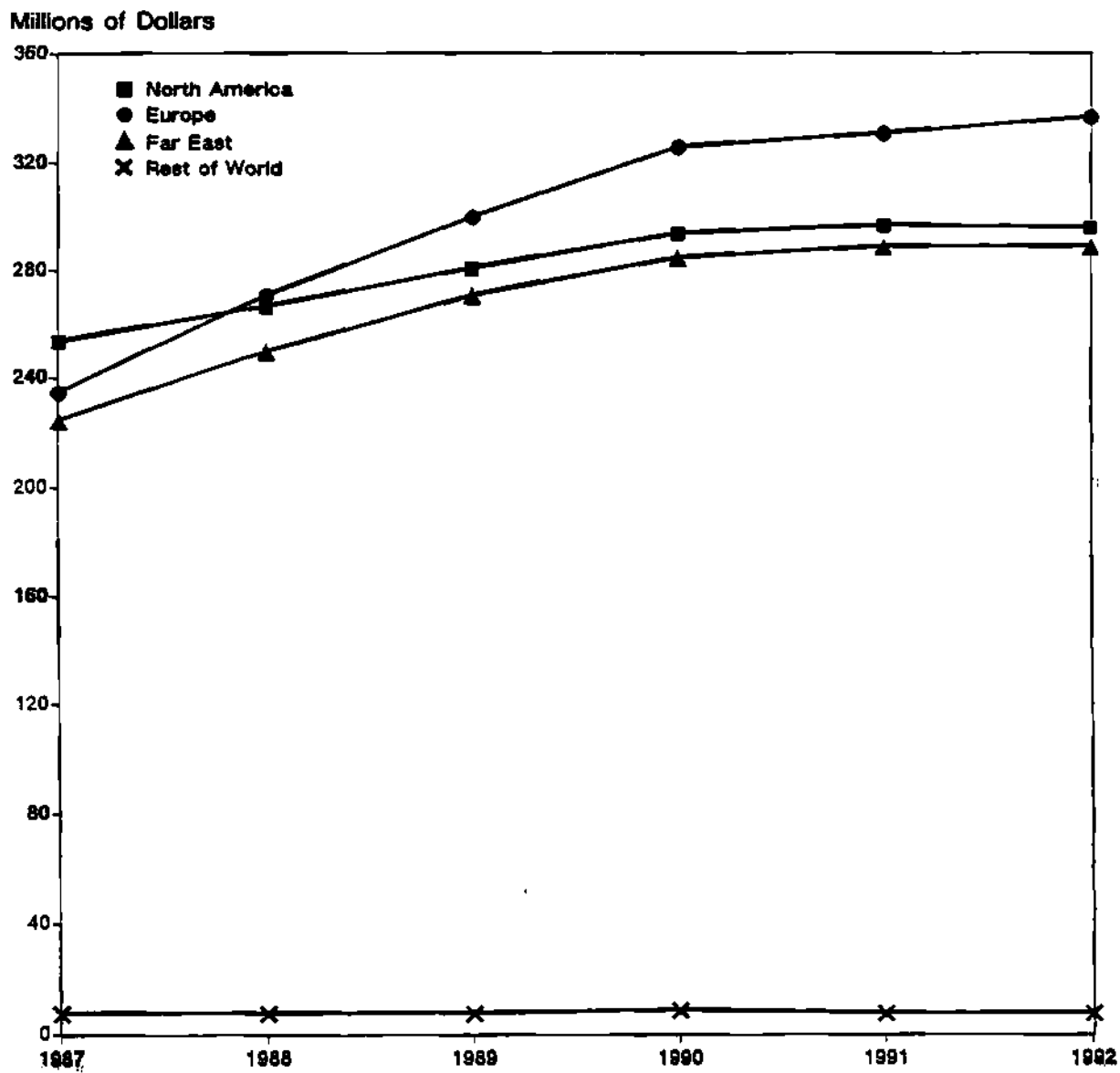
This section presents Dataquest's forecast and analysis for the total PCB layout market segmented by region, as illustrated in Figures 4.4-3 and 4.4-4 and Tables 4.4-2 and 4.4-3. These data are summarized as follows:

- North American revenue was \$254 million and is expected to have a CAGR of only 3.1 percent, increasing to \$296 million in 1992, the slowest growth rate for any region.
- North American revenue is forecast to grow to \$267 million in 1988, an increase of only 5.0 percent.
- North America represents 35.0 percent of the PCB market but will decline to 32.0 percent as a result of its relatively slow growth.
- In 1987, the European revenue of \$235 million was 33.0 percent of the total worldwide revenue. It is forecast to increase at a 7.4 percent CAGR to \$337 million in 1992, representing 36.0 percent of the total market.
- Dataquest forecasts that European revenue will rise 15.0 percent in 1988 to \$271 million, continuing the strong growth it experienced in 1987.
- Dataquest expects the Far East to be one of the two strongest growth markets. Revenue in 1987 was \$225 million, 31.0 percent of the worldwide total, and is expected to rise to \$289 million in 1992, a 5.2 percent CAGR and 31.0 percent of the worldwide total. In 1988, revenue is expected to grow 11.0 percent.
- Dataquest believes that as the Far East and European markets rise as a percent of the total market, and as the U.S. market declines, PCB vendors will have to adopt a balanced sales strategy and also meet the buying criteria of an international customer base. Corporate stability, reputation, service, and support are as important as product content.

4.4 PCB Layout Forecasts

Figure 4.4-3

PCB Layout Regional Forecast Revenue



Source: Dataquest
July 1988

Figure 4.4-4

PCB Layout Regional Forecast
Shipments

Workstation Shipments (in Thousands)

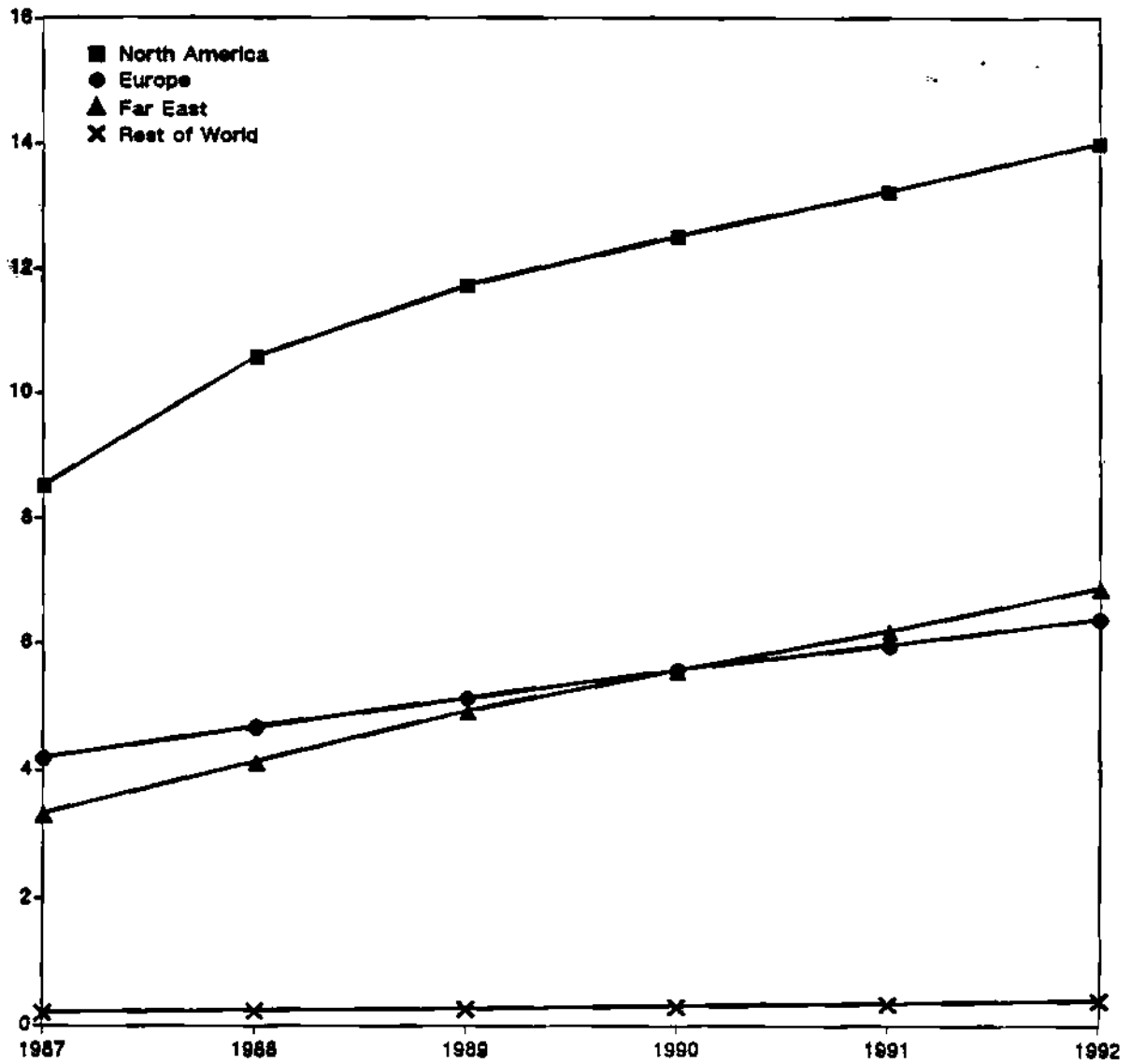
Source: Dataquest
July 1988

Table 4.4-2

PCB Layout Worldwide Forecast by Region
(Millions of Dollars, Actual Units)

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Market							
Revenue	722	795	860	914	925	930	5.2%
Systems	14,940	18,740	21,450	23,630	25,530	27,560	13.0%
Workstations	16,315	19,700	22,130	24,060	25,860	27,790	11.2%
North America							
Revenue	254	267	281	294	297	296	3.1%
Systems	8,125	10,460	11,680	12,550	13,270	14,030	11.5%
Workstations	8,546	10,600	11,750	12,550	13,270	14,030	10.4%
Europe							
Revenue	235	271	300	326	331	337	7.4%
Systems	3,912	4,500	5,070	5,600	6,000	6,430	10.4%
Workstations	4,211	4,690	5,150	5,600	6,000	6,430	8.8%
Far East							
Revenue	225	250	271	285	289	289	5.2%
Systems	2,710	3,540	4,430	5,160	5,910	6,700	19.8%
Workstations	3,336	4,150	4,950	5,590	6,230	6,920	15.7%
Rest of World							
Revenue	8	8	8	9	8	8	.6%
Systems	192	230	270	320	360	410	16.4%
Workstations	222	250	280	320	360	410	13.0%

Source: Dataquest
July 1988

Table 4.4-3

**PCB Layout Regional Forecast
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
North America						
Revenue	35%	34%	33%	32%	32%	32%
Systems	54%	56%	54%	53%	52%	51%
Workstations	52%	54%	53%	52%	51%	50%
Europe						
Revenue	33%	34%	35%	36%	36%	36%
Systems	26%	24%	24%	24%	24%	23%
Workstations	26%	24%	23%	23%	23%	23%
Far East						
Revenue	31%	31%	32%	31%	31%	31%
Systems	18%	19%	21%	22%	23%	24%
Workstations	20%	21%	22%	23%	24%	25%
Rest of World						
Revenue	1%	1%	1%	1%	1%	1%
Systems	1%	1%	1%	1%	1%	1%
Workstations	1%	1%	1%	1%	1%	1%

Source: Dataquest
July 1988

PLATFORMS

This section presents Dataquest's forecast and analysis for the total PCB layout market segmented by platform, as illustrated in Figures 4.4-5 and 4.4-6 and Tables 4.4-4 and 4.4-5. These data are summarized as follows:

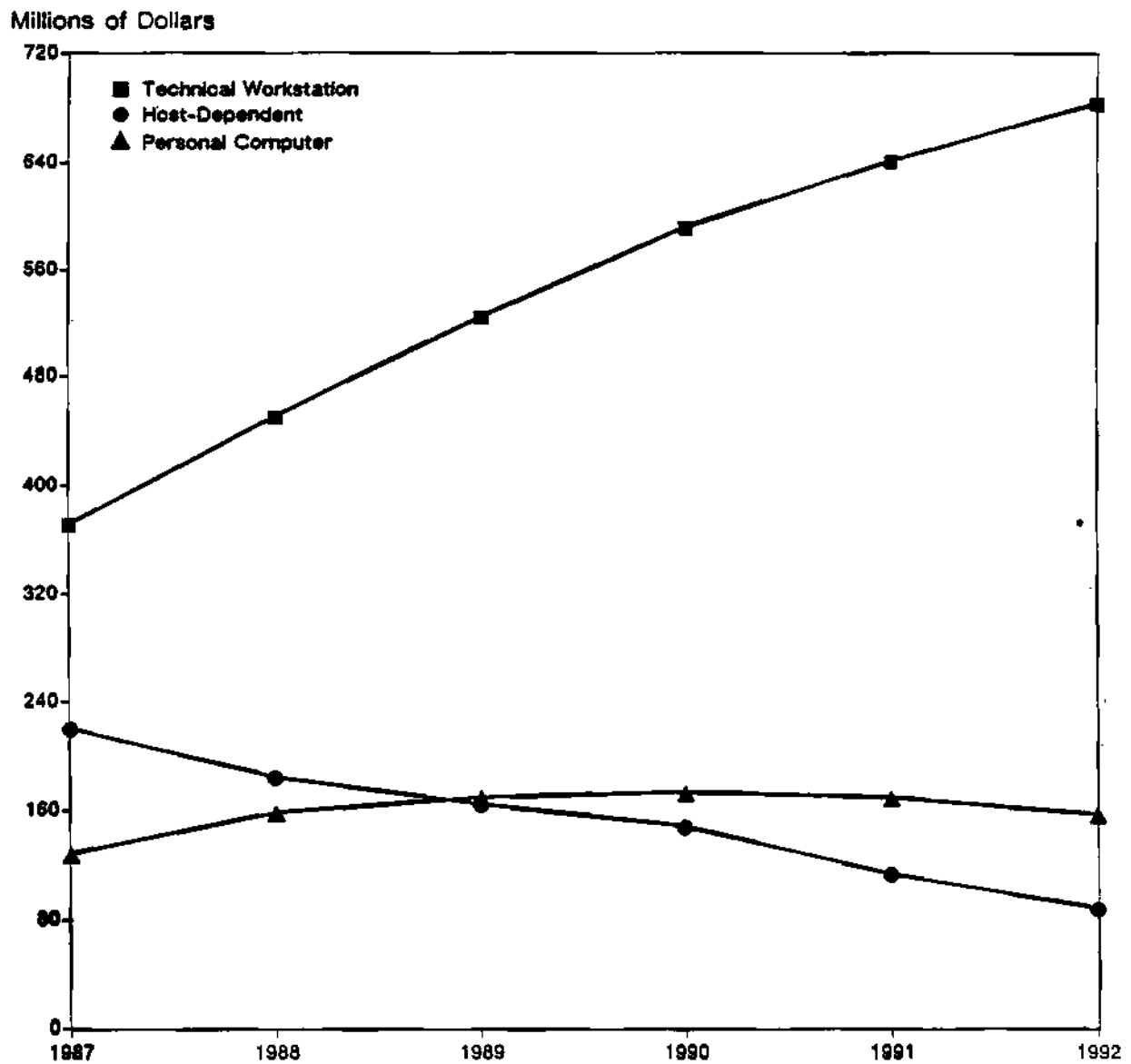
- In 1987, workstation shipments were 16,315 units and are forecast to increase to 27,790 units in 1992, an 11.2 percent CAGR.
- Technical workstation shipments were 5,571 units in 1987, representing 34.0 percent of total unit shipments. However, technical workstation revenue was \$372 million, representing 52.0 percent of the total PCB market.
- Technical workstation revenue and shipments are expected to have the highest growth rates for all platform types. Unit shipments are forecast to grow at a 21.1 percent CAGR to 14,530 units in 1992. Revenue is expected to grow at a 12.9 percent CAGR to \$684 million in 1992. That year, technical workstations will represent 73.0 percent of total revenue and 52.0 percent of total shipments.
- Host-dependent workstation shipments were 1,969 units, representing 12.0 percent of total unit shipments. However, host-dependent revenue was \$221 million, representing 31.0 percent of the total PCB layout market.
- Host-dependent revenue and shipments are expected to have the slowest growth rates for all platform types. Unit shipments are forecast to decline, at a CAGR of 18.2 percent, to 720 units in 1992. Revenue is also expected to decline, at a CAGR of 16.6 percent, to \$89 million in 1992. Host-dependent systems in 1992 will represent 10.0 percent of total revenue and 3.0 percent of total shipments.
- Personal computer shipments were 8,775 units, representing 54.0 percent of total workstation shipments. Revenue was only \$129 million, representing 18.0 percent of the total PCB layout market.
- Personal computer revenue and shipments are expected to have moderate growth rates. Unit shipments are forecast to have a 7.4 percent CAGR, increasing to 12,530 units in 1992. Revenue is expected to have a 4.1 percent CAGR, growing to \$158 million in 1992. That year, personal computers will represent 17.0 percent of total revenue and 45.0 percent of total shipments.
- Dataquest believes that this shift toward the technical workstation and away from the personal computer and host-dependent systems reflects the following major trends:
 - The increasing CPU power of the technical workstation

- The demand for 32-bit applications over 16-bit tools
- The declining price of technical workstations

Taken together, these factors tend to limit personal computers to documentation and design entry tasks, and host-dependent systems to network server roles.

Figure 4.4-5

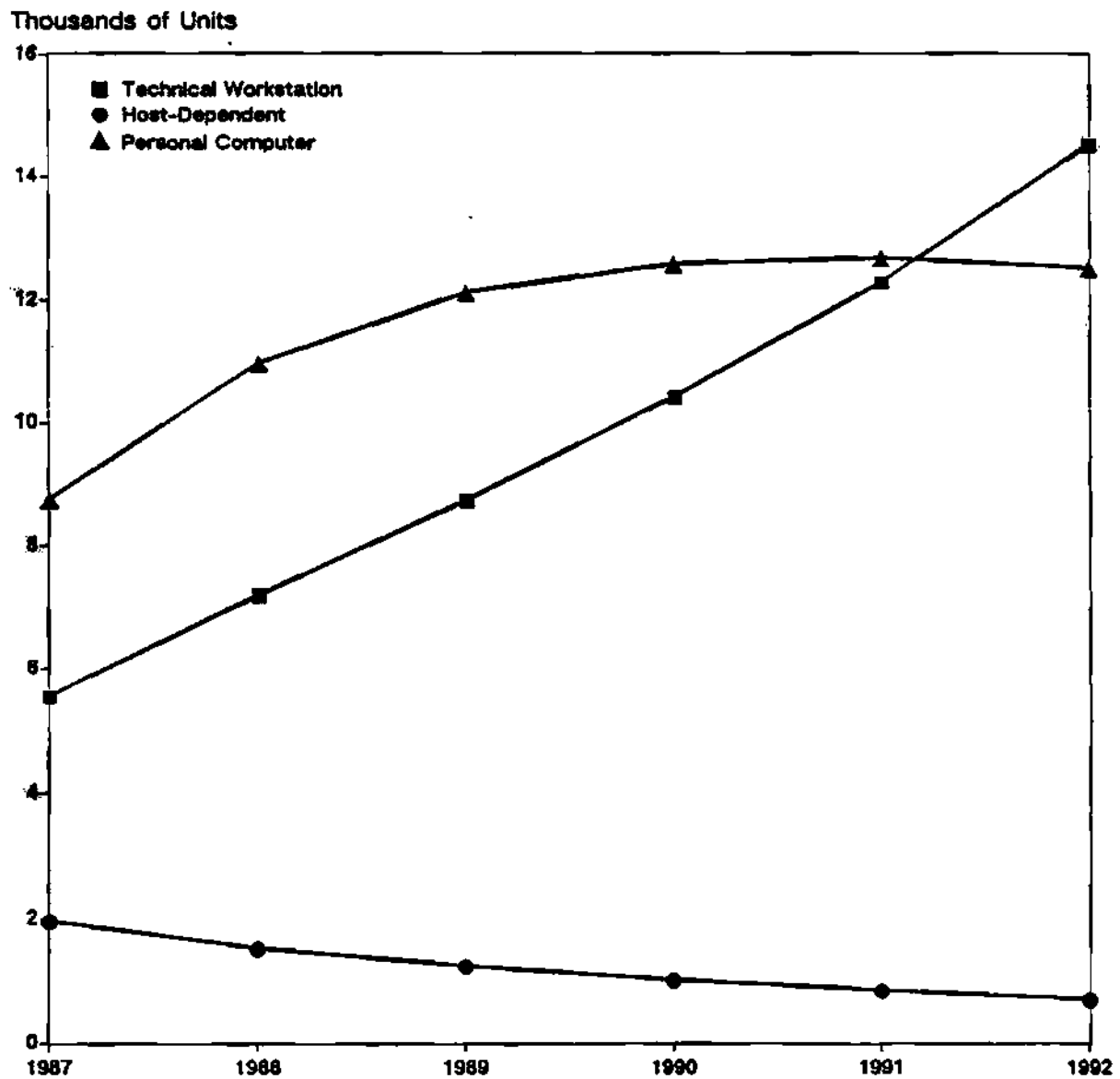
PCB Layout Worldwide Forecast by Platform
Revenue



Source: Dataquest
July 1988

Figure 4.4-6

PCB Layout Worldwide Forecast by Platform Shipments

Source: Dataquest
July 1988

4.4 PCB Layout Forecasts

Table 4.4-4

**PCB Layout Worldwide Forecast by Platform
(Millions of Dollars, Actual Units)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Market							
Revenue	722	795	860	914	925	930	5.2%
Systems	14,940	18,740	21,450	23,630	25,530	27,560	13.0%
Workstations	16,315	19,700	22,130	24,060	25,860	27,790	11.2%
Technical Workstation							
Revenue	372	451	525	592	641	684	12.9%
Systems	5,571	7,200	8,750	10,430	12,300	14,530	21.1%
Workstations	5,571	7,200	8,750	10,430	12,300	14,530	21.1%
Host-Dependent							
Revenue	221	185	165	149	114	89	-16.6%
Systems	593	560	570	600	540	500	-3.4%
Workstations	1,969	1,530	1,250	1,030	860	720	-18.2%
Personal Computer							
Revenue	129	159	170	174	170	158	4.1%
Systems	8,775	10,970	12,130	12,600	12,690	12,530	7.4%
Workstations	8,775	10,970	12,130	12,600	12,690	12,530	7.4%

Source: Dataquest
July 1988

Table 4.4-5

**PCB Layout Worldwide Forecast by Platform
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
Technical Workstation						
Revenue	52%	57%	61%	65%	69%	73%
Systems	37%	38%	41%	44%	48%	53%
Workstations	34%	37%	40%	43%	48%	52%
Host-Dependent						
Revenue	31%	23%	19%	16%	12%	10%
Systems	4%	3%	3%	3%	2%	2%
Workstations	12%	8%	6%	4%	3%	3%
Personal Computer						
Revenue	18%	20%	20%	19%	18%	17%
Systems	59%	59%	57%	53%	50%	45%
Workstations	54%	56%	55%	52%	49%	45%

Source: Dataquest
July 1988

AVERAGE PRICE PER SEAT

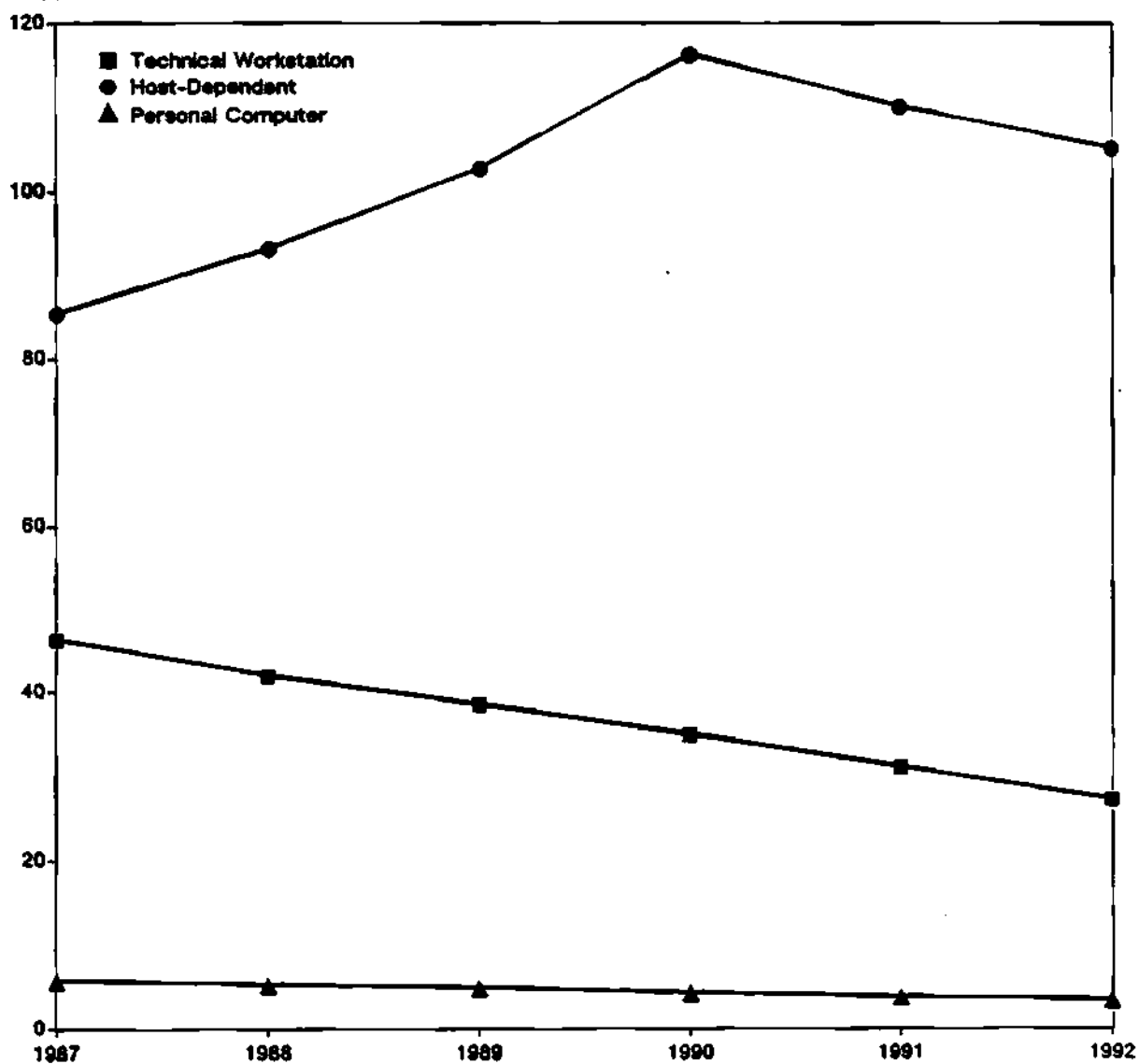
This section presents Dataquest's forecast and analysis for the average price per seat by platform for the PCB layout market, as illustrated in Figure 4.4-7 and Table 4.4-6. These data are summarized as follows:

- For all PCB layout product types worldwide, the average price per seat (APPS) was \$29,400 in 1987. It is forecast to decline at a CAGR of 8.6 percent, to \$18,700 in 1992.
- The technical workstation APPS was \$46,500 in 1987. It is forecast to have the sharpest decline, at a CAGR of 10.0 percent, to \$27,500 in 1992.
- The host-dependent APPS was \$85,600 in 1987. It is forecast to rise steadily at a CAGR of 4.2 percent to \$105,400 in 1992.
- The personal computer APPS was \$5,900 in 1987 and is forecast to decline at a CAGR of 9.9 percent to \$3,500 in 1992.
- Dataquest believes that these price declines will be driven by steady price erosion in both hardware and software. Basic applications such as manual editing have already dropped below the \$1,000 price point, and, given fixed functionality, prices can only continue to fall. Prices can be held upward only by increases in product functionality or performance.

Figure 4.4-7

PCB Layout Worldwide Average Price per Seat by Platform

Thousands of Dollars

Source: Dataquest
July 1988

4.4 PCB Layout Forecasts

Table 4.4-6

**PCB Layout Worldwide Average Price
Per Seat Forecast by Platform
(Thousands of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Turnkey & Hardware-Only							
Technical Workstation	46.5	42.2	38.7	35.1	31.3	27.5	-10.0%
Host-Dependent	85.6	93.4	102.9	116.5	110.3	105.4	4.2%
Personal Computer	5.9	5.4	5.0	4.4	3.9	3.5	-9.9%
All Platforms	29.4	25.7	23.8	22.5	20.5	18.7	-8.6%
Turnkey							
Technical Workstation	54.2	50.4	47.8	44.9	42.0	38.9	-6.4%
Host-Dependent	82.6	80.4	76.9	71.6	65.7	60.2	-6.1%
Personal Computer	18.3	16.9	15.8	15.0	14.8	14.8	-4.2%
All Platforms	53.0	47.3	43.9	41.3	39.1	36.5	-7.2%
Hardware-Only							
Technical Workstation	22.8	20.7	18.7	16.8	14.8	13.1	-10.5%
Host-Dependent	91.9	115.0	141.4	181.0	160.0	141.1	9.0%
Personal Computer	3.8	3.5	3.2	2.9	2.6	2.3	-9.6%
All Platforms	12.5	11.7	11.5	11.3	10.1	9.2	-5.9%

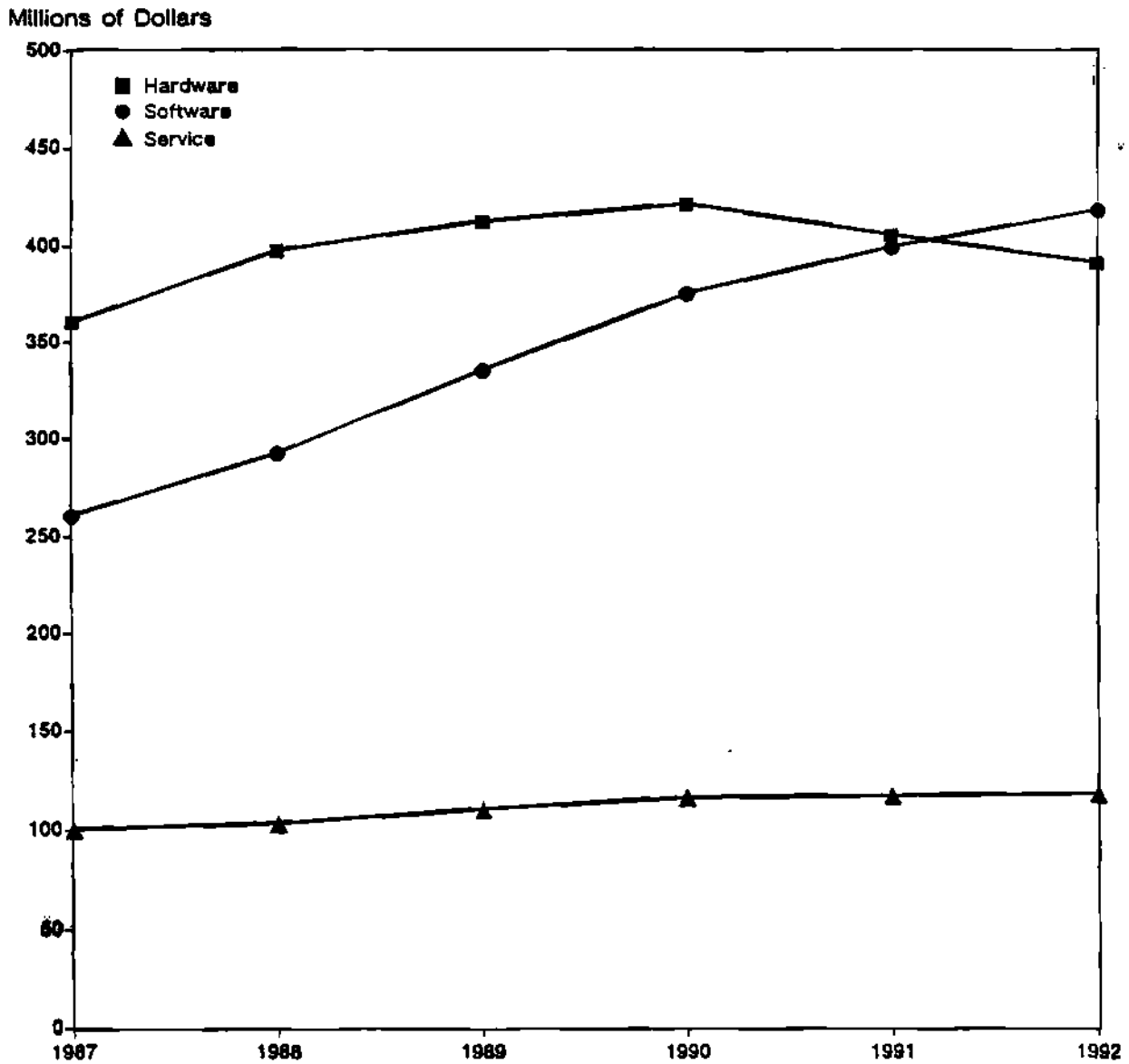
Source: Dataquest
July 1988

REVENUE SOURCES

This section presents Dataquest's forecast and analysis for the total PCB layout market segmented by revenue source for each platform, as illustrated in Figure 4.4-8 and Tables 4.4-7 and 4.4-8. These data are summarized as follows:

- Hardware revenue was approximately \$361 million in 1987, or roughly 50.0 percent of the total PCB revenue. Hardware revenue overall will have a CAGR of only 1.7 percent through 1992, amounting to \$392 million, or only 42.0 percent of the total 1992 revenue.
- Software and service revenue is forecast to have the strongest growth. In 1987, revenue for software and service was \$261 million and \$101 million, respectively. Software revenue is expected to grow to 9.9 percent CAGR, to \$449 million in 1992, while service revenue will increase at 3.4 percent CAGR, to \$119 million.
- Dataquest believes that the growth of service and software revenue reflect the steady maturation of the PCB market. Not only are hardware prices falling, but large installed customer bases also require increasing levels of support, training, and service. Moreover, as penetration increases, the demand for more hardware declines while the demand to add more software to the same system starts to rise.

Figure 4.4-8
PCB Layout Worldwide Revenue Sources



Source: Dataquest
July 1988

Table 4.4-7

**PCB Layout Worldwide Forecast by Revenue Source
(Millions of Dollars)**

	1987	1988	1989	1990	1991	1992	CAGR
	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$	%%
All Platforms							
Hardware	361	398	413	422	406	392	1.7%
Software	261	293	336	376	400	419	9.9%
Service	101	104	111	117	118	119	3.4%
Total	722	795	860	914	925	930	5.2%
Technical Workstation							
Hardware	178	222	247	265	276	283	9.8%
Software	141	164	203	243	275	305	16.7%
Service	54	65	75	83	90	95	12.1%
Total	372	451	525	592	641	684	12.9%
Host-Dependent							
Hardware	140	128	118	111	89	72	-12.5%
Software	44	31	26	19	11	7	-31.3%
Service	36	26	22	19	14	10	-22.3%
Total	221	185	165	149	114	89	-16.6%
Personal Computer							
Hardware	43	48	49	46	41	37	-3.1%
Software	76	98	107	114	114	108	7.3%
Service	10	13	14	15	15	14	5.7%
Total	129	159	170	174	170	158	4.1%

Source: Dataquest
July 1988

4.4 PCB Layout Forecasts

Table 4.4-8

**PCB Layout Worldwide Forecast by Revenue Source
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
	----	----	----	----	----	----
All Platforms						
Hardware	50%	50%	48%	46%	44%	42%
Software	36%	37%	39%	41%	43%	45%
Service	14%	13%	13%	13%	13%	13%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	48%	49%	47%	45%	43%	41%
Software	38%	36%	39%	41%	43%	45%
Service	14%	14%	14%	14%	14%	14%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	63%	69%	71%	75%	78%	81%
Software	20%	17%	16%	13%	10%	8%
Service	16%	14%	13%	12%	12%	11%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	33%	30%	29%	26%	24%	23%
Software	59%	61%	63%	65%	67%	68%
Service	8%	8%	8%	8%	9%	9%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

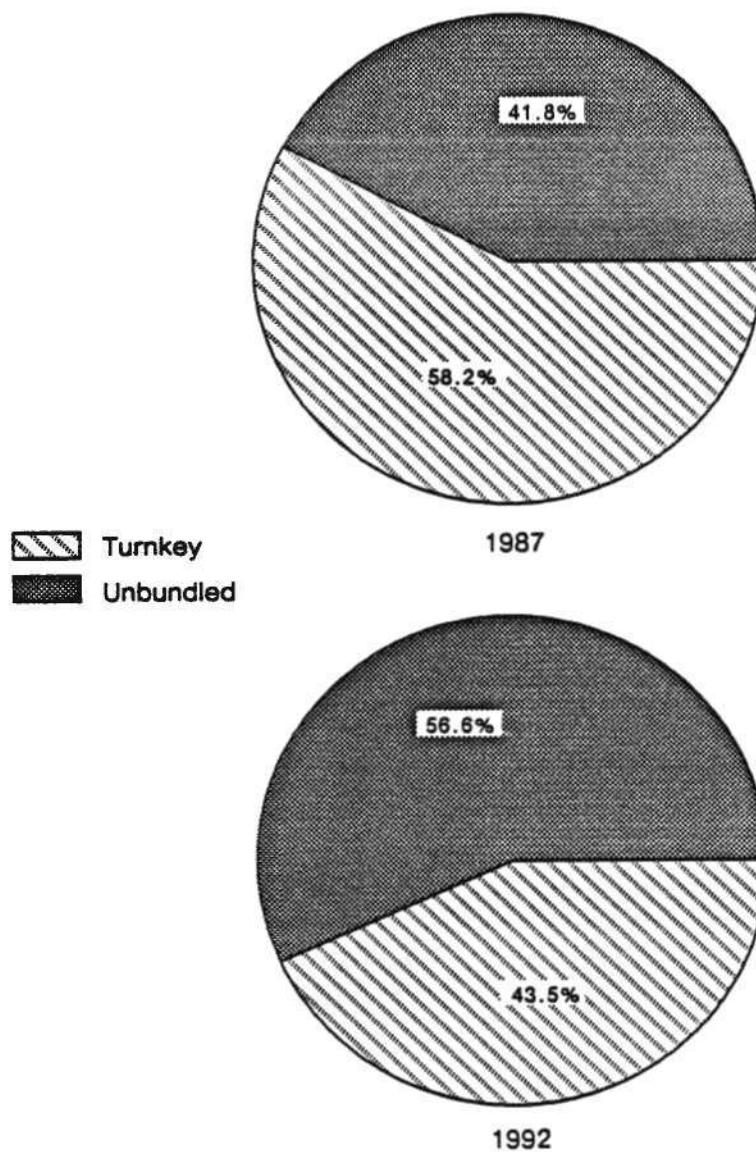
Schematic Capture
Tech W.S. } 55%
PC

DISTRIBUTION CHANNELS

This section presents Dataquest's forecast and analysis for turnkey versus unbundled sales for the PCB market, as illustrated in Figure 4.4-9 and Tables 4.4-9 and 4.4-10. These data are summarized as follows:

- Turnkey hardware and software revenue is forecast to stay flat from \$362 million in 1987 to \$353 million in 1992, but it will drop from 58 percent of the total market to 43 percent of the market by 1992.
- Unbundled hardware and software revenue is forecast to grow at a 12.0 percent CAGR, from \$260 million in 1987 to \$459 million in 1992. It will grow from 42.0 percent of total revenue to 57 percent.
- Dataquest believes that this shift reflects a fundamental change in the buying practices of all customers, large and small. Hardware is increasingly purchased separately from software. For large corporations, this means purchasing workstations directly from the manufacturer and then assembling a software solution. For the small company, it means purchasing a personal computer and then buying software through a discount chain or mail order company.

Figure 4.4-9
PCB Layout—Turnkey versus Unbundled
(Percentage of Revenue)



Source: Dataquest
July 1988

Table 4.4-9

**PCB Layout Worldwide Forecast
Turnkey versus Unbundled
(Millions of Dollars, Actual Units)**

	1987	1988	1989	1990	1991	1992	CAGR
	----	----	----	----	----	----	----
Total Hardware and Software Revenue							
Turnkey	362	366	371	372	364	353	-1.5%
Unbundled	260	325	379	426	443	459	12.0%
Total	622	691	749	798	807	811	5.5%
Hardware Revenue							
Turnkey	243	258	257	252	240	225	-1.5%
Unbundled	118	140	156	170	166	167	7.2%
Total	361	398	413	422	406	392	1.7%
Software Revenue							
Turnkey	119	108	114	120	124	128	1.5%
Unbundled	142	185	222	256	276	291	15.4%
Total	261	293	336	376	400	419	9.9%
Workstation Shipments							
Turnkey	6,822	7,740	8,440	9,000	9,320	9,650	7.2%
Unbundled	9,493	11,960	13,700	15,070	16,530	18,140	13.8%
Total	16,315	19,700	22,130	24,060	25,860	27,790	11.2%

Source: Dataquest
July 1988

Table 4.4-10

**PCB Layout Worldwide Forecast
Turnkey versus Unbundled
(Percentage of Total)**

	1987	1988	1989	1990	1991	1992
Total Hardware and Software Revenue	100%	100%	100%	100%	100%	100%
Turnkey	58%	53%	49%	47%	45%	43%
Unbundled	42%	47%	51%	53%	55%	57%
Total	100%	100%	100%	100%	100%	100%
Hardware Revenue						
Turnkey	67%	65%	62%	60%	59%	57%
Unbundled	33%	35%	38%	40%	41%	43%
Total	100%	100%	100%	100%	100%	100%
Software Revenue						
Turnkey	45%	37%	34%	32%	31%	31%
Unbundled	55%	63%	66%	68%	69%	69%
Total	100%	100%	100%	100%	100%	100%
Workstation Shipments						
Turnkey	42%	39%	38%	37%	36%	35%
Unbundled	58%	61%	62%	63%	64%	65%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
July 1988

4.5 PCB Layout Market Shares

Figures 4.5-1 through 4.5-4 and Table 4.5-1 present Dataquest's analysis of the PCB layout market share measured in total revenue, hardware and software revenue, and workstation shipments, as follows:

- Racal-Redac remains on top of the PCB layout market, with \$76.4 million in total revenue and 10.6 percent market share.
 - Racal-Redac is also the leading software supplier, with a 22.1 percent share, outdistancing its nearest competitor by more than a factor of three.
 - Racal-Redac has managed to stay competitive technologically and has aggressively pursued software unbundling; although the company still does best in the European market, it has made major inroads in the Far East and North America.
- Scientific Calculations, another old-line supplier, has maintained its position as the second largest vendor, with \$51.5 million in sales and a 7.1 percent share; it has made the transition to technical workstation- and personal computer-based systems as well.
- Digital Equipment Corporation appears as the third largest supplier, with \$39.6 million in sales and the number one position in hardware.
- Cadnetix has made its move up to the number four position in the market, with \$37.7 million in sales.
 - Cadnetix has developed a strong reputation for its excellence in technology, ease of use, and innovation.
 - The Company has capitalized on this reputation to gain market share.
- Computervision continues to hold its ground in PCB layout as the fifth largest supplier of PCB tools.
 - Computervision, through its strengths in MCAD and its installed base, is still a presence in the market.
 - Nevertheless, it still remains to be seen how Prime's acquisition of the company will affect its behavior and performance in PCB layout.
- Zuken, with its strength in the Japanese market, is the sixth largest vendor; Zuken continues to maintain its position in spite of strong competition from Cadnetix, Mentor Graphics, and Racal-Redac.

- Hewlett-Packard (HP) has emerged as the seventh largest supplier in PCB, with \$31.9 million in sales, though still mostly on the hardware side; HP appears to be benefiting from its ability to service the customer in every application from ECAE through PCB to MCAD, although its sales in this market are not growing as fast as those of some other challengers.
- IBM, through its personal computer strengths, remains an important player as the eighth largest vendor, with \$28.7 million in sales; its revenue has been declining in this market, however.
- Calay, after its port to the Sun workstation and its acquisition by a German corporation, is the ninth largest vendor in the market, with \$27.2 million in sales; its total sales are down slightly from the previous year, and it is losing market share.
- Mentor Graphics was tenth in the market in total revenue for 1987, with \$24.2 million and 3.3 percent market share.
 - Although Mentor Graphics is heavily committed to this market, it does not dominate the market the way it does ECAE.
 - The company has created a special sales force, and it is determined to market electromechanical design.
- Sharp Systems is eleventh in the market, with \$16.3 million in sales resulting from its position in Japan, although its revenue is down from the previous year.
- NEC, the fourteenth vendor in the market, gained market share, however.
- Personal CAD Systems (PCAD), the twelfth vendor in the market, with \$15.6 million in sales, deserves special mention for its performance and strategy in the personal computer-based market.
 - PCAD is the only EDA vendor to have made a significant commitment to a dealer representative sales force.
 - The company has used this strategy very effectively to become a leader in the personal computer market serving smaller PCB layout customers with complete solutions.

Figure 4.5-1

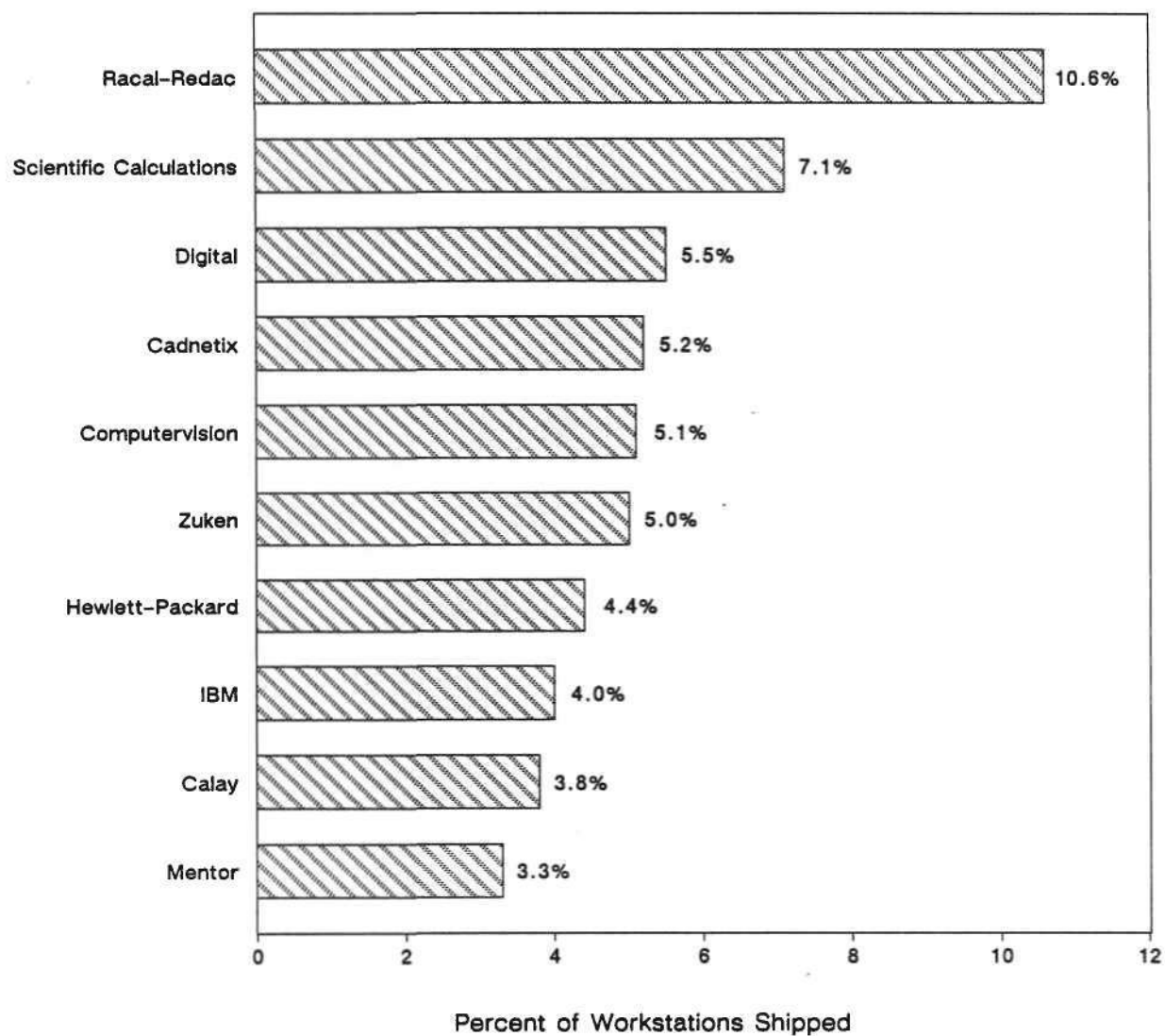
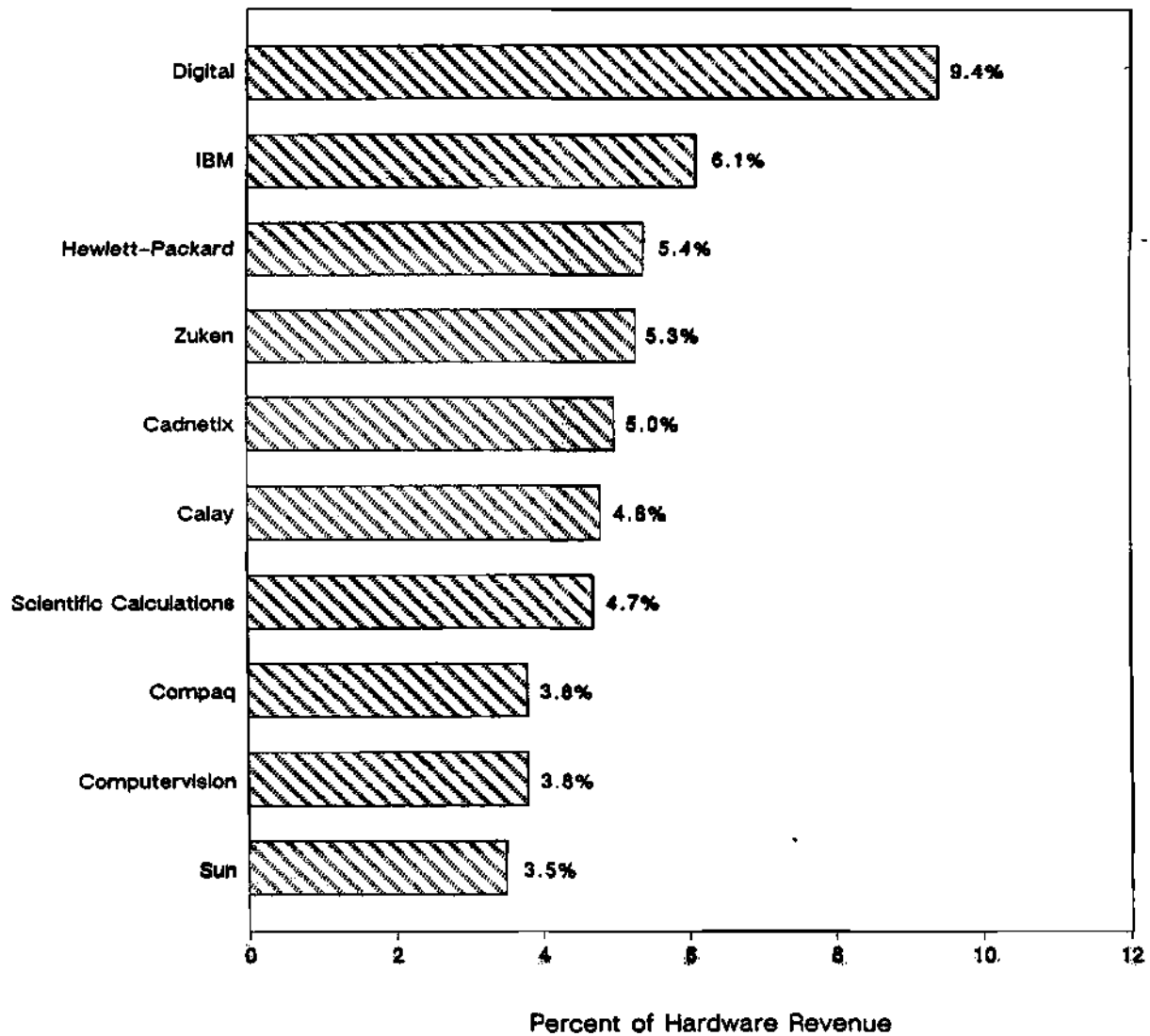
PCB Layout 1987 Worldwide Market Share
Total RevenueSource: Dataquest
July 1988

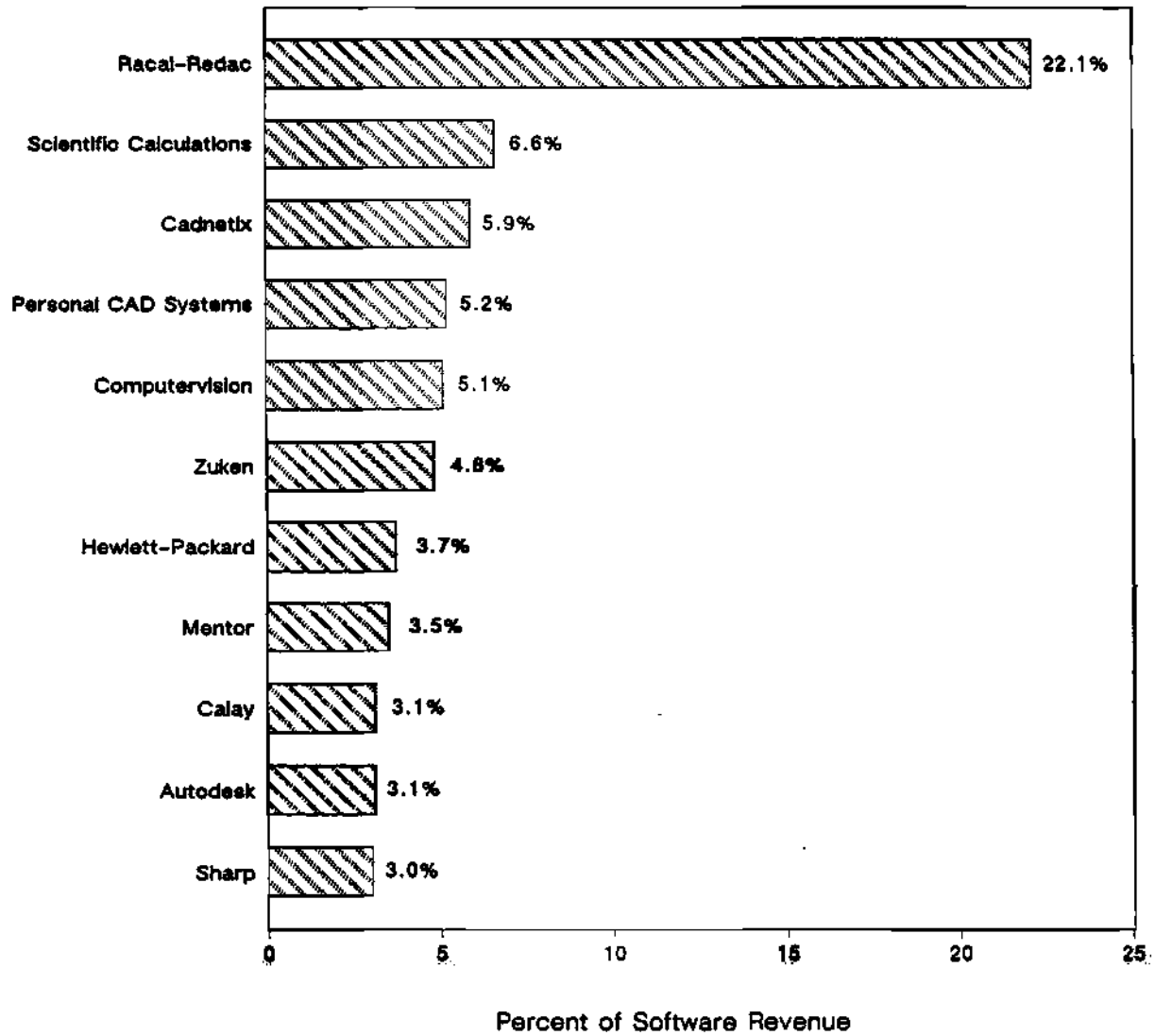
Figure 4.5-2

PCB Layout 1987 Worldwide Market Share
Hardware Revenue



Source: Dataquest
July 1988

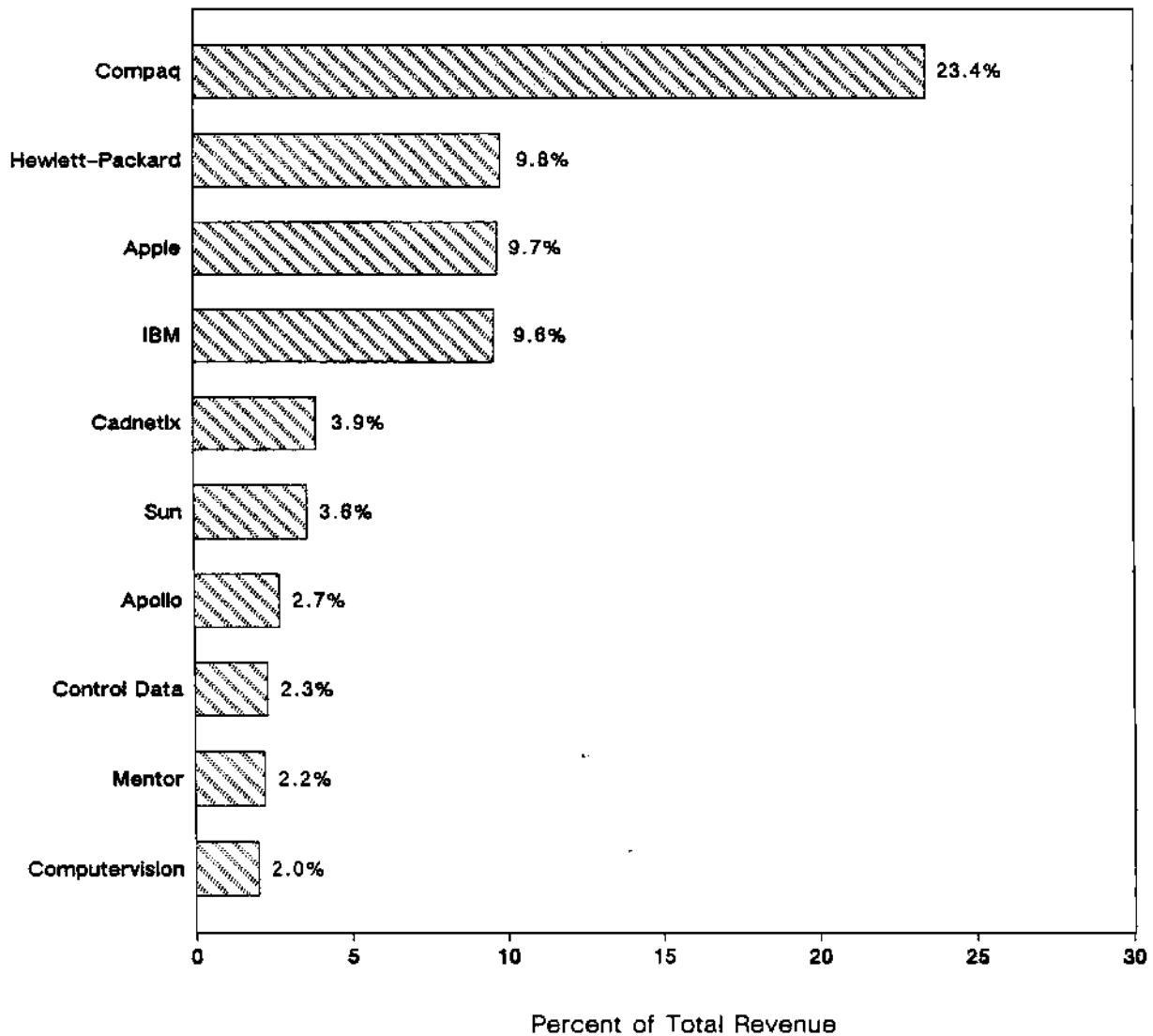
Figure 4.5-3

**PCB Layout 1987 Worldwide Market Share
Software Revenue**

Source: Dataquest
July 1988

Figure 4.5-4

PCB Layout 1987 Worldwide Market Share
Workstation Shipments



Source: Dataquest
July 1988

Table 4.5-1

PCB Layout 1987 Worldwide Market Share
(Millions of Dollars, Actual Units)

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Recal-Redac	76.4	8.0	57.8	167	10.6%	2.2%	22.1%	1.0%
Scientific Calculations	51.5	16.8	17.3	154	7.1%	4.7%	6.6%	.9%
Digital	39.6	34.0	.0	178	5.5%	9.4%	.0%	1.1%
Cadnetix	37.7	17.9	15.4	644	5.2%	5.0%	5.9%	3.9%
Computervision	37.0	13.5	13.3	325	5.1%	3.8%	5.1%	2.0%
Zuken	36.2	19.0	12.5	287	5.0%	5.3%	4.8%	1.8%
Hewlett-Packard	31.9	19.6	9.8	1,598	4.4%	5.4%	3.7%	9.8%
IBM	28.7	21.9	3.3	1,563	4.0%	6.1%	1.3%	9.6%
Calay	27.2	17.1	8.1	230	3.8%	4.8%	3.1%	1.4%
Mentor	24.2	11.4	9.0	366	3.3%	3.1%	3.5%	2.2%
Sharp System Products	16.3	6.8	7.9	85	2.2%	1.9%	3.0%	.5%
Personal CAD Systems	15.6	.0	13.6	0	2.2%	.0%	5.2%	.0%
NEC	15.4	7.6	6.2	160	2.1%	2.1%	2.4%	1.0%
Fujitsu	14.2	10.2	2.6	200	2.0%	2.8%	1.0%	1.2%
Sun.	14.1	12.5	.0	585	2.0%	3.5%	.0%	3.6%
Compaq	13.6	13.6	.0	3,820	1.9%	3.8%	.0%	23.4%
Hitachi	12.4	8.0	3.3	221	1.7%	2.2%	1.2%	1.4%
Apollo	11.3	10.2	.0	440	1.6%	2.8%	.0%	2.7%
Daisy	10.2	2.6	5.4	77	1.4%	.7%	2.1%	.5%
Asahi Optical (No OEM)	10.0	7.4	1.6	55	1.4%	2.1%	.6%	.3%
Applicon	9.5	3.9	2.7	200	1.3%	1.1%	1.0%	1.2%
Valid	8.9	3.2	3.5	76	1.2%	.9%	1.3%	.5%
Autodesk	8.1	.0	8.1	0	1.1%	.0%	3.1%	.0%
Calma	7.5	3.6	2.2	81	1.0%	1.0%	.9%	.5%
Toshiba (No OEM)	7.2	5.5	1.0	84	1.0%	1.5%	.4%	.5%
Intergraph	6.4	4.0	1.2	56	.9%	1.1%	.5%	.3%
Control Data	5.3	3.0	1.1	370	.7%	.8%	.4%	2.3%
Hitachi Zosen	4.4	1.6	2.4	29	.6%	.4%	.9%	.2%
Apple Computer	4.4	4.4	.0	1,580	.6%	1.2%	.0%	9.7%
CADAM	4.2	.0	3.8	0	.6%	.0%	1.5%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	.5%	.6%	.4%	.3%
Futurenet	3.2	.0	2.8	0	.4%	.0%	1.1%	.0%

(Continued)

4.5 PCB Layout Market Shares

Table 4.5-1 (Continued)

**PCB Layout 1987 Worldwide Market Share
(Millions of Dollars, Actual Units)**

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Tektronix	1.5	.7	.6	20	.2%	.2%	.2%	.1%
Silver-Lisco	.9	.0	.9	0	.1%	.0%	.3%	.0%
ICL	.8	.6	.2	19	.1%	.2%	.1%	.1%
ECAD	.3	.0	.3	0	.0%	.0%	.1%	.0%
Other Companies	123.0	69.8	42.5	2,603	17.0%	19.3%	16.3%	16.0%
All Companies	722.5	360.7	261.1	16,315	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	428.3	231.4	129.9	13,769	59.3%	64.2%	49.7%	84.4%
All Asian-Based Companies	154.0	87.1	50.1	1,894	21.3%	24.1%	19.2%	11.6%
All European-Based Companies	140.2	42.2	81.1	652	19.4%	11.7%	31.0%	4.0%
All Hardware Companies	128.9	117.9	.2	9,493	17.8%	32.7%	.1%	58.2%
All Turnkey & SW Companies	593.7	242.8	260.9	6,822	82.2%	67.3%	99.9%	41.8%

Source: Dataquest
July 1988



Forecast Data Base Introduction

STRUCTURE OF THE FORECAST DATA BASE

For these research notebooks, the forecast data base is structured in three parts. Each part is found in one of the following appendices:

- History and Forecast—Five years each of history and forecasts, segmented by application, region, and platform
- Market Share—Data for all companies with total company CAD/CAM revenue of \$15 million or more, segmented by application, region, and platform
- Company History—Five years of history for all companies with CAD/CAM revenue of \$15 million or more, segmented by application

Each applications binder contains its own Appendix A and Appendix B. Appendix C, for all companies and all applications, is found only in the *Industry Overview* notebook.

Information in the forecast data base appendices is presented in table format only. These data are intended to cover all possible market segmentation. Please refer to the applications modules, *Industry Overview*, and each relevant segment for Dataquest's analysis and interpretation of the data.

Definitions of forecasting terms can be found in the glossary located behind the Glossary tab. A list of companies and countries contained in the data base and a description of forecasting methodology can be found in the section entitled "Introduction to the Service" that appears in each binder.

The forecast data base hierarchy is reflected in each of the reports. The History and Forecast and Market Share appendices are organized as follows:

- Application—All, mechanical, facilities design, mapping, electronic design automation, electronic CAE, IC layout, and PCB layout by
 - Region—Worldwide, North America, Europe, Far East, and Rest of World by
 - Platform—All, technical workstation, host-dependent, and personal computer

DOUBLE COUNTING

Dataquest takes great care to avoid double counting company revenue and shipment data in our estimates for the total market. To avoid this, we collect information on vendors' total CAD/CAM revenue as well as OEM revenue, or revenue derived from sales to another CAD/CAM company for its resale. OEM revenue is then subtracted from total company revenue to count just end-user sales.

We do, however, distinguish between distributors such as those companies that provide a sales service for a CAD/CAM vendor's product and true OEMs. In most cases, the distributors in our data base are Japanese companies that sell, install, and/or service CAD/CAM products for a vendor based outside of Japan. The following guideline and examples illustrate our definitions and how we avoid double counting.

- **Computer manufacturers**—We collect and count only revenue direct to end users, either turnkey or hardware only. For example, we report \$110 million for Sun Microsystems, which is 50 percent of that company's total CAD/CAM revenue. The unreported \$110 million is from sales to OEM customers.
- **Software vendors**—We collect total CAD/CAM sales, then subtract any reported OEM revenue. For example, CADAM reported \$53 million in total CAD/CAM revenue, of which \$17 million was through OEM channels. To arrive at CADAM's end-user sales of \$36 million, the amount we use to calculate market share, we subtracted \$17 million from \$53 million.
- **Distributors**—Seiko Instruments, based in Japan, reported \$89.5 million in CAD/CAM sales. Seiko is a distributor for Daisy Systems and McDonnell Douglas, as well as a vendor of its own proprietary products. Only the portion of Seiko's revenue that is derived from its own products is included in the total market calculation, even though we show all of Seiko's revenue in the Asian segment market share tables.

REPORTING CHANGES FROM 1986 TO 1987

In order to best serve our clients' needs, we continue to expand the scope of how we report on the CAD/CAM market. For the current reports, dated July 1988, the changes noted in the following subsections have been made.

Integrated Worldwide Data Base

Since 1985, Dataquest has been collecting sales information on seven European regions and Japan. In addition, in 1988, we have collected information on five other Asian regions for the first time. We included all regional data in the CAD/CAM data base, thus achieving a truly integrated, worldwide data base. Data on individual European and Asian countries are available in the respective CCIS segments.

Turnkey and Unbundled Forecasts

Because of the pronounced trend toward users purchasing CAD/CAM products directly from the original suppliers, thus bypassing the turnkey channel, we expanded the level at which we forecast. Dataquest now forecasts the unbundled and turnkey channels individually, giving more clarification and analysis to each.

PC-Based CAD/CAM Software Companies

To best analyze and report on the trends of the personal CAD market, we have expanded our data collection to include revenue information from 35 additional companies participating in this segment. Most of these companies have revenue of significantly less than \$15 million; for the CCIS application and regional segments, they are included in the "Other" category. Refer to the personal CAD segment binder for complete information on all of the companies participating in the PC market.

PC Software Units

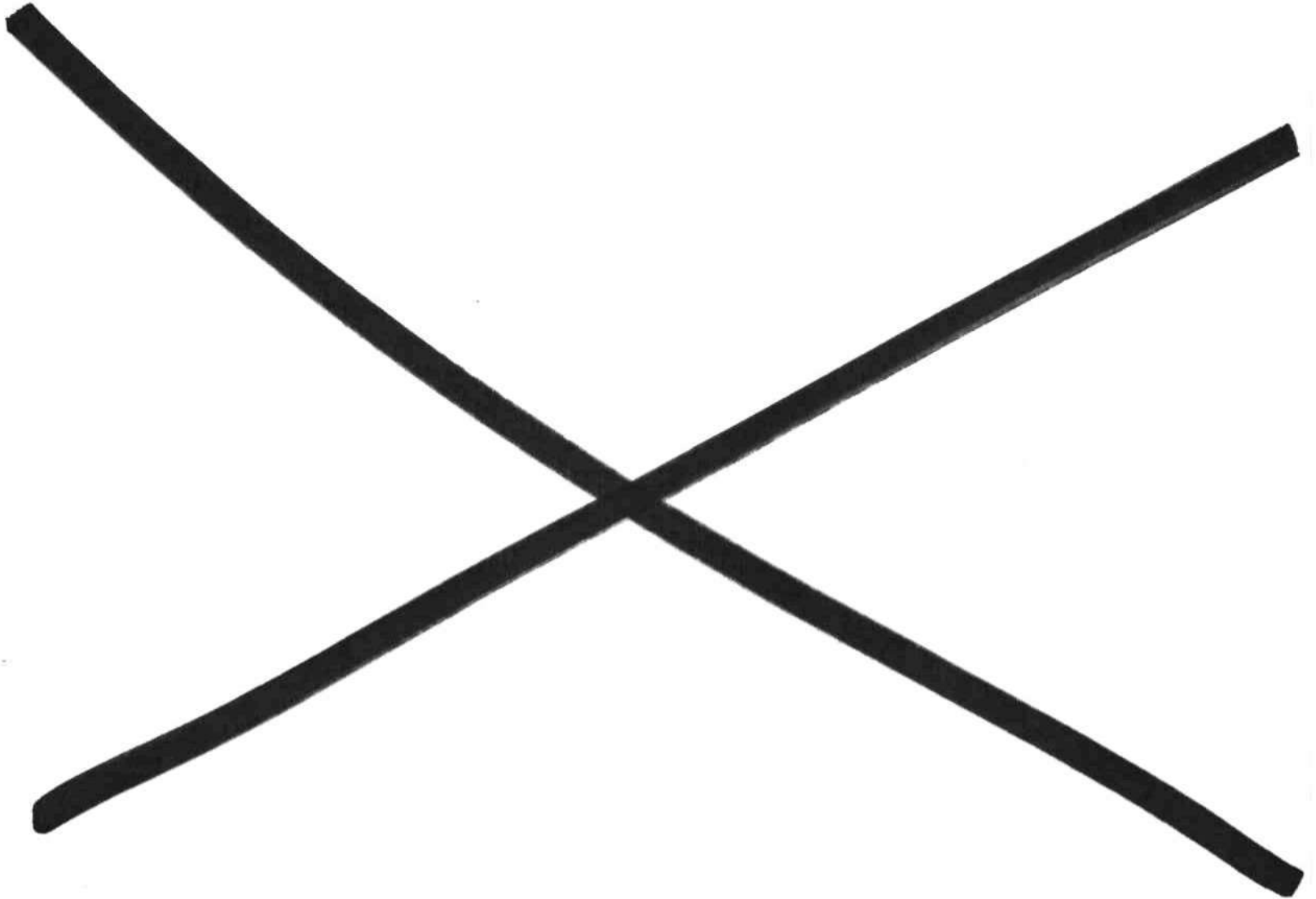
For the first time, Dataquest's CCIS is reporting software units sold; we include this measure in our market share estimates. Because of the high need for unit information in the PC CAD segment, this information is available first and only in our personal CAD segment binder.

Installed Base Versus Workstations Shipped to Date

We have developed a retirement model that takes into account platform and year sold to calculate installed base. The retirement model, in tandem with our forecast by platform, provides clients with product life cycle analysis and data. We differentiate between installed base and workstations shipped to date in such a way that the latter is shown only on a company basis and installed base is calculated only at the aggregate market level.

More Information in the History and Forecast Tables

Three new line items are included in the History and Forecast Appendix: Turnkey versus hardware-only average system price, total hardware revenue, and bundled versus unbundled software revenue. So that clients can better understand the turnkey versus unbundled channels, and because we now forecast at this level, we distinguish system pricing and software revenue based on point of sale. For convenience, the sum of CPU, workstation, and peripheral revenue is shown in the hardware revenue line.



Appendix A—Forecast

INTRODUCTION

The following history and forecast tables present Dataquest's 10-year CAD/CAM market window. The tables contained in this section represent our estimates for the years 1983 through 1987 and our forecasts for 1988 through 1992. Each table is a consolidation of all the companies contained in our data base model for each applicable segment.

Please refer to the section entitled "Introduction to the Service" for a complete list of companies, forecasting methodologies, and caveats. Forecasting terms and definitions can be found behind the Glossary tab.

This chapter is structured as follows:

- Application by
 - Region by
 - Platform

TABLE NUMBER: 1
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	2,396	11,607	21,979	34,889	48,339	59,400	69,170	76,860	83,320	88,780	112%	13%
Workstation Shipments	4,025	13,620	23,905	37,506	50,369	60,800	70,210	77,610	83,930	89,210	88%	12%
CPU Installed Base	2,436	11,005	31,471	62,269	110,036	166,840	228,700	290,300	348,110	399,730	159%	29%
Workstation Installed Base	4,698	14,574	36,728	69,152	117,950	174,770	236,050	296,430	352,370	401,640	124%	28%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	159.9	104.7	97.9	76.9	50.8	45.3	41.8	39.1	37.1	34.3	-25%	-8%
Hardware-Only ASP	343.6	34.5	28.2	19.5	14.6	12.4	10.9	9.9	9.1	8.5	-55%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	924	1,044	1,000	1,091	1,112	1,118	1,098	1,061	NA	1%
CPU Revenue	NA	NA	434	478	452	491	506	513	503	488	NA	2%
Workstation Revenue	NA	NA	290	389	359	429	450	462	461	449	NA	5%
Peripheral Revenue	NA	NA	200	177	188	172	156	143	134	125	NA	-8%
Software Revenue	NA	NA	401	550	721	797	909	1,014	1,095	1,165	NA	10%
Bundled	NA	NA	309	315	280	245	257	270	283	292	NA	1%
Unbundled	NA	NA	92	235	442	552	652	743	812	873	NA	15%
Service Revenue	60	87	134	186	260	282	301	318	327	336	44%	5%
Total Revenue	509	849	1,484	1,791	1,982	2,170	2,322	2,450	2,521	2,563	40%	5%
Increase over Prior Year	NA	67%	75%	21%	11%	10%	7%	6%	3%	2%		

Source: Dataquest
 July 1988

TABLE NUMBER: 2
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,683	5,072	8,827	13,029	19,328	24,580	30,030	35,860	42,370	49,190	84%	21%
Workstation Shipments	1,683	5,159	8,827	13,029	19,328	24,580	30,030	35,860	42,370	49,190	84%	21%
CPU Installed Base	1,293	4,891	12,717	24,126	43,279	67,190	95,330	127,050	161,900	199,050	141%	36%
Workstation Installed Base	1,293	4,891	12,717	24,126	43,279	67,190	95,330	127,050	161,900	199,050	141%	36%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	59.8	55.6	82.3	74.1	47.1	43.6	40.7	37.9	35.3	32.7	-6%	-7%
Hardware-Only ASP	40.1	31.8	28.6	24.7	22.8	20.6	18.7	16.7	14.8	13.0	-13%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	365	492	511	641	709	760	793	802	NA	9%
CPU Revenue	NA	NA	130	200	204	277	310	336	354	359	NA	12%
Workstation Revenue	NA	NA	130	200	204	277	310	336	354	359	NA	12%
Peripheral Revenue	NA	NA	105	93	103	88	89	88	85	83	NA	-4%
Software Revenue	NA	NA	242	301	449	514	620	728	829	929	NA	16%
Bundled	NA	NA	224	221	221	198	218	236	252	265	NA	4%
Unbundled	NA	NA	18	80	228	316	402	492	577	664	NA	24%
Service Revenue	8	18	69	91	158	194	223	248	267	279	112%	12%
Total Revenue	106	286	701	894	1,118	1,350	1,551	1,736	1,888	2,010	80%	12%
Increase over Prior Year	NA	171%	146%	27%	25%	21%	15%	12%	9%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 3
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	713	1,017	1,326	1,430	1,636	1,460	1,300	1,230	1,150	1,100	23%	-8%
Workstation Shipments	2,342	2,943	3,251	4,047	3,666	2,860	2,350	1,980	1,750	1,530	12%	-16%
CPU Installed Base	1,144	1,719	2,843	4,031	5,668	7,130	8,430	9,660	10,810	11,910	49%	16%
Workstation Installed Base	3,405	5,288	8,099	10,915	13,581	15,060	15,790	15,790	15,070	13,820	41%	0%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	464.4	455.0	384.2	521.4	282.4	278.6	285.5	270.2	248.1	228.2	-12%	-4%
Hardware-Only ASP	559.8	387.0	354.1	248.1	216.1	198.4	180.8	164.4	144.9	127.2	-21%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	441	418	360	307	256	219	181	152	NA	-16%
CPU Revenue	NA	NA	251	219	188	145	124	109	89	77	NA	-16%
Workstation Revenue	NA	NA	106	130	95	83	68	58	47	37	NA	-17%
Peripheral Revenue	NA	NA	84	69	77	79	63	52	45	38	NA	-13%
Software Revenue	NA	NA	90	111	103	79	71	62	52	45	NA	-15%
Bundled	NA	NA	52	52	39	28	24	22	21	19	NA	-13%
Unbundled	NA	NA	38	59	64	51	47	40	31	26	NA	-17%
Service Revenue	52	68	62	75	78	60	49	40	33	33	11%	-16%
Total Revenue	403	505	591	604	542	445	375	322	265	229	8%	-16%
Increase over Prior Year	NA	25%	17%	2%	-10%	-18%	-16%	-14%	-18%	-14%		

Source: Dataquest
 July 1988

TABLE NUMBER: 4
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	5,518	11,826	20,430	27,375	33,350	37,840	39,770	39,810	38,490	NA	7%
Workstation Shipments	0	5,518	11,826	20,430	27,375	33,350	37,840	39,770	39,810	38,490	NA	7%
CPU Installed Base	0	4,396	15,911	34,111	61,090	92,530	124,930	153,580	175,410	188,770	NA	25%
Workstation Installed Base	0	4,396	15,911	34,111	61,090	92,530	124,930	153,580	175,410	188,770	NA	25%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	34.1	36.3	29.6	14.4	13.6	12.6	12.7	14.2	14.8	NA	1%
Hardware-Only ASP	.0	10.3	8.9	4.4	4.3	3.9	3.6	3.3	2.9	2.6	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	118	134	129	143	148	140	125	108	NA	-4%
CPU Revenue	NA	NA	53	59	60	69	72	68	61	52	NA	-3%
Workstation Revenue	NA	NA	53	59	60	69	72	68	61	52	NA	-3%
Peripheral Revenue	NA	NA	11	15	9	5	4	3	4	4	NA	-15%
Software Revenue	NA	NA	69	138	169	204	218	224	215	192	NA	3%
Bundled	NA	NA	32	42	19	19	15	13	10	8	NA	-17%
Unbundled	NA	NA	36	96	149	185	203	211	205	184	NA	4%
Service Revenue	0	1	3	20	24	28	29	29	28	25	NA	1%
Total Revenue	0	59	191	293	322	375	395	393	367	324	NA	0%
Increase over Prior Year	NA	NA	226%	53%	10%	17%	5%	-1%	-6%	-12%		

Source: Dataquest
 July 1988

TABLE NUMBER: 5
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,555	8,444	15,288	19,974	27,280	33,380	38,250	41,960	44,740	47,100	105%	12%
Workstation Shipments	2,570	9,740	16,373	20,949	27,816	33,540	38,320	41,960	44,740	47,100	81%	11%
CPU Installed Base	2,059	10,504	25,789	45,732	72,448	103,540	135,830	166,550	194,190	218,250	144%	25%
Workstation Installed Base	3,893	13,622	29,909	50,515	77,092	107,340	138,420	167,640	193,700	216,310	111%	23%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	144.8	100.3	86.2	63.8	41.0	32.9	28.6	25.8	23.6	21.6	-27%	-12%
Hardware-Only ASP	258.3	25.8	21.3	16.6	12.0	9.9	8.7	8.1	7.5	7.1	-54%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	506	478	442	429	421	416	404	391	NA	-2%
CPU Revenue	NA	NA	226	224	194	201	201	200	195	189	NA	-1%
Workstation Revenue	NA	NA	170	170	161	171	176	178	174	170	NA	1%
Peripheral Revenue	NA	NA	110	84	87	57	43	38	35	33	NA	-18%
Software Revenue	NA	NA	255	269	309	353	394	436	468	495	NA	10%
Bundled	NA	NA	187	112	76	76	74	74	72	72	NA	-1%
Unbundled	NA	NA	68	157	233	277	319	362	396	424	NA	13%
Service Revenue	35	55	92	104	119	119	123	129	132	132	36%	2%
Total Revenue	287	537	853	851	870	901	937	980	1,003	1,019	32%	3%
Increase over Prior Year	NA	87%	59%	-0%	2%	4%	4%	5%	2%	2%		

Source: Dataquest
 July 1988

TABLE NUMBER: 6
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,189	3,579	5,795	7,109	9,823	12,170	14,430	16,720	19,170	22,200	70%	18%
Workstation Shipments	1,189	3,579	5,795	7,109	9,823	12,170	14,430	16,720	19,170	22,200	70%	18%
CPU Installed Base	1,293	4,872	10,665	17,743	27,391	38,920	51,700	65,180	79,220	94,270	115%	28%
Workstation Installed Base	1,293	4,872	10,665	17,743	27,391	38,920	51,700	65,180	79,220	94,270	115%	28%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	56.8	56.0	70.8	57.9	35.6	32.2	29.1	26.3	23.8	21.6	-11%	-10%
Hardware-Only ASP	40.1	31.9	27.6	23.3	22.0	20.0	18.2	16.3	14.4	12.7	-14%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	214	226	230	258	274	283	285	288	NA	5%
CPU Revenue	NA	NA	79	92	92	113	122	127	130	132	NA	7%
Workstation Revenue	NA	NA	79	92	92	113	122	127	130	132	NA	7%
Peripheral Revenue	NA	NA	56	42	46	32	31	28	25	23	NA	-13%
Software Revenue	NA	NA	161	147	183	229	270	311	353	396	NA	17%
Bundled	NA	NA	146	90	65	71	73	72	72	72	NA	2%
Unbundled	NA	NA	15	58	118	158	197	239	282	325	NA	22%
Service Revenue	5	12	42	55	73	87	97	105	111	115	97%	9%
Total Revenue	70	202	417	428	486	573	641	699	749	799	62%	10%
Increase over Prior Year	NA	189%	106%	3%	14%	18%	12%	9%	7%	7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 7
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	366	557	691	734	714	510	370	350	350	340	18%	-14%
Workstation Shipments	1,381	1,853	1,776	1,710	1,250	670	440	350	350	340	-2%	-23%
CPU Installed Base	766	1,323	2,014	2,749	3,463	3,970	4,350	4,700	5,040	5,390	46%	9%
Workstation Installed Base	2,600	4,441	6,134	7,532	8,106	7,780	6,940	5,790	4,550	3,440	33%	-16%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	470.4	468.2	390.0	516.0	208.4	156.0	144.5	.0	.0	.0	-18%	-100%
Hardware-Only ASP	640.8	407.0	296.2	219.8	197.1	179.3	162.7	146.9	129.6	113.8	-26%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	212	195	138	88	60	51	45	39	NA	-22%
CPU Revenue	NA	NA	108	104	65	47	37	32	29	25	NA	-17%
Workstation Revenue	NA	NA	52	51	32	17	12	10	8	7	NA	-27%
Peripheral Revenue	NA	NA	52	39	40	23	12	9	8	7	NA	-29%
Software Revenue	NA	NA	50	52	40	25	21	16	12	9	NA	-25%
Bundled	NA	NA	26	11	6	2	0	0	0	0	NA	-100%
Unbundled	NA	NA	24	41	34	23	21	16	12	9	NA	-23%
Service Revenue	30	42	47	40	36	20	14	12	9	8	5%	-27%
Total Revenue	217	292	309	286	214	133	96	79	66	56	-0%	-23%
Increase over Prior Year	NA	35%	6%	-7%	-25%	-38%	-28%	-17%	-17%	-14%		

Source: Dataquest
 July 1988

TABLE NUMBER: 8
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	4,308	8,802	12,130	16,742	20,700	23,450	24,890	25,230	24,560	NA	8%
Workstation Shipments	0	4,308	8,802	12,130	16,742	20,700	23,450	24,890	25,230	24,560	NA	8%
CPU Installed Base	0	4,308	13,111	25,240	41,595	60,640	79,780	96,670	109,930	118,590	NA	23%
Workstation Installed Base	0	4,308	13,111	25,240	41,595	60,640	79,780	96,670	109,930	118,590	NA	23%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	34.1	32.7	20.6	19.8	16.3	10.4	9.4	8.5	.0	NA	-100%
Hardware-Only ASP	.0	9.5	9.0	4.3	4.3	3.9	3.6	3.3	2.9	2.6	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	80	57	75	84	86	82	74	64	NA	-3%
CPU Revenue	NA	NA	39	27	37	41	43	41	36	31	NA	-3%
Workstation Revenue	NA	NA	39	27	37	41	43	41	36	31	NA	-3%
Peripheral Revenue	NA	NA	2	3	2	1	1	1	1	2	NA	5%
Software Revenue	NA	NA	44	69	86	100	103	108	103	90	NA	1%
Bundled	NA	NA	15	11	5	4	1	1	1	0	NA	-100%
Unbundled	NA	NA	28	59	81	96	102	107	103	90	NA	2%
Service Revenue	0	0	2	10	10	11	11	12	11	10	NA	-0%
Total Revenue	0	42	126	137	171	195	201	202	189	164	NA	-1%
Increase over Prior Year	NA	NA	199%	8%	25%	14%	3%	0%	-6%	-13%		

Source: Dataquest
 July 1988

TABLE NUMBER: 9
 TITLE: History and forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	686	1,944	3,515	7,833	11,983	14,470	16,740	18,740	20,630	22,150	104%	13%
Workstation Shipments	1,144	2,292	3,772	8,211	12,456	14,720	16,830	18,750	20,640	22,160	82%	12%
CPU Installed Base	0	0	3,509	11,340	23,323	37,590	53,410	69,490	84,710	98,270	NA	33%
Workstation Installed Base	0	0	3,766	11,975	24,431	38,950	54,830	70,790	85,740	98,850	NA	32%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	149.1	90.7	109.5	78.9	36.4	33.0	30.1	27.8	26.8	24.7	-30%	-7%
Hardware-Only ASP	503.0	65.8	42.9	18.0	17.7	16.1	14.1	12.8	11.3	10.5	-57%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	198	232	237	270	275	275	271	264	NA	2%
CPU Revenue	NA	NA	93	109	110	126	130	132	129	126	NA	3%
Workstation Revenue	NA	NA	46	84	85	103	107	111	112	110	NA	5%
Peripheral Revenue	NA	NA	59	38	42	42	38	31	29	28	NA	-8%
Software Revenue	NA	NA	68	147	240	281	328	366	392	416	NA	12%
Bundled	NA	NA	51	100	67	54	55	57	58	59	NA	-2%
Unbundled	NA	NA	17	47	173	227	273	310	334	357	NA	16%
Service Revenue	19	19	24	37	83	99	108	116	121	125	45%	9%
Total Revenue	149	175	283	428	560	650	711	757	784	804	39%	8%
Increase over Prior Year	NA	17%	62%	51%	31%	16%	9%	6%	4%	3%		

Source: Dataquest
 July 1988

Forecasts

TABLE NUMBER: 10
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	428	1,045	1,501	3,503	5,588	7,030	8,700	10,510	12,630	14,640	90%	21%
Workstation Shipments	428	1,132	1,501	3,503	5,588	7,030	8,700	10,510	12,630	14,640	90%	21%
CPU Installed Base	0	0	1,496	4,997	10,585	17,590	26,110	35,960	46,910	58,340	NA	41%
Workstation Installed Base	0	0	1,496	4,997	10,585	17,590	26,110	35,960	46,910	58,340	NA	41%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	65.1	49.7	101.5	81.7	39.7	36.2	32.9	29.9	27.2	24.7	-12%	-9%
Hardware-Only ASP	.0	31.5	32.5	26.7	23.5	21.1	18.9	17.0	15.0	13.2	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	86	144	132	164	181	195	205	208	NA	10%
CPU Revenue	NA	NA	25	59	53	71	80	86	92	93	NA	12%
Workstation Revenue	NA	NA	25	59	53	71	80	86	92	93	NA	12%
Peripheral Revenue	NA	NA	37	26	26	22	22	22	21	21	NA	-4%
Software Revenue	NA	NA	41	92	160	186	227	268	301	335	NA	16%
Bundled	NA	NA	39	81	60	49	53	55	58	59	NA	-0%
Unbundled	NA	NA	2	11	100	136	174	213	244	276	NA	23%
Service Revenue	3	4	17	20	56	71	83	94	102	108	115%	14%
Total Revenue	31	54	145	266	348	421	491	556	609	651	84%	13%
Increase over Prior Year	NA	78%	166%	84%	31%	21%	17%	13%	9%	7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 11
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	258	266	151	154	353	370	340	310	280	280	8%	-5%
Workstation Shipments	716	527	408	532	827	620	430	310	280	280	4%	-19%
CPU Installed Base	0	0	151	305	658	1,030	1,370	1,680	1,960	2,240	NA	28%
Workstation Installed Base	0	0	408	939	1,766	2,390	2,790	2,990	2,990	2,830	NA	10%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	352.3	368.2	386.9	506.0	255.3	243.5	265.8	.0	.0	.0	-8%	-100%
Hardware-Only ASP	503.0	367.7	692.3	389.0	232.2	210.7	189.4	173.2	153.8	134.8	-18%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	89	60	80	79	66	54	43	37	NA	-14%
CPU Revenue	NA	NA	60	39	45	42	36	33	26	23	NA	-12%
Workstation Revenue	NA	NA	14	14	20	18	14	12	9	8	NA	-18%
Peripheral Revenue	NA	NA	15	7	15	19	15	9	7	6	NA	-16%
Software Revenue	NA	NA	13	20	30	26	22	18	14	11	NA	-18%
Bundled	NA	NA	5	6	4	2	1	0	0	0	NA	-100%
Unbundled	NA	NA	8	14	26	23	22	18	14	11	NA	-16%
Service Revenue	16	15	6	14	19	17	13	10	7	6	4%	-20%
Total Revenue	119	113	101	94	129	121	101	82	64	55	2%	-16%
Increase over Prior Year	NA	-5%	-11%	-7%	38%	-6%	-16%	-18%	-22%	-15%		

Source: Dataquest
 July 1988

TABLE NUMBER: 12
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	====	====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	633	1,864	4,176	6,041	7,060	7,700	7,920	7,720	7,240	NA	4%
Workstation Shipments	0	633	1,864	4,176	6,041	7,060	7,700	7,920	7,720	7,240	NA	4%
CPU Installed Base	0	0	1,862	6,039	12,080	18,980	25,930	31,840	35,840	37,690	NA	26%
Workstation Installed Base	0	0	1,862	6,039	12,080	18,980	25,930	31,840	35,840	37,690	NA	26%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	73.8	37.7	6.2	6.0	5.5	5.4	8.8	.0	NA	-100%
Hardware-Only ASP	.0	11.5	9.0	4.7	4.3	3.9	3.6	3.2	2.9	2.6	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	23	28	25	27	27	26	23	19	NA	-6%
CPU Revenue	NA	NA	8	12	12	13	13	13	11	9	NA	-5%
Workstation Revenue	NA	NA	8	12	12	13	13	13	11	9	NA	-5%
Peripheral Revenue	NA	NA	7	4	1	1	1	0	1	1	NA	-11%
Software Revenue	NA	NA	14	35	49	70	79	80	77	70	NA	7%
Bundled	NA	NA	7	14	3	3	2	1	0	0	NA	-100%
Unbundled	NA	NA	7	22	47	67	77	79	76	70	NA	8%
Service Revenue	0	0	1	3	8	11	12	12	12	10	NA	6%
Total Revenue	0	8	37	68	83	108	118	118	111	99	NA	4%
Increase over Prior Year	NA	NA	391%	82%	22%	31%	10%	-0%	-6%	-11%		

Source: Dataquest
 July 1988

TABLE NUMBER: 13
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Asia
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	146	1,094	2,847	6,311	8,376	10,470	12,510	14,370	16,070	17,550	175%	16%
Workstation Shipments	277	1,433	3,398	7,421	9,364	11,430	13,380	15,120	16,670	17,980	141%	14%
CPU Installed Base	0	0	1,341	3,594	11,970	22,360	34,550	47,800	61,300	74,050	NA	44%
Workstation Installed Base	0	0	1,781	4,627	13,991	25,340	38,350	52,150	65,800	78,200	NA	41%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	395.8	161.9	120.8	98.2	82.8	77.6	71.7	66.4	61.8	56.4	-32%	-7%
Hardware-Only ASP	509.2	61.7	73.6	28.8	21.1	17.7	15.6	13.6	11.9	10.9	-55%	-12%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	208	296	303	376	400	411	408	391	NA	5%
CPU Revenue	NA	NA	109	124	139	156	167	172	171	166	NA	4%
Workstation Revenue	NA	NA	69	121	107	148	159	166	167	162	NA	9%
Peripheral Revenue	NA	NA	30	51	56	72	74	73	70	63	NA	2%
Software Revenue	NA	NA	75	131	169	158	182	206	229	248	NA	8%
Bundled	NA	NA	68	101	135	113	126	139	151	160	NA	3%
Unbundled	NA	NA	7	30	33	45	56	67	78	88	NA	21%
Service Revenue	6	12	15	40	55	62	67	71	72	76	76%	7%
Total Revenue	68	126	331	465	526	596	650	688	708	715	67%	6%
Increase over Prior Year	NA	85%	163%	41%	13%	13%	9%	6%	3%	1%		

Source: Dataquest
 July 1988

TABLE NUMBER: 14
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Asia
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	66	429	1,358	1,968	3,679	5,040	6,530	8,230	10,110	11,830	173%	26%
Workstation Shipments	66	429	1,358	1,968	3,679	5,040	6,530	8,230	10,110	11,830	173%	26%
CPU Installed Base	0	0	364	745	4,424	9,460	15,950	24,000	33,570	43,980	NA	58%
Workstation Installed Base	0	0	364	745	4,424	9,460	15,950	24,000	33,570	43,980	NA	58%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	71.2	66.7	115.0	123.0	88.7	81.1	74.4	67.7	61.5	56.0	6%	-9%
Hardware-Only ASP	.0	31.7	28.0	26.0	24.0	21.5	19.3	17.4	15.4	13.6	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	60	109	143	211	246	275	295	299	NA	16%
CPU Revenue	NA	NA	24	43	56	89	105	119	128	130	NA	18%
Workstation Revenue	NA	NA	24	43	56	89	105	119	128	130	NA	18%
Peripheral Revenue	NA	NA	11	24	30	33	35	37	38	38	NA	5%
Software Revenue	NA	NA	39	60	104	97	120	145	171	194	NA	13%
Bundled	NA	NA	38	48	94	77	91	106	121	133	NA	7%
Unbundled	NA	NA	1	11	10	21	29	39	49	61	NA	43%
Service Revenue	0	1	8	14	27	35	41	48	52	54	201%	15%
Total Revenue	5	28	132	181	274	343	407	468	517	547	172%	15%
Increase over Prior Year	NA	455%	372%	38%	51%	25%	19%	15%	11%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 15
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Asia
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	80	176	466	441	525	560	570	550	500	460	60%	-3%
Workstation Shipments	211	516	1,017	1,551	1,513	1,520	1,440	1,300	1,100	890	64%	-10%
CPU Installed Base	0	0	265	464	989	1,550	2,120	2,660	3,160	3,620	NA	30%
Workstation Installed Base	0	0	705	1,497	3,010	4,520	5,920	7,020	7,660	7,770	NA	21%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	929.7	521.9	372.4	532.8	341.1	318.5	294.4	270.2	248.1	228.2	-22%	-8%
Hardware-Only ASP	509.2	374.8	279.6	264.2	242.5	218.2	197.1	179.1	159.7	140.7	-17%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	134	139	132	136	125	109	89	72	NA	-12%
CPU Revenue	NA	NA	79	61	72	54	49	41	32	26	NA	-18%
Workstation Revenue	NA	NA	39	58	40	46	41	35	28	22	NA	-12%
Peripheral Revenue	NA	NA	16	20	20	36	36	34	30	24	NA	4%
Software Revenue	NA	NA	26	39	33	28	28	27	26	24	NA	-6%
Bundled	NA	NA	20	35	29	24	23	22	21	19	NA	-8%
Unbundled	NA	NA	6	4	4	4	5	5	5	5	NA	6%
Service Revenue	5	10	7	19	22	22	21	19	15	18	42%	-4%
Total Revenue	63	90	172	197	187	186	174	155	131	114	31%	-9%
Increase over Prior Year	NA	43%	91%	14%	-5%	-0%	-7%	-11%	-16%	-13%		

Source: Dataquest
 July 1988

TABLE NUMBER: 16
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Asia
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	488	1,023	3,902	4,173	4,870	5,410	5,600	5,460	5,260	NA	5%
Workstation Shipments	0	488	1,023	3,902	4,173	4,870	5,410	5,600	5,460	5,260	NA	5%
CPU Installed Base	0	0	713	2,384	6,557	11,360	16,480	21,130	24,570	26,460	NA	32%
Workstation Installed Base	0	0	713	2,384	6,557	11,360	16,480	21,130	24,570	26,460	NA	32%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	29.7	31.4	18.2	17.3	16.4	15.6	15.3	14.9	NA	-4%
Hardware-Only ASP	.0	14.6	9.0	4.7	4.1	3.8	3.5	3.1	2.8	2.5	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	14	48	27	29	29	27	24	21	NA	-5%
CPU Revenue	NA	NA	6	20	11	13	13	12	11	10	NA	-2%
Workstation Revenue	NA	NA	6	20	11	13	13	12	11	10	NA	-2%
Peripheral Revenue	NA	NA	2	8	6	3	2	2	2	1	NA	-26%
Software Revenue	NA	NA	11	32	31	33	34	34	32	30	NA	-1%
Bundled	NA	NA	9	18	12	12	12	10	9	7	NA	-9%
Unbundled	NA	NA	1	14	20	20	22	23	23	22	NA	2%
Service Revenue	0	1	0	6	6	5	5	5	4	4	NA	-6%
Total Revenue	0	8	27	87	65	67	68	66	60	54	NA	-3%
Increase over Prior Year	NA	NA	240%	220%	-26%	3%	3%	-4%	-8%	-10%		

Source: Dataquest
 July 1988

TABLE NUMBER: 17
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	*****	*****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	9	125	330	771	700	1,090	1,660	1,780	1,880	1,980	198%	23%
Workstation Shipments	34	154	363	925	733	1,110	1,670	1,780	1,880	1,980	116%	22%
CPU Installed Base	377	502	832	1,603	2,295	3,350	4,910	6,470	7,910	9,160	57%	32%
Workstation Installed Base	805	953	1,272	2,035	2,435	3,140	4,450	5,840	7,140	8,280	32%	28%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	381.7	274.4	171.9	71.0	49.6	37.8	33.7	30.0	27.6	25.2	-40%	-13%
Hardware-Only ASP	479.6	33.8	28.7	49.4	24.4	13.4	9.3	8.7	7.9	7.0	-53%	-22%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	13	38	18	16	17	17	16	15	NA	-3%
CPU Revenue	NA	NA	6	21	9	8	8	8	8	8	NA	-4%
Workstation Revenue	NA	NA	4	14	6	7	7	7	7	7	NA	3%
Peripheral Revenue	NA	NA	2	3	3	1	1	1	1	1	NA	-19%
Software Revenue	NA	NA	2	4	4	5	5	6	6	6	NA	9%
Bundled	NA	NA	2	2	2	2	1	1	1	1	NA	-1%
Unbundled	NA	NA	0	2	3	3	4	4	5	5	NA	13%
Service Revenue	1	1	2	5	3	3	3	3	3	3	38%	-1%
Total Revenue	5	12	18	47	25	23	25	26	25	24	54%	-1%
Increase over Prior Year	NA	157%	51%	171%	-47%	-8%	7%	2%	-1%	-3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 18
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	18	174	448	238	350	370	410	470	520	NA	17%
Workstation Shipments	0	18	174	448	238	350	370	410	470	520	NA	17%
CPU Installed Base	0	18	193	641	879	1,220	1,570	1,900	2,200	2,460	NA	23%
Workstation Installed Base	0	18	193	641	879	1,220	1,570	1,900	2,200	2,460	NA	23%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	66.7	84.7	58.6	40.1	39.8	35.3	31.2	28.6	26.1	NA	-8%
Hardware-Only ASP	.0	29.0	27.5	27.4	25.3	22.5	20.0	18.0	15.9	13.9	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	6	14	6	8	8	8	8	8	NA	5%
CPU Revenue	NA	NA	2	6	2	4	4	4	4	4	NA	8%
Workstation Revenue	NA	NA	2	6	2	4	4	4	4	4	NA	8%
Peripheral Revenue	NA	NA	1	1	1	1	1	1	1	1	NA	-15%
Software Revenue	NA	NA	1	2	2	2	3	3	3	4	NA	14%
Bundled	NA	NA	1	2	1	1	1	1	1	1	NA	3%
Unbundled	NA	NA	0	0	1	1	1	2	2	2	NA	25%
Service Revenue	0	0	1	2	1	2	2	2	2	2	NA	9%
Total Revenue	0	1	8	18	9	13	13	13	13	13	NA	7%
Increase over Prior Year	NA	NA	605%	131%	-47%	33%	0%	1%	4%	1%		

Source: Dataquest
 July 1988

TABLE NUMBER: 19
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	9	18	18	101	44	20	20	20	20	20	49%	-15%
Workstation Shipments	34	48	50	255	76	40	30	20	20	20	23%	-23%
CPU Installed Base	377	395	413	514	558	580	600	620	650	670	10%	4%
Workstation Installed Base	805	846	853	946	698	370	140	0	(120)	(210)	-3%	ERR
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	381.7	534.2	627.1	379.7	487.0	.0	.0	.0	.0	.0	6%	-100%
Hardware-Only ASP	479.6	360.5	316.3	230.7	215.3	219.7	209.7	195.0	170.3	148.1	-18%	-7%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	7	24	10	5	4	5	4	3	NA	-19%
CPU Revenue	NA	NA	4	14	6	3	2	3	2	2	NA	-19%
Workstation Revenue	NA	NA	2	7	2	1	1	1	1	1	NA	-15%
Peripheral Revenue	NA	NA	1	2	2	1	1	1	1	0	NA	-24%
Software Revenue	NA	NA	1	1	1	0	0	0	0	0	NA	-17%
Bundled	NA	NA	1	0	0	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	-11%
Service Revenue	1	1	1	3	1	1	0	0	0	0	13%	-23%
Total Revenue	5	10	9	27	12	5	5	5	5	4	27%	-19%
Increase over Prior Year	NA	111%	-7%	205%	-56%	-55%	-8%	8%	-13%	-12%		

Source: Dataquest
 July 1988

TABLE NUMBER: 20
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	88	138	222	419	720	1,270	1,350	1,390	1,430	NA	28%
Workstation Shipments	0	88	138	222	419	720	1,270	1,350	1,390	1,430	NA	28%
CPU Installed Base	0	88	226	448	858	1,550	2,740	3,940	5,070	6,030	NA	48%
Workstation Installed Base	0	88	226	448	858	1,550	2,740	3,940	5,070	6,030	NA	48%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	.0	14.9	24.5	24.4	22.6	19.5	16.7	12.3	NA	-13%
Hardware-Only ASP	.0	11.2	5.0	4.0	4.6	4.2	3.9	3.5	3.2	2.8	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	1	1	2	3	5	5	4	4	NA	15%
CPU Revenue	NA	NA	0	0	1	2	3	2	2	2	NA	15%
Workstation Revenue	NA	NA	0	0	1	2	3	2	2	2	NA	15%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	6%
Software Revenue	NA	NA	0	1	2	2	2	2	3	2	NA	7%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-20%
Unbundled	NA	NA	0	1	2	2	2	2	2	2	NA	8%
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	6%
Total Revenue	0	1	1	2	4	6	8	8	7	7	NA	11%
Increase over Prior Year	NA	NA	-10%	169%	71%	35%	38%	-1%	-3%	-5%		

Source: Dataquest
 July 1988

TABLE NUMBER: 21
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,413	8,922	15,975	22,670	29,415	35,710	41,550	46,300	50,190	52,760	114%	12%
Workstation Shipments	1,598	8,970	15,877	23,615	29,850	36,020	41,800	46,540	50,420	52,960	108%	12%
CPU Installed Base	1,303	8,226	23,208	42,962	71,879	105,400	141,120	176,160	209,030	238,130	173%	27%
Workstation Installed Base	1,495	8,539	23,475	43,887	73,207	106,950	142,760	177,770	210,400	238,960	165%	27%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	56.5	53.5	71.8	54.6	39.9	36.5	34.1	31.9	30.3	27.8	-8%	-7%
Hardware-Only ASP	297.6	25.8	22.3	17.9	13.7	11.2	9.6	8.6	7.9	7.5	-54%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	451	531	503	541	546	546	540	520	NA	1%
CPU Revenue	NA	NA	215	245	232	247	254	256	253	246	NA	1%
Workstation Revenue	NA	NA	128	191	168	196	210	220	225	221	NA	6%
Peripheral Revenue	NA	NA	108	95	103	97	82	70	62	53	NA	-13%
Software Revenue	NA	NA	206	260	313	343	390	436	477	515	NA	11%
Bundled	NA	NA	148	133	122	103	109	116	123	128	NA	1%
Unbundled	NA	NA	59	127	191	240	281	321	354	387	NA	15%
Service Revenue	11	23	48	83	124	139	149	157	163	169	85%	6%
Total Revenue	141	353	721	868	940	1,022	1,085	1,139	1,181	1,204	61%	5%
Increase over Prior Year	NA	151%	104%	20%	8%	9%	6%	5%	4%	2%		

Source: Dataquest
 July 1988

TABLE NUMBER: 22
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,313	3,981	5,553	7,320	11,023	13,840	16,870	20,140	23,890	27,520	70%	20%
Workstation Shipments	1,313	3,981	5,553	7,320	11,023	13,840	16,870	20,140	23,890	27,520	70%	20%
CPU Installed Base	1,173	4,182	9,114	15,409	26,276	39,560	55,000	72,310	91,530	112,030	118%	34%
Workstation Installed Base	1,173	4,182	9,114	15,409	26,276	39,560	55,000	72,310	91,530	112,030	118%	34%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	56.2	53.0	75.2	60.7	38.7	35.8	33.1	30.8	28.6	26.2	-9%	-8%
Hardware-Only ASP	40.0	32.0	28.3	25.7	23.2	21.0	19.0	17.0	15.0	13.2	-13%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	202	247	253	318	352	378	397	398	NA	10%
CPU Revenue	NA	NA	72	99	101	140	158	173	184	187	NA	13%
Workstation Revenue	NA	NA	72	99	101	140	158	173	184	187	NA	13%
Peripheral Revenue	NA	NA	59	48	51	39	36	33	29	25	NA	-14%
Software Revenue	NA	NA	138	131	197	226	272	322	372	423	NA	17%
Bundled	NA	NA	125	91	107	92	102	111	119	125	NA	3%
Unbundled	NA	NA	13	40	90	134	170	211	252	298	NA	27%
Service Revenue	5	12	29	43	79	100	115	129	138	142	105%	12%
Total Revenue	77	214	386	414	529	645	740	830	907	963	62%	13%
Increase over Prior Year	NA	180%	80%	7%	28%	22%	15%	12%	9%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 23
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	99	215	399	576	842	700	570	480	440	430	71%	-13%
Workstation Shipments	284	262	300	1,520	1,277	1,010	820	720	670	640	46%	-13%
CPU Installed Base	129	245	570	1,031	1,872	2,570	3,130	3,620	4,060	4,490	95%	19%
Workstation Installed Base	322	559	836	1,956	3,200	4,120	4,780	5,230	5,430	5,320	78%	11%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	470.0	392.9	598.3	1158.4	223.9	232.7	258.5	251.2	224.9	202.1	-17%	-2%
Hardware-Only ASP	586.6	379.1	344.3	267.8	199.8	180.3	161.9	144.5	124.8	108.9	-24%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	154	182	168	133	103	79	64	54	NA	-20%
CPU Revenue	NA	NA	98	101	92	65	51	40	30	27	NA	-22%
Workstation Revenue	NA	NA	11	46	28	13	7	4	3	2	NA	-42%
Peripheral Revenue	NA	NA	45	36	48	56	44	35	31	26	NA	-12%
Software Revenue	NA	NA	23	38	36	25	23	21	17	15	NA	-16%
Bundled	NA	NA	3	6	6	2	2	2	3	3	NA	-13%
Unbundled	NA	NA	19	32	30	23	21	18	14	12	NA	-17%
Service Revenue	6	11	16	24	32	25	20	16	13	17	52%	-13%
Total Revenue	64	92	189	244	237	184	145	116	94	85	39%	-19%
Increase over Prior Year	NA	43%	105%	29%	-3%	-23%	-21%	-21%	-18%	-10%		

Source: Dataquest
 July 1988

TABLE NUMBER: 24
 TITLE: History and forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	4,727	10,023	14,774	17,550	21,180	24,110	25,680	25,860	24,810	NA	7%
Workstation Shipments	0	4,727	10,023	14,774	17,550	21,180	24,110	25,680	25,860	24,810	NA	7%
CPU Installed Base	0	3,798	13,525	26,523	43,731	63,270	82,980	100,220	113,440	121,610	NA	23%
Workstation Installed Base	0	3,798	13,525	26,523	43,731	63,270	82,980	100,220	113,440	121,610	NA	23%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	34.1	32.0	30.5	13.1	11.8	9.3	9.2	10.5	23.9	NA	13%
Hardware-Only ASP	.0	9.6	9.0	4.5	4.5	4.1	3.8	3.4	3.0	2.7	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	95	102	82	89	92	88	79	67	NA	-4%
CPU Revenue	NA	NA	45	45	39	43	45	43	38	32	NA	-4%
Workstation Revenue	NA	NA	45	45	39	43	45	43	38	32	NA	-4%
Peripheral Revenue	NA	NA	4	11	4	3	2	2	2	3	NA	-6%
Software Revenue	NA	NA	46	91	80	91	95	94	89	78	NA	-1%
Bundled	NA	NA	20	36	9	8	4	3	1	0	NA	-66%
Unbundled	NA	NA	26	55	70	83	90	91	88	78	NA	2%
Service Revenue	0	1	3	16	12	13	14	13	12	11	NA	-3%
Total Revenue	0	47	146	210	174	194	200	194	180	156	NA	-2%
Increase over Prior Year	NA	NA	212%	44%	-17%	12%	3%	-3%	-8%	-13%		

Source: Dataquest
 July 1988

TABLE NUMBER: 25
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,121	6,814	11,769	13,530	17,192	20,640	23,900	26,330	28,000	29,130	98%	11%
Workstation Shipments	1,354	6,938	11,637	13,951	17,246	20,650	23,910	26,330	28,000	29,130	89%	11%
CPU Installed Base	1,262	8,076	19,843	33,344	50,047	68,710	87,680	105,300	121,170	135,130	151%	22%
Workstation Installed Base	1,458	8,396	20,029	33,945	50,675	69,280	88,100	105,520	121,090	134,640	143%	22%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	56.6	53.3	65.3	50.4	35.9	29.8	25.5	22.8	20.7	18.7	-11%	-12%
Hardware-Only ASP	251.1	21.5	17.7	15.3	11.7	9.5	8.1	7.4	6.9	6.6	-54%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	275	266	258	247	239	234	227	219	NA	-3%
CPU Revenue	NA	NA	126	123	113	118	117	116	112	108	NA	-1%
Workstation Revenue	NA	NA	84	90	86	95	99	100	98	95	NA	2%
Peripheral Revenue	NA	NA	65	53	59	35	23	18	16	15	NA	-24%
Software Revenue	NA	NA	143	140	141	158	176	196	213	229	NA	10%
Bundled	NA	NA	98	52	38	40	39	40	40	41	NA	1%
Unbundled	NA	NA	45	88	103	118	136	156	173	189	NA	13%
Service Revenue	8	16	34	52	62	64	65	69	70	70	68%	2%
Total Revenue	103	248	452	457	461	469	480	498	510	518	46%	2%
Increase over Prior Year	NA	142%	82%	1%	1%	2%	2%	4%	2%	2%		

Source: Dataquest
 July 1988

Forecasts

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 - 10/6

TABLE NUMBER: 26
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	1,069	2,992	3,654	4,112	5,846	7,130	8,450	9,690	11,030	12,660	53%	17%
Workstation Shipments	1,069	2,992	3,654	4,112	5,846	7,130	8,450	9,690	11,030	12,660	53%	17%
CPU Installed Base	1,173	4,165	7,817	11,901	17,591	24,190	31,360	38,740	46,420	54,720	97%	25%
Workstation Installed Base	1,173	4,165	7,817	11,901	17,591	24,190	31,360	38,740	46,420	54,720	97%	25%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	56.1	52.6	65.0	50.0	30.3	27.6	25.1	22.8	20.7	18.7	-14%	-9%
Hardware-Only ASP	40.0	32.0	27.5	24.3	22.6	20.6	18.7	16.8	14.8	13.0	-13%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	120	118	125	139	150	154	155	156	NA	5%
CPU Revenue	NA	NA	45	48	50	62	68	71	72	74	NA	8%
Workstation Revenue	NA	NA	45	48	50	62	68	71	72	74	NA	8%
Peripheral Revenue	NA	NA	30	22	25	16	14	12	10	9	NA	-19%
Software Revenue	NA	NA	97	70	84	109	131	153	174	197	NA	19%
Bundled	NA	NA	85	41	34	37	39	40	40	41	NA	4%
Unbundled	NA	NA	11	29	50	72	91	113	134	156	NA	26%
Service Revenue	4	9	20	27	40	48	54	59	61	62	76%	9%
Total Revenue	62	160	237	216	249	296	334	366	390	415	41%	11%
Increase over Prior Year	NA	156%	48%	-9%	15%	19%	13%	10%	7%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 27
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	51	112	252	347	468	330	210	180	180	180	74%	-17%
Workstation Shipments	284	237	121	767	522	340	220	180	180	180	16%	-19%
CPU Installed Base	89	201	453	800	1,269	1,600	1,810	1,980	2,160	2,340	94%	13%
Workstation Installed Base	284	521	640	1,400	1,897	2,170	2,240	2,210	2,080	1,840	61%	-1%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	470.0	458.3	626.9	1890.7	162.6	146.3	131.7	118.4	106.2	95.1	-23%	-10%
Hardware-Only ASP	713.2	411.3	279.6	235.9	183.3	165.0	148.5	133.1	116.3	101.1	-29%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	84	103	81	52	31	23	20	18	NA	-26%
CPU Revenue	NA	NA	47	54	38	29	21	17	15	13	NA	-19%
Workstation Revenue	NA	NA	4	22	11	5	2	1	1	0	NA	-48%
Peripheral Revenue	NA	NA	33	28	32	18	8	5	5	4	NA	-33%
Software Revenue	NA	NA	16	23	17	8	6	4	2	1	NA	-43%
Bundled	NA	NA	2	1	1	1	0	0	0	0	NA	-100%
Unbundled	NA	NA	14	22	16	7	6	4	2	1	NA	-42%
Service Revenue	4	6	13	17	17	10	7	5	4	3	46%	-28%
Total Revenue	40	53	113	143	115	70	44	32	26	22	30%	-28%
Increase over Prior Year	NA	31%	115%	26%	-19%	-39%	-38%	-26%	-18%	-16%		

Source: Dataquest
 July 1988

TABLE NUMBER: 28
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	3,710	7,862	9,071	10,878	13,180	15,240	16,460	16,790	16,290	NA	8%
Workstation Shipments	0	3,710	7,862	9,071	10,878	13,180	15,240	16,460	16,790	16,290	NA	8%
CPU Installed Base	0	3,710	11,572	20,644	31,187	42,920	54,510	64,580	72,590	78,080	NA	20%
Workstation Installed Base	0	3,710	11,572	20,644	31,187	42,920	54,510	64,580	72,590	78,080	NA	20%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	34.1	25.9	21.1	30.6	28.2	25.9	23.8	21.9	20.0	NA	-8%
Hardware-Only ASP	.0	9.4	9.0	4.5	4.5	4.1	3.8	3.4	3.1	2.7	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	70	44	51	56	58	56	51	45	NA	-3%
CPU Revenue	NA	NA	35	21	25	28	29	28	25	21	NA	-3%
Workstation Revenue	NA	NA	35	21	25	28	29	28	25	21	NA	-3%
Peripheral Revenue	NA	NA	1	3	1	1	0	1	1	2	NA	11%
Software Revenue	NA	NA	30	47	40	41	39	39	37	31	NA	-5%
Bundled	NA	NA	11	10	3	2	0	0	0	0	NA	-100%
Unbundled	NA	NA	19	37	37	39	39	39	37	31	NA	-3%
Service Revenue	0	0	2	7	6	6	5	5	5	4	NA	-6%
Total Revenue	0	36	103	99	97	103	102	100	93	80	NA	-4%
Increase over Prior Year	NA	NA	187%	-4%	-2%	6%	-1%	-2%	-7%	-14%		

Source: Dataquest
 July 1988

TABLE NUMBER: 29
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	213	1,244	2,522	4,349	7,032	8,800	10,390	11,820	13,320	14,270	140%	15%
Workstation Shipments	184	1,208	2,571	4,422	7,176	8,860	10,400	11,820	13,320	14,270	150%	15%
CPU Installed Base	0	0	2,521	6,872	13,903	22,550	32,310	42,400	52,370	61,410	NA	35%
Workstation Installed Base	0	0	2,570	6,993	14,169	22,880	32,640	42,700	52,600	61,510	NA	34%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	52.8	48.5	76.0	58.0	31.4	29.2	27.7	24.5	23.2	21.0	-12%	-8%
Hardware-Only ASP	453.6	41.7	34.0	19.1	16.8	13.9	11.9	10.7	9.7	9.1	-56%	-12%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	102	110	124	140	144	142	144	141	NA	3%
CPU Revenue	NA	NA	49	52	58	67	70	71	71	70	NA	4%
Workstation Revenue	NA	NA	23	36	41	50	55	59	62	62	NA	9%
Peripheral Revenue	NA	NA	29	22	25	23	19	12	11	10	NA	-18%
Software Revenue	NA	NA	35	61	94	117	137	151	165	177	NA	14%
Bundled	NA	NA	22	41	29	23	23	24	24	24	NA	-4%
Unbundled	NA	NA	13	19	64	94	113	128	141	152	NA	19%
Service Revenue	2	4	8	12	39	50	55	58	62	64	116%	11%
Total Revenue	25	60	141	184	257	307	335	352	371	383	80%	8%
Increase over Prior Year	NA	142%	136%	31%	39%	20%	9%	5%	6%	3%		

Source: Dataquest
 July 1988

-117 x .67
 = 78.39

TABLE NUMBER: 30
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	184	597	991	1,777	3,106	3,980	4,990	6,130	7,520	8,700	103%	23%
Workstation Shipments	184	597	991	1,777	3,106	3,980	4,990	6,130	7,520	8,700	103%	23%
CPU Installed Base	0	0	990	2,767	5,873	9,830	14,710	20,450	27,020	33,940	NA	42%
Workstation Installed Base	0	0	990	2,767	5,873	9,830	14,710	20,450	27,020	33,940	NA	42%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	52.8	48.6	87.3	64.4	34.0	31.0	28.2	25.6	23.2	21.0	-10%	-9%
Hardware-Only ASP	.0	31.7	31.0	28.2	24.0	21.5	19.2	17.3	15.2	13.4	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	48	65	66	85	96	105	113	115	NA	12%
CPU Revenue	NA	NA	13	25	26	38	43	49	53	54	NA	16%
Workstation Revenue	NA	NA	13	25	26	38	43	49	53	54	NA	16%
Peripheral Revenue	NA	NA	21	15	14	9	9	8	7	6	NA	-15%
Software Revenue	NA	NA	22	33	62	74	90	107	123	140	NA	18%
Bundled	NA	NA	21	28	27	21	22	23	24	24	NA	-2%
Unbundled	NA	NA	2	5	35	54	68	83	99	115	NA	27%
Service Revenue	0	1	7	8	27	37	43	48	53	57	200%	16%
Total Revenue	10	30	76	106	155	196	229	260	290	311	98%	15%
Increase over Prior Year	NA	195%	158%	39%	46%	27%	17%	14%	12%	7%		

Source: Dataquest
 July 1988

Forecasts

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TABLE NUMBER: 31
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	29	62	49	47	187	180	160	130	100	100	59%	-12%
Workstation Shipments	0	26	98	119	332	240	180	130	100	100	NA	-21%
CPU Installed Base	0	0	49	95	282	470	630	750	860	960	NA	28%
Workstation Installed Base	0	0	98	217	548	790	960	1,060	1,090	1,050	NA	14%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	1250.0	780.4	334.9	308.3	288.3	.0	.0	.0	NA	-100%
Hardware-Only ASP	453.6	351.6	737.0	548.9	210.9	185.6	163.4	146.5	129.3	113.7	-17%	-12%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	40	26	42	37	29	18	13	12	NA	-23%
CPU Revenue	NA	NA	30	19	24	20	17	13	10	9	NA	-19%
Workstation Revenue	NA	NA	4	4	7	4	2	1	0	0	NA	-48%
Peripheral Revenue	NA	NA	6	3	11	13	10	4	3	3	NA	-23%
Software Revenue	NA	NA	5	8	13	13	12	11	9	8	NA	-9%
Bundled	NA	NA	0	0	1	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	5	8	12	13	12	11	9	8	NA	-7%
Service Revenue	1	3	1	1	9	8	7	5	4	3	56%	-18%
Total Revenue	15	24	41	36	64	58	48	34	26	23	44%	-19%
Increase over Prior Year	NA	64%	72%	-14%	79%	-8%	-18%	-29%	-23%	-13%		

Source: Dataquest
 July 1988

TABLE NUMBER: 32
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: Personal Computer.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	585	1,483	2,525	3,739	4,640	5,240	5,570	5,700	5,470	NA	8%
Workstation Shipments	0	585	1,483	2,525	3,739	4,640	5,240	5,570	5,700	5,470	NA	8%
CPU Installed Base	0	0	1,483	4,009	7,748	12,260	16,970	21,190	24,500	26,510	NA	28%
Workstation Installed Base	0	0	1,483	4,009	7,748	12,260	16,970	21,190	24,500	26,510	NA	28%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	26.6	40.2	5.8	5.0	3.9	2.9	.0	.0	NA	-100%
Hardware-Only ASP	.0	10.2	9.0	4.7	4.5	4.1	3.8	3.4	3.0	2.7	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	14	19	16	18	19	19	17	15	NA	-1%
CPU Revenue	NA	NA	6	7	8	9	9	9	8	7	NA	-1%
Workstation Revenue	NA	NA	6	7	8	9	9	9	8	7	NA	-1%
Peripheral Revenue	NA	NA	2	4	1	0	0	0	0	1	NA	2%
Software Revenue	NA	NA	8	20	19	29	34	34	32	29	NA	9%
Bundled	NA	NA	2	13	2	1	1	0	0	0	NA	-100%
Unbundled	NA	NA	7	7	18	28	34	34	32	29	NA	10%
Service Revenue	0	0	0	3	3	5	5	5	5	5	NA	7%
Total Revenue	0	6	23	43	38	52	59	58	55	48	NA	5%
Increase over Prior Year	NA	NA	287%	84%	-10%	37%	12%	-2%	-5%	-11%		

Source: Dataquest
 July 1988

TABLE NUMBER: 33
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Asia
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	77	755	1,498	4,310	4,729	5,600	6,440	7,260	7,930	8,360	180%	12%
Workstation Shipments	60	718	1,480	4,641	4,963	5,830	6,670	7,500	8,150	8,570	202%	12%
CPU Installed Base	0	0	509	1,930	6,659	12,230	18,470	25,050	31,410	36,950	NA	41%
Workstation Installed Base	0	0	544	2,020	6,983	12,780	19,260	26,060	32,590	38,200	NA	40%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	67.3	63.3	92.3	58.5	56.1	55.8	54.3	52.3	50.3	46.3	-4%	-4%
Hardware-Only ASP	453.5	41.2	51.1	22.4	17.1	14.4	12.3	10.5	9.1	8.7	-56%	-13%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	68	134	111	145	155	162	161	152	NA	6%
CPU Revenue	NA	NA	36	59	55	58	63	65	65	64	NA	3%
Workstation Revenue	NA	NA	20	56	38	47	52	58	61	60	NA	9%
Peripheral Revenue	NA	NA	12	19	18	39	40	39	35	28	NA	10%
Software Revenue	NA	NA	28	58	76	65	75	85	96	105	NA	7%
Bundled	NA	NA	27	39	54	39	45	52	58	62	NA	3%
Unbundled	NA	NA	1	19	22	26	30	34	38	43	NA	14%
Service Revenue	1	3	5	17	21	24	27	29	29	33	122%	10%
Total Revenue	13	41	121	202	208	234	256	276	286	290	101%	7%
Increase over Prior Year	NA	227%	192%	67%	3%	12%	10%	8%	4%	1%		

Source: Dataquest
 July 1988

$$65 \times 1.67 = 43.55$$

TABLE NUMBER: 34
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Asia
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	60	375	799	1,151	1,917	2,490	3,170	4,030	4,990	5,760	138%	25%
Workstation Shipments	60	375	799	1,151	1,917	2,490	3,170	4,030	4,990	5,760	138%	25%
CPU Installed Base	0	0	180	335	2,251	4,730	7,880	11,830	16,560	21,600	NA	57%
Workstation Installed Base	0	0	180	335	2,251	4,730	7,880	11,830	16,560	21,600	NA	57%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	67.3	63.3	115.4	98.7	66.6	60.8	55.5	50.6	46.0	41.7	-0%	-9%
Hardware-Only ASP	.0	31.9	27.8	26.5	23.8	21.2	18.9	17.0	15.0	13.3	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	31	56	58	88	101	114	122	121	NA	16%
CPU Revenue	NA	NA	12	23	23	37	44	51	56	56	NA	19%
Workstation Revenue	NA	NA	12	23	23	37	44	51	56	56	NA	19%
Peripheral Revenue	NA	NA	6	11	11	13	13	12	11	9	NA	-4%
Software Revenue	NA	NA	19	27	51	41	50	60	72	84	NA	10%
Bundled	NA	NA	19	21	46	34	40	47	54	59	NA	5%
Unbundled	NA	NA	0	6	5	7	10	13	18	24	NA	35%
Service Revenue	0	1	2	6	11	15	17	20	22	22	NA	13%
Total Revenue	4	23	70	82	120	144	168	194	216	226	133%	13%
Increase over Prior Year	NA	480%	197%	18%	46%	20%	17%	16%	11%	5%		

Source: Dataquest
 July 1988

TABLE NUMBER: 35
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Asia
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	17	37	90	133	162	180	190	180	160	150	76%	-2%
Workstation Shipments	0	0	72	464	396	410	420	420	390	360	NA	-2%
CPU Installed Base	0	0	16	34	196	380	560	740	910	1,060	NA	40%
Workstation Installed Base	0	0	51	124	520	930	1,350	1,750	2,090	2,310	NA	35%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	506.6	752.0	316.1	291.9	275.3	251.2	224.9	202.1	NA	-9%
Hardware-Only ASP	453.5	336.1	270.4	261.6	234.8	210.7	189.2	170.7	148.3	129.1	-15%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	27	40	40	43	42	37	30	24	NA	-9%
CPU Revenue	NA	NA	20	20	26	15	13	9	6	5	NA	-29%
Workstation Revenue	NA	NA	3	16	9	4	3	2	2	1	NA	-34%
Peripheral Revenue	NA	NA	5	4	4	25	26	26	23	18	NA	34%
Software Revenue	NA	NA	2	6	6	4	5	6	6	6	NA	-1%
Bundled	NA	NA	1	4	4	1	2	2	3	3	NA	-4%
Unbundled	NA	NA	1	2	2	3	3	3	3	3	NA	4%
Service Revenue	1	2	3	5	6	6	7	6	5	10	62%	11%
Total Revenue	9	14	32	52	52	54	53	49	42	40	56%	-5%
Increase over Prior Year	NA	62%	127%	64%	-0%	4%	-1%	-7%	-16%	-3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 36
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Asia
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	344	609	3,026	2,650	2,930	3,080	3,050	2,770	2,450	NA	-2%
Workstation Shipments	0	344	609	3,026	2,650	2,930	3,080	3,050	2,770	2,450	NA	-2%
CPU Installed Base	0	0	313	1,561	4,211	7,120	10,020	12,480	13,950	14,290	NA	28%
Workstation Installed Base	0	0	313	1,561	4,211	7,120	10,020	12,480	13,950	14,290	NA	28%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	44.0	31.9	13.9	12.8	11.8	10.8	9.9	.0	NA	-100%
Hardware-Only ASP	.0	10.6	9.0	4.8	4.2	3.8	3.5	3.2	2.9	2.6	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	10	38	14	13	12	11	8	6	NA	-14%
CPU Revenue	NA	NA	4	17	6	6	6	5	4	3	NA	-12%
Workstation Revenue	NA	NA	4	17	6	6	6	5	4	3	NA	-12%
Peripheral Revenue	NA	NA	1	4	2	1	1	1	0	0	NA	-34%
Software Revenue	NA	NA	7	25	19	20	20	20	18	16	NA	-4%
Bundled	NA	NA	7	14	5	4	3	2	1	0	NA	-100%
Unbundled	NA	NA	0	11	15	16	17	17	17	16	NA	1%
Service Revenue	0	0	0	5	3	3	3	2	2	2	NA	-14%
Total Revenue	0	4	19	68	36	36	35	33	28	24	NA	-8%
Increase over Prior Year	NA	NA	389%	247%	-46%	-2%	-1%	-8%	-13%	-16%		

Source: Dataquest
 July 1988

TABLE NUMBER: 37
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	2	109	186	480	462	670	820	900	950	1,000	301%	17%
Workstation Shipments	0	105	189	601	465	680	820	900	950	1,000	NA	17%
CPU Installed Base	40	149	336	816	1,270	1,920	2,660	3,410	4,070	4,630	137%	30%
Workstation Installed Base	38	143	331	930	1,379	2,020	2,760	3,480	4,110	4,610	146%	27%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	66.7	205.4	43.1	94.8	63.3	58.5	55.3	52.1	48.7	NA	-12%
Hardware-Only ASP	452.5	24.6	30.0	45.7	21.3	11.7	9.4	8.0	7.6	7.1	-53%	-20%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	6	21	11	9	9	8	8	8	NA	-6%
CPU Revenue	NA	NA	3	12	5	4	4	4	4	4	NA	-7%
Workstation Revenue	NA	NA	2	8	3	4	4	4	4	4	NA	4%
Peripheral Revenue	NA	NA	1	1	2	1	1	0	0	0	NA	-30%
Software Revenue	NA	NA	0	1	2	2	3	3	4	4	NA	16%
Bundled	NA	NA	0	0	1	1	1	1	1	1	NA	1%
Unbundled	NA	NA	0	1	1	2	2	3	3	3	NA	23%
Service Revenue	0	0	1	2	2	2	2	2	2	2	109%	0%
Total Revenue	1	3	7	25	15	13	13	13	14	14	100%	-1%
Increase over Prior Year	NA	281%	98%	263%	-41%	-12%	3%	1%	4%	0%		

Source: Dataquest
 July 1988

TABLE NUMBER: 38
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	17	110	280	154	240	270	290	350	400	NA	21%
Workstation Shipments	0	17	110	280	154	240	270	290	350	400	NA	21%
CPU Installed Base	0	17	127	406	560	800	1,050	1,290	1,530	1,770	NA	26%
Workstation Installed Base	0	17	127	406	560	800	1,050	1,290	1,530	1,770	NA	26%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	66.7	79.3	43.4	82.7	75.3	68.5	62.2	56.5	51.1	NA	-9%
Hardware-Only ASP	.0	31.8	27.4	28.0	25.0	22.3	19.8	17.8	15.7	13.8	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	3	8	4	6	6	6	6	6	NA	8%
CPU Revenue	NA	NA	1	4	2	3	3	3	3	3	NA	12%
Workstation Revenue	NA	NA	1	4	2	3	3	3	3	3	NA	12%
Peripheral Revenue	NA	NA	1	0	1	0	0	0	0	0	NA	-21%
Software Revenue	NA	NA	0	1	1	1	2	2	2	3	NA	23%
Bundled	NA	NA	0	0	1	1	1	1	1	1	NA	7%
Unbundled	NA	NA	0	0	0	1	1	1	2	2	NA	37%
Service Revenue	0	0	0	1	1	1	1	2	2	2	NA	13%
Total Revenue	0	1	4	10	6	9	9	10	10	10	NA	12%
Increase over Prior Year	NA	NA	232%	170%	-37%	44%	4%	5%	7%	3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 39
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	2	4	8	49	24	0	0	0	0	0	92%	-100%
Workstation Shipments	0	0	10	170	27	10	0	0	0	0	NA	-100%
CPU Installed Base	40	44	52	101	125	130	130	130	140	140	33%	2%
Workstation Installed Base	38	38	47	215	235	230	230	210	170	120	58%	-13%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	1000.0	2888.9	532.4	479.2	431.2	387.6	347.7	311.4	NA	-10%
Hardware-Only ASP	452.5	335.1	304.8	256.1	198.0	178.2	160.4	143.8	125.6	109.2	-19%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	3	13	5	1	1	0	0	0	NA	-54%
CPU Revenue	NA	NA	2	8	3	1	0	0	0	0	NA	-52%
Workstation Revenue	NA	NA	0	4	1	0	0	0	0	0	NA	-100%
Peripheral Revenue	NA	NA	1	1	1	0	0	0	0	0	NA	-53%
Software Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Service Revenue	0	0	0	1	1	0	0	0	0	0	71%	-53%
Total Revenue	1	1	3	14	6	1	1	0	0	0	62%	-54%
Increase over Prior Year	NA	55%	112%	377%	-56%	-83%	-37%	-70%	-20%	-19%		

Source: Dataquest
 July 1988

TABLE NUMBER: 40
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	88	69	151	284	430	550	600	600	600	NA	16%
Workstation Shipments	0	88	69	151	284	430	550	600	600	600	NA	16%
CPU Installed Base	0	88	157	308	585	990	1,480	1,980	2,410	2,730	NA	36%
Workstation Installed Base	0	88	157	308	585	990	1,480	1,980	2,410	2,730	NA	36%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	.0	10.9	36.8	33.9	31.1	28.6	26.3	24.1	NA	-8%
Hardware-Only ASP	.0	11.2	4.9	4.1	4.8	4.3	3.9	3.5	3.1	2.8	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	0	1	1	2	2	2	2	2	NA	4%
CPU Revenue	NA	NA	0	0	1	1	1	1	1	1	NA	3%
Workstation Revenue	NA	NA	0	0	1	1	1	1	1	1	NA	3%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	10%
Software Revenue	NA	NA	0	0	1	1	1	1	1	1	NA	13%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-23%
Unbundled	NA	NA	0	0	1	1	1	1	1	1	NA	17%
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	9%
Total Revenue	0	1	0	1	2	3	4	4	4	3	NA	7%
Increase over Prior Year	NA	NA	-66%	229%	112%	32%	16%	2%	-2%	-7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 41
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Worldwide
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	230	702	1,516	2,441	3,985	4,950	6,170	6,930	7,600	8,460	104%	16%
Workstation Shipments	588	1,413	1,983	2,666	4,204	5,070	6,280	7,010	7,650	8,460	64%	15%
CPU Installed Base	315	785	2,114	4,279	8,257	13,160	19,120	25,400	31,580	37,550	126%	35%
Workstation Installed Base	1,032	1,888	3,643	5,847	9,712	14,300	19,890	25,730	31,420	36,930	75%	31%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	545.1	250.3	126.9	124.1	69.9	70.7	67.5	67.8	73.5	70.1	-40%	0%
Hardware-Only ASP	344.5	188.6	124.8	41.6	28.1	22.8	17.6	15.1	13.5	12.0	-47%	-16%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	137	139	136	153	153	151	152	150	NA	2%
CPU Revenue	NA	NA	64	68	65	71	71	70	70	69	NA	1%
Workstation Revenue	NA	NA	45	48	50	64	67	68	69	68	NA	7%
Peripheral Revenue	NA	NA	29	22	21	17	15	13	13	12	NA	-10%
Software Revenue	NA	NA	71	104	148	162	183	201	217	230	NA	9%
Bundled	NA	NA	50	48	39	34	34	35	36	36	NA	-2%
Unbundled	NA	NA	21	57	109	127	148	167	182	195	NA	12%
Service Revenue	15	24	28	32	35	39	41	44	46	48	24%	6%
Total Revenue	130	191	241	275	319	353	377	396	415	429	25%	6%
Increase over Prior Year	NA	47%	26%	14%	16%	11%	7%	5%	5%	3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 42
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Worldwide
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	24	386	1,204	1,817	2,734	3,540	4,400	5,280	6,180	7,130	226%	21%
Workstation Shipments	24	386	1,204	1,817	2,734	3,540	4,400	5,280	6,180	7,130	226%	21%
CPU Installed Base	19	310	1,359	2,936	5,664	9,160	13,400	18,210	23,430	28,910	314%	39%
Workstation Installed Base	19	310	1,359	2,936	5,664	9,160	13,400	18,210	23,430	28,910	314%	39%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	54.0	78.0	88.3	99.2	72.4	69.2	65.4	61.7	57.9	53.9	8%	-6%
Hardware-Only ASP	40.1	31.4	29.2	21.7	21.7	19.8	17.9	16.0	14.2	12.5	-14%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	52	74	80	101	110	116	120	121	NA	9%
CPU Revenue	NA	NA	18	30	33	46	50	53	55	56	NA	11%
Workstation Revenue	NA	NA	18	30	33	46	50	53	55	56	NA	11%
Peripheral Revenue	NA	NA	16	15	14	10	10	9	9	9	NA	-9%
Software Revenue	NA	NA	40	75	111	124	144	162	182	201	NA	13%
Bundled	NA	NA	35	40	33	24	24	24	24	24	NA	-7%
Unbundled	NA	NA	5	35	78	100	120	138	159	177	NA	18%
Service Revenue	0	2	12	19	25	29	33	36	39	42	189%	11%
Total Revenue	1	28	110	169	216	255	287	315	341	363	253%	11%
Increase over Prior Year	NA	1914%	290%	53%	28%	18%	13%	10%	8%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 43
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Worldwide
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	206	315	264	269	201	210	170	150	160	170	-1%	-3%
Workstation Shipments	564	1,027	732	494	421	320	280	230	210	170	-7%	-17%
CPU Installed Base	296	474	709	942	1,143	1,350	1,520	1,670	1,830	2,000	40%	12%
Workstation Installed Base	1,012	1,578	2,238	2,510	2,598	2,490	2,290	2,000	1,670	1,380	27%	-12%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	559.4	458.1	371.4	461.2	368.1	368.7	390.5	343.9	305.2	271.3	-10%	-6%
Hardware-Only ASP	517.5	391.9	364.6	193.8	231.6	208.7	188.5	168.9	149.3	130.8	-18%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	84	63	51	45	36	29	28	26	NA	-13%
CPU Revenue	NA	NA	45	38	30	23	18	14	13	11	NA	-17%
Workstation Revenue	NA	NA	26	18	14	16	13	12	11	11	NA	-6%
Peripheral Revenue	NA	NA	13	8	7	7	5	4	4	4	NA	-13%
Software Revenue	NA	NA	29	26	23	23	22	22	23	23	NA	0%
Bundled	NA	NA	14	8	5	11	10	11	12	12	NA	20%
Unbundled	NA	NA	15	18	18	12	12	12	11	11	NA	-9%
Service Revenue	15	22	16	12	9	9	7	6	6	6	-11%	-9%
Total Revenue	128	163	128	101	84	77	65	57	57	55	-10%	-8%
Increase over Prior Year	NA	27%	-21%	-21%	-17%	-8%	-15%	-11%	-1%	-3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 44
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Worldwide
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	47	356	1,049	1,200	1,600	1,490	1,250	1,150	NA	2%
Workstation Shipments	0	0	47	356	1,049	1,200	1,600	1,490	1,250	1,150	NA	2%
CPU Installed Base	0	0	45	401	1,450	2,650	4,210	5,520	6,320	6,640	NA	36%
Workstation Installed Base	0	0	45	401	1,450	2,650	4,210	5,520	6,320	6,640	NA	36%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	30.7	.0	5.6	5.5	5.1	5.7	11.9	.0	NA	-100%
Hardware-Only ASP	.0	.0	.0	5.0	5.0	4.6	4.1	3.8	3.4	3.1	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	1	2	5	6	7	6	5	4	NA	-4%
CPU Revenue	NA	NA	0	1	2	3	3	3	2	2	NA	-3%
Workstation Revenue	NA	NA	0	1	2	3	3	3	2	2	NA	-3%
Peripheral Revenue	NA	NA	1	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	2	3	13	15	17	17	12	7	NA	-13%
Bundled	NA	NA	1	0	1	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	1	3	13	15	17	17	12	7	NA	-12%
Service Revenue	0	0	0	0	1	1	2	1	1	1	NA	-13%
Total Revenue	0	0	3	6	19	22	25	24	18	11	NA	-11%
Increase over Prior Year	NA	NA	NA	116%	247%	16%	14%	-3%	-28%	-39%		

Source: Dataquest
 July 1988

TABLE NUMBER: 45
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	149	462	952	1,581	1,963	2,280	2,670	3,080	3,480	3,950	90%	15%
Workstation Shipments	394	842	1,260	1,697	2,024	2,280	2,670	3,080	3,480	3,950	51%	14%
CPU Installed Base	282	744	1,695	3,276	5,231	7,480	9,970	12,580	15,140	17,700	108%	28%
Workstation Installed Base	898	1,735	2,960	4,526	6,271	8,150	10,230	12,410	14,570	16,830	63%	22%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	470.9	218.3	122.7	93.8	54.3	49.1	43.1	39.2	35.6	32.2	-42%	-10%
Hardware-Only ASP	235.1	139.3	103.9	34.7	24.3	20.8	17.1	14.7	13.0	11.5	-43%	-14%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	78	69	54	54	51	50	49	49	NA	-2%
CPU Revenue	NA	NA	34	35	25	26	25	24	24	24	NA	-1%
Workstation Revenue	NA	NA	28	23	20	22	22	23	23	23	NA	3%
Peripheral Revenue	NA	NA	16	11	10	5	4	3	3	3	NA	-23%
Software Revenue	NA	NA	46	63	84	94	106	117	126	133	NA	10%
Bundled	NA	NA	35	24	8	7	6	5	4	4	NA	-15%
Unbundled	NA	NA	11	39	75	87	100	112	121	129	NA	11%
Service Revenue	10	13	21	20	17	18	19	20	22	23	15%	6%
Total Revenue	72	107	146	152	155	166	176	187	197	205	21%	6%
Increase over Prior Year	NA	48%	36%	4%	2%	7%	6%	6%	5%	4%		

Source: Dataquest
 July 1988

TABLE NUMBER: 46
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	19	291	791	1,088	1,447	1,730	2,120	2,540	2,950	3,440	195%	19%
Workstation Shipments	19	291	791	1,088	1,447	1,730	2,120	2,540	2,950	3,440	195%	19%
CPU Installed Base	19	310	1,101	2,189	3,629	5,320	7,300	9,480	11,770	14,200	271%	31%
Workstation Installed Base	19	310	1,101	2,189	3,629	5,320	7,300	9,480	11,770	14,200	271%	31%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	77.5	87.8	77.5	52.1	47.4	43.1	39.2	35.6	32.2	NA	-9%
Hardware-Only ASP	40.1	31.5	27.7	20.4	20.7	18.8	17.1	15.4	13.6	11.9	-15%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	35	36	37	39	42	44	44	45	NA	4%
CPU Revenue	NA	NA	13	15	15	18	20	21	21	21	NA	7%
Workstation Revenue	NA	NA	13	15	15	18	20	21	21	21	NA	7%
Peripheral Revenue	NA	NA	9	7	7	3	3	2	2	2	NA	-23%
Software Revenue	NA	NA	30	45	63	73	85	96	110	122	NA	14%
Bundled	NA	NA	26	20	8	7	6	5	4	4	NA	-14%
Unbundled	NA	NA	4	25	56	67	80	92	105	118	NA	16%
Service Revenue	0	1	9	12	13	14	16	18	20	21	354%	11%
Total Revenue	1	21	74	94	114	127	143	158	173	187	245%	11%
Increase over Prior Year	NA	2499%	256%	26%	21%	11%	13%	10%	10%	8%		

Source: Dataquest
 July 1988

TABLE NUMBER: 47
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	130	171	152	152	74	70	40	30	30	20	-13%	-23%
Workstation Shipments	375	551	460	269	135	70	40	30	30	20	-22%	-32%
CPU Installed Base	263	434	586	738	812	880	920	950	970	1,000	33%	4%
Workstation Installed Base	879	1,425	1,850	1,988	1,852	1,550	1,180	780	400	130	20%	-41%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	470.9	440.0	353.1	294.0	130.3	117.3	105.5	94.9	85.1	76.2	-27%	-10%
Hardware-Only ASP	520.2	393.8	316.9	200.0	227.1	204.4	184.0	164.9	144.0	125.2	-19%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	43	32	15	12	7	5	4	3	NA	-27%
CPU Revenue	NA	NA	21	19	9	7	4	3	2	2	NA	-28%
Workstation Revenue	NA	NA	15	7	4	3	2	1	1	1	NA	-27%
Peripheral Revenue	NA	NA	7	5	2	2	1	1	1	1	NA	-22%
Software Revenue	NA	NA	16	15	11	9	8	7	7	7	NA	-8%
Bundled	NA	NA	9	4	1	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	7	11	10	8	8	7	7	7	NA	-7%
Service Revenue	10	12	12	7	4	3	2	2	2	1	-21%	-18%
Total Revenue	72	86	71	54	29	24	17	14	12	12	-20%	-17%
Increase over Prior Year	NA	21%	-18%	-24%	-45%	-18%	-29%	-21%	-10%	-6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 48
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	8	340	442	490	510	510	510	480	NA	2%
Workstation Shipments	0	0	8	340	442	490	510	510	510	480	NA	2%
CPU Installed Base	0	0	8	348	791	1,280	1,750	2,150	2,410	2,510	NA	26%
Workstation Installed Base	0	0	8	348	791	1,280	1,750	2,150	2,410	2,510	NA	26%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	25.9	.0	43.2	40.5	38.0	35.6	33.3	31.1	NA	-6%
Hardware-Only ASP	.0	.0	.0	5.0	5.0	4.6	4.2	3.8	3.5	3.2	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	0	2	2	2	2	2	2	2	NA	-8%
CPU Revenue	NA	NA	0	1	1	1	1	1	1	1	NA	-7%
Workstation Revenue	NA	NA	0	1	1	1	1	1	1	1	NA	-7%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	1	2	9	12	13	13	9	4	NA	-14%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	1	2	9	12	13	13	9	4	NA	-14%
Service Revenue	0	0	0	0	1	1	1	1	1	0	NA	-14%
Total Revenue	0	0	1	4	12	15	16	16	11	6	NA	-13%
Increase over Prior Year	NA	NA	NA	353%	191%	20%	7%	-2%	-28%	-44%		

Source: Dataquest
 July 1988

TABLE NUMBER: 49
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	55	107	266	408	1,038	1,170	1,280	1,330	1,310	1,460	109%	7%
Workstation Shipments	138	194	317	425	1,069	1,170	1,280	1,330	1,310	1,460	67%	6%
CPU Installed Base	0	0	266	674	1,712	2,870	4,120	5,320	6,300	7,130	NA	33%
Workstation Installed Base	0	0	317	742	1,811	2,970	4,210	5,390	6,330	7,100	NA	31%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	412.9	231.1	103.1	105.2	25.5	24.6	20.4	22.3	33.8	30.6	-50%	4%
Hardware-Only ASP	520.7	273.8	235.0	46.5	30.5	27.6	21.9	18.2	16.1	14.2	-51%	-14%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	27	21	25	27	25	23	23	22	NA	-2%
CPU Revenue	NA	NA	13	11	13	14	12	11	11	11	NA	-4%
Workstation Revenue	NA	NA	6	7	8	10	10	10	10	10	NA	4%
Peripheral Revenue	NA	NA	8	3	4	3	3	2	2	2	NA	-15%
Software Revenue	NA	NA	11	20	34	36	41	45	48	51	NA	8%
Bundled	NA	NA	7	8	5	4	3	3	2	2	NA	-13%
Unbundled	NA	NA	4	12	30	32	38	43	46	49	NA	11%
Service Revenue	4	4	4	4	9	10	10	11	11	12	23%	5%
Total Revenue	28	30	42	45	68	73	75	79	82	85	25%	5%
Increase over Prior Year	NA	9%	39%	7%	50%	7%	3%	5%	4%	3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 50
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	5	56	200	343	494	630	790	950	1,140	1,310	215%	22%
Workstation Shipments	5	56	200	343	494	630	790	950	1,140	1,310	215%	22%
CPU Installed Base	0	0	200	543	1,037	1,670	2,440	3,320	4,280	5,280	NA	38%
Workstation Installed Base	0	0	200	543	1,037	1,670	2,440	3,320	4,280	5,280	NA	38%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	54.0	78.3	93.3	94.2	49.3	45.1	41.0	37.2	33.8	30.6	-2%	-9%
Hardware-Only ASP	.0	31.2	37.2	21.4	21.5	19.5	17.8	15.9	14.1	12.4	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	11	12	12	15	16	17	18	18	NA	8%
CPU Revenue	NA	NA	3	5	5	7	8	8	8	9	NA	12%
Workstation Revenue	NA	NA	3	5	5	7	8	8	8	9	NA	12%
Peripheral Revenue	NA	NA	5	2	3	1	1	1	1	1	NA	-19%
Software Revenue	NA	NA	6	13	26	30	35	40	44	48	NA	13%
Bundled	NA	NA	5	7	4	3	3	3	2	2	NA	-12%
Unbundled	NA	NA	1	6	22	27	32	37	42	46	NA	16%
Service Revenue	0	0	2	3	6	7	8	9	10	11	109%	11%
Total Revenue	1	4	20	28	45	53	60	66	72	77	194%	11%
Increase over Prior Year	NA	610%	368%	41%	58%	18%	14%	11%	9%	7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 51
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	*****	*****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	50	52	32	49	48	50	40	30	30	30	-1%	-9%
Workstation Shipments	133	138	83	67	78	50	40	30	30	30	-12%	-17%
CPU Installed Base	0	0	32	81	129	180	220	250	280	300	NA	18%
Workstation Installed Base	0	0	83	149	227	280	310	320	310	280	NA	4%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	461.4	453.9	333.7	344.2	198.6	183.3	.0	.0	.0	.0	-19%	-100%
Hardware-Only ASP	520.7	390.8	721.0	167.9	238.1	211.6	188.5	168.7	149.8	132.2	-18%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	15	9	11	11	7	5	4	4	NA	-20%
CPU Revenue	NA	NA	10	6	7	6	4	3	2	2	NA	-23%
Workstation Revenue	NA	NA	3	2	2	3	2	1	1	1	NA	-17%
Peripheral Revenue	NA	NA	3	1	1	2	1	1	1	1	NA	-9%
Software Revenue	NA	NA	5	6	7	3	2	2	2	2	NA	-23%
Bundled	NA	NA	2	1	0	1	0	0	0	0	NA	-100%
Unbundled	NA	NA	3	5	6	2	2	2	2	2	NA	-22%
Service Revenue	4	4	2	1	2	2	1	1	1	1	-11%	-21%
Total Revenue	27	26	21	16	20	15	10	8	7	6	-8%	-21%
Increase over Prior Year	NA	-5%	-20%	-23%	21%	-22%	-35%	-23%	-11%	-10%		

Source: Dataquest
 July 1988

TABLE NUMBER: 52
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	35	16	497	480	450	340	150	120	NA	-25%
Workstation Shipments	0	0	35	16	497	480	450	340	150	120	NA	-25%
CPU Installed Base	0	0	35	50	547	1,020	1,460	1,750	1,740	1,550	NA	23%
Workstation Installed Base	0	0	35	50	547	1,020	1,460	1,750	1,740	1,550	NA	23%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	29.2	.0	2.0	1.9	1.7	1.5	.0	.0	NA	-100%
Hardware-Only ASP	.0	.0	.0	5.1	5.0	4.6	4.1	3.7	3.5	3.3	NA	-8%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	1	0	1	1	1	1	1	0	NA	-25%
CPU Revenue	NA	NA	0	0	1	1	1	0	0	0	NA	-24%
Workstation Revenue	NA	NA	0	0	1	1	1	0	0	0	NA	-24%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	1	1	2	3	4	4	2	1	NA	-4%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	1	2	3	4	4	2	1	NA	-2%
Service Revenue	0	0	0	0	0	1	1	1	0	0	NA	-8%
Total Revenue	0	0	1	1	4	5	5	5	3	2	NA	-10%
Increase over Prior Year	NA	NA	NA	-28%	283%	38%	9%	-7%	-33%	-38%		

Source: Dataquest
 July 1988

TABLE NUMBER: 53
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Asia
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	25	125	266	375	937	1,320	1,650	1,950	2,240	2,490	146%	22%
Workstation Shipments	56	356	367	462	1,066	1,440	1,760	2,040	2,290	2,490	109%	19%
CPU Installed Base	0	0	79	180	1,117	2,440	4,080	6,000	8,110	10,240	NA	56%
Workstation Installed Base	0	0	183	345	1,411	2,850	4,590	6,560	8,640	10,670	NA	50%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	1336.1	371.1	166.1	240.0	130.7	125.8	115.4	105.3	101.3	95.4	-44%	-6%
Hardware-Only ASP	510.8	263.1	124.8	63.1	36.3	26.7	22.8	18.7	16.5	14.5	-48%	-17%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	29	43	55	70	75	76	78	77	NA	7%
CPU Revenue	NA	NA	16	19	26	31	33	33	34	34	NA	5%
Workstation Revenue	NA	NA	10	17	22	31	33	34	35	35	NA	10%
Peripheral Revenue	NA	NA	4	7	7	8	8	8	8	8	NA	2%
Software Revenue	NA	NA	12	21	29	31	35	39	43	45	NA	9%
Bundled	NA	NA	7	15	26	24	26	27	29	30	NA	3%
Unbundled	NA	NA	5	6	4	8	10	12	14	16	NA	35%
Service Revenue	1	6	2	6	9	11	12	13	13	14	63%	8%
Total Revenue	29	50	48	71	93	112	122	127	134	136	34%	8%
Increase over Prior Year	NA	71%	-3%	46%	32%	21%	9%	4%	5%	2%		

Source: Dataquest
 July 1988

TABLE NUMBER: 54
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Asia
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	39	185	327	782	1,160	1,470	1,780	2,080	2,370	NA	25%
Workstation Shipments	0	39	185	327	782	1,160	1,470	1,780	2,080	2,370	NA	25%
CPU Installed Base	0	0	30	118	901	2,060	3,530	5,280	7,260	9,320	NA	60%
Workstation Installed Base	0	0	30	118	901	2,060	3,530	5,280	7,260	9,320	NA	60%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	81.3	83.5	174.7	113.1	103.1	94.0	85.6	77.8	70.5	NA	-9%
Hardware-Only ASP	.0	31.2	28.5	25.7	23.9	21.4	19.2	17.2	15.3	13.4	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	5	24	30	47	52	55	57	58	NA	14%
CPU Revenue	NA	NA	2	9	13	21	23	25	26	26	NA	15%
Workstation Revenue	NA	NA	2	9	13	21	23	25	26	26	NA	15%
Peripheral Revenue	NA	NA	1	5	4	6	6	6	6	6	NA	9%
Software Revenue	NA	NA	4	16	22	20	23	26	28	31	NA	7%
Bundled	NA	NA	3	12	21	14	15	16	17	18	NA	-4%
Unbundled	NA	NA	0	4	1	6	8	10	11	13	NA	92%
Service Revenue	0	0	1	4	6	7	8	9	10	10	NA	11%
Total Revenue	0	3	14	44	57	74	83	90	95	98	NA	11%
Increase over Prior Year	NA	NA	347%	213%	31%	30%	12%	8%	6%	3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 55
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Asia
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	25	86	76	48	71	80	90	90	110	120	29%	11%
Workstation Shipments	56	317	178	134	199	200	200	180	160	120	38%	-10%
CPU Installed Base	0	0	47	59	130	210	300	390	500	630	NA	37%
Workstation Installed Base	0	0	151	224	424	620	810	950	1,040	1,050	NA	20%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	1336.1	498.8	415.9	1223.1	478.2	445.1	390.5	343.9	305.2	271.3	-23%	-11%
Hardware-Only ASP	510.8	389.9	275.4	213.3	244.0	219.2	197.5	179.1	159.0	138.2	-17%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	24	19	24	22	22	19	20	19	NA	-5%
CPU Revenue	NA	NA	14	10	13	10	10	8	8	8	NA	-9%
Workstation Revenue	NA	NA	8	8	8	10	10	9	10	9	NA	2%
Peripheral Revenue	NA	NA	3	2	3	3	2	2	2	2	NA	-8%
Software Revenue	NA	NA	8	4	5	11	12	13	14	14	NA	21%
Bundled	NA	NA	4	3	4	10	10	11	12	12	NA	25%
Unbundled	NA	NA	5	1	1	2	2	2	2	2	NA	8%
Service Revenue	1	6	1	3	3	4	4	4	4	4	25%	4%
Total Revenue	29	47	34	26	33	36	37	36	37	37	3%	3%
Increase over Prior Year	NA	61%	-27%	-22%	24%	11%	3%	-4%	5%	-1%		

Source: Dataquest
 July 1988

TABLE NUMBER: 56
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Asia
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	4	0	84	80	80	80	40	0	NA	-100%
Workstation Shipments	0	0	4	0	84	80	80	80	40	0	NA	-100%
CPU Installed Base	0	0	2	2	86	170	250	330	350	290	NA	27%
Workstation Installed Base	0	0	2	2	86	170	250	330	350	290	NA	27%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	51.5	.0	15.3	14.4	13.4	12.6	11.9	.0	NA	-100%
Hardware-Only ASP	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	NA	NA
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	0	0	1	1	1	1	1	0	NA	-100%
CPU Revenue	NA	NA	0	0	0	1	1	1	0	0	NA	-100%
Workstation Revenue	NA	NA	0	0	0	1	1	1	0	0	NA	-100%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	0	0	2	0	0	0	0	0	NA	-26%
Bundled	NA	NA	0	0	1	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	0	2	0	0	0	0	0	NA	-21%
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	-29%
Total Revenue	0	0	0	0	3	2	2	2	1	1	NA	-30%
Increase over Prior Year	NA	NA	NA	9%	760%	-44%	-2%	-2%	-35%	-50%		

Source: Dataquest
 July 1988

TABLE NUMBER: 57
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	7	32	78	46	180	570	570	570	570	220%	65%
Workstation Shipments	0	21	38	82	46	180	570	570	570	570	NA	66%
CPU Installed Base	33	41	72	150	196	380	940	1,500	2,030	2,480	56%	66%
Workstation Installed Base	133	153	183	234	219	330	850	1,380	1,880	2,320	13%	60%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	440.0	184.0	113.5	80.9	70.9	65.3	62.5	56.8	51.1	NA	-9%
Hardware-Only ASP	454.5	264.3	55.5	69.5	47.9	8.5	4.4	4.0	3.7	3.3	-43%	-41%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	3	6	2	2	3	2	2	2	NA	-3%
CPU Revenue	NA	NA	1	3	2	1	1	1	1	1	NA	-9%
Workstation Revenue	NA	NA	1	2	1	1	1	1	1	1	NA	15%
Peripheral Revenue	NA	NA	1	1	0	0	0	0	0	0	NA	-39%
Software Revenue	NA	NA	1	1	1	1	1	0	0	0	NA	-2%
Bundled	NA	NA	1	1	0	0	0	0	0	0	NA	-20%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	4%
Service Revenue	0	0	1	1	0	0	0	0	0	0	95%	-16%
Total Revenue	0	3	4	8	3	3	3	3	3	3	94%	-3%
Increase over Prior Year	NA	1436%	26%	81%	-60%	-10%	26%	-13%	-7%	-7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 58
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	28	58	11	20	20	10	10	10	NA	-2%
Workstation Shipments	0	0	28	58	11	20	20	10	10	10	NA	-2%
CPU Installed Base	0	0	28	86	98	120	130	130	130	110	NA	2%
Workstation Installed Base	0	0	28	86	98	120	130	130	130	110	NA	2%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	109.4	81.9	76.1	70.8	65.8	61.1	56.7	52.5	NA	-7%
Hardware-Only ASP	.0	20.8	28.0	24.9	28.6	25.5	22.7	20.8	18.8	16.9	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	1	2	0	1	1	0	0	0	NA	-11%
CPU Revenue	NA	NA	0	1	0	0	0	0	0	0	NA	-8%
Workstation Revenue	NA	NA	0	1	0	0	0	0	0	0	NA	-8%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-26%
Software Revenue	NA	NA	0	1	0	0	0	0	0	0	NA	-3%
Bundled	NA	NA	0	1	0	0	0	0	0	0	NA	-19%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	10%
Service Revenue	0	0	0	1	0	0	0	0	0	0	NA	-6%
Total Revenue	0	0	2	3	1	1	1	1	1	1	NA	-7%
Increase over Prior Year	NA	NA	19700%	55%	-71%	41%	-24%	-29%	-4%	-5%		

Source: Dataquest
 July 1988

TABLE NUMBER: 59
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	7	4	19	9	0	0	0	0	0	110%	-100%
Workstation Shipments	0	20	11	24	8	0	0	0	0	0	NA	-100%
CPU Installed Base	33	40	44	64	72	80	80	80	80	80	21%	2%
Workstation Installed Base	133	152	155	148	96	30	(10)	(40)	(70)	(80)	-8%	ERR
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	440.0	532.5	317.9	187.5	172.5	158.7	145.8	133.7	122.4	NA	-8%
Hardware-Only ASP	454.5	391.3	311.1	178.1	194.6	175.1	157.6	144.5	129.1	114.8	-19%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	1	4	2	1	0	0	0	0	NA	-100%
CPU Revenue	NA	NA	1	3	1	0	0	0	0	0	NA	-100%
Workstation Revenue	NA	NA	0	1	0	0	0	0	0	0	NA	-100%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-1%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	0%
Service Revenue	0	0	0	1	0	0	0	0	0	0	71%	-29%
Total Revenue	0	3	2	5	2	1	0	0	0	0	73%	-38%
Increase over Prior Year	NA	1432%	-33%	104%	-57%	-64%	-75%	0%	0%	0%		

Source: Dataquest
 July 1988

TABLE NUMBER: 60
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	0	0	26	160	550	550	550	550	NA	84%
Workstation Shipments	0	0	0	0	26	160	550	550	550	550	NA	84%
CPU Installed Base	0	0	0	0	26	180	740	1,290	1,830	2,290	NA	144%
Workstation Installed Base	0	0	0	0	26	180	740	1,290	1,830	2,290	NA	144%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	NA	NA
Hardware-Only ASP	.0	.0	.0	.0	5.0	4.5	4.1	3.7	3.4	3.1	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	0	0	0	1	2	2	2	2	NA	65%
CPU Revenue	NA	NA	0	0	0	0	1	1	1	1	NA	65%
Workstation Revenue	NA	NA	0	0	0	0	1	1	1	1	NA	65%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	NA
Software Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	0%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	NA
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	0%
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	NA
Total Revenue	0	0	0	0	0	1	2	2	2	2	NA	52%
Increase over Prior Year	NA	NA	NA	NA	NA	264%	192%	-8%	-8%	-8%		

Source: Dataquest
 July 1988

TABLE NUMBER: 61
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	753	1,984	4,489	9,778	14,940	18,740	21,450	23,630	25,530	27,560	111%	13%
Workstation Shipments	1,839	3,237	6,045	11,225	16,315	19,700	22,130	24,060	25,860	27,790	73%	11%
CPU Installed Base	818	1,995	6,149	15,027	29,900	48,280	68,460	88,740	107,510	124,060	146%	33%
Workstation Installed Base	2,171	4,148	9,610	19,418	35,031	53,520	73,400	92,930	110,550	125,760	100%	29%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	245.4	208.7	134.7	103.1	61.8	51.9	46.9	43.4	40.5	37.4	-29%	-10%
Hardware-Only ASP	443.3	59.1	46.8	18.8	13.0	12.0	11.6	11.3	10.1	9.2	-59%	-7%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	336	374	361	398	413	422	406	392	NA	2%
CPU Revenue	NA	NA	156	164	155	172	181	187	180	173	NA	2%
Workstation Revenue	NA	NA	116	150	142	168	173	174	167	159	NA	2%
Peripheral Revenue	NA	NA	64	59	64	58	59	61	59	59	NA	-1%
Software Revenue	NA	NA	124	186	261	293	336	376	400	419	NA	10%
Bundled	NA	NA	111	135	119	108	114	120	124	128	NA	2%
Unbundled	NA	NA	13	51	142	185	222	256	276	291	NA	15%
Service Revenue	34	40	57	72	101	104	111	117	118	119	31%	3%
Total Revenue	238	305	523	648	722	795	860	914	925	930	32%	5%
Increase over Prior Year	NA	28%	71%	24%	11%	10%	8%	6%	1%	1%		

Source: Dataquest
 July 1988

TABLE NUMBER: 62
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	345	706	2,070	3,892	5,571	7,200	8,750	10,430	12,300	14,530	100%	21%
Workstation Shipments	345	793	2,070	3,892	5,571	7,200	8,750	10,430	12,300	14,530	100%	21%
CPU Installed Base	100	398	2,244	5,781	11,339	18,470	26,930	36,520	46,940	58,120	226%	39%
Workstation Installed Base	100	398	2,244	5,781	11,339	18,470	26,930	36,520	46,940	58,120	226%	39%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	73.1	59.1	94.7	84.2	54.2	50.4	47.8	44.9	42.0	38.9	-7%	-6%
Hardware-Only ASP	40.1	31.2	29.9	24.1	22.8	20.7	18.7	16.8	14.8	13.1	-13%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	111	171	178	222	247	265	276	283	NA	10%
CPU Revenue	NA	NA	40	71	70	91	102	110	114	117	NA	11%
Workstation Revenue	NA	NA	40	71	70	91	102	110	114	117	NA	11%
Peripheral Revenue	NA	NA	31	30	37	39	43	45	47	50	NA	6%
Software Revenue	NA	NA	65	95	141	164	203	243	275	305	NA	17%
Bundled	NA	NA	65	90	81	82	92	101	109	116	NA	7%
Unbundled	NA	NA	0	5	60	82	112	142	166	189	NA	26%
Service Revenue	3	4	27	29	54	65	75	83	90	95	106%	12%
Total Revenue	28	43	205	311	372	451	525	592	641	684	92%	13%
Increase over Prior Year	NA	57%	374%	52%	20%	21%	16%	13%	8%	7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 63
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	====	====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	408	487	663	586	593	560	570	600	540	500	10%	-3%
Workstation Shipments	1,494	1,653	2,219	2,033	1,969	1,530	1,250	1,030	860	720	7%	-18%
CPU Installed Base	718	999	1,564	2,059	2,652	3,220	3,780	4,380	4,920	5,420	39%	15%
Workstation Installed Base	2,071	3,151	5,025	6,449	7,783	8,450	8,730	8,570	7,970	7,110	39%	-2%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	415.1	454.0	361.6	457.3	308.6	284.8	267.8	247.9	227.3	208.2	-7%	-8%
Hardware-Only ASP	544.2	399.0	368.1	248.5	247.3	224.8	201.4	181.0	160.0	141.1	-18%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	203	172	140	128	118	111	89	72	NA	-12%
CPU Revenue	NA	NA	108	80	66	58	56	55	46	39	NA	-10%
Workstation Revenue	NA	NA	69	67	53	54	47	42	32	25	NA	-14%
Peripheral Revenue	NA	NA	27	25	21	17	15	14	11	9	NA	-17%
Software Revenue	NA	NA	38	48	44	31	26	19	11	7	NA	-31%
Bundled	NA	NA	34	38	28	15	11	9	6	4	NA	-32%
Unbundled	NA	NA	4	9	16	16	15	10	5	3	NA	-30%
Service Revenue	31	35	30	39	36	26	22	19	14	10	4%	-23%
Total Revenue	211	250	274	259	221	185	165	149	114	89	1%	-17%
Increase over Prior Year	NA	19%	10%	-6%	-15%	-16%	-11%	-10%	-23%	-22%		

Source: Dataquest
 July 1988

TABLE NUMBER: 64
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	791	1,756	5,300	8,775	10,970	12,130	12,600	12,690	12,530	NA	7%
Workstation Shipments	0	791	1,756	5,300	8,775	10,970	12,130	12,600	12,690	12,530	NA	7%
CPU Installed Base	0	598	2,341	7,187	15,909	26,600	37,740	47,840	55,650	60,520	NA	31%
Workstation Installed Base	0	598	2,341	7,187	15,909	26,600	37,740	47,840	55,650	60,520	NA	31%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	47.6	25.9	18.3	16.9	15.8	15.0	14.8	14.8	NA	-4%
Hardware-Only ASP	.0	14.1	8.8	4.1	3.8	3.5	3.2	2.9	2.6	2.3	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	22	30	43	48	49	46	41	37	NA	-3%
CPU Revenue	NA	NA	8	13	19	23	24	22	20	18	NA	-1%
Workstation Revenue	NA	NA	8	13	19	23	24	22	20	18	NA	-1%
Peripheral Revenue	NA	NA	6	4	5	2	2	2	1	1	NA	-24%
Software Revenue	NA	NA	21	43	76	98	107	114	114	108	NA	7%
Bundled	NA	NA	12	6	9	11	11	10	9	7	NA	-4%
Unbundled	NA	NA	9	37	67	87	96	103	105	100	NA	8%
Service Revenue	0	1	0	4	10	13	14	15	15	14	NA	6%
Total Revenue	0	12	43	78	129	159	170	174	170	158	NA	4%
Increase over Prior Year	NA	NA	260%	81%	65%	24%	7%	2%	-2%	-7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 65
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	285	1,169	2,568	4,862	8,125	10,460	11,680	12,550	13,270	14,030	131%	12%
Workstation Shipments	822	1,960	3,476	5,301	8,546	10,600	11,750	12,550	13,270	14,030	80%	10%
CPU Installed Base	515	1,684	4,251	9,112	17,170	27,360	38,180	48,670	57,880	65,420	140%	31%
Workstation Installed Base	1,537	3,491	6,920	12,045	20,145	29,910	40,090	49,710	58,040	64,830	90%	26%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	335.8	281.5	117.3	77.7	47.0	35.1	31.5	29.2	27.4	25.7	-39%	-11%
Hardware-Only ASP	305.2	36.1	34.2	15.5	9.7	8.3	7.9	7.8	7.3	6.9	-58%	-7%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	153	144	130	129	131	132	127	123	NA	-1%
CPU Revenue	NA	NA	66	66	56	58	59	60	59	57	NA	0%
Workstation Revenue	NA	NA	58	57	55	54	55	55	53	52	NA	-1%
Peripheral Revenue	NA	NA	28	20	19	17	17	16	15	15	NA	-5%
Software Revenue	NA	NA	66	66	84	101	112	123	130	133	NA	9%
Bundled	NA	NA	54	36	29	30	29	29	28	27	NA	-1%
Unbundled	NA	NA	12	30	55	72	83	94	102	105	NA	14%
Service Revenue	17	26	36	33	40	37	38	40	40	40	23%	0%
Total Revenue	112	181	255	242	254	267	281	294	297	296	23%	3%
Increase over Prior Year	NA	62%	41%	-5%	5%	5%	5%	5%	1%	-0%		

Source: Dataquest
 July 1988

TABLE NUMBER: 66
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	100	297	1,349	1,909	2,531	3,310	3,860	4,480	5,190	6,090	124%	19%
Workstation Shipments	100	297	1,349	1,909	2,531	3,310	3,860	4,480	5,190	6,090	124%	19%
CPU Installed Base	100	397	1,746	3,653	6,171	9,410	13,050	16,960	21,030	25,360	180%	33%
Workstation Installed Base	100	397	1,746	3,653	6,171	9,410	13,050	16,960	21,030	25,360	180%	33%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	65.4	74.8	75.1	62.6	41.6	37.9	34.4	31.3	28.4	25.7	-11%	-9%
Hardware-Only ASP	40.1	31.4	28.0	22.8	21.7	19.7	18.0	16.1	14.2	12.5	-14%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	58	72	67	80	83	85	86	87	NA	5%
CPU Revenue	NA	NA	21	30	27	33	35	36	37	37	NA	7%
Workstation Revenue	NA	NA	21	30	27	33	35	36	37	37	NA	7%
Peripheral Revenue	NA	NA	16	13	13	14	14	13	13	12	NA	-1%
Software Revenue	NA	NA	35	32	36	46	54	62	70	78	NA	16%
Bundled	NA	NA	35	28	24	27	28	28	27	27	NA	3%
Unbundled	NA	NA	0	4	12	19	26	34	43	50	NA	32%
Service Revenue	1	2	13	15	21	25	27	29	30	32	134%	9%
Total Revenue	7	21	107	119	124	151	164	176	186	196	107%	10%
Increase over Prior Year	NA	217%	398%	11%	5%	22%	8%	7%	6%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 67
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	184	273	287	235	172	120	120	140	140	140	-2%	-4%
Workstation Shipments	722	1,065	1,195	674	593	260	190	140	140	140	-5%	-25%
CPU Installed Base	415	688	975	1,210	1,382	1,500	1,620	1,760	1,910	2,050	35%	8%
Workstation Installed Base	1,437	2,495	3,643	4,143	4,357	4,060	3,530	2,810	2,070	1,460	32%	-20%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	470.1	486.1	356.4	429.8	333.5	306.8	282.3	259.3	237.9	217.8	-8%	-8%
Hardware-Only ASP	543.8	404.3	326.2	197.1	220.7	198.6	178.8	160.3	143.2	127.4	-20%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	85	60	42	23	22	23	21	18	NA	-15%
CPU Revenue	NA	NA	40	31	19	12	12	13	12	11	NA	-11%
Workstation Revenue	NA	NA	33	22	18	9	8	8	6	5	NA	-21%
Peripheral Revenue	NA	NA	12	7	6	3	3	3	3	2	NA	-16%
Software Revenue	NA	NA	18	14	12	8	7	5	2	1	NA	-37%
Bundled	NA	NA	15	7	4	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	3	7	7	7	7	5	2	1	NA	-31%
Service Revenue	17	24	23	16	15	7	6	5	4	3	-2%	-28%
Total Revenue	105	153	126	90	69	38	34	33	27	23	-10%	-20%
Increase over Prior Year	NA	46%	-18%	-29%	-24%	-44%	-10%	-5%	-19%	-16%		

Source: Dataquest
 July 1988

TABLE NUMBER: 68
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	*****	*****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	598	932	2,718	5,422	7,030	7,700	7,920	7,930	7,790	NA	8%
Workstation Shipments	0	598	932	2,718	5,422	7,030	7,700	7,920	7,930	7,790	NA	8%
CPU Installed Base	0	598	1,530	4,249	9,617	16,450	23,520	29,940	34,940	38,010	NA	32%
Workstation Installed Base	0	598	1,530	4,249	9,617	16,450	23,520	29,940	34,940	38,010	NA	32%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	126.2	17.9	11.9	10.9	10.1	9.3	8.5	7.8	NA	-8%
Hardware-Only ASP	.0	10.7	9.0	3.7	3.8	3.5	3.2	2.9	2.6	2.3	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	9	11	21	26	26	24	21	18	NA	-3%
CPU Revenue	NA	NA	4	5	10	13	13	12	10	9	NA	-3%
Workstation Revenue	NA	NA	4	5	10	13	13	12	10	9	NA	-3%
Peripheral Revenue	NA	NA	1	0	0	0	0	0	0	0	NA	-33%
Software Revenue	NA	NA	13	20	37	47	52	56	57	54	NA	8%
Bundled	NA	NA	4	1	1	2	1	1	1	0	NA	-100%
Unbundled	NA	NA	9	19	35	46	50	55	57	54	NA	9%
Service Revenue	0	0	0	2	4	5	5	6	6	5	NA	7%
Total Revenue	0	6	23	34	62	78	83	86	84	78	NA	5%
Increase over Prior Year	NA	NA	253%	50%	83%	26%	6%	4%	-2%	-8%		

Source: Dataquest
 July 1988

TABLE NUMBER: 69
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	418	593	726	3,076	3,912	4,500	5,070	5,600	6,000	6,430	75%	10%
Workstation Shipments	822	891	884	3,364	4,211	4,690	5,150	5,600	6,000	6,430	50%	9%
CPU Installed Base	0	0	721	3,795	7,707	12,170	16,980	21,770	26,040	29,720	NA	31%
Workstation Installed Base	0	0	879	4,240	8,451	13,110	17,970	22,700	26,810	30,240	NA	29%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	166.6	115.5	199.3	103.0	45.3	39.0	34.5	31.8	29.9	27.9	-28%	-9%
Hardware-Only ASP	534.0	171.1	57.5	12.5	16.0	18.6	18.5	18.0	15.3	13.7	-58%	-3%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	69	100	88	103	106	110	104	100	NA	3%
CPU Revenue	NA	NA	31	46	39	45	48	50	47	45	NA	3%
Workstation Revenue	NA	NA	17	41	37	42	42	43	41	39	NA	1%
Peripheral Revenue	NA	NA	21	13	12	16	16	17	16	16	NA	6%
Software Revenue	NA	NA	22	66	112	128	150	169	179	187	NA	11%
Bundled	NA	NA	21	51	33	28	29	30	31	32	NA	-0%
Unbundled	NA	NA	0	15	79	100	121	139	148	155	NA	15%
Service Revenue	13	11	12	21	35	40	43	47	48	49	29%	7%
Total Revenue	97	85	100	198	235	271	300	326	331	337	25%	7%
Increase over Prior Year	NA	-12%	17%	99%	19%	15%	11%	9%	1%	2%		

Source: Dataquest
 July 1988

TABLE NUMBER: 70
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	239	393	310	1,383	1,988	2,420	2,910	3,430	3,980	4,620	70%	18%
Workstation Shipments	239	480	310	1,383	1,988	2,420	2,910	3,430	3,980	4,620	70%	18%
CPU Installed Base	0	0	307	1,687	3,675	6,090	8,960	12,190	15,610	19,120	NA	39%
Workstation Installed Base	0	0	307	1,687	3,675	6,090	8,960	12,190	15,610	19,120	NA	39%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	74.8	47.7	141.5	96.5	44.5	40.7	37.1	33.8	30.7	27.9	-12%	-9%
Hardware-Only ASP	.0	30.8	41.0	27.1	23.3	20.9	18.7	16.8	14.8	13.0	NA	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	27	66	53	65	70	73	74	75	NA	7%
CPU Revenue	NA	NA	9	29	22	26	29	30	30	30	NA	7%
Workstation Revenue	NA	NA	9	29	22	26	29	30	30	30	NA	7%
Peripheral Revenue	NA	NA	10	9	9	12	12	13	13	14	NA	9%
Software Revenue	NA	NA	13	46	72	81	101	121	134	147	NA	15%
Bundled	NA	NA	13	46	30	26	27	29	31	32	NA	2%
Unbundled	NA	NA	0	0	43	56	74	92	103	114	NA	22%
Service Revenue	2	2	8	9	23	27	32	36	39	41	85%	12%
Total Revenue	20	21	48	132	149	173	203	230	247	262	65%	12%
Increase over Prior Year	NA	4%	136%	173%	12%	16%	17%	14%	7%	6%		

Source: Dataquest
 July 1988

TABLE NUMBER: 71
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	179	152	70	58	118	130	140	160	150	150	-10%	5%
Workstation Shipments	583	363	228	346	417	330	220	160	150	150	-8%	-19%
CPU Installed Base	0	0	70	128	246	380	520	680	830	980	NA	32%
Workstation Installed Base	0	0	228	573	991	1,320	1,520	1,610	1,600	1,490	NA	9%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	323.4	347.3	409.7	508.4	216.4	196.2	178.0	.0	.0	.0	-10%	-100%
Hardware-Only ASP	534.0	380.3	608.5	513.9	278.9	246.6	217.1	195.1	171.4	149.8	-15%	-12%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	33	26	27	31	30	31	25	22	NA	-4%
CPU Revenue	NA	NA	21	13	13	15	16	17	14	13	NA	-1%
Workstation Revenue	NA	NA	7	9	11	12	10	10	8	7	NA	-10%
Peripheral Revenue	NA	NA	6	4	3	4	4	4	3	3	NA	-2%
Software Revenue	NA	NA	4	6	11	10	8	5	3	1	NA	-34%
Bundled	NA	NA	4	4	2	1	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	1	8	9	8	5	3	1	NA	-30%
Service Revenue	11	8	3	11	8	7	5	4	3	2	-8%	-21%
Total Revenue	77	63	38	42	46	47	43	41	31	26	-12%	-11%
Increase over Prior Year	NA	-19%	-39%	9%	10%	3%	-9%	-5%	-24%	-17%		

Source: Dataquest
 July 1988

TABLE NUMBER: 72
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	48	346	1,635	1,806	1,950	2,020	2,010	1,870	1,650	NA	-2%
Workstation Shipments	0	48	346	1,635	1,806	1,950	2,020	2,010	1,870	1,650	NA	-2%
CPU Installed Base	0	0	344	1,979	3,785	5,700	7,500	8,900	9,600	9,630	NA	21%
Workstation Installed Base	0	0	344	1,979	3,785	5,700	7,500	8,900	9,600	9,630	NA	21%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	849.7	22.3	12.3	11.3	10.4	9.5	8.8	.0	NA	-100%
Hardware-Only ASP	.0	27.9	9.0	4.7	3.8	3.4	3.0	2.7	2.4	2.2	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	8	8	8	7	7	6	5	4	NA	-15%
CPU Revenue	NA	NA	2	4	4	4	3	3	2	2	NA	-14%
Workstation Revenue	NA	NA	2	4	4	4	3	3	2	2	NA	-14%
Peripheral Revenue	NA	NA	5	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	5	14	28	38	41	43	42	39	NA	7%
Bundled	NA	NA	5	1	1	1	1	1	0	0	NA	-100%
Unbundled	NA	NA	0	14	28	36	40	42	42	39	NA	7%
Service Revenue	0	0	0	1	4	6	6	6	6	6	NA	5%
Total Revenue	0	2	13	24	41	51	54	55	53	49	NA	4%
Increase over Prior Year	NA	NA	694%	89%	69%	25%	7%	2%	-3%	-9%		

Source: Dataquest
 July 1988

TABLE NUMBER: 73
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Asia
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	44	214	1,083	1,627	2,710	3,540	4,430	5,160	5,910	6,700	180%	20%
Workstation Shipments	161	359	1,550	2,319	3,336	4,150	4,950	5,590	6,230	6,920	113%	16%
CPU Installed Base	0	0	753	1,484	4,194	7,700	11,990	16,750	21,780	26,860	NA	45%
Workstation Installed Base	0	0	1,054	2,262	5,598	9,710	14,490	19,530	24,560	29,330	NA	39%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	494.8	522.7	138.3	149.7	104.1	90.9	80.4	72.5	64.7	57.8	-32%	-11%
Hardware-Only ASP	569.1	83.5	167.2	42.2	24.0	20.1	17.9	16.3	13.9	12.1	-55%	-13%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	110	119	137	161	170	174	169	163	NA	4%
CPU Revenue	NA	NA	57	46	58	67	72	74	72	68	NA	3%
Workstation Revenue	NA	NA	39	48	48	70	73	74	71	67	NA	7%
Peripheral Revenue	NA	NA	14	25	31	24	25	26	27	28	NA	-3%
Software Revenue	NA	NA	35	52	63	62	72	82	90	97	NA	9%
Bundled	NA	NA	34	47	56	50	56	60	64	68	NA	4%
Unbundled	NA	NA	1	5	7	12	16	22	26	30	NA	32%
Service Revenue	4	3	8	17	25	27	28	29	29	29	62%	3%
Total Revenue	26	35	162	193	225	250	271	285	289	289	71%	5%
Increase over Prior Year	NA	31%	367%	19%	17%	11%	9%	5%	1%	0%		

Source: Dataquest
 July 1988

TABLE NUMBER: 74
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Asia
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	====	====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	6	15	373	490	979	1,390	1,890	2,420	3,030	3,710	257%	31%
Workstation Shipments	6	15	373	490	979	1,390	1,890	2,420	3,030	3,710	257%	31%
CPU Installed Base	0	0	153	292	1,272	2,660	4,540	6,900	9,760	13,050	NA	59%
Workstation Installed Base	0	0	153	292	1,272	2,660	4,540	6,900	9,760	13,050	NA	59%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	110.0	202.0	128.3	134.0	123.9	113.0	103.0	93.7	85.1	77.2	3%	-9%
Hardware-Only ASP	.0	31.1	28.6	24.5	24.3	22.1	20.0	18.0	16.0	14.1	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	24	29	56	76	93	106	115	120	NA	17%
CPU Revenue	NA	NA	10	11	20	31	38	43	47	49	NA	19%
Workstation Revenue	NA	NA	10	11	20	31	38	43	47	49	NA	19%
Peripheral Revenue	NA	NA	4	8	15	14	16	19	21	23	NA	9%
Software Revenue	NA	NA	16	16	32	36	48	59	70	80	NA	20%
Bundled	NA	NA	16	15	28	29	36	43	50	56	NA	15%
Unbundled	NA	NA	0	1	4	8	11	16	20	24	NA	41%
Service Revenue	0	0	5	5	10	12	16	18	21	22	133%	18%
Total Revenue	1	1	48	55	97	124	156	183	206	223	215%	18%
Increase over Prior Year	NA	36%	3459%	14%	77%	28%	25%	18%	12%	8%		

Source: Dataquest
 July 1988

TABLE NUMBER: 75
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Asia
 PLATFORM: Host-Dependent

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	38	54	300	261	292	300	290	270	220	180	67%	-9%
Workstation Shipments	155	199	767	953	917	910	820	700	550	410	56%	-15%
CPU Installed Base	0	0	202	372	663	960	1,250	1,530	1,750	1,930	NA	24%
Workstation Installed Base	0	0	503	1,149	2,067	2,970	3,750	4,320	4,530	4,400	NA	16%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	599.2	583.4	354.6	461.4	321.1	295.0	270.2	247.9	227.3	208.2	-14%	-8%
Hardware-Only ASP	569.1	418.7	294.2	290.6	254.5	228.6	205.2	184.9	165.1	146.7	-18%	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	83	79	68	71	62	53	39	28	NA	-16%
CPU Revenue	NA	NA	46	32	33	29	26	23	18	13	NA	-17%
Workstation Revenue	NA	NA	28	34	23	33	28	23	17	12	NA	-13%
Peripheral Revenue	NA	NA	9	14	12	9	8	6	5	3	NA	-24%
Software Revenue	NA	NA	15	28	21	13	11	9	6	4	NA	-28%
Bundled	NA	NA	15	27	21	13	11	9	6	4	NA	-28%
Unbundled	NA	NA	0	1	0	0	0	0	0	0	NA	NA
Service Revenue	3	3	3	11	13	12	10	9	6	5	41%	-19%
Total Revenue	25	29	107	119	103	96	84	70	52	37	42%	-19%
Increase over Prior Year	NA	15%	263%	11%	-13%	-7%	-13%	-16%	-26%	-29%		

Source: Dataquest
 July 1988

TABLE NUMBER: 76
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Asia
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	****	****	****	****	****	****	****	****	****	****	*****	*****
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	145	409	876	1,439	1,850	2,250	2,470	2,650	2,810	NA	14%
Workstation Shipments	0	145	409	876	1,439	1,850	2,250	2,470	2,650	2,810	NA	14%
CPU Installed Base	0	0	398	820	2,259	4,070	6,200	8,320	10,280	11,880	NA	39%
Workstation Installed Base	0	0	398	820	2,259	4,070	6,200	8,320	10,280	11,880	NA	39%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	16.0	29.7	22.6	20.9	19.2	17.6	16.2	14.9	NA	-8%
Hardware-Only ASP	.0	23.9	.0	4.4	4.0	3.6	3.3	3.0	2.7	2.4	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	4	10	13	15	16	15	15	14	NA	2%
CPU Revenue	NA	NA	2	3	5	7	7	7	7	7	NA	8%
Workstation Revenue	NA	NA	2	3	5	7	7	7	7	7	NA	8%
Peripheral Revenue	NA	NA	1	4	4	1	1	1	1	1	NA	-22%
Software Revenue	NA	NA	3	8	10	12	13	14	13	13	NA	6%
Bundled	NA	NA	3	4	7	8	8	8	8	7	NA	2%
Unbundled	NA	NA	1	3	3	4	5	6	6	6	NA	13%
Service Revenue	0	1	0	1	2	2	2	2	2	2	NA	4%
Total Revenue	0	4	7	19	25	29	31	31	31	30	NA	4%
Increase over Prior Year	NA	NA	83%	158%	33%	16%	8%	0%	-2%	-3%		

Source: Dataquest
 July 1988

TABLE NUMBER: 77
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: All Platforms

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	7	8	112	213	192	230	270	320	360	410	131%	16%
Workstation Shipments	34	28	136	241	222	250	280	320	360	410	60%	13%
CPU Installed Base	303	312	424	637	829	1,060	1,300	1,560	1,810	2,050	29%	20%
Workstation Installed Base	634	657	758	871	837	790	840	980	1,140	1,350	7%	10%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	381.7	628.3	159.9	73.4	31.5	22.8	20.9	19.0	17.3	15.6	-46%	-13%
Hardware-Only ASP	563.4	275.6	20.5	52.6	28.1	25.6	23.9	23.5	17.9	13.7	-53%	-13%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	4	11	5	5	6	6	6	5	NA	1%
CPU Revenue	NA	NA	2	6	2	3	3	3	3	3	NA	3%
Workstation Revenue	NA	NA	2	4	2	2	2	2	2	2	NA	-3%
Peripheral Revenue	NA	NA	1	1	1	1	1	1	1	1	NA	3%
Software Revenue	NA	NA	1	2	2	2	2	2	2	2	NA	0%
Bundled	NA	NA	1	1	1	1	1	1	1	1	NA	0%
Unbundled	NA	NA	0	1	1	1	1	1	1	1	NA	0%
Service Revenue	1	0	1	1	1	1	1	1	1	1	2%	-1%
Total Revenue	3	5	6	15	8	8	8	9	8	8	22%	1%
Increase over Prior Year	NA	41%	34%	131%	-49%	2%	7%	11%	-7%	-7%		

Source: Dataquest
 July 1988

TABLE NUMBER: 78
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: Technical Workstation

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	1	37	111	73	80	90	100	110	110	NA	9%
Workstation Shipments	0	1	37	111	73	80	90	100	110	110	NA	9%
CPU Installed Base	0	1	38	148	221	300	390	470	540	590	NA	22%
Workstation Installed Base	0	1	38	148	221	300	390	470	540	590	NA	22%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	71.9	58.9	26.3	23.9	21.8	19.8	18.0	16.3	NA	-9%
Hardware-Only ASP	.0	26.0	27.4	26.2	28.1	25.6	23.3	20.9	18.4	16.2	NA	-10%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	1	4	1	1	1	1	1	1	NA	-3%
CPU Revenue	NA	NA	1	2	1	1	1	1	1	0	NA	-4%
Workstation Revenue	NA	NA	1	2	1	1	1	1	1	0	NA	-4%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	1%
Software Revenue	NA	NA	1	1	1	1	1	1	1	1	NA	3%
Bundled	NA	NA	1	1	1	1	1	1	1	1	NA	4%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	0%
Service Revenue	0	0	0	1	0	0	0	0	0	0	NA	-1%
Total Revenue	0	0	2	5	2	3	3	3	2	2	NA	-1%
Increase over Prior Year	NA	NA	11050%	137%	-53%	3%	0%	0%	-4%	-5%		

Source: Dataquest
 July 1988

TABLE NUMBER: 79
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: Host-Dependent

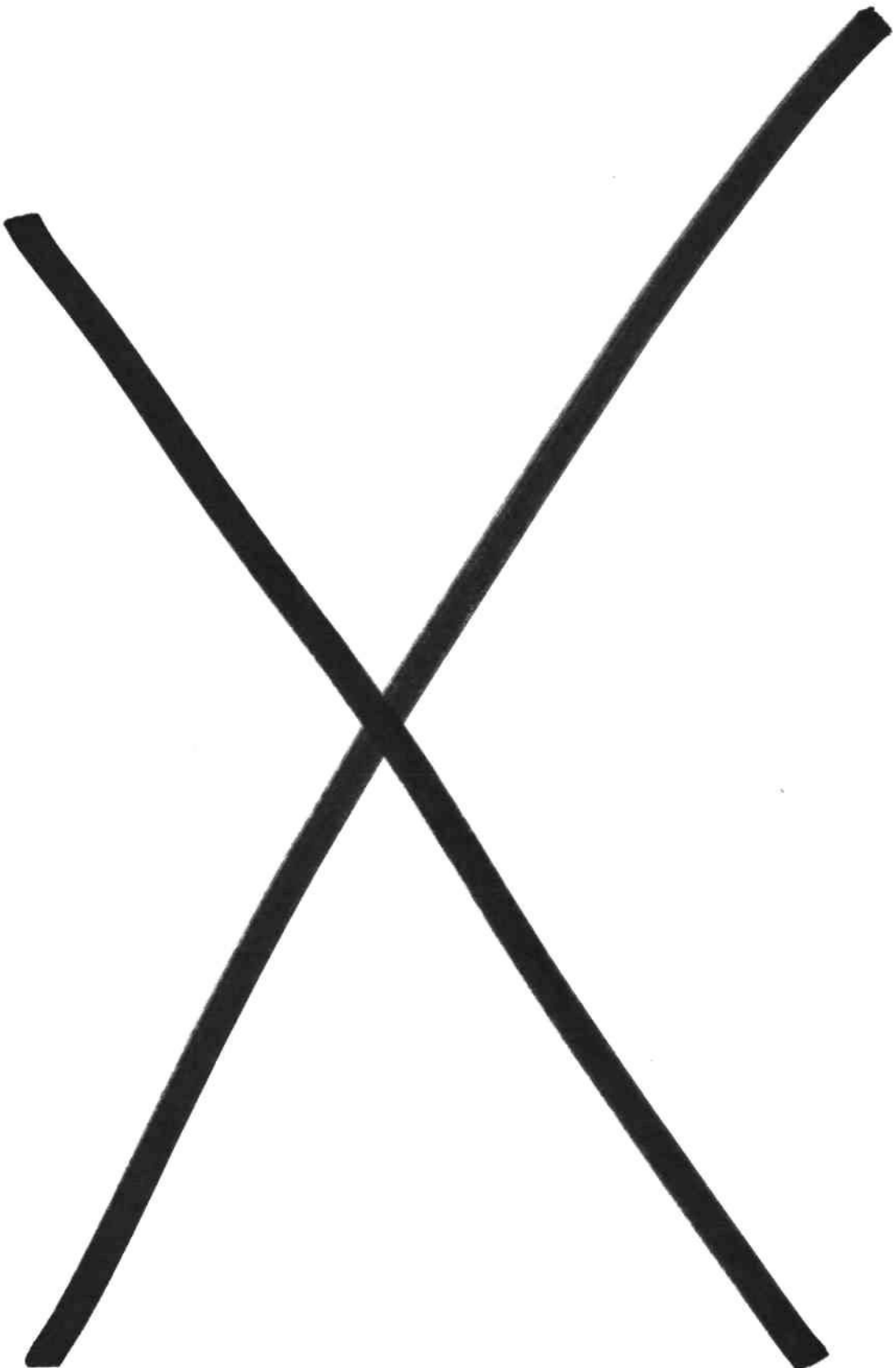
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	7	7	6	32	11	10	20	20	20	20	13%	13%
Workstation Shipments	34	27	30	61	41	30	20	20	20	20	5%	-13%
CPU Installed Base	303	311	317	349	360	370	390	410	440	460	4%	5%
Workstation Installed Base	634	656	651	583	368	110	(70)	(160)	(220)	(240)	-13%	ERR
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	381.7	628.3	641.3	363.4	520.4	468.4	421.5	378.8	339.9	304.4	8%	-10%
Hardware-Only ASP	563.4	405.4	348.4	217.5	271.6	244.4	220.0	197.3	172.3	149.8	-17%	-11%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	3	7	3	3	4	4	4	3	NA	1%
CPU Revenue	NA	NA	1	4	2	2	2	2	2	2	NA	5%
Workstation Revenue	NA	NA	1	2	1	1	1	1	1	1	NA	-4%
Peripheral Revenue	NA	NA	0	1	0	0	0	1	0	0	NA	4%
Software Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-17%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Unbundled	NA	NA	0	0	0	0	0	0	0	0	NA	0%
Service Revenue	1	0	1	1	0	0	0	0	0	0	-17%	-1%
Total Revenue	3	5	4	8	4	4	4	5	4	4	2%	1%
Increase over Prior Year	NA	40%	-24%	128%	-56%	-1%	13%	21%	-13%	-13%		

Source: Dataquest
 July 1988

TABLE NUMBER: 80
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: Personal Computer

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	CAGR 83-87	CAGR 87-92
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA (Workstation Shipments)												
CPU Shipments	0	0	69	70	108	140	160	200	230	280	NA	21%
Workstation Shipments	0	0	69	70	108	140	160	200	230	280	NA	21%
CPU Installed Base	0	0	69	139	247	380	520	670	830	1,010	NA	32%
Workstation Installed Base	0	0	69	139	247	380	520	670	830	1,010	NA	32%
AVERAGE SYSTEM PRICE DATA (Thousands of Dollars)												
Turnkey ASP	.0	.0	.0	25.2	10.7	9.8	9.1	8.3	7.6	7.0	NA	-8%
Hardware-Only ASP	.0	.0	5.1	3.9	4.0	3.7	3.4	3.0	2.7	2.4	NA	-9%
REVENUE DATA (Millions of Dollars)												
Hardware Revenue	NA	NA	0	0	0	1	1	1	1	1	NA	9%
CPU Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	9%
Workstation Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	9%
Peripheral Revenue	NA	NA	0	0	0	0	0	0	0	0	NA	-100%
Software Revenue	NA	NA	0	1	1	1	1	1	1	1	NA	0%
Bundled	NA	NA	0	0	0	0	0	0	0	0	NA	-8%
Unbundled	NA	NA	0	1	1	1	1	1	1	1	NA	0%
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	0%
Total Revenue	0	0	1	1	1	2	2	2	2	2	NA	3%
Increase over Prior Year	NA	NA	NA	131%	17%	6%	3%	2%	2%	2%		

Source: Dataquest
 July 1988



Appendix B—Market Share

INTRODUCTION

The following market share tables present Dataquest's vendor estimates for the CAD/CAM industry. It is against Dataquest's corporate policy to publish or release individual forecasts for any company.

Please refer to the section entitled "Introduction to the Service" for information on forecasting methodologies, companies contained within the data base, and caveats. Forecasting terms and definitions can be found behind the Glossary tab.

We have tried to segment the market share data in as many meaningful ways as possible. As the forecast data base tends to be quite large by nature, we have limited market shares to the following structure:

- Application by
 - Region by
 - Platform

Each market share analysis section includes data arranged by total CAD/CAM revenue, hardware revenue, software revenue, and workstation shipments. The sum of hardware and software revenue does not equal total revenue because we did not include revenue derived from servicing CAD/CAM systems for these market share analyses.

Market Share

TABLE NUMBER: 1
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company	Total				Market Share			
	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Mentor	210.7	99.9	79.8	4,936	10.6%	10.0%	11.1%	9.8%
Digital	174.1	149.5	.0	779	8.8%	15.0%	.0%	1.5%
Daisy	103.5	26.2	55.2	831	5.2%	2.6%	7.6%	1.7%
Racal-Redac	89.8	10.0	67.3	199	4.5%	1.0%	9.3%	.4%
Apollo	82.6	74.0	.0	3,115	4.2%	7.4%	.0%	6.2%
IBM	80.2	68.8	4.9	9,775	4.0%	6.9%	.7%	19.4%
Sun	68.5	60.5	.0	2,886	3.5%	6.0%	.0%	5.7%
Valid	67.3	19.3	33.6	688	3.4%	1.9%	4.7%	1.4%
Hewlett-Packard	58.7	34.7	18.9	2,466	3.0%	3.5%	2.6%	4.9%
Cadnetix	53.9	25.6	22.0	990	2.7%	2.6%	3.0%	2.0%
Scientific Calculations	51.5	16.8	17.3	154	2.6%	1.7%	2.4%	.3%
Computervision	47.5	17.0	17.3	424	2.4%	1.7%	2.4%	.8%
Calma	43.5	23.2	12.4	359	2.2%	2.3%	1.7%	.7%
Zuken	41.7	21.9	14.4	346	2.1%	2.2%	2.0%	.7%
Fujitsu	37.9	26.1	8.1	508	1.9%	2.6%	1.1%	1.0%
Seiko Instruments (No OEM)	35.0	18.1	13.4	200	1.8%	1.8%	1.9%	.4%
NEC	34.3	17.8	13.0	639	1.7%	1.8%	1.8%	1.3%
Calay	27.2	17.1	8.1	230	1.4%	1.7%	1.1%	.5%
Compaq	27.2	27.2	.0	7,640	1.4%	2.7%	.0%	15.2%
Zycad	27.1	23.9	.0	53	1.4%	2.4%	.0%	.1%
Silicon Compiler Systems	27.0	.0	23.8	0	1.4%	.0%	3.3%	.0%
Silver-Lisco	25.3	.0	23.0	0	1.3%	.0%	3.2%	.0%
Intergraph	24.5	13.5	5.8	222	1.2%	1.3%	.8%	.4%
Control Data	21.8	14.2	2.6	374	1.1%	1.4%	.4%	.7%
ECAD	21.4	.0	21.4	0	1.1%	.0%	3.0%	.0%
Futurenet	17.9	.0	15.7	0	.9%	.0%	2.2%	.0%
SDA	16.5	.4	15.4	10	.8%	.0%	2.1%	.0%
Sharp System Products	16.3	6.8	7.9	85	.8%	.7%	1.1%	.2%
Personal CAD Systems	15.9	.0	13.9	0	.8%	.0%	1.9%	.0%
Autodesk	15.0	.0	15.0	0	.8%	.0%	2.1%	.0%
Hitachi	13.7	9.3	3.3	245	.7%	.9%	.5%	.5%
Asahi Optical (No OEM)	10.0	7.4	1.6	55	.5%	.7%	.2%	.1%

(Continued)

Market Share

TABLE NUMBER: 1 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Applicon	9.5	3.9	2.7	200	.5%	.4%	.4%	.4%
Tektronix	7.5	3.5	3.1	95	.4%	.3%	.4%	.2%
Toshiba (No OEM)	7.2	5.5	1.0	84	.4%	.6%	.1%	.2%
Apple Computer	7.0	7.1	.0	2,527	.4%	.7%	.0%	5.0%
Mitachi Zosen	4.4	1.6	2.4	29	.2%	.2%	.3%	.1%
CADAM	4.2	.0	3.8	0	.2%	.0%	.5%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	.2%	.2%	.1%	.1%
Tokyo Electron (No OEM)	.8	.0	.7	0	.0%	.0%	.1%	.0%
ICL	.8	.6	.2	19	.0%	.1%	.0%	.0%
Other Companies	349.2	146.4	171.7	9,160	17.6%	14.6%	23.8%	18.2%
All Companies	1,981.9	999.6	721.4	50,369	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	1,540.0	807.2	521.6	45,293	77.7%	80.7%	72.3%	89.9%
All Asian-Based Companies	265.2	143.9	93.7	3,629	13.4%	14.4%	13.0%	7.2%
All European-Based Companies	176.8	48.6	106.1	1,447	8.9%	4.9%	14.7%	2.9%
All Hardware Companies	527.3	474.7	.6	32,971	26.6%	47.5%	.1%	65.5%
All Turnkey & SW Companies	1,454.6	525.0	720.8	17,398	73.4%	52.5%	99.9%	34.5%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 2
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Mksts Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Mksts Shipped *****
Mentor	210.7	99.9	79.8	4,936	18.8%	19.6%	17.8%	25.5%
Apollo	82.6	74.0	.0	3,115	7.4%	14.5%	.0%	16.1%
Daisy	77.4	22.1	39.7	546	6.9%	4.3%	8.8%	2.8%
Sun	68.5	60.5	.0	2,886	6.1%	11.8%	.0%	14.9%
Racal-Redac	63.4	9.9	44.9	199	5.7%	1.9%	10.0%	1.0%
Valid	63.3	18.6	31.2	659	5.7%	3.6%	6.9%	3.4%
Hewlett-Packard	58.7	34.7	18.9	2,466	5.2%	6.8%	4.2%	12.8%
Cadnetix	45.9	25.6	14.9	990	4.1%	5.0%	3.3%	5.1%
Computervision	42.2	16.0	14.0	360	3.8%	3.1%	3.1%	1.9%
Calma	28.9	13.6	10.0	254	2.6%	2.7%	2.2%	1.3%
Seiko Instruments (No OEM)	28.0	12.6	12.6	180	2.5%	2.5%	2.8%	.9%
NEC	27.4	13.7	10.9	321	2.4%	2.7%	2.4%	1.7%
Celay	27.2	17.1	8.1	230	2.4%	3.4%	1.8%	1.2%
Digital	22.7	19.4	.0	779	2.0%	3.8%	.0%	4.0%
Silicon Compiler Systems	21.6	.0	19.0	0	1.9%	.0%	4.2%	.0%
ECAD	20.3	.0	20.3	0	1.8%	.0%	4.5%	.0%
Scientific Calculations	18.7	6.8	6.4	64	1.7%	1.3%	1.4%	.3%
Silver-Lisco	18.5	.0	16.8	0	1.7%	.0%	3.7%	.0%
Intergraph	16.8	8.7	4.5	112	1.5%	1.7%	1.0%	.6%
SDA	16.5	.4	15.4	10	1.5%	.1%	3.4%	.1%
Sharp System Products	16.3	6.8	7.9	85	1.5%	1.3%	1.8%	.4%
Asahi Optical (No OEM)	7.6	5.5	1.4	45	.7%	1.1%	.3%	.2%
Zuken	5.5	2.9	1.9	59	.5%	.6%	.4%	.3%
Tektronix	5.3	2.3	2.3	63	.5%	.5%	.5%	.3%
Hitachi Zosen	4.4	1.6	2.4	29	.4%	.3%	.5%	.1%
Hitachi	1.9	1.9	.0	35	.2%	.4%	.0%	.2%
IBM	1.7	.9	.4	29	.2%	.2%	.1%	.2%
ICL	.8	.6	.2	19	.1%	.1%	.0%	.1%
Fujitsu	.6	.0	.6	0	.1%	.0%	.1%	.0%
Tokyo Electron (No OEM)	.4	.0	.4	0	.0%	.0%	.1%	.0%

(Continued)

Market Share

TABLE NUMBER: 2 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Autodesk	.1	.0	.1	0	.0%	.0%	.0%	.0%
Other Companies	114.2	34.7	64.7	856	10.2%	6.8%	14.4%	4.4%
All Companies	1,118.2	510.6	449.5	19,328	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	872.1	409.4	333.1	17,589	78.0%	80.2%	74.1%	91.0%
All Asian-Based Companies	111.9	56.4	44.3	1,051	10.0%	11.0%	9.9%	5.4%
All European-Based Companies	134.3	44.8	72.1	687	12.0%	8.8%	16.0%	3.6%
All Hardware Companies	188.9	167.0	.6	7,355	16.9%	32.7%	.1%	38.1%
All Turnkey & SW Companies	929.3	343.6	448.9	11,973	83.1%	67.3%	99.9%	61.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 3
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	151.4	130.1	.0	0	28.0%	36.1%	.0%	.0%
Zuken	36.2	19.0	12.5	287	6.7%	5.3%	12.1%	7.8%
Fujitsu	36.2	26.1	6.5	508	6.7%	7.2%	6.3%	13.9%
Scientific Calculations	32.8	10.1	10.8	90	6.1%	2.8%	10.5%	2.5%
IBM	28.9	21.3	3.5	331	5.3%	5.9%	3.4%	9.0%
Zycad	27.1	23.9	.0	53	5.0%	6.6%	.0%	1.5%
Control Data	17.3	11.8	1.5	4	3.2%	3.3%	1.4%	.1%
Celma	13.9	9.2	2.2	72	2.6%	2.6%	2.1%	2.0%
Applicon	9.5	3.9	2.7	200	1.7%	1.1%	2.7%	5.5%
Intergraph	7.6	4.8	1.1	110	1.4%	1.3%	1.1%	3.0%
Toshiba (No OEM)	7.2	5.5	1.0	84	1.3%	1.5%	.9%	2.3%
Seiko Instruments (No OEM)	7.0	5.5	.8	20	1.3%	1.5%	.8%	.5%
Silver-Lisco	6.8	.0	6.2	0	1.3%	.0%	6.0%	.0%
Daisy	6.3	1.1	3.7	32	1.2%	.3%	3.5%	.9%
Nitachi	5.6	4.0	1.0	40	1.0%	1.1%	1.0%	1.1%
Silicon Compiler Systems	5.4	.0	4.8	0	1.0%	.0%	4.6%	.0%
CADAM	4.2	.0	3.8	0	.8%	.0%	3.7%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	.6%	.6%	.9%	1.2%
NEC	3.5	2.5	.6	20	.6%	.7%	.6%	.5%
Asahi Optical (No OEM)	2.4	1.9	.2	10	.4%	.5%	.2%	.3%
Tektronix	2.3	1.2	.8	32	.4%	.3%	.8%	.9%
Computervision	1.4	.6	.4	9	.3%	.2%	.4%	.3%
ECAD	1.1	.0	1.1	0	.2%	.0%	1.0%	.0%

(Continued)

Market Share

TABLE NUMBER: 3 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Tokyo Electron (No OEM)	.4	.0	.4	0	.1%	.0%	.3%	.0%
Other Companies	123.8	75.6	36.7	1,720	22.9%	21.0%	35.6%	46.9%
All Companies	541.6	360.0	103.2	3,666	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	419.2	285.7	69.0	2,540	77.4%	79.4%	66.9%	69.3%
All Asian-Based Companies	112.5	71.6	27.7	1,076	20.8%	19.9%	26.8%	29.3%
All European-Based Companies	10.0	2.7	6.5	50	1.8%	.7%	6.3%	1.4%
All Hardware Companies	234.0	204.6	.0	1,412	43.2%	56.8%	.0%	38.5%
All Turnkey & SW Companies	307.6	155.3	103.2	2,254	56.8%	43.2%	100.0%	61.5%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 4
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
IBM	49.6	46.6	1.0	9,415	15.4%	36.1%	.6%	34.4%
Compaq	27.2	27.2	.0	7,640	8.4%	21.1%	.0%	27.9%
Racal-Redac	26.4	.1	22.4	0	8.2%	.0%	13.3%	.0%
Daisy	19.8	3.1	11.8	253	6.2%	2.4%	7.0%	.9%
Futurenet	17.9	.0	15.7	0	5.6%	.0%	9.3%	.0%
Personal CAD Systems	15.9	.0	13.9	0	4.9%	.0%	8.2%	.0%
Autodesk	14.9	.0	14.9	0	4.6%	.0%	8.8%	.0%
Cadnetix	8.0	.0	7.1	0	2.5%	.0%	4.2%	.0%
Apple Computer	7.0	7.1	.0	2,527	2.2%	5.5%	.0%	9.2%
Hitachi	6.3	3.4	2.3	170	1.9%	2.6%	1.3%	.6%
Control Data	4.6	2.4	1.1	370	1.4%	1.9%	.7%	1.4%
Valid	4.0	.7	2.4	29	1.2%	.5%	1.4%	.1%
Computervision	3.9	.4	2.9	54	1.2%	.3%	1.7%	.2%
NEC	3.5	1.6	1.6	299	1.1%	1.2%	.9%	1.1%
Fujitsu	1.1	.0	1.0	0	.3%	.0%	.6%	.0%
Calma	.7	.4	.2	34	.2%	.3%	.1%	.1%
Intergraph	.2	.0	.2	0	.1%	.0%	.1%	.0%
Other Companies	111.3	36.1	70.3	6,584	34.5%	28.0%	41.7%	24.1%
All Companies	322.1	129.1	168.7	27,375	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	248.8	112.1	119.5	25,164	77.2%	86.8%	70.8%	91.9%
All Asian-Based Companies	40.8	15.9	21.8	1,502	12.7%	12.3%	12.9%	5.5%
All European-Based Companies	32.6	1.1	27.5	709	10.1%	.9%	16.3%	2.6%
All Hardware Companies	104.5	103.0	.0	24,204	32.4%	79.8%	.0%	88.4%
All Turnkey & SW Companies	217.7	26.1	168.7	3,171	67.6%	20.2%	100.0%	11.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 5
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	112.6	62.0	33.8	2,982	12.9%	14.0%	10.9%	10.7%
Digital	79.7	67.7	.0	393	9.2%	15.3%	.0%	1.4%
Sun	47.0	41.4	.0	2,038	5.4%	9.4%	.0%	7.3%
Apollo	40.4	35.6	.0	1,445	4.6%	8.0%	.0%	5.2%
Daisy	39.0	10.4	18.9	316	4.5%	2.3%	6.1%	1.1%
Valid	37.1	9.3	17.4	346	4.3%	2.1%	5.6%	1.2%
Cadnetix	36.6	16.5	15.7	673	4.2%	3.7%	5.1%	2.4%
IBM	35.6	32.0	2.0	4,875	4.1%	7.2%	.6%	17.5%
Scientific Calculations	30.6	10.1	8.3	92	3.5%	2.3%	2.7%	.3%
Zycad	21.8	19.0	.0	41	2.5%	4.3%	.0%	.1%
Hewlett-Packard	19.7	12.7	5.4	1,032	2.3%	2.9%	1.8%	3.7%
Compeq	19.0	19.0	.0	5,348	2.2%	4.3%	.0%	19.2%
Silicon Compiler Systems	18.4	.0	16.2	0	2.1%	.0%	5.2%	.0%
Computervision	16.2	7.2	4.4	129	1.9%	1.6%	1.4%	.5%
Control Data	15.8	10.1	1.5	205	1.8%	2.3%	.5%	.7%
Intergraph	15.1	8.5	3.8	119	1.7%	1.9%	1.2%	.4%
ECAD	14.5	.0	14.5	0	1.7%	.0%	4.7%	.0%
Futurenet	13.1	.0	11.6	0	1.5%	.0%	3.7%	.0%
Racal-Redac	13.0	.3	10.8	29	1.5%	.1%	3.5%	.1%
Celay	12.1	9.4	1.8	111	1.4%	2.1%	.6%	.4%
Silvar-Lisco	11.5	.0	9.2	0	1.3%	.0%	3.0%	.0%
Calma	11.4	6.3	3.9	178	1.3%	1.4%	1.3%	.6%
Autodesk	10.9	.0	10.9	0	1.3%	.0%	3.5%	.0%
SDA	8.3	.2	7.7	5	.9%	.0%	2.5%	.0%
Personal CAD Systems	7.8	.0	6.8	0	.9%	.0%	2.2%	.0%
Tektronix	6.4	3.0	2.7	81	.7%	.7%	.9%	.3%
Apple Computer	5.1	5.2	.0	1,845	.6%	1.2%	.0%	6.6%
Applicon	4.7	2.4	.9	108	.5%	.6%	.3%	.4%
CADAM	1.7	.0	1.5	0	.2%	.0%	.5%	.0%

(Continued)

Market Share

TABLE NUMBER: 5 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Zuken	.4	.3	.1	0	.0%	.1%	.0%	.0%
Other Companies	165.1	53.9	99.5	5,423	19.0%	12.2%	32.2%	19.5%
All Companies	870.5	442.1	309.1	27,816	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	842.9	431.9	294.9	27,666	96.8%	97.7%	95.4%	99.5%
All Asian-Based Companies	.4	.3	.1	0	.0%	.1%	.0%	.0%
All European-Based Companies	27.1	9.9	14.2	149	3.1%	2.2%	4.6%	.5%
All Hardware Companies	276.6	249.1	.0	20,929	31.8%	56.3%	.0%	75.2%
All Turnkey & SW Companies	593.8	193.0	309.1	6,887	68.2%	43.7%	100.0%	24.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 6
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Mentor	112.6	62.0	33.8	2,982	23.2%	26.9%	18.4%	30.4%
Sun	47.0	41.4	.0	2,038	9.7%	18.0%	.0%	20.7%
Apollo	40.4	35.6	.0	1,445	8.3%	15.5%	.0%	14.7%
Valid	34.8	8.6	16.4	317	7.2%	3.7%	9.0%	3.2%
Cadnetix	29.3	16.5	9.3	673	6.0%	7.2%	5.1%	6.9%
Daisy	26.5	7.3	12.6	163	5.5%	3.2%	6.9%	1.7%
Hewlett-Packard	19.7	12.7	5.4	1,032	4.1%	5.5%	3.0%	10.5%
Silicon Compiler Systems	14.7	.0	12.9	0	3.0%	.0%	7.1%	.0%
Computervision	14.6	7.0	3.2	116	3.0%	3.0%	1.7%	1.2%
ECAD	13.8	.0	13.8	0	2.8%	.0%	7.5%	.0%
Calay	12.1	9.4	1.8	111	2.5%	4.1%	1.0%	1.1%
Intergraph	10.8	5.7	3.2	82	2.2%	2.5%	1.7%	.8%
Digital	10.4	8.8	.0	393	2.1%	3.8%	.0%	4.0%
Calma	9.5	5.2	3.4	130	2.0%	2.2%	1.9%	1.3%
Scientific Calculations	9.2	2.5	3.0	21	1.9%	1.1%	1.6%	.2%
Racal-Redac	8.6	.3	7.1	29	1.8%	.1%	3.9%	.3%
Silver-Lisco	8.3	.0	6.6	0	1.7%	.0%	3.6%	.0%
SDA	8.3	.2	7.7	5	1.7%	.1%	4.2%	.1%
Tektronix	4.5	2.0	2.0	53	.9%	.9%	1.1%	.5%
IBM	.6	.3	.2	11	.1%	.1%	.1%	.1%
Autodesk	.1	.0	.1	0	.0%	.0%	.1%	.0%
Other Companies	50.6	4.7	40.8	221	10.4%	2.0%	22.3%	2.2%
All Companies	486.3	229.9	183.3	9,823	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	464.3	220.1	173.3	9,677	95.5%	95.7%	94.6%	98.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	22.1	9.8	9.9	146	4.5%	4.3%	5.4%	1.5%
All Hardware Companies	99.9	87.7	.0	3,992	20.5%	38.1%	.0%	40.6%
All Turnkey & SW Companies	386.4	142.3	183.3	5,831	79.5%	61.9%	100.0%	59.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 7
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****				 Market Share			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	69.3	58.9	.0	0	32.5%	42.8%	.0%	.0%
Zyced	21.8	19.0	.0	41	10.2%	13.8%	.0%	3.3%
Scientific Calculations	21.4	7.6	5.3	71	10.0%	5.5%	13.3%	5.7%
Control Data	13.3	9.0	.8	2	6.2%	6.5%	2.0%	.1%
IBM	10.4	7.6	1.4	119	4.9%	5.5%	3.4%	9.6%
Applicon	4.7	2.4	.9	108	2.2%	1.8%	2.2%	8.6%
Intergraph	4.3	2.9	.6	37	2.0%	2.1%	1.6%	3.0%
Silicon Compiler Systems	3.7	.0	3.2	0	1.7%	.0%	8.1%	.0%
Silvar-Lisco	3.2	.0	2.5	0	1.5%	.0%	6.4%	.0%
Daisy	3.1	1.0	1.3	31	1.5%	.7%	3.3%	2.5%
Tektronix	1.9	1.0	.7	27	.9%	.7%	1.8%	2.2%
CADAM	1.7	.0	1.5	0	.8%	.0%	3.7%	.0%
Calma	1.1	.7	.3	14	.5%	.5%	.7%	1.1%
ECAD	.7	.0	.7	0	.3%	.0%	1.8%	.0%
Zuken	.4	.3	.1	0	.2%	.2%	.1%	.0%
Computervision	.1	.1	.0	1	.1%	.0%	.1%	.0%
Other Companies	52.4	27.2	20.6	799	24.5%	19.7%	51.6%	63.9%
All Companies	213.5	137.6	39.9	1,250	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	212.4	137.2	39.4	1,247	99.5%	99.7%	98.8%	99.8%
All Asian-Based Companies	.4	.3	.1	0	.2%	.2%	.1%	.0%
All European-Based Companies	.6	.1	.4	3	.3%	.1%	1.1%	.2%
All Hardware Companies	107.2	92.0	.0	683	50.2%	66.8%	.0%	54.6%
All Turnkey & SW Companies	106.2	45.6	39.9	567	49.8%	33.2%	100.0%	45.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 8
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
IBM	24.6	24.0	.4	4,745	14.4%	32.2%	.5%	28.3%
Compaq	19.0	19.0	.0	5,348	11.2%	25.5%	.0%	31.9%
Futurenet	13.1	.0	11.6	0	7.7%	.0%	13.4%	.0%
Autodesk	10.8	.0	10.8	0	6.3%	.0%	12.6%	.0%
Daisy	9.4	2.0	5.0	122	5.5%	2.7%	5.8%	.7%
Personal CAD Systems	7.8	.0	6.8	0	4.6%	.0%	7.9%	.0%
Cadnetix	7.3	.0	6.4	0	4.3%	.0%	7.5%	.0%
Apple Computer	5.1	5.2	.0	1,845	3.0%	6.9%	.0%	11.0%
Racal-Redac	4.4	.0	3.7	0	2.6%	.0%	4.3%	.0%
Control Data	2.5	1.1	.7	204	1.5%	1.4%	.8%	1.2%
Valid	2.3	.7	1.0	29	1.3%	.9%	1.2%	.2%
Computervision	1.5	.2	1.1	12	.9%	.2%	1.3%	.1%
Calma	.7	.4	.2	34	.4%	.6%	.3%	.2%
Other Companies	62.1	22.0	38.2	4,403	36.4%	29.5%	44.4%	26.3%
All Companies	170.7	74.6	86.0	16,742	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	166.2	74.6	82.2	16,742	97.4%	100.0%	95.6%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	4.5	.0	3.8	0	2.6%	.0%	4.4%	.0%
All Hardware Companies	69.5	69.5	.0	16,253	40.7%	93.2%	.0%	97.1%
All Turnkey & SW Companies	101.2	5.1	86.0	489	59.3%	6.8%	100.0%	2.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 9
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Racal-Redac	64.9	1.3	54.2	144	11.6%	.5%	22.6%	1.2%
Digital	54.7	46.4	.0	213	9.8%	19.6%	.0%	1.7%
Mentor	53.1	21.8	21.8	1,276	9.5%	9.2%	9.1%	10.2%
Daisy	37.9	4.8	23.5	292	6.8%	2.0%	9.8%	2.3%
Apollo	28.8	25.3	.0	1,031	5.1%	10.7%	.0%	8.3%
Computervision	25.3	6.5	11.5	254	4.5%	2.7%	4.8%	2.0%
Valid	22.1	6.3	12.4	216	3.9%	2.7%	5.2%	1.7%
IBM	21.2	18.3	1.5	2,493	3.8%	7.7%	.6%	20.0%
Hewlett-Packard	19.0	11.1	6.3	992	3.4%	4.7%	2.6%	8.0%
Scientific Calculations	15.3	2.7	8.0	46	2.7%	1.1%	3.3%	.4%
Cadnetix	14.0	7.1	5.2	257	2.5%	3.0%	2.2%	2.1%
Calay	13.6	6.6	6.1	105	2.4%	2.8%	2.5%	.8%
Sun	12.0	10.5	.0	520	2.1%	4.4%	.0%	4.2%
Silver-Lisco	11.2	.0	11.2	0	2.0%	.0%	4.7%	.0%
Calma	10.4	4.4	1.3	83	1.9%	1.9%	.6%	.7%
Intergraph	8.5	4.4	1.7	96	1.5%	1.9%	.7%	.8%
Compaq	6.8	6.8	.0	1,910	1.2%	2.9%	.0%	15.3%
Personal CAD Systems	6.1	.0	5.3	0	1.1%	.0%	2.2%	.0%
Control Data	5.7	4.0	.9	146	1.0%	1.7%	.4%	1.2%
Silicon Compiler Systems	5.1	.0	4.5	0	.9%	.0%	1.9%	.0%
Applicon	4.5	1.3	1.8	86	.8%	.5%	.8%	.7%
ECAD	4.1	.0	4.1	0	.7%	.0%	1.7%	.0%
Zycad	3.7	3.4	.0	9	.7%	1.4%	.0%	.1%
SDA	3.2	.1	3.0	2	.6%	.0%	1.2%	.0%
Autodesk	2.6	.0	2.6	0	.5%	.0%	1.1%	.0%
Futurenet	2.3	.0	2.0	0	.4%	.0%	.9%	.0%
CADAM	1.3	.0	1.1	0	.2%	.0%	.5%	.0%
Apple Computer	1.2	1.2	.0	430	.2%	.5%	.0%	3.4%
Tektronix	1.1	.5	.5	14	.2%	.2%	.2%	.1%

(Continued)

Market Share

TABLE NUMBER: 9 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
ICL	.8	.6	.2	19	.1%	.3%	.1%	.2%
Other Companies	99.7	41.3	48.8	1,820	17.8%	17.5%	20.4%	14.6%
All Companies	560.2	236.7	239.5	12,456	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	424.4	207.7	150.6	11,201	75.8%	87.7%	62.9%	89.9%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	135.8	29.0	88.9	1,255	24.2%	12.3%	37.1%	10.1%
All Hardware Companies	138.3	124.4	.0	7,231	24.7%	52.5%	.0%	58.0%
All Turnkey & SW Companies	421.9	112.3	239.5	5,225	75.3%	47.5%	100.0%	42.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 10
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	53.1	21.8	21.8	1,276	15.3%	16.5%	13.6%	22.8%
Racal-Redac	43.1	1.3	35.6	144	12.4%	1.0%	22.2%	2.6%
Apollo	28.8	25.3	.0	1,031	8.3%	19.2%	.0%	18.4%
Daisy	25.8	3.9	15.5	166	7.4%	2.9%	9.7%	3.0%
Computervision	22.8	6.2	9.7	212	6.5%	4.7%	6.1%	3.8%
Valid	20.4	6.3	11.1	216	5.9%	4.8%	6.9%	3.9%
Hewlett-Packard	19.0	11.1	6.3	992	5.4%	8.4%	4.0%	17.8%
Cadnetix	14.0	7.1	5.2	257	4.0%	5.4%	3.2%	4.6%
Calay	13.6	6.6	6.1	105	3.9%	5.0%	3.8%	1.9%
Sun	12.0	10.5	.0	520	3.4%	8.0%	.0%	9.3%
Silver-Lisco	8.2	.0	8.2	0	2.4%	.0%	5.2%	.0%
Calma	7.3	2.9	1.1	61	2.1%	2.2%	.7%	1.1%
Digital	7.1	6.0	.0	213	2.0%	4.6%	.0%	3.8%
Intergraph	5.2	2.6	1.1	25	1.5%	2.0%	.7%	.4%
Scientific Calculations	4.6	.7	2.6	30	1.3%	.5%	1.6%	.5%
Silicon Compiler Systems	4.1	.0	3.6	0	1.2%	.0%	2.3%	.0%
ECAD	3.9	.0	3.9	0	1.1%	.0%	2.4%	.0%
SDA	3.2	.1	3.0	2	.9%	.1%	1.9%	.0%
ICL	.8	.6	.2	19	.2%	.5%	.1%	.3%
Tektronix	.8	.4	.4	9	.2%	.3%	.2%	.2%
IBM	.5	.2	.2	8	.1%	.2%	.1%	.1%
Other Companies	49.8	18.0	24.6	301	14.3%	13.7%	15.4%	5.4%
All Companies	348.2	131.5	160.0	5,588	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	249.6	106.1	100.5	5,089	71.7%	80.7%	62.8%	91.1%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	98.7	25.4	59.5	500	28.3%	19.3%	37.2%	8.9%
All Hardware Companies	49.2	43.0	.0	1,833	14.1%	32.7%	.0%	32.8%
All Turnkey & SW Companies	299.0	88.5	160.0	3,755	85.9%	67.3%	100.0%	67.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 11
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Digital	47.5	40.4	.0	0	36.8%	50.4%	.0%	.0%
Scientific Calculations	10.7	2.0	5.5	17	8.3%	2.5%	18.2%	2.0%
IBM	8.1	5.9	1.0	92	6.2%	7.3%	3.4%	11.2%
Applicon	4.5	1.3	1.8	86	3.5%	1.6%	6.1%	10.4%
Control Data	3.9	2.8	.6	2	3.0%	3.5%	2.0%	.3%
Zycad	3.7	3.4	.0	9	2.8%	4.3%	.0%	1.1%
Calma	3.1	1.5	.2	22	2.4%	1.8%	.7%	2.7%
Intergraph	3.1	1.8	.4	71	2.4%	2.2%	1.5%	8.6%
Daisy	3.0	.0	2.3	0	2.3%	.0%	7.5%	.0%
Silver-Lisco	3.0	.0	3.0	0	2.3%	.0%	9.9%	.0%
CADAM	1.3	.0	1.1	0	1.0%	.0%	3.8%	.0%
Silicon Compiler Systems	1.0	.0	.9	0	.8%	.0%	3.0%	.0%
Tektronix	.3	.2	.1	5	.3%	.2%	.4%	.6%
ECAD	.2	.0	.2	0	.2%	.0%	.7%	.0%
Computervision	.2	.1	.0	2	.1%	.1%	.1%	.2%
Other Companies	35.7	20.9	12.9	521	27.6%	26.1%	42.9%	63.0%
All Companies	129.2	80.2	30.1	827	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	119.9	77.6	24.1	780	92.8%	96.8%	80.0%	94.4%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	9.4	2.6	6.0	47	7.2%	3.2%	20.0%	5.6%
All Hardware Companies	67.9	60.3	.0	432	52.5%	75.3%	.0%	52.3%
All Turnkey & SW Companies	61.3	19.8	30.1	395	47.5%	24.7%	100.0%	47.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 12
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Racal-Redac	21.8	.0	18.6	0	26.4%	.0%	37.7%	.0%
IBM	12.7	12.1	.3	2,393	15.3%	48.5%	.6%	39.6%
Daisy	9.1	1.0	5.7	125	11.0%	4.0%	11.6%	2.1%
Compaq	6.8	6.8	.0	1,910	8.2%	27.2%	.0%	31.6%
Personal CAD Systems	6.1	.0	5.3	0	7.3%	.0%	10.7%	.0%
Autodesk	2.6	.0	2.6	0	3.2%	.0%	5.3%	.0%
Computervision	2.3	.2	1.8	41	2.8%	.9%	3.5%	.7%
Futurenet	2.3	.0	2.0	0	2.8%	.0%	4.1%	.0%
Control Data	1.8	1.2	.3	144	2.2%	5.0%	.6%	2.4%
Valid	1.6	.0	1.4	0	2.0%	.0%	2.8%	.0%
Apple Computer	1.2	1.2	.0	430	1.5%	4.8%	.0%	7.1%
Intergraph	.2	.0	.2	0	.3%	.0%	.3%	.0%
Other Companies	14.2	2.4	11.2	998	17.2%	9.7%	22.7%	16.5%
All Companies	82.7	25.0	49.5	6,041	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	55.0	24.0	26.1	5,332	66.5%	95.7%	52.7%	88.3%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	27.7	1.1	23.4	709	33.5%	4.3%	47.3%	11.7%
All Hardware Companies	21.2	21.0	.0	4,966	25.6%	84.0%	.0%	82.2%
All Turnkey & SW Companies	61.6	4.0	49.5	1,075	74.4%	16.0%	100.0%	17.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 13
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Mentor	45.0	16.2	24.3	678	8.5%	5.3%	14.4%	7.2%
Zuken	41.3	21.5	14.4	346	7.9%	7.1%	8.5%	3.7%
Fujitsu	37.9	26.1	8.1	508	7.2%	8.6%	4.8%	5.4%
Seiko Instruments (No OEM)	35.0	18.1	13.4	200	6.7%	6.0%	8.0%	2.1%
NEC	34.3	17.8	13.0	639	6.5%	5.9%	7.7%	6.8%
Digital	31.8	28.6	.0	142	6.1%	9.5%	.0%	1.5%
Daisy	24.9	10.6	11.9	210	4.7%	3.5%	7.0%	2.2%
Calma	21.3	12.2	7.0	92	4.1%	4.0%	4.2%	1.0%
IBM	21.3	16.7	1.4	2,115	4.0%	5.5%	.8%	22.6%
Hewlett-Packard	18.9	10.2	6.8	386	3.6%	3.4%	4.1%	4.1%
Sharp System Products	16.3	6.8	7.9	85	3.1%	2.2%	4.7%	.9%
Hitachi	13.7	9.3	3.3	245	2.6%	3.1%	1.9%	2.6%
Racal-Redac	11.6	8.4	2.1	25	2.2%	2.8%	1.2%	.3%
Apollo	10.2	10.3	.0	522	1.9%	3.4%	.0%	5.6%
Asahi Optical (No OEM)	10.0	7.4	1.6	55	1.9%	2.4%	.9%	.6%
Sun	9.5	8.6	.0	328	1.8%	2.8%	.0%	3.5%
Valid	7.5	3.4	3.4	120	1.4%	1.1%	2.0%	1.3%
Toshiba (No OEM)	7.2	5.5	1.0	84	1.4%	1.8%	.6%	.9%
Scientific Calculations	5.6	4.1	1.0	15	1.1%	1.3%	.6%	.2%
Computervision	5.5	3.1	1.3	37	1.1%	1.0%	.8%	.4%
SDA	5.0	.1	4.7	3	1.0%	.0%	2.8%	.0%
Mitachi Zosen	4.4	1.6	2.4	29	.8%	.5%	1.4%	.3%
Silicon Compiler Systems	3.5	.0	3.1	0	.7%	.0%	1.8%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	.7%	.7%	.6%	.5%
Cadnetix	3.2	2.0	1.1	59	.6%	.7%	.6%	.6%
ECAD	2.8	.0	2.8	0	.5%	.0%	1.7%	.0%
Silver-Lisco	2.4	.0	2.4	0	.5%	.0%	1.4%	.0%
Futurenet	2.2	.0	1.9	0	.4%	.0%	1.1%	.0%
Personal CAD Systems	1.4	.0	1.3	0	.3%	.0%	.7%	.0%
Compeq	1.4	1.4	.0	382	.3%	.4%	.0%	4.1%
Autodesk	1.3	.0	1.3	0	.2%	.0%	.8%	.0%
CADAM	1.3	.0	1.1	0	.2%	.0%	.7%	.0%

(Continued)

Market Share

TABLE NUMBER: 13 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Calay	1.3	1.0	.2	12	.2%	.3%	.1%	.1%
Zycad	1.1	1.0	.0	2	.2%	.3%	.0%	.0%
Tokyo Electron (No OEM)	.8	.0	.7	0	.2%	.0%	.4%	.0%
Apple Computer	.5	.5	.0	177	.1%	.2%	.0%	1.9%
Control Data	.3	.1	.1	19	.1%	.0%	.1%	.2%
Applicon	.3	.2	.1	6	.1%	.0%	.0%	.1%
Other Companies	80.3	47.9	22.7	1,799	15.3%	15.8%	13.5%	19.2%
All Companies	525.9	302.7	168.5	9,364	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	248.1	149.7	72.4	5,697	47.2%	49.4%	43.0%	60.8%
All Asian-Based Companies	264.7	143.6	93.7	3,629	50.3%	47.4%	55.6%	38.8%
All European-Based Companies	13.1	9.4	2.4	38	2.5%	3.1%	1.4%	.4%
All Hardware Companies	96.3	86.6	.6	4,192	18.3%	28.6%	.4%	44.8%
All Turnkey & SW Companies	429.6	216.0	167.9	5,172	81.7%	71.4%	99.6%	55.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 14
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	45.0	16.2	24.3	678	16.4%	11.3%	23.3%	18.4%
Seiko Instruments (No OEM)	28.0	12.6	12.6	180	10.2%	8.8%	12.1%	4.9%
NEC	27.4	13.7	10.9	321	10.0%	9.6%	10.4%	8.7%
Daisy	23.9	10.6	11.0	210	8.7%	7.4%	10.5%	5.7%
Hewlett-Packard	18.9	10.2	6.8	386	6.9%	7.2%	6.6%	10.5%
Sharp System Products	16.3	6.8	7.9	85	5.9%	4.7%	7.5%	2.3%
Calma	11.8	5.3	5.3	58	4.3%	3.7%	5.1%	1.6%
Racal-Redac	11.5	8.3	2.1	25	4.2%	5.8%	2.0%	.7%
Apollo	10.2	10.3	.0	522	3.7%	7.2%	.0%	14.2%
Sun	9.5	8.6	.0	328	3.5%	6.0%	.0%	8.9%
Asahi Optical (No OEM)	7.6	5.5	1.4	45	2.8%	3.8%	1.3%	1.2%
Valid	7.5	3.4	3.4	120	2.7%	2.4%	3.3%	3.3%
Zuken	5.5	2.9	1.9	59	2.0%	2.0%	1.9%	1.6%
SDA	5.0	.1	4.7	3	1.8%	.1%	4.5%	.1%
Scientific Calculations	4.9	3.6	.9	13	1.8%	2.5%	.9%	.3%
Computervision	4.4	2.6	1.0	29	1.6%	1.8%	.9%	.8%
Hitachi Zosen	4.4	1.6	2.4	29	1.6%	1.1%	2.3%	.8%
Digital	4.1	3.7	.0	142	1.5%	2.6%	.0%	3.8%
Silicon Compiler Systems	2.8	.0	2.5	0	1.0%	.0%	2.4%	.0%
ECAD	2.7	.0	2.7	0	1.0%	.0%	2.6%	.0%
Cadnetix	2.6	2.0	.4	59	.9%	1.4%	.4%	1.6%
Hitachi	1.9	1.9	.0	35	.7%	1.3%	.0%	1.0%
Silver-Lisco	1.9	.0	1.9	0	.7%	.0%	1.8%	.0%
Calay	1.3	1.0	.2	12	.5%	.7%	.2%	.3%
Fujitsu	.6	.0	.6	0	.2%	.0%	.5%	.0%
IBM	.6	.3	.1	10	.2%	.2%	.1%	.3%
Tokyo Electron (No OEM)	.4	.0	.4	0	.2%	.0%	.3%	.0%

(Continued)

Market Share

TABLE NUMBER: 14 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Autodesk	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	13.4	11.9	(.9)	330	4.9%	8.3%	-.9%	9.0%
All Companies	274.2	143.0	104.3	3,679	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	149.3	77.3	57.6	2,589	54.5%	54.0%	55.2%	70.4%
All Asian-Based Companies	111.9	56.4	44.3	1,051	40.8%	39.5%	42.5%	28.6%
All European-Based Companies	13.0	9.3	2.4	38	4.7%	6.5%	2.3%	1.0%
All Hardware Companies	35.3	32.5	.6	1,379	12.9%	22.7%	.6%	37.5%
All Turnkey & SW Companies	238.8	110.5	103.7	2,300	87.1%	77.3%	99.4%	62.5%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 15
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Fujitsu	36.2	26.1	6.5	508	19.3%	19.7%	19.9%	33.6%
Zuken	35.8	18.7	12.5	287	19.1%	14.1%	38.0%	19.0%
Digital	27.7	24.9	.0	0	14.8%	18.8%	.0%	.0%
IBM	9.8	7.4	1.1	113	5.3%	5.6%	3.3%	7.5%
Calma	9.6	6.9	1.7	35	5.1%	5.2%	5.2%	2.3%
Toshiba (No OEM)	7.2	5.5	1.0	84	3.8%	4.2%	3.0%	5.5%
Seiko Instruments (No OEM)	7.0	5.5	.8	20	3.7%	4.1%	2.5%	1.3%
Hitachi	5.6	4.0	1.0	40	3.0%	3.0%	3.1%	2.6%
Mitsubishi Electric	3.5	2.2	1.0	43	1.9%	1.7%	2.9%	2.9%
NEC	3.5	2.5	.6	20	1.8%	1.9%	1.9%	1.3%
Asahi Optical (No OEM)	2.4	1.9	.2	10	1.3%	1.5%	.7%	.7%
CADAM	1.3	.0	1.1	0	.7%	.0%	3.5%	.0%
Zycad	1.1	1.0	.0	2	.6%	.7%	.0%	.1%
Computervision	1.1	.5	.4	7	.6%	.4%	1.1%	.5%
Silicon Compiler Systems	.7	.0	.6	0	.4%	.0%	1.9%	.0%
Scientific Calculations	.7	.5	.1	3	.4%	.4%	.2%	.2%
Silvar-Lisco	.5	.0	.5	0	.3%	.0%	1.6%	.0%
Tokyo Electron (No OEM)	.4	.0	.4	0	.2%	.0%	1.1%	.0%
Applicon	.3	.2	.1	6	.1%	.1%	.2%	.4%
ECAD	.1	.0	.1	0	.1%	.0%	.4%	.0%
Control Data	.1	.0	.1	0	.1%	.0%	.2%	.0%
Other Companies	32.6	24.5	3.1	335	17.4%	18.6%	9.5%	22.2%
All Companies	187.1	132.2	32.8	1,513	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	75.0	60.9	5.1	437	40.1%	46.1%	15.6%	28.9%
All Asian-Based Companies	112.0	71.3	27.6	1,076	59.9%	53.9%	84.3%	71.1%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.1%	.0%
All Hardware Companies	49.0	43.5	.0	232	26.2%	32.9%	.0%	15.4%
All Turnkey & SW Companies	138.1	88.7	32.8	1,280	73.8%	67.1%	100.0%	84.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 16
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
IBM	10.8	9.0	.2	1,992	16.8%	32.9%	.6%	47.7%
Hitachi	6.3	3.4	2.3	170	9.7%	12.4%	7.1%	4.1%
NEC	3.5	1.6	1.6	299	5.3%	5.7%	4.9%	7.2%
Futurenet	2.2	.0	1.9	0	3.4%	.0%	5.9%	.0%
Personal CAD Systems	1.4	.0	1.3	0	2.2%	.0%	4.0%	.0%
Compaq	1.4	1.4	.0	382	2.1%	5.0%	.0%	9.2%
Autodesk	1.3	.0	1.3	0	2.0%	.0%	4.1%	.0%
Fujitsu	1.1	.0	1.0	0	1.7%	.0%	3.2%	.0%
Daisy	1.0	.0	.9	0	1.5%	.0%	2.8%	.0%
Cadnetix	.6	.0	.6	0	1.0%	.0%	1.9%	.0%
Apple Computer	.5	.5	.0	177	.8%	1.9%	.0%	4.2%
Control Data	.2	.1	.1	19	.4%	.4%	.2%	.4%
Racal-Redac	.1	.1	.0	0	.1%	.2%	.0%	.0%
Other Companies	34.3	11.4	20.5	1,134	53.1%	41.6%	65.2%	27.2%
All Companies	64.7	27.4	31.5	4,173	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	23.7	11.5	9.7	2,671	36.7%	41.9%	30.9%	64.0%
All Asian-Based Companies	40.8	15.9	21.8	1,502	63.2%	57.9%	69.1%	36.0%
All European-Based Companies	.1	.1	.0	0	.1%	.2%	.0%	.0%
All Hardware Companies	12.0	10.6	.0	2,581	18.5%	38.7%	.0%	61.8%
All Turnkey & SW Companies	52.7	16.8	31.5	1,592	81.5%	61.3%	100.0%	38.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 17
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Digital	8.0	6.8	.0	31	31.3%	37.3%	.0%	4.2%
Apollo	3.3	2.9	.0	116	12.8%	15.8%	.0%	15.9%
IBM	2.1	1.9	.1	292	8.2%	10.2%	2.6%	39.8%
Daisy	1.8	.5	.9	14	6.9%	2.5%	20.2%	1.9%
Hewlett-Packard	1.1	.7	.3	56	4.2%	3.9%	7.1%	7.7%
Intergraph	1.0	.5	.2	8	3.8%	2.9%	5.6%	1.0%
Valid	.7	.3	.3	6	2.6%	1.7%	7.1%	.9%
Personal CAD Systems	.6	.0	.6	0	2.5%	.0%	12.9%	.0%
Zycad	.6	.5	.0	1	2.2%	2.7%	.0%	.1%
Computervision	.4	.2	.1	4	1.7%	1.0%	2.8%	.5%
Calma	.4	.3	.1	6	1.7%	1.4%	3.3%	.8%
Futurenet	.3	.0	.3	0	1.1%	.0%	5.9%	.0%
Racal-Redac	.3	.0	.2	1	1.1%	.0%	5.4%	.1%
Calay	.3	.2	.0	2	1.0%	1.1%	.9%	.3%
Silver-Lisco	.2	.0	.2	0	.9%	.0%	4.7%	.0%
Apple Computer	.2	.2	.0	76	.8%	1.2%	.0%	10.3%
Autodesk	.2	.0	.2	0	.6%	.0%	3.8%	.0%
Control Data	.1	.0	.0	4	.3%	.1%	.5%	.5%
CADAM	.0	.0	.0	0	.2%	.0%	.9%	.0%
Other Companies	4.1	3.3	.7	117	16.0%	18.2%	16.2%	16.0%
All Companies	25.4	18.1	4.3	733	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	24.6	17.9	3.7	729	96.7%	98.8%	87.3%	99.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.8	.2	.5	4	3.3%	1.2%	12.7%	.5%
All Hardware Companies	16.1	14.5	.0	620	63.4%	80.2%	.0%	84.6%
All Turnkey & SW Companies	9.3	3.6	4.3	113	36.6%	19.8%	100.0%	15.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 18
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Mkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Mkstns Shipped *****
Apollo	3.3	2.9	.0	116	34.4%	47.0%	.0%	48.9%
Daisy	1.2	.3	.6	7	12.7%	5.4%	29.1%	3.1%
Hewlett-Packard	1.1	.7	.3	56	11.4%	11.5%	15.3%	23.7%
Digital	1.0	.9	.0	31	10.9%	14.2%	.0%	12.9%
Intergraph	.7	.4	.2	6	7.8%	6.1%	10.7%	2.4%
Valid	.6	.3	.3	6	6.7%	4.7%	14.3%	2.5%
Computervision	.4	.2	.1	3	4.2%	3.1%	4.6%	1.4%
Calma	.3	.2	.1	5	3.6%	3.1%	6.1%	1.9%
Calay	.3	.2	.0	2	2.6%	3.3%	2.0%	1.0%
Recal-Redac	.2	.0	.2	1	1.9%	.0%	7.7%	.3%
Silvar-Lisco	.1	.0	.1	0	.7%	.0%	3.1%	.0%
IBM	.0	.0	.0	1	.3%	.0%	.5%	.2%
Other Companies	.3	.1	.1	4	2.7%	1.6%	6.6%	1.7%
All Companies	9.5	6.1	2.0	238	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	8.9	5.9	1.7	235	94.3%	96.4%	86.2%	98.6%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.5	.2	.3	3	5.7%	3.6%	13.8%	1.4%
All Hardware Companies	4.4	3.8	.0	151	46.1%	62.5%	.0%	63.3%
All Turnkey & SM Companies	5.1	2.3	2.0	87	53.9%	37.5%	100.0%	36.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 19
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	6.9	5.9	.0	0	58.2%	58.9%	.0%	.0%
IBM	.6	.4	.1	7	4.9%	4.1%	14.0%	8.7%
Zycad	.6	.5	.0	1	4.8%	4.9%	.0%	1.4%
Intergraph	.2	.2	.0	2	1.9%	1.5%	6.0%	2.6%
Silver-Lisco	.2	.0	.1	0	1.4%	.0%	28.0%	.0%
Daisy	.1	.0	.1	1	1.2%	.4%	12.0%	.9%
Calma	.1	.1	.0	1	.8%	.6%	4.0%	1.4%
CADAM	.0	.0	.0	0	.3%	.0%	8.0%	.0%
Control Data	.0	.0	.0	0	.2%	.0%	2.0%	.0%
Other Companies	3.1	3.0	.1	65	26.3%	29.6%	26.0%	85.0%
All Companies	11.9	10.0	.5	76	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	11.9	10.0	.5	76	99.8%	100.0%	98.0%	99.8%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.2%	.0%	2.0%	.2%
All Hardware Companies	9.9	8.8	.0	65	83.2%	88.5%	.0%	84.7%
All Turnkey & SW Companies	2.0	1.2	.5	12	16.8%	11.5%	100.0%	15.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 20
 TITLE: 1987 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
IBM	1.5	1.4	.0	284	36.3%	71.3%	1.7%	67.9%
Personal CAD Systems	.6	.0	.6	0	15.4%	.0%	30.7%	.0%
Daisy	.4	.1	.2	6	10.3%	4.5%	12.8%	1.3%
Futurenet	.3	.0	.3	0	6.9%	.0%	14.0%	.0%
Apple Computer	.2	.2	.0	76	5.1%	10.4%	.0%	18.1%
Autodesk	.2	.0	.2	0	3.9%	.0%	8.9%	.0%
Racal-Redac	.1	.0	.1	0	2.2%	.0%	4.5%	.0%
Control Data	.1	.0	.0	4	1.2%	1.0%	.6%	.9%
Computervision	.0	.0	.0	0	1.0%	.0%	1.7%	.1%
Valid	.0	.0	.0	0	1.0%	1.0%	1.1%	.1%
Other Companies	.7	.2	.4	48	16.7%	11.9%	24.0%	11.6%
All Companies	4.1	2.0	1.8	419	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	3.8	2.0	1.5	419	93.4%	100.0%	85.5%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.3	.0	.3	0	6.6%	.0%	14.5%	.0%
All Hardware Companies	1.9	1.9	.0	405	45.8%	92.6%	.0%	96.7%
All Turnkey & SW Companies	2.2	.2	1.8	14	54.2%	7.4%	100.0%	3.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 21
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	158.7	75.5	60.0	4,157	16.9%	15.0%	19.2%	13.9%
Digital	112.5	96.6	.0	503	12.0%	19.2%	.0%	1.7%
Daisy	86.4	21.5	46.2	694	9.2%	4.3%	14.8%	2.3%
Apollo	65.0	57.7	.0	2,394	6.9%	11.5%	.0%	8.0%
Valid	54.4	15.0	27.8	589	5.8%	3.0%	8.9%	2.0%
IBM	48.1	43.5	1.6	7,530	5.1%	8.6%	.5%	25.2%
Sun	27.3	24.0	.0	1,153	2.9%	4.8%	.0%	3.9%
Zycad	27.1	23.9	.0	53	2.9%	4.7%	.0%	.2%
Hewlett-Packard	22.7	12.8	7.8	716	2.4%	2.5%	2.5%	2.4%
NEC	18.1	9.4	6.8	449	1.9%	1.9%	2.2%	1.5%
Cadnetix	16.2	7.7	6.6	345	1.7%	1.5%	2.1%	1.2%
Fujitsu	15.8	10.1	4.1	197	1.7%	2.0%	1.3%	.7%
Futurenet	14.8	.0	13.0	0	1.6%	.0%	4.1%	.0%
Compaq	13.6	13.6	.0	3,820	1.4%	2.7%	.0%	12.8%
Silvar-Lisco	13.3	.0	12.3	0	1.4%	.0%	3.9%	.0%
Control Data	12.0	7.8	1.5	4	1.3%	1.5%	.5%	.0%
Intergraph	11.7	6.1	2.7	123	1.2%	1.2%	.8%	.4%
Racal-Redac	11.6	1.8	8.2	31	1.2%	.4%	2.6%	.1%
Computervision	10.5	3.4	4.0	98	1.1%	.7%	1.3%	.3%
Seiko Instruments (No OEM)	7.0	3.1	3.2	30	.7%	.6%	1.0%	.1%
Zuken	5.5	2.9	1.9	59	.6%	.6%	.6%	.2%
Calma	5.3	2.8	1.7	84	.6%	.5%	.5%	.3%
Apple Computer	2.6	2.7	.0	948	.3%	.5%	.0%	3.2%
Autodesk	1.6	.0	1.6	0	.2%	.0%	.5%	.0%
Tektronix	1.5	.7	.6	28	.2%	.1%	.2%	.1%
Tokyo Electron (No OEM)	.8	.0	.7	0	.1%	.0%	.2%	.0%
Hitachi	.7	.7	.0	13	.1%	.1%	.0%	.0%
Personal CAD Systems	.3	.0	.3	0	.0%	.0%	.1%	.0%

Market Share

TABLE NUMBER: 21 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	175.3	60.0	100.1	5,830	18.6%	11.9%	32.0%	19.5%
All Companies	940.3	503.0	312.6	29,850	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	850.8	466.1	270.5	28,100	90.5%	92.7%	86.5%	94.1%
All Asian-Based Companies	66.3	32.4	27.5	1,251	7.1%	6.4%	8.8%	4.2%
All European-Based Companies	23.2	4.5	14.7	499	2.5%	.9%	4.7%	1.7%
All Hardware Companies	320.2	287.0	.2	20,931	34.1%	57.1%	.1%	70.1%
All Turnkey & SW Companies	620.1	216.0	312.4	8,919	65.9%	42.9%	99.9%	29.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 22
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	158.7	75.5	60.0	4,157	30.0%	29.8%	30.5%	37.7%
Apollo	65.0	57.7	.0	2,394	12.3%	22.8%	.0%	21.7%
Daisy	64.0	17.9	32.9	451	12.1%	7.1%	16.7%	4.1%
Valid	50.4	14.3	25.4	560	9.5%	5.6%	12.9%	5.1%
Sun	27.3	24.0	.0	1,153	5.1%	9.5%	.0%	10.5%
Hewlett-Packard	22.7	12.8	7.8	716	4.3%	5.0%	4.0%	6.5%
Digital	14.6	12.6	.0	503	2.8%	5.0%	.0%	4.6%
Cadnetix	13.8	7.7	4.5	345	2.6%	3.0%	2.3%	3.1%
NEC	11.2	5.4	4.7	130	2.1%	2.1%	2.4%	1.2%
Silvar-Lisco	10.3	.0	9.4	0	1.9%	.0%	4.8%	.0%
Computervision	9.4	3.3	3.2	83	1.8%	1.3%	1.6%	.8%
Racal-Redac	8.4	1.8	5.5	31	1.6%	.7%	2.8%	.3%
Intergraph	8.4	4.3	2.1	52	1.6%	1.7%	1.0%	.5%
Seiko Instruments (No OEM)	7.0	3.1	3.2	30	1.3%	1.2%	1.6%	.3%
Zuken	5.5	2.9	1.9	59	1.0%	1.1%	1.0%	.5%
Calma	4.7	2.4	1.6	61	.9%	1.0%	.8%	.6%
Tektronix	1.1	.5	.5	20	.2%	.2%	.2%	.2%
Hitachi	.7	.7	.0	13	.1%	.3%	.0%	.1%
Fujitsu	.6	.0	.6	0	.1%	.0%	.3%	.0%
IBM	.6	.3	.2	10	.1%	.1%	.1%	.1%
Tokyo Electron (No OEM)	.4	.0	.4	0	.1%	.0%	.2%	.0%
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	44.6	5.9	33.4	254	8.4%	2.3%	16.9%	2.3%
All Companies	529.3	252.9	197.1	11,023	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	487.0	235.6	178.0	10,656	92.0%	93.2%	90.3%	96.7%
All Asian-Based Companies	28.4	14.3	11.2	316	5.4%	5.7%	5.7%	2.9%
All European-Based Companies	13.9	3.0	7.9	51	2.6%	1.2%	4.0%	.5%
All Hardware Companies	113.3	100.0	.2	4,315	21.4%	39.5%	.1%	39.1%
All Turnkey & SW Companies	416.0	152.9	196.9	6,708	78.6%	60.5%	99.9%	60.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 23
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	97.9	84.0	.0	0	41.3%	49.9%	.0%	.0%
Zycad	27.1	23.9	.0	53	11.5%	14.2%	.0%	4.2%
Fujitsu	14.1	10.1	2.5	197	5.9%	6.0%	7.0%	15.5%
Control Data	12.0	7.8	1.5	4	5.1%	4.6%	4.1%	.3%
IBM	9.6	7.1	1.2	110	4.1%	4.2%	3.2%	8.6%
Daisy	5.4	.9	3.1	27	2.3%	.5%	8.7%	2.1%
NEC	3.5	2.5	.6	20	1.5%	1.5%	1.7%	1.6%
Intergraph	3.1	1.8	.4	71	1.3%	1.1%	1.2%	5.5%
Silver-Lisco	3.1	.0	2.8	0	1.3%	.0%	7.9%	.0%
Tektronix	.5	.2	.2	8	.2%	.1%	.5%	.6%
Tokyo Electron (No OEM)	.4	.0	.4	0	.2%	.0%	1.0%	.0%
Calma	.2	.1	.0	2	.1%	.0%	.0%	.1%
Other Companies	60.3	30.2	23.3	784	25.4%	17.9%	64.7%	61.4%
All Companies	237.0	168.5	36.0	1,277	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	216.1	154.7	31.1	1,038	91.2%	91.8%	86.6%	81.3%
All Asian-Based Companies	18.2	12.8	3.6	220	7.7%	7.6%	10.1%	17.2%
All European-Based Companies	2.7	1.1	1.2	19	1.1%	.6%	3.4%	1.5%
All Hardware Companies	134.3	115.7	.0	582	56.7%	68.7%	.0%	45.6%
All Turnkey & SW Companies	102.7	52.8	36.0	695	43.3%	31.3%	100.0%	54.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 24
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
IBM	37.9	36.2	.3	7,410	21.8%	44.3%	.4%	42.2%
Daisy	17.0	2.7	10.2	215	9.8%	3.3%	12.8%	1.2%
Futurenet	14.8	.0	13.0	0	8.5%	.0%	16.3%	.0%
Compaq	13.6	13.6	.0	3,820	7.8%	16.7%	.0%	21.8%
Valid	4.0	.7	2.4	29	2.3%	.8%	3.0%	.2%
NEC	3.5	1.6	1.6	299	2.0%	1.9%	1.9%	1.7%
Racal-Redac	3.2	.0	2.7	0	1.8%	.0%	3.4%	.0%
Apple Computer	2.6	2.7	.0	948	1.5%	3.2%	.0%	5.4%
Cadnetix	2.4	.0	2.1	0	1.4%	.0%	2.7%	.0%
Autodesk	1.6	.0	1.6	0	.9%	.0%	2.0%	.0%
Fujitsu	1.1	.0	1.0	0	.6%	.0%	1.3%	.0%
Computervision	1.1	.1	.8	16	.6%	.1%	1.0%	.1%
Calma	.5	.3	.1	22	.3%	.3%	.2%	.1%
Personal CAD Systems	.3	.0	.3	0	.2%	.0%	.4%	.0%
Intergraph	.2	.0	.2	0	.1%	.0%	.2%	.0%
Other Companies	70.4	24.0	43.4	4,792	40.4%	29.4%	54.6%	27.3%
All Companies	174.0	81.7	79.6	17,550	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	147.7	75.8	61.3	16,407	84.9%	92.9%	77.1%	93.5%
All Asian-Based Companies	19.7	5.3	12.7	715	11.3%	6.5%	16.0%	4.1%
All European-Based Companies	6.6	.5	5.5	429	3.8%	.6%	6.9%	2.4%
All Hardware Companies	72.6	71.4	.0	16,035	41.7%	87.4%	.0%	91.4%
All Turnkey & SW Companies	101.4	10.3	79.6	1,515	58.3%	12.6%	100.0%	8.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 25
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Mentor	86.5	47.6	25.9	2,573	18.8%	18.5%	18.4%	14.9%
Digital	51.6	43.9	.0	255	11.2%	17.0%	.0%	1.5%
Daisy	33.0	8.8	16.0	268	7.2%	3.4%	11.4%	1.6%
Apollo	32.6	28.7	.0	1,165	7.1%	11.1%	.0%	6.8%
Valid	28.5	6.6	13.9	300	6.2%	2.6%	9.9%	1.7%
IBM	22.3	21.1	.7	3,717	4.8%	8.2%	.5%	21.6%
Zyccad	21.8	19.0	.0	41	4.7%	7.4%	.0%	.2%
Sun	19.0	16.7	.0	824	4.1%	6.5%	.0%	4.8%
Cadnetix	11.0	5.0	4.7	245	2.4%	1.9%	3.3%	1.4%
Futurenet	10.5	.0	9.3	0	2.3%	.0%	6.6%	.0%
Compaq	9.5	9.5	.0	2,674	2.1%	3.7%	.0%	15.5%
Control Data	9.1	5.9	.8	2	2.0%	2.3%	.6%	.0%
Silver-Lisco	5.3	.0	4.2	0	1.1%	.0%	3.0%	.0%
Calma	4.6	2.5	1.6	79	1.0%	1.0%	1.2%	.5%
Computervision	4.1	1.8	1.1	32	.9%	.7%	.8%	.2%
Hewlett-Packard	3.0	2.0	.8	159	.7%	.8%	.6%	.9%
Intergraph	2.9	1.5	.9	24	.6%	.6%	.6%	.1%
Apple Computer	1.9	1.9	.0	692	.4%	.8%	.0%	4.0%
Racal-Redac	1.6	.0	1.3	4	.3%	.0%	.9%	.0%
Tektronix	1.3	.6	.5	24	.3%	.2%	.4%	.1%
Personal CAD Systems	.2	.0	.1	0	.0%	.0%	.1%	.0%
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	100.7	34.5	59.1	4,170	21.9%	13.4%	41.9%	24.2%
All Companies	460.8	257.5	141.0	17,246	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	458.9	257.4	139.4	17,240	99.6%	99.9%	98.9%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	2.0	.1	1.6	6	.4%	.1%	1.1%	.0%
All Hardware Companies	173.5	156.3	.0	13,303	37.6%	60.7%	.0%	77.1%
All Turnkey & SW Companies	287.4	101.3	141.0	3,942	62.4%	39.3%	100.0%	22.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 26
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	86.5	47.6	25.9	2,573	34.8%	38.0%	31.0%	44.0%
Apollo	32.6	28.7	.0	1,165	13.1%	22.9%	.0%	19.9%
Valid	26.3	6.0	12.9	272	10.6%	4.8%	15.5%	4.6%
Daisy	22.4	6.2	10.7	138	9.0%	4.9%	12.7%	2.4%
Sun	19.0	16.7	.0	824	7.6%	13.4%	.0%	14.1%
Cadnetix	8.8	5.0	2.8	245	3.5%	4.0%	3.3%	4.2%
Digital	6.7	5.7	.0	255	2.7%	4.6%	.0%	4.4%
Silver-Lisco	4.2	.0	3.4	0	1.7%	.0%	4.0%	.0%
Calma	4.1	2.2	1.5	57	1.7%	1.8%	1.8%	1.0%
Computervision	3.7	1.8	.8	29	1.5%	1.4%	1.0%	.5%
Hewlett-Packard	3.0	2.0	.8	159	1.2%	1.6%	1.0%	2.7%
Intergraph	2.9	1.5	.9	24	1.2%	1.2%	1.0%	.4%
Racal-Redac	1.0	.0	.9	4	.4%	.0%	1.0%	.1%
Tektronix	.9	.4	.4	17	.4%	.3%	.5%	.3%
IBM	.2	.1	.1	4	.1%	.1%	.1%	.1%
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	26.4	1.4	22.7	82	10.6%	1.1%	27.1%	1.4%
All Companies	248.6	125.1	83.7	5,846	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	247.4	125.1	82.7	5,841	99.5%	99.9%	98.9%	99.9%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	1.2	.1	1.0	5	.5%	.1%	1.1%	.1%
All Hardware Companies	59.7	52.4	.0	2,320	24.0%	41.8%	.0%	39.7%
All Turnkey & SW Companies	188.9	72.8	83.7	3,526	76.0%	58.2%	100.0%	60.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 27
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	44.9	38.2	.0	0	38.9%	47.0%	.0%	.0%
Zycad	21.8	19.0	.0	41	18.9%	23.3%	.0%	7.9%
Control Data	9.1	5.9	.8	2	7.8%	7.2%	4.5%	.3%
IBM	3.5	2.5	.5	40	3.0%	3.1%	2.6%	7.6%
Daisy	2.6	.9	1.1	27	2.3%	1.1%	6.5%	5.1%
Silvar-Lisco	1.1	.0	.8	0	.9%	.0%	4.9%	.0%
Tektronix	.4	.2	.1	7	.3%	.2%	.8%	1.3%
Other Companies	32.2	14.7	13.9	406	27.9%	18.1%	80.7%	77.8%
All Companies	115.5	81.3	17.2	522	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	115.4	81.3	17.2	521	99.9%	99.9%	99.7%	99.8%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.1	.1	.1	1	.1%	.1%	.3%	.2%
All Hardware Companies	65.8	55.9	.0	305	57.0%	68.7%	.0%	58.3%
All Turnkey & SW Companies	49.7	25.5	17.2	218	43.0%	31.3%	100.0%	41.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 28
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
IBM	18.7	18.5	.1	3,673	19.3%	36.2%	.3%	33.8%
Futurenet	10.5	.0	9.3	0	10.9%	.0%	23.1%	.0%
Compaq	9.5	9.5	.0	2,674	9.8%	18.7%	.0%	24.6%
Daisy	7.9	1.7	4.2	103	8.2%	3.4%	10.6%	1.0%
Valid	2.3	.7	1.0	29	2.4%	1.3%	2.5%	.3%
Cadnetix	2.2	.0	1.9	0	2.3%	.0%	4.8%	.0%
Apple Computer	1.9	1.9	.0	692	2.0%	3.8%	.0%	6.4%
Racal-Redac	.5	.0	.5	0	.5%	.0%	1.1%	.0%
Calma	.5	.3	.1	22	.5%	.5%	.3%	.2%
Computervision	.4	.0	.3	3	.4%	.1%	.7%	.0%
Personal CAD Systems	.2	.0	.1	0	.2%	.0%	.3%	.0%
Other Companies	42.2	18.4	22.5	3,681	43.6%	36.1%	56.1%	33.8%
All Companies	96.7	51.0	40.1	10,878	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	96.1	51.0	39.5	10,878	99.4%	100.0%	98.6%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.6	.0	.6	0	.6%	.0%	1.4%	.0%
All Hardware Companies	48.0	48.0	.0	10,679	49.6%	94.1%	.0%	98.2%
All Turnkey & SW Companies	48.7	3.0	40.1	199	50.4%	5.9%	100.0%	1.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 29
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Mentor	37.7	15.4	15.5	1,008	14.7%	12.5%	16.5%	14.0%
Digital	35.6	30.3	.0	139	13.9%	24.4%	.0%	1.9%
Daisy	32.2	4.1	20.0	248	12.5%	3.3%	21.4%	3.5%
Apollo	24.7	21.7	.0	883	9.6%	17.5%	.0%	12.3%
Valid	20.3	5.8	11.4	210	7.9%	4.7%	12.2%	2.9%
IBM	12.3	11.3	.5	1,877	4.8%	9.1%	.5%	26.1%
Intergraph	8.5	4.4	1.7	96	3.3%	3.6%	1.8%	1.3%
Racal-Redac	7.8	.2	6.5	21	3.0%	.1%	6.9%	.3%
Computervision	6.3	1.6	2.9	65	2.5%	1.3%	3.1%	.9%
Silvar-Lisco	5.6	.0	5.6	0	2.2%	.0%	6.0%	.0%
Sun	5.0	4.4	.0	215	1.9%	3.5%	.0%	3.0%
Hewlett-Packard	4.9	2.9	1.7	258	1.9%	2.3%	1.8%	3.6%
Cadnetix	4.2	2.1	1.6	77	1.6%	1.7%	1.7%	1.1%
Zycad	3.7	3.4	.0	9	1.4%	2.8%	.0%	.1%
Compaq	3.4	3.4	.0	955	1.3%	2.7%	.0%	13.3%
Control Data	2.8	1.9	.6	2	1.1%	1.5%	.6%	.0%
Futurenet	1.9	.0	1.6	0	.7%	.0%	1.7%	.0%
Autodesk	1.6	.0	1.6	0	.6%	.0%	1.7%	.0%
Calma	.7	.3	.1	6	.3%	.2%	.1%	.1%
Apple Computer	.5	.4	.0	161	.2%	.4%	.0%	2.2%
Tektronix	.2	.1	.1	4	.1%	.1%	.1%	.1%
Personal CAD Systems	.1	.0	.1	0	.1%	.0%	.1%	.0%
Other Companies	36.7	10.2	22.3	942	14.3%	8.3%	23.8%	13.1%
All Companies	256.7	123.8	93.6	7,176	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	237.8	121.0	81.0	6,689	92.7%	97.7%	86.6%	93.2%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	18.9	2.8	12.6	487	7.3%	2.3%	13.4%	6.8%
All Hardware Companies	86.9	77.5	.0	4,612	33.9%	62.6%	.0%	64.3%
All Turnkey & SW Companies	169.8	46.3	93.6	2,565	66.1%	37.4%	100.0%	35.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 30
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Mentor	37.7	15.4	15.5	1,008	24.4%	23.4%	25.1%	32.4%
Apollo	24.7	21.7	.0	883	16.0%	32.8%	.0%	28.4%
Daisy	21.9	3.3	13.2	142	14.2%	4.9%	21.4%	4.6%
Valid	18.7	5.8	10.0	210	12.1%	8.8%	16.3%	6.8%
Computervision	5.7	1.5	2.4	53	3.7%	2.3%	3.9%	1.7%
Intergraph	5.2	2.6	1.1	25	3.4%	4.0%	1.8%	.8%
Recal-Redac	5.2	.2	4.3	21	3.3%	.2%	6.9%	.7%
Sun	5.0	4.4	.0	215	3.2%	6.6%	.0%	6.9%
Hewlett-Packard	4.9	2.9	1.7	258	3.2%	4.4%	2.7%	8.3%
Digital	4.6	3.9	.0	139	3.0%	6.0%	.0%	4.5%
Cadnetix	4.2	2.1	1.6	77	2.7%	3.2%	2.5%	2.5%
Silvar-Lisco	4.1	.0	4.1	0	2.7%	.0%	6.7%	.0%
Calma	.5	.2	.1	4	.3%	.3%	.1%	.1%
IBM	.2	.1	.1	3	.1%	.1%	.1%	.1%
Tektronix	.2	.1	.1	3	.1%	.1%	.1%	.1%
Other Companies	11.9	1.9	7.6	66	7.7%	2.9%	12.3%	2.1%
All Companies	154.7	66.0	61.6	3,106	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	144.2	64.7	55.1	3,066	93.2%	98.0%	89.4%	98.7%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	10.5	1.3	6.5	40	6.8%	2.0%	10.6%	1.3%
All Hardware Companies	35.1	30.7	.0	1,284	22.7%	46.6%	.0%	41.3%
All Turnkey & SW Companies	119.5	35.3	61.6	1,822	77.3%	53.4%	100.0%	58.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 31
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Mksts Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Mksts Shipped *****
Digital	31.0	26.3	.0	0	48.7%	62.5%	.0%	.0%
Zycad	3.7	3.4	.0	9	5.8%	8.1%	.0%	2.7%
Intergraph	3.1	1.8	.4	71	4.9%	4.2%	3.5%	21.4%
Control Data	2.8	1.9	.6	2	4.5%	4.5%	4.7%	.7%
IBM	2.7	1.9	.3	30	4.2%	4.6%	2.7%	9.2%
Daisy	2.6	.0	1.9	0	4.0%	.0%	15.3%	.0%
Silver-Lisco	1.5	.0	1.5	0	2.3%	.0%	11.6%	.0%
Calma	.2	.1	.0	2	.3%	.2%	.0%	.5%
Tektronix	.1	.0	.0	1	.1%	.1%	.2%	.4%
Other Companies	16.1	6.7	7.9	216	25.3%	15.9%	62.0%	65.2%
All Companies	63.7	42.2	12.7	332	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	61.1	41.2	11.6	314	96.0%	97.6%	91.0%	94.6%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	2.6	1.0	1.2	18	4.0%	2.4%	9.0%	5.4%
All Hardware Companies	37.6	32.7	.0	156	59.1%	77.6%	.0%	47.1%
All Turnkey & SW Companies	26.0	9.4	12.7	175	40.9%	22.4%	100.0%	52.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 32
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
IBM	9.5	9.3	.1	1,843	24.6%	59.1%	.5%	49.3%
Daisy	7.7	.9	4.9	106	20.1%	5.5%	25.3%	2.8%
Compaq	3.4	3.4	.0	955	8.9%	21.7%	.0%	25.5%
Recal-Redac	2.6	.0	2.2	0	6.8%	.0%	11.6%	.0%
Futurenet	1.9	.0	1.6	0	4.8%	.0%	8.5%	.0%
Valid	1.6	.0	1.4	0	4.2%	.0%	7.1%	.0%
Autodesk	1.6	.0	1.6	0	4.1%	.0%	8.1%	.0%
Computervision	.6	.1	.5	12	1.6%	.4%	2.4%	.3%
Apple Computer	.5	.4	.0	161	1.2%	2.8%	.0%	4.3%
Intergraph	.2	.0	.2	0	.5%	.0%	.8%	.0%
Personal CAD Systems	.1	.0	.1	0	.3%	.0%	.6%	.0%
Other Companies	8.7	1.6	6.8	661	22.7%	10.5%	35.1%	17.7%
All Companies	38.4	15.7	19.3	3,739	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	32.5	15.2	14.4	3,310	84.8%	96.7%	74.8%	88.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	5.8	.5	4.9	429	15.2%	3.3%	25.2%	11.5%
All Hardware Companies	14.1	14.1	.0	3,171	36.9%	89.8%	.0%	84.8%
All Turnkey & SW Companies	24.2	1.6	19.3	567	63.1%	10.2%	100.0%	15.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 33
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	34.5	12.4	18.6	577	16.6%	11.2%	24.5%	11.6%
Digital	20.1	18.1	.0	89	9.6%	16.3%	.0%	1.8%
Daisy	19.4	8.1	9.4	165	9.3%	7.3%	12.3%	3.3%
NEC	18.1	9.4	6.8	449	8.7%	8.5%	9.0%	9.1%
Fujitsu	15.8	10.1	4.1	197	7.6%	9.1%	5.4%	4.0%
Hewlett-Packard	14.7	7.9	5.3	299	7.1%	7.2%	7.0%	6.0%
IBM	12.1	9.9	.4	1,714	5.8%	8.9%	.6%	34.5%
Seiko Instruments (No OEM)	7.0	3.1	3.2	30	3.4%	2.8%	4.1%	.6%
Zuken	5.5	2.9	1.9	59	2.7%	2.6%	2.5%	1.2%
Valid	5.2	2.3	2.3	75	2.5%	2.1%	3.0%	1.5%
Apollo	4.5	4.5	.0	230	2.1%	4.1%	.0%	4.6%
Sun	3.3	2.9	.0	114	1.6%	2.7%	.0%	2.3%
Silvar-Lisco	2.4	.0	2.4	0	1.2%	.0%	3.2%	.0%
Racal-Redac	2.2	1.6	.4	6	1.1%	1.4%	.5%	.1%
Futurenet	2.2	.0	1.9	0	1.1%	.0%	2.5%	.0%
Zycad	1.1	1.0	.0	2	.5%	.9%	.0%	.0%
Cadnetix	1.0	.6	.3	23	.5%	.5%	.4%	.5%
Tokyo Electron (No OEM)	.8	.0	.7	0	.4%	.0%	.9%	.0%
Hitachi	.7	.7	.0	13	.3%	.6%	.0%	.3%
Compaq	.7	.7	.0	191	.3%	.6%	.0%	3.8%
Apple Computer	.2	.2	.0	66	.1%	.2%	.0%	1.3%
Control Data	.1	.0	.1	0	.1%	.0%	.1%	.0%

Market Share

TABLE NUMBER: 33 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Personal CAD Systems	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	36.4	14.4	18.3	664	17.5%	12.9%	24.0%	13.4%
All Companies	208.1	110.9	76.2	4,963	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	139.5	76.9	48.3	3,707	67.0%	69.4%	63.3%	74.7%
All Asian-Based Companies	66.3	32.4	27.5	1,251	31.9%	29.2%	36.1%	25.2%
All European-Based Companies	2.3	1.6	.4	6	1.1%	1.4%	.5%	.1%
All Hardware Companies	49.4	43.9	.2	2,578	23.7%	39.6%	.3%	51.9%
All Turnkey & SW Companies	158.8	67.0	76.0	2,385	76.3%	60.4%	99.7%	48.1%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 34
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	34.5	12.4	18.6	577	28.8%	21.6%	36.6%	30.1%
Daisy	18.5	8.1	8.5	165	15.4%	14.1%	16.6%	8.6%
Hewlett-Packard	14.7	7.9	5.3	299	12.3%	13.8%	10.4%	15.6%
NEC	11.2	5.4	4.7	130	9.3%	9.3%	9.2%	6.8%
Seiko Instruments (No OEM)	7.0	3.1	3.2	30	5.8%	5.5%	6.2%	1.6%
Zuken	5.5	2.9	1.9	59	4.6%	5.0%	3.8%	3.1%
Valid	5.2	2.3	2.3	75	4.3%	4.0%	4.6%	3.9%
Apollo	4.5	4.5	.0	230	3.7%	7.8%	.0%	12.0%
Sun	3.3	2.9	.0	114	2.7%	5.1%	.0%	5.9%
Digital	2.6	2.4	.0	89	2.2%	4.1%	.0%	4.7%
Racal-Redac	2.2	1.6	.4	6	1.9%	2.7%	.8%	.3%
Silvar-Lisco	1.9	.0	1.9	0	1.6%	.0%	3.8%	.0%
Cadnetix	.8	.6	.1	23	.7%	1.0%	.3%	1.2%
Nitachi	.7	.7	.0	13	.6%	1.3%	.0%	.7%
Fujitsu	.6	.0	.6	0	.5%	.0%	1.1%	.0%
Tokyo Electron (No OEM)	.4	.0	.4	0	.4%	.0%	.7%	.0%
IBM	.2	.1	.0	3	.2%	.2%	.1%	.2%
Other Companies	6.2	2.5	3.0	104	5.2%	4.4%	6.0%	5.4%
All Companies	120.0	57.6	50.9	1,917	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	89.3	41.7	39.4	1,595	74.5%	72.4%	77.3%	83.2%
All Asian-Based Companies	28.4	14.3	11.2	316	23.7%	24.9%	21.9%	16.5%
All European-Based Companies	2.2	1.6	.4	6	1.9%	2.7%	.8%	.3%
All Hardware Companies	14.5	13.4	.2	572	12.1%	23.2%	.5%	29.8%
All Turnkey & SW Companies	105.5	44.2	50.7	1,345	87.9%	76.8%	99.5%	70.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 35
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	17.5	15.7	.0	0	33.8%	39.4%	.0%	.0%
Fujitsu	14.1	10.1	2.5	197	27.2%	25.5%	43.4%	49.8%
NEC	3.5	2.5	.6	20	6.7%	6.2%	10.6%	5.1%
IBM	3.3	2.5	.4	38	6.4%	6.2%	6.0%	9.5%
Zycad	1.1	1.0	.0	2	2.2%	2.5%	.0%	.5%
Silvar-Lisco	.5	.0	.5	0	1.0%	.0%	8.9%	.0%
Tokyo Electron (No DEM)	.4	.0	.4	0	.8%	.0%	6.2%	.0%
Control Data	.1	.0	.1	0	.2%	.0%	1.2%	.0%
Other Companies	11.2	8.0	1.4	139	21.7%	20.2%	23.7%	35.0%
All Companies	51.6	39.8	5.8	396	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	33.4	27.0	2.2	176	64.7%	67.9%	37.9%	44.4%
All Asian-Based Companies	18.2	12.8	3.6	220	35.3%	32.1%	62.1%	55.6%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	25.8	22.6	.0	98	49.9%	56.7%	.0%	24.7%
All Turnkey & SW Companies	25.9	17.2	5.8	298	50.1%	43.3%	100.0%	75.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 36
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
IBM	8.7	7.3	.1	1,673	23.7%	54.0%	.3%	63.1%
NEC	3.5	1.6	1.6	299	9.4%	11.5%	8.0%	11.3%
Futurenet	2.2	.0	1.9	0	6.0%	.0%	9.6%	.0%
Fujitsu	1.1	.0	1.0	0	3.0%	.0%	5.1%	.0%
Daisy	1.0	.0	.9	0	2.7%	.0%	4.5%	.0%
Compeq	.7	.7	.0	191	1.9%	5.0%	.0%	7.2%
Cadnetix	.2	.0	.2	0	.5%	.0%	.9%	.0%
Apple Computer	.2	.2	.0	66	.5%	1.4%	.0%	2.5%
Personal CAD Systems	.0	.0	.0	0	.1%	.0%	.2%	.0%
Racal-Redac	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	19.0	3.8	13.9	421	52.1%	28.0%	71.4%	15.9%
All Companies	36.5	13.5	19.4	2,650	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	16.8	8.2	6.7	1,935	46.0%	60.7%	34.5%	73.0%
All Asian-Based Companies	19.7	5.3	12.7	715	54.0%	39.3%	65.5%	27.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	9.1	8.0	.0	1,908	24.9%	58.8%	.0%	72.0%
All Turnkey & SW Companies	27.4	5.6	19.4	742	75.1%	41.2%	100.0%	28.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 37
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	5.2	4.4	.0	20	35.1%	40.6%	.0%	4.3%
Apollo	3.3	2.9	.0	116	22.2%	26.6%	.0%	25.0%
Daisy	1.8	.5	.9	14	12.0%	4.3%	44.8%	2.9%
IBM	1.3	1.2	.0	223	9.0%	11.4%	1.6%	47.9%
Zycaid	.6	.5	.0	1	3.9%	4.5%	.0%	.2%
Valid	.4	.2	.2	4	2.8%	1.7%	9.4%	.9%
Intergraph	.3	.2	.1	3	2.2%	1.5%	4.7%	.6%
Futurenet	.2	.0	.2	0	1.5%	.0%	10.4%	.0%
Computervision	.1	.1	.0	1	.7%	.5%	1.6%	.2%
Apple Computer	.1	.1	.0	28	.5%	.7%	.0%	6.1%
Racal-Redac	.0	.0	.0	0	.2%	.0%	1.6%	.0%
Control Data	.0	.0	.0	0	.1%	.0%	.5%	.0%
Personal CAD Systems	.0	.0	.0	0	.1%	.0%	.5%	.0%
Other Companies	1.4	.9	.5	55	9.7%	8.2%	25.0%	11.8%
All Companies	14.7	10.8	1.9	465	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	14.6	10.8	1.8	465	99.0%	100.0%	92.7%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.1	.0	.1	0	1.0%	.0%	7.3%	.0%
All Hardware Companies	10.5	9.3	.0	438	71.4%	86.4%	.0%	94.3%
All Turnkey & SW Companies	4.2	1.5	1.9	26	28.6%	13.6%	100.0%	5.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 38
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Apollo	3.3	2.9	.0	116	53.6%	68.7%	.0%	75.7%
Daisy	1.2	.3	.6	7	19.7%	7.9%	62.0%	4.8%
Digital	.7	.6	.0	20	11.0%	13.6%	.0%	12.9%
Valid	.4	.2	.2	4	6.1%	3.8%	17.4%	2.5%
Intergraph	.3	.2	.1	3	5.3%	3.8%	9.8%	1.7%
Computervision	.1	.1	.0	1	1.6%	1.2%	2.2%	.5%
Racal-Redac	.0	.0	.0	0	.3%	.0%	2.2%	.1%
IBM	.0	.0	.0	0	.2%	.0%	.0%	.1%
Other Companies	.1	.0	.1	2	2.1%	1.0%	6.5%	1.6%
All Companies	6.1	4.2	.9	154	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	6.1	4.2	.9	154	99.5%	100.0%	96.7%	99.9%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.5%	.0%	3.3%	.1%
All Hardware Companies	4.0	3.5	.0	139	65.5%	83.3%	.0%	90.2%
All Turnkey & SW Companies	2.1	.7	.9	15	34.5%	16.7%	100.0%	9.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 39
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Digital	4.5	3.8	.0	0	71.7%	73.7%	.0%	.0%
Zycad	.6	.5	.0	1	9.1%	9.5%	.0%	3.9%
IBM	.2	.1	.0	2	3.0%	2.5%	9.5%	8.2%
Daisy	.1	.0	.1	1	2.2%	.8%	28.6%	2.6%
Control Data	.0	.0	.0	0	.3%	.0%	4.8%	.1%
Other Companies	.8	.7	.1	23	13.6%	13.5%	57.1%	85.1%
All Companies	6.3	5.2	.2	27	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	6.3	5.2	.2	27	100.0%	100.0%	100.0%	99.9%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.1%
All Hardware Companies	5.2	4.5	.0	23	82.9%	87.2%	.0%	85.0%
All Turnkey & SW Companies	1.1	.7	.2	4	17.1%	12.8%	100.0%	15.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 40
 TITLE: 1987 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
IBM	1.1	1.1	.0	220	47.5%	76.9%	1.3%	77.5%
Daisy	.4	.1	.2	6	17.8%	6.3%	29.1%	1.9%
Futurenet	.2	.0	.2	0	9.3%	.0%	25.3%	.0%
Apple Computer	.1	.1	.0	28	3.4%	5.6%	.0%	10.0%
Valid	.0	.0	.0	0	1.7%	1.4%	2.5%	.2%
Computervision	.0	.0	.0	0	.4%	.0%	1.3%	.0%
Personal CAD Systems	.0	.0	.0	0	.4%	.0%	1.3%	.0%
Racal-Redac	.0	.0	.0	0	.4%	.0%	1.3%	.0%
Other Companies	.4	.1	.3	30	19.1%	9.8%	38.0%	10.4%
All Companies	2.4	1.4	.8	284	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	2.3	1.4	.7	284	95.3%	100.0%	86.1%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.1	.0	.1	0	4.7%	.0%	13.9%	.0%
All Hardware Companies	1.3	1.3	.0	277	56.4%	92.3%	.0%	97.4%
All Turnkey & SW Companies	1.0	.1	.8	7	43.6%	7.7%	100.0%	2.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 41
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Calma	30.7	16.8	8.5	194	9.6%	12.4%	5.7%	4.6%
Seiko Instruments (No OEM)	28.0	14.9	10.3	170	8.8%	11.0%	7.0%	4.0%
Mentor	27.8	13.1	10.8	412	8.7%	9.6%	7.3%	9.8%
Sun	27.1	23.9	.0	1,148	8.5%	17.6%	.0%	27.3%
Silicon Compiler Systems	27.0	.0	23.8	0	8.5%	.0%	16.1%	.0%
Digital	22.0	18.9	.0	98	6.9%	13.9%	.0%	2.3%
ECAD	21.1	.0	21.1	0	6.6%	.0%	14.3%	.0%
SDA	16.5	.4	15.4	10	5.2%	.3%	10.4%	.2%
Silvar-Lisco	11.1	.0	9.9	0	3.5%	.0%	6.7%	.0%
Fujitsu	7.9	5.7	1.4	111	2.5%	4.2%	1.0%	2.6%
Daisy	6.9	2.2	3.5	61	2.2%	1.6%	2.4%	1.5%
Intergraph	6.4	3.4	1.9	44	2.0%	2.5%	1.3%	1.0%
Apollo	6.4	6.1	.0	281	2.0%	4.5%	.0%	6.7%
Autodesk	5.4	.0	5.4	0	1.7%	.0%	3.6%	.0%
Control Data	4.5	3.5	.0	0	1.4%	2.5%	.0%	.0%
Tektronix	4.5	2.1	1.9	47	1.4%	1.5%	1.3%	1.1%
Hewlett-Packard	4.1	2.4	1.3	153	1.3%	1.8%	.9%	3.6%
Valid	4.1	1.1	2.2	23	1.3%	.8%	1.5%	.5%
IBM	3.4	3.4	.0	682	1.1%	2.5%	.0%	16.2%
Racal-Redac	1.8	.2	1.3	2	.6%	.1%	.9%	.0%
NEC	.8	.7	.0	30	.3%	.5%	.0%	.7%
Hitachi	.6	.6	.0	11	.2%	.4%	.0%	.3%
Other Companies	51.0	16.6	29.1	727	16.0%	12.2%	19.7%	17.3%
All Companies	319.1	135.9	147.7	4,204	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	260.8	109.6	121.3	3,424	81.7%	80.6%	82.1%	81.4%
All Asian-Based Companies	44.8	24.5	16.1	484	14.0%	18.0%	10.9%	11.5%
All European-Based Companies	13.4	1.9	10.3	296	4.2%	1.4%	7.0%	7.0%
All Hardware Companies	78.2	69.8	.2	2,548	24.5%	51.3%	.2%	60.6%
All Turnkey & SW Companies	240.9	66.2	147.5	1,657	75.5%	48.7%	99.8%	39.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 42
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	27.8	13.1	10.8	412	12.9%	16.3%	9.7%	15.1%
Sun	27.1	23.9	.0	1,148	12.5%	29.8%	.0%	42.0%
Silicon Compiler Systems	21.6	.0	19.0	0	10.0%	.0%	17.1%	.0%
Seiko Instruments (No OEM)	21.0	9.5	9.5	150	9.7%	11.8%	8.5%	5.5%
ECAD	20.0	.0	20.0	0	9.3%	.0%	18.0%	.0%
Calma	18.1	8.3	6.4	133	8.4%	10.4%	5.7%	4.9%
SDA	16.5	.4	15.4	10	7.6%	.5%	13.8%	.4%
Silver-Lisco	7.6	.0	6.8	0	3.5%	.0%	6.1%	.0%
Intergraph	6.4	3.4	1.9	44	3.0%	4.2%	1.7%	1.6%
Apollo	6.4	6.1	.0	281	3.0%	7.6%	.0%	10.3%
Daisy	5.8	2.0	2.9	49	2.7%	2.5%	2.6%	1.8%
Hewlett-Packard	4.1	2.4	1.3	153	1.9%	3.0%	1.2%	5.6%
Valid	4.1	1.1	2.2	23	1.9%	1.4%	2.0%	.8%
Tektronix	3.2	1.4	1.4	30	1.5%	1.7%	1.2%	1.1%
Digital	2.9	2.4	.0	98	1.3%	3.0%	.0%	3.6%
Racal-Redac	1.3	.2	.9	2	.6%	.2%	.8%	.1%
NEC	.8	.7	.0	30	.4%	.9%	.0%	1.1%
Hitachi	.6	.6	.0	11	.3%	.7%	.0%	.4%
Autodesk	.1	.0	.1	0	.0%	.0%	.1%	.0%
Other Companies	21.1	4.7	12.8	160	9.7%	5.8%	11.5%	5.9%
All Companies	216.3	80.1	111.2	2,734	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	183.0	66.4	95.1	2,447	84.6%	82.9%	85.5%	89.5%
All Asian-Based Companies	25.3	12.6	10.2	269	11.7%	15.7%	9.2%	9.9%
All European-Based Companies	8.1	1.1	5.9	18	3.7%	1.4%	5.3%	.6%
All Hardware Companies	40.6	36.0	.2	1,673	18.8%	44.9%	.2%	61.2%
All Turnkey & SW Companies	175.8	44.1	111.0	1,061	81.2%	55.1%	99.8%	38.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 43
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	19.1	16.5	.0	0	22.9%	32.1%	.0%	.0%
Calma	12.6	8.5	2.1	61	15.0%	16.6%	9.1%	14.4%
Fujitsu	7.9	5.7	1.4	111	9.4%	11.1%	6.2%	26.4%
Seiko Instruments (No OEM)	7.0	5.5	.8	20	8.4%	10.7%	3.6%	4.8%
Silicon Compiler Systems	5.4	.0	4.8	0	6.5%	.0%	20.6%	.0%
Control Data	4.5	3.5	.0	0	5.4%	6.7%	.0%	.0%
Silver-Lisco	3.6	.0	3.1	0	4.3%	.0%	13.5%	.0%
Tektronix	1.4	.7	.5	17	1.6%	1.3%	2.1%	4.0%
ECAD	1.1	.0	1.1	0	1.3%	.0%	4.6%	.0%
Daisy	.3	.0	.2	1	.3%	.1%	.7%	.3%
Other Companies	20.9	11.0	9.1	211	25.0%	21.4%	39.6%	50.1%
All Companies	83.6	51.3	23.1	421	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	62.7	39.7	15.4	283	75.0%	77.5%	67.0%	67.4%
All Asian-Based Companies	16.6	11.2	3.7	131	19.8%	21.8%	16.2%	31.1%
All European-Based Companies	4.4	.4	3.9	6	5.2%	.8%	16.9%	1.5%
All Hardware Companies	34.2	30.4	.0	192	40.9%	59.2%	.0%	45.7%
All Turnkey & SW Companies	49.4	20.9	23.1	228	59.1%	40.8%	100.0%	54.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 44
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Autodesk	5.3	.0	5.3	0	27.8%	.0%	39.8%	.0%
IBM	3.4	3.4	.0	682	17.9%	75.6%	.0%	65.0%
Daisy	.8	.1	.5	11	4.4%	2.2%	3.6%	1.1%
Racal-Redac	.5	.0	.4	0	2.6%	.0%	3.2%	.0%
Other Companies	9.0	1.0	7.1	356	47.2%	22.2%	53.4%	33.9%
All Companies	19.2	4.5	13.4	1,049	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	15.2	3.5	10.7	694	79.2%	77.8%	80.2%	66.1%
All Asian-Based Companies	3.0	.7	2.2	84	15.7%	14.9%	16.1%	8.0%
All European-Based Companies	1.0	.3	.5	271	5.1%	7.3%	3.7%	25.9%
All Hardware Companies	3.4	3.4	.0	682	17.9%	75.6%	.0%	65.0%
All Turnkey & SW Companies	15.7	1.1	13.4	367	82.1%	24.4%	100.0%	35.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 45
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Sun	19.0	16.7	.0	824	12.2%	30.8%	.0%	40.7%
Silicon Compiler Systems	18.4	.0	16.2	0	11.8%	.0%	19.3%	.0%
Mentor	14.8	8.1	4.4	231	9.5%	15.0%	5.3%	11.4%
ECAD	14.3	.0	14.3	0	9.2%	.0%	17.1%	.0%
Digital	9.6	8.2	.0	47	6.2%	15.0%	.0%	2.3%
SDA	8.3	.2	7.7	5	5.3%	.4%	9.2%	.2%
Intergraph	6.1	3.2	1.8	42	3.9%	5.9%	2.2%	2.1%
Silvar-Lisco	6.1	.0	4.9	0	3.9%	.0%	5.8%	.0%
Autodesk	4.8	.0	4.8	0	3.1%	.0%	5.7%	.0%
Celma	4.3	2.4	1.4	57	2.7%	4.4%	1.7%	2.8%
Tektronix	3.8	1.8	1.6	40	2.5%	3.3%	1.9%	2.0%
Control Data	3.6	2.7	.0	0	2.3%	4.9%	.0%	.0%
IBM	2.2	2.2	.0	438	1.4%	4.0%	.0%	21.6%
Apollo	2.1	1.9	.0	77	1.4%	3.5%	.0%	3.8%
Hewlett-Packard	1.6	1.0	.4	84	1.0%	1.9%	.5%	4.2%
Daisy	1.6	.4	.8	13	1.0%	.8%	.9%	.6%
Valid	1.4	.2	.8	4	.9%	.4%	.9%	.2%
Racal-Redac	.3	.0	.2	0	.2%	.0%	.3%	.0%
Other Companies	33.3	5.4	24.5	163	21.4%	9.9%	29.3%	8.0%
All Companies	155.3	54.4	83.7	2,024	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	154.5	54.4	83.0	2,024	99.5%	100.0%	99.2%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.8	.0	.7	1	.5%	.0%	.8%	.0%
All Hardware Companies	40.5	35.4	.0	1,498	26.1%	65.2%	.0%	74.0%
All Turnkey & SW Companies	114.8	18.9	83.7	527	73.9%	34.8%	100.0%	26.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 46
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Sun	19.0	16.7	.0	824	16.7%	44.6%	.0%	57.0%
Mentor	14.8	8.1	4.4	231	13.0%	21.7%	7.0%	16.0%
Silicon Compiler Systems	14.7	.0	12.9	0	12.9%	.0%	20.4%	.0%
ECAD	13.6	.0	13.6	0	11.9%	.0%	21.4%	.0%
SDA	8.3	.2	7.7	5	7.3%	.6%	12.1%	.3%
Intergraph	6.1	3.2	1.8	42	5.4%	8.5%	2.8%	2.9%
Silvar-Lisco	4.0	.0	3.2	0	3.5%	.0%	5.0%	.0%
Colma	3.4	1.9	1.2	46	3.0%	4.9%	1.9%	3.2%
Tektronix	2.7	1.2	1.2	26	2.4%	3.2%	1.9%	1.8%
Apollo	2.1	1.9	.0	77	1.9%	5.0%	.0%	5.3%
Hewlett-Packard	1.6	1.0	.4	84	1.4%	2.7%	.7%	5.8%
Valid	1.4	.2	.8	4	1.2%	.6%	1.2%	.3%
Digital	1.3	1.1	.0	47	1.1%	2.8%	.0%	3.3%
Daisy	1.1	.3	.5	6	.9%	.8%	.8%	.4%
Recal-Redac	.2	.0	.1	0	.1%	.0%	.2%	.0%
Autodesk	.1	.0	.1	0	.0%	.0%	.1%	.0%
Other Companies	19.5	1.7	15.5	54	17.2%	4.5%	24.5%	3.7%
All Companies	113.6	37.5	63.4	1,447	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	113.2	37.5	63.0	1,446	99.6%	100.0%	99.4%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.4	.0	.4	0	.4%	.0%	.6%	.0%
All Hardware Companies	22.7	19.9	.0	963	20.0%	53.2%	.0%	66.6%
All Turnkey & SW Companies	90.9	17.6	63.4	483	80.0%	46.8%	100.0%	33.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 47
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Digital	8.4	7.1	.0	0	28.4%	48.5%	.0%	.0%
Silicon Compiler Systems	3.7	.0	3.2	0	12.5%	.0%	29.6%	.0%
Control Data	3.6	2.7	.0	0	12.3%	18.2%	.0%	.0%
Silver-Lisco	2.1	.0	1.7	0	7.2%	.0%	15.5%	.0%
Tektronix	1.2	.6	.4	14	3.9%	4.0%	3.8%	10.5%
Calma	.9	.6	.2	11	2.9%	3.8%	1.9%	7.9%
ECAD	.7	.0	.7	0	2.4%	.0%	6.5%	.0%
Daisy	.1	.0	.1	1	.4%	.3%	.5%	.9%
Other Companies	8.8	3.7	4.6	109	29.9%	25.3%	42.0%	80.6%
All Companies	29.4	14.7	10.9	135	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	29.1	14.6	10.7	135	99.1%	99.9%	97.9%	99.8%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.3	.0	.2	0	.9%	.1%	2.1%	.2%
All Hardware Companies	15.6	13.3	.0	97	53.3%	91.1%	.0%	71.4%
All Turnkey & SW Companies	13.7	1.3	10.9	39	46.7%	8.9%	100.0%	28.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 48
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Autodesk	4.7	.0	4.7	0	38.3%	.0%	50.1%	.0%
IBM	2.2	2.2	.0	438	17.8%	96.5%	.0%	98.9%
Daisy	.4	.1	.2	5	3.0%	3.5%	2.1%	1.1%
Racal-Redac	.1	.0	.1	0	.7%	.0%	.7%	.0%
Other Companies	4.9	(.0)	4.4	0	40.1%	-.0%	47.0%	.0%
All Companies	12.3	2.3	9.4	442	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	12.2	2.3	9.3	442	99.3%	100.0%	99.3%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.1	.0	.1	0	.7%	.0%	.7%	.0%
All Hardware Companies	2.2	2.2	.0	438	17.8%	96.5%	.0%	98.9%
All Turnkey & SW Companies	10.1	.1	9.4	5	82.2%	3.5%	100.0%	1.1%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 49
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	7.1	6.1	.0	28	10.5%	24.7%	.0%	2.6%
Calma	6.8	2.9	.9	55	10.1%	11.9%	2.6%	5.1%
Mentor	5.3	2.2	2.2	106	7.8%	8.8%	6.3%	9.9%
Silicon Compiler Systems	5.1	.0	4.5	0	7.6%	.0%	13.2%	.0%
Sun	5.0	4.4	.0	215	7.3%	17.7%	.0%	20.1%
Silver-Lisco	4.8	.0	4.8	0	7.1%	.0%	14.0%	.0%
ECAD	4.0	.0	4.0	0	5.9%	.0%	11.7%	.0%
SDA	3.2	.1	3.0	2	4.7%	.3%	8.7%	.2%
Daisy	1.9	.2	1.2	14	2.8%	1.0%	3.5%	1.4%
Valid	1.6	.4	.9	5	2.3%	1.5%	2.7%	.5%
Racal-Redac	1.3	.0	1.1	1	1.9%	.1%	3.1%	.1%
IBM	1.1	1.1	.0	219	1.6%	4.4%	.0%	20.5%
Control Data	.9	.8	.0	0	1.3%	3.2%	.0%	.0%
Apollo	.9	.8	.0	32	1.3%	3.3%	.0%	3.0%
Tektronix	.7	.3	.3	7	1.0%	1.3%	.8%	.7%
Hewlett-Packard	.6	.3	.2	28	.8%	1.3%	.5%	2.6%
Other Companies	17.5	5.0	11.3	356	25.8%	20.5%	32.9%	33.3%
All Companies	67.9	24.5	34.3	1,069	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	55.4	22.9	24.7	774	81.6%	93.2%	71.9%	72.4%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	12.5	1.7	9.6	295	18.4%	6.8%	28.1%	27.6%
All Hardware Companies	18.4	16.5	.0	557	27.1%	67.1%	.0%	52.1%
All Turnkey & SW Companies	49.5	8.1	34.3	512	72.9%	32.9%	100.0%	47.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 50
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	5.3	2.2	2.2	106	11.9%	17.6%	8.3%	21.5%
Sun	5.0	4.4	.0	215	11.1%	35.3%	.0%	43.5%
Calma	4.8	1.9	.7	40	10.7%	15.6%	2.8%	8.1%
Silicon Compiler Systems	4.1	.0	3.6	0	9.2%	.0%	13.9%	.0%
ECAD	3.8	.0	3.8	0	8.5%	.0%	14.6%	.0%
Silvar-Lisco	3.5	.0	3.5	0	7.9%	.0%	13.6%	.0%
SDA	3.2	.1	3.0	2	7.2%	.6%	11.5%	.4%
Valid	1.6	.4	.9	5	3.5%	3.0%	3.6%	1.1%
Daisy	1.3	.2	.8	8	2.9%	1.8%	3.1%	1.6%
Digital	.9	.8	.0	28	2.1%	6.3%	.0%	5.6%
Apollo	.9	.8	.0	32	2.0%	6.5%	.0%	6.5%
Racal-Redac	.9	.0	.7	1	1.9%	.2%	2.7%	.3%
Hewlett-Packard	.6	.3	.2	28	1.2%	2.7%	.7%	5.7%
Tektronix	.5	.2	.2	5	1.1%	1.8%	.8%	.9%
Other Companies	8.4	1.1	6.4	24	18.7%	8.8%	24.4%	4.8%
All Companies	44.7	12.3	26.1	494	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	37.2	11.4	20.5	477	83.3%	92.1%	78.7%	96.6%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	7.5	1.0	5.5	17	16.7%	7.9%	21.3%	3.4%
All Hardware Companies	7.0	6.1	.0	283	15.6%	49.2%	.0%	57.3%
All Turnkey & SW Companies	37.7	6.3	26.1	211	84.4%	50.8%	100.0%	42.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 51
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	6.2	5.3	.0	0	31.7%	49.0%	.0%	.0%
Calma	2.1	1.0	.1	14	10.5%	9.2%	2.2%	18.5%
Silver-Lisco	1.3	.0	1.3	0	6.6%	.0%	19.7%	.0%
Silicon Compiler Systems	1.0	.0	.9	0	5.3%	.0%	13.8%	.0%
Control Data	.9	.8	.0	0	4.7%	7.3%	.0%	.0%
ECAD	.2	.0	.2	0	1.0%	.0%	3.1%	.0%
Tektronix	.2	.1	.1	3	1.0%	.9%	1.1%	3.2%
Daisy	.2	.0	.1	0	.8%	.0%	1.7%	.0%
Other Companies	7.5	3.6	3.8	61	38.4%	33.5%	58.5%	78.3%
All Companies	19.5	10.8	6.5	78	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	15.4	10.4	2.9	72	78.9%	96.6%	43.8%	92.2%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	4.1	.4	3.7	6	21.1%	3.4%	56.2%	7.8%
All Hardware Companies	10.3	9.3	.0	55	53.0%	86.4%	.0%	70.4%
All Turnkey & SW Companies	9.2	1.5	6.5	23	47.0%	13.6%	100.0%	29.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 52
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
IBM	1.1	1.1	.0	219	30.1%	75.5%	.0%	44.1%
Daisy	.5	.0	.3	6	12.8%	1.4%	15.9%	1.3%
Racal-Redac	.4	.0	.4	0	12.0%	.0%	20.5%	.0%
Other Companies	1.7	.3	1.1	271	45.1%	23.1%	63.6%	54.7%
All Companies	3.7	1.4	1.8	497	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	2.8	1.1	1.3	225	75.7%	76.9%	75.6%	45.3%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.9	.3	.4	271	24.3%	23.1%	24.4%	54.7%
All Hardware Companies	1.1	1.1	.0	219	30.1%	75.5%	.0%	44.1%
All Turnkey & SW Companies	2.6	.4	1.8	278	69.9%	24.5%	100.0%	55.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 53
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Seiko Instruments (No OEM)	28.0	14.9	10.3	170	30.1%	27.3%	35.2%	16.0%
Calma	19.2	11.3	6.0	77	20.6%	20.6%	20.7%	7.2%
Fujitsu	7.9	5.7	1.4	111	8.5%	10.4%	4.9%	10.4%
Mentor	7.7	2.8	4.2	75	8.3%	5.1%	14.3%	7.0%
SDA	5.0	.1	4.7	3	5.4%	.2%	16.1%	.3%
Digital	4.3	3.9	.0	19	4.6%	7.1%	.0%	1.8%
Silicon Compiter Systems	3.5	.0	3.1	0	3.8%	.0%	10.6%	.0%
Daisy	3.5	1.5	1.6	34	3.7%	2.8%	5.5%	3.2%
Apollo	3.4	3.4	.0	172	3.6%	6.2%	.0%	16.2%
Sun	3.2	2.8	.0	109	3.4%	5.2%	.0%	10.3%
ECAD	2.8	.0	2.8	0	3.0%	.0%	9.6%	.0%
Hewlett-Packard	1.9	1.0	.7	40	2.0%	1.9%	2.4%	3.8%
Valid	1.1	.5	.5	13	1.2%	.9%	1.8%	1.3%
NEC	.8	.7	.0	30	.9%	1.3%	.0%	2.8%
Hitachi	.6	.6	.0	11	.6%	1.1%	.0%	1.0%
Autodesk	.6	.0	.6	0	.6%	.0%	2.0%	.0%
Racal-Redac	.2	.2	.0	0	.2%	.3%	.1%	.0%
Other Companies	(.7)	5.3	(6.7)	200	-.8%	9.7%	-23.1%	18.8%
All Companies	92.9	54.7	29.2	1,066	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	47.9	30.1	13.0	581	51.5%	55.0%	44.7%	54.5%
All Asian-Based Companies	44.8	24.5	16.1	484	48.3%	44.7%	55.2%	45.5%
All European-Based Companies	.2	.2	.0	0	.2%	.3%	.1%	.0%
All Hardware Companies	17.3	16.0	.2	456	18.7%	29.3%	.8%	42.8%
All Turnkey & SW Companies	75.6	38.7	28.9	610	81.3%	70.7%	99.2%	57.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 54
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Seiko Instruments (No OEM)	21.0	9.5	9.5	150	36.8%	31.7%	43.9%	19.2%
Calma	9.6	4.3	4.3	42	16.8%	14.5%	20.0%	5.4%
Mentor	7.7	2.8	4.2	75	13.5%	9.3%	19.3%	9.6%
SDA	5.0	.1	4.7	3	8.8%	.4%	21.8%	.4%
Daisy	3.5	1.5	1.6	34	6.1%	5.1%	7.4%	4.3%
Apollo	3.4	3.4	.0	172	5.9%	11.3%	.0%	22.0%
Sun	3.2	2.8	.0	109	5.5%	9.5%	.0%	14.0%
Silicon Compiler Systems	2.8	.0	2.5	0	4.9%	.0%	11.5%	.0%
ECAD	2.7	.0	2.7	0	4.7%	.0%	12.4%	.0%
Hewlett-Packard	1.9	1.0	.7	40	3.3%	3.5%	3.2%	5.1%
Valid	1.1	.5	.5	13	1.9%	1.7%	2.4%	1.7%
NEC	.8	.7	.0	30	1.4%	2.4%	.0%	3.8%
Hitachi	.6	.6	.0	11	1.1%	2.0%	.0%	1.4%
Digital	.6	.5	.0	19	1.0%	1.7%	.0%	2.4%
Racal-Redac	.2	.2	.0	0	.4%	.5%	.2%	.0%
Autodesk	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	(6.8)	1.9	(9.1)	82	-12.0%	6.3%	-42.0%	10.5%
All Companies	57.1	29.8	21.6	782	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	31.7	17.1	11.3	512	55.4%	57.2%	52.5%	65.5%
All Asian-Based Companies	25.3	12.6	10.2	269	44.2%	42.3%	47.3%	34.4%
All European-Based Companies	.2	.2	.0	0	.4%	.5%	.2%	.0%
All Hardware Companies	10.8	9.9	.2	422	18.9%	33.2%	1.1%	54.0%
All Turnkey & SW Companies	46.3	19.9	21.3	360	81.1%	66.8%	98.9%	46.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 55
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Calma	9.6	6.9	1.7	35	29.3%	28.6%	31.6%	17.3%
Fujitsu	7.9	5.7	1.4	111	24.1%	23.5%	26.1%	55.7%
Seiko Instruments (No OEM)	7.0	5.5	.8	20	21.4%	22.6%	15.0%	10.0%
Digital	3.7	3.4	.0	0	11.4%	13.9%	.0%	.0%
Silicon Compiler Systems	.7	.0	.6	0	2.1%	.0%	11.4%	.0%
ECAD	.1	.0	.1	0	.4%	.0%	2.6%	.0%
Other Companies	3.7	2.7	.7	34	11.3%	11.4%	13.4%	16.9%
All Companies	32.8	24.2	5.5	199	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	16.2	13.0	1.7	68	49.5%	53.8%	31.6%	34.3%
All Asian-Based Companies	16.6	11.2	3.7	131	50.5%	46.2%	68.4%	65.7%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	6.5	6.1	.0	34	20.0%	25.2%	.0%	16.9%
All Turnkey & SW Companies	26.2	18.1	5.5	165	80.0%	74.8%	100.0%	83.1%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 56
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Autodesk	.6	.0	.6	0	18.7%	.0%	26.0%	.0%
Other Companies	2.4	.7	1.6	84	81.3%	100.0%	74.0%	100.0%
All Companies	3.0	.7	2.2	84	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Asian-Based Companies	3.0	.7	2.2	84	100.0%	100.0%	100.0%	100.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Turnkey & SW Companies	3.0	.7	2.2	84	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 57
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	1.0	.8	.0	4	30.7%	35.4%	.0%	8.1%
Celma	.4	.3	.1	6	13.9%	10.9%	25.9%	12.5%
Intergraph	.3	.2	.1	2	10.4%	7.0%	16.7%	4.8%
Silver-Lisco	.2	.0	.2	0	7.8%	.0%	37.0%	.0%
IBM	.1	.1	.0	26	4.2%	6.1%	.0%	57.5%
Autodesk	.1	.0	.1	0	2.3%	.0%	13.0%	.0%
Valid	.0	.0	.0	0	1.0%	.9%	3.7%	.6%
Other Companies	.9	.9	.0	8	29.8%	39.7%	3.7%	16.5%
All Companies	3.1	2.3	.5	46	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	3.1	2.3	.5	46	100.0%	100.0%	100.0%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	2.0	1.9	.0	38	64.1%	81.2%	.0%	82.1%
All Turnkey & SW Companies	1.1	.4	.5	8	35.9%	18.8%	100.0%	17.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 58
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Calma	.3	.2	.1	5	38.2%	38.8%	41.4%	41.1%
Intergraph	.3	.2	.1	2	36.0%	32.7%	31.0%	19.4%
Digital	.1	.1	.0	4	13.5%	20.4%	.0%	32.8%
Silver-Lisco	.1	.0	.1	0	7.9%	.0%	20.7%	.0%
Valid	.0	.0	.0	0	3.4%	4.1%	6.9%	2.4%
Other Companies	.0	.0	(.0)	0	1.1%	4.1%	-.0%	4.3%
All Companies	.9	.5	.3	11	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	.9	.5	.3	11	100.0%	100.0%	100.0%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	.1	.1	.0	4	14.6%	24.5%	.0%	37.1%
All Turnkey & SW Companies	.8	.4	.3	7	85.4%	75.5%	100.0%	62.9%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 59
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	.8	.7	.0	0	41.9%	42.8%	.0%	.0%
Silver-Lisco	.2	.0	.1	0	8.6%	.0%	87.5%	.0%
Calma	.1	.1	.0	1	4.5%	3.6%	12.5%	13.2%
Other Companies	.9	.9	(.0)	7	44.9%	53.6%	-.0%	86.8%
All Companies	2.0	1.7	.2	8	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	2.0	1.7	.2	8	100.0%	100.0%	100.0%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1.7	1.6	.0	7	86.9%	96.4%	.0%	86.8%
All Turnkey & SW Companies	.3	.1	.2	1	13.1%	3.6%	100.0%	13.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 60
 TITLE: 1987 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
IBM	.1	.1	.0	26	59.1%	100.0%	.0%	100.0%
Autodesk	.1	.0	.1	0	31.8%	.0%	77.8%	.0%
Other Companies	.0	.0	.0	0	9.1%	.0%	22.2%	.0%
All Companies	.2	.1	.1	26	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	.2	.1	.1	26	100.0%	100.0%	100.0%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All Hardware Companies	.1	.1	.0	26	59.1%	100.0%	.0%	100.0%
All Turnkey & SW Companies	.1	.0	.1	0	40.9%	.0%	100.0%	.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 61
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Racal-Redac	76.4	8.0	57.8	167	10.6%	2.2%	22.1%	1.0%
Scientific Calculations	51.5	16.8	17.3	154	7.1%	4.7%	6.6%	.9%
Digital	39.6	34.0	.0	178	5.5%	9.4%	.0%	1.1%
Cadnetix	37.7	17.9	15.4	644	5.2%	5.0%	5.9%	3.9%
Computervision	37.0	13.5	13.3	325	5.1%	3.8%	5.1%	2.0%
Zuken	36.2	19.0	12.5	287	5.0%	5.3%	4.8%	1.8%
Hewlett-Packard	31.9	19.6	9.8	1,598	4.4%	5.4%	3.7%	9.8%
IBM	28.7	21.9	3.3	1,563	4.0%	6.1%	1.3%	9.6%
Calay	27.2	17.1	8.1	230	3.8%	4.8%	3.1%	1.4%
Mentor	24.2	11.4	9.0	366	3.3%	3.1%	3.5%	2.2%
Sharp System Products	16.3	6.8	7.9	85	2.2%	1.9%	3.0%	.5%
Personal CAD Systems	15.6	.0	13.6	0	2.2%	.0%	5.2%	.0%
NEC	15.4	7.6	6.2	160	2.1%	2.1%	2.4%	1.0%
Fujitsu	14.2	10.2	2.6	200	2.0%	2.8%	1.0%	1.2%
Sun	14.1	12.5	.0	585	2.0%	3.5%	.0%	3.6%
Compaq	13.6	13.6	.0	3,820	1.9%	3.8%	.0%	23.4%
Hitachi	12.4	8.0	3.3	221	1.7%	2.2%	1.2%	1.4%
Apollo	11.3	10.2	.0	440	1.6%	2.8%	.0%	2.7%
Daisy	10.2	2.6	5.4	77	1.4%	.7%	2.1%	.5%
Asahi Optical (No OEM)	10.0	7.4	1.6	55	1.4%	2.1%	.6%	.3%
Applicon	9.5	3.9	2.7	200	1.3%	1.1%	1.0%	1.2%
Valid	8.9	3.2	3.5	76	1.2%	.9%	1.3%	.5%
Autodesk	8.1	.0	8.1	0	1.1%	.0%	3.1%	.0%
Celma	7.5	3.6	2.2	81	1.0%	1.0%	.9%	.5%
Toshiba (No OEM)	7.2	5.5	1.0	84	1.0%	1.5%	.4%	.5%
Intergraph	6.4	4.0	1.2	56	.9%	1.1%	.5%	.3%
Control Data	5.3	3.0	1.1	370	.7%	.8%	.4%	2.3%
Hitachi Zosen	4.4	1.6	2.4	29	.6%	.4%	.9%	.2%
Apple Computer	4.4	4.4	.0	1,580	.6%	1.2%	.0%	9.7%
CADAM	4.2	.0	3.8	0	.6%	.0%	1.5%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	.5%	.6%	.4%	.3%
Futurenet	3.2	.0	2.8	0	.4%	.0%	1.1%	.0%

(Continued)

Market Share

TABLE NUMBER: 61 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Tektronix	1.5	.7	.6	20	.2%	.2%	.2%	.1%
Silver-Lisco	.9	.0	.9	0	.1%	.0%	.3%	.0%
ICL	.8	.6	.2	19	.1%	.2%	.1%	.1%
ECAD	.3	.0	.3	0	.0%	.0%	.1%	.0%
Other Companies	123.0	69.8	42.5	2,603	17.0%	19.3%	16.3%	16.0%
All Companies	722.5	360.7	261.1	16,315	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	428.3	231.4	129.9	13,769	59.3%	64.2%	49.7%	84.4%
All Asian-Based Companies	154.0	87.1	50.1	1,894	21.3%	24.1%	19.2%	11.6%
All European-Based Companies	140.2	42.2	81.1	652	19.4%	11.7%	31.0%	4.0%
All Hardware Companies	128.9	117.9	.2	9,493	17.8%	32.7%	.1%	58.2%
All Turnkey & SW Companies	593.7	242.8	260.9	6,822	82.2%	67.3%	99.9%	41.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 62
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Racal-Redac	53.8	7.9	38.5	167	14.4%	4.5%	27.3%	3.0%
Computervision	32.8	12.6	10.7	277	8.8%	7.1%	7.6%	5.0%
Cadnetix	32.1	17.9	10.5	644	8.6%	10.1%	7.4%	11.6%
Hewlett-Packard	31.9	19.6	9.8	1,598	8.6%	11.0%	6.9%	28.7%
Calay	27.2	17.1	8.1	230	7.3%	9.7%	5.7%	4.1%
Mentor	24.2	11.4	9.0	366	6.5%	6.4%	6.4%	6.6%
Scientific Calculations	18.7	6.8	6.4	64	5.0%	3.8%	4.6%	1.1%
Sharp System Products	16.3	6.8	7.9	85	4.4%	3.8%	5.6%	1.5%
NEC	15.4	7.6	6.2	160	4.1%	4.3%	4.4%	2.9%
Sun	14.1	12.5	.0	585	3.8%	7.1%	.0%	10.5%
Apollo	11.3	10.2	.0	440	3.0%	5.7%	.0%	7.9%
Valid	8.9	3.2	3.5	76	2.4%	1.8%	2.5%	1.4%
Daisy	7.6	2.1	3.9	47	2.0%	1.2%	2.8%	.8%
Asahi Optical (No OEM)	7.6	5.5	1.4	45	2.0%	3.1%	1.0%	.8%
Calma	6.2	2.9	2.0	60	1.7%	1.6%	1.4%	1.1%
Digital	5.2	4.4	.0	178	1.4%	2.5%	.0%	3.2%
Hitachi Zosen	4.4	1.6	2.4	29	1.2%	.9%	1.7%	.5%
Intergraph	1.9	1.0	.6	17	.5%	.6%	.4%	.3%
IBM	1.2	.6	.3	20	.3%	.3%	.2%	.4%
Tektronix	1.1	.5	.5	12	.3%	.3%	.3%	.2%
ICL	.8	.6	.2	19	.2%	.3%	.1%	.3%
Silvar-Lisco	.7	.0	.7	0	.2%	.0%	.5%	.0%
Hitachi	.6	.6	.0	11	.2%	.3%	.0%	.2%
ECAD	.3	.0	.3	0	.1%	.0%	.2%	.0%

(Continued)

Market Share

TABLE NUMBER: 62 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Autodesk	.1	.0	.1	0	.0%	.0%	.0%	.0%
Other Companies	48.5	24.2	18.5	441	13.0%	13.6%	13.1%	7.9%
All Companies	372.5	177.6	141.1	5,571	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	202.1	107.4	60.0	4,486	54.2%	60.5%	42.5%	80.5%
All Asian-Based Companies	58.2	29.5	22.9	466	15.6%	16.6%	16.3%	8.4%
All European-Based Companies	112.3	40.7	58.2	618	30.1%	22.9%	41.3%	11.1%
All Hardware Companies	35.0	31.1	.2	1,368	9.4%	17.5%	.1%	24.5%
All Turnkey & SW Companies	337.6	146.5	141.0	4,204	90.6%	82.5%	99.9%	75.5%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 63
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Zuken	36.2	19.0	12.5	287	16.4%	13.5%	28.3%	14.6%
Digital	34.5	29.6	.0	0	15.6%	21.1%	.0%	.0%
Scientific Calculations	32.8	10.1	10.8	90	14.8%	7.2%	24.5%	4.6%
IBM	19.3	14.2	2.4	221	8.7%	10.1%	5.4%	11.2%
Fujitsu	14.2	10.2	2.6	200	6.4%	7.3%	5.8%	10.1%
Applicon	9.5	3.9	2.7	200	4.3%	2.8%	6.2%	10.2%
Toshiba (No OEM)	7.2	5.5	1.0	84	3.3%	3.9%	2.2%	4.2%
Hitachi	5.6	4.0	1.0	40	2.5%	2.9%	2.3%	2.0%
Intergraph	4.5	3.0	.7	39	2.0%	2.1%	1.5%	2.0%
CADAM	4.2	.0	3.8	0	1.9%	.0%	8.6%	.0%
Mitsubishi Electric	3.5	2.2	1.0	43	1.6%	1.6%	2.2%	2.2%
Asahi Optical (No OEM)	2.4	1.9	.2	10	1.1%	1.4%	.5%	.5%
Computervision	1.4	.6	.4	9	.6%	.5%	.9%	.5%
Calma	1.1	.6	.1	9	.5%	.4%	.3%	.5%
Control Data	.7	.6	.0	0	.3%	.4%	.0%	.0%
Daisy	.7	.1	.4	4	.3%	.1%	.8%	.2%
Tektronix	.5	.2	.2	7	.2%	.2%	.4%	.4%
Silver-Lisco	.2	.0	.2	0	.1%	.0%	.5%	.0%
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	42.6	34.4	4.3	725	19.3%	24.6%	9.7%	36.8%
All Companies	221.0	140.2	44.2	1,969	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	140.4	91.3	22.5	1,219	63.5%	65.1%	50.8%	61.9%
All Asian-Based Companies	77.7	47.7	20.3	725	35.1%	34.0%	46.0%	36.8%
All European-Based Companies	3.0	1.2	1.4	25	1.3%	.9%	3.1%	1.3%
All Hardware Companies	65.4	58.6	.0	638	29.6%	41.8%	.0%	32.4%
All Turnkey & SW Companies	155.6	81.6	44.2	1,330	70.4%	58.2%	100.0%	67.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 64
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Racal-Redac	22.7	.1	19.3	0	17.6%	.1%	25.5%	.0%
Personal CAD Systems	15.6	.0	13.6	0	12.1%	.0%	18.0%	.0%
Compaq	13.6	13.6	.0	3,820	10.5%	31.7%	.0%	43.5%
IBM	8.3	7.1	.7	1,322	6.4%	16.5%	.9%	15.1%
Autodesk	8.0	.0	8.0	0	6.2%	.0%	10.5%	.0%
Hitachi	6.3	3.4	2.3	170	4.8%	7.9%	3.0%	1.9%
Cadnetix	5.6	.0	4.9	0	4.3%	.0%	6.5%	.0%
Control Data	4.6	2.4	1.1	370	3.5%	5.6%	1.5%	4.2%
Apple Computer	4.4	4.4	.0	1,580	3.4%	10.3%	.0%	18.0%
Futurenet	3.2	.0	2.8	0	2.4%	.0%	3.7%	.0%
Computervision	2.8	.3	2.1	38	2.2%	.6%	2.8%	.4%
Daisy	2.0	.3	1.1	26	1.5%	.8%	1.5%	.3%
Calma	.3	.2	.1	12	.2%	.4%	.1%	.1%
Other Companies	31.9	11.1	19.8	1,436	24.7%	26.0%	26.1%	16.4%
All Companies	129.0	42.9	75.8	8,775	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	85.9	32.7	47.5	8,064	66.6%	76.3%	62.7%	91.9%
All Asian-Based Companies	18.1	9.9	6.9	703	14.0%	23.0%	9.1%	8.0%
All European-Based Companies	25.0	.3	21.4	9	19.4%	.7%	28.3%	.1%
All Hardware Companies	28.5	28.2	.0	7,487	22.1%	65.8%	.0%	85.3%
All Turnkey & SW Companies	100.5	14.7	75.8	1,288	77.9%	34.2%	100.0%	14.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 65
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Scientific Calculations	30.6	10.1	8.3	92	12.0%	7.7%	9.8%	1.1%
Cadnetix	25.6	11.6	11.0	428	10.1%	8.9%	13.0%	5.0%
Digital	18.4	15.7	.0	91	7.2%	12.0%	.0%	1.1%
Hewlett-Packard	15.1	9.7	4.2	789	5.9%	7.4%	4.9%	9.2%
Computervision	12.2	5.4	3.3	97	4.8%	4.2%	3.8%	1.1%
Calay	12.1	9.4	1.8	111	4.8%	7.2%	2.1%	1.3%
Mentor	11.4	6.2	3.4	178	4.5%	4.8%	4.0%	2.1%
Racal-Redac	11.2	.2	9.3	25	4.4%	.2%	11.0%	.3%
IBM	11.1	8.7	1.3	721	4.4%	6.7%	1.5%	8.4%
Compaq	9.5	9.5	.0	2,674	3.7%	7.3%	.0%	31.3%
Sun	9.0	7.9	.0	390	3.5%	6.1%	.0%	4.6%
Personal CAD Systems	7.6	.0	6.7	0	3.0%	.0%	7.9%	.0%
Valid	7.2	2.4	2.8	42	2.8%	1.9%	3.3%	.5%
Autodesk	6.2	.0	6.2	0	2.4%	.0%	7.3%	.0%
Intergraph	6.1	3.8	1.2	53	2.4%	2.9%	1.4%	.6%
Apollo	5.7	5.0	.0	204	2.2%	3.9%	.0%	2.4%
Applicon	4.7	2.4	.9	108	1.9%	1.9%	1.0%	1.3%
Daisy	4.5	1.2	2.2	36	1.8%	.9%	2.6%	.4%
Apple Computer	3.2	3.2	.0	1,153	1.3%	2.5%	.0%	13.5%
Control Data	3.1	1.5	.7	204	1.2%	1.2%	.8%	2.4%
Futurenet	2.6	.0	2.3	0	1.0%	.0%	2.7%	.0%
Calma	2.5	1.4	.9	42	1.0%	1.1%	1.0%	.5%
CADAM	1.7	.0	1.5	0	.6%	.0%	1.8%	.0%
Tektronix	1.3	.6	.5	17	.5%	.5%	.6%	.2%
Zuken	.4	.3	.1	0	.2%	.2%	.1%	.0%
ECAD	.2	.0	.2	0	.1%	.0%	.2%	.0%

(Continued)

Market Share

TABLE NUMBER: 65 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Silvar-Lisco	.1	.0	.1	0	.0%	.0%	.1%	.0%
Other Companies	31.2	13.9	16.0	1,091	12.2%	10.7%	18.9%	12.8%
All Companies	254.4	130.2	84.5	8,546	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	229.5	120.2	72.5	8,403	90.2%	92.3%	85.8%	98.3%
All Asian-Based Companies	.4	.3	.1	0	.2%	.2%	.1%	.0%
All European-Based Companies	24.4	9.8	12.0	142	9.6%	7.5%	14.1%	1.7%
All Hardware Companies	62.7	57.4	.0	6,128	24.6%	44.1%	.0%	71.7%
All Turnkey & SW Companies	191.7	72.8	84.5	2,418	75.4%	55.9%	100.0%	28.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 66
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Cadnetix	20.5	11.6	6.5	428	16.5%	17.2%	17.9%	16.9%
Hewlett-Packard	15.1	9.7	4.2	789	12.1%	14.4%	11.5%	31.2%
Calay	12.1	9.4	1.8	111	9.8%	13.9%	4.9%	4.4%
Mentor	11.4	6.2	3.4	178	9.2%	9.3%	9.4%	7.0%
Computervision	11.0	5.3	2.4	87	8.8%	7.8%	6.6%	3.4%
Scientific Calculations	9.2	2.5	3.0	21	7.4%	3.8%	8.2%	.8%
Sun	9.0	7.9	.0	390	7.3%	11.8%	.0%	15.4%
Racal-Redac	7.4	.2	6.1	25	6.0%	.3%	16.9%	1.0%
Valid	7.2	2.4	2.8	42	5.8%	3.6%	7.6%	1.6%
Apollo	5.7	5.0	.0	204	4.6%	7.5%	.0%	8.1%
Dafsy	3.0	.8	1.4	19	2.4%	1.2%	4.0%	.7%
Digital	2.4	2.0	.0	91	1.9%	3.0%	.0%	3.6%
Calma	2.0	1.1	.7	27	1.6%	1.6%	2.0%	1.1%
Intergraph	1.8	1.0	.5	16	1.5%	1.4%	1.5%	.6%
Tektronix	.9	.4	.4	10	.7%	.6%	1.1%	.4%
IBM	.4	.2	.1	7	.3%	.3%	.3%	.3%
ECAD	.2	.0	.2	0	.1%	.0%	.5%	.0%
Silvar-Lisco	.1	.0	.1	0	.1%	.0%	.2%	.0%
Autodesk	.1	.0	.1	0	.0%	.0%	.2%	.0%
Other Companies	4.7	1.6	2.6	85	3.8%	2.3%	7.2%	3.4%
All Companies	124.1	67.3	36.2	2,531	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	103.6	57.6	27.6	2,390	83.5%	85.6%	76.3%	94.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	20.5	9.7	8.6	140	16.5%	14.4%	23.7%	5.5%
All Hardware Companies	17.6	15.4	.0	709	14.1%	22.8%	.0%	28.0%
All Turnkey & SW Companies	106.6	52.0	36.2	1,822	85.9%	77.2%	100.0%	72.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 67
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Scientific Calculations	21.4	7.6	5.3	71	31.2%	18.1%	45.3%	12.0%
Digital	16.0	13.6	.0	0	23.4%	32.8%	.0%	.0%
IBM	7.0	5.1	.9	80	10.1%	12.2%	7.7%	13.4%
Applicon	4.7	2.4	.9	108	6.9%	5.9%	7.4%	18.1%
Intergraph	4.3	2.9	.6	37	6.2%	6.9%	5.4%	6.2%
CADAM	1.7	.0	1.5	0	2.4%	.0%	12.7%	.0%
Control Data	.6	.5	.0	0	.9%	1.1%	.0%	.0%
Zuken	.4	.3	.1	0	.6%	.8%	.4%	.0%
Tektronix	.4	.2	.1	6	.6%	.5%	1.2%	1.1%
Daisy	.4	.1	.2	4	.5%	.3%	1.3%	.6%
Calma	.3	.2	.1	3	.4%	.4%	.5%	.5%
Computervision	.1	.1	.0	1	.2%	.1%	.2%	.1%
ECAD	.0	.0	.0	0	.0%	.0%	.1%	.0%
Other Companies	11.4	8.7	2.1	284	16.6%	21.0%	17.8%	47.9%
All Companies	68.6	41.6	11.7	593	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	67.9	41.2	11.5	591	99.0%	99.1%	98.3%	99.7%
All Asian-Based Companies	.4	.3	.1	0	.6%	.8%	.4%	.0%
All European-Based Companies	.2	.1	.2	2	.3%	.1%	1.3%	.3%
All Hardware Companies	25.8	22.8	.0	282	37.6%	54.7%	.0%	47.6%
All Turnkey & SW Companies	42.8	18.8	11.7	311	62.4%	45.3%	100.0%	52.4%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 68
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Compeq	9.5	9.5	.0	2,674	15.4%	44.7%	.0%	49.3%
Personal CAD Systems	7.6	.0	6.7	0	12.4%	.0%	18.3%	.0%
Autodesk	6.1	.0	6.1	0	9.9%	.0%	16.7%	.0%
Cadnetix	5.1	.0	4.5	0	8.3%	.0%	12.3%	.0%
IBM	3.8	3.4	.3	634	6.1%	15.8%	.8%	11.7%
Racal-Redac	3.8	.0	3.2	0	6.1%	.0%	8.8%	.0%
Apple Computer	3.2	3.2	.0	1,153	5.2%	15.1%	.0%	21.3%
Futurenet	2.6	.0	2.3	0	4.3%	.0%	6.3%	.0%
Control Data	2.5	1.1	.7	204	4.1%	5.0%	1.9%	3.8%
Computervision	1.1	.1	.8	9	1.8%	.5%	2.3%	.2%
Daisy	1.1	.2	.6	14	1.7%	1.1%	1.6%	.3%
Calma	.3	.2	.1	12	.4%	.8%	.2%	.2%
Other Companies	15.0	3.6	11.3	722	24.3%	17.0%	30.8%	13.3%
All Companies	61.7	21.3	36.5	5,422	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	57.9	21.3	33.3	5,422	93.9%	100.0%	91.2%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	3.8	.0	3.2	0	6.1%	.0%	8.8%	.0%
All Hardware Companies	19.3	19.3	.0	5,137	31.3%	90.6%	.0%	94.7%
All Turnkey & SW Companies	42.4	2.0	36.5	286	68.7%	9.4%	100.0%	5.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 69
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Recal-Redac	55.8	1.1	46.6	122	23.7%	1.3%	41.8%	2.9%
Computervision	19.0	4.9	8.6	190	8.0%	5.5%	7.7%	4.5%
Scientific Calculations	15.3	2.7	8.0	46	6.5%	3.0%	7.2%	1.1%
Calay	13.6	6.6	6.1	105	5.8%	7.5%	5.5%	2.5%
Hewlett-Packard	13.5	7.9	4.5	706	5.7%	8.9%	4.0%	16.8%
Digital	11.9	10.1	.0	46	5.0%	11.4%	.0%	1.1%
Mentor	10.1	4.2	4.1	162	4.3%	4.7%	3.7%	3.9%
Cadnetix	9.8	5.0	3.6	180	4.2%	5.6%	3.3%	4.3%
IBM	7.8	5.9	1.0	398	3.3%	6.7%	.9%	9.5%
Personal CAD Systems	5.9	.0	5.2	0	2.5%	.0%	4.6%	.0%
Applicon	4.5	1.3	1.8	86	1.9%	1.5%	1.6%	2.1%
Daisy	3.8	.5	2.3	29	1.6%	.5%	2.1%	.7%
Compaq	3.4	3.4	.0	955	1.4%	3.8%	.0%	22.7%
Apollo	3.2	2.8	.0	115	1.4%	3.2%	.0%	2.7%
Calma	2.9	1.2	.4	23	1.2%	1.4%	.3%	.5%
Sun	2.1	1.8	.0	90	.9%	2.1%	.0%	2.1%
Control Data	1.9	1.4	.3	144	.8%	1.5%	.3%	3.4%
CADAM	1.3	.0	1.1	0	.5%	.0%	1.0%	.0%
Autodesk	1.1	.0	1.1	0	.4%	.0%	.9%	.0%
ICL	.8	.6	.2	19	.4%	.7%	.1%	.5%
Silver-Lisco	.8	.0	.8	0	.3%	.0%	.7%	.0%
Apple Computer	.8	.8	.0	269	.3%	.9%	.0%	6.4%
Futurenet	.5	.0	.4	0	.2%	.0%	.4%	.0%
Tektronix	.2	.1	.1	3	.1%	.1%	.1%	.1%
Valid	.2	.1	.1	1	.1%	.1%	.1%	.0%

(Continued)

Market Share

TABLE NUMBER: 69 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
ECAD	.1	.0	.1	0	.0%	.0%	.0%	.0%
Other Companies	45.5	26.1	15.2	521	19.3%	29.5%	13.6%	12.4%
All Companies	235.6	88.3	111.6	4,211	100.0%	100.0%	100.0%	100.0%
 All U.S.-Based Companies	 131.2	 63.8	 44.9	 3,737	 55.7%	 72.2%	 40.2%	 88.7%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	104.4	24.5	66.7	474	44.3%	27.8%	59.8%	11.3%
All Hardware Companies	32.9	30.4	.0	2,063	14.0%	34.4%	.0%	49.0%
All Turnkey & SW Companies	202.7	58.0	111.6	2,149	86.0%	65.6%	100.0%	51.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 70
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Racal-Redac	37.1	1.1	30.6	122	24.9%	2.1%	42.3%	6.1%
Computervision	17.1	4.7	7.3	159	11.5%	8.8%	10.0%	8.0%
Calay	13.6	6.6	6.1	105	9.2%	12.4%	8.4%	5.3%
Hewlett-Packard	13.5	7.9	4.5	706	9.1%	14.8%	6.2%	35.5%
Mentor	10.1	4.2	4.1	162	6.8%	7.8%	5.7%	8.2%
Cadnetix	9.8	5.0	3.6	180	6.6%	9.3%	5.0%	9.0%
Scientific Calculations	4.6	.7	2.6	30	3.1%	1.3%	3.5%	1.5%
Apollo	3.2	2.8	.0	115	2.2%	5.3%	.0%	5.8%
Daisy	2.6	.4	1.6	17	1.7%	.7%	2.1%	.8%
Sun	2.1	1.8	.0	90	1.4%	3.4%	.0%	4.5%
Calma	2.0	.8	.3	17	1.3%	1.5%	.5%	.8%
Digital	1.6	1.3	.0	46	1.0%	2.4%	.0%	2.3%
ICL	.8	.6	.2	19	.6%	1.2%	.2%	1.0%
Silvar-Lisco	.6	.0	.6	0	.4%	.0%	.8%	.0%
IBM	.3	.2	.1	6	.2%	.3%	.1%	.3%
Valid	.2	.1	.1	1	.1%	.2%	.1%	.1%
Tektronix	.2	.1	.1	2	.1%	.1%	.1%	.1%
ECAD	.1	.0	.1	0	.0%	.0%	.1%	.0%
Other Companies	29.5	15.0	10.7	212	19.8%	28.3%	14.8%	10.6%
All Companies	148.9	53.2	72.4	1,988	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	68.1	30.1	24.9	1,545	45.8%	56.5%	34.4%	77.7%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	80.7	23.1	47.4	443	54.2%	43.5%	65.6%	22.3%
All Hardware Companies	7.1	6.2	.0	266	4.8%	11.7%	.0%	13.4%
All Turnkey & SW Companies	141.7	47.0	72.4	1,722	95.2%	88.3%	100.0%	86.6%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 71
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Scientific Calculations	10.7	2.0	5.5	17	23.3%	7.4%	50.4%	4.0%
Digital	10.3	8.8	.0	0	22.5%	32.2%	.0%	.0%
IBM	5.4	4.0	.7	62	11.7%	14.5%	6.4%	14.8%
Applicon	4.5	1.3	1.8	86	9.7%	4.8%	16.8%	20.7%
CADAM	1.3	.0	1.1	0	2.8%	.0%	10.5%	.0%
Calma	.9	.4	.1	6	1.9%	1.5%	.6%	1.5%
Daisy	.3	.0	.2	0	.7%	.0%	1.9%	.0%
Silvar-Lisco	.2	.0	.2	0	.5%	.0%	1.9%	.0%
Computervision	.2	.1	.0	2	.4%	.2%	.2%	.4%
Control Data	.1	.1	.0	0	.3%	.4%	.0%	.0%
Tektronix	.1	.0	.0	1	.2%	.1%	.3%	.3%
Other Companies	12.1	10.6	1.2	244	26.3%	38.8%	11.1%	58.4%
All Companies	46.1	27.2	10.8	417	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	43.4	26.1	9.6	395	94.2%	95.7%	88.9%	94.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	2.7	1.2	1.2	23	5.8%	4.3%	11.1%	5.5%
All Hardware Companies	19.9	18.3	.0	221	43.2%	67.2%	.0%	52.9%
All Turnkey & SW Companies	26.2	8.9	10.8	196	56.8%	32.8%	100.0%	47.1%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 72
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Racal-Redac	18.8	.0	16.0	0	46.1%	.0%	56.4%	.0%
Personal CAD Systems	5.9	.0	5.2	0	14.5%	.0%	18.2%	.0%
Compeq	3.4	3.4	.0	955	8.4%	43.0%	.0%	52.9%
IBM	2.1	1.8	.2	331	5.2%	22.6%	.8%	18.3%
Control Data	1.8	1.2	.3	144	4.4%	15.7%	1.1%	8.0%
Computervision	1.7	.2	1.3	29	4.2%	2.0%	4.5%	1.6%
Autodesk	1.1	.0	1.1	0	2.6%	.0%	3.7%	.0%
Daisy	.9	.1	.6	13	2.2%	1.3%	2.0%	.7%
Apple Computer	.8	.8	.0	269	1.8%	9.6%	.0%	14.9%
Futurenet	.5	.0	.4	0	1.1%	.0%	1.4%	.0%
Other Companies	3.8	.5	3.3	66	9.4%	5.8%	11.8%	3.7%
All Companies	40.7	7.9	28.4	1,806	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	19.7	7.7	10.3	1,797	48.4%	97.2%	36.4%	99.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	21.0	.2	18.1	9	51.6%	2.8%	63.6%	.5%
All Hardware Companies	5.9	5.9	.0	1,575	14.5%	74.1%	.0%	87.2%
All Turnkey & SW Companies	34.8	2.1	28.4	230	85.5%	25.9%	100.0%	12.8%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 73
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Zuken	35.8	18.7	12.5	287	15.9%	13.6%	19.7%	8.6%
Sharp System Products	16.3	6.8	7.9	85	7.2%	4.9%	12.5%	2.6%
NEC	15.4	7.6	6.2	160	6.8%	5.6%	9.8%	4.8%
Fujitsu	14.2	10.2	2.6	200	6.3%	7.5%	4.1%	6.0%
Hitachi	12.4	8.0	3.3	221	5.5%	5.8%	5.1%	6.6%
Asahi Optical (No OEM)	10.0	7.4	1.6	55	4.4%	5.4%	2.5%	1.6%
Racal-Redac	9.2	6.7	1.7	20	4.1%	4.9%	2.6%	.6%
IBM	9.1	6.8	.9	401	4.1%	5.0%	1.5%	12.0%
Digital	7.5	6.7	.0	33	3.3%	4.9%	.0%	1.0%
Toshiba (No OEM)	7.2	5.5	1.0	84	3.2%	4.0%	1.5%	2.5%
Scientific Calculations	5.6	4.1	1.0	15	2.5%	3.0%	1.5%	.5%
Computervision	5.5	3.1	1.3	37	2.5%	2.2%	2.1%	1.1%
Hitachi Zosen	4.4	1.6	2.4	29	2.0%	1.2%	3.8%	.9%
Mitsubishi Electric	3.5	2.2	1.0	43	1.6%	1.6%	1.5%	1.3%
Sun	3.0	2.8	.0	105	1.3%	2.0%	.0%	3.1%
Mentor	2.7	1.0	1.5	26	1.2%	.7%	2.3%	.8%
Apollo	2.4	2.4	.0	120	1.0%	1.7%	.0%	3.6%
Hewlett-Packard	2.3	1.3	.8	46	1.0%	.9%	1.3%	1.4%
Cadnetix	2.3	1.4	.7	36	1.0%	1.0%	1.2%	1.1%
Calma	2.2	1.0	1.0	15	1.0%	.7%	1.5%	.5%
Daisy	2.0	.9	.9	11	.9%	.7%	1.5%	.3%
Personal CAD Systems	1.4	.0	1.2	0	.6%	.0%	1.9%	.0%
CADAM	1.3	.0	1.1	0	.6%	.0%	1.8%	.0%
Calay	1.3	1.0	.2	12	.6%	.7%	.3%	.3%
Valid	1.2	.6	.6	32	.5%	.4%	.9%	1.0%
Autodesk	.7	.0	.7	0	.3%	.0%	1.2%	.0%
Compaq	.7	.7	.0	191	.3%	.5%	.0%	5.7%
Apple Computer	.3	.3	.0	111	.1%	.2%	.0%	3.3%
Applicon	.3	.2	.1	6	.1%	.1%	.1%	.2%
Control Data	.2	.1	.1	19	.1%	.1%	.1%	.6%

(Continued)

Market Share

TABLE NUMBER: 73 (Continued)
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
ECAD	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	44.6	28.2	11.1	935	19.8%	20.6%	17.6%	28.0%
All Companies	224.9	137.0	63.2	3,336	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	60.7	42.6	11.1	1,409	27.0%	31.1%	17.6%	42.3%
All Asian-Based Companies	153.6	86.8	50.1	1,894	68.3%	63.3%	79.3%	56.8%
All European-Based Companies	10.6	7.7	2.0	32	4.7%	5.6%	3.1%	1.0%
All Hardware Companies	29.6	26.7	.2	1,158	13.2%	19.5%	.2%	34.7%
All Turnkey & SW Companies	195.3	110.4	63.0	2,177	86.8%	80.5%	99.8%	65.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 74
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Sharp System Products	16.3	6.8	7.9	85	16.7%	12.2%	24.7%	8.7%
NEC	15.4	7.6	6.2	160	15.9%	13.7%	19.5%	16.4%
Racal-Redec	9.1	6.6	1.7	20	9.4%	11.9%	5.2%	2.0%
Asahi Optical (No OEM)	7.6	5.5	1.4	45	7.8%	9.8%	4.3%	4.6%
Scientific Calculations	4.9	3.6	.9	13	5.1%	6.4%	2.8%	1.3%
Computervision	4.4	2.6	1.0	29	4.6%	4.6%	3.1%	3.0%
Nitachi Zosen	4.4	1.6	2.4	29	4.5%	2.9%	7.5%	3.0%
Sun	3.0	2.8	.0	105	3.1%	5.0%	.0%	10.7%
Mentor	2.7	1.0	1.5	26	2.8%	1.7%	4.7%	2.7%
Apollo	2.4	2.4	.0	120	2.4%	4.2%	.0%	12.3%
Hewlett-Packard	2.3	1.3	.8	46	2.4%	2.3%	2.6%	4.7%
Calma	2.2	1.0	1.0	15	2.2%	1.7%	3.1%	1.6%
Daisy	2.0	.9	.9	11	2.1%	1.6%	2.9%	1.2%
Cadnetix	1.8	1.4	.3	36	1.9%	2.6%	1.0%	3.7%
Celcy	1.3	1.0	.2	12	1.3%	1.8%	.6%	1.2%
Valid	1.2	.6	.6	32	1.3%	1.0%	1.8%	3.2%
Digital	1.0	.9	.0	33	1.0%	1.6%	.0%	3.4%
Nitachi	.6	.6	.0	11	.6%	1.1%	.0%	1.1%
IBM	.4	.2	.1	7	.4%	.4%	.2%	.7%
ECAD	.0	.0	.0	0	.0%	.0%	.1%	.0%
Autodesk	.0	.0	.0	0	.0%	.0%	.0%	.0%
Other Companies	14.1	7.5	5.1	143	14.5%	13.5%	16.0%	14.6%
All Companies	97.1	55.6	31.8	979	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	28.3	18.5	6.9	481	29.2%	33.3%	21.7%	49.1%
All Asian-Based Companies	58.2	29.5	22.9	466	60.0%	53.1%	72.1%	47.6%
All European-Based Companies	10.5	7.6	2.0	32	10.9%	13.7%	6.2%	3.3%
All Hardware Companies	10.0	9.2	.2	385	10.3%	16.6%	.5%	39.3%
All Turnkey & SW Companies	87.0	46.4	31.7	595	89.7%	83.4%	99.5%	60.7%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 75
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Zuken	35.8	18.7	12.5	287	34.8%	27.3%	57.9%	31.3%
Fujitsu	14.2	10.2	2.6	200	13.8%	15.0%	11.9%	21.8%
Toshiba (No OEM)	7.2	5.5	1.0	84	7.0%	8.1%	4.5%	9.1%
IBM	6.6	4.9	.7	75	6.4%	7.2%	3.4%	8.2%
Digital	6.5	5.8	.0	0	6.3%	8.6%	.0%	.0%
Hitachi	5.6	4.0	1.0	40	5.4%	5.9%	4.7%	4.3%
Mitsubishi Electric	3.5	2.2	1.0	43	3.4%	3.3%	4.4%	4.7%
Asahi Optical (No OEM)	2.4	1.9	.2	10	2.3%	2.8%	1.0%	1.1%
CADAM	1.3	.0	1.1	0	1.2%	.0%	5.3%	.0%
Computervision	1.1	.5	.4	7	1.1%	.8%	1.7%	.8%
Scientific Calculations	.7	.5	.1	3	.6%	.7%	.3%	.3%
Applicon	.3	.2	.1	6	.3%	.2%	.2%	.7%
Other Companies	17.7	13.8	1.0	162	17.2%	20.2%	4.6%	17.7%
All Companies	102.7	68.2	21.5	917	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	25.4	20.9	1.2	192	24.8%	30.6%	5.5%	21.0%
All Asian-Based Companies	77.2	47.4	20.3	725	75.2%	69.4%	94.4%	79.0%
All European-Based Companies	.0	.0	.0	0	.0%	.0%	.1%	.0%
All Hardware Companies	16.7	14.8	.0	101	16.3%	21.7%	.0%	11.0%
All Turnkey & SW Companies	86.0	53.4	21.5	816	83.7%	78.3%	100.0%	89.0%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 76
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Asia
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Hitachi	6.3	3.4	2.3	170	24.9%	25.7%	22.7%	11.8%
IBM	2.2	1.7	.2	319	8.6%	12.9%	1.5%	22.2%
Personal CAD Systems	1.4	.0	1.2	0	5.6%	.0%	12.4%	.0%
Autodesk	.7	.0	.7	0	2.9%	.0%	7.4%	.0%
Compaq	.7	.7	.0	191	2.7%	5.1%	.0%	13.3%
Cadnetix	.5	.0	.4	0	1.8%	.0%	4.3%	.0%
Apple Computer	.3	.3	.0	111	1.2%	2.4%	.0%	7.7%
Control Data	.2	.1	.1	19	.9%	.8%	.6%	1.3%
Racal-Redac	.1	.1	.0	0	.3%	.5%	.0%	.0%
Other Companies	12.8	7.0	5.1	629	51.1%	52.6%	51.0%	43.7%
All Companies	25.1	13.2	9.9	1,439	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	6.9	3.3	3.0	736	27.6%	24.8%	30.7%	51.1%
All Asian-Based Companies	18.1	9.9	6.9	703	72.1%	74.8%	69.3%	48.9%
All European-Based Companies	.1	.1	.0	0	.3%	.5%	.0%	.0%
All Hardware Companies	2.9	2.6	.0	673	11.4%	20.0%	.0%	46.8%
All Turnkey & SW Companies	22.3	10.6	9.9	766	88.6%	80.0%	100.0%	53.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 77
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	1.8	1.6	.0	7	24.1%	30.9%	.0%	3.2%
Hewlett-Packard	1.1	.7	.3	56	14.1%	13.9%	16.8%	25.3%
IBM	.6	.5	.1	43	8.4%	9.5%	4.5%	19.2%
Personal CAD Systems	.6	.0	.5	0	8.1%	.0%	30.2%	.0%
Computervision	.3	.1	.1	3	4.3%	2.8%	5.0%	1.2%
Intergraph	.3	.2	.1	3	4.2%	4.0%	3.4%	1.3%
Calay	.3	.2	.0	2	3.3%	4.0%	2.2%	1.0%
Racal-Redac	.2	.0	.2	1	3.1%	.0%	11.2%	.2%
Valid	.2	.1	.1	2	3.0%	2.2%	5.6%	.8%
Apple Computer	.1	.1	.0	47	1.7%	2.6%	.0%	21.3%
Autodesk	.1	.0	.1	0	1.2%	.0%	5.0%	.0%
Futurenet	.1	.0	.1	0	.8%	.0%	2.8%	.0%
Control Data	.1	.0	.0	4	.7%	.4%	.6%	1.7%
CADAM	.0	.0	.0	0	.5%	.0%	2.2%	.0%
Other Companies	1.7	1.5	.2	55	22.5%	29.9%	10.6%	24.7%
All Companies	7.6	5.1	1.8	222	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	7.0	4.8	1.4	219	91.0%	95.6%	77.7%	98.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.7	.2	.4	3	9.0%	4.4%	22.3%	1.5%
All Hardware Companies	3.6	3.4	.0	144	47.6%	66.5%	.0%	64.8%
All Turnkey & SW Companies	4.0	1.7	1.8	78	52.4%	33.5%	100.0%	35.2%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 78
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Hewlett-Packard	1.1	.7	.3	56	43.2%	48.6%	40.0%	77.3%
Computervision	.3	.1	.1	2	12.0%	9.7%	9.3%	3.3%
Calay	.3	.2	.0	2	10.0%	13.9%	5.3%	3.2%
Digital	.2	.2	.0	7	9.6%	13.9%	.0%	9.7%
Valid	.2	.1	.1	2	9.2%	7.6%	13.3%	2.5%
Racal-Redac	.2	.0	.1	1	6.4%	.0%	17.3%	.7%
Intergraph	.1	.1	.0	1	4.0%	3.5%	4.0%	1.2%
IBM	.0	.0	.0	0	.8%	.0%	1.3%	.5%
Other Companies	.1	.0	.1	1	4.8%	2.8%	9.3%	1.6%
All Companies	2.5	1.4	.8	73	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	2.0	1.2	.5	70	79.6%	84.7%	68.0%	95.5%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.5	.2	.2	3	20.4%	15.3%	32.0%	4.5%
All Hardware Companies	.3	.2	.0	8	10.4%	15.3%	.0%	10.7%
All Turnkey & SW Companies	2.2	1.2	.8	65	89.6%	84.7%	100.0%	89.3%

Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 79
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	1.6	1.4	.0	0	44.0%	43.0%	.0%	.0%
IBM	.4	.3	.1	4	10.7%	8.9%	38.5%	10.7%
Intergraph	.2	.2	.0	2	6.0%	4.7%	23.1%	4.7%
CADAM	.0	.0	.0	0	1.1%	.0%	30.8%	.0%
Other Companies	1.4	1.4	.0	35	38.2%	43.4%	7.7%	84.5%
All Companies	3.6	3.2	.1	41	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	3.6	3.2	.1	41	99.5%	100.0%	92.3%	99.6%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.0	.0	.0	0	.5%	.0%	7.7%	.4%
All Hardware Companies	3.0	2.7	.0	35	81.6%	86.4%	.0%	84.1%
All Turnkey & SW Companies	.7	.4	.1	7	18.4%	13.6%	100.0%	15.9%

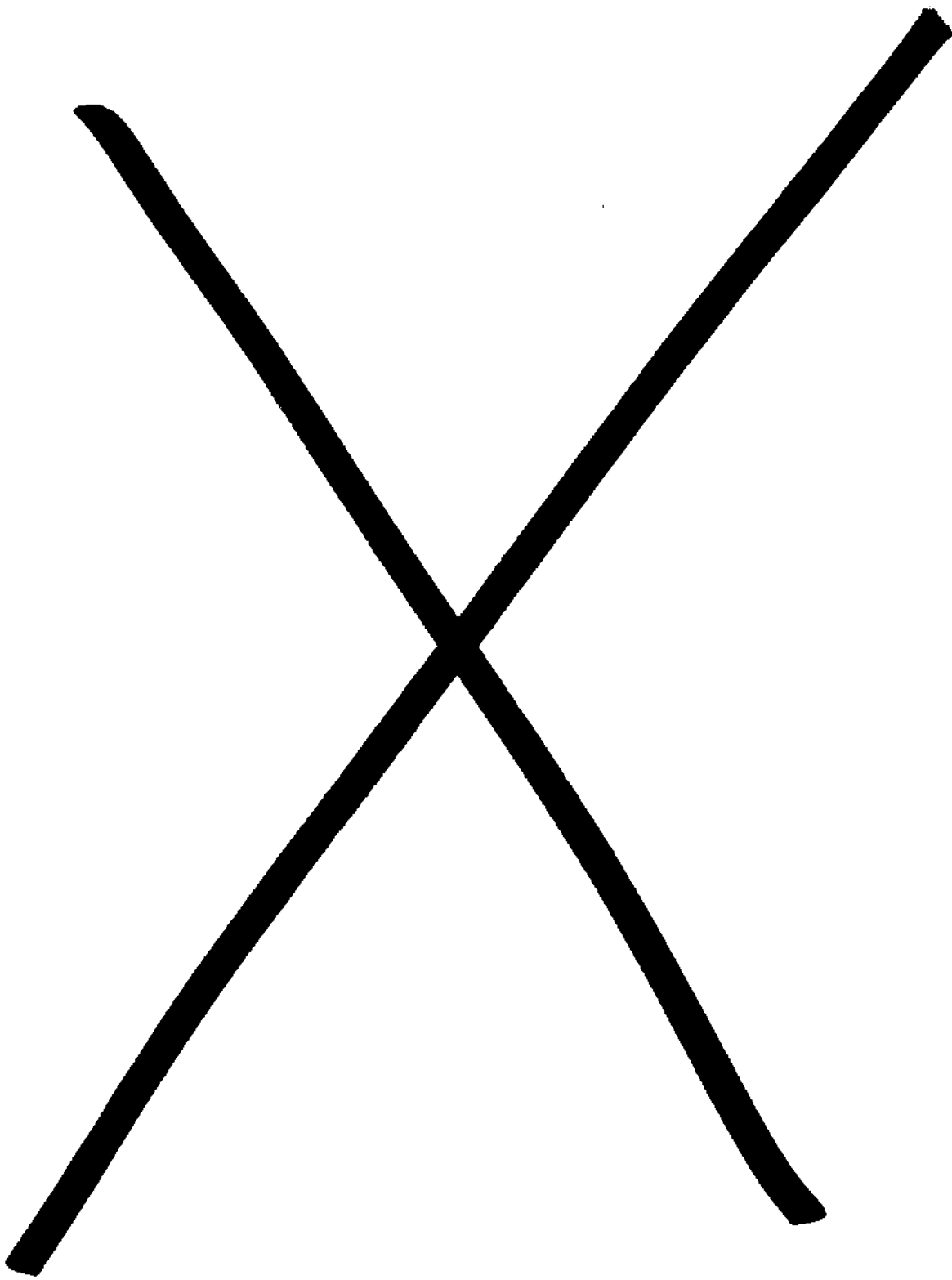
Source: Dataquest
 July 1988

Market Share

TABLE NUMBER: 80
 TITLE: 1987 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Personal CAD Systems	.6	.0	.5	0	41.3%	.0%	59.3%	.0%
IBM	.2	.2	.0	38	15.3%	44.4%	2.2%	35.0%
Apple Computer	.1	.1	.0	47	8.7%	28.9%	.0%	43.8%
Autodesk	.1	.0	.1	0	6.0%	.0%	9.9%	.0%
Racal-Redac	.1	.0	.1	0	5.3%	.0%	7.7%	.0%
Futurenet	.1	.0	.1	0	4.0%	.0%	5.5%	.0%
Control Data	.1	.0	.0	4	3.3%	4.4%	1.1%	3.4%
Computervision	.0	.0	.0	0	2.0%	.0%	2.2%	.2%
Other Companies	.2	.1	.1	19	14.0%	22.2%	12.1%	17.5%
All Companies	1.5	.5	.9	108	100.0%	100.0%	100.0%	100.0%
All U.S.-Based Companies	1.3	.5	.8	108	89.3%	100.0%	83.5%	100.0%
All Asian-Based Companies	.0	.0	.0	0	.0%	.0%	.0%	.0%
All European-Based Companies	.2	.0	.2	0	10.7%	.0%	16.5%	.0%
All Hardware Companies	.4	.4	.0	102	27.3%	91.1%	.0%	93.9%
All Turnkey & SW Companies	1.1	.0	.9	7	72.7%	8.9%	100.0%	6.1%

Source: Dataquest
 July 1988



Appendix G—Glossary

DATAQUEST CAD/CAM GLOSSARY

accelerator. Hardware used to increase throughput by decreasing processing time. An accelerator may be in the form of a plug-in board or a self-contained, standalone unit used in a network.

AEC. Architecture, engineering, and construction. See **facilities design**.

analog. Denotes the dominant component type, function(s), or circuit characteristics of a particular design. May include software-generated analog test instruments, such as oscilloscopes.

annual GDP growth. The percentage change in the gross domestic product (GDP), in local currency, from the previous year's GDP. This statistic allows one to view a country's growth independent of the dollar exchange rates.

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

A.S.E.A.N. (Association of Southeast Asian Nations). An international organization whose members include Brunei, Indonesia, Malaysia, Philippines, Singapore, and Thailand.

Asia. Includes China, Hong Kong, Japan, Korea, Singapore, and Taiwan.

ASIC. Application-specific integrated circuit.

automated mapping/facilities management (AM/FM). Software used to create and/or develop a digital map data base of corporate facility assets (AM) and the related software whose purpose is to efficiently and effectively manage the capital assets of the company through utilization of the digital data base.

average price per seat. The price a buyer pays for accessing a workstation or a CAD/CAM seat. (In the case of host-dependent systems, the system price takes into account the average workstation price and the average number of workstations per system. In the case of a technical workstation and personal computer-based workstation, there is a 1:1 ratio between the price of the system and the price of the workstation.)

average system selling price. The price a buyer pays for a CAD/CAM system, workstation, and all of the system's peripherals and software. (In the case of technical workstations and personal computer-based workstations, there is a 1:1 ratio between the price of the system and the price of the workstation.)

balance of payments. A double-entry accounting of the value of all exchanges and transfers of goods, services, capital loans, investments, and gold and international reserves between the public and private sectors of a given country and the rest of the world over a given time, usually one year. Balance of payments is divided into three accounts—current, capital, and the reserve and gold account.

balance of trade. The difference between the value of a country's exports and imports of *tangible goods* over a given period, usually one year.

balance on current account. See **current account**.

behavioral simulation. Simulation of ICs or systems that are based on high-level models, as opposed to gate, transistor, or switch-level models. Behavioral models can be of an entire section of an IC or system (e.g., I/O management) or of a specific complex component (e.g., a microprocessor or register).

block place and route. An IC design methodology for interconnecting large blocks in a design. The blocks can be made up of smaller cells or handcrafted custom blocks. A special placer positions the blocks to minimize the routing distances and optimize the IC performance. The blocks are then connected by a router or routers that takes into account the block topology.

bundled software revenue. The value of a turnkey system that is associated with application-related software.

CAD. Computer-aided design. The use of a computer for automated product design.

CAM. Computer-aided manufacturing. See **manufacturing automation**.

capacity utilization. The ratio of actual production output to potential production output, with existing plant, workers, and equipment.

capital account. Balance of payments category for the inward and outward flow of investment capital.

capital goods. All goods used for the *production* of other goods and services. See also **consumer goods**.

cell-based IC. An IC design methodology that allows creation of ICs or blocks within ICs from predefined cells that are placed and then routed together to create logic functions. See **block place and route**.

channel type. Identifies how CAD/CAM systems reach the end user; distinguishes the various distribution channels and marketing arrangements used when selling CAD/CAM systems.

c.i.f. Cost, insurance, and freight, or charged-in-full. For example, most nations record imports in terms of their c.i.f. value and exports in terms of f.o.b. (See f.o.b.)

circuit simulation. The process of simulating an IC at the switch, transistor, or device level. This is the most accurate form of IC verification. The best-known circuit simulator is SPICE, which was invented at Berkeley and is now available in the public domain. It is also available in enhanced forms from several suppliers.

compound annual growth rate (CAGR). Determines the average compound rate of growth over a specified period. (The formula used to calculate CAGR is (future value/present value) raised to the power of $(1/\text{number of years}) - 1$.)

consumer. An individual who buys goods and services for personal use, rather than for manufacturing, processing, or resale.

consumer goods. Products used directly to satisfy human needs or wants, such as food and clothing. The distinction between consumer and capital goods lies in how products are used rather than in the products themselves.

consumer price indices (CPI). Monthly measures by the U.S. Bureau of Labor Statistics of the average retail prices of products commonly bought by households, compared with the average prices of a selected base year.

consumption. Expenditures for durable goods, nondurable goods, and services.

copyright. An intangible right granted by statute to the author of certain works; a form of intellectual property.

Council for Mutual Economic Aid (Comecon). A council set up in 1949 to develop the member nations' economies for the purpose of achieving self-sufficiency. Members include: Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania, and the U.S.S.R. with outer Mongolia.

CPU installed base. The installed base of CPUs at the end of a given year, minus any system retirements. (This element takes into account current year system shipments, estimated current year system retirements, and previous year system population.)

CPU revenue. The portion of revenue derived from a system sale that is related to the value of the CPU. (In the case of technical workstations and personal computer-based workstations, CPU revenue and workstation revenue are equal.)

CPUs shipped. The unit number of systems shipped. (In the case of technical workstations and personal computers, there is a 1:1 ratio of systems shipped and workstations shipped.)

current account. Balance of payments category for goods and services. The difference between total exports and imports of goods and services is the balance on current account.

custom IC. A handcrafted IC that has been constructed for a specific use by designing at the polygon level.

dealer. A product reseller with storefront selling to end users. A dealer's primary added value is distribution; secondary added values are service, training, and support.

design rule checking. The process of verifying that an IC or board layout meets known fabrication tolerances. Examples of such tolerances or rules include trace-to-trace spacing, via adjacency, or trace-to-via spacing.

design service. An organization that creates and/or executes CAD designs for external customers.

deutsche mark. German currency.

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

disposable income. An individual's income remaining after any payments to government (taxes, fines) and thus available for either spending or saving.

distributor. (1) A wholesaler selling to dealers and large end users. Distributors primarily provide dealers and VARs with a warehouse of suitable inventory. (2) A company providing sales and product support services for another company that manufactures the product. Distributors in this case are usually based in a different country than the manufacturer.

documentation. A general term used to describe a large family of related documents, including drawings, specification or operation sheets, bills of materials, schematics, training manuals, technical illustrations, diagrams, or other documents. All or part of these documents may be created using CAD/CAM tools.

dollar. Currency term used for different currencies in Canada, Hong Kong, Singapore, Taiwan, and the United States.

drachma. Greek currency.

drafting. A process used to generate drawings in virtually all CAD/CAM applications.

drafting software. A program used to create mostly two-dimensional representations of a drawing or design. Drawings typically include noted information describing material, processing, and/or unusual manufacturing specifications.

DRC/ERC. Design rule check/electrical rule check.

durable goods. Items that yield their services over an extended period of time, generally three years or more. Durables are often divided into the categories of *producer durables* (e.g., metals, machinery, equipment) and *consumer durables* (e.g., automobiles, appliances).

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

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

electrical. Creation of a diagram of the logical arrangement of hardware in an electrical circuit/system using conventional component symbols.

electrical rule checking. A term used to describe two distinct types of design verification. ERC can refer to verifying that a final layout corresponds to the original design that was done prior to layout (netlist vs. layout). It can also refer to making sure that a logic design conforms to known process limitations (e.g., maximum fanout from a component). This second process is also called logic design rule checking (LDRC).

electronic testing. ECAE software applications used to create the test patterns that will be used during the manufacture of a product. Electronic test products include pattern editing, pattern generation, and fault grading or simulation.

escudo. Portuguese currency.

Europe. Includes Benelux countries, France, Italy, Scandinavian countries, United Kingdom, West Germany, and the rest of Europe.

European Economic Community (EEC). European countries that have joined together to form a common market. The 12 member nations include Belgium, Denmark, France, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, West Germany, and the United Kingdom. The EEC provides a common external tariff, a common agricultural policy, a joint transportation policy, and the free movement of goods, labor, and capital.

European Free Trade Association (EFTA). In principle similar to the EEC, EFTA members include Austria, Finland, Iceland, Norway, Sweden, and Switzerland. Member nations have eliminated all import duties originating from goods of its members. Free trade agreements exist between the EFTA and EEC, exempting most industrial products and certain processed agricultural products from import duties.

external debt. The total sum of a country's public and private debt owed to foreigners.

facilities design. Also known as *AEC and facilities design/management*. The use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and others associated with these disciplines to aid in designing buildings, power plants, process plants, ships, and other types of nondiscrete entities.

Far East. See Asia.

fault simulation. Also referred to as fault grading. A fault simulator is used to evaluate or grade the quality of test patterns relative to a design. Quality is determined by a measure of the coverage of the test vectors (i.e., the percent of the time that the patterns will identify potential errors in a circuit).

federal debt, federal deficit. See public debt, public deficit.

FEM/FEA. Finite element modeling/finite element analysis.

finite element analysis. Method for determining the structural integrity of a mechanical design by analyzing a finite element model to determine a structure's strength, safety, or performance characteristics. Typical applications include stress analysis, vibration analysis, acoustics, electromagnetics, and fluid/structure interaction.

finite element modeling. Creation of a mathematical model to represent a mechanical design by subdividing the design model into smaller and simpler elements, such as triangles or bricks, which are interconnected. The finite element model is composed of all interconnected elements, attributes such as material and thickness, as well as boundary conditions and loads.

fixed investment. Assets for production of goods or services that cannot be quickly converted into money without disrupting operations, such as plant and equipment.

flat pattern. The design and unfolding of a three-dimensional design of a sheet metal part.

f.o.b. (free on board). A term applied to the valuation of goods up to the point of embarkation; trade unit applied to exports.

franc (Fr). Currency term used in Belgium (BFr), France (FFr) and Switzerland (SFr). Different national francs trade at different exchange rates.

gate array. Software tools used to create ASICs. The gate array itself is a predefined pattern of transistors that a semiconductor supplier prefabricates on wafers. It is customized for users by interconnecting the transistors using one or more layers of metal.

geographic information systems (GIS). A computer-based technology, composed of hardware, software, and data used to capture, edit, display, and, most importantly, analyze geographic information.

geologic modeling. Software used to model the geology of the earth's surface and subsurface strata. Models may be several miles deep and are often used for geologic exploration.

goods. Tangible items of trade, such as automobiles or shoes. Merchandise.

gross domestic product (GDP). The market value of an economy's domestically produced goods and services. GDP is calculated as the gross national product (GNP) minus the net factor income from abroad. As used here, GDP is expressed in two ways: (1) in terms of 1980 US dollars and (2) in terms of a country's 1987 valuation of local currency. The 1987 GDP (\$US 1980) provides a basis for comparing the economic status of different countries, independent of short-term variations in exchange rates. The 1987 GDP (local currency) provides a basis for evaluating an individual country's growth, independent of the value of the US dollar in that country. From a CAD/CAM business perspective, this makes sense because most prices are set in local currency.

gross national product (GNP). GNP equals GDP plus the net of income accrued by domestic residents from investments abroad minus income earned in the domestic market by foreigners abroad.

gross national product deflator. A revision in the calculation of GNP derived by adjusting each component of GNP for price changes, then summing each into a weighted total. The result thus measures both changes in prices and shifts in consumption patterns.

group technology. A coding and classification system for combining similar, often-used parts into families to allow groups of similar parts to be retrieved, processed, and fabricated in an efficient, economical batch mode.

guilder. Currency used in The Netherlands; also known as gulden.

hardware revenue. The sum of revenue derived from the sale of CPUs, workstations, and peripherals.

host-dependent. A shared logic system in which the external workstations' functions are dependent on a host computer.

HVAC. Heating, ventilation, and air-conditioning design and analysis.

hybrids. A hybrid is made by putting several integrated circuit dies and/or passive components into a single package and interconnecting the dies inside of the package.

IC layout. Software tools that are used to create and validate physical implementations of an integrated circuit. IC layout tools include polygon editors for creating geometric data, symbolic editors, placement and routing (gate array, cell, and block), and DRC/ERC verification tools.

image processing. A variety of techniques for processing pictorial information by computer.

increase over prior year. Total revenue percent change over the prior year's total revenue. (The formula used for this calculation is (present year revenue minus previous year revenue) divided by previous year revenue.)

indirect channels. The sale of CAD/CAM equipment through independent dealers and distributors that do not contribute significant development or integration to the product. This channel is typically used for sales of personal computer-based CAD/CAM systems. Examples of indirect CAD/CAM suppliers include Businessland, ComputerLand, and National CAD Pro.

industrial production index. A monthly measure of the quantity of U.S. output in mining, manufacturing, and utilities industries compared with a base year and seasonally adjusted.

inflation. A sustained increase in the average level of all prices.

input devices. A variety of data entry devices, such as mice, digitizers, or scanners, that allow users to communicate with CAD/CAM systems.

intellectual property. The intangible product of intellectual, scientific or artistic creation associated with four bodies of law: copyright, patent, trade secret, and (in the United States and other countries) legislation providing specific protection for semiconductor mask designs.

internal debt. The total sum of a country's public and private debt owed to citizens of the same country.

International Monetary Fund (IMF). A fund established to provide international cooperation in the monetary field and the removal of foreign exchange restrictions, to stabilize exchange rates and to facilitate a multilateral payments system between member countries.

investment. Expenditures for capital goods.

invisibles. Items of foreign trade that are intangible, such as banking, insurance, tourism, and transportation. Unlike visibles, such items are not recognized by customs and until recently were not reported in trade statistics.

kinematics. An MCAE process for plotting or animating the motion of parts in a design. Kinematics simulation allows the motion of mechanisms to be studied for interference, acceleration, and force.

krona (SKr). Swedish currency.

krone. Currency term used to refer to Danish (DKr) and Norwegian (Nkr) currencies. The different krone trade at different exchange rates.

lira. Italian currency.

logic design automation. Tools used to automate the process of design specification and creation of electronic circuits, including behavioral/architectural tools, logic minimization, technology conversion, and automatic schematic synthesis/generation.

logic simulation. ECAE software that verifies the logic and timing behavior of a digital electronic design.

manufacturing. The process of producing finished goods; the people and equipment used to plan, build, and operate production, fabrication, assembly, and test equipment. It also refers to the use of CAD/CAM in the manufacturing process.

manufacturing automation. Use of a computer to aid and improve a manufacturing process.

manufacturing engineering. An organization responsible for the efficient design of the manufacturing process. It involves the design of tooling, fixtures, and procedures.

manufacturing process simulation. Computer-aided simulation of the manufacturing process. Numerical control, off-line robot, and coordinate measuring machine programming are examples of CAD/CAM manufacturing applications.

map compilation. Software used in the process of manually entering discrete spatial data items, including symbols and text, into a digital map file.

map conversion. Software that converts existing hard-copy maps to a computer data base.

mapping. Computer-aided tools that allow geographically related data to be captured, edited, analyzed, and managed. Typical users are civil and utility engineers, geophysicists, and geologists.

mechanical. Mechanical CAD/CAM is the application of computer-aided tools to design, analyze, document, and manufacture discrete parts, components, and assemblies.

mechanical computer-aided engineering (MCAE). The application of CAD/CAM tools for mechanical design and analysis. MCAE applications range from conceptual product design through detail product design and analysis, and supporting production product design. Commonly used MCAE products are solid modeling and finite element analysis technology.

mechanical testing. Software that combines and compares simulated test data with laboratory test data for further analysis prior to manufacture; includes modal analysis.

mechanisms. Software that models machinery capable of mechanical action. See **kinematics**.

mold design/analysis. Typically means design of plastic injection molds and analysis of material flow; can also include design and analysis of molds for any material.

nesting. Arrangement of multiple parts on a larger sheet or plate for optimum use of material.

net factor income from abroad. Income earned by residents of a country from labor supplied to foreign countries or from net claims on foreign assets.

newly industrializing nations (NIC). Reference to countries with GNPs that only recently show a significant industrial component, e.g., Hong Kong, Korea, People's Republic of China, Singapore, and Taiwan.

N.I.C. See **newly industrializing nations**.

nominal GDP/GNP. GDP/GNP valued in prices prevailing at the time of measurement. Year-to-year changes then reflect differences in both quantities and market prices.

nondurable goods. Items that yield their services over a short period of time, generally less than three years. Examples are food, clothing, paper, chemicals, petroleum, and rubber.

nonturnkey channels. These channels allow users to pick and choose individual system components (e.g., computers, software) and perform system integration to assemble complete CAD/CAM systems. Examples of vendors who sell components directly to end users include software vendors such as Futurenet, MacNeal-Schwendler, and PDA Engineering. Examples of nonturnkey hardware vendors include Apollo, Digital Equipment, and IBM.

North America. Includes the United States, Canada, and Mexico.

numerical control. A technique of simulating the operation of a machine tool. Also the process that generates the data or tapes necessary to guide a machine tool in the manufacture of a part.

Organization for Economic Cooperation and Development (OECD). The OECD arose from the European Recovery Program, originally set up to guide efficient distribution of U.S. aid to Europe following World War II. Under the original agreement, multilateral trading was reestablished along with a system of trade adjustments and restrictions. The organization's activities have more recently included freeing labor and capital payments. Member nations include: Austria, Belgium, Denmark, and France.

output devices. A variety of devices, such as plotters and printers, that make hard copies of designs, documentation, or analysis created on a CAD system.

patent. A legal monopoly granted to an inventor. The U.S. Patent Act defines patentable inventions as any new and useful process, machine, manufacture, or composition of matter.

PCB layout. Products that are used to create the layout of the traces and components to be placed on a printed circuit board.

penetration. The amount of the total available market (TAM) that is using a CAD/CAM system. It is expressed as either a ratio of the number of users per system or as a percent of TAM using a system.

peripherals revenue. The value of all peripherals of a system sale. (Peripherals include all hardware except the CPU itself and any associated workstations.)

personal computer. A single-user computer with a nonvirtual operating system whose networking, high-performance graphics, or multitasking capabilities are optional features rather than integrated capabilities. A personal computer's operating system is typically DOS, OS/2, or Apple's Macintosh System.

peseta. Spanish currency.

pipng. Software for design and analysis of a facility's pipe network.

platform. A group of computer products with common characteristics, i.e., the personal computer platform.

PLD. Programmable logic device. A type of application-specific IC that is user programmable rather than mask programmable. The function of a PLD is determined by blowing fuse links or programming memory devices to create the desired interconnections between the fixed logic elements on the device.

pound. Currency used in the United Kingdom.

private. Relating to individuals and businesses, rather than government.

producer price indices (PPI). Monthly measures by the U.S. Bureau of Labor Statistics of the prices of 2,800 representative commodities compared with those prices of a given base year.

production planning. Software used to plan for all factory resources of a manufacturing company.

public. Relating to local, state, or national governments.

public debt. The sum of debts outstanding of local, state, and national governments in a given country. Debt of the national government alone is the *national public debt* or *national debt*. In effect, the public debt is a measure of the extent to which government expenditures are financed by borrowing rather than taxation.

public deficit. Circumstance where government outlays for goods and services exceed receipts for a fiscal year.

real effective exchange rate. An exchange rate measure that takes into account inflation differences between countries. This is the exchange rate multiplied by the real exchange rate.

real exchange rate. The exchange rate between two currencies divided by the ratio of the price levels of the two countries.

real GDP/GNP. GDP/GNP valued in *constant* prices prevailing in a reference base year—1982 in this publication. Year-to-year changes thus reflect changes only in *quantities* produced.

real GDP growth rates. GDP growth, expressed as a percentage, here represents aggregates at 1980 prices and 1980 exchange rates. This measure factors out inflation.

recession. A broad downward movement of the economy over an extended time. Generally defined for the United States as two successive quarterly decreases in U.S. GNP.

renminbi. Internally traded currency of the People's Republic of China.

rest of world. Includes territories not included in North America, Europe, or the Far East.

retirement. The number of CPUs or workstations that are retired in any given year from general day-to-day CAD/CAM use. The retirement model takes into account product life cycles.

robotics. Programs for controlling robots.

schematic capture. Automated graphic design entry method that allows a designer to define the logic of a circuit to create a schematic design. Following schematic capture, a netlist (list of logic components and their logical connections) can be produced.

schilling. Austrian currency.

seasonal variation. A regularly recurring pattern of change in economic activity owing to factors such as periodic climate changes, holidays, and vacations. Seasonal variations are commonly adjusted for in the analysis of data to clarify overall trends.

server. A hardware device attached to a network to facilitate sharing or managing resources.

service revenue. Revenue derived from the service and support of CAD/CAM systems. (Service revenue does not include revenue from the portions of a company's business related to service bureaus or product designs.)

services. Intangible items of trade, such as education, transportation, banking, and legal and medical care.

shipment. Shipment estimates include only products actually delivered to paying customers, not the total number manufactured (the backlog).

silicon compilation. IC design methodology that employs high-level specifications to automatically generate the mask tooling as output. A silicon compiler is a layout system; silicon compilation is a design method.

site engineering. Software used for the modeling of the earth's surface, permitting the development of manipulated models to examine alternative designs for cut and fill operations.

software revenue. The sum of bundled and unbundled software revenue.

solid modeling. Representation of all the external and internal geometry of a part, allowing the solid nature of an object to be represented in a computer. Solid models are constructed in two ways: using primitive building blocks (constructive solid geometry) and/or using boundary definitions (boundary representation).

specification/assessment. Software that allows definition of high-level behavioral and performance characteristics of an electronic product.

structural. Software for modeling and analysis of the integrity of a structure.

surface-mount design. Design methodology that supports designs using surface-mount devices (SMDs). SMD is a type of IC package that can be attached to the surface of a PC board, as opposed to through-hole mounted devices.

system. Comprises many parts, including the computer, operating system, peripherals, graphics devices, and application software. (The lowest common denominator of a system is that it contains the CPU that runs the operating system. By this definition, technical workstations and personal computer-based workstations are also counted as systems.)

system revenue. Revenue derived from system sales. (System revenue does not include service revenue. System revenue is the sum of CPU revenue, workstation revenue, bundled software revenue, and peripherals revenue.)

technical publications. Software to create product information in a format suitable for use outside of the engineering and manufacturing environments. Products provide for merging of text and graphics; typical applications include operating/maintenance manuals and technical illustrations.

technical workstation. A single-user computer with a virtual, multitasking operating system designed to run high-performance graphic applications in a networked environment. A technical workstation's operating system is typically UNIX, VMS, or DOMAIN.

terms of trade. The ratio of the average price of a country's exports to the average price of its imports.

third-party software. Software sold directly to end users or resellers, as opposed to software that is a part of a turnkey system.

three-dimensional. A representation of the surface or edges of a design that contains X, Y, and Z coordinates.

total available market (TAM). The universe of technical professionals that could benefit from the use of a CAD/CAM system.

total revenue. Total CAD/CAM-related revenue received, measured in U.S. dollars. It is the sum of system, unbundled software, and service revenue. Total revenue as reported does not include revenue that a company may receive from products that are sold to another company for resale (OEM revenue).

total workstations shipped. The sum of workstations shipped.

trademark. The U.S. federal trademark laws define a trademark as "any word, name, symbol or device . . . used by a manufacturer or merchant to identify his goods"; a form of intellectual property.

turnkey. A complete CAD/CAM system that includes a computer, a graphics workstation, an operating system, application software, and any applicable peripherals. A turnkey sale also typically provides full system support, including system maintenance, product training, and software for applications support.

turnkey channels. The sale of a complete CAD/CAM system, including computers, graphic workstations, operating systems, applications software, and any applicable peripherals. A turnkey sale also typically provides full system support, including system maintenance, product training, and software or applications support. Turnkey vendors essentially act as systems integrators by integrating the various components into complete systems. Examples of turnkey CAD/CAM vendors include Computervision, Daisy Systems, IBM, Intergraph, Mentor, and Prime Computer.

unbundled software. See third-party software.

unbundled software revenue. Revenue derived from the sale of software only, or software that is not sold as part of a turnkey system. (Unbundled software is sold by software-only companies as well as by a growing number of turnkey companies.)

value-added reseller (VAR). A product reseller whose primary added value is to the product itself, in the form of software or integration. VARs typically operate from one geographic area, do not maintain a storefront, and sell a specific application solution to end users.

value-added tax (VAT). A general tax applied at each point of exchange of goods or services from production to final consumption. The tax is levied on the difference between the sale price of the goods and services and the cost of goods and services bought for use in production. The VAT is a form of indirect taxation applied by the EEC, used as a basis for contributing to the community budget.

visibles or visible goods. Tangible items of foreign trade.

workstation. Commonly referred to as a "seat," a workstation is where CAD/CAM activities are performed. It may be any one of the three platforms.

workstation installed base. The workstation installed base at the end of a given year, less any workstation retirements. (This element takes into account current year workstation shipments and retirements and the previous year workstation installed base.)

workstation revenue. Revenue derived from the sale of workstations that are used to graphically create, analyze, or manipulate designs. In the case of technical workstations and personal computers, CPU revenue and workstation revenue are equal.

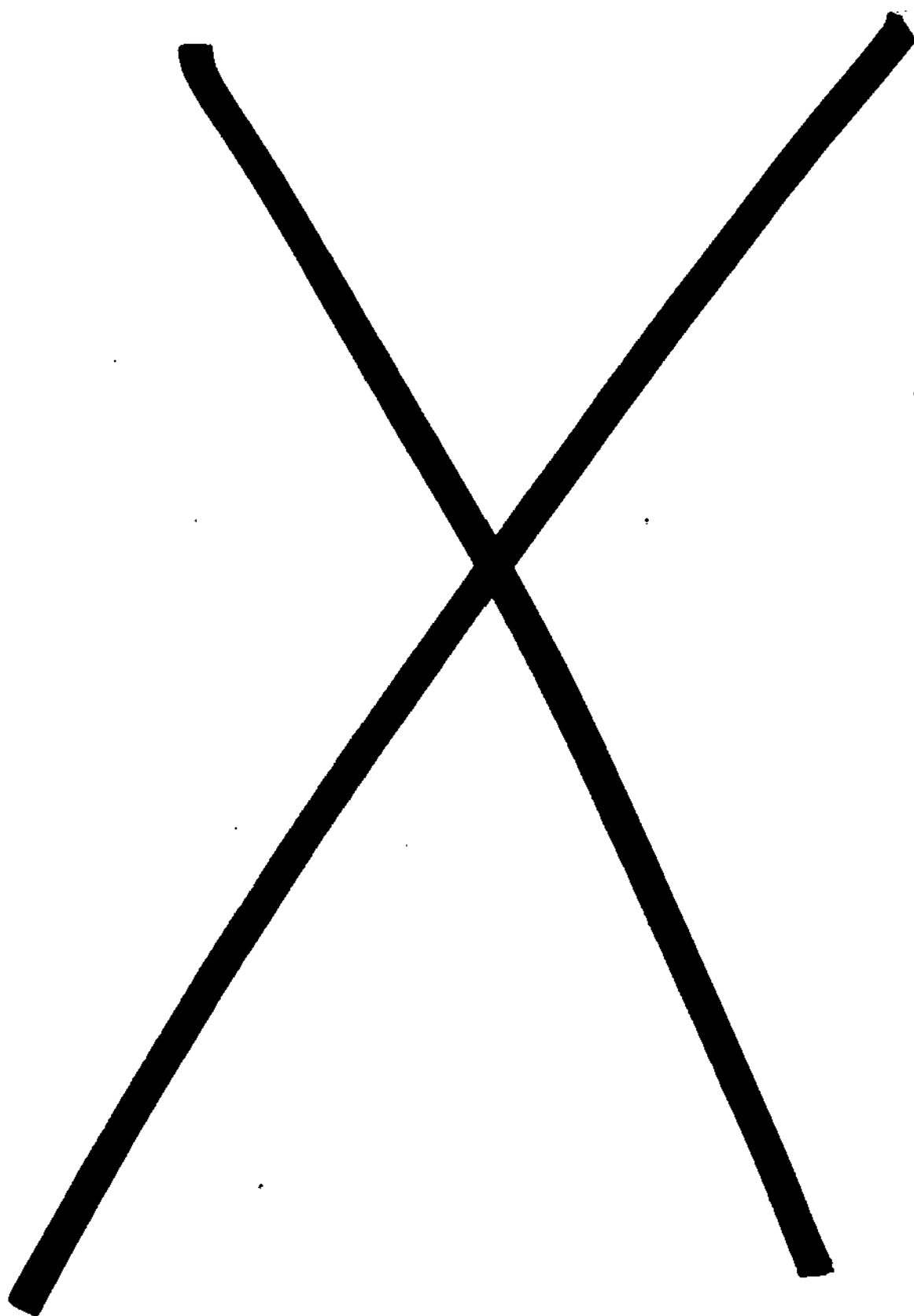
workstations shipped. The total number of workstations shipped as parts of systems. (In the case of technical workstations and personal computer-based workstations, there is a 1:1 ratio of system shipments and workstation shipments.)

workstations-shipped-to-date. The cumulative number of workstations shipped by a CAD/CAM vendor. This differs from installed base in that it does not take into account retirements.

World Bank, The. International bank with the purpose of encouraging capital investment for the reconstruction and development of its member countries, either by channeling the necessary private funds or by making loans. The bank began operations in June 1946 as a post-war reconstruction effort.

yen. Japanese currency.

yuan. The externally traded currency of the People's Republic of China.



Appendix L—Lotus Disks

DATA BASE WORKSHEETS

What You Are Getting

- Diskette containing CAD/CAM Industry Service's application forecast in Lotus format
- Hard copy of the tables—one set per application
- Directions on:
 - How to install the worksheet files
 - How to use the worksheet within Lotus
- A map of the worksheet format
- Hot line number
- Form for comments and suggestions
- Disclaimer

FORECAST DISKETTE

What Is on the Diskette

The Dataquest CAD/CAM Industry service is pleased to offer clients its forecast data base in Lotus format. The diskette you are receiving contains one or more Lotus worksheet files with the same forecast information as that published in Appendix A.

Why We Are Supplying Worksheets

By offering our forecast data base in electronic form, in addition to the published tables in the binders, clients can now easily use our data for a wide range of applications. Some suggestions follow:

- Reformatting Dataquest data for company reports
- Making presentation graphics
- Supplementing internally generated forecasts
- Comparing Dataquest forecasts with other forecasts

- Performing regression and other mathematical analysis
- Segmenting the data differently from the way Dataquest published it

HOW TO INSTALL THE WORKSHEET FILES

If using a PC with a hard disk, copy the files onto the hard disk into the appropriate directory (such as the directory in which Lotus 1-2-3 resides).

If using a PC with two floppy disk drives, make a copy of the worksheet files and work from your copy, *not* from the original files sent to you.

In any case, make a copy of the files and *do not* write over the original files from Dataquest. There is no write protection for these worksheets.

Keep the original Dataquest diskettes and this documentation in the jacket provided in the appropriate application module behind the blue tab marked "Appendix L—Lotus Disks."

HOW TO USE THE WORKSHEET WITHIN LOTUS 1-2-3

These directions assume a working knowledge of Lotus. They are intended to explain what Dataquest is providing and how to use it, not how to use Lotus.

Retrieving a File (/FR)

Once in an empty Lotus worksheet, retrieve the file in which you want to work. Depending on which application modules you subscribe to, and therefore which worksheets you have, the valid choices for retrieval once you are in Lotus are:

Module	File Name	Application
Industry Overview	ALL	All applications
Mechanical	MECH	Mechanical CAD/CAM
Facilities and Mapping	FD MAPP	Facilities Design Mapping
Electronic Design Automation	EDA	Electronic Design
	ECAE	Electronic CAE
	IC	IC Layout
	PCB	PCB Layout

What You See upon Retrieving a File

After the file is retrieved, you will automatically be sent to several screens, each of which asks you to page down for more information. These screens contain information about what is in the file and how to move around. Press the Home key to get to the beginning of the data.

What Is in the Worksheet

Line Items

First, refer to the "Worksheet Map" for a description of the worksheet. Once in the worksheet, you will see the same line items for all segments. The line items include the following data:

- Workstation Shipments
- Workstation Installed Base
- Average Price per Seat
- CPU Revenue
- Workstation Revenue
- Software Revenue
- Peripheral Revenue
- Service Revenue
- Total Revenue

Percentages

All data are for 1985 through 1991. The compound annual growth rate (CAGR) is shown for each line.

What Is the Menu Macro? (ALT M)

When you retrieve the worksheet, you are in control of a macro that shows you several screens about the worksheet. It then puts you into a custom Lotus menu that operates like the standard Lotus menu. You have four choices in this menu: Go To, View Graph, HP Print, and Quit. Each command is explained further.

Go To

Type in the appropriate response, and you can quickly and easily move around the worksheet. The menu will prompt you to choose one of the following named worksheet locations:

Name	Data for Segment:
WW	Worldwide
NA	North America
EUR	Europe
FE	Far East

(In addition to using the Menu Macro to move around the worksheet, you can use your cursor keys to move within the worksheet, or use page up and down, or use the home key. You can also just press the F5 function key (GOTO) and type in one of the ranges named above.)

View Graph

There are 12 predefined graphs; however, you need a graphics card to view them. The View Graph command asks you to select the graph, lets you view it, then returns you to the menu. The graph names and their contents are shown below:

Data by the Platform Segments (PT):

PTREV	Platform revenue
PTREV%	Platform revenue percent change
PTSHIP	Platform workstation shipments
PTSHIP%	Platform workstation shipments percent change

(The three platform segments are technical workstation (TW), host-dependent (HD), and personal computer (PC).)

Data by the Regional Segments (REG):

REGREV	Regional revenue
REGREV%	Regional revenue percent change
REGSHIP	Regional workstation shipments
REGSHIP%	Regional workstation shipments percent change

(The four regional segments are North America (NA), Europe (EUR), Far East (FE), and Rest of World (ROW).)

Data For Worldwide (WW):

WWREV	Worldwide revenue
WWREV%	Worldwide revenue percent change
WWSHIP	Worldwide workstation shipments
WWSHIP%	Worldwide workstation shipments percent change

HP Print

This command allows you to print the entire worksheet formatted for the HP Laser printer. Because of the printer setup strings in Lotus, this command works *only* with the HP Laser. (To print on another printer, you will have to manually change the setup strings, and possibly adjust the margins. The print command in the menu should then work.)

Quit

This command allows you to quit the Menu Macro and return control to yourself.

Note that to quit the worksheet, not the Menu Macro, type the normal Lotus command: \QY.

Remember, you can return to the Menu Macro at any time by pressing ALT M.

WORKSHEET MAP FORMAT

The data base worksheet format is as follows:

- Data: columns A through I, rows 12 through 248
- Percent Changes: columns K through P, rows 12 through 248
- Years: 1985 through 1991
- Segments:
 - Worldwide
 - Technical Workstation
 - Host-Dependent
 - Personal Computer

- North America
 - Technical Workstation
 - Host-Dependent
 - Personal Computer
- Europe
 - Technical Workstation
 - Host-Dependent
 - Personal Computer
- Far East
 - Technical Workstation
 - Host-Dependent
 - Personal Computer
- Rest of World
 - Technical Workstation
 - Host-Dependent
 - Personal Computer

Line Items for Each Segment Above

- Workstation Shipments
- Workstation Installed Base
- Average Price per Seat
- CPU Revenue
- Workstation Revenue
- Software Revenue
- Peripheral Revenue
- Service Revenue
- Total Revenue

DATA BASE WORKSHEETS DISCLAIMER

IMPORTANT MESSAGE—READ THIS

By accepting this worksheet file, you agree that Dataquest is not responsible for any changes that you may make to the data. If changes are made, Dataquest is no longer the source of the data.

You also agree that you will not divulge, publish, loan, give, sell, or permit anyone else to divulge, publish, loan, give, or sell copies of this data to any person outside your organization.

Dataquest's liability with respect to the data provided is limited to the following:

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HOT LINE INFORMATION

If your questions concern the data base format, calculations, or the worksheet and how to use it, call:

Beth Tucker Romig
CAD/CAM Industry Service
Dataquest Incorporated
(408) 971-9000, Ext. 257

If your questions concern the market, application, or the trends and assumptions used to develop the forecast data base, please call one of the following people in the CAD/CAM Industry Service:

Electronic Design Automation	Isadore Katz (408) 971-9000, Ext. 632
Mechanical CAD/CAM	Mike Seely (408) 971-9000, Ext. 600
Workstations	Dave Burdick (408) 971-9000, Ext. 274
Facilities Design or Mapping	Mike Gunville (408) 971-9000, Ext. 670

**DATAQUEST'S CAD/CAM INDUSTRY SERVICE
DATA BASE WORKSHEETS**

COMMENT AND SUGGESTION FORM

Please return to Dataquest

Name _____

Company _____

Application Modules _____

How useful is the Lotus formatted diskette?

_____ Very _____ Somewhat _____ Not at All

How often do you use the worksheet?

_____ Very _____ Somewhat _____ Not at All

What other information would you like contained in the worksheet?

What other comments do you have about the worksheet?

Return to: Beth Tucker Romig
CAD/CAM Industry Service
Dataquest Incorporated
1290 Ridder Park Drive
San Jose, California 95131

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE ALL PLATFORMS														
Wkstn Shipments	24,915	35,653	43,747	48,327	51,901	54,892	57,686	10.1%	43.1%	22.7%	10.5%	7.4%	5.8%	5.1%
Wkstn Installed Base	54,074	89,727	132,140	178,169	225,131	272,036	317,611	28.8%	65.9%	47.3%	34.8%	26.4%	20.8%	16.8%
Average Price Per Seat	52.6	39.8	32.7	28.9	26.3	24.3	22.8	-10.6%	-24.4%	-17.9%	-11.6%	-8.9%	-7.6%	-6.3%
CPU Revenue	485	592	603	595	582	570	558	-1.2%	22.2%	1.8%	-1.3%	-2.2%	-2.1%	-2.1%
Workstation Revenue	308	355	374	376	374	368	361	.3%	15.1%	5.4%	.6%	-.6%	-1.6%	-1.9%
Software Revenue	416	506	639	764	856	916	951	13.4%	21.6%	26.2%	19.6%	12.1%	7.0%	3.8%
Peripheral Revenue	196	187	204	218	232	249	268	7.5%	-4.6%	9.4%	6.8%	6.5%	7.1%	7.6%
Service Revenue	168	211	292	358	422	482	537	20.5%	25.6%	38.3%	22.7%	17.7%	14.3%	11.5%
Total Revenue	1,569	1,851	2,112	2,312	2,466	2,585	2,674	7.6%	17.9%	14.1%	9.5%	6.7%	4.8%	3.5%
WORLDWIDE TECHNICAL WORKSTATION														
Wkstn Shipments	8,720	12,691	16,665	20,262	23,883	27,428	30,828	19.4%	45.5%	31.3%	21.6%	17.9%	14.8%	12.4%
Wkstn Installed Base	16,827	29,517	46,007	65,864	88,100	112,540	138,423	36.2%	75.4%	55.9%	43.2%	33.8%	27.7%	23.0%
Average Price Per Seat	66.8	52.1	42.3	35.8	31.1	27.5	24.8	-13.8%	-22.0%	-18.8%	-15.4%	-13.1%	-11.6%	-9.8%
CPU Revenue	131	188	211	226	238	245	250	5.9%	42.9%	12.7%	7.1%	5.0%	3.1%	1.7%
Workstation Revenue	131	187	211	226	238	245	250	5.9%	42.5%	13.0%	7.1%	5.0%	3.1%	1.7%
Software Revenue	249	273	358	457	534	588	622	18.0%	9.6%	31.5%	27.4%	16.9%	10.1%	5.9%
Peripheral Revenue	88	90	106	119	134	149	166	13.0%	2.8%	17.5%	13.1%	12.2%	11.5%	11.1%
Service Revenue	73	101	148	195	242	289	333	26.8%	39.5%	45.8%	32.1%	24.1%	19.1%	15.3%
Total Revenue	671	838	1,035	1,224	1,386	1,516	1,621	14.1%	24.9%	23.4%	18.3%	13.2%	9.4%	6.9%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE HOST-DEPENDENT														
Wkstn Shipments	3,711	3,425	3,571	3,434	3,323	3,222	3,119	-1.9%	-7.7%	4.3%	-3.8%	-3.2%	-3.0%	-3.2%
Wkstn Installed Base	18,991	22,416	24,910	27,062	28,799	30,270	31,374	7.0%	18.0%	11.1%	8.6%	6.4%	5.1%	3.6%
Average Price Per Seat	157.4	171.9	149.5	141.6	134.6	130.8	128.7	-5.6%	9.2%	-13.0%	-5.3%	-4.9%	-2.8%	-1.6%
CPU Revenue	300	344	318	294	272	257	245	-6.6%	14.9%	-7.6%	-7.6%	-7.4%	-5.4%	-4.7%
Workstation Revenue	123	107	89	75	64	55	48	-14.8%	-12.7%	-16.8%	-16.2%	-14.6%	-13.2%	-13.0%
Software Revenue	95	111	125	133	138	142	143	5.2%	17.7%	12.3%	6.1%	4.2%	2.3%	1.4%
Peripheral Revenue	103	84	83	82	82	83	86	.3%	-18.5%	-1.2%	-.9%	-.7%	1.8%	2.7%
Service Revenue	92	89	122	133	143	151	157	12.0%	-2.6%	36.5%	9.5%	7.0%	5.6%	4.2%
Total Revenue	712	736	737	717	699	688	679	-1.6%	3.4%	-.1%	-2.7%	-2.6%	-1.5%	-1.3%
WORLDWIDE PERSONAL COMPUTER														
Wkstn Shipments	12,484	19,538	23,511	24,631	24,694	24,241	23,739	4.0%	56.5%	20.3%	4.8%	.3%	-1.8%	-2.1%
Wkstn Installed Base	18,256	37,794	61,224	85,242	108,232	129,226	147,814	31.4%	107.0%	62.0%	39.2%	27.0%	19.4%	14.4%
Average Price Per Seat	11.6	8.7	8.1	7.5	7.0	6.6	6.2	-6.6%	-25.0%	-6.9%	-7.4%	-6.7%	-5.7%	-6.1%
CPU Revenue	54	60	73	75	72	67	63	.9%	12.1%	21.5%	2.3%	-3.5%	-7.0%	-6.3%
Workstation Revenue	54	60	73	75	72	67	63	.9%	12.0%	21.5%	2.3%	-3.5%	-7.0%	-6.3%
Software Revenue	73	122	155	175	184	187	185	8.7%	67.7%	27.2%	12.4%	5.4%	1.5%	-1.0%
Peripheral Revenue	5	13	15	16	16	16	16	5.2%	156.4%	22.6%	5.2%	1.4%	-1.5%	.1%
Service Revenue	4	20	22	30	36	42	47	18.2%	448.3%	8.6%	33.2%	23.0%	16.1%	11.6%
Total Revenue	186	276	339	370	382	380	374	6.3%	48.6%	23.1%	9.1%	3.0%	-.5%	-1.4%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA ALL PLATFORMS														
Wkstn Shipments	16,597	20,377	22,741	24,101	25,166	25,966	26,745	5.6%	22.8%	11.6%	6.0%	4.4%	3.2%	3.0%
Wkstn Installed Base	35,964	56,340	78,329	101,119	123,547	145,176	165,514	24.1%	56.7%	39.0%	29.1%	22.2%	17.5%	14.0%
Average Price Per Seat	45.2	33.0	25.6	22.1	19.8	18.3	17.2	-12.2%	-27.0%	-22.5%	-13.5%	-10.7%	-7.5%	-5.9%
CPU Revenue	266	301	254	235	218	206	198	-8.1%	13.3%	-15.5%	-7.5%	-7.2%	-5.5%	-4.2%
Workstation Revenue	175	168	145	135	128	123	120	-6.5%	-3.9%	-13.6%	-7.1%	-4.9%	-3.7%	-2.9%
Software Revenue	251	254	332	395	439	468	485	13.8%	1.2%	30.7%	18.9%	11.2%	6.7%	3.6%
Peripheral Revenue	121	90	86	87	88	92	98	1.6%	-25.5%	-4.7%	.8%	1.8%	4.2%	6.0%
Service Revenue	100	110	136	157	176	194	210	13.9%	10.1%	24.4%	15.2%	12.1%	10.1%	8.4%
Total Revenue	913	924	954	1,009	1,050	1,084	1,111	3.8%	1.2%	3.3%	5.7%	4.1%	3.3%	2.5%
NORTH AMERICA TECHNICAL WORKSTATION														
Wkstn Shipments	5,746	6,784	7,878	9,005	10,136	11,247	12,323	12.7%	18.1%	16.1%	14.3%	12.6%	11.0%	9.6%
Wkstn Installed Base	11,454	18,238	26,013	34,798	44,063	53,812	63,760	28.4%	59.2%	42.6%	33.8%	26.6%	22.1%	18.5%
Average Price Per Seat	62.3	46.2	37.0	31.0	26.8	23.9	21.7	-14.0%	-25.8%	-19.9%	-16.2%	-13.5%	-10.8%	-9.2%
CPU Revenue	78	92	87	87	86	86	86	-1.3%	18.1%	-4.7%	-.8%	-.3%	-.2%	-.3%
Workstation Revenue	78	91	87	87	86	86	86	-1.2%	17.7%	-4.3%	-.8%	-.3%	-.2%	-.3%
Software Revenue	159	138	180	229	265	290	306	17.3%	-13.3%	30.8%	26.9%	15.7%	9.5%	5.5%
Peripheral Revenue	56	41	44	46	49	53	58	7.2%	-27.3%	7.1%	4.9%	6.8%	8.2%	9.2%
Service Revenue	43	53	70	86	101	116	129	19.4%	23.4%	30.5%	23.2%	17.8%	14.5%	11.8%
Total Revenue	414	415	468	534	588	631	665	9.9%	.4%	12.9%	14.0%	10.0%	7.4%	5.4%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
NORTH AMERICA HOST-DEPENDENT														
Wkstn Shipments	1,983	1,519	1,396	1,299	1,225	1,170	1,130	-5.7%	-23.4%	-8.1%	-7.0%	-5.7%	-4.5%	-3.4%
Wkstn Installed Base	11,147	12,665	13,451	14,048	14,450	14,733	14,888	3.3%	13.6%	6.2%	4.4%	2.9%	2.0%	1.1%
Average Price Per Seat	149.3	186.5	162.9	154.1	143.6	136.5	131.6	-6.7%	24.9%	-12.6%	-5.4%	-6.8%	-4.9%	-3.6%
CPU Revenue	149	179	143	127	112	101	93	-12.3%	19.8%	-20.3%	-11.0%	-12.1%	-9.7%	-7.7%
Workstation Revenue	58	46	33	26	21	18	15	-20.0%	-20.9%	-27.5%	-20.5%	-19.1%	-17.0%	-15.5%
Software Revenue	50	52	68	73	76	78	79	8.8%	3.9%	30.7%	7.9%	4.3%	2.3%	1.3%
Peripheral Revenue	63	47	37	36	35	35	35	-5.6%	-25.8%	-20.3%	-2.8%	-4.1%	-1.9%	1.6%
Service Revenue	54	47	57	59	61	62	64	6.3%	-13.1%	21.1%	4.4%	3.0%	2.4%	1.8%
Total Revenue	374	370	338	322	305	294	286	-5.1%	-1.1%	-8.8%	-4.6%	-5.3%	-3.8%	-2.7%
NORTH AMERICA PERSONAL COMPUTER														
Wkstn Shipments	8,868	12,074	13,467	13,797	13,806	13,549	13,292	1.9%	36.2%	11.5%	2.4%	.1%	-1.9%	-1.9%
Wkstn Installed Base	13,363	25,437	38,865	52,273	65,033	76,631	86,866	27.8%	90.4%	52.8%	34.5%	24.4%	17.8%	13.4%
Average Price Per Seat	10.8	6.2	4.7	3.9	3.6	3.4	3.3	-11.8%	-42.6%	-24.2%	-17.0%	-7.7%	-5.6%	-2.9%
CPU Revenue	39	31	25	22	20	19	19	-9.4%	-21.4%	-20.3%	-11.5%	-5.9%	-4.6%	-3.4%
Workstation Revenue	39	31	25	22	20	19	19	-9.4%	-21.4%	-20.3%	-11.5%	-5.9%	-4.6%	-3.4%
Software Revenue	42	64	84	93	98	100	100	9.2%	52.6%	30.3%	10.3%	5.5%	2.5%	-.1%
Peripheral Revenue	2	3	5	5	5	5	5	11.6%	36.8%	84.6%	-8.3%	-1.3%	.6%	2.8%
Service Revenue	2	9	10	12	14	16	17	12.7%	283.7%	5.5%	20.5%	16.1%	12.4%	9.7%
Total Revenue	125	138	148	153	157	160	160	2.9%	10.6%	7.1%	3.2%	2.9%	1.5%	.1%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE ALL PLATFORMS														
Wkstn Shipments	4,913	7,819	9,366	10,494	11,530	12,402	13,190	11.0%	59.1%	19.8%	12.0%	9.9%	7.6%	6.4%
Wkstn Installed Base	8,832	16,650	25,814	35,916	46,492	57,270	67,924	32.5%	88.5%	55.0%	39.1%	29.4%	23.2%	18.6%
Average Price Per Seat	61.5	42.6	32.2	26.7	22.8	19.9	17.7	-16.1%	-30.7%	-24.3%	-17.2%	-14.6%	-12.5%	-11.4%
CPU Revenue	115	131	114	107	101	95	90	-7.3%	14.3%	-12.8%	-6.7%	-5.9%	-5.5%	-5.5%
Workstation Revenue	68	84	82	78	74	70	66	-4.6%	23.1%	-2.5%	-4.7%	-4.5%	-5.3%	-6.0%
Software Revenue	97	136	170	211	242	259	267	14.5%	39.8%	25.0%	24.2%	14.5%	7.0%	3.3%
Peripheral Revenue	41	40	44	45	46	48	49	4.0%	-1.9%	9.5%	2.0%	2.6%	3.0%	3.2%
Service Revenue	44	56	68	83	98	111	122	16.9%	26.9%	22.1%	22.7%	17.0%	13.2%	10.1%
Total Revenue	365	447	478	524	560	582	594	5.9%	22.4%	7.0%	9.6%	6.9%	3.9%	2.0%
EUROPE TECHNICAL WORKSTATION														
Wkstn Shipments	1,673	3,535	4,886	6,000	7,066	8,060	8,964	20.5%	111.3%	38.2%	22.8%	17.8%	14.1%	11.2%
Wkstn Installed Base	3,472	7,008	11,849	17,732	24,348	31,567	39,125	41.1%	101.8%	69.1%	49.6%	37.3%	29.6%	23.9%
Average Price Per Seat	77.6	56.0	41.9	33.3	27.2	22.7	19.3	-19.2%	-27.8%	-25.2%	-20.5%	-18.3%	-16.5%	-15.0%
CPU Revenue	30	55	61	61	60	58	55	.1%	80.5%	11.2%	.7%	-1.7%	-3.6%	-5.1%
Workstation Revenue	30	55	61	61	60	58	55	.2%	80.2%	11.4%	.7%	-1.7%	-3.6%	-5.1%
Software Revenue	53	84	107	138	163	178	187	17.3%	58.1%	26.8%	29.8%	18.1%	9.2%	4.7%
Peripheral Revenue	19	26	31	33	35	36	38	7.8%	38.3%	18.5%	7.1%	5.7%	4.6%	3.9%
Service Revenue	18	31	44	58	71	83	93	24.8%	71.2%	42.5%	31.8%	22.5%	16.8%	12.6%
Total Revenue	150	250	303	351	389	413	428	11.4%	66.1%	21.2%	16.1%	10.8%	6.2%	3.5%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE MOST-DEPENDENT														
Wkstn Shipments	802	653	566	512	478	454	437	-7.7%	-18.6%	-13.3%	-9.5%	-6.8%	-5.0%	-3.7%
Wkstn Installed Base	2,270	2,922	3,352	3,697	3,960	4,176	4,339	8.2%	28.8%	14.7%	10.3%	7.1%	5.5%	3.9%
Average Price Per Seat	173.7	159.8	130.5	120.0	111.5	106.1	102.5	-8.5%	-8.0%	-18.3%	-8.0%	-7.1%	-4.9%	-3.3%
CPU Revenue	75	67	45	38	33	30	28	-15.7%	-11.4%	-32.8%	-15.0%	-12.3%	-8.9%	-6.7%
Workstation Revenue	29	19	12	9	7	6	5	-24.7%	-32.2%	-38.2%	-24.6%	-21.6%	-19.1%	-18.2%
Software Revenue	23	21	27	30	32	33	34	10.1%	-6.9%	27.9%	9.8%	7.3%	4.2%	3.0%
Peripheral Revenue	21	12	12	10	10	10	10	-3.6%	-43.4%	-1.5%	-9.3%	-6.2%	-1.9%	1.1%
Service Revenue	25	19	20	20	21	21	21	2.3%	-24.9%	4.4%	3.3%	1.7%	1.3%	.7%
Total Revenue	172	138	115	107	103	100	98	-6.6%	-20.1%	-16.6%	-6.5%	-4.5%	-2.8%	-1.8%
EUROPE PERSONAL COMPUTER														
Wkstn Shipments	2,438	3,631	3,914	3,981	3,986	3,888	3,789	.9%	48.9%	7.8%	1.7%	.1%	-2.5%	-2.5%
Wkstn Installed Base	3,089	6,720	10,613	14,487	18,184	21,527	24,460	29.5%	117.5%	57.9%	36.5%	25.5%	18.4%	13.6%
Average Price Per Seat	13.6	8.5	5.8	4.6	4.2	4.0	3.9	-14.4%	-37.5%	-31.8%	-20.7%	-8.7%	-4.8%	-2.5%
CPU Revenue	9	10	9	7	7	7	6	-8.3%	7.1%	-9.6%	-15.1%	-7.1%	-5.6%	-3.8%
Workstation Revenue	9	10	9	7	7	7	6	-8.3%	7.1%	-9.6%	-15.1%	-7.1%	-5.6%	-3.8%
Software Revenue	22	31	37	43	47	47	46	8.5%	43.7%	18.2%	18.5%	7.9%	1.4%	-1.9%
Peripheral Revenue	2	3	2	2	2	2	2	-9.7%	61.4%	-29.9%	-11.7%	-3.0%	-1.2%	1.3%
Service Revenue	1	6	5	5	6	7	8	4.3%	539.2%	-26.0%	19.0%	14.8%	11.8%	9.1%
Total Revenue	42	59	61	65	68	69	68	2.9%	40.1%	2.4%	7.8%	4.7%	.9%	-1.1%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST ALL PLATFORMS														
Wkstn Shipments	3,032	6,595	10,363	12,144	13,312	14,340	15,296	18.3%	117.5%	57.1%	17.2%	9.6%	7.7%	6.7%
Wkstn Installed Base	5,036	11,631	21,815	33,584	45,967	58,686	71,372	43.7%	131.0%	87.6%	53.9%	36.9%	27.7%	21.6%
Average Price Per Seat	79.6	54.9	47.1	43.3	40.7	38.2	36.1	-8.1%	-31.0%	-14.2%	-8.1%	-6.1%	-6.1%	-5.7%
CPU Revenue	96	126	207	225	235	239	241	13.8%	31.6%	63.9%	9.0%	4.2%	2.0%	.7%
Workstation Revenue	61	92	135	150	156	157	156	11.3%	50.2%	47.3%	10.9%	4.2%	.6%	-.5%
Software Revenue	66	112	123	141	153	161	167	8.4%	70.5%	10.4%	13.9%	8.7%	5.7%	3.7%
Peripheral Revenue	30	52	65	76	86	96	106	15.5%	69.7%	26.4%	16.9%	13.0%	11.4%	10.4%
Service Revenue	22	39	71	99	125	151	175	35.2%	77.4%	84.3%	38.3%	27.1%	20.5%	15.8%
Total Revenue	271	420	602	690	755	805	845	15.0%	54.8%	43.3%	14.8%	9.4%	6.6%	5.1%
FAR EAST TECHNICAL WORKSTATION														
Wkstn Shipments	1,125	1,860	3,042	4,104	5,226	6,367	7,499	32.2%	65.3%	63.6%	34.9%	27.3%	21.8%	17.8%
Wkstn Installed Base	1,695	3,555	6,575	10,624	15,590	21,442	28,023	51.1%	109.7%	84.9%	61.6%	46.7%	37.5%	30.7%
Average Price Per Seat	78.2	71.5	60.5	52.7	46.2	40.8	36.7	-12.5%	-8.6%	-15.4%	-12.9%	-12.3%	-11.7%	-10.0%
CPU Revenue	21	35	56	69	79	86	92	21.6%	63.6%	61.5%	23.1%	15.0%	9.5%	6.3%
Workstation Revenue	21	34	56	69	79	86	92	21.7%	63.5%	61.7%	23.1%	15.0%	9.5%	6.3%
Software Revenue	35	49	64	80	92	102	109	17.6%	37.2%	32.3%	23.9%	15.7%	10.7%	7.2%
Peripheral Revenue	12	22	28	36	44	51	60	21.8%	93.2%	23.7%	29.0%	22.3%	18.1%	16.0%
Service Revenue	10	15	30	45	61	77	93	44.3%	43.7%	103.8%	48.4%	34.9%	26.8%	21.0%
Total Revenue	100	155	234	298	354	403	446	23.6%	55.5%	51.0%	27.3%	19.1%	13.8%	10.6%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST HOST-DEPENDENT														
Wkstn Shipments	875	1,109	1,445	1,452	1,449	1,434	1,400	4.8%	26.7%	30.3%	.5%	-.2%	-1.0%	-2.4%
Wkstn Installed Base	1,781	2,890	4,199	5,441	6,571	7,612	8,502	24.1%	62.3%	45.3%	29.6%	20.8%	15.8%	11.7%
Average Price Per Seat	158.9	150.2	139.7	135.6	133.4	133.7	134.8	-2.1%	-5.5%	-7.0%	-3.0%	-1.6%	.2%	.8%
CPU Revenue	70	72	111	111	111	112	112	9.1%	4.0%	54.1%	-.1%	-.0%	.7%	-.3%
Workstation Revenue	35	38	40	36	32	29	27	-6.8%	9.1%	4.7%	-10.1%	-9.3%	-8.9%	-9.7%
Software Revenue	21	38	28	27	27	27	27	-6.4%	77.5%	-26.4%	-2.0%	.0%	-.1%	-.4%
Peripheral Revenue	18	22	29	31	33	35	37	10.5%	25.6%	32.1%	5.2%	5.4%	6.6%	5.4%
Service Revenue	11	19	33	42	49	55	60	25.5%	71.8%	74.9%	24.6%	16.7%	12.6%	9.0%
Total Revenue	154	189	242	247	252	258	262	6.7%	22.7%	27.7%	2.1%	2.1%	2.4%	1.3%
FAR EAST PERSONAL COMPUTER														
Wkstn Shipments	1,032	3,626	5,876	6,588	6,637	6,540	6,397	12.0%	251.4%	62.0%	12.1%	.7%	-1.5%	-2.2%
Wkstn Installed Base	1,560	5,186	11,041	17,519	23,806	29,631	34,847	46.4%	232.5%	112.9%	58.7%	35.9%	24.5%	17.6%
Average Price Per Seat	14.0	17.2	17.5	17.1	16.2	14.8	13.8	-4.3%	22.9%	1.7%	-2.3%	-5.3%	-8.6%	-6.8%
CPU Revenue	5	19	40	45	45	41	38	14.3%	268.3%	105.2%	14.8%	-1.7%	-8.4%	-8.2%
Workstation Revenue	5	19	40	45	45	41	38	14.3%	268.3%	105.2%	14.8%	-1.7%	-8.4%	-8.2%
Software Revenue	9	25	31	34	33	32	31	4.0%	186.5%	23.2%	7.3%	-.8%	-3.4%	-3.7%
Peripheral Revenue	1	7	8	10	10	10	10	6.4%	504.3%	16.7%	17.7%	3.4%	-2.5%	-1.3%
Service Revenue	0	5	8	12	16	19	22	36.4%	1453.3%	61.2%	58.9%	33.7%	21.0%	14.1%
Total Revenue	17	76	126	146	149	143	138	12.7%	335.4%	66.6%	15.8%	1.8%	-3.8%	-3.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD ALL PLATFORMS														
Wkstn Shipments	373	863	1,277	1,589	1,893	2,184	2,454	23.2%	131.7%	48.0%	24.4%	19.1%	15.4%	12.4%
Wkstn Installed Base	4,243	5,106	6,182	7,549	9,126	10,904	12,801	20.2%	20.3%	21.1%	22.1%	20.9%	19.5%	17.4%
Average Price Per Seat	46.8	60.0	44.0	37.6	33.4	30.5	28.2	-14.0%	28.3%	-26.7%	-14.6%	-11.1%	-8.8%	-7.6%
CPU Revenue	8	34	27	28	29	29	29	-2.9%	323.0%	-18.9%	2.4%	2.6%	1.6%	-1.1%
Workstation Revenue	5	12	12	14	16	18	19	10.4%	157.1%	7.4%	13.7%	12.5%	10.4%	8.2%
Software Revenue	2	4	13	17	23	27	31	50.6%	80.9%	227.4%	32.8%	30.2%	21.5%	12.6%
Peripheral Revenue	3	4	9	10	12	13	15	28.2%	53.9%	99.5%	14.9%	15.8%	14.7%	13.5%
Service Revenue	3	7	16	19	23	26	30	33.9%	160.2%	130.6%	18.2%	18.0%	16.6%	14.8%
Total Revenue	20	61	78	88	101	114	124	15.4%	199.8%	28.0%	14.1%	14.4%	12.3%	9.3%
REST OF WORLD TECHNICAL WORKSTATION														
Wkstn Shipments	175	512	858	1,153	1,455	1,754	2,041	31.9%	192.2%	67.7%	34.3%	26.2%	20.5%	16.4%
Wkstn Installed Base	205	717	1,570	2,710	4,099	5,719	7,515	60.0%	250.1%	119.1%	72.6%	51.2%	39.5%	31.4%
Average Price Per Seat	38.7	31.6	28.8	27.1	25.8	24.8	24.1	-5.3%	-18.3%	-8.9%	-5.9%	-4.8%	-3.9%	-2.8%
CPU Revenue	2	7	8	10	12	15	17	19.9%	200.4%	12.0%	32.5%	24.2%	18.2%	13.7%
Workstation Revenue	2	7	8	10	12	15	17	20.0%	199.1%	12.5%	32.5%	24.2%	18.2%	13.7%
Software Revenue	1	2	7	9	13	17	20	59.2%	71.9%	255.1%	35.2%	39.7%	29.8%	17.5%
Peripheral Revenue	1	1	4	5	7	9	11	60.9%	-13.8%	272.0%	39.0%	31.7%	27.6%	24.3%
Service Revenue	1	2	4	7	10	13	17	48.5%	118.3%	68.9%	66.9%	46.6%	35.8%	28.5%
Total Revenue	8	19	30	41	55	68	81	34.1%	138.3%	58.2%	38.7%	32.3%	25.4%	18.9%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD HOST-DEPENDENT														
Wkstn Shipments	51	144	164	171	172	165	151	1.0%	181.5%	13.8%	4.0%	.7%	-4.0%	-8.2%
Wkstn Installed Base	3,794	3,939	3,908	3,876	3,818	3,748	3,644	-1.5%	3.8%	-.8%	-.8%	-1.5%	-1.8%	-2.8%
Average Price Per Seat	190.1	238.8	185.6	160.8	144.0	133.3	124.8	-12.2%	25.6%	-22.3%	-13.4%	-10.4%	-7.5%	-6.4%
CPU Revenue	5	26	19	17	16	14	12	-14.7%	391.4%	-26.9%	-9.4%	-9.7%	-11.4%	-14.6%
Workstation Revenue	2	4	5	4	3	3	2	-14.6%	129.8%	2.7%	-16.4%	-16.7%	-18.8%	-22.0%
Software Revenue	1	1	3	3	3	3	3	36.0%	-16.1%	263.0%	8.3%	10.1%	5.7%	1.8%
Peripheral Revenue	2	3	5	5	5	5	4	4.6%	103.0%	45.4%	-2.9%	-1.5%	-3.6%	-6.9%
Service Revenue	2	4	12	12	12	13	13	23.2%	179.4%	167.8%	1.7%	2.2%	1.4%	.4%
Total Revenue	11	39	43	41	39	37	34	-2.7%	245.6%	10.1%	-5.2%	-4.5%	-5.6%	-7.6%
REST OF WORLD PERSONAL COMPUTER														
Wkstn Shipments	146	207	255	265	265	264	262	4.8%	41.8%	23.1%	4.0%	.1%	-.4%	-1.1%
Wkstn Installed Base	244	451	704	963	1,209	1,437	1,641	29.5%	84.9%	56.1%	36.6%	25.6%	18.9%	14.2%
Average Price Per Seat	6.1	5.5	4.4	3.9	3.7	3.6	3.6	-8.1%	-9.8%	-20.0%	-11.4%	-5.1%	-2.7%	.0%
CPU Revenue	0	1	0	0	0	0	0	-5.0%	55.9%	-18.9%	.0%	-2.3%	-2.4%	.0%
Workstation Revenue	0	1	0	0	0	0	0	-5.0%	43.2%	-18.9%	.0%	-2.3%	-2.4%	.0%
Software Revenue	0	1	3	5	6	7	7	41.7%	578.9%	165.1%	46.8%	23.9%	11.9%	5.9%
Peripheral Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	-10.0%	11.1%	.0%	.0%
Service Revenue	0	0	0	0	0	0	0	13.3%	ERR	.0%	26.7%	21.1%	13.0%	7.7%
Total Revenue	1	3	5	6	7	8	9	27.6%	163.5%	79.4%	35.5%	20.0%	10.3%	5.3%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE ALL PLATFORMS														
Wkstn Shipments	16,133	22,567	27,600	30,494	32,721	34,809	36,816	10.3%	39.9%	22.3%	10.5%	7.3%	6.4%	5.8%
Wkstn Installed Base	27,407	49,974	77,510	107,424	137,884	168,466	198,492	31.8%	82.3%	55.1%	38.6%	28.4%	22.2%	17.8%
Average Price Per Seat	42.3	30.8	25.6	22.8	20.8	19.2	18.0	-10.2%	-27.2%	-16.8%	-11.0%	-9.0%	-7.4%	-6.4%
CPU Revenue	283	315	320	314	301	291	281	-2.2%	11.2%	1.7%	-2.0%	-4.1%	-3.5%	-3.3%
Workstation Revenue	135	164	182	189	192	194	195	3.5%	21.5%	11.1%	3.8%	1.7%	.8%	.7%
Software Revenue	209	243	300	350	387	409	420	11.5%	16.2%	23.5%	16.5%	10.5%	5.7%	2.7%
Peripheral Revenue	117	98	107	115	123	134	147	8.5%	-16.3%	9.7%	7.6%	7.1%	8.7%	9.4%
Service Revenue	67	100	126	159	191	222	251	20.3%	49.0%	26.4%	26.5%	20.0%	16.1%	13.2%
Total Revenue	808	919	1,036	1,127	1,195	1,249	1,294	7.1%	13.8%	12.7%	8.8%	6.0%	4.6%	3.6%
WORLDWIDE TECHNICAL WORKSTATION														
Wkstn Shipments	5,438	7,450	9,831	11,885	14,066	16,295	18,501	20.0%	37.0%	32.0%	20.9%	18.3%	15.8%	13.5%
Wkstn Installed Base	11,124	18,574	28,405	40,290	53,550	68,238	84,010	35.2%	67.0%	52.9%	41.8%	32.9%	27.4%	23.1%
Average Price Per Seat	59.2	42.3	33.5	28.2	24.7	22.3	20.5	-13.5%	-28.5%	-20.8%	-15.8%	-12.4%	-9.7%	-8.1%
CPU Revenue	72	94	105	111	118	125	131	6.7%	30.8%	11.3%	5.9%	6.4%	5.7%	4.5%
Workstation Revenue	72	94	105	111	118	125	131	6.7%	30.8%	11.3%	5.9%	6.4%	5.7%	4.5%
Software Revenue	141	123	152	184	211	228	237	14.1%	-12.6%	23.4%	21.2%	14.8%	8.3%	3.9%
Peripheral Revenue	48	44	51	57	65	74	85	14.1%	-8.9%	15.0%	11.8%	14.2%	15.0%	14.8%
Service Revenue	31	49	66	85	105	126	146	24.5%	57.5%	34.0%	30.2%	23.4%	19.4%	16.3%
Total Revenue	364	404	478	548	617	679	730	12.5%	11.0%	18.1%	14.7%	12.7%	9.9%	7.6%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE HOST-DEPENDENT														
Wkstn Shipments	539	789	889	925	926	916	893	2.5%	46.5%	12.6%	4.0%	.1%	-1.1%	-2.5%
Wkstn Installed Base	1,353	2,142	2,967	3,773	4,510	5,200	5,833	22.2%	58.3%	38.5%	27.2%	19.5%	15.3%	12.2%
Average Price Per Seat	472.7	316.3	258.7	232.4	209.9	197.1	188.9	-9.8%	-33.1%	-18.2%	-10.2%	-9.6%	-6.1%	-4.2%
CPU Revenue	166	175	159	144	126	113	101	-10.4%	5.5%	-9.3%	-9.3%	-12.5%	-10.6%	-10.5%
Workstation Revenue	18	24	21	19	18	16	15	-8.9%	36.5%	-14.6%	-6.6%	-9.5%	-7.1%	-6.5%
Software Revenue	24	37	47	53	56	58	59	9.5%	53.1%	25.3%	13.2%	6.3%	3.1%	1.4%
Peripheral Revenue	66	45	45	47	46	47	49	1.7%	-32.2%	1.3%	2.7%	-.5%	2.1%	2.8%
Service Revenue	33	35	41	48	54	59	64	12.8%	6.5%	16.7%	17.6%	12.5%	9.7%	7.7%
Total Revenue	307	316	312	311	300	294	287	-1.9%	3.0%	-1.2%	-.5%	-3.4%	-2.2%	-2.1%
WORLDWIDE PERSONAL COMPUTER														
Wkstn Shipments	10,156	14,327	16,879	17,685	17,730	17,599	17,423	4.0%	41.1%	17.8%	4.8%	.3%	-.7%	-1.0%
Wkstn Installed Base	14,930	29,258	46,137	63,360	79,823	95,027	108,649	30.0%	96.0%	57.7%	37.3%	26.0%	19.0%	14.3%
Average Price Per Seat	10.5	9.1	8.8	8.3	7.7	7.1	6.7	-5.9%	-13.3%	-3.3%	-5.7%	-7.2%	-7.8%	-5.6%
CPU Revenue	45	46	57	59	57	53	49	1.6%	.8%	24.4%	3.7%	-3.4%	-7.1%	-6.3%
Workstation Revenue	45	46	57	59	57	53	49	1.6%	.8%	24.4%	3.7%	-3.4%	-7.1%	-6.3%
Software Revenue	44	83	102	113	120	122	124	8.3%	87.1%	22.9%	11.2%	5.5%	2.4%	1.0%
Peripheral Revenue	2	9	11	12	12	12	13	7.5%	290.3%	25.5%	8.2%	3.1%	.4%	2.2%
Service Revenue	3	16	20	26	32	37	41	21.2%	441.4%	24.4%	32.4%	22.7%	15.9%	11.6%
Total Revenue	136	199	246	269	277	277	276	6.8%	45.6%	23.8%	9.3%	3.2%	-.0%	-.3%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
								86-91						
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA ALL PLATFORMS														
Wkstn Shipments	11,749	14,288	15,407	16,042	16,515	16,897	17,299	3.9%	21.6%	7.8%	4.1%	3.0%	2.3%	2.4%
Wkstn Installed Base	20,364	34,652	50,024	65,684	80,825	95,249	108,710	25.7%	70.2%	44.4%	31.3%	23.1%	17.8%	14.1%
Average Price Per Seat	36.5	25.4	20.4	17.6	15.5	14.3	13.3	-12.1%	-30.4%	-19.9%	-13.7%	-11.7%	-8.0%	-6.5%
CPU Revenue	167	169	151	137	123	113	106	-9.0%	1.5%	-10.8%	-9.1%	-10.3%	-8.2%	-6.5%
Workstation Revenue	87	85	74	67	63	61	59	-7.1%	-2.2%	-13.6%	-8.7%	-6.2%	-4.1%	-2.6%
Software Revenue	140	134	167	192	209	219	224	10.8%	-4.0%	24.2%	15.0%	9.1%	4.7%	2.1%
Peripheral Revenue	76	56	50	50	50	51	54	-.7%	-26.3%	-11.0%	.0%	-.1%	2.9%	5.4%
Service Revenue	41	54	65	76	86	95	103	13.7%	32.6%	19.4%	17.5%	12.9%	10.4%	8.5%
Total Revenue	511	500	506	523	532	539	546	1.8%	-2.3%	1.4%	3.2%	1.7%	1.4%	1.2%
NORTH AMERICA TECHNICAL WORKSTATION														
Wkstn Shipments	3,639	4,047	4,478	4,930	5,404	5,897	6,408	9.6%	11.2%	10.6%	10.1%	9.6%	9.1%	8.7%
Wkstn Installed Base	8,030	12,076	16,554	21,485	26,459	31,562	36,708	24.9%	50.4%	37.1%	29.8%	23.2%	19.3%	16.3%
Average Price Per Seat	56.5	39.8	30.4	24.6	20.9	18.4	16.6	-16.0%	-29.6%	-23.6%	-19.1%	-15.0%	-12.0%	-9.8%
CPU Revenue	45	49	43	40	38	37	37	-5.6%	9.2%	-11.4%	-7.0%	-4.6%	-2.9%	-1.7%
Workstation Revenue	45	49	43	40	38	37	37	-5.6%	9.2%	-11.4%	-7.0%	-4.6%	-2.9%	-1.7%
Software Revenue	94	66	75	88	98	103	106	10.1%	-30.2%	14.2%	17.0%	11.3%	5.9%	2.6%
Peripheral Revenue	31	22	21	21	21	22	24	1.7%	-28.0%	-5.2%	-1.8%	2.3%	5.5%	7.9%
Service Revenue	20	27	33	38	43	47	52	13.8%	36.6%	20.9%	16.9%	12.6%	10.3%	8.5%
Total Revenue	234	213	215	227	239	248	255	3.7%	-9.2%	1.2%	5.5%	5.0%	3.8%	2.9%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA HOST-DEPENDENT														
Wkstn Shipments	244	411	485	504	504	499	494	3.8%	68.2%	18.0%	4.0%	.0%	-1.0%	-1.0%
Wkstn Installed Base	722	1,133	1,584	2,025	2,427	2,805	3,159	22.8%	56.9%	39.8%	27.8%	19.9%	15.6%	12.6%
Average Price Per Seat	580.4	340.2	265.9	239.7	213.7	197.5	187.0	-11.3%	-41.4%	-21.8%	-9.9%	-10.8%	-7.6%	-5.3%
CPU Revenue	88	96	89	81	70	62	55	-10.4%	9.2%	-7.1%	-8.9%	-13.7%	-11.9%	-10.2%
Workstation Revenue	8	12	12	11	10	9	8	-6.4%	47.0%	-.1%	-6.2%	-10.8%	-8.6%	-6.2%
Software Revenue	16	24	34	38	41	42	43	12.2%	50.2%	39.2%	14.1%	6.6%	3.3%	1.6%
Peripheral Revenue	44	31	25	26	26	26	27	-3.3%	-28.9%	-19.3%	3.1%	-1.9%	.7%	3.1%
Service Revenue	19	20	23	27	31	34	37	12.8%	4.3%	15.8%	17.7%	12.5%	9.9%	8.2%
Total Revenue	175	183	183	184	177	172	170	-1.5%	4.5%	-.1%	.5%	-3.7%	-2.6%	-1.5%
NORTH AMERICA PERSONAL COMPUTER														
Wkstn Shipments	7,866	9,830	10,444	10,607	10,607	10,501	10,396	1.1%	25.0%	6.2%	1.6%	.0%	-1.0%	-1.0%
Wkstn Installed Base	11,613	21,442	31,886	42,175	51,939	60,882	68,843	26.3%	84.6%	48.7%	32.3%	23.2%	17.2%	13.1%
Average Price Per Seat	10.4	6.3	4.7	3.8	3.4	3.2	3.2	-12.7%	-39.4%	-25.4%	-19.1%	-10.5%	-5.9%	.0%
CPU Revenue	35	25	19	16	15	14	14	-10.9%	-28.2%	-24.1%	-14.3%	-7.1%	-4.3%	-2.7%
Workstation Revenue	35	25	19	16	15	14	14	-10.9%	-28.2%	-24.1%	-14.3%	-7.1%	-4.3%	-2.7%
Software Revenue	30	44	58	66	71	73	75	11.0%	50.1%	30.9%	12.9%	7.6%	3.9%	1.8%
Peripheral Revenue	1	3	4	3	3	3	4	6.0%	98.5%	38.1%	-10.8%	-.9%	3.4%	6.2%
Service Revenue	2	7	9	11	12	14	15	15.6%	262.9%	23.3%	18.9%	15.0%	11.8%	9.3%
Total Revenue	102	104	108	112	116	119	121	3.1%	2.0%	4.3%	3.2%	3.8%	2.6%	1.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

	ANNUAL PERCENT CHANGES														
	86-91														
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991	
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	
EUROPE ALL PLATFORMS															
Wkstin Shipments	2,922	4,277	5,204	5,784	6,301	6,757	7,167	10.9%	46.4%	21.7%	11.2%	8.9%	7.2%	6.1%	
Wkstin Installed Base	4,514	8,791	13,980	19,671	25,557	31,531	37,428	33.6%	94.7%	59.0%	40.7%	29.9%	23.4%	18.7%	
Average Price Per Seat	52.5	34.5	24.4	19.3	16.1	14.2	12.9	-17.9%	-34.2%	-29.5%	-20.8%	-16.4%	-12.0%	-9.4%	
CPU Revenue	69	64	54	48	43	40	38	-9.9%	-7.2%	-15.9%	-11.3%	-9.3%	-6.9%	-5.6%	
Workstation Revenue	28	34	34	31	29	28	27	-4.5%	19.8%	-.1%	-8.6%	-5.8%	-4.3%	-3.5%	
Software Revenue	45	62	74	90	104	112	117	13.5%	36.4%	18.9%	22.5%	15.0%	8.2%	4.0%	
Peripheral Revenue	24	20	20	19	19	20	21	1.3%	-17.4%	-.1%	-2.4%	.3%	3.3%	5.3%	
Service Revenue	16	25	28	34	40	45	50	14.9%	53.7%	11.6%	22.7%	16.6%	13.2%	10.6%	
Total Revenue	183	204	209	222	235	245	252	4.3%	11.9%	2.2%	6.4%	5.9%	4.3%	2.9%	
EUROPE TECHNICAL WORKSTATION															
Wkstin Shipments	1,059	1,930	2,702	3,242	3,761	4,242	4,677	19.4%	82.3%	40.0%	20.0%	16.0%	12.8%	10.2%	
Wkstin Installed Base	1,890	3,819	6,521	9,763	13,329	17,171	21,161	40.8%	102.1%	70.7%	49.7%	36.5%	28.8%	23.2%	
Average Price Per Seat	66.4	41.2	28.7	21.7	17.5	14.8	12.9	-20.7%	-38.0%	-30.3%	-24.4%	-19.4%	-15.4%	-12.8%	
CPU Revenue	16	23	25	23	22	22	21	-2.1%	45.5%	6.2%	-5.4%	-4.2%	-3.6%	-3.3%	
Workstation Revenue	16	23	25	23	22	22	21	-2.1%	45.5%	6.2%	-5.4%	-4.2%	-3.6%	-3.3%	
Software Revenue	30	34	45	58	69	77	81	18.5%	16.6%	29.5%	29.8%	19.8%	10.6%	5.1%	
Peripheral Revenue	11	11	12	12	12	13	14	3.9%	6.4%	6.1%	-.1%	2.8%	4.8%	6.2%	
Service Revenue	7	13	17	22	26	31	34	20.8%	95.9%	25.5%	29.9%	20.8%	15.9%	12.5%	
Total Revenue	79	106	123	138	153	163	170	10.0%	33.8%	16.3%	12.8%	10.4%	6.9%	4.4%	

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE HOST-DEPENDENT														
Wkstn Shipments	171	149	140	136	133	132	132	-2.4%	-12.5%	-6.2%	-3.1%	-1.6%	-.8%	-.4%
Wkstn Installed Base	341	490	615	726	824	915	1,001	15.3%	43.8%	25.6%	18.0%	13.4%	11.1%	9.4%
Average Price Per Seat	386.9	304.9	238.0	213.5	189.8	175.2	165.5	-11.5%	-21.2%	-22.0%	-10.3%	-11.1%	-7.7%	-5.5%
CPU Revenue	46	35	23	19	16	14	13	-17.7%	-24.8%	-33.7%	-15.6%	-15.3%	-11.9%	-9.8%
Workstation Revenue	5	5	3	3	2	2	2	-15.5%	-16.5%	-34.4%	-13.0%	-12.6%	-8.3%	-5.7%
Software Revenue	6	8	10	11	12	12	13	10.5%	24.8%	31.9%	12.4%	6.2%	3.0%	1.5%
Peripheral Revenue	13	6	7	6	6	6	6	1.5%	-54.4%	12.3%	-4.4%	-3.7%	.5%	3.6%
Service Revenue	9	7	7	8	8	9	9	5.2%	-20.9%	.3%	8.8%	6.4%	5.5%	5.0%
Total Revenue	79	60	50	47	45	44	43	-6.4%	-24.8%	-16.9%	-4.8%	-5.0%	-2.9%	-1.6%
EUROPE PERSONAL COMPUTER														
Wkstn Shipments	1,693	2,197	2,362	2,407	2,407	2,382	2,359	1.4%	29.8%	7.5%	1.9%	.0%	-1.0%	-1.0%
Wkstn Installed Base	2,284	4,481	6,843	9,181	11,404	13,445	15,266	27.8%	96.2%	52.7%	34.2%	24.2%	17.9%	13.5%
Average Price Per Seat	10.1	10.3	6.7	5.0	4.4	4.1	4.0	-17.2%	2.0%	-35.0%	-25.4%	-12.0%	-6.8%	-2.4%
CPU Revenue	7	6	6	5	4	4	4	-7.6%	-11.9%	1.3%	-19.4%	-9.7%	-5.7%	-3.1%
Workstation Revenue	7	6	6	5	4	4	4	-7.6%	-11.9%	1.3%	-19.4%	-9.7%	-5.7%	-3.1%
Software Revenue	10	20	19	21	22	23	24	3.5%	103.6%	-4.3%	10.6%	6.7%	3.4%	1.6%
Peripheral Revenue	0	3	1	1	1	1	1	-16.9%	504.7%	-54.6%	-15.3%	-4.0%	2.1%	5.1%
Service Revenue	1	5	4	5	6	6	7	7.4%	662.3%	-11.4%	17.2%	13.9%	11.1%	8.8%
Total Revenue	24	39	36	37	38	39	39	.1%	60.5%	-6.7%	.5%	3.0%	2.4%	1.8%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST ALL PLATFORMS														
Wkstn Shipments	1,274	3,534	6,243	7,681	8,654	9,632	10,559	24.5%	177.5%	76.6%	23.0%	12.7%	11.3%	9.6%
Wkstn Installed Base	2,184	5,719	11,950	19,536	27,775	36,554	45,639	51.5%	161.8%	109.0%	63.5%	42.2%	31.6%	24.9%
Average Price Per Seat	72.5	44.4	37.7	34.7	32.4	29.9	27.7	-9.0%	-38.8%	-15.1%	-7.9%	-6.6%	-8.0%	-7.4%
CPU Revenue	43	62	99	112	117	119	118	13.6%	46.3%	59.2%	12.9%	4.3%	1.4%	-.4%
Workstation Revenue	18	39	68	83	90	93	95	19.4%	119.5%	74.3%	21.1%	8.8%	3.7%	2.1%
Software Revenue	24	46	54	60	61	61	59	5.3%	92.2%	18.6%	9.8%	2.8%	-.7%	-2.5%
Peripheral Revenue	15	19	32	39	46	53	60	25.3%	30.9%	63.5%	23.6%	17.1%	15.2%	13.2%
Service Revenue	9	17	28	41	54	68	81	37.2%	93.4%	67.0%	47.2%	32.8%	24.6%	19.2%
Total Revenue	105	184	282	335	369	394	414	17.6%	75.7%	53.5%	18.9%	10.1%	6.8%	5.1%
FAR EAST TECHNICAL WORKSTATION														
Wkstn Shipments	630	1,150	2,071	2,899	3,826	4,806	5,790	38.2%	82.7%	80.0%	40.0%	32.0%	25.6%	20.5%
Wkstn Installed Base	1,078	2,228	4,298	7,197	10,880	15,360	20,536	55.9%	106.8%	92.9%	67.4%	51.2%	41.2%	33.7%
Average Price Per Seat	68.2	57.1	48.7	42.3	37.3	33.3	30.1	-12.0%	-16.3%	-14.7%	-13.1%	-11.8%	-10.7%	-9.6%
CPU Revenue	10	18	32	41	49	55	60	27.1%	79.7%	77.3%	26.6%	19.2%	13.5%	9.1%
Workstation Revenue	10	18	32	41	49	55	60	27.1%	79.7%	77.3%	26.6%	19.2%	13.5%	9.1%
Software Revenue	17	22	28	32	34	34	33	8.4%	32.2%	26.3%	13.3%	6.5%	1.0%	-2.6%
Peripheral Revenue	7	10	16	21	27	33	39	30.4%	56.8%	49.3%	33.7%	28.0%	23.4%	19.8%
Service Revenue	4	7	14	21	29	39	48	46.1%	79.7%	88.1%	54.6%	39.9%	31.2%	24.9%
Total Revenue	48	76	121	155	187	216	241	25.9%	59.5%	59.7%	27.6%	20.6%	15.5%	11.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST HOST-DEPENDENT														
Wkstn Shipments	115	180	205	219	219	217	206	2.8%	56.6%	14.0%	7.0%	.0%	-1.0%	-5.0%
Wkstn Installed Base	231	410	603	798	977	1,145	1,294	25.8%	77.9%	46.9%	32.4%	22.5%	17.2%	13.0%
Average Price Per Seat	367.5	257.2	251.8	230.9	219.6	216.9	216.5	-3.4%	-30.0%	-2.1%	-8.3%	-4.9%	-1.2%	-.2%
CPU Revenue	29	30	36	34	31	29	27	-2.1%	2.9%	19.7%	-4.7%	-7.9%	-5.8%	-9.2%
Workstation Revenue	4	7	5	5	4	4	4	-9.4%	60.2%	-29.4%	-1.9%	-4.8%	-2.1%	-5.2%
Software Revenue	2	5	2	3	3	3	3	-14.1%	158.2%	-55.5%	5.0%	.8%	.8%	-1.6%
Peripheral Revenue	8	6	10	11	11	12	13	18.4%	-28.9%	83.5%	7.9%	4.7%	7.6%	4.3%
Service Revenue	4	6	8	10	11	12	13	18.5%	33.3%	37.7%	22.8%	15.1%	11.2%	8.1%
Total Revenue	47	53	61	62	61	61	60	2.4%	12.3%	14.6%	1.6%	-1.5%	.4%	-2.3%
FAR EAST PERSONAL COMPUTER														
Wkstn Shipments	529	2,204	3,968	4,563	4,609	4,609	4,562	15.7%	316.4%	80.0%	15.0%	1.0%	.0%	-1.0%
Wkstn Installed Base	876	3,081	7,048	11,541	15,919	20,050	23,810	50.5%	251.5%	128.8%	63.7%	37.9%	26.0%	18.8%
Average Price Per Seat	13.7	20.5	20.9	20.5	19.5	17.5	16.1	-4.7%	49.6%	2.0%	-1.9%	-4.9%	-10.3%	-8.0%
CPU Revenue	4	15	32	38	37	34	31	16.6%	294.0%	117.5%	18.8%	-1.0%	-8.4%	-8.2%
Workstation Revenue	4	15	32	38	37	34	31	16.6%	294.0%	117.5%	18.8%	-1.0%	-8.4%	-8.2%
Software Revenue	5	18	24	25	25	24	24	5.3%	265.8%	31.0%	6.2%	-1.6%	-3.2%	-2.5%
Peripheral Revenue	0	4	6	8	8	8	8	17.6%	630.6%	73.5%	24.0%	5.6%	-1.0%	.1%
Service Revenue	0	4	6	10	14	17	19	39.1%	1255.6%	71.0%	62.1%	35.1%	21.5%	14.5%
Total Revenue	10	55	100	118	121	117	113	15.7%	461.5%	82.5%	18.8%	2.4%	-3.4%	-3.2%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD ALL PLATFORMS														
Wkstn Shipments	188	469	746	987	1,251	1,523	1,792	30.8%	149.2%	59.3%	32.3%	26.7%	21.8%	17.6%
Wkstn Installed Base	344	813	1,556	2,533	3,726	5,132	6,715	52.6%	136.1%	91.4%	62.8%	47.1%	37.7%	30.8%
Average Price Per Seat	43.7	58.9	42.7	35.7	31.8	28.9	26.9	-14.5%	34.8%	-27.5%	-16.2%	-11.1%	-8.9%	-7.1%
CPU Revenue	5	19	16	17	18	18	19	-.1%	307.0%	-15.5%	2.8%	5.8%	4.9%	3.4%
Workstation Revenue	2	6	6	8	10	12	14	19.7%	236.8%	11.8%	28.0%	24.5%	19.5%	15.3%
Software Revenue	0	1	5	8	12	17	20	80.4%	477.8%	425.0%	50.9%	49.8%	34.4%	19.7%
Peripheral Revenue	2	2	6	7	8	10	11	38.5%	37.4%	147.8%	19.1%	21.6%	20.0%	18.1%
Service Revenue	1	4	5	8	11	14	17	37.1%	271.1%	48.3%	47.4%	37.1%	29.8%	24.6%
Total Revenue	9	32	39	48	59	71	82	20.8%	246.8%	22.5%	22.1%	24.0%	20.3%	15.4%
REST OF WORLD TECHNICAL WORKSTATION														
Wkstn Shipments	110	323	581	814	1,074	1,349	1,626	38.2%	193.9%	80.0%	40.0%	32.0%	25.6%	20.5%
Wkstn Installed Base	127	450	1,031	1,845	2,883	4,145	5,605	65.6%	254.1%	129.2%	78.9%	56.2%	43.8%	35.2%
Average Price Per Seat	28.8	27.2	26.0	25.1	24.4	23.8	23.4	-3.0%	-5.6%	-4.4%	-3.5%	-2.8%	-2.5%	-1.7%
CPU Revenue	1	4	5	7	9	11	13	26.6%	224.2%	19.7%	40.7%	31.5%	24.2%	18.5%
Workstation Revenue	1	4	5	7	9	11	13	26.6%	224.2%	19.7%	40.7%	31.5%	24.2%	18.5%
Software Revenue	0	1	4	6	10	14	17	102.5%	363.6%	686.3%	58.6%	59.3%	40.1%	22.4%
Peripheral Revenue	1	0	2	3	5	7	9	87.3%	-33.9%	527.0%	48.7%	40.9%	35.0%	30.2%
Service Revenue	0	1	2	4	6	9	12	58.5%	212.8%	97.5%	75.5%	53.2%	41.4%	33.3%
Total Revenue	4	10	18	28	39	52	64	44.5%	187.0%	80.2%	50.2%	42.4%	32.5%	23.6%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD HOST-DEPENDENT														
Wkstn Shipments	9	50	60	66	69	67	61	4.0%	438.5%	20.0%	10.0%	5.0%	-2.5%	-10.0%
Wkstn Installed Base	59	109	165	225	282	335	379	28.3%	83.9%	51.8%	35.7%	25.7%	18.8%	13.0%
Average Price Per Seat	509.7	367.2	272.2	220.2	191.0	173.2	161.8	-15.1%	-27.9%	-25.9%	-19.1%	-13.3%	-9.3%	-6.6%
CPU Revenue	3	15	11	10	9	7	6	-17.0%	351.8%	-24.8%	-13.5%	-12.0%	-14.9%	-19.4%
Workstation Revenue	0	2	1	1	1	1	1	-10.1%	400.0%	-2.7%	-11.0%	-8.5%	-11.8%	-16.2%
Software Revenue	0	0	1	1	1	1	1	42.7%	85.7%	376.9%	11.3%	8.7%	4.0%	-1.3%
Peripheral Revenue	1	2	3	3	3	3	3	8.6%	74.8%	71.1%	-2.2%	.3%	-2.9%	-7.5%
Service Revenue	1	2	3	4	4	5	5	16.8%	300.0%	21.6%	24.5%	18.2%	12.5%	8.1%
Total Revenue	5	21	19	18	18	17	15	-5.8%	291.3%	-6.7%	-5.0%	-3.1%	-5.3%	-8.6%
REST OF WORLD PERSONAL COMPUTER														
Wkstn Shipments	69	96	105	108	108	107	106	2.0%	39.0%	9.8%	2.4%	.0%	-1.0%	-1.0%
Wkstn Installed Base	158	254	359	463	561	651	731	23.6%	60.7%	41.4%	29.0%	21.3%	16.0%	12.2%
Average Price Per Seat	4.9	5.4	4.3	3.9	3.7	3.6	3.6	-7.8%	10.2%	-20.4%	-9.3%	-5.1%	-2.7%	.0%
CPU Revenue	0	0	0	0	0	0	0	-7.8%	41.2%	-29.2%	.0%	.0%	-5.9%	.0%
Workstation Revenue	0	0	0	0	0	0	0	-7.8%	41.2%	-29.2%	.0%	.0%	-5.9%	.0%
Software Revenue	0	0	1	1	1	2	2	33.7%	ERR	107.5%	43.4%	22.7%	11.0%	5.6%
Peripheral Revenue	0	0	0	0	0	0	0	ERR	ERR	ERR	.0%	33.3%	.0%	.0%
Service Revenue	0	0	0	0	0	0	0	25.9%	ERR	83.3%	18.2%	23.1%	12.5%	5.6%
Total Revenue	0	1	1	2	2	2	2	19.0%	179.4%	38.9%	28.0%	17.8%	8.5%	5.1%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE ALL PLATFORMS														
Wkstn Shipments	2,163	2,517	2,948	3,303	3,541	3,688	3,778	8.5%	16.3%	17.1%	12.0%	7.2%	4.2%	2.4%
Wkstn Installed Base	7,506	10,023	12,557	15,300	18,116	20,887	23,517	18.6%	33.5%	25.3%	21.8%	18.4%	15.3%	12.6%
Average Price Per Seat	87.9	79.4	64.1	54.4	46.7	40.2	35.0	-15.1%	-9.7%	-19.2%	-15.1%	-14.2%	-13.8%	-13.0%
CPU Revenue	61	86	82	82	79	75	71	-3.8%	40.1%	-4.2%	-.9%	-3.3%	-5.0%	-5.6%
Workstation Revenue	50	47	47	45	42	36	31	-8.2%	-6.0%	-.7%	-2.6%	-8.2%	-12.9%	-15.6%
Software Revenue	71	89	136	188	224	253	277	25.5%	25.5%	52.4%	38.1%	19.6%	12.9%	9.5%
Peripheral Revenue	26	23	24	25	24	22	21	-2.1%	-11.4%	4.8%	2.3%	-2.9%	-6.5%	-7.7%
Service Revenue	32	36	44	51	57	62	65	12.9%	10.5%	24.2%	16.1%	11.6%	8.1%	5.2%
Total Revenue	240	281	333	390	426	449	465	10.6%	16.7%	18.7%	17.3%	9.1%	5.3%	3.5%
WORLDWIDE TECHNICAL WORKSTATION														
Wkstn Shipments	1,164	1,603	2,042	2,380	2,616	2,773	2,889	12.5%	37.7%	27.3%	16.6%	9.9%	6.0%	4.2%
Wkstn Installed Base	1,689	3,292	5,235	7,459	9,777	12,159	14,440	34.4%	94.9%	59.0%	42.5%	31.1%	24.4%	18.8%
Average Price Per Seat	75.4	61.8	52.3	44.3	37.2	30.7	25.5	-16.2%	-18.0%	-15.4%	-15.3%	-16.0%	-17.5%	-16.9%
CPU Revenue	19	26	30	33	32	29	26	.4%	33.8%	19.5%	6.9%	-2.4%	-8.5%	-10.6%
Workstation Revenue	19	25	30	33	32	29	26	.5%	33.1%	20.1%	6.9%	-2.4%	-8.5%	-10.6%
Software Revenue	41	65	108	155	187	213	234	29.3%	56.7%	67.1%	43.7%	20.7%	13.4%	9.9%
Peripheral Revenue	13	13	15	16	16	14	13	.5%	-3.0%	19.8%	6.9%	-2.3%	-8.5%	-10.6%
Service Revenue	13	20	23	30	36	41	45	18.2%	56.9%	17.0%	31.3%	20.5%	14.1%	9.1%
Total Revenue	105	148	207	267	303	327	344	18.4%	40.9%	40.1%	28.8%	13.7%	7.7%	5.2%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE HOST-DEPENDENT														
Wkstn Shipments	831	657	595	564	548	539	531	-4.2%	-21.0%	-9.5%	-5.1%	-2.9%	-1.6%	-1.3%
Wkstn Installed Base	5,649	6,306	6,585	6,754	6,897	6,952	6,997	2.1%	11.6%	4.4%	2.6%	2.1%	.8%	.6%
Average Price Per Seat	120.6	151.1	136.4	129.4	121.9	114.9	108.3	-6.5%	25.3%	-9.7%	-5.2%	-5.8%	-5.8%	-5.8%
CPU Revenue	42	60	51	48	47	45	44	-5.8%	43.5%	-14.2%	-5.5%	-3.9%	-2.6%	-2.4%
Workstation Revenue	30	21	16	12	9	7	4	-27.8%	-30.9%	-25.5%	-21.2%	-23.9%	-28.7%	-38.3%
Software Revenue	29	24	28	32	37	41	44	12.5%	-15.8%	13.8%	16.3%	14.0%	10.7%	7.9%
Peripheral Revenue	13	10	9	8	8	8	8	-5.8%	-19.1%	-14.2%	-5.5%	-4.1%	-2.6%	-2.2%
Service Revenue	20	16	21	21	21	20	20	4.3%	-18.8%	32.8%	-.5%	-1.3%	-2.6%	-2.7%
Total Revenue	133	131	124	122	121	121	119	-1.9%	-1.4%	-5.2%	-1.8%	-.8%	-.6%	-1.0%
WORLDWIDE PERSONAL COMPUTER														
Wkstn Shipments	168	257	312	359	377	377	358	6.9%	52.9%	21.6%	15.0%	5.0%	.0%	-5.0%
Wkstn Installed Base	168	424	736	1,087	1,442	1,776	2,080	37.4%	152.9%	73.5%	47.7%	32.6%	23.1%	17.1%
Average Price Per Seat	13.4	5.3	3.9	3.4	3.2	3.1	3.1	-10.2%	-60.4%	-26.4%	-12.8%	-5.9%	-3.1%	.0%
CPU Revenue	1	1	1	1	1	1	1	-4.1%	8.5%	-10.9%	.0%	-1.8%	.0%	-7.1%
Workstation Revenue	1	1	1	1	1	1	1	-4.1%	3.2%	-10.9%	.0%	-1.8%	.0%	-7.1%
Software Revenue	1	0	0	0	0	0	0	-11.1%	-79.8%	-27.8%	7.7%	.0%	-14.3%	-16.7%
Peripheral Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	.0%	.0%	.0%	-14.3%
Service Revenue	0	0	0	0	0	0	0	55.2%	-80.0%	300.0%	37.5%	27.3%	21.4%	5.9%
Total Revenue	2	2	1	1	1	1	1	-1.7%	-37.0%	-6.7%	2.9%	1.4%	-.7%	-4.8%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

	ANNUAL PERCENT CHANGES													
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA ALL PLATFORMS														
Wkstn Shipments	1,330	1,395	1,502	1,612	1,706	1,784	1,842	5.7%	4.9%	7.7%	7.3%	5.8%	4.5%	3.3%
Wkstn Installed Base	5,284	6,678	7,898	9,145	10,406	11,645	12,832	14.0%	26.4%	18.3%	15.8%	13.8%	11.9%	10.2%
Average Price Per Seat	86.0	75.0	58.4	48.2	40.5	34.4	29.7	-16.9%	-12.9%	-22.1%	-17.6%	-15.9%	-15.0%	-13.8%
CPU Revenue	34	45	39	36	34	33	31	-7.3%	32.1%	-14.5%	-6.1%	-5.4%	-5.2%	-5.1%
Workstation Revenue	29	23	21	19	17	14	12	-13.1%	-19.7%	-7.5%	-10.8%	-12.9%	-15.4%	-18.4%
Software Revenue	45	54	79	106	123	137	148	22.5%	18.0%	46.5%	34.9%	16.5%	11.2%	7.8%
Peripheral Revenue	16	12	11	10	10	9	8	-7.2%	-25.2%	-8.3%	-5.6%	-6.5%	-7.3%	-8.1%
Service Revenue	21	20	24	26	28	28	29	7.3%	-3.6%	19.5%	7.9%	5.3%	3.2%	1.5%
Total Revenue	146	155	174	198	212	222	228	8.0%	6.0%	12.6%	13.8%	7.0%	4.5%	2.8%
NORTH AMERICA TECHNICAL WORKSTATION														
Wkstn Shipments	791	919	1,038	1,145	1,239	1,321	1,391	8.6%	16.1%	12.9%	10.3%	8.3%	6.6%	5.3%
Wkstn Installed Base	1,187	2,106	3,081	4,133	5,207	6,319	7,394	28.6%	77.4%	46.3%	34.2%	26.0%	21.4%	17.0%
Average Price Per Seat	77.2	57.5	46.0	36.8	29.4	23.6	18.8	-20.0%	-25.5%	-20.0%	-20.0%	-20.1%	-19.7%	-20.3%
CPU Revenue	13	13	14	13	12	11	9	-6.9%	.9%	3.2%	-4.6%	-8.2%	-10.9%	-12.9%
Workstation Revenue	13	13	14	13	12	11	9	-6.7%	.1%	4.0%	-4.6%	-8.2%	-10.9%	-12.9%
Software Revenue	29	40	64	90	106	119	129	26.3%	36.4%	59.2%	40.8%	18.1%	12.0%	8.4%
Peripheral Revenue	9	6	7	6	6	5	5	-6.5%	-28.1%	5.0%	-4.7%	-8.2%	-10.8%	-12.9%
Service Revenue	9	12	12	15	16	18	19	9.8%	29.4%	2.4%	20.0%	13.0%	9.1%	5.5%
Total Revenue	74	85	110	137	152	163	171	15.0%	15.0%	29.8%	24.4%	11.3%	7.2%	4.6%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA HOST-DEPENDENT														
Wkstn Shipments	480	355	309	289	279	275	273	-5.1%	-26.0%	-13.0%	-6.5%	-3.3%	-1.6%	-.8%
Wkstn Installed Base	4,038	4,393	4,483	4,503	4,512	4,471	4,431	.2%	8.8%	2.0%	.4%	.2%	-.9%	-.9%
Average Price Per Seat	109.6	143.9	127.3	120.6	114.2	108.3	102.5	-6.6%	31.3%	-11.6%	-5.2%	-5.3%	-5.2%	-5.3%
CPU Revenue	21	32	25	23	22	22	22	-7.6%	51.8%	-22.0%	-7.0%	-3.8%	-2.2%	-1.3%
Workstation Revenue	16	10	8	6	4	3	2	-27.2%	-36.9%	-22.9%	-22.5%	-23.7%	-28.4%	-37.5%
Software Revenue	16	13	15	16	17	18	19	7.5%	-16.0%	9.5%	9.6%	8.0%	6.1%	4.4%
Peripheral Revenue	7	6	4	4	4	4	4	-8.1%	-21.2%	-24.2%	-7.0%	-3.8%	-2.1%	-1.3%
Service Revenue	12	8	12	12	11	10	10	3.1%	-28.8%	43.1%	-4.4%	-4.6%	-5.6%	-5.4%
Total Revenue	72	69	64	61	59	58	56	-4.0%	-3.3%	-8.2%	-4.5%	-2.7%	-2.4%	-2.3%
NORTH AMERICA PERSONAL COMPUTER														
Wkstn Shipments	58	121	156	179	188	188	178	8.2%	107.4%	29.0%	15.0%	5.0%	.0%	-5.0%
Wkstn Installed Base	58	179	334	510	687	854	1,007	41.3%	207.4%	87.0%	52.5%	34.8%	24.3%	17.9%
Average Price Per Seat	11.5	5.5	4.1	3.5	3.3	3.2	3.1	-10.8%	-52.2%	-25.5%	-14.6%	-5.7%	-3.0%	-3.1%
CPU Revenue	0	0	0	0	0	0	0	-2.8%	11.1%	-3.3%	.0%	-3.4%	.0%	-7.1%
Workstation Revenue	0	0	0	0	0	0	0	-2.8%	11.1%	-3.3%	.0%	-3.4%	.0%	-7.1%
Software Revenue	0	0	0	0	0	0	0	-8.5%	55.6%	-28.6%	10.0%	.0%	-9.1%	-10.0%
Peripheral Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	.0%	.0%	.0%	-25.0%
Service Revenue	0	0	0	0	0	0	0	55.2%	-50.0%	300.0%	25.0%	40.0%	14.3%	12.5%
Total Revenue	1	1	1	1	1	1	1	-.5%	7.1%	.0%	2.7%	1.3%	-1.3%	-5.2%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE ALL PLATFORMS														
Wkstn Shipments	381	541	681	785	845	876	886	10.4%	41.9%	25.9%	15.4%	7.7%	3.6%	1.2%
Wkstn Installed Base	742	1,283	1,918	2,630	3,362	4,084	4,759	30.0%	72.8%	49.5%	37.2%	27.8%	21.5%	16.5%
Average Price Per Seat	97.1	61.0	47.8	39.0	32.9	28.2	24.6	-16.6%	-37.2%	-21.7%	-18.3%	-15.8%	-14.2%	-13.0%
CPU Revenue	12	15	15	14	14	13	13	-4.1%	25.3%	-6.0%	-0.8%	-3.5%	-4.9%	-5.4%
Workstation Revenue	9	7	8	8	7	6	5	-9.5%	-20.6%	7.2%	-4.7%	-11.4%	-16.1%	-20.1%
Software Revenue	14	18	32	47	59	66	71	31.8%	28.7%	76.5%	49.6%	23.9%	12.2%	8.5%
Peripheral Revenue	5	3	4	4	4	4	3	-.2%	-36.3%	22.5%	1.0%	-4.8%	-7.9%	-8.8%
Service Revenue	7	8	6	7	8	9	10	5.1%	3.1%	-21.5%	22.3%	14.8%	9.7%	5.8%
Total Revenue	48	52	64	81	91	97	101	14.4%	7.2%	24.2%	25.8%	13.4%	6.4%	4.1%
EUROPE TECHNICAL WORKSTATION														
Wkstn Shipments	203	337	472	566	623	654	670	14.7%	65.9%	40.0%	20.0%	10.0%	5.0%	2.5%
Wkstn Installed Base	285	622	1,075	1,608	2,167	2,734	3,267	39.4%	118.3%	72.9%	49.7%	34.7%	26.2%	19.5%
Average Price Per Seat	82.3	45.5	36.4	29.1	23.3	18.6	14.9	-20.0%	-44.7%	-20.0%	-20.1%	-19.9%	-20.2%	-19.9%
CPU Revenue	4	4	5	5	5	4	4	-2.4%	9.9%	22.8%	3.7%	-6.7%	-12.2%	-15.1%
Workstation Revenue	4	4	5	5	5	4	4	-2.4%	9.9%	22.8%	3.7%	-6.7%	-12.2%	-15.1%
Software Revenue	8	12	24	38	48	54	58	37.3%	56.7%	100.6%	58.7%	25.9%	12.4%	8.5%
Peripheral Revenue	3	2	2	3	2	2	2	.0%	-32.6%	38.6%	3.7%	-6.7%	-12.3%	-15.0%
Service Revenue	2	4	3	5	5	6	7	11.2%	67.8%	-13.6%	33.4%	20.6%	13.4%	7.9%
Total Revenue	20	26	40	55	65	70	74	23.6%	29.1%	54.9%	39.6%	17.9%	8.0%	5.0%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE HOST-DEPENDENT														
Wkstn Shipments	138	127	120	117	116	115	115	-2.0%	-8.4%	-5.0%	-2.5%	-1.2%	-.6%	-.3%
Wkstn Installed Base	418	545	638	717	790	850	905	10.7%	30.3%	17.1%	12.4%	10.2%	7.6%	6.5%
Average Price Per Seat	139.5	136.2	124.3	117.7	111.6	105.6	100.1	-6.0%	-2.4%	-8.7%	-5.3%	-5.2%	-5.3%	-5.2%
CPU Revenue	9	11	9	9	9	9	9	-4.8%	31.3%	-16.0%	-3.1%	-1.7%	-1.1%	-.9%
Workstation Revenue	6	3	3	2	2	1	1	-24.0%	-42.1%	-10.8%	-19.1%	-22.3%	-27.6%	-37.4%
Software Revenue	6	6	8	9	11	12	13	16.8%	5.9%	28.6%	20.7%	16.0%	11.6%	8.3%
Peripheral Revenue	3	2	2	2	2	2	2	-.8%	-38.3%	3.2%	-3.1%	-1.9%	-1.3%	-.7%
Service Revenue	5	4	3	3	3	3	3	-4.1%	-26.1%	-30.3%	7.1%	4.8%	2.5%	1.4%
Total Revenue	27	26	24	25	26	27	27	1.1%	-6.1%	-5.8%	3.6%	3.6%	2.6%	1.7%
EUROPE PERSONAL COMPUTER														
Wkstn Shipments	40	77	88	102	107	107	102	5.7%	94.8%	15.0%	15.0%	5.0%	.0%	-5.0%
Wkstn Installed Base	40	116	205	305	405	500	587	38.2%	194.8%	76.0%	48.7%	33.1%	23.4%	17.3%
Average Price Per Seat	25.1	5.3	4.0	3.4	3.3	3.2	3.2	-9.6%	-78.9%	-24.5%	-15.0%	-2.9%	-3.0%	.0%
CPU Revenue	0	0	0	0	0	0	0	-4.6%	58.3%	-15.8%	.0%	.0%	.0%	-6.3%
Workstation Revenue	0	0	0	0	0	0	0	-4.6%	58.3%	-15.8%	.0%	.0%	.0%	-6.3%
Software Revenue	1	0	0	0	0	0	0	-24.2%	-94.3%	-50.0%	.0%	.0%	.0%	-50.0%
Peripheral Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	.0%	.0%	.0%	.0%
Service Revenue	0	0	0	0	0	0	0	38.0%	-87.5%	100.0%	50.0%	33.3%	25.0%	.0%
Total Revenue	1	0	0	0	0	0	0	-2.4%	-59.8%	-11.6%	2.6%	2.6%	.0%	-5.0%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

	ANNUAL PERCENT CHANGES													
								86-91						
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST ALL PLATFORMS														
Wkstn Shipments	406	474	599	700	761	793	819	11.5%	16.9%	26.3%	16.8%	8.7%	4.3%	3.2%
Wkstn Installed Base	646	1,121	1,679	2,313	2,973	3,627	4,256	30.6%	73.4%	49.8%	37.8%	28.5%	22.0%	17.3%
Average Price Per Seat	87.1	111.4	95.7	85.1	75.4	65.7	57.7	-12.3%	27.9%	-14.0%	-11.1%	-11.5%	-12.8%	-12.1%
CPU Revenue	13	19	23	25	25	24	23	3.0%	45.4%	19.0%	6.1%	.4%	-4.1%	-4.7%
Workstation Revenue	11	14	15	16	16	14	13	-2.2%	33.0%	2.3%	9.5%	-1.3%	-9.0%	-11.0%
Software Revenue	11	17	23	32	39	47	55	26.7%	53.2%	39.7%	35.1%	23.8%	20.1%	16.6%
Peripheral Revenue	4	7	7	8	9	8	8	2.9%	67.7%	12.5%	12.9%	2.1%	-5.1%	-6.1%
Service Revenue	3	6	11	14	18	20	22	29.1%	112.0%	74.5%	32.7%	22.1%	15.1%	10.2%
Total Revenue	42	63	80	95	106	114	120	13.7%	50.9%	25.5%	19.5%	11.4%	7.2%	5.9%
FAR EAST TECHNICAL WORKSTATION														
Wkstn Shipments	142	278	411	509	570	604	634	18.0%	95.7%	47.9%	23.9%	12.0%	6.0%	5.0%
Wkstn Installed Base	189	467	864	1,347	1,863	2,392	2,907	44.2%	146.8%	85.0%	55.9%	38.3%	28.4%	21.5%
Average Price Per Seat	58.6	101.8	91.6	82.5	72.2	61.3	52.1	-12.5%	73.7%	-10.0%	-9.9%	-12.5%	-15.1%	-15.0%
CPU Revenue	2	7	11	13	13	13	12	9.7%	293.0%	46.1%	20.6%	3.8%	-5.9%	-7.7%
Workstation Revenue	2	7	11	13	13	13	12	9.7%	292.5%	46.3%	20.6%	3.8%	-5.9%	-7.7%
Software Revenue	4	12	19	26	32	39	45	30.1%	211.8%	56.6%	37.0%	23.5%	20.2%	17.0%
Peripheral Revenue	1	4	5	6	7	6	6	6.8%	258.1%	27.4%	20.6%	3.9%	-6.0%	-7.6%
Service Revenue	1	3	7	10	13	16	18	39.2%	374.6%	103.0%	47.4%	29.6%	19.4%	12.8%
Total Revenue	10	34	53	68	79	86	92	21.8%	260.7%	53.3%	29.9%	15.1%	9.0%	7.2%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST HOST-DEPENDENT														
Wkstn Shipments	201	140	123	116	113	111	110	-4.7%	-30.3%	-12.0%	-6.0%	-3.0%	-1.5%	-.7%
Wkstn Installed Base	395	535	632	710	780	836	888	10.7%	35.6%	18.1%	12.4%	9.9%	7.2%	6.2%
Average Price Per Seat	131.5	173.2	157.7	149.4	141.6	134.1	127.0	-6.0%	31.6%	-8.9%	-5.2%	-5.2%	-5.3%	-5.3%
CPU Revenue	11	12	12	12	11	11	11	-2.1%	5.8%	2.8%	-6.5%	-3.5%	-2.1%	-1.3%
Workstation Revenue	9	7	4	3	2	2	1	-31.8%	-21.6%	-44.8%	-21.9%	-23.6%	-28.3%	-37.5%
Software Revenue	7	5	4	6	7	9	10	16.0%	-32.9%	-4.3%	27.4%	25.2%	19.7%	14.7%
Peripheral Revenue	3	2	2	2	2	2	2	-5.5%	-11.2%	-13.5%	-6.6%	-3.5%	-2.1%	-1.1%
Service Revenue	2	3	4	4	4	5	5	10.1%	27.6%	39.7%	7.1%	4.5%	2.3%	1.3%
Total Revenue	32	29	27	26	27	27	28	-.5%	-10.0%	-7.4%	-.9%	1.8%	2.3%	2.0%
FAR EAST PERSONAL COMPUTER														
Wkstn Shipments	63	56	65	75	78	78	74	5.7%	-9.8%	15.0%	15.0%	5.0%	.0%	-5.0%
Wkstn Installed Base	63	119	184	257	330	398	461	31.1%	90.2%	54.5%	39.6%	28.5%	20.8%	15.7%
Average Price Per Seat	8.5	5.0	3.7	3.2	3.1	2.9	3.0	-9.7%	-41.2%	-26.0%	-13.5%	-3.1%	-6.5%	3.4%
CPU Revenue	0	0	0	0	0	0	0	-6.5%	-30.0%	-21.4%	.0%	.0%	.0%	-9.1%
Workstation Revenue	0	0	0	0	0	0	0	-6.5%	-30.0%	-21.4%	.0%	.0%	.0%	-9.1%
Software Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	.0%	.0%	-100.0%	ERR
Peripheral Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	.0%	.0%	.0%	.0%
Service Revenue	0	0	0	0	0	0	0	ERR	ERR	ERR	50.0%	.0%	33.3%	.0%
Total Revenue	1	0	0	0	0	0	0	-2.2%	-47.3%	-10.3%	3.8%	.0%	.0%	-3.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD ALL PLATFORMS														
Wksth Shipments	47	107	166	206	228	235	231	16.7%	128.7%	55.7%	23.7%	10.8%	3.2%	-1.7%
Wksth Installed Base	834	941	1,063	1,212	1,375	1,531	1,670	12.2%	12.8%	12.9%	14.0%	13.5%	11.3%	9.1%
Average Price Per Seat	76.2	86.6	69.1	57.9	48.6	42.2	36.6	-15.8%	13.7%	-20.3%	-16.2%	-16.0%	-13.1%	-13.4%
CPU Revenue	1	6	6	6	6	5	5	-3.5%	354.0%	3.7%	5.5%	-5.4%	-7.5%	-12.6%
Workstation Revenue	1	2	3	3	3	2	2	-2.4%	105.0%	26.1%	3.4%	-7.0%	-12.0%	-17.2%
Software Revenue	1	1	2	3	3	3	3	29.8%	14.1%	159.6%	19.5%	11.6%	5.5%	.9%
Peripheral Revenue	1	1	1	2	2	1	1	9.0%	66.7%	63.5%	12.2%	-1.3%	-5.2%	-10.3%
Service Revenue	1	1	3	3	4	4	4	24.2%	77.8%	113.9%	11.7%	9.6%	7.2%	5.2%
Total Revenue	4	11	15	17	17	16	15	7.1%	149.9%	39.2%	9.3%	.8%	-2.4%	-5.9%
REST OF WORLD TECHNICAL WORKSTATION														
Wksth Shipments	28	70	122	161	185	194	194	22.8%	152.4%	75.0%	32.0%	15.0%	5.0%	.0%
Wksth Installed Base	28	98	216	371	541	713	871	54.9%	248.1%	121.7%	71.3%	45.9%	31.9%	22.2%
Average Price Per Seat	59.9	37.9	34.1	30.7	27.7	24.9	22.4	-10.0%	-36.7%	-10.0%	-10.0%	-9.8%	-10.1%	-10.0%
CPU Revenue	0	1	1	2	2	2	2	10.0%	102.1%	25.3%	27.7%	9.9%	-1.2%	-7.3%
Workstation Revenue	0	1	1	2	2	2	2	10.2%	100.0%	26.6%	27.7%	9.9%	-1.2%	-7.3%
Software Revenue	0	1	1	2	2	2	1	19.3%	34.9%	141.4%	10.7%	1.3%	-4.5%	-6.7%
Peripheral Revenue	0	0	1	1	1	1	1	25.9%	-14.3%	145.8%	28.8%	9.2%	-1.2%	-7.3%
Service Revenue	0	1	1	1	1	2	2	31.7%	57.6%	23.1%	60.9%	37.9%	24.6%	16.4%
Total Revenue	2	3	5	6	7	7	7	17.7%	64.8%	54.8%	27.6%	12.2%	3.2%	-1.4%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD HOST-DEPENDENT														
Wkstn Shipments	12	35	42	42	40	38	34	- .5%	200.4%	20.0%	.0%	-5.0%	-5.0%	-10.0%
Wkstn Installed Base	798	833	833	825	815	795	774	-1.5%	4.4%	.0%	-1.0%	-1.2%	-2.4%	-2.7%
Average Price Per Seat	160.0	190.0	175.9	167.2	150.6	135.3	121.7	-8.5%	18.8%	-7.4%	-4.9%	-10.0%	-10.1%	-10.1%
CPU Revenue	1	5	5	5	4	4	3	-7.5%	506.5%	-.6%	-.2%	-10.4%	-10.1%	-15.0%
Workstation Revenue	1	1	1	1	1	1	0	-23.7%	119.6%	25.9%	-17.0%	-29.1%	-33.7%	-47.3%
Software Revenue	0	0	1	1	2	2	2	43.4%	-11.4%	193.5%	33.0%	24.8%	15.9%	7.4%
Peripheral Revenue	0	1	1	1	1	1	1	-2.0%	165.2%	31.1%	.0%	-11.3%	-9.9%	-14.1%
Service Revenue	0	1	2	2	2	2	2	18.9%	91.7%	165.2%	-1.2%	-2.5%	-3.4%	-3.5%
Total Revenue	2	8	10	10	10	9	8	1.1%	226.0%	33.0%	.3%	-6.4%	-6.6%	-9.6%
REST OF WORLD PERSONAL COMPUTER														
Wkstn Shipments	8	3	3	3	4	4	3	5.7%	-66.2%	15.2%	14.9%	5.0%	.0%	-5.0%
Wkstn Installed Base	8	10	13	16	20	23	25	20.0%	33.8%	29.1%	24.9%	19.7%	15.2%	12.0%
Average Price Per Seat	7.9	7.8	3.4	2.9	2.8	2.8	2.9	-18.0%	-1.3%	-56.4%	-14.7%	-3.4%	.0%	3.6%
CPU Revenue	0	0	0	0	0	0	0	.0%	ERR	.0%	.0%	.0%	.0%	.0%
Workstation Revenue	0	0	0	0	0	0	0	.0%	-66.7%	.0%	.0%	.0%	.0%	.0%
Software Revenue	0	0	0	0	0	0	0	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Peripheral Revenue	0	0	0	0	0	0	0	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Service Revenue	0	0	0	0	0	0	0	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Total Revenue	0	0	0	0	0	0	0	-19.7%	-50.0%	-66.7%	.0%	.0%	.0%	.0%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE ALL PLATFORMS														
Wkstn Shipments	6,619	10,569	13,199	14,530	15,639	16,395	17,091	10.1%	59.7%	24.9%	10.1%	7.6%	4.8%	4.2%
Wkstn Installed Base	19,161	29,730	42,074	55,445	69,132	82,683	95,602	26.3%	55.2%	41.5%	31.8%	24.7%	19.6%	15.6%
Average Price Per Seat	66.2	49.6	40.3	36.0	33.3	31.6	30.3	-9.4%	-25.2%	-18.6%	-10.8%	-7.4%	-5.1%	-4.1%
CPU Revenue	140	191	200	200	202	204	206	1.5%	36.6%	4.6%	-1.2%	1.2%	1.0%	.7%
Workstation Revenue	123	144	145	142	140	138	135	-1.3%	16.7%	1.0%	-2.3%	-1.2%	-1.6%	-2.0%
Software Revenue	136	174	203	226	245	254	254	7.9%	27.9%	16.5%	11.7%	8.2%	3.6%	-0.0%
Peripheral Revenue	53	66	73	78	85	93	101	8.7%	24.2%	10.5%	7.2%	8.7%	8.8%	8.7%
Service Revenue	69	76	122	148	173	198	220	23.8%	10.0%	60.4%	21.3%	17.3%	14.3%	11.4%
Total Revenue	521	651	743	794	846	887	916	7.1%	24.9%	14.1%	6.9%	6.5%	4.8%	3.3%
WORLDWIDE TECHNICAL WORKSTATION														
Wkstn Shipments	2,118	3,637	4,792	5,996	7,201	8,361	9,438	21.0%	71.7%	31.7%	25.1%	20.1%	16.1%	12.9%
Wkstn Installed Base	4,014	7,651	12,366	18,115	24,773	32,143	39,973	39.2%	90.6%	61.6%	46.5%	36.8%	29.7%	24.4%
Average Price Per Seat	81.7	67.7	56.0	47.6	41.4	36.7	33.0	-13.4%	-17.1%	-17.3%	-15.0%	-13.0%	-11.4%	-10.1%
CPU Revenue	40	68	76	83	88	91	93	6.5%	69.0%	12.2%	8.9%	6.1%	3.8%	1.9%
Workstation Revenue	40	67	76	83	88	91	93	6.6%	68.1%	12.8%	8.9%	6.1%	3.8%	1.9%
Software Revenue	67	85	99	117	135	147	152	12.2%	27.0%	15.9%	19.1%	15.1%	8.5%	3.4%
Peripheral Revenue	26	33	40	47	54	61	68	15.3%	27.4%	19.8%	17.0%	14.9%	13.2%	11.8%
Service Revenue	29	33	59	80	101	121	141	33.9%	12.9%	80.6%	34.5%	26.3%	20.6%	16.3%
Total Revenue	202	286	350	410	465	511	546	13.8%	41.5%	22.2%	17.1%	13.6%	9.9%	6.9%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
WORLDWIDE HOST-DEPENDENT														
Wkstn Shipments	2,341	1,978	2,088	1,946	1,850	1,768	1,695	-3.0%	-15.5%	5.5%	-6.8%	-4.9%	-4.4%	-4.2%
Wkstn Installed Base	11,989	13,968	15,357	16,535	17,392	18,117	18,543	5.8%	16.5%	9.9%	7.7%	5.2%	4.2%	2.4%
Average Price Per Seat	98.0	121.2	106.7	101.9	100.6	101.3	103.3	-3.1%	23.7%	-12.0%	-4.5%	-1.2%	.7%	2.0%
CPU Revenue	92	109	108	101	99	99	100	-1.8%	19.1%	-1.2%	-6.2%	-1.9%	-.1%	.7%
Workstation Revenue	75	62	53	43	37	33	29	-14.2%	-17.1%	-14.8%	-18.5%	-14.2%	-12.2%	-11.0%
Software Revenue	41	50	51	48	46	43	41	-3.8%	20.3%	1.9%	-5.9%	-4.7%	-5.3%	-4.8%
Peripheral Revenue	25	29	29	28	28	28	29	.1%	18.4%	-.5%	-5.0%	.1%	2.5%	3.8%
Service Revenue	39	38	60	64	68	71	73	13.9%	-2.2%	56.2%	7.4%	5.6%	4.8%	3.2%
Total Revenue	272	289	301	284	277	274	273	-1.2%	6.2%	4.1%	-5.5%	-2.4%	-1.1%	-.6%
WORLDWIDE PERSONAL COMPUTER														
Wkstn Shipments	2,160	4,954	6,320	6,587	6,587	6,266	5,959	3.8%	129.4%	27.6%	4.2%	.0%	-4.9%	-4.9%
Wkstn Installed Base	3,158	8,112	14,350	20,794	26,966	32,423	37,085	35.5%	156.9%	76.9%	44.9%	29.7%	20.2%	14.4%
Average Price Per Seat	16.7	7.7	6.5	5.8	5.5	5.3	5.1	-7.9%	-53.9%	-15.6%	-10.8%	-5.2%	-3.6%	-3.8%
CPU Revenue	8	14	16	16	15	14	13	-1.5%	75.3%	13.7%	-2.3%	-3.8%	-7.2%	-6.4%
Workstation Revenue	8	14	16	16	15	14	13	-1.5%	75.3%	13.7%	-2.3%	-3.8%	-7.2%	-6.4%
Software Revenue	28	39	53	61	64	64	61	9.4%	41.3%	36.6%	14.9%	5.1%	-.2%	-4.7%
Peripheral Revenue	2	4	4	4	4	4	3	-1.5%	48.4%	13.9%	-2.6%	-3.4%	-7.4%	-6.6%
Service Revenue	1	5	3	4	5	5	6	4.6%	547.9%	-45.0%	38.8%	24.9%	17.3%	12.1%
Total Revenue	47	76	92	100	103	101	97	5.1%	61.4%	21.8%	8.8%	2.7%	-1.7%	-4.3%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

	ANNUAL PERCENT CHANGES													
								86-91						
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA ALL PLATFORMS														
Wkstn Shipments	3,518	4,694	5,832	6,446	6,944	7,285	7,605	10.1%	33.4%	24.2%	10.5%	7.7%	4.9%	4.4%
Wkstn Installed Base	10,316	15,010	20,407	26,290	32,316	38,282	43,973	24.0%	45.5%	36.0%	28.8%	22.9%	18.5%	14.9%
Average Price Per Seat	58.9	43.7	30.9	26.8	24.6	23.6	22.9	-12.1%	-25.8%	-29.1%	-13.4%	-8.2%	-4.2%	-2.9%
CPU Revenue	65	86	65	61	61	61	61	-6.8%	33.8%	-25.3%	-4.9%	-1.4%	-.1%	.6%
Workstation Revenue	59	59	50	48	48	49	49	-3.6%	1.4%	-16.0%	-3.1%	.1%	.8%	1.1%
Software Revenue	66	66	87	97	106	112	114	11.4%	.6%	30.9%	11.8%	9.3%	5.6%	1.4%
Peripheral Revenue	29	22	25	26	29	32	35	9.7%	-23.6%	13.3%	5.1%	8.8%	10.4%	11.2%
Service Revenue	38	35	47	55	62	70	78	17.5%	-6.9%	34.9%	15.8%	14.2%	12.9%	11.1%
Total Revenue	256	269	274	288	306	324	337	4.6%	5.3%	1.6%	5.2%	6.4%	5.6%	4.3%
NORTH AMERICA TECHNICAL WORKSTATION														
Wkstn Shipments	1,316	1,818	2,363	2,930	3,493	4,029	4,524	20.0%	38.2%	30.0%	24.0%	19.2%	15.4%	12.3%
Wkstn Installed Base	2,238	4,055	6,378	9,180	12,397	15,931	19,658	37.1%	81.2%	57.3%	43.9%	35.0%	28.5%	23.4%
Average Price Per Seat	69.6	54.8	45.5	39.3	35.0	32.0	29.7	-11.5%	-21.3%	-17.0%	-13.6%	-10.9%	-8.6%	-7.2%
CPU Revenue	20	30	30	33	36	38	40	6.3%	49.6%	3.0%	9.7%	7.9%	6.2%	4.7%
Workstation Revenue	20	29	30	33	36	38	40	6.4%	48.5%	3.8%	9.7%	7.9%	6.2%	4.7%
Software Revenue	36	32	42	52	61	68	71	17.3%	-9.6%	29.5%	23.7%	18.8%	11.1%	5.2%
Peripheral Revenue	16	12	16	19	22	25	29	19.0%	-25.8%	30.4%	17.9%	16.9%	15.8%	14.9%
Service Revenue	14	14	25	33	42	50	59	32.5%	1.3%	71.5%	33.1%	26.1%	21.0%	17.1%
Total Revenue	106	118	143	170	197	220	240	15.3%	11.2%	21.7%	18.7%	15.7%	11.9%	8.9%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA HOST-DEPENDENT														
Wkstn Shipments	1,258	753	602	506	441	396	364	-13.5%	-40.2%	-20.0%	-16.0%	-12.8%	-10.2%	-8.2%
Wkstn Installed Base	6,386	7,139	7,384	7,521	7,511	7,456	7,298	.4%	11.8%	3.4%	1.9%	-.1%	-.7%	-2.1%
Average Price Per Seat	80.8	122.9	98.3	88.0	82.2	79.2	78.1	-8.7%	52.0%	-20.0%	-10.5%	-6.6%	-3.7%	-1.4%
CPU Revenue	41	51	29	23	19	17	16	-20.6%	26.3%	-43.9%	-20.8%	-14.9%	-10.3%	-6.7%
Workstation Revenue	35	24	14	10	7	6	5	-28.1%	-29.2%	-42.3%	-31.2%	-25.5%	-21.2%	-17.6%
Software Revenue	18	14	19	19	18	17	17	3.5%	-20.0%	36.3%	-4.0%	-3.6%	-3.3%	-2.8%
Peripheral Revenue	12	10	8	6	5	5	5	-13.4%	-17.3%	-21.1%	-19.8%	-13.2%	-7.8%	-3.8%
Service Revenue	23	18	21	20	19	18	17	-1.3%	-19.5%	16.8%	-5.1%	-5.6%	-5.1%	-5.7%
Total Revenue	128	118	91	78	69	64	60	-12.7%	-7.4%	-22.6%	-15.1%	-10.9%	-8.0%	-6.1%
NORTH AMERICA PERSONAL COMPUTER														
Wkstn Shipments	944	2,124	2,867	3,010	3,010	2,860	2,717	5.0%	124.9%	35.0%	5.0%	.0%	-5.0%	-5.0%
Wkstn Installed Base	1,692	3,816	6,645	9,589	12,407	14,895	17,016	34.9%	125.5%	74.1%	44.3%	29.4%	20.0%	14.2%
Average Price Per Seat	14.7	6.0	4.8	4.3	4.1	4.0	4.0	-7.8%	-59.2%	-20.0%	-10.4%	-4.7%	-2.4%	.0%
CPU Revenue	4	6	5	5	5	5	5	-4.0%	31.0%	-4.4%	-2.0%	-2.5%	-5.8%	-5.1%
Workstation Revenue	4	6	5	5	5	5	5	-4.0%	31.0%	-4.4%	-2.0%	-2.5%	-5.8%	-5.1%
Software Revenue	13	20	26	27	27	27	25	4.9%	58.7%	29.4%	4.4%	.2%	-.9%	-5.5%
Peripheral Revenue	1	0	1	1	1	1	1	61.3%	-83.1%	1181.8%	-2.1%	-2.2%	-5.9%	-5.5%
Service Revenue	0	2	1	1	2	2	2	-1.2%	400.0%	-58.1%	36.4%	25.0%	17.3%	12.5%
Total Revenue	22	34	39	40	40	40	38	2.4%	50.3%	16.2%	3.1%	.1%	-1.6%	-4.5%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE ALL PLATFORMS														
Wkstn Shipments	1,610	3,001	3,481	3,924	4,384	4,769	5,137	11.3%	86.4%	16.0%	12.7%	11.7%	8.8%	7.7%
Wkstn Installed Base	3,575	6,576	9,916	13,615	17,572	21,655	25,737	31.4%	84.0%	50.8%	37.3%	29.1%	23.2%	18.8%
Average Price Per Seat	69.4	50.7	40.9	35.1	30.3	26.6	23.2	-14.4%	-27.0%	-19.4%	-14.2%	-13.7%	-12.3%	-12.5%
CPU Revenue	34	52	46	45	43	42	39	-5.4%	54.6%	-11.0%	-3.1%	-3.0%	-4.2%	-5.4%
Workstation Revenue	30	42	40	39	38	37	35	-4.0%	39.7%	-6.1%	-1.5%	-2.2%	-4.1%	-5.8%
Software Revenue	38	56	65	74	80	81	79	7.1%	48.0%	15.4%	13.8%	7.8%	1.8%	-1.9%
Peripheral Revenue	12	17	20	22	23	24	25	7.5%	43.6%	17.8%	6.5%	6.0%	4.7%	3.3%
Service Revenue	20	23	34	42	49	56	62	21.8%	14.0%	47.6%	22.8%	17.7%	13.8%	10.4%
Total Revenue	134	191	205	221	234	240	240	4.7%	42.2%	7.6%	7.8%	5.5%	2.5%	.3%
EUROPE TECHNICAL WORKSTATION														
Wkstn Shipments	411	1,268	1,712	2,192	2,683	3,164	3,617	23.3%	208.6%	35.0%	28.0%	22.4%	17.9%	14.3%
Wkstn Installed Base	1,298	2,566	4,253	6,360	8,852	11,662	14,696	41.8%	97.7%	65.7%	49.5%	39.2%	31.7%	26.0%
Average Price Per Seat	104.1	81.2	64.2	51.5	41.8	34.3	28.4	-19.0%	-22.0%	-20.9%	-19.8%	-18.8%	-17.9%	-17.2%
CPU Revenue	11	27	31	33	33	32	31	2.3%	157.0%	13.7%	5.0%	.9%	-2.4%	-5.0%
Workstation Revenue	11	27	31	33	33	32	31	2.3%	156.0%	14.1%	5.0%	.9%	-2.4%	-5.0%
Software Revenue	16	38	38	43	46	48	48	4.9%	135.1%	1.1%	11.5%	8.8%	3.8%	-.2%
Peripheral Revenue	6	13	16	18	20	21	22	11.6%	132.2%	26.6%	12.9%	9.2%	6.5%	4.3%
Service Revenue	9	13	24	31	39	46	52	31.1%	52.9%	75.8%	32.9%	24.0%	17.8%	13.3%
Total Revenue	52	119	140	158	171	180	184	9.1%	129.5%	18.3%	12.4%	8.6%	4.9%	2.1%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE HOST-DEPENDENT														
Wkstn Shipments	493	377	306	259	228	206	190	-12.8%	-23.6%	-18.9%	-15.1%	-12.1%	-9.7%	-7.7%
Wkstn Installed Base	1,511	1,887	2,099	2,253	2,346	2,412	2,433	5.2%	24.9%	11.2%	7.4%	4.1%	2.8%	.9%
Average Price Per Seat	109.5	110.3	83.8	72.2	65.6	62.0	60.3	-11.4%	.7%	-24.0%	-13.8%	-9.1%	-5.5%	-2.8%
CPU Revenue	21	21	12	10	8	7	7	-20.7%	1.0%	-40.5%	-22.9%	-16.5%	-11.5%	-7.6%
Workstation Revenue	18	12	6	4	3	2	2	-30.4%	-34.0%	-47.3%	-33.0%	-27.0%	-22.1%	-18.5%
Software Revenue	11	8	9	9	9	9	9	2.7%	-31.1%	23.1%	-1.9%	-.2%	-3.0%	-2.0%
Peripheral Revenue	5	4	3	3	2	2	2	-14.9%	-19.2%	-22.1%	-21.9%	-14.9%	-9.0%	-5.0%
Service Revenue	11	8	10	10	10	9	9	2.1%	-27.5%	23.4%	-1.6%	-2.7%	-2.7%	-3.5%
Total Revenue	66	52	41	35	32	30	28	-11.8%	-20.1%	-21.5%	-14.4%	-9.5%	-7.3%	-5.3%
EUROPE PERSONAL COMPUTER														
Wkstn Shipments	706	1,356	1,463	1,473	1,473	1,399	1,329	-.4%	92.0%	7.9%	.7%	.0%	-5.0%	-5.0%
Wkstn Installed Base	766	2,123	3,564	5,001	6,374	7,582	8,608	32.3%	177.0%	67.9%	40.3%	27.4%	18.9%	13.5%
Average Price Per Seat	21.4	5.7	4.6	4.1	3.9	3.8	3.8	-7.8%	-73.4%	-19.3%	-10.9%	-4.9%	-2.6%	.0%
CPU Revenue	2	4	3	2	2	2	2	-9.8%	61.9%	-27.4%	-6.1%	-2.4%	-5.8%	-4.9%
Workstation Revenue	2	4	3	2	2	2	2	-9.8%	61.9%	-27.4%	-6.1%	-2.4%	-5.8%	-4.9%
Software Revenue	11	11	17	22	24	24	23	15.8%	-.5%	59.1%	27.1%	9.0%	-.5%	-5.2%
Peripheral Revenue	1	0	1	1	1	1	1	47.6%	-93.1%	750.0%	-5.9%	-1.6%	-6.3%	-5.1%
Service Revenue	0	2	0	1	1	1	1	-9.2%	450.0%	-70.8%	33.3%	21.7%	16.4%	11.8%
Total Revenue	17	20	24	28	30	30	29	7.7%	17.0%	20.6%	19.0%	7.0%	-1.0%	-4.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST ALL PLATFORMS														
Wkstn Shipments	1,353	2,586	3,521	3,763	3,897	3,915	3,918	8.7%	91.2%	36.2%	6.9%	3.6%	.5%	.1%
Wkstn Installed Base	2,205	4,791	8,186	11,735	15,219	18,505	21,477	35.0%	117.3%	70.9%	43.3%	29.7%	21.6%	16.1%
Average Price Per Seat	84.1	58.8	55.7	53.0	52.3	53.1	54.1	-1.7%	-30.2%	-5.2%	-4.8%	-1.3%	1.5%	1.8%
CPU Revenue	40	44	84	89	93	97	101	17.8%	11.1%	90.4%	5.2%	5.2%	4.2%	3.5%
Workstation Revenue	32	38	52	51	50	49	48	4.7%	17.6%	36.4%	-2.0%	-1.7%	-2.1%	-2.3%
Software Revenue	31	49	46	49	52	53	53	1.5%	59.9%	-7.4%	7.7%	6.2%	2.3%	-.6%
Peripheral Revenue	12	25	26	28	31	35	38	8.4%	120.3%	1.6%	9.8%	10.6%	10.3%	10.0%
Service Revenue	10	16	33	43	54	63	72	35.3%	54.3%	106.4%	32.6%	23.3%	18.1%	13.9%
Total Revenue	125	173	240	260	280	297	311	12.5%	38.6%	39.0%	8.4%	7.7%	6.1%	4.8%
FAR EAST TECHNICAL WORKSTATION														
Wkstn Shipments	354	432	561	696	829	957	1,074	20.0%	22.0%	30.0%	24.0%	19.2%	15.4%	12.3%
Wkstn Installed Base	429	860	1,413	2,080	2,847	3,690	4,580	39.7%	100.7%	64.2%	47.2%	36.9%	29.6%	24.1%
Average Price Per Seat	103.9	90.4	81.0	74.3	69.3	65.6	62.8	-7.0%	-13.0%	-10.4%	-8.3%	-6.7%	-5.3%	-4.3%
CPU Revenue	9	9	13	15	17	19	20	17.4%	-1.1%	42.5%	16.5%	13.0%	10.2%	7.7%
Workstation Revenue	9	9	13	15	17	19	20	17.4%	-1.3%	42.8%	16.5%	13.0%	10.2%	7.7%
Software Revenue	15	14	17	22	26	29	31	16.6%	-3.1%	20.8%	26.7%	19.8%	11.5%	5.5%
Peripheral Revenue	4	8	7	8	10	12	15	13.7%	105.9%	-12.8%	25.0%	22.5%	20.1%	18.2%
Service Revenue	6	4	10	14	18	23	27	44.9%	-23.8%	130.8%	40.5%	31.2%	25.0%	20.2%
Total Revenue	42	44	60	74	89	102	113	20.6%	4.8%	34.4%	24.4%	19.5%	14.8%	11.2%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST HOST-DEPENDENT														
Wkstn Shipments	559	789	1,117	1,117	1,117	1,106	1,084	6.6%	41.1%	41.6%	.0%	.0%	-1.0%	-2.0%
Wkstn Installed Base	1,156	1,945	2,964	3,933	4,814	5,631	6,321	26.6%	68.3%	52.4%	32.7%	22.4%	17.0%	12.2%
Average Price Per Seat	126.0	121.8	117.2	115.5	115.7	117.3	120.1	-.3%	-3.3%	-3.8%	-1.5%	.2%	1.5%	2.4%
CPU Revenue	29	31	64	66	69	72	74	19.4%	4.4%	107.5%	3.7%	4.6%	4.2%	3.4%
Workstation Revenue	22	24	31	28	26	24	22	-2.5%	11.7%	27.7%	-9.8%	-8.5%	-8.4%	-8.6%
Software Revenue	12	28	21	19	18	16	15	-11.9%	126.9%	-24.6%	-9.1%	-7.7%	-8.4%	-8.3%
Peripheral Revenue	7	14	17	18	19	21	22	9.0%	99.2%	20.0%	5.1%	6.8%	6.9%	6.6%
Service Revenue	5	11	22	28	33	38	42	31.5%	128.7%	104.3%	28.4%	19.2%	14.4%	10.2%
Total Revenue	75	108	154	159	165	170	174	10.1%	43.1%	43.5%	2.9%	3.6%	3.2%	2.5%
FAR EAST PERSONAL COMPUTER														
Wkstn Shipments	440	1,365	1,843	1,950	1,950	1,853	1,760	5.2%	210.4%	35.0%	5.8%	.0%	-5.0%	-5.0%
Wkstn Installed Base	621	1,986	3,809	5,721	7,557	9,183	10,576	39.7%	219.9%	91.8%	50.2%	32.1%	21.5%	15.2%
Average Price Per Seat	15.1	12.4	10.7	9.7	8.9	8.4	8.1	-8.2%	-17.9%	-13.7%	-9.3%	-8.2%	-5.6%	-3.6%
CPU Revenue	1	5	8	8	7	7	6	5.9%	241.8%	69.9%	-1.3%	-5.2%	-8.8%	-8.0%
Workstation Revenue	1	5	8	8	7	7	6	5.9%	241.8%	69.9%	-1.3%	-5.2%	-8.8%	-8.0%
Software Revenue	4	7	7	8	8	8	7	.6%	89.2%	2.9%	10.9%	1.8%	-4.2%	-7.4%
Peripheral Revenue	1	3	2	2	2	2	2	-14.5%	436.9%	-41.8%	-1.5%	-5.0%	-8.9%	-8.1%
Service Revenue	0	1	1	2	2	3	3	23.8%	3233.3%	23.0%	42.3%	26.3%	17.6%	11.9%
Total Revenue	7	21	26	27	27	26	24	3.0%	192.5%	25.8%	4.2%	-1.1%	-5.2%	-5.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								86-91 CAGR	ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD ALL PLATFORMS														
Wkstn Shipments	138	288	365	396	414	425	431	8.4%	108.9%	26.7%	8.5%	4.5%	2.8%	1.4%
Wkstn Installed Base	3,065	3,353	3,564	3,805	4,024	4,241	4,415	5.7%	9.4%	6.3%	6.8%	5.8%	5.4%	4.1%
Average Price Per Seat	40.9	51.7	35.5	31.4	30.2	29.3	28.8	-11.0%	26.4%	-31.4%	-11.4%	-4.0%	-2.9%	-1.7%
CPU Revenue	2	9	5	5	5	5	5	-10.0%	341.6%	-41.0%	-2.3%	1.6%	.6%	.6%
Workstation Revenue	2	4	3	3	3	3	3	-3.8%	110.6%	-9.5%	-5.2%	-1.5%	-1.3%	-1.3%
Software Revenue	1	2	5	6	7	8	8	30.3%	65.3%	156.6%	19.8%	12.9%	5.9%	2.3%
Peripheral Revenue	1	1	2	2	2	2	2	13.4%	82.9%	39.1%	3.9%	9.2%	8.9%	9.1%
Service Revenue	1	2	8	8	8	8	8	33.8%	115.4%	293.9%	.5%	2.4%	3.0%	2.8%
Total Revenue	7	18	23	24	25	26	27	8.5%	167.7%	31.0%	3.7%	5.0%	3.3%	2.2%
REST OF WORLD TECHNICAL WORKSTATION														
Wkstn Shipments	38	119	155	179	196	211	222	13.2%	216.2%	30.0%	15.0%	10.0%	7.5%	5.0%
Wkstn Installed Base	50	169	322	495	676	860	1,039	43.8%	241.0%	90.9%	53.4%	36.7%	27.2%	20.8%
Average Price Per Seat	52.2	39.7	34.9	32.9	31.9	31.4	31.2	-4.7%	-23.9%	-12.1%	-5.7%	-3.0%	-1.6%	-.6%
CPU Revenue	1	2	2	2	2	2	2	3.2%	232.1%	-12.5%	10.4%	8.2%	7.1%	4.6%
Workstation Revenue	1	2	2	2	2	2	2	3.4%	228.3%	-11.5%	10.4%	8.2%	7.1%	4.6%
Software Revenue	1	1	2	2	1	1	1	8.2%	45.0%	78.2%	-3.2%	-3.3%	-4.8%	-6.5%
Peripheral Revenue	0	0	1	1	1	1	2	30.9%	21.9%	107.7%	18.5%	16.7%	17.0%	14.5%
Service Revenue	0	1	1	1	2	2	3	35.3%	73.0%	51.6%	49.5%	33.8%	25.3%	19.3%
Total Revenue	2	5	6	7	8	9	10	12.8%	126.1%	18.8%	14.6%	12.0%	10.5%	8.3%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
								86-91						
								CAGR	1986	1987	1988	1989	1990	1991
REST OF WORLD HOST-DEPENDENT														
Wkstn Shipments	30	60	63	63	63	60	57	- .9%	96.2%	5.0%	1.0%	.0%	-5.0%	-5.0%
Wkstn Installed Base	2,937	2,996	2,909	2,827	2,721	2,618	2,492	-3.6%	2.0%	-2.9%	-2.8%	-3.8%	-3.8%	-4.8%
Average Price Per Seat	104.5	160.1	109.8	94.5	88.9	87.3	87.4	-11.4%	53.1%	-31.4%	-14.0%	-5.9%	-1.8%	.1%
CPU Revenue	1	7	3	3	3	3	3	-15.6%	424.4%	-49.8%	-8.4%	-1.6%	-3.3%	-2.1%
Workstation Revenue	1	2	2	1	1	1	1	-14.3%	60.9%	-7.3%	-20.7%	-13.8%	-15.2%	-13.7%
Software Revenue	0	0	1	1	1	1	1	20.9%	-35.6%	286.2%	-13.4%	-7.2%	-10.0%	-7.4%
Peripheral Revenue	0	1	1	1	1	1	1	-1.1%	147.2%	1.1%	-7.8%	1.2%	-1.2%	1.2%
Service Revenue	1	1	7	6	6	6	5	34.6%	127.8%	445.5%	-6.9%	-5.0%	-4.4%	-4.4%
Total Revenue	4	11	14	12	12	11	11	- .3%	193.0%	26.1%	-9.5%	-4.9%	-5.3%	-4.4%
REST OF WORLD PERSONAL COMPUTER														
Wkstn Shipments	70	109	147	154	154	154	153	7.0%	56.3%	35.0%	4.9%	.0%	.0%	-1.0%
Wkstn Installed Base	79	187	332	483	628	763	885	36.4%	138.4%	77.4%	45.4%	29.9%	21.6%	16.0%
Average Price Per Seat	7.0	5.5	4.4	4.0	3.8	3.7	3.6	-8.1%	-21.4%	-20.0%	-9.1%	-5.0%	-2.6%	-2.7%
CPU Revenue	0	0	0	0	0	0	0	-3.0%	64.7%	-10.7%	.0%	-4.0%	.0%	.0%
Workstation Revenue	0	0	0	0	0	0	0	-3.0%	64.7%	-10.7%	.0%	-4.0%	.0%	.0%
Software Revenue	0	1	3	4	5	5	6	44.8%	368.4%	191.0%	47.9%	24.3%	12.2%	6.0%
Peripheral Revenue	0	0	0	0	0	0	0	ERR	-100.0%	ERR	-14.3%	.0%	.0%	.0%
Service Revenue	0	0	0	0	0	0	0	.0%	ERR	-55.6%	50.0%	16.7%	14.3%	12.5%
Total Revenue	1	2	3	4	5	6	6	32.3%	176.8%	107.1%	38.6%	20.9%	11.0%	5.4%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

Dataquest

DB a company of
The Dun & Bradstreet Corporation

November 25, 1987

**CAD/CAM INDUSTRY SERVICE
FILING INSTRUCTIONS**

TITLE: Appendix L--Lotus Disks

VOLUME: Industry Overview

TAB: Appendix L Lotus Disks

PAGES: 19

FILING INSTRUCTIONS: File this service section directly behind the Appendix L Lotus Disk tab. Please remove the diskette from the cardboard mailer, and place the diskette in the plastic insert included in this mailing..

Appendix L—Lotus Disks

DATA BASE WORKSHEETS

What You Are Getting

- Diskette containing CAD/CAM Industry Service's application forecast in Lotus format
- Hard copy of the tables—one set per application
- Directions on:
 - How to install the worksheet files
 - How to use the worksheet within Lotus
- A map of the worksheet format
- Hot line number
- Form for comments and suggestions
- Disclaimer

FORECAST DISKETTE

What Is on the Diskette

The Dataquest CAD/CAM Industry service is pleased to offer clients its forecast data base in Lotus format. The diskette you are receiving contains one or more Lotus worksheet files with the same forecast information as that published in Appendix A.

Why We Are Supplying Worksheets

By offering our forecast data base in electronic form, in addition to the published tables in the binders, clients can now easily use our data for a wide range of applications. Some suggestions follow:

- Reformatting Dataquest data for company reports
- Making presentation graphics
- Supplementing internally generated forecasts
- Comparing Dataquest forecasts with other forecasts

- Performing regression and other mathematical analysis
- Segmenting the data differently from the way Dataquest published it

HOW TO INSTALL THE WORKSHEET FILES

If using a PC with a hard disk, copy the files onto the hard disk into the appropriate directory (such as the directory in which Lotus 1-2-3 resides).

If using a PC with two floppy disk drives, make a copy of the worksheet files and work from your copy, *not* from the original files sent to you.

In any case, make a copy of the files and *do not* write over the original files from Dataquest. There is no write protection for these worksheets.

Keep the original Dataquest diskettes and this documentation in the jacket provided in the appropriate application module behind the blue tab marked "Appendix L—Lotus Disks."

HOW TO USE THE WORKSHEET WITHIN LOTUS 1-2-3

These directions assume a working knowledge of Lotus. They are intended to explain what Dataquest is providing and how to use it, not how to use Lotus.

Retrieving a File (/FR)

Once in an empty Lotus worksheet, retrieve the file in which you want to work. Depending on which application modules you subscribe to, and therefore which worksheets you have, the valid choices for retrieval once you are in Lotus are:

Module	File Name	Application
Industry Overview	ALL	All applications
Mechanical	MECH	Mechanical CAD/CAM
Facilities and Mapping	FD MAPP	Facilities Design Mapping
Electronic Design Automation	EDA	Electronic Design
	ECAE	Electronic CAE
	IC	IC Layout
	PCB	PCB Layout

What You See upon Retrieving a File

After the file is retrieved, you will automatically be sent to several screens, each of which asks you to page down for more information. These screens contain information about what is in the file and how to move around. Press the Home key to get to the beginning of the data.

What Is in the Worksheet

Line Items

First, refer to the "Worksheet Map" for a description of the worksheet. Once in the worksheet, you will see the same line items for all segments. The line items include the following data:

- Workstation Shipments
- Workstation Installed Base
- Average Price per Seat
- CPU Revenue
- Workstation Revenue
- Software Revenue
- Peripheral Revenue
- Service Revenue
- Total Revenue

Percentages

All data are for 1985 through 1991. The compound annual growth rate (CAGR) is shown for each line.

What Is the Menu Macro? (ALT M)

When you retrieve the worksheet, you are in control of a macro that shows you several screens about the worksheet. It then puts you into a custom Lotus menu that operates like the standard Lotus menu. You have four choices in this menu: Go To, View Graph, HP Print, and Quit. Each command is explained further.

Go To

Type in the appropriate response, and you can quickly and easily move around the worksheet. The menu will prompt you to choose one of the following named worksheet locations:

Name	Data for Segment:
WW	Worldwide
NA	North America
EUR	Europe
FE	Far East

(In addition to using the Menu Macro to move around the worksheet, you can use your cursor keys to move within the worksheet, or use page up and down, or use the home key. You can also just press the F5 function key (GOTO) and type in one of the ranges named above.)

View Graph

There are 12 predefined graphs; however, you need a graphics card to view them. The View Graph command asks you to select the graph, lets you view it, then returns you to the menu. The graph names and their contents are shown below:

Data by the Platform Segments (PT):

PTREV	Platform revenue
PTREV%	Platform revenue percent change
PTSHIP	Platform workstation shipments
PTSHIP%	Platform workstation shipments percent change

(The three platform segments are technical workstation (TW), host-dependent (HD), and personal computer (PC).)

Data by the Regional Segments (REG):

REGREV	Regional revenue
REGREV%	Regional revenue percent change
REGSHIP	Regional workstation shipments
REGSHIP%	Regional workstation shipments percent change

(The four regional segments are North America (NA), Europe (EUR), Far East (FE), and Rest of World (ROW).)

Data For Worldwide (WW):

WWREV	Worldwide revenue
WWREV%	Worldwide revenue percent change
WWSHIP	Worldwide workstation shipments
WWSHIP%	Worldwide workstation shipments percent change

HP Print

This command allows you to print the entire worksheet formatted for the HP Laser printer. Because of the printer setup strings in Lotus, this command works *only* with the HP Laser. (To print on another printer, you will have to manually change the setup strings, and possibly adjust the margins. The print command in the menu should then work.)

Quit

This command allows you to quit the Menu Macro and return control to yourself.

Note that to quit the worksheet, not the Menu Macro, type the normal Lotus command: \QY.

Remember, you can return to the Menu Macro at any time by pressing ALT M.

WORKSHEET MAP FORMAT

The data base worksheet format is as follows:

- Data: columns A through I, rows 12 through 248
- Percent Changes: columns K through P, rows 12 through 248
- Years: 1985 through 1991
- Segments:
 - Worldwide
 - Technical Workstation
 - Host-Dependent
 - Personal Computer

- North America
 - Technical Workstation
 - Host-Dependent
 - Personal Computer
- Europe
 - Technical Workstation
 - Host-Dependent
 - Personal Computer
- Far East
 - Technical Workstation
 - Host-Dependent
 - Personal Computer
- Rest of World
 - Technical Workstation
 - Host-Dependent
 - Personal Computer

Line Items for Each Segment Above

- Workstation Shipments
- Workstation Installed Base
- Average Price per Seat
- CPU Revenue
- Workstation Revenue
- Software Revenue
- Peripheral Revenue
- Service Revenue
- Total Revenue

DATA BASE WORKSHEETS DISCLAIMER**IMPORTANT MESSAGE—READ THIS**

By accepting this worksheet file, you agree that Dataquest is not responsible for any changes that you may make to the data. If changes are made, Dataquest is no longer the source of the data.

You also agree that you will not divulge, publish, loan, give, sell, or permit anyone else to divulge, publish, loan, give, or sell copies of this data to any person outside your organization.

Dataquest's liability with respect to the data provided is limited to the following:

Dataquest Incorporated represents and warrants to the subscriber that the information contained in the service has been compiled by and is the original product of Dataquest, and that it has the exclusive and unrestricted right to sell the same to the subscriber. The research represents our interpretation and analysis of information generally available to the public but is not guaranteed as to accuracy and completeness. Dataquest will indemnify and hold harmless the subscriber from any obligation or liability to a third party based upon any adverse proprietary claim to such information, but shall not be liable for any other actual, special, or consequential damages.

HOT LINE INFORMATION

If your questions concern the data base format, calculations, or the worksheet and how to use it, call:

Beth Tucker Romig
CAD/CAM Industry Service
Dataquest Incorporated
(408) 971-9000, Ext. 257

If your questions concern the market, application, or the trends and assumptions used to develop the forecast data base, please call one of the following people in the CAD/CAM Industry Service:

Electronic Design Automation	Isadore Katz (408) 971-9000, Ext. 632
Mechanical CAD/CAM	Mike Seely (408) 971-9000, Ext. 600
Workstations	Dave Burdick (408) 971-9000, Ext. 274
Facilities Design or Mapping	Mike Gunville (408) 971-9000, Ext. 670

**DATAQUEST'S CAD/CAM INDUSTRY SERVICE
DATA BASE WORKSHEETS**

COMMENT AND SUGGESTION FORM

Please return to Dataquest

Name _____

Company _____

Application Modules _____

How useful is the Lotus formatted diskette?

____ Very ____ Somewhat ____ Not at All

How often do you use the worksheet?

____ Very ____ Somewhat ____ Not at All

What other information would you like contained in the worksheet?

What other comments do you have about the worksheet?

Return to: Beth Tucker Romig
CAD/CAM Industry Service
Dataquest Incorporated
1290 Ridder Park Drive
San Jose, California 95131

									ANNUAL PERCENT CHANGES					
									86-91					
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991
	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
WORLDWIDE ALL PLATFORMS														
Wkstn Shipments	97,941	142,661	183,664	218,072	245,450	268,634	287,601	15.1%	45.7%	28.7%	18.7%	12.6%	9.4%	7.1%
Wkstn Installed Base	204,636	347,297	526,410	737,618	970,975	1,218,954	1,475,400	33.5%	69.7%	51.6%	40.1%	31.6%	25.5%	21.0%
Average Price Per Seat	48.6	41.3	33.4	28.9	25.7	23.5	21.8	-12.0%	-15.0%	-19.0%	-13.4%	-11.1%	-8.6%	-7.2%
CPU Revenue	1,748	2,212	2,257	2,304	2,288	2,262	2,124	-.8%	26.5%	2.1%	2.1%	-.7%	-1.1%	-6.1%
Workstation Revenue	1,500	1,989	2,089	2,146	2,141	2,117	1,977	-.1%	32.6%	5.0%	2.8%	-.3%	-1.1%	-6.6%
Software Revenue	1,187	1,502	1,879	2,255	2,604	2,955	3,353	17.4%	26.5%	25.1%	20.0%	15.5%	13.5%	13.5%
Peripheral Revenue	553	677	718	752	771	793	937	6.7%	22.5%	6.0%	4.8%	2.5%	2.8%	18.2%
Service Revenue	728	956	1,270	1,601	1,927	2,252	2,569	21.9%	31.4%	32.8%	26.0%	20.4%	16.9%	14.1%
Total Revenue	5,713	7,336	8,212	9,058	9,730	10,379	10,959	8.4%	28.4%	11.9%	10.3%	7.4%	6.7%	5.6%
WORLDWIDE TECHNICAL WORKSTATION														
Wkstn Shipments	15,788	27,690	39,440	52,243	67,628	86,200	106,904	31.0%	75.4%	42.4%	32.5%	29.5%	27.5%	24.0%
Wkstn Installed Base	28,030	55,721	94,986	146,824	212,805	294,815	395,032	48.0%	98.8%	70.5%	54.6%	44.9%	38.5%	34.0%
Average Price Per Seat	64.3	49.8	43.3	37.7	32.9	29.6	27.1	-11.5%	-22.6%	-13.1%	-12.9%	-12.7%	-10.0%	-8.4%
CPU Revenue	248	412	522	609	689	788	796	14.1%	65.8%	26.7%	16.6%	13.2%	14.4%	1.0%
Workstation Revenue	248	408	518	604	684	782	790	14.1%	64.4%	26.8%	16.6%	13.2%	14.4%	1.0%
Software Revenue	401	514	719	945	1,183	1,459	1,831	28.9%	28.2%	40.0%	31.4%	25.2%	23.4%	25.5%
Peripheral Revenue	156	176	226	269	312	366	542	25.2%	13.1%	28.2%	18.9%	16.2%	17.4%	48.0%
Service Revenue	132	231	328	473	637	825	1,040	35.1%	75.1%	42.3%	44.1%	34.7%	29.6%	26.0%
Total Revenue	1,185	1,741	2,313	2,899	3,505	4,221	4,999	23.5%	46.9%	32.9%	25.3%	20.9%	20.5%	18.4%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
									86-91					
									1986	1987	1988	1989	1990	1991
									=====	=====	=====	=====	=====	=====
									=====	=====	=====	=====	=====	=====
WORLDWIDE HOST-DEPENDENT														
Wkstn Shipments	34,053	37,961	42,432	44,549	45,095	44,362	42,267	2.2%	11.5%	11.8%	5.0%	1.2%	-1.6%	-4.7%
Wkstn Installed Base	100,986	138,947	177,085	215,787	252,141	285,818	313,748	17.7%	37.6%	27.4%	21.9%	16.8%	13.4%	9.8%
Average Price Per Seat	97.4	101.3	83.5	73.9	66.6	60.3	55.3	-11.4%	4.1%	-17.6%	-11.5%	-9.9%	-9.5%	-8.2%
CPU Revenue	1,335	1,562	1,413	1,310	1,192	1,064	937	-9.7%	17.0%	-9.6%	-7.3%	-9.0%	-10.7%	-11.9%
Workstation Revenue	1,086	1,343	1,248	1,158	1,051	925	797	-9.9%	23.6%	-7.0%	-7.3%	-9.2%	-11.9%	-13.9%
Software Revenue	629	656	673	684	689	684	673	.5%	4.2%	2.7%	1.5%	.8%	-.7%	-1.6%
Peripheral Revenue	378	446	418	396	368	336	303	-7.4%	18.0%	-6.3%	-5.3%	-7.0%	-8.6%	-9.9%
Service Revenue	586	669	874	1,029	1,159	1,265	1,340	14.9%	14.2%	30.7%	17.7%	12.6%	9.2%	6.0%
Total Revenue	4,014	4,676	4,626	4,576	4,459	4,275	4,051	-2.8%	16.5%	-1.1%	-1.1%	-2.6%	-4.1%	-5.2%
WORLDWIDE PERSONAL COMPUTER														
Wkstn Shipments	48,100	77,010	101,791	121,280	132,727	138,072	138,430	12.4%	60.1%	32.2%	19.1%	9.4%	4.0%	.3%
Wkstn Installed Base	75,620	152,629	254,340	375,008	506,030	638,321	766,620	38.1%	101.8%	66.6%	47.4%	34.9%	26.1%	20.1%
Average Price Per Seat	8.9	8.6	8.7	8.6	8.2	7.9	7.6	-2.4%	-3.4%	1.2%	-1.1%	-4.7%	-3.7%	-3.8%
CPU Revenue	165	238	323	385	406	410	390	10.4%	44.2%	35.5%	19.3%	5.6%	.8%	-4.8%
Workstation Revenue	165	238	323	385	406	410	390	10.4%	44.1%	35.5%	19.3%	5.6%	.8%	-4.8%
Software Revenue	157	332	487	626	732	811	848	20.6%	111.5%	46.5%	28.6%	16.9%	10.8%	4.6%
Peripheral Revenue	19	55	74	88	91	90	91	10.7%	189.3%	34.5%	18.8%	3.8%	-1.2%	1.4%
Service Revenue	10	57	67	99	131	161	189	27.3%	455.0%	18.7%	47.0%	32.5%	23.2%	17.4%
Total Revenue	513	920	1,273	1,582	1,766	1,882	1,909	15.7%	79.3%	38.4%	24.3%	11.7%	6.5%	1.4%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA ALL PLATFORMS														
Wkstn Shipments	56,117	71,943	89,803	105,268	117,655	129,363	139,220	14.1%	28.2%	24.8%	17.2%	11.8%	10.0%	7.6%
Wkstn Installed Base	128,418	200,361	287,510	388,875	499,877	618,399	741,403	29.9%	56.0%	43.5%	35.3%	28.5%	23.7%	19.9%
Average Price Per Seat	46.3	38.8	30.4	26.2	23.5	21.6	20.3	-12.2%	-16.3%	-21.5%	-13.8%	-10.4%	-8.0%	-6.2%
CPU Revenue	918	1,094	1,008	1,009	998	994	927	-3.3%	19.1%	-7.9%	.2%	-1.1%	-.4%	-6.7%
Workstation Revenue	829	974	927	938	936	937	872	-2.2%	17.5%	-4.9%	1.2%	-.1%	.0%	-6.9%
Software Revenue	689	719	978	1,186	1,377	1,567	1,777	19.8%	4.3%	36.1%	21.2%	16.1%	13.7%	13.4%
Peripheral Revenue	318	308	321	330	337	347	435	7.2%	-3.2%	4.4%	2.9%	1.9%	3.0%	25.5%
Service Revenue	448	485	603	731	861	995	1,131	18.5%	8.1%	24.4%	21.2%	17.7%	15.6%	13.7%
Total Revenue	3,203	3,579	3,837	4,195	4,509	4,839	5,142	7.5%	11.7%	7.2%	9.3%	7.5%	7.3%	6.3%
NORTH AMERICA TECHNICAL WORKSTATION														
Wkstn Shipments	10,195	15,196	19,896	25,565	32,447	40,407	49,557	26.7%	49.1%	30.9%	28.5%	26.9%	24.5%	22.6%
Wkstn Installed Base	19,113	34,308	54,100	79,445	111,022	149,294	195,580	41.6%	79.5%	57.7%	46.8%	39.7%	34.5%	31.0%
Average Price Per Seat	63.2	45.4	39.6	34.9	31.1	28.6	26.5	-10.2%	-28.2%	-12.8%	-11.9%	-10.9%	-8.0%	-7.3%
CPU Revenue	155	210	240	273	308	348	334	9.8%	35.0%	14.4%	14.1%	12.5%	13.1%	-3.9%
Workstation Revenue	155	207	238	271	305	345	332	9.9%	33.6%	14.7%	14.1%	12.5%	13.1%	-3.8%
Software Revenue	259	272	369	479	589	711	885	26.6%	5.2%	35.6%	29.8%	22.9%	20.7%	24.4%
Peripheral Revenue	103	85	103	120	138	160	259	25.0%	-17.4%	21.8%	16.0%	15.2%	16.2%	61.6%
Service Revenue	84	131	171	237	312	399	499	30.7%	55.9%	30.5%	38.7%	32.0%	27.8%	25.0%
Total Revenue	756	905	1,121	1,380	1,652	1,964	2,309	20.6%	19.7%	23.8%	23.2%	19.7%	18.9%	17.6%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
								86-91 CAGR						
	1985	1986	1987	1988	1989	1990	1991		1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
NORTH AMERICA HOST-DEPENDENT														
Wkstn Shipments	19,358	19,027	20,379	21,265	21,686	21,829	21,470	2.4%	-1.7%	7.1%	4.4%	2.0%	.7%	-1.6%
Wkstn Installed Base	62,996	82,023	99,890	117,860	134,810	150,937	164,873	15.0%	30.2%	21.8%	18.0%	14.4%	12.0%	9.2%
Average Price Per Seat	90.5	97.2	79.7	70.6	63.6	57.4	52.5	-11.6%	7.5%	-18.0%	-11.4%	-10.0%	-9.7%	-8.6%
CPU Revenue	674	780	650	598	545	495	446	-10.6%	15.7%	-16.6%	-8.0%	-8.8%	-9.2%	-9.8%
Workstation Revenue	585	662	571	528	486	440	393	-9.9%	13.2%	-13.8%	-7.5%	-8.0%	-9.3%	-10.7%
Software Revenue	357	290	335	346	356	364	369	5.0%	-18.7%	15.7%	3.1%	3.0%	2.3%	1.5%
Peripheral Revenue	211	214	193	182	170	158	145	-7.5%	1.6%	-10.1%	-5.7%	-6.6%	-7.1%	-7.8%
Service Revenue	360	335	410	463	509	548	578	11.5%	-7.1%	22.3%	13.1%	9.9%	7.7%	5.4%
Total Revenue	2,187	2,281	2,159	2,117	2,066	2,005	1,932	-3.3%	4.3%	-5.4%	-1.9%	-2.4%	-2.9%	-3.6%
NORTH AMERICA PERSONAL COMPUTER														
Wkstn Shipments	26,565	37,721	49,529	58,438	63,521	67,127	68,193	12.6%	42.0%	31.3%	18.0%	8.7%	5.7%	1.6%
Wkstn Installed Base	46,309	84,030	133,520	191,569	254,045	318,168	380,951	35.3%	81.5%	58.9%	43.5%	32.6%	25.2%	19.7%
Average Price Per Seat	7.7	6.6	6.4	6.3	6.0	5.8	5.7	-2.9%	-14.3%	-3.0%	-1.6%	-4.8%	-3.3%	-1.7%
CPU Revenue	89	104	118	138	145	151	146	7.0%	16.9%	13.0%	17.0%	5.3%	3.9%	-3.1%
Workstation Revenue	89	104	118	138	145	151	146	7.0%	16.9%	13.0%	17.0%	5.3%	3.9%	-3.1%
Software Revenue	74	156	274	362	433	492	523	27.3%	112.6%	75.1%	32.0%	19.6%	13.7%	6.3%
Peripheral Revenue	4	9	25	29	29	29	31	28.9%	100.5%	194.6%	14.2%	.2%	-.8%	6.4%
Service Revenue	4	19	23	31	39	47	54	23.4%	366.6%	20.3%	36.4%	26.3%	19.8%	15.3%
Total Revenue	260	393	558	697	791	869	900	18.0%	50.8%	42.1%	25.0%	13.5%	9.9%	3.5%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE ALL PLATFORMS														
Wkstn Shipments	26,571	39,324	50,676	59,269	65,757	70,671	73,856	13.4%	48.0%	28.9%	17.0%	10.9%	7.5%	4.5%
Wkstn Installed Base	40,413	79,737	129,585	187,461	250,556	316,291	382,590	36.8%	97.3%	62.5%	44.7%	33.7%	26.2%	21.0%
Average Price Per Seat	42.5	39.3	33.4	29.2	25.7	23.3	21.5	-11.4%	-7.4%	-15.1%	-12.6%	-11.9%	-9.3%	-7.9%
CPU Revenue	420	561	602	610	589	565	514	-1.7%	33.6%	7.4%	1.4%	-3.5%	-4.1%	-9.1%
Workstation Revenue	359	551	588	600	582	560	507	-1.6%	53.2%	6.7%	2.2%	-3.0%	-3.9%	-9.3%
Software Revenue	278	394	497	591	673	754	841	16.4%	41.6%	26.1%	19.0%	13.7%	12.0%	11.6%
Peripheral Revenue	123	161	197	204	203	203	227	7.2%	30.7%	22.5%	3.8%	-5%	-2%	12.0%
Service Revenue	184	256	338	446	548	646	736	23.5%	39.0%	32.1%	31.7%	22.9%	17.8%	14.0%
Total Revenue	1,365	1,923	2,222	2,453	2,596	2,727	2,825	8.0%	40.9%	15.6%	10.4%	5.8%	5.1%	3.6%
EUROPE TECHNICAL WORKSTATION														
Wkstn Shipments	3,306	7,806	12,121	16,193	21,054	26,902	32,842	33.3%	136.1%	55.3%	33.6%	30.0%	27.8%	22.1%
Wkstn Installed Base	5,556	13,362	25,438	41,514	62,117	87,809	118,694	54.8%	140.5%	90.4%	63.2%	49.6%	41.4%	35.2%
Average Price Per Seat	66.8	53.9	45.2	38.2	32.3	28.7	26.0	-13.6%	-19.3%	-16.1%	-15.5%	-15.4%	-11.1%	-9.4%
CPU Revenue	55	125	168	192	212	239	243	14.3%	127.2%	34.8%	14.2%	10.3%	13.0%	1.6%
Workstation Revenue	55	124	166	190	209	237	240	14.2%	125.3%	34.6%	14.1%	10.3%	13.0%	1.6%
Software Revenue	87	153	214	278	341	412	501	26.7%	76.3%	39.6%	30.0%	22.6%	21.0%	21.5%
Peripheral Revenue	32	51	71	83	93	107	145	23.4%	57.6%	40.9%	15.8%	12.3%	14.7%	36.3%
Service Revenue	31	60	93	138	186	241	302	38.0%	94.7%	54.4%	47.6%	35.5%	29.4%	25.2%
Total Revenue	260	513	713	880	1,041	1,236	1,431	22.8%	97.2%	39.1%	23.4%	18.3%	18.7%	15.8%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
EUROPE HOST-DEPENDENT														
Wkstn Shipments	7,640	9,949	11,944	12,879	12,786	12,071	10,755	1.6%	30.2%	20.1%	7.8%	-.7%	-5.6%	-10.9%
Wkstn Installed Base	15,600	25,549	36,731	48,440	59,304	68,924	76,287	24.5%	63.8%	43.8%	31.9%	22.4%	16.2%	10.7%
Average Price Per Seat	104.0	98.8	81.5	71.4	63.7	57.0	51.8	-12.1%	-5.0%	-17.5%	-12.4%	-10.8%	-10.6%	-9.1%
CPU Revenue	322	378	371	348	306	256	207	-11.3%	17.5%	-1.8%	-6.3%	-12.2%	-16.2%	-19.1%
Workstation Revenue	261	369	358	340	301	253	203	-11.3%	41.2%	-2.8%	-5.2%	-11.4%	-16.0%	-19.7%
Software Revenue	154	171	185	191	191	188	183	1.4%	10.9%	8.1%	3.5%	.2%	-1.7%	-2.9%
Peripheral Revenue	86	104	111	106	95	81	67	-8.4%	21.1%	7.2%	-4.9%	-10.6%	-14.2%	-17.4%
Service Revenue	148	183	231	289	337	375	399	16.9%	23.0%	26.6%	24.9%	16.7%	11.2%	6.6%
Total Revenue	971	1,204	1,257	1,273	1,229	1,152	1,059	-2.5%	24.0%	4.4%	1.3%	-3.5%	-6.3%	-8.1%
EUROPE PERSONAL COMPUTER														
Wkstn Shipments	15,625	21,570	26,611	30,197	31,918	31,698	30,259	7.0%	38.0%	23.4%	13.5%	5.7%	-.7%	-4.5%
Wkstn Installed Base	19,256	40,826	67,416	97,507	129,135	159,559	187,609	35.7%	112.0%	65.1%	44.6%	32.4%	23.6%	17.6%
Average Price Per Seat	7.3	6.7	6.5	6.4	6.1	5.9	5.8	-2.8%	-8.4%	-3.0%	-1.5%	-4.7%	-3.3%	-1.7%
CPU Revenue	43	58	63	71	72	70	64	1.9%	34.5%	8.1%	12.2%	2.0%	-2.6%	-8.7%
Workstation Revenue	43	58	63	71	72	70	64	1.9%	34.5%	8.1%	12.2%	2.0%	-2.6%	-8.7%
Software Revenue	37	70	99	123	141	153	157	17.5%	87.6%	40.4%	24.3%	14.7%	9.1%	2.7%
Peripheral Revenue	5	6	14	16	16	15	15	19.3%	21.0%	128.8%	11.8%	-.2%	-3.9%	-1.4%
Service Revenue	5	13	14	19	25	30	34	21.2%	171.4%	6.1%	38.4%	27.6%	20.6%	15.8%
Total Revenue	134	206	253	299	325	339	335	10.2%	53.8%	22.6%	18.4%	8.7%	4.1%	-1.1%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

	ANNUAL PERCENT CHANGES													
	86-91													
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
FAR EAST ALL PLATFORMS														
Wkstn Shipments	13,490	27,362	35,807	42,047	46,952	50,474	53,589	14.4%	102.8%	30.9%	17.4%	11.7%	7.5%	6.2%
Wkstn Installed Base	23,743	51,105	86,250	127,244	172,183	218,949	266,920	39.2%	115.2%	68.8%	47.5%	35.3%	27.2%	21.9%
Average Price Per Seat	69.6	49.3	40.6	35.7	32.1	29.6	27.6	-11.0%	-29.1%	-17.7%	-12.0%	-10.3%	-7.7%	-6.9%
CPU Revenue	376	452	548	567	569	565	544	3.8%	20.1%	21.3%	3.6%	.4%	-.8%	-3.6%
Workstation Revenue	279	395	487	502	499	490	465	3.3%	41.5%	23.1%	3.1%	-.4%	-1.9%	-5.0%
Software Revenue	203	364	345	399	457	520	603	10.6%	79.4%	-5.2%	15.7%	14.4%	13.8%	16.0%
Peripheral Revenue	101	191	168	180	188	196	218	2.7%	89.5%	-11.9%	6.8%	4.5%	4.2%	11.7%
Service Revenue	79	185	277	358	436	511	581	25.7%	134.6%	49.7%	29.4%	21.6%	17.1%	13.8%
Total Revenue	1,035	1,587	1,825	2,007	2,150	2,281	2,412	8.7%	53.3%	15.0%	10.0%	7.1%	6.1%	5.7%
FAR EAST TECHNICAL WORKSTATION														
Wkstn Shipments	1,913	3,559	5,472	7,581	10,199	13,597	17,834	38.0%	86.0%	53.8%	38.5%	34.5%	33.3%	31.2%
Wkstn Installed Base	2,848	6,407	11,856	19,383	29,322	42,270	58,982	55.9%	124.9%	85.1%	63.5%	51.3%	44.2%	39.5%
Average Price Per Seat	68.3	64.8	56.7	49.2	42.4	37.1	32.6	-12.8%	-5.1%	-12.5%	-13.2%	-13.8%	-12.5%	-12.1%
CPU Revenue	33	62	95	117	138	162	176	23.1%	90.8%	52.6%	23.4%	17.5%	17.3%	8.9%
Workstation Revenue	33	62	95	117	137	161	175	23.0%	90.2%	52.1%	23.4%	17.5%	17.2%	8.9%
Software Revenue	50	82	118	161	217	288	384	36.3%	62.2%	44.4%	36.9%	34.5%	32.7%	33.1%
Peripheral Revenue	18	37	43	54	66	81	110	24.2%	110.3%	14.5%	27.3%	22.1%	21.5%	36.7%
Service Revenue	14	33	54	81	112	148	190	41.8%	138.0%	63.8%	50.3%	38.2%	32.0%	27.9%
Total Revenue	147	276	404	531	671	840	1,035	30.2%	87.5%	46.3%	31.3%	26.3%	25.1%	23.2%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
FAR EAST HOST-DEPENDENT														
Wkstn Shipments	6,382	7,447	7,831	7,606	7,256	6,807	6,222	-3.5%	16.7%	5.2%	-2.9%	-4.6%	-6.2%	-8.6%
Wkstn Installed Base	12,154	19,601	26,813	33,531	39,384	44,486	48,400	19.8%	61.3%	36.8%	25.1%	17.5%	13.0%	8.8%
Average Price Per Seat	110.0	114.8	98.2	89.7	83.4	78.4	74.8	-8.2%	4.4%	-14.5%	-8.7%	-6.9%	-6.0%	-4.6%
CPU Revenue	313	318	318	288	261	236	212	-7.8%	1.6%	.3%	-9.7%	-9.4%	-9.5%	-10.2%
Workstation Revenue	216	261	258	223	191	162	134	-12.6%	21.0%	-1.3%	-13.6%	-14.0%	-15.6%	-17.4%
Software Revenue	108	182	125	115	106	95	84	-14.4%	68.2%	-31.4%	-8.0%	-7.8%	-10.6%	-11.7%
Peripheral Revenue	74	114	93	85	79	73	68	-9.8%	54.6%	-18.5%	-8.1%	-7.5%	-7.2%	-7.5%
Service Revenue	64	128	194	231	260	283	298	18.4%	100.7%	51.4%	19.2%	12.7%	8.8%	5.2%
Total Revenue	774	1,003	988	942	897	848	794	-4.6%	29.5%	-1.5%	-4.7%	-4.7%	-5.4%	-6.4%
FAR EAST PERSONAL COMPUTER														
Wkstn Shipments	5,195	16,355	22,504	26,860	29,497	30,069	29,533	12.5%	214.8%	37.6%	19.4%	9.8%	1.9%	-1.8%
Wkstn Installed Base	8,741	25,096	47,581	74,330	103,477	132,193	159,537	44.8%	187.1%	89.6%	56.2%	39.2%	27.8%	20.7%
Average Price Per Seat	20.5	16.1	16.6	16.6	15.8	15.1	14.5	-2.1%	-21.5%	3.1%	.0%	-4.8%	-4.4%	-4.0%
CPU Revenue	31	72	134	162	171	167	157	16.9%	133.7%	87.1%	20.9%	5.3%	-2.0%	-6.5%
Workstation Revenue	31	72	134	162	171	167	157	16.9%	133.7%	87.1%	20.9%	5.3%	-2.0%	-6.5%
Software Revenue	44	100	102	123	134	137	136	6.3%	126.1%	2.0%	20.3%	8.8%	2.5%	-.9%
Peripheral Revenue	10	40	33	40	42	42	40	.1%	319.2%	-17.8%	21.9%	5.9%	-2.0%	-3.1%
Service Revenue	1	24	29	46	63	80	94	31.3%	1828.0%	21.8%	57.6%	37.2%	25.3%	18.1%
Total Revenue	113	308	433	534	582	593	583	13.6%	172.0%	40.6%	23.3%	8.9%	2.0%	-1.7%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

								ANNUAL PERCENT CHANGES						
	1985	1986	1987	1988	1989	1990	1991	86-91 CAGR	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
REST OF WORLD ALL PLATFORMS														
Wkstrn Shipments	1,762	4,032	7,377	11,489	15,086	18,126	20,936	39.0%	128.8%	83.0%	55.7%	31.3%	20.2%	15.5%
Wkstrn Installed Base	12,062	16,094	23,064	34,039	48,360	65,315	84,487	39.3%	33.4%	43.3%	47.6%	42.1%	35.1%	29.4%
Average Price Per Seat	52.0	51.4	35.3	27.2	23.6	21.1	19.1	-18.0%	-1.1%	-31.3%	-23.0%	-13.3%	-10.5%	-9.4%
CPU Revenue	34	106	99	117	131	138	138	5.5%	212.5%	-5.9%	17.4%	12.2%	5.6%	.1%
Workstation Revenue	32	69	88	107	123	131	133	13.9%	116.8%	26.4%	21.8%	15.0%	7.0%	1.1%
Software Revenue	17	25	59	77	97	114	132	39.9%	47.2%	138.9%	31.5%	24.9%	18.0%	15.7%
Peripheral Revenue	11	18	31	38	43	47	56	26.0%	59.4%	77.1%	20.7%	15.6%	9.5%	17.7%
Service Revenue	16	30	51	65	82	101	121	31.9%	88.9%	68.4%	27.7%	25.8%	22.7%	20.1%
Total Revenue	110	248	328	404	476	532	580	18.5%	125.9%	32.4%	23.1%	17.9%	11.8%	9.0%
REST OF WORLD TECHNICAL WORKSTATION														
Wkstrn Shipments	374	1,130	1,951	2,904	3,929	5,294	6,671	42.6%	201.9%	72.6%	48.8%	35.3%	34.7%	26.0%
Wkstrn Installed Base	513	1,644	3,590	6,481	10,344	15,442	21,775	67.7%	220.3%	118.4%	80.5%	59.6%	49.3%	41.0%
Average Price Per Seat	49.8	34.7	31.9	28.9	25.9	23.8	22.1	-8.6%	-30.3%	-8.1%	-9.4%	-10.4%	-8.1%	-7.1%
CPU Revenue	6	15	19	26	32	40	43	22.8%	172.2%	25.3%	37.2%	22.4%	23.3%	7.8%
Workstation Revenue	6	15	19	26	32	39	42	22.9%	169.0%	25.8%	37.1%	22.4%	23.3%	7.8%
Software Revenue	5	7	19	27	36	48	62	56.0%	46.3%	176.3%	42.8%	35.0%	33.1%	30.3%
Peripheral Revenue	3	3	8	12	15	19	27	53.3%	6.6%	155.6%	39.7%	26.6%	27.5%	47.0%
Service Revenue	3	6	10	17	26	37	49	50.1%	120.5%	58.4%	70.4%	49.9%	40.7%	33.9%
Total Revenue	22	47	75	108	141	182	224	36.7%	115.0%	60.4%	43.4%	30.4%	29.5%	23.0%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

									ANNUAL PERCENT CHANGES					
									86-91					
	1985	1986	1987	1988	1989	1990	1991	CAGR	1986	1987	1988	1989	1990	1991
	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
REST OF WORLD HOST-DEPENDENT														
Wkstn Shipments	673	1,538	2,278	2,799	3,367	3,654	3,820	20.0%	128.4%	48.1%	22.9%	20.3%	8.5%	4.5%
Wkstn Installed Base	10,236	11,774	13,651	15,956	18,644	21,471	24,188	15.5%	15.0%	15.9%	16.9%	16.8%	15.2%	12.7%
Average Price Per Seat	101.9	103.8	78.1	68.3	60.8	54.3	48.9	-14.0%	1.9%	-24.8%	-12.6%	-11.0%	-10.6%	-10.0%
CPU Revenue	26	87	73	77	81	77	72	-3.6%	229.5%	-15.9%	5.2%	5.1%	-4.0%	-6.7%
Workstation Revenue	24	50	61	67	73	71	67	5.8%	106.6%	21.3%	9.2%	8.6%	-2.6%	-5.4%
Software Revenue	10	13	28	32	36	37	38	24.5%	20.9%	123.5%	13.1%	13.2%	4.1%	.3%
Peripheral Revenue	8	14	21	23	25	24	23	10.2%	78.8%	49.9%	8.2%	7.9%	-2.0%	-5.2%
Service Revenue	13	24	40	46	53	59	66	22.7%	79.3%	69.4%	15.0%	15.0%	12.5%	10.5%
Total Revenue	82	187	223	244	267	269	265	7.2%	128.1%	19.1%	9.3%	9.2%	.9%	-1.4%
REST OF WORLD PERSONAL COMPUTER														
Wkstn Shipments	715	1,364	3,148	5,786	7,790	9,178	10,445	50.3%	90.8%	130.9%	83.8%	34.6%	17.8%	13.8%
Wkstn Installed Base	1,314	2,677	5,823	11,602	19,373	28,402	38,524	70.5%	103.8%	117.5%	99.2%	67.0%	46.6%	35.6%
Average Price Per Seat	5.9	6.1	6.4	6.5	6.4	6.3	6.2	.3%	3.4%	4.9%	1.6%	-1.5%	-1.6%	-1.6%
CPU Revenue	2	4	7	14	18	21	23	44.4%	96.8%	97.9%	86.8%	31.8%	16.8%	10.2%
Workstation Revenue	2	4	7	14	18	21	23	44.4%	93.8%	97.9%	86.8%	31.8%	16.8%	10.2%
Software Revenue	2	5	12	19	25	29	32	43.1%	206.9%	127.7%	56.5%	30.1%	16.1%	11.3%
Peripheral Revenue	0	0	2	3	4	5	5	111.0%	160.0%	1107.7%	89.2%	32.7%	15.0%	20.1%
Service Revenue	0	0	1	2	3	5	7	76.4%	1200.0%	169.2%	98.1%	65.4%	44.8%	33.9%
Total Revenue	6	13	30	52	69	81	91	46.6%	134.7%	120.0%	74.8%	32.6%	17.9%	12.6%

Workstations in actual units, Revenue in millions of dollars, Price in thousands of dollars

EDWARD J. CHURCH

1960	1961	1962	1963	1964	1965
1960	1961	1962	1963	1964	1965

1960 1961 1962 1963 1964 1965

THIS SECTION WAS NOT READY IN TIME FOR PUBLICATION.
IT WILL BE MAILED AS SOON AS IT BECOMES AVAILABLE.

CAD/CAM Industry Service

Electronic Design

Automation Applications

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IBM More Than Challenges Digital with 9370
Computer Companies Move to Grab the Lucrative
Intergraph Bucks Industry Trend...
1986 Dataquest CAD/CAM Conference Cites ...
Workstation Vendors Rush out the Gate...
Digital Announces New Numberbuster
Digital Restructures VAX Product Line...
IBM Announces PC RT RISC Technology System
1985 Japan CAD/CAM User Survey

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Hewlett-Packard Company
Intergraph Corporation
IBM Corporation
MacNeal-Schwendler Corporation
McDonnell Douglas Automation Company
Mentor Graphics Corporation
PDA Engineering
Personal CAD Systems, Incorporated
Prime Computer, Incorporated
Racal-Redac Limited
Scientific Calculations, Incorporated
Silvar-Lisco
Synercom
Tektronix, Incorporated
Telesis Systems Corporation
Valid Logic Systems



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.

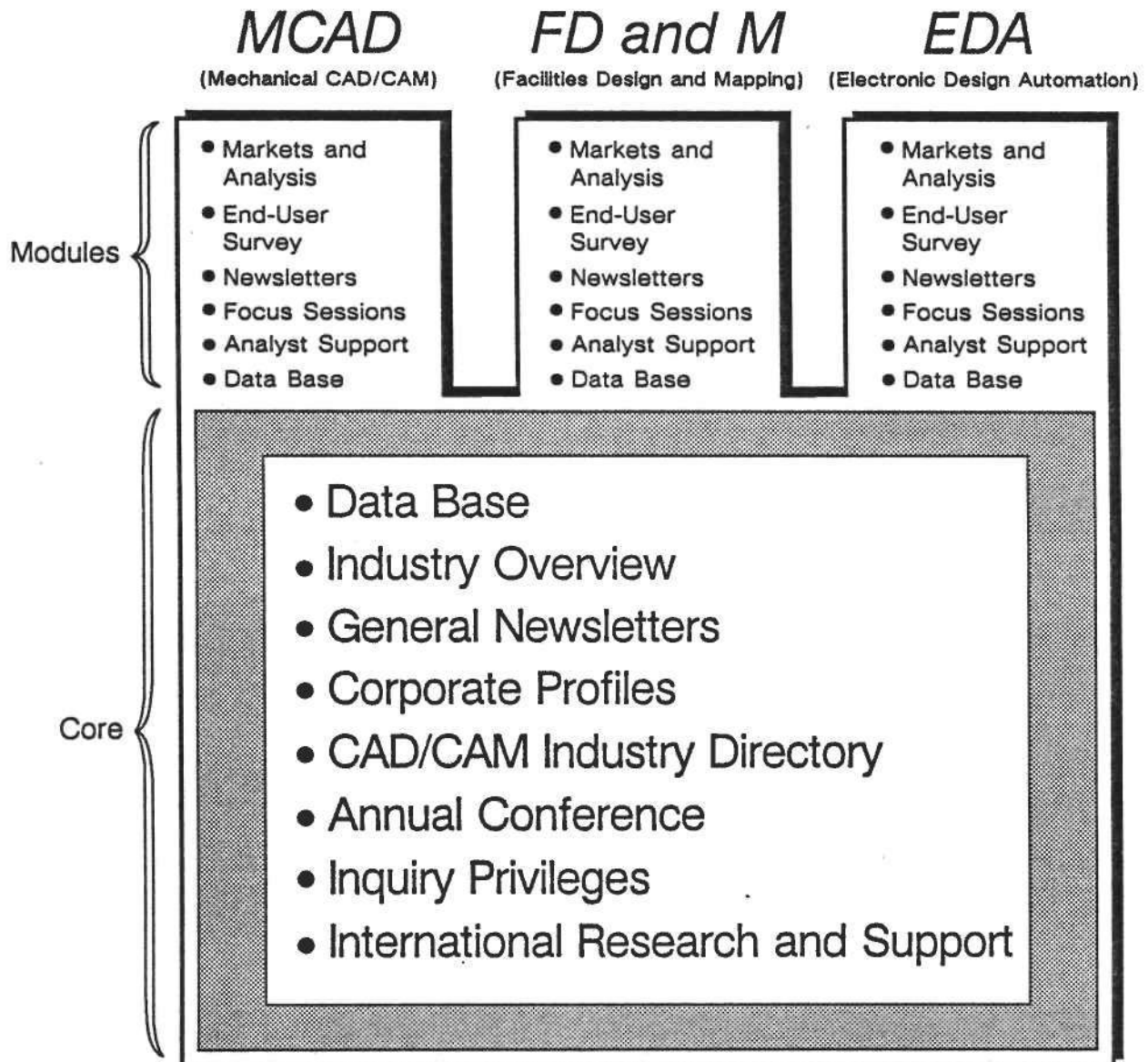
Core Service

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*

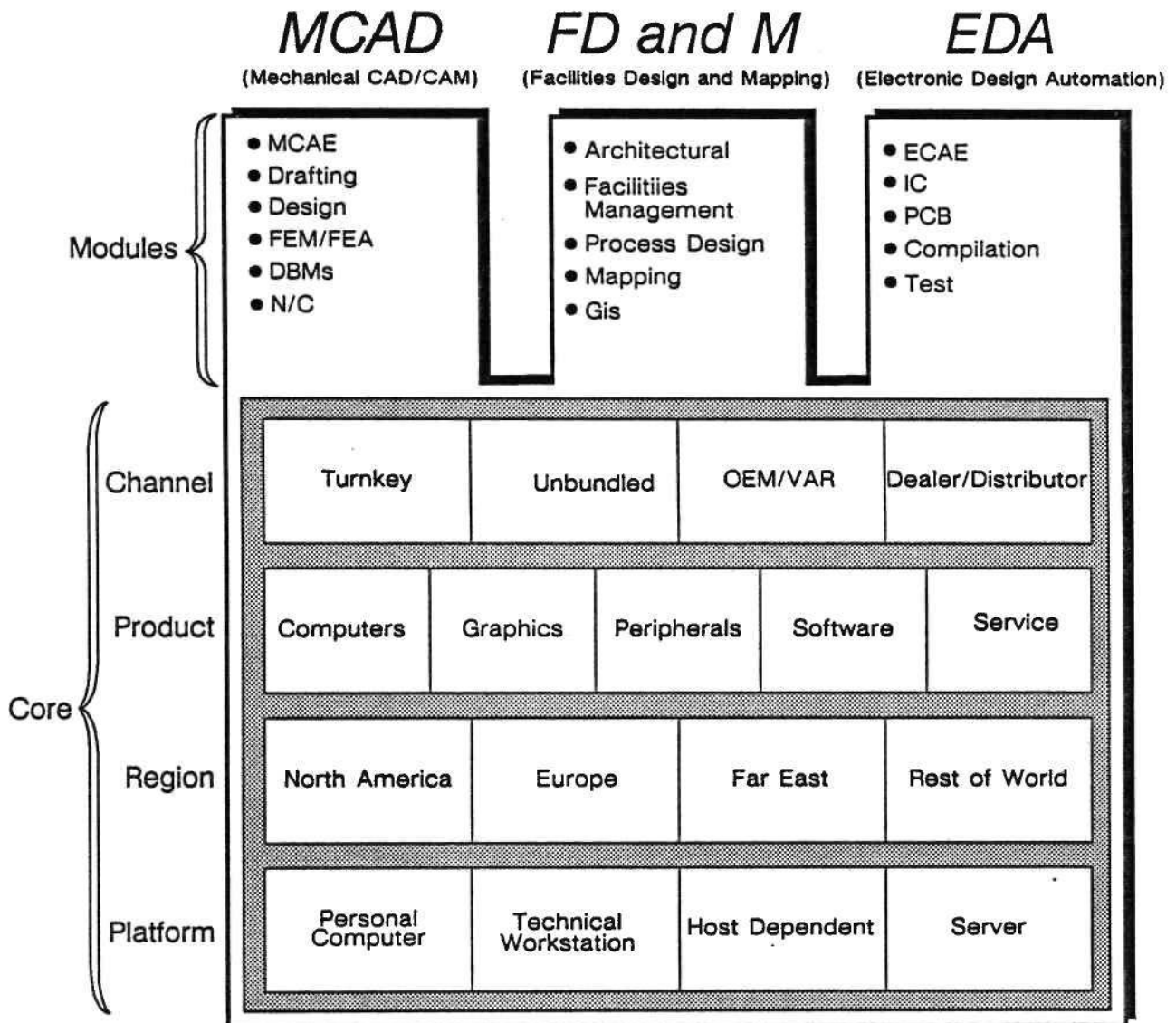
Each application module contains information and analyses particular to the specific application, including newsletters and other event-driven publications, market overview, market shares and forecasts, and specialized research and surveys. Each application module is supported by a staff of CCIS analysts 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 | • Control Data |
| • Applicon | • Daisy |
| • Auto-Trol | • Digital |
| • Autodesk | • Exapt |
| • CISI | • Ferranti |
| • Cadnetix | • Fujitsu |
| • Calay | • Futurenet |
| • Calcomp | • Gerber Systems |
| • Calma | • Graftek |
| • Cimline | • Hewlett-Packard |
| • Computervision | • 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
- Silver-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.

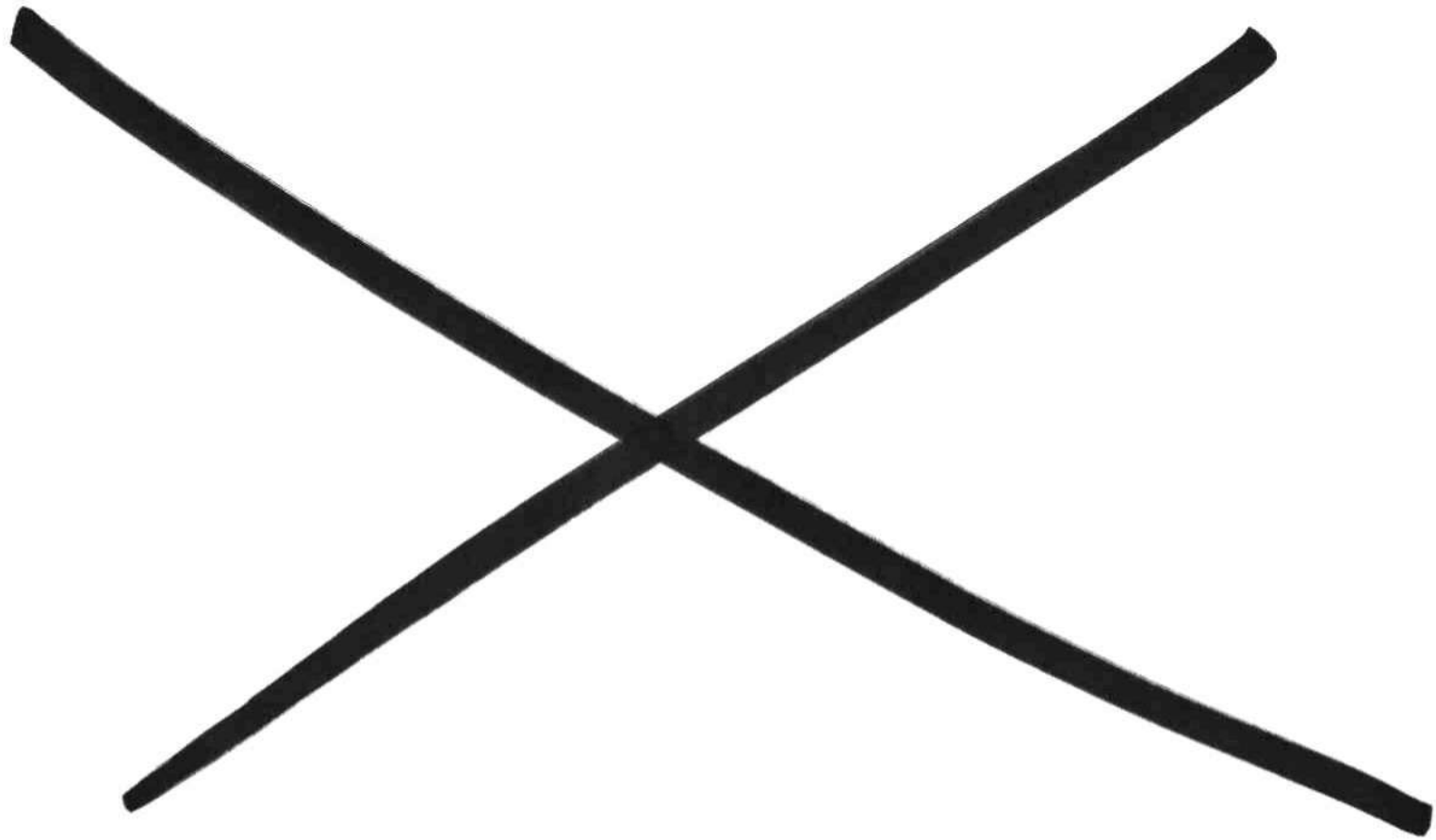
Dataquest's revenue and shipment estimates are based on the following sources:

- 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.



1.1 EDA Definitions

The electronic segment encompasses design automation products that are typically used to support the design and manufacture of electronics products. Their primary users are engineers, designers, and draftspeople involved in the design, documentation, and engineering process. This section defines the major electronic design automation (EDA) product areas: electronic computer-aided engineering (ECAE), printed circuit board (PCB) layout, and integrated circuit (IC) layout. It is followed by a general discussion of the history, trends, and opportunities in the EDA market. Other sections in this binder contain detailed discussions of each individual product area.

Dataquest would like to provide one further note of explanation of our use of the term EDA. Dataquest now uses EDA rather than the term ECAD to describe the entire electronic CAD market. The term ECAE (rather than EDA, which was used formerly) is used to distinguish tools used up front in the electronics engineering process. We made these changes in order to keep pace with industry-standard terms and practices.

DEFINITION OF THE EDA MARKET

Dataquest has defined the EDA market in terms of major applications, users, and technology. Figure 1.1-1 illustrates the basic model used in our analysis.

Definition by Technology

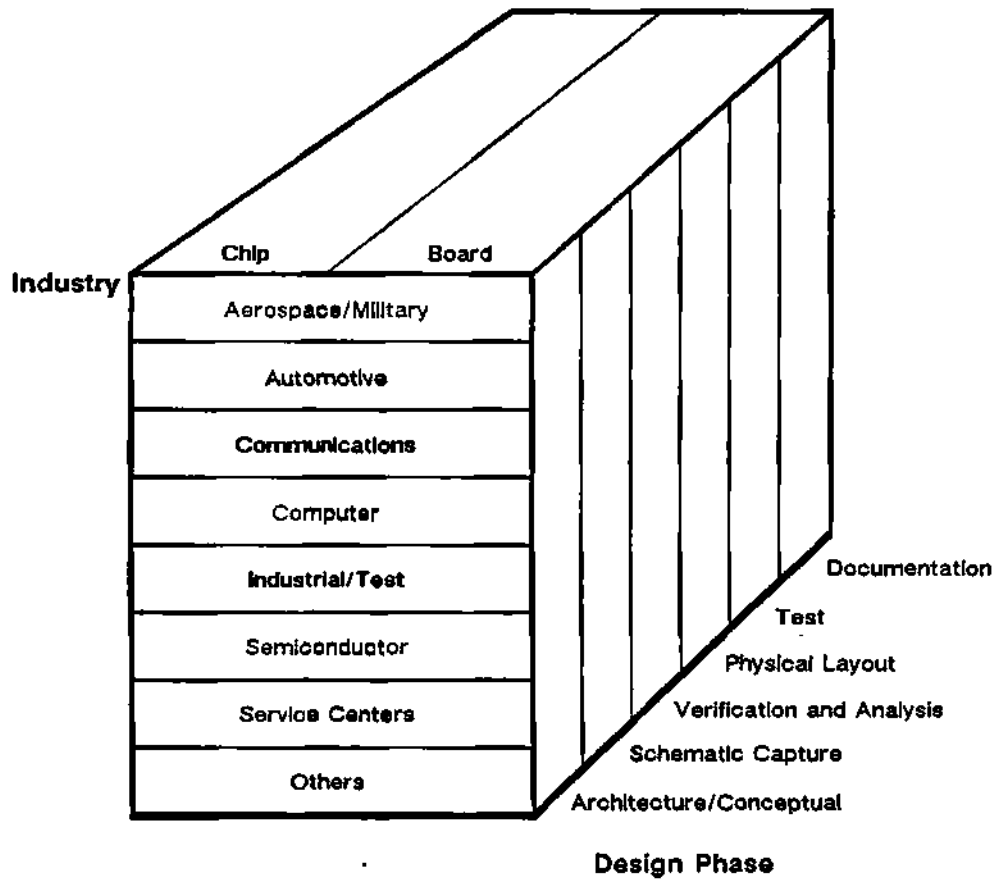
Dataquest distinguishes between two major technology applications: IC design and PCB design. Integrated circuits include standard components, such as TTL and ECL; very large scale integrated (VLSI) circuits such as the Intel 80386 or the Motorola 68030; and application-specific integrated circuits (ASICs), such as gate arrays, standard cells, and PLDs. PCBs cover the complete range of board design, including single-board systems, multiboard computers, or embedded hardware for real-time operations.

Definition by Application

The EDA market applications are organized by major design phase, from the initial conceptual design of the product to layout, test, and release to manufacturing. For purposes of forecasting, we group together three major classes of application: ECAE, IC layout and PCB layout.

Figure 1.1-1

**Electronic Design Automation
Application Model**



Source: Dataquest
June 1987

ECAE applications are used in the up-front part of the design process for the engineering and documentation of the product. ECAE includes the following design stages and applications:

- Architectural design tools that specify and evaluate the general concept of the design
- Schematic capture tools that create detailed implementations and documentation drawings of the design
- Verification and analysis tools that debug the design's logical and timing behavior, and check conformity to electrical rules, thermal behavior, and other key characteristics
- Test tools that generate and create the patterns used in the manufacture of the product
- Documentation tools
- Data base management tools that link applications, manage design data, and track libraries

IC layout tools are used during the physical design phase to create and validate the geometric patterns that will be used in the manufacture of the IC (e.g., mask data or e-beam information). Applications that are tracked in the IC layout market include:

- Polygon editing systems that create mask geometries manually
- Automated place-and-route systems for gate arrays, standard cells, and cell-based designs
- Silicon compilation systems that generate IC structures automatically
- Layout verification that performs electrical rule checks (opens, shorts), design rule checks (design rule spacing), and net-list versus layout comparison on the final geometries

PCB layout tools are used during the physical design phase to create and validate the data that will be used to manufacture boards (e.g., solder masks, board outline, and drill data). Applications that are tracked in the PCB layout market include:

- Layout editing systems that place-and-route board designs manually
- Automated routers and routing accelerators

- Layout verification tools that check design rule spacing
- Thermal and reliability analysis packages that evaluate the layout's cross talk, noise, and stability under varying conditions
- Software interfaces to manufacturing systems (numeric control output and Gerber and photoplot information)

Dataquest established this differentiation between ECAE, IC layout, and PCB layout by distinguishing between the primary output of each system. Layout systems primarily generate manufacturing information (mask sets, numeric control data, etc.). ECAE systems primarily generate net-list data used to drive physical layout systems (though other major ECAE output includes test patterns and schematic documentation).

Definition by User

We also characterize the market in terms of eight major classes of user. Dataquest user surveys examine attitudes, needs, levels of penetration, and spending plans in each category. This data is the basis of our overall forecasts and underlies our analyses of major technology trends.

Aerospace/Military

The aerospace/military segment is among the early adopters of all EDA technologies, and, while not the largest segment, has continued to assume the role of technology leadership. Military/aerospace companies are driven by the need to provide very sophisticated real-time systems in increasingly compact spaces. The military also sets very rigid standards for reliability and documentation. As such, they have been aggressive users of ASICs, surface-mount technology, simulation, and special-purpose hardware, such as logic accelerators. The pending navy purchase of millions of dollars worth of EDA equipment ensures that the military will be a significant factor in the EDA market for years to come.

Automotive

With the growing amount of electronics in today's cars (fuel systems, brakes, repair monitors, etc.), the automotive segment uses EDA technology aggressively. The automobile industry's use of ASIC components and surface-mount board designs is behind this market's increasing use of advanced ECAE and PCB systems.

Communications

EDA is used in most communications companies wherever possible (e.g., digital switches), but in some cases the design automation tools have not equaled the design problem (e.g., microwave design). In addition, major communications companies, particularly AT&T, have extensive amounts of internally developed software and IC design capability (full custom and standard cell). This in-house design and manufacturing capacity has tended to slow the acquisition of commercially available tools at these user sites.

Computer

As is the case in communications, EDA plays an important role in computer design, but many organizations have internally developed capabilities that augment commercially purchased tools. The heavy use of ASICs and microprocessors tends to encourage the use of EDA technology. As tools emerge that can support the rigors of very large digital systems design, such as mixed hardware and software development, penetration into computer companies can only increase.

Industrial/Test

This segment is among the slowest of EDA adopters and has only begun to enter the market. The heavy analog component of the designs in this segment (e.g., controllers) has tended to limit the applicability of the available tools. This factor, coupled with conservative design practices, has tended to slow the rate of penetration.

Semiconductor

Semiconductor companies are among the heaviest users of EDA. The absolute need for EDA technology in order to design and manufacture ICs has forced semiconductor companies to make substantial investments in design automation. In the case of ASIC, EDA tools are required just to deliver the technology to the end user. In spite of the high levels of penetration in this segment, competitive pressures (more complex chips developed in less time) are pushing these companies to continue to purchase more equipment and more advanced technology, such as silicon compilation, as it comes onto the market.

Service Centers

Service centers are perhaps the heaviest of users of EDA, if only because they depend on it for their business. PCB layout shops, ASIC design centers, and custom software businesses all need EDA in order to be competitive. While not the largest market segment, these end users are the most quality conscious. A company in the CAD system business cannot afford downtime on a CAD system.

Other

This segment includes several important areas of EDA users, most notably consumer and education. The consumer electronics market is dominated by Japan and the newly industrialized countries. While the semiconductor arms of these companies (e.g., Matsushita, Samsung, and Hitachi) are heavy users of EDA, the consumer divisions themselves have been slower to adopt EDA. Universities, on the other hand, have been eager adopters of EDA and suppliers of public domain software. The advent of PC-based packages saw a steady influx of design capabilities to engineering schools, and universities like Berkeley have established an excellent reputation for supplying state-of-the-art design packages like SPICE or UNIX.

1.2 EDA Executive Summary

This summary highlights the key points and analyses presented in this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the electronic design automation segment.

- The EDA market was \$1.851 billion in 1986 and is forecast to grow to \$2.674 billion in 1991, at a CAGR of 7.6 percent.
- The EDA market is expected to grow to \$2.112 billion in 1987, a 14 percent increase. This is down from a 19 percent increase in 1986 and a 50 percent increase in 1985.
- Dataquest expects workstation unit shipments still to be relatively strong. In 1986, workstation shipments were 35,653. They are expected to grow at a 10.1 percent CAGR to 57,700 in 1991. In 1987, shipments are expected to rise 22.7 percent to 43,750.
- Dataquest believes, however, that strong workstation shipments will be offset by a declining average price per seat. The average price per seat was \$39,800 in 1986 and is forecast to have a negative CAGR of 10.6 percent to \$22,800 in 1991.
- Regionally, the Far East and Europe will remain the strongest areas with CAGRs of 15 percent and 5.9 percent in revenue, respectively, from 1986 to 1991. North American revenue, while still the largest part of the market (50 percent in 1986) will grow at only a 3.8 percent CAGR.
- Dataquest believes that the decline in revenue growth rates indicates that the EDA market is maturing and that 1986 was a key transitional year. Dataquest views the following events and trends as pointing toward the maturation of the market:
 - Key vendors, Daisy and Valid Logic, had relatively weak performances, and several other firms merged and consolidated.
 - The major growth segment of the market, ECAE, had sharply lower revenue increases. Total revenue growth was 14 percent in 1986, down from 83 percent the prior year.
 - Major end users are much more experienced, and their buying practices are increasingly conservative. This is tending to hold prices down and to put more pressure on vendors.

1.3 EDA Market Overview

HISTORY

Overview

Over the past 20 years, the electronic design automation (EDA) industry has been transformed from a handful of start-up companies to a \$1.8 billion market in 1986. In the process, it has evolved from serving the needs of a few design specialists to serving the entire electronics community. Indeed, the EDA industry has been a highly competitive, explosive market that has permanently changed the nature of electronics design.

The EDA market's evolution can roughly be characterized by three major phases: automated drafting, automated design, and computer-aided engineering (CAE). Each of these phases has seen the EDA market expand dramatically. New tools from new companies on lower-cost platforms addressed the needs of an exponentially increasing audience and generated the dynamics between customers, technology, price, and suppliers that has fueled the market's growth.

The first wave of EDA products in the early 1970s was drafting tools for printed circuit board (PCB) and integrated circuit (IC) designers. Provided by companies such as Calma and Computervision, these tools replaced the error-prone and tedious technique of mylar and tape for generating the mask sets, numerical control data, and other information used in IC/PCB manufacturing. The automated drafting tools were all host-based systems connected to graphics terminals. This made these systems high in price, and initially limited them to the larger companies that could afford them.

In the next phase, companies such as Genrad, Silvar Lisco, and Teradyne began to supply automated design tools. These tools—logic simulators, circuit simulators, and placement-and-routing—provided truly automated solutions to tasks that had theretofore been done manually. However, the use of such tools was limited to sophisticated engineers doing VLSI and large-system design. Although these products, like the drafting systems, were host-based, the automated tools were primarily batch programs with textual input and output, as opposed to interactive graphics.

The most recent wave, CAE, began in 1981 and saw the EDA market extend to include the general engineering community. Companies like Daisy, Mentor, and Valid took the EDA technologies invented in the 1970s, made them more user-friendly, and integrated them on technical workstations and PCs. Bringing EDA tools to the average electrical engineer made it possible to apply them to problems such as application-specific IC (ASIC) design or system verification. In addition, the shift to technical workstations and PCs made it much less expensive to purchase and support systems. Rather than a mainframe that was cost-effective only with a large number of users, companies could now acquire systems on an incremental, per engineer basis—and at a much lower price per engineering seat.

Today, EDA is an integral part of most companies' electronics design environment, and most of these organizations have made the commitment to expand their EDA capabilities. However, the most obvious places where EDA can be applied—layout, ASIC design, and design documentation—have been tapped. Further penetration of EDA will require changes in designers' habits as well as technological innovation. And, while it is possible to see another wave of EDA suppliers (Cadnetix, EDA, SCSI, and SSC) driving the market forward, new leaders are only starting to emerge.

1986—A YEAR OF TRANSITION

The year 1986 marked a significant transition point for the EDA industry. After several years of strong revenue growth, the market began to slow down. Dataquest believes that, while some of the slowdown is attributable to temporary factors, others point to maturation of the market.

Dataquest sees three major factors slowing the EDA market:

- Weak North American markets
- Sharp price erosion in both hardware and software
- Slowing growth for electronic CAE (ECAE)

Slow North American Markets

The first major factor that slowed down the EDA industry in 1986 was an extremely weak North American market. From 1985 to 1986, North American EDA revenue grew only 1 percent, down from 40 percent the previous year. Dataquest attributes this to general weakness in the North American electronics industry, particularly in semiconductors. With the North American market representing 49 percent of the total market, the slowdown in this region more than offset very strong years in Europe and the Far East, where growth was 12 percent and 76 percent, respectively. For many EDA suppliers, the European and Far Eastern markets salvaged what would have otherwise been a disastrous year.

While Dataquest believes that the North American EDA market will improve next year, it does not believe that the market will ever again see the 100 percent growth rates it saw in the past. The intense competition between suppliers created by the market slowdown has had some permanent effects. Not only has it driven a number of suppliers out of the market and forced others to merge and consolidate, but it has also set in motion price erosion that has cut into profits and held back revenue.

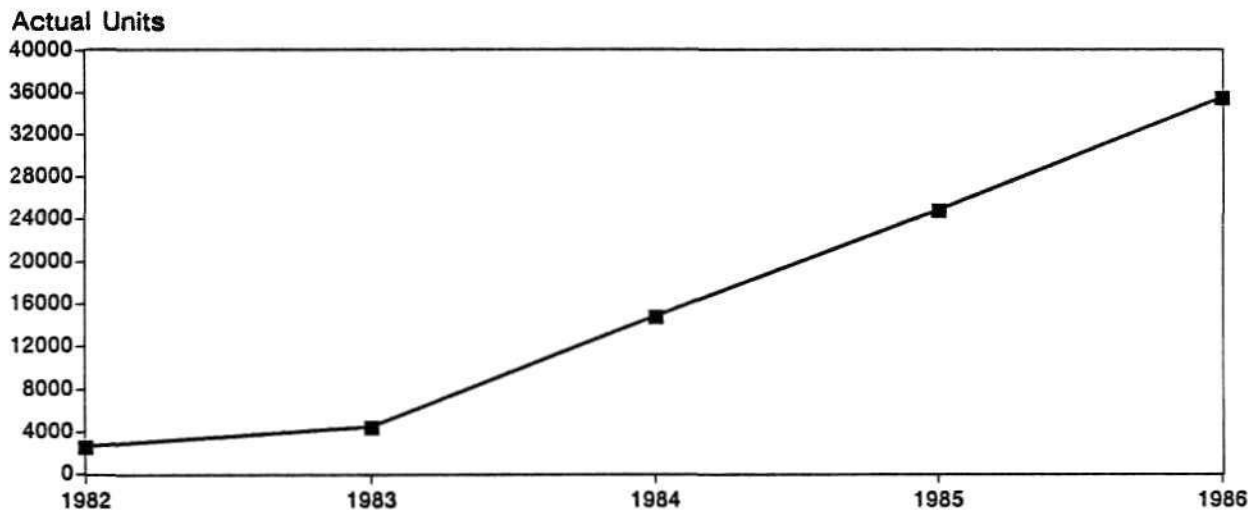
Price Erosion

Worldwide price erosion is the second major factor in the 1986 market slowdown. The average price per seat (APPS) fell 24 percent from 1985 to 1986, continuing the steady downward trend shown in Figure 1.3-1. This heavily offset increases in unit shipments of 43 percent in 1986, as illustrated in Figure 1.3-2. Many EDA vendors this year felt the frustration of selling significantly more units, but with frequent declines in profits and total revenue.

Dataquest feels that this trend of declining prices will continue into the future, particularly since it occurred on both the hardware and software side. On the hardware side, both technical workstations and PCs fell in price due to stiff competition. The APPS of technical workstations, for example, is forecast to drop at a 15 percent negative compound annual growth rate (CAGR) through 1991. On the software side, applications such as schematic capture, which listed for \$15,000 or more in 1984, are now selling for well under \$5,000. Indeed, low-cost \$500 schematic capture packages now threaten to turn this application into a commodity.

Figure 1.3-1

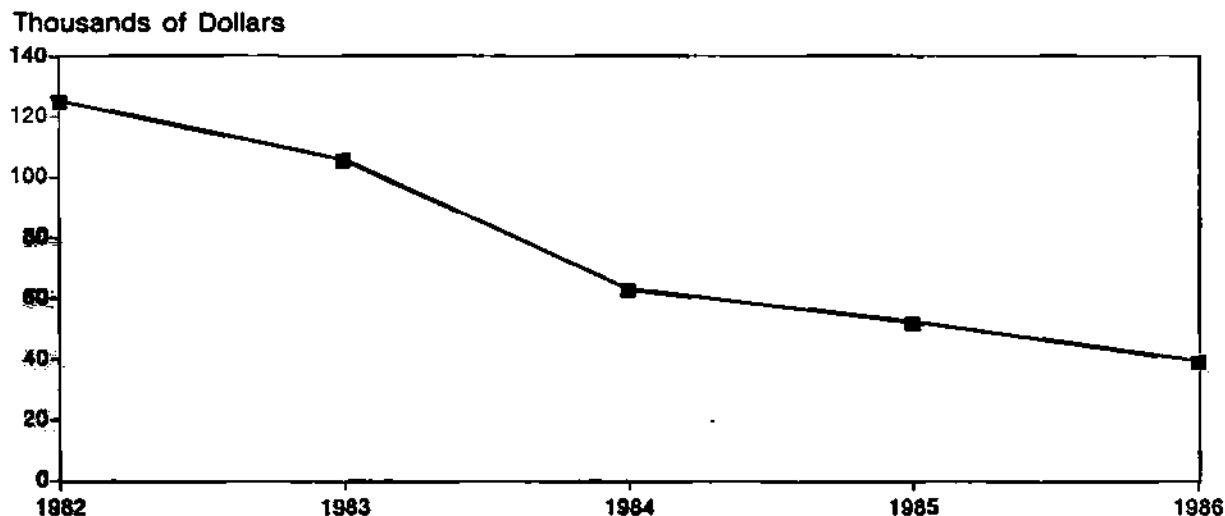
Electronic Design Automation
Worldwide Workstation Shipments
(Actual Units)



Source: Dataquest
June 1987

Figure 1.3-2

**Electronic Design Automation
Average Price Per Seat
(Thousands of Dollars)**



Source: Dataquest
June 1987

ECAE Slowdown

The third major factor is the slowdown of the ECAE segment, which accounted for most of the explosive growth in the EDA industry from 1983 to 1985. The ECAE segment grew 14 percent from 1985 to 1986, down from 83 percent the prior year. Part of this slowdown is attributable to price erosion and the weak North American market. However, Dataquest sees several other important indications of market maturation. The number of suppliers is consolidating, the pace of innovation is slowing down, and buyers are becoming more conservative in their outlook. With ECAE representing the major force in the growth of the overall EDA market, Dataquest believes that the maturation of this segment indicates slower growth for the market as a whole.

EDA BUYERS

Dataquest believes that another key part of the transition in 1986 was the shift in EDA buyer attitudes. Current ECAE buyers are experienced and much more conservative. Many companies have already made substantial investments in EDA technology. Moreover, they are now considering large purchases that have significant long-term implications for their corporations, and they are conscious of this fact.

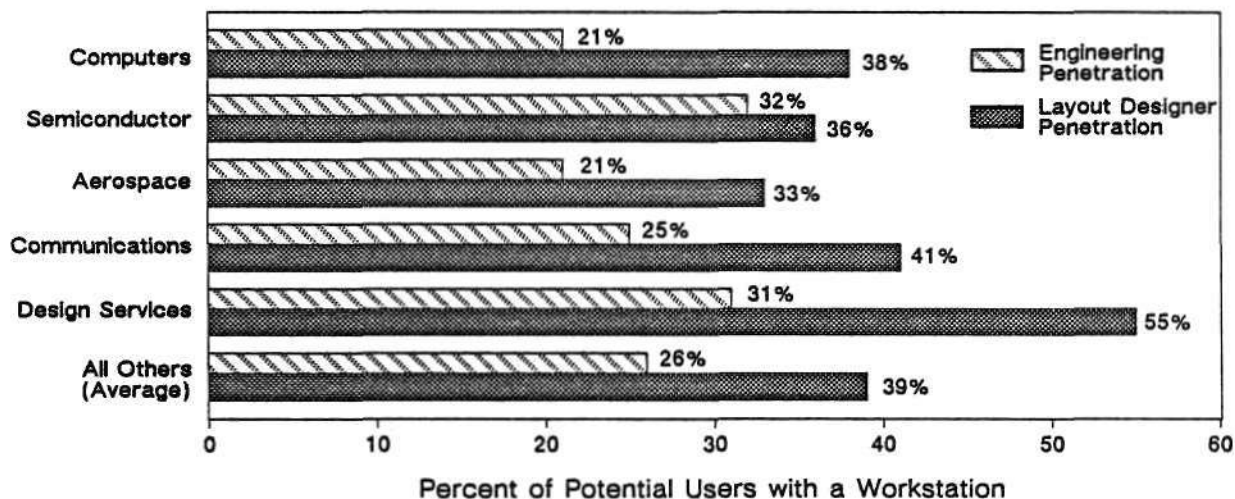
A recent Dataquest survey of current North American EDA users indicates the extensive level of commitment and penetration among buyers. Figure 1.3-3 shows the level of workstation penetration across various industry segments. The layout designers that would use drafting packages for PCB or IC design have the highest level of penetration across all industry segments. Not surprisingly, design services, such as PCB or ASIC design houses, exhibit the highest level of penetration. But equally surprising is the level of penetration among engineers. In the semiconductor market, which is inherently dependent on EDA for design, one out of every three engineers in the survey has access to an EDA workstation. In the worst case, computers and aerospace, one out of every five engineers has direct access to a workstation.

Along with this investment in EDA technology, an ongoing shift in EDA buyer attitudes has made several lasting changes in the industry. These changes have had an impact both on suppliers and on the industry as a whole. Dataquest has identified three major areas where these shifts are occurring:

- Buying criteria
- Purchasing practices
- Vendor-supplier relationships

Figure 1.3-3

EDA End User Workstation Penetration



Source: Dataquest
June 1987

Buying Criteria

The first major point of change is in end-user buying criteria—the major items a buyer looks for in a supplier and the supplier's products when making a purchase. Today's EDA buyers place much more emphasis on the vendor as a company, on reliable and robust core applications, on hardware and software integration, and, last but not least, on service, support, and training. Potential buyers are looking for demonstrated success and strategic directions—not unproven promises.

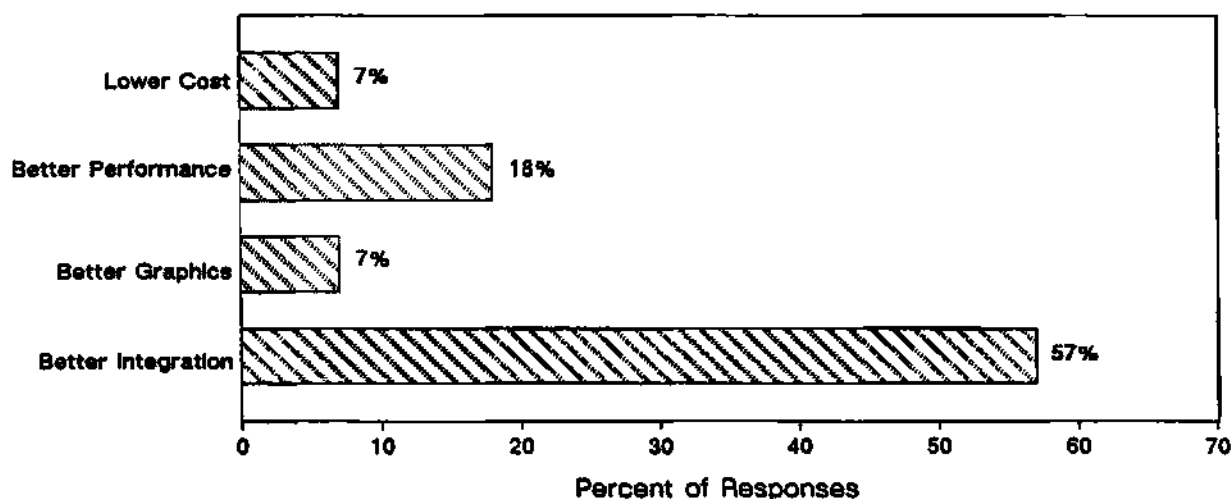
Dataquest believes the transition in buyers' criteria is driven by their past experience with EDA and demand for productivity, not just by technology. Early adopters of EDA, most recently ECAE, made purchases on the basis of either technology leadership through advanced R&D or a technology imperative. For example, EDA tools are an absolute necessity in ASIC design. In contrast, current buyers are now attempting to integrate EDA tools into their entire design and manufacturing process—even when there is no technology imperative.

The end-user's objective is to be more competitive through shorter times to market and better products. Figure 1.3-4, from Dataquest's EDA user survey, illustrates this buyer need. When asked what they would change in their CAD system, current EDA users asked for two things: better integration and faster performance. This clearly indicates that users' interests lie with productivity, not technology. Users want the products they originally purchased to work as promised. They are far less interested in the next round of products or technologies.

End-User Purchasing Practices

The second major area of change is in purchasing practices. As opposed to spot purchases made by separate engineering teams or divisions, the major users are now making decisions at the corporate level. These corporations are making long-term agreements involving large purchases that may be spread out over several years. While this presents significant opportunities for vendors, it also slows the decision process considerably. Lengthy and time-consuming benchmarks are required, and vendors are closely scrutinized. The most dramatic example of this change in practices is the pending U.S. Navy CAD procurement, but examples in the corporate world abound as well.

Figure 1.3-4

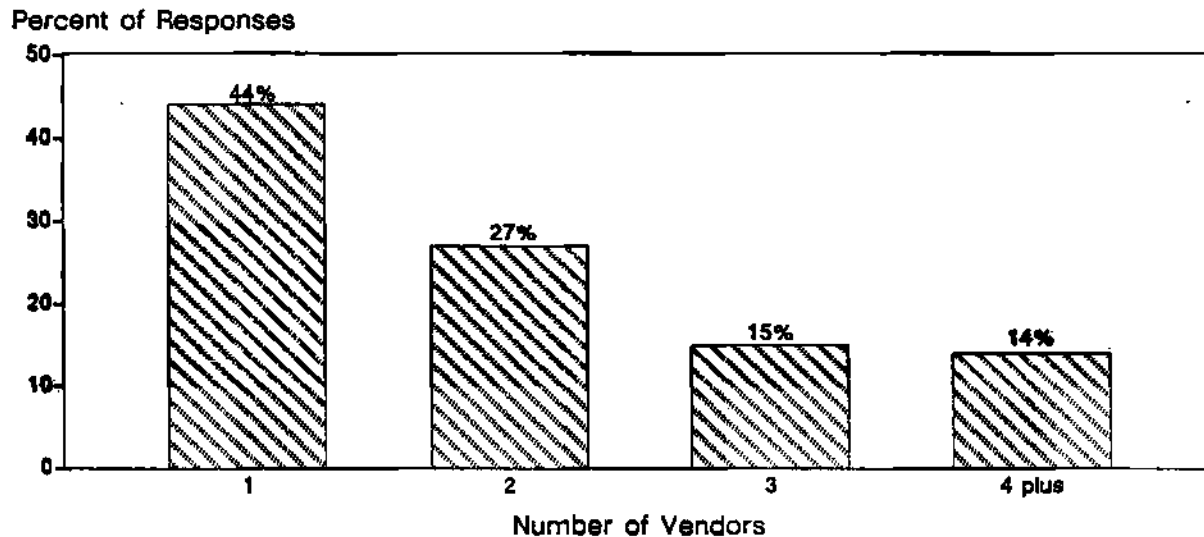
**What EDA Users Would Change in
Their EDA Systems**Source: Dataquest
June 1987**Buyer-Vendor Relations**

The final major shift is occurring in the relationship between buyers and vendors. As the dollar volume of purchases and the level of user penetration increases, buyers are seeking ways to control their commitment to specific hardware and software suppliers. Many buyers no longer purchase turnkey stations with bundled hardware and software. Instead, they purchase hardware and software separately from the respective manufacturers to obtain the best prices. Buyers are aggressively negotiating volume purchase or site-licensing agreements with their vendors.

This shift in relationship is further indicated by buyers' pursuit of multivendor integration strategies. A multivendor strategy enables buyers to limit their dependency on one supplier and to still effectively create a uniform environment. Figure 1.3-5 shows that at more than 56 percent of user sites, there are two or more vendors, and that a significant number of sites have three or more vendors. This puts even more emphasis on buyers' interest in better integration and highlights the opportunity for vendors that act as integrators, not simply as application sellers.

Figure 1.3-5

Number of Vendors per
EDA-User Site



Source: Dataquest
June 1987

BUSINESS STRATEGIES

Dataquest believes that vendors' success in the maturing EDA market will be determined by their development and execution of their business strategies. In the growth phase of the market, many suppliers were pulled upward by the demand for their technologies in the marketplace. However, in the maturing market, vendors' profits and revenue are pulled down by declining prices and rigorous competition. Only suppliers able to deliver on their promises and to demonstrate that they are well managed companies will be able to push their revenue and profits up, and, with luck, gain market share.

We believe that there are two major viable strategies in the marketplace today: full line and niche. A full-line supplier is a company that markets and distributes a complete set of EDA products to end users (e.g., Daisy, HP, Mentor Graphics, and Valid). A niche supplier is a company that develops and sells individual products or services that meet specific needs in the EDA market (e.g., ECAD, IKOS, and Trimeter).

Dataquest feels that it is possible to pursue one or the other of these two strategies, but not both. In the early days of the EDAE market, companies simultaneously pursued niche strategies, such as developing state-of-the-art simulation, and full-line strategies, by offering integrated EDAE and layout. Several companies, most notably Daisy and

Valid, went so far as to develop both software and proprietary hardware. In the early stages of the ECAE market, these companies enjoyed the best operating margins and profitability.

However, as the number of individual applications multiplied and general-purpose hardware suppliers (Apollo and Digital) surpassed proprietary solutions, it was no longer possible for one company to be all things to all people. Niche players began to focus on developing the best IC simulator or schematic capture package. Former full-line suppliers that attempted to maintain a lead in each individual software application and still be fully integrated found that their resources were badly diffused. Companies that integrated other vendors' hardware or software packages along with their own core applications have remained both focused and profitable.

Full-Line Strategies

The full-line supplier has the most to gain and lose in this transitional market. As a full-line supplier, a company can control key distribution and marketing channels through its relationship with end users. This, in turn, allows the full-line supplier to capture important revenue in the final value-added chain by integrating its own applications with products from niche suppliers.

From a practical standpoint, Dataquest identifies three ways that full-line suppliers can increase their revenue.

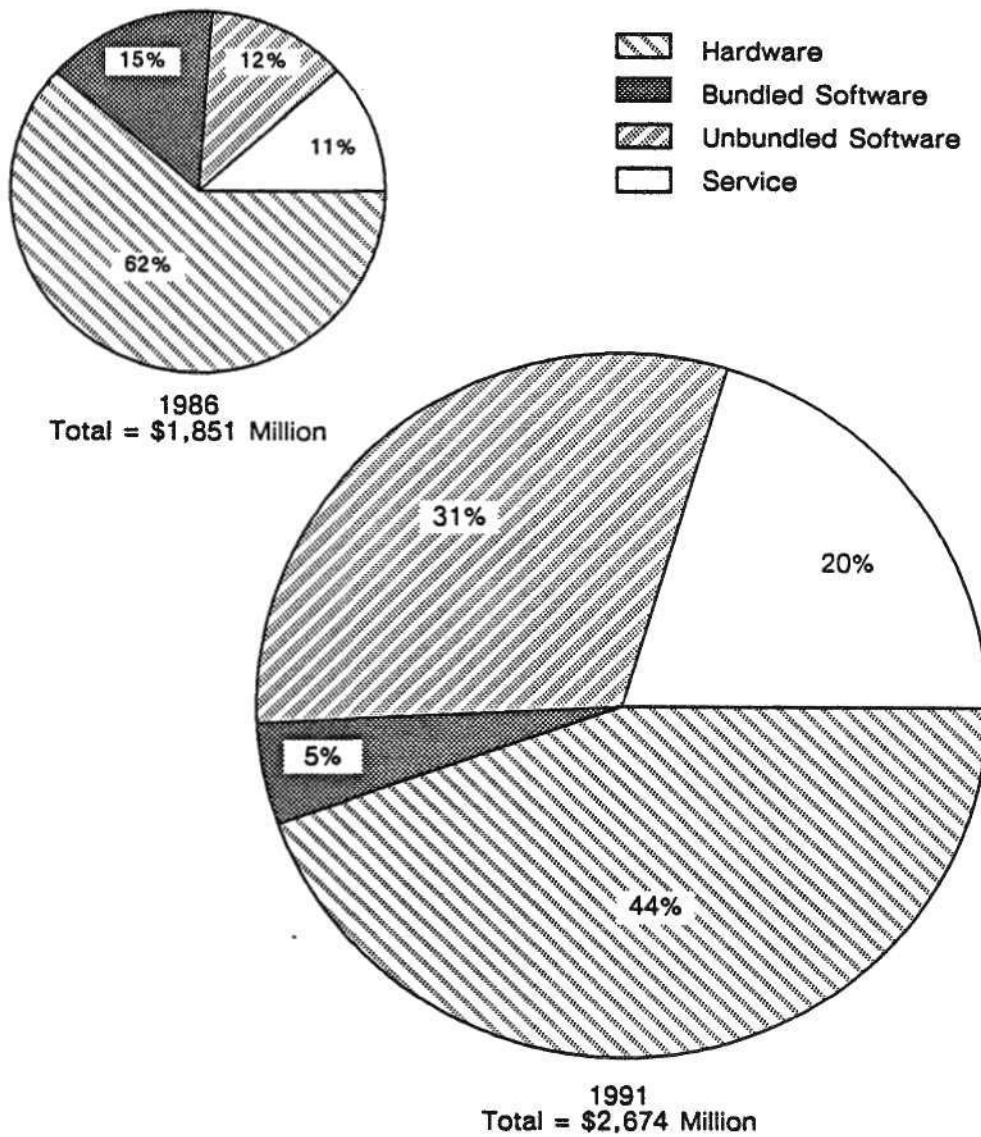
- Option 1: Sell more of the same applications they offer today
- Option 2: Develop and sell or OEM new products
- Option 3: Grow a service/support business based on an effective combination of the first and second strategies

Figure 1.3-6 shows Dataquest's forecast for the mix of products in 1991 relative to 1986. As this Figure indicates, service and unbundled software are the two fastest-growing segments. Hardware and bundled software revenue, on the other hand, are each forecasted to decrease drastically as a percentage of total revenue.

Given this forecast, as well as our expectations of continued price erosion for applications (see Figure 1.4-7), options 1 and 2 alone are clearly not viable. Price erosion and the separation of hardware and software sales make option 1 (sell more of the same products) untenable; current products are becoming commodities. The second option, market or OEM new products, holds equal perils. Developing new products stretches resources. OEM has low margins. And the more products a vendor has to sell, the less focused a sales force can be. Only the third option, which is based on service, support, and integration, holds promise.

Figure 1.3-6

EDA Revenue Sources
Actual and Estimated



Source: Dataquest
June 1987

The following are what Dataquest believes to be the critical success factors for the third full-line supplier option:

- Provide robust core applications or platforms
- Integrate products from multiple suppliers
- Manage, service, and support the installed base
- Market, sell, and distribute

These are the key factors that can transform a company from an application vendor into a solution provider—and a profitable one.

On the other hand, full-line suppliers can also effectively differentiate themselves by clearly targeting distinct segments of the electronics industry, such as semiconductor, aerospace/military, or computer. One supplier might emphasize PCB design tools, while another might stress IC layout or ASIC design. Likewise, it is possible to imagine full-line suppliers having distinct software or hardware orientations.

Niche Strategies

The alternative to a full-line strategy is a niche strategy—specialized hardware or software designed to satisfy focused EDA requirements, such as emitter-coupled logic (ECL) board routers, simulation accelerators, and logic synthesis. Dataquest believes that, as the market expands, opportunities will be created to develop many specialized applications or bridges between applications. These areas will be beyond the reach of full-line suppliers but of great interest to end users. A \$30 million or \$40 million niche opportunity can make for very profitable businesses but may still be too small for a full-line supplier to pursue.

Niche opportunities are essentially user-driven. They are created as users adopt primary EDA technologies but find that the core technologies are insufficient, too costly, or only partial solutions. These opportunities roughly fall into three major categories:

- Low-cost products
- Leading-edge technologies
- Technology and service bridges

In each of these categories, there are focused user demands that go outside of the bounds of the full-line suppliers' application capabilities.

Low-cost products, such as \$500 schematic capture and PCB layout, have already had a significant impact on the market. Large companies that are anxious to put EDA tools on every engineer's desk and small companies that cannot afford large systems have both eagerly evaluated - and purchased - these low-cost products. Companies that could not justify buying a \$40,000 EDA workstation for an engineer have been able to justify spending \$5,000 or \$10,000 per engineer. Provided that the products are tools and not toys, large-volume, low-cost products present a sizable dollar opportunity.

Leading-edge technologies represent an equally important area of opportunity. Although full-line suppliers answer the requirements of the mainstream market, many companies and R&D groups continue to need advanced products as they pursue increasingly complex design problems. Examples of such problems are very large scale ASIC design (20,000 gates and up), 300 package surface-mount board designs, and mixed analog/digital designs. These problems can be solved only with new EDA technologies, and users who need them will pay for them.

The final major opportunity lies in bridging technologies—products that fill key gaps in full-line supplier applications. Examples of such products include libraries, simulation/test integration packages, and specialized netlisters. Often these products may seem like very simple concepts, but actually they require much attention to detail and accuracy. Bridging technologies make usable the mainstream products (capture, simulation, and layout) and integrate discrete applications. These products are of immediate interest to an end user since they can make existing EDA investments that much more productive. Most companies spend an extra dollar on integration and bridging problems for each dollar invested in EDA tools, which underscores the size of the total opportunity in this area.

As is the case with full-line suppliers, there are several fundamental success factors for all niche suppliers, no matter what their product may be:

- Strong marketing/distribution programs
- Close linkages with full-line suppliers
- Special relationships with key users/major accounts

These factors enable niche players to create barriers to entry that can keep out other niche players. Technology alone is not sufficient. If all a company has is technology, then a new competitor with a better technology can always displace it. Only niche players that build barriers to entry on top of their technology—unique product positioning, contractual relationships with large users, or integration into full-line supplier products—can succeed.

PRODUCT OPPORTUNITIES

Given these basic business strategies—and in spite of the maturation of the market—a significant number of important product opportunities exist. Even as market growth slows down, user needs are continuing to evolve and change. Productivity-driven customers want solutions.

Major product opportunities can be mapped back to the primary business strategies described earlier: full line and niche. Full-line strategies require core products that both meet basic user needs and integrate the design environment. Niche products correspond to the different niche strategies—low cost, leading edge, and bridge—and segment further by application—ECAE, IC layout and PCB layout.

Full-Line Product Opportunities

While nothing excludes full-line suppliers from selectively pursuing niche opportunities, there are specific product opportunities that can directly support their strategies. Given the objective of selling to large mainstream users, full-line suppliers must meet user demands for a stable, integrated design environment. In other words, they must go back to basics.

Basics, in this case, begin with robust core applications. For example, even schematic-capture packages have failed to meet customer expectations. Users were promised, and expect, capture packages that can be used for documentation (e.g., the drawings need page numbers), netlist generation (flat or hierarchical) and back-annotation from a layout. Thus, the first major product opportunity for full-line suppliers is to deliver the products they originally claimed would ship.

Looking forward, the next major opportunity is to effectively integrate the basic applications around a common data management system. Ideally, this system would allow the user or the full-line supplier to integrate other elements into the same environment. These elements could include tools from other vendors, in-house tools, or linkages to other automated systems (e.g., manufacturing or mechanical design). Such a data management system would provide for the following facilities:

- Design and library management
- Design documentation
- Third-party tool integration
- System management utilities
- Project management

- Technology-independent design
- Mixed-methodology design

This management product would provide users with the flexibility and structure to effectively control the design process, accommodate special user needs, and be open to future technology developments.

The major product opportunity for full-line suppliers is to develop the product integration tools to sustain their market positions, rather than pursue more niche applications. Integration products enable them to focus on stabilizing their original application set, while allowing them the opportunity to work with the niche suppliers. Moreover, offering well-integrated products coupled with data management tools enables full-line suppliers to command higher prices per application—even in the face of low-cost competition.

Niche Product Opportunities

In contrast with full-line product opportunities, niche opportunities cover a wider expanse of technologies. Although a complete list is not possible, the following outline examines low-cost, leading-edge, and bridge technologies allocated by application:

- Low-cost technologies
 - ECAE:
 - Schematic capture
 - Technical documentation
 - Pattern editors
 - Board verification
 - PCB layout:
 - Symbolic editors
 - Single-board routing accelerators
 - IC layout:
 - ASIC interfaces to cell-based design

- Leading-edge technologies
 - ECAE:
 - Architectural design tools
 - Specialized ASIC simulators
 - Mixed analog/digital design
 - Board verification
 - Test pattern generation
 - Acceleration
 - PCB layout:
 - Manufacturability analysis
 - Reliability analysis
 - SMT routing
 - Thermal analysis
 - SMT testability
 - Acceleration
 - IC layout:
 - Performance-driven layout
 - Very large gate-array design
 - Block place-and-route
 - Mixed methodology integration
 - Very high speed IC layout
 - Linear DRC

- Bridge technologies
 - ECAE:
 - Libraries
 - Logic design to test linkages
 - Mixed software/hardware design

HARDWARE PLATFORMS

All of the preceeding discussion on strategies and product opportunities is as applicable to hardware platforms as it is to applications. Distinct market positions are available for full-line and niche hardware vendors. Full-line hardware vendors are the suppliers of core platforms and integrated development and operating environments. Niche vendors, on the other hand, offer specialized systems that meet specific user needs for leading-edge CPU or graphics performance, low-cost entry stations, or linking hardware technologies.

Nonetheless, within the general framework of platforms, there are certain unique issues and trends. The balance between personal computers, technical workstations, host-computers, and special-purpose hardware is shifting. This is partly driven by improvements and changes in technology and dropping prices, but it also reflects the changes in user base described above. Pressures from users to put a station on every engineer's desk are operating at the low end, while increasing user familiarity and experimentation with EDA applications are driving the mid-to-high end. (Dataquest forecasts of EDA products by platform type are shown in Figures 1.4-5 and 1.4-6).

Technical Workstations

Dataquest believes that the technical workstation will be at the center of EDA shipment and revenue growth. The technical workstation has the right mix of capabilities and is in the right location - the desk top - to provide the hardware platform for EDA. We believe the technical workstation will take on this role for the following reasons:

- Low incremental cost per user
- Steady improvements in price/performance
 - Given fixed performance, price dropping 30 percent per year
 - Given fixed price, mips doubling each year
- 32-bit processing needed for most EDA applications

- Computational alignment with each user's requirements
- Wide range of computation/graphics capabilities
 - Supertechnical workstations at the high end
 - Diskless stations at the low end

The technical workstation has all of the key elements. First, it has the computing capabilities required for most EDA applications (32-bit CPU, virtual addressing, and nonsegmented memory), and the horsepower available is steadily improving both in terms of graphics and processing power. Second, the cost per seat is dropping steadily. The result is that the technical workstation is able to displace the personal computer at the low end and is starting to rival superminicomputers at the high end. Indeed, the proliferation of capabilities among technical workstation suppliers is rapidly causing the distinctions between PCs, mainframes, and workstations to blur.

Personal Computers

Dataquest believes that, while the PC will continue to be the system of choice for the engineer's desk and represent the bulk of unit shipments in the near future, it will eventually give way to the technical workstation. The PC's primary advantage today is its price, but rapid declines in technical workstation prices are eliminating this distinction. It is important to note that, by Dataquest's definition, an 80386-based system running OS2 in 80286 mode is a personal computer. The same hardware running UNIX in true 80386 mode is a technical workstation. However, the fact that this hardware is now being marketed for, and can be used for, significantly larger applications is extremely important. This "simple" shift in operating system increases the memory space. It can also eliminate memory segmentation (or make the segments so large as not to be an issue), increase application speed (if only through simpler memory management schemes), and make the process of porting software from other workstations much easier.

Dataquest believes that the PC will remain important for the following reasons:

- Low cost per seat will continue to make PCs attractive.
- PC-based application prices have dropped significantly.
- OS2 and IBM's Personal System/2 will extend the PC's life.
- 80386 PC AT clones will increase performance even as prices fall.

Dataquest believes that PCs will eventually decline in popularity for the following reasons:

- Applications are limited by the 16-bit operation.
- Technical workstation prices will meet those of the PC.
- Rising user needs will drive users to 32-bit stations.

Again, the distinction between PCs and technical workstations is a fine but important one. User needs for increasing performance will force the transition in both operating systems and platform type.

Host-Dependent Computing

Dataquest sees the role of the host computer as declining but still important. With most graphics applications migrating to the technical workstation and the personal computer, the host computer emerges as a computational engine and a network server. As a computational engine, the host computer still can be a shared resource for large batch processes that are still too large for technical workstations. As a network server, it serves the need for data base management and archival and other shared resources such as printers, plotters, big disks, and tapes.

Dataquest views the following factors as dominating the future of host computers as an EDA platform:

- The rising computing capabilities of technical workstations
- The constantly expanding need for very large computing
- The existence of resources that will always be best shared on a network

Again, part of the reason for the decline in the role of host computing is definitional. The difference between a supertechnical workstation and a supermini-computer will eventually come down to the graphics tube: a headless station is a host, a station with a tube is a workstation. This is as fine a distinction as the one between personal computers and technical workstations, but it is important for understanding the basic makeup of the users hardware environment.

Special-Purpose Hardware

Dataquest believes that special-purpose hardware will still have an important niche role in EDA, particularly in the areas of hardware modeling and application-specific accelerators. Both of these hardware options have capabilities that cannot be easily matched by general-purpose platforms, and have demonstrated their usefulness in real design environments.

Hardware modeling began as a substitute for software models of complicated VLSI chips during system simulation. Yet even though software behavioral models now exist for 68020s or Ethernet controllers, hardware modeling has taken on many other roles. Users continue to surprise simulation vendors with the applications they find for hardware modeling. For example, one company plugged a microwave dish into its physical modeler and used real responses from this system to drive its simulation of several ASIC designs. Hardware modeling is a quick and simple window that bridges the real world and the software world, and, as such, will always have a place in the EDA design environment.

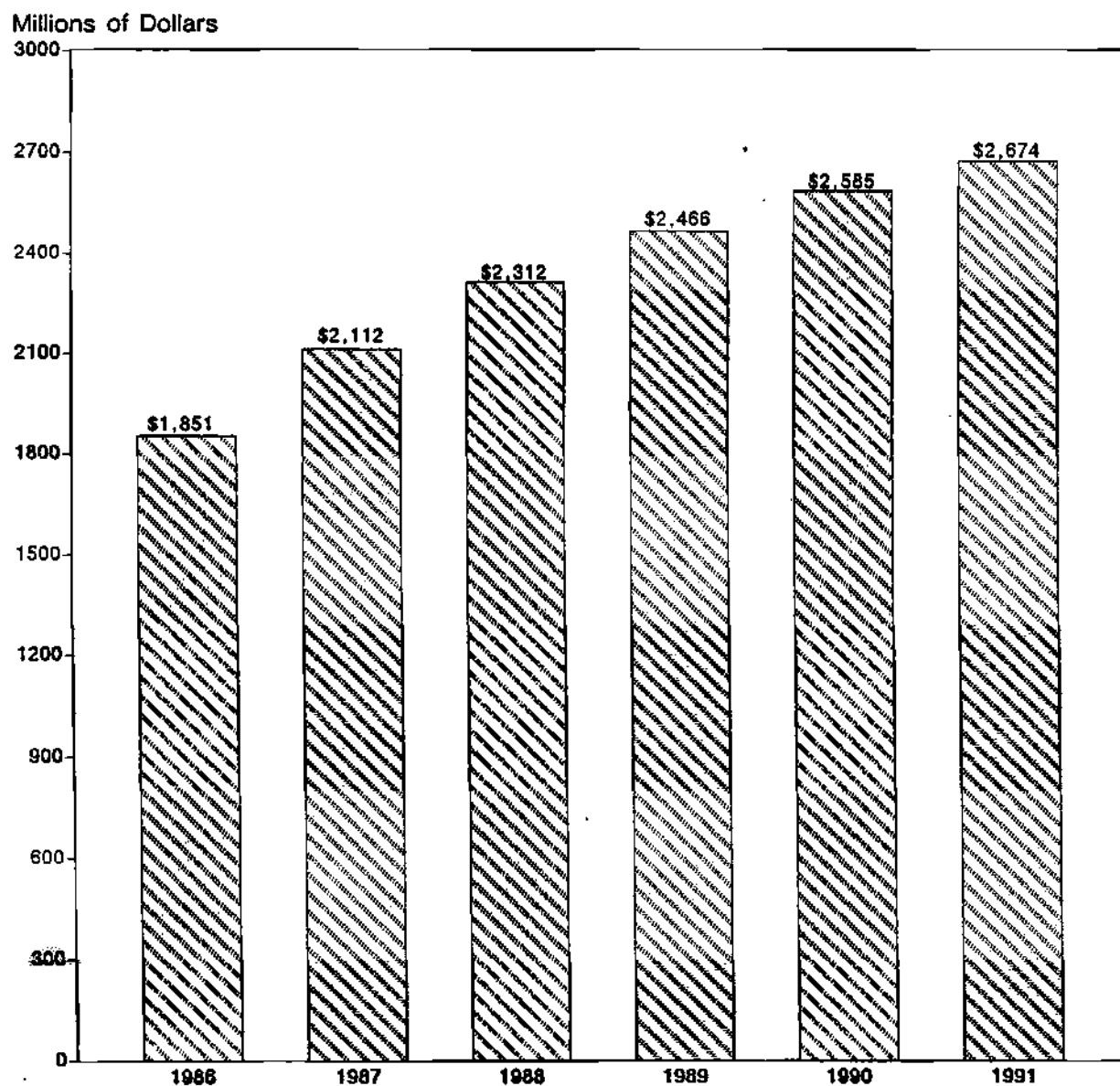
Application-specific accelerators for routing, simulation and fault grading pose a different problem. On the one hand, it is possible to imagine general-purpose hardware catching up with today's accelerators. Reduced-instruction-set computing (RISC) architectures and high-performance workstations suggest the possibility of general-purpose accelerators displacing application-specific accelerators. On the other hand, the same technologies that promise speedups in general-purpose hardware (ASICs, faster SRAMs, and 25+ MHz CPUs) can also be applied to keep application-specific accelerators ahead in the game. As a result, Dataquest believes that application-specific accelerators can remain an important factor in EDA environments.

1.4 EDA Forecasts

These bullets present Dataquest's forecast and analysis for the total electronic design automation (EDA) market for all regions and platforms. This section contains Figures 1.4-1 and 1.4-2 and Table 1.4-1.

- The EDA market was an estimated \$1.851 billion in 1986 and is forecast to grow to \$2.674 billion in 1991, a 7.6 percent CAGR.
- Dataquest forecasts that the market will grow to \$2.112 billion in 1987, a growth rate of only 14 percent.
- Workstation shipments in 1986 were 35,653 and are forecast to grow to 43,750 in 1987, an increase of 23 percent; the CAGR through 1991 is expected to be 10.6 percent, with shipments rising to 57,700.

Figure 1.4-1
EDA Worldwide Forecast
Revenue



Source: Dataquest
June 1987

Figure 1.4-2

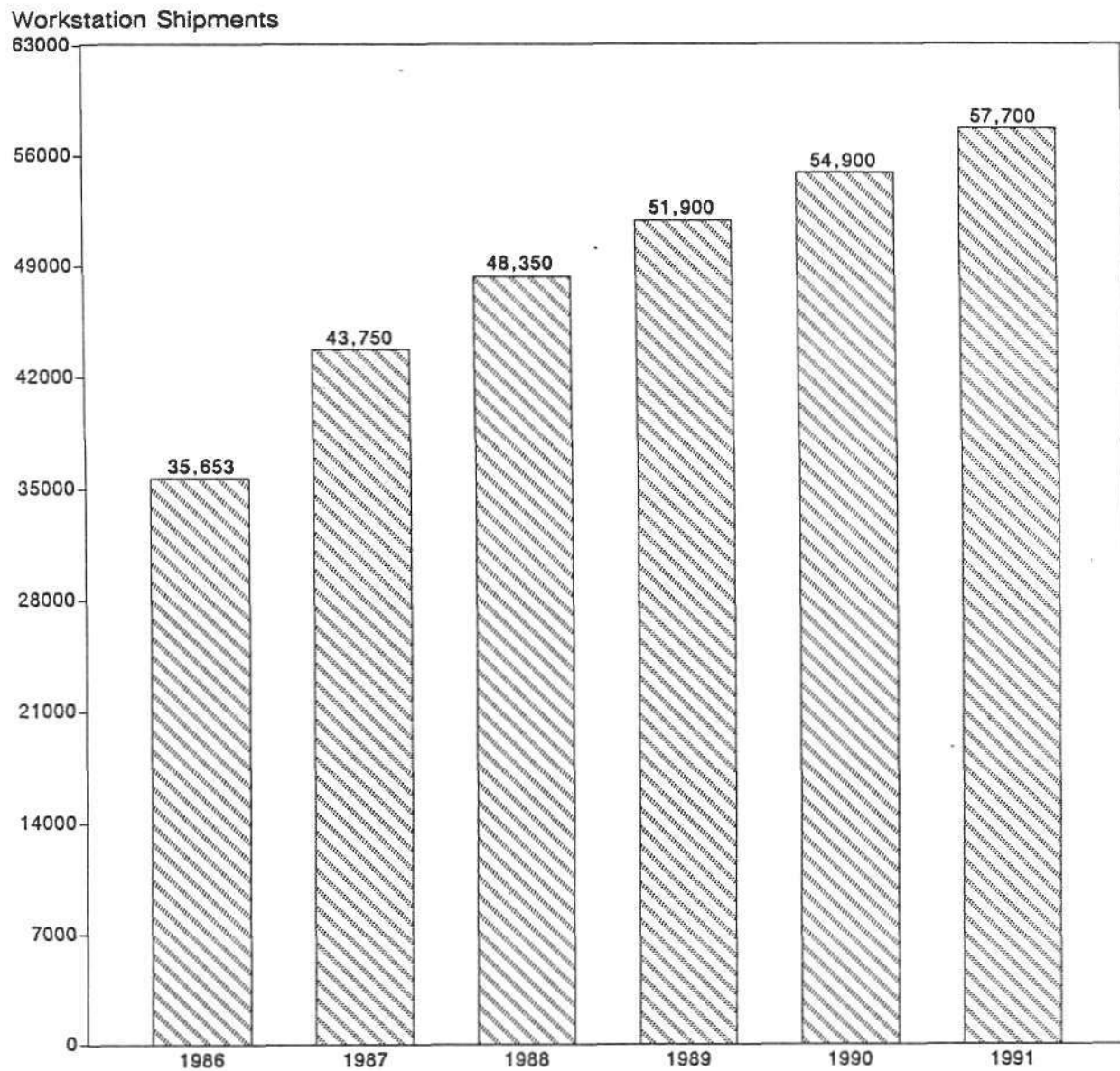
EDA Worldwide Forecast
ShipmentsSource: Dataquest
June 1987

Table 1.4-1

**EDA Worldwide Forecast
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	=====	=====	=====	=====	=====	=====	=====
Total Market							
Revenue	1,851	2,112	2,312	2,466	2,585	2,674	7.6%
Systems	34,686	42,800	47,650	51,350	54,450	57,350	10.6%
Workstations	35,653	43,750	48,350	51,900	54,900	57,700	10.1%

Source: Dataquest
June 1987

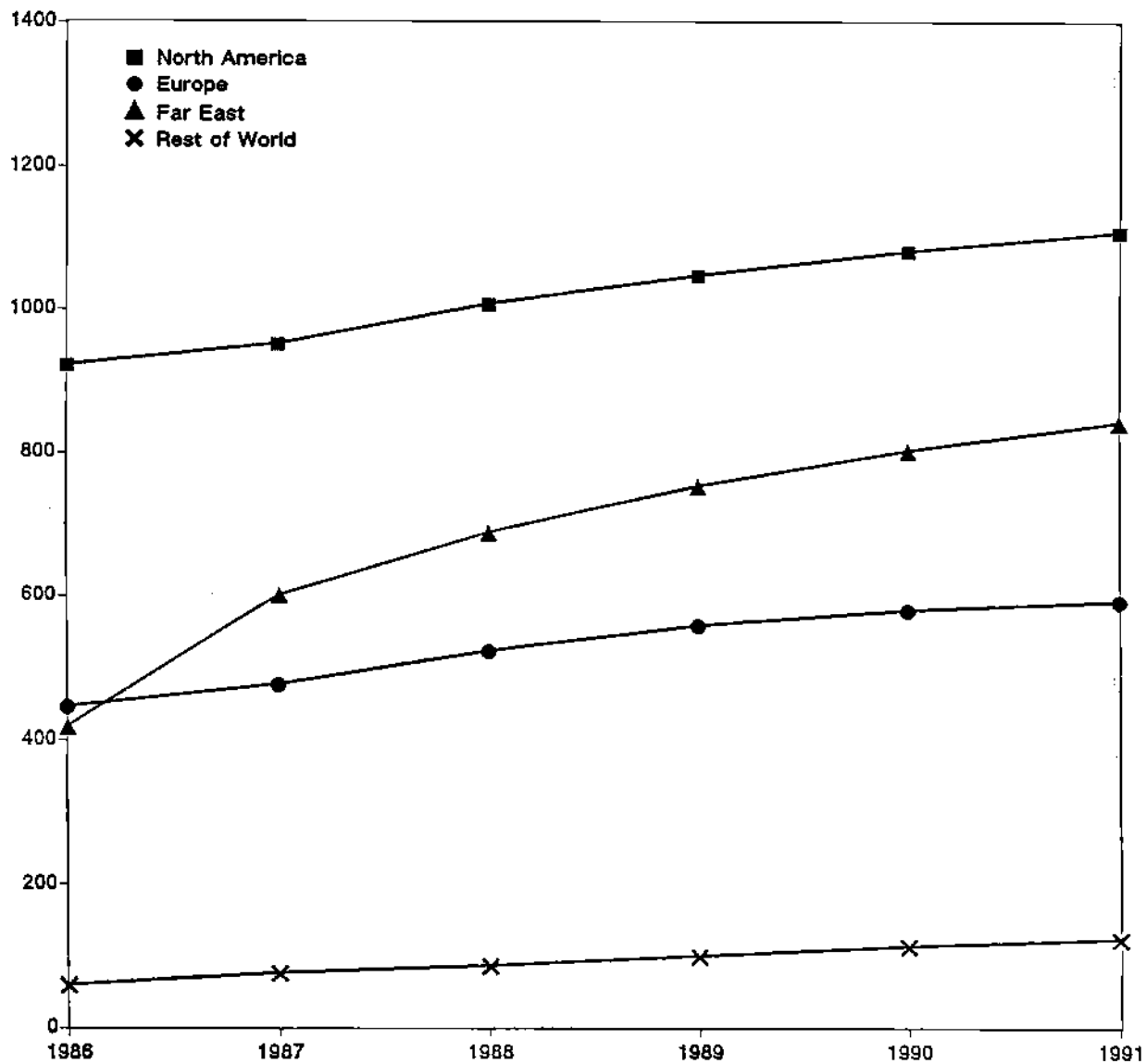
These bullets present Dataquest's forecast and analysis of the EDA market, segmented by region. This section contains Figures 1.4-3 and 1.4-4 and Tables 1.4-2 and 1.4-3.

- North American revenue was \$924 million in 1986 and is expected to grow at only a 3.8 percent CAGR to \$1.111 million in 1991, the slowest growth rate of any region.
- North American revenue is forecast to grow to \$954 million in 1987, up only 1 percent.
- North America represents 50 percent of the EDA market, but will decline to 42 percent as a result of its relatively slow growth.
- European revenue was 24 percent of the total worldwide revenue in 1986 at \$447 million. It is forecast to grow at an 11.5 percent CAGR to \$594 million in 1991, representing 22 percent of the total market.
- Dataquest forecasts that European revenue will rise 7 percent in 1987 to \$478 million, continuing the strong growth it experienced in 1986.
- Dataquest expects the Far East to be one of the two strongest growth markets. Revenue in 1986 was \$420 million, 23 percent of the total, and is expected to rise to \$845 million in 1991, a 15 percent CAGR and 32 percent of total revenue. In 1987, revenue is expected to grow 43 percent.
- The rest of the world (ROW) accounted for 3 percent of total revenue at \$61 million, but is expected to have a relatively healthy growth rate at a 15 percent CAGR through 1991.
- Dataquest believes that as the Far East and European markets rise as a percentage of the total market and the United States declines, EDA vendors will have to take on a balanced sales strategy, as well as meeting the buying criteria of an international customer base. Corporate stability and reputation, and service and support are as important as product content.

Figure 1.4-3

EDA Regional Forecast
Revenue

Millions of Dollars



Source: Dataquest
June 1987

Figure 1.4-4

EDA Regional Forecast
Shipments

Workstation Shipments

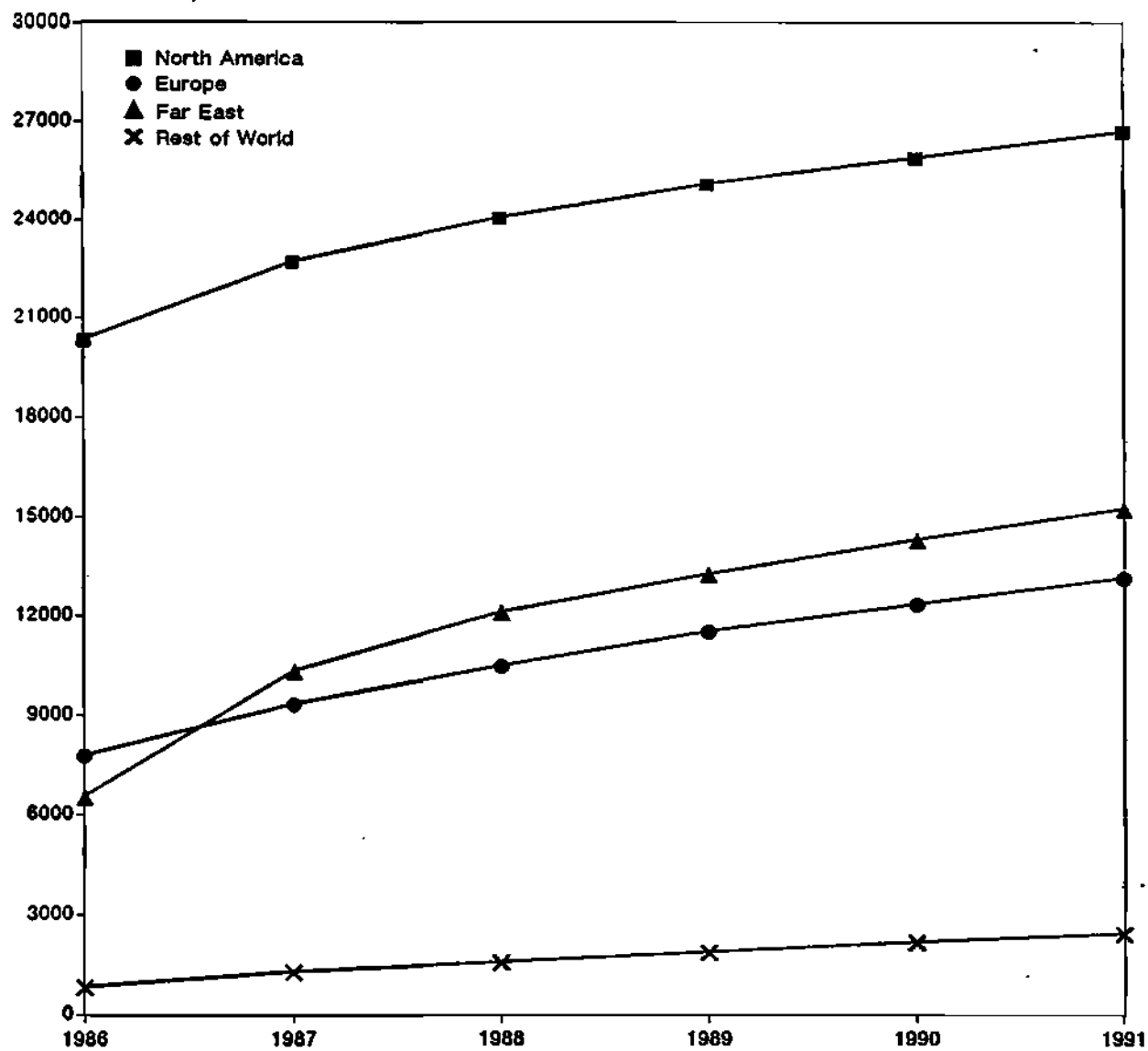
Source: Dataquest
June 1987

Table 1.4-2

EDA Regional Forecast
(Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	1,851	2,112	2,312	2,466	2,585	2,674	7.6%
Systems	34,686	42,800	47,650	51,350	54,450	57,350	10.6%
Workstations	35,653	43,750	48,350	51,900	54,900	57,700	10.1%
North America							
Revenue	924	954	1,009	1,050	1,084	1,111	3.8%
Systems	20,134	22,650	24,150	25,250	26,100	26,900	6.0%
Workstations	20,377	22,750	24,100	25,150	25,950	26,750	5.6%
Europe							
Revenue	447	478	524	560	582	594	5.9%
Systems	7,633	9,200	10,400	11,450	12,350	13,150	11.5%
Workstations	7,819	9,350	10,500	11,550	12,400	13,200	11.0%
Far East							
Revenue	420	602	690	755	805	845	15.0%
Systems	6,017	9,650	11,450	12,700	13,750	14,800	19.7%
Workstations	6,595	10,350	12,150	13,300	14,350	15,300	18.3%
Rest of World							
Revenue	61	78	88	101	114	124	15.4%
Systems	902	1,350	1,650	1,950	2,250	2,500	22.6%
Workstations	863	1,300	1,600	1,900	2,200	2,450	23.2%

Source: Dataquest
June 1987

Table 1.4-3

**EDA Regional Forecast
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
North America						
Revenue	50%	45%	44%	43%	42%	42%
Systems	58%	53%	51%	49%	48%	47%
Workstations	57%	52%	50%	48%	47%	46%
Europe						
Revenue	24%	23%	23%	23%	23%	22%
Systems	22%	21%	22%	22%	23%	23%
Workstations	22%	21%	22%	22%	23%	23%
Far East						
Revenue	23%	28%	30%	31%	31%	32%
Systems	17%	23%	24%	25%	25%	26%
Workstations	18%	24%	25%	26%	26%	27%
Rest of World						
Revenue	3%	4%	4%	4%	4%	5%
Systems	3%	3%	3%	4%	4%	4%
Workstations	2%	3%	3%	4%	4%	4%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the EDA market segmented by platform. This section contains Figures 1.4-5 and 1.4-6 and Tables 1.4-4 and 1.4-5.

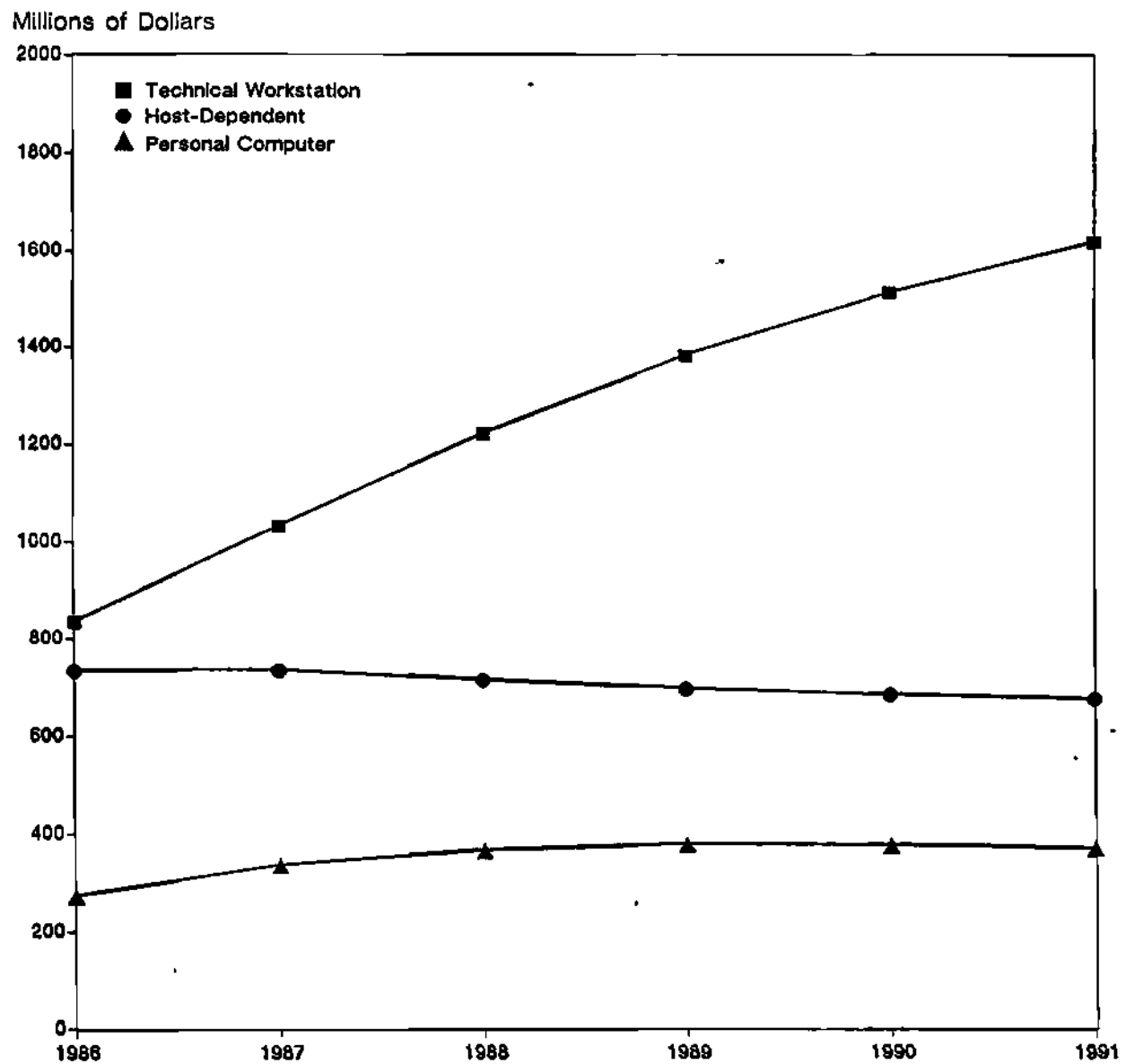
- In 1986, workstation shipments were 35,653 units. They are forecast to grow to 57,700 units in 1991, a 10.1 percent CAGR.
- Technical workstation shipments were 12,691 units, representing 36 percent of total unit shipments. However, technical workstation revenue was \$838 million, representing 45 percent of the total EDA market.
- Technical workstation revenue and shipments are expected to have the highest growth rates for all platform types. Unit shipments are forecast to grow at a 19.4 percent CAGR to 30,850 units in 1991. Revenue is expected to grow at a 14.1 percent CAGR to \$1,621 million in 1991. Technical workstations in 1991 will represent 61 percent of total revenue and 53 percent of total shipments.
- Host-dependent workstation shipments were 3,425 units, representing 10 percent of total unit shipments. However, host-dependent revenue were \$736 million, representing 40 percent of the total EDA market.
- Host-dependent revenue and shipments are expected to have the slowest growth rates for all platform types. Unit shipments are forecast to wane at a negative CAGR of 2 percent to 3,100 units in 1991. Revenue is expected to dwindle at a negative CAGR of 1.6 percent to \$1,621 million in 1991. Host-dependent systems in 1991 will represent 25 percent of total revenue and 5 percent of total shipments.
- Personal computer shipments were 19,538 units, representing 55 percent of total unit shipments. Revenue was only \$276 million, representing 15 percent of the total EDA market.
- Technical workstation revenue and shipments are expected to have moderate growth rates. Unit shipments are forecast to grow at a 4 percent CAGR to 23,750 units in 1991. Revenue is expected to grow at a 6.3 percent CAGR to \$374 million in 1991. Technical workstations in 1991 will represent 14 of total revenue and 41 percent of total shipments.

- Dataquest believes that this shift toward the technical workstation and away from the personal computer and host-dependent system reflects the following major trends:
 - The increasing CPU power of the technical workstation
 - The demand for 32-bit applications over 16-bit tools
 - The declining price of technical workstations

Taken together, these factors tend to limit personal computers to documentation and design entry tasks, and host-dependent systems to network server roles.

Figure 1.4-5

EDA Worldwide Forecast by Platform
Revenue



Source: Dataquest
June 1987

Figure 1.4-6

EDA Worldwide Forecast by Platform
Shipments

Workstation Shipments

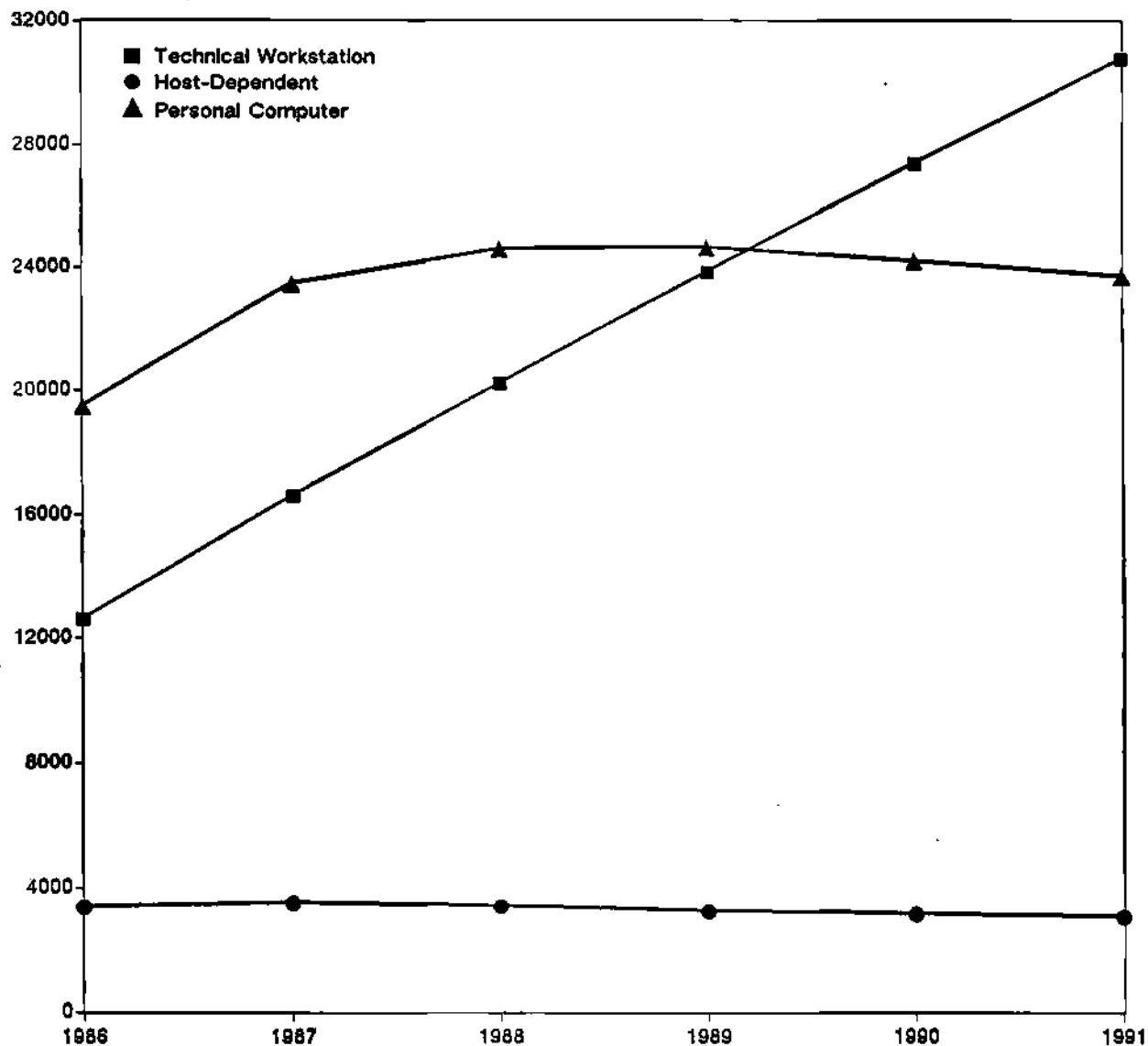
Source: Dataquest
June 1987

Table 1.4-4

EDA Worldwide Forecast by Platform
(Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	1,851	2,112	2,312	2,466	2,585	2,674	7.6%
Systems	34,686	42,800	47,650	51,350	54,450	57,350	10.6%
Workstations	35,653	43,750	48,350	51,900	54,900	57,700	10.1%
Technical Workstation							
Revenue	838	1,035	1,224	1,386	1,516	1,621	14.1%
Systems	12,691	16,650	20,250	23,900	27,450	30,850	19.4%
Workstations	12,691	16,650	20,250	23,900	27,450	30,850	19.4%
Host-Dependent							
Revenue	736	737	717	699	688	679	-1.6%
Systems	2,458	2,650	2,750	2,800	2,800	2,800	2.6%
Workstations	3,425	3,550	3,450	3,300	3,200	3,100	-2.0%
Personal Computer							
Revenue	276	339	370	382	380	374	6.3%
Systems	19,538	23,500	24,650	24,700	24,250	23,750	4.0%
Workstations	19,538	23,500	24,650	24,700	24,250	23,750	4.0%

Source: Dataquest
June 1987

Table 1.4-5

**EDA Worldwide Forecast by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
Technical Workstation						
Revenue	45%	49%	53%	56%	59%	61%
Systems	37%	39%	42%	47%	50%	54%
Workstations	36%	38%	42%	46%	50%	53%
Host-Dependent						
Revenue	40%	35%	31%	28%	27%	25%
Systems	7%	6%	6%	5%	5%	5%
Workstations	10%	8%	7%	6%	6%	5%
Personal Computer						
Revenue	15%	16%	16%	15%	15%	14%
Systems	56%	55%	52%	48%	45%	41%
Workstations	55%	54%	51%	48%	44%	41%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the average price per seat by platform for the EDA market. This section contains Figure 1.4-7 and Table 1.4-6.

- For all EDA product types worldwide, the average price per seat (APPS) was \$39,800 in 1986. It is forecast to decline at a negative 10.5 percent CAGR to \$22,800 in 1991. In 1987, the APPS is expected to be \$32,700, a decrease of 18 percent.
- The technical workstation APPS was \$52,100 in 1986. It is forecast to have the sharpest decline, a negative 13.8 percent CAGR, to \$24,800 in 1991. In 1987, the APPS is expected to be \$42,300, a decrease of 19 percent.
- The host-dependent APPS was \$171,900 in 1986. It is forecast to decline steadily at a negative 5.6 percent CAGR to \$128,700 in 1991. In 1987, the APPS is expected to be \$149,500, a decrease of 13 percent.
- The personal computer APPS was \$8,700 in 1986 and is forecast to decline at a negative 6.6 percent CAGR to \$6,200 in 1991. The APPS in 1987 is expected to be \$8,100.
- Dataquest believes that these declines in prices will be driven by steady price erosion in both hardware and software. Basic applications, such as schematic capture, have already dropped below the \$1,000 price point, and, given fixed functionality, prices can only continue to fall. Current prices can be maintained only by increases in product functionality or performance.

Figure 1.4-7

EDA Worldwide Average Price Per Seat by Platform

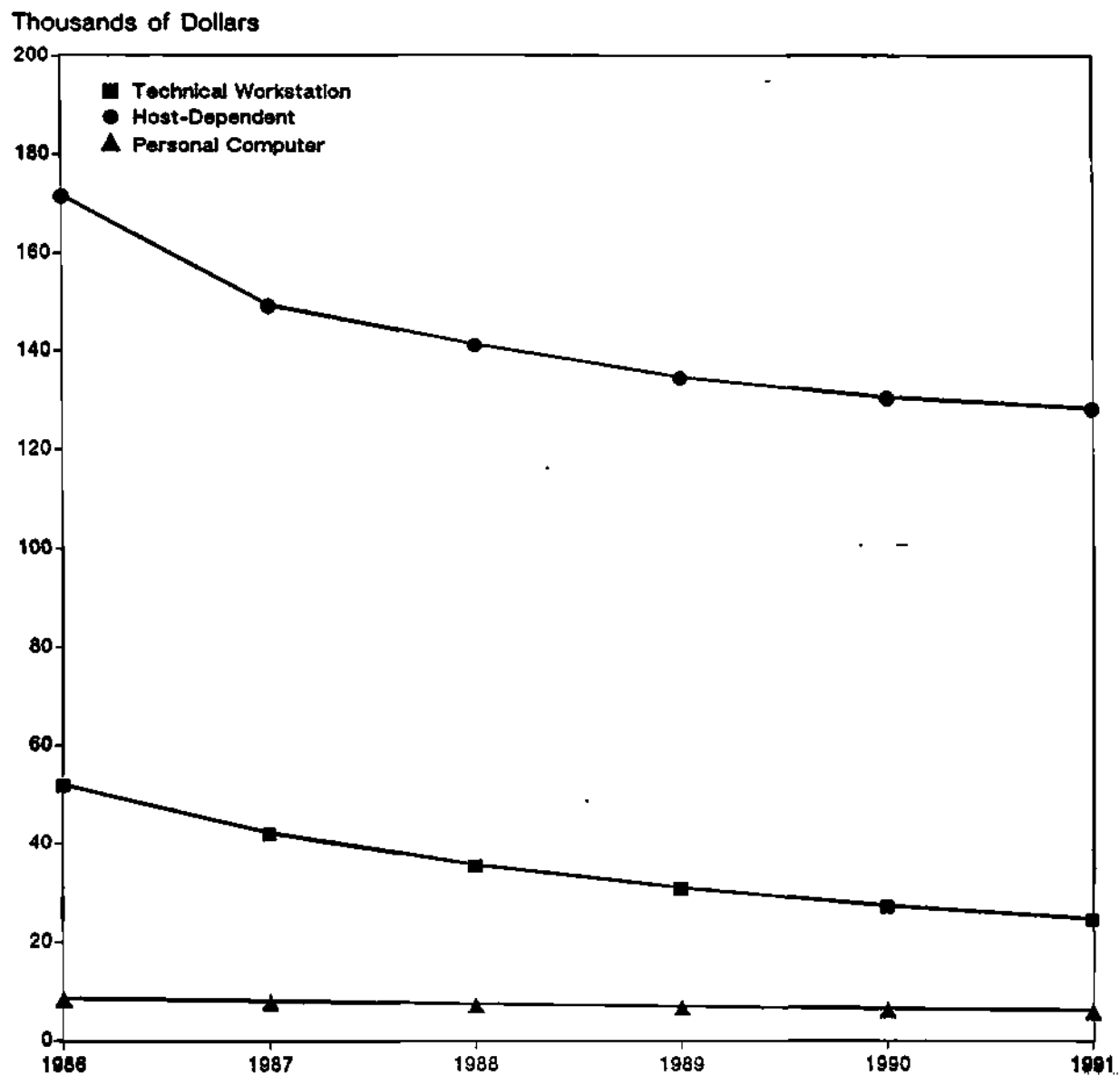
Source: Dataquest
June 1987

Table 1.4-6

**EDA Worldwide Average Price per Seat by Platform
(Thousands of Dollars)**

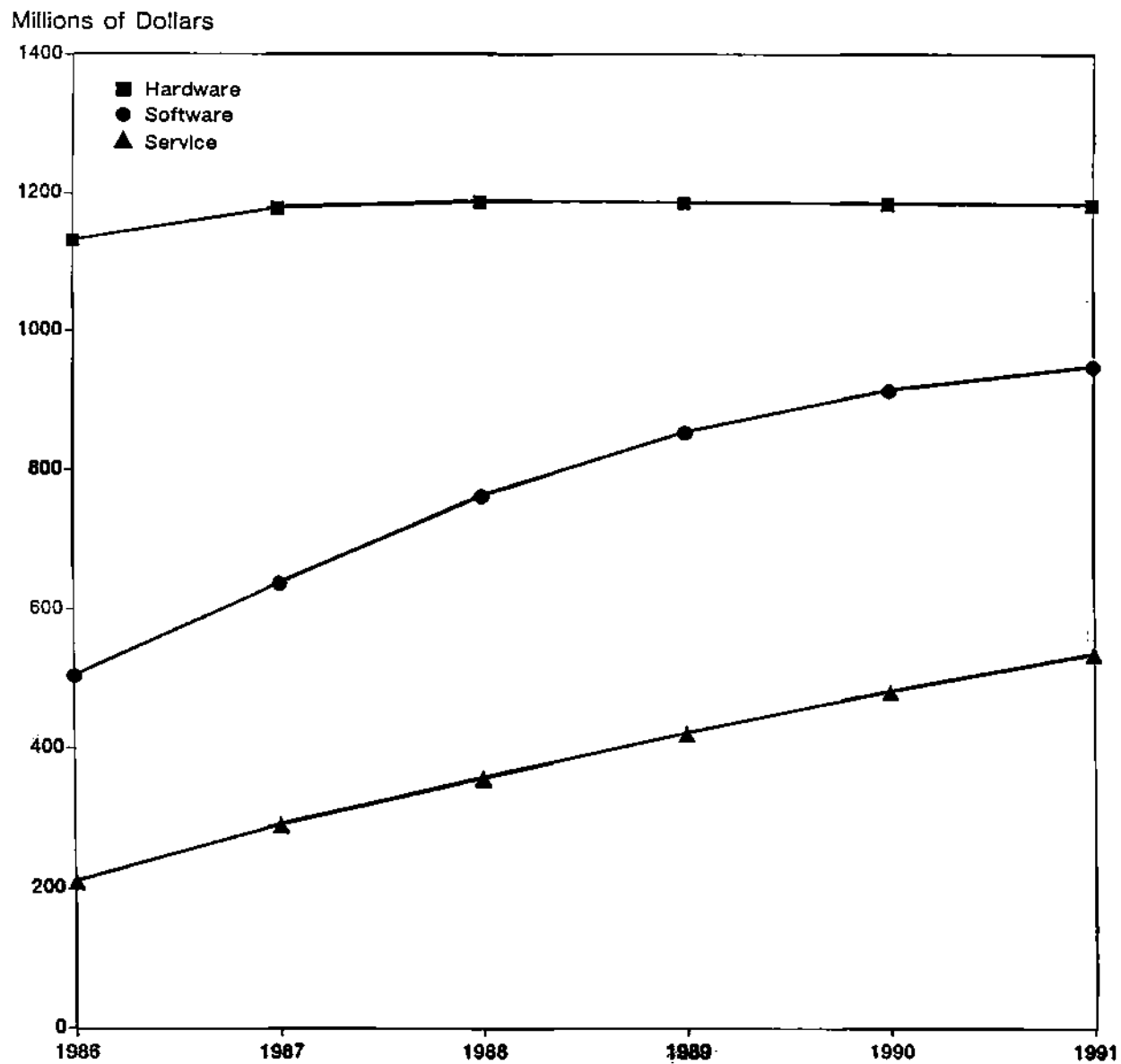
	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
All Product Types	39.8	32.7	28.9	26.3	24.3	22.8	-10.6%
Technical Workstation	52.1	42.3	35.8	31.1	27.5	24.8	-13.8%
Host-Dependent	171.9	149.5	141.6	134.6	130.8	128.7	-5.6%
Personal Computer	8.7	8.1	7.5	7.0	6.6	6.2	-6.6%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the EDA market segmented by revenue source for each platform. This section contains Figure 1.4-8 and Tables 1.4-7 and 1.4-8.

- Hardware revenue was approximately \$1,134 million in 1986, or roughly 61 percent of total EDA revenue. Hardware revenue growth overall will be only a .9 percent CAGR through 1991 and will be \$1,186 million or only 44 percent of total 1991 revenue.
- Software and service revenue is forecast to have the strongest growth. In 1986, revenue for software and service was \$506 million and \$211 million, respectively. Software revenue is expected to grow at a 13.4 percent CAGR to \$951 million in 1991, while service revenue will grow at a 20.5 percent CAGR to \$537 million.
- Dataquest believes that the growth of service and software revenue reflects the steady maturation of the EDA market. Not only are hardware prices falling, but large installed customer bases are also requiring increasing levels of support, training, and service. Moreover, as penetration increases, the demand for more hardware declines, while the demand to add more software to the same system starts to rise.

Figure 1.4-8
EDA Worldwide Revenue Sources



Source: Dataquest
June 1987

Table 1.4-7

**EDA Worldwide Revenue Sources by Platform
Worldwide**

	1986	1987	1988	1989	1990	1991	CAGR
	----	----	----	----	----	----	----
All Platforms							
Hardware	1,134	1,181	1,190	1,189	1,187	1,186	.9%
Software	506	639	764	856	916	951	13.4%
Service	211	292	358	422	482	537	20.5%
Total	1,851	2,112	2,312	2,466	2,585	2,674	7.6%
Technical Workstation							
Hardware	465	528	572	610	640	665	7.4%
Software	273	358	457	534	588	622	18.0%
Service	101	148	195	242	289	333	26.8%
Total	838	1,035	1,224	1,386	1,516	1,621	14.1%
Host-Dependent							
Hardware	536	491	451	418	396	379	-6.7%
Software	111	125	133	138	142	143	5.2%
Service	89	122	133	143	151	157	12.0%
Total	736	737	717	699	688	679	-1.6%
Personal Computer							
Hardware	133	162	166	161	151	142	1.3%
Software	122	155	175	184	187	185	8.7%
Service	20	22	30	36	42	47	18.2%
Total	276	339	370	382	380	374	6.3%

Source: Dataquest
June 1987

Table 1.4-8

**EDA Worldwide Revenue Sources by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
All Platforms						
Hardware	61%	56%	51%	48%	46%	44%
Software	27%	30%	33%	35%	35%	36%
Service	11%	14%	15%	17%	19%	20%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	55%	51%	47%	44%	42%	41%
Software	33%	35%	37%	39%	39%	38%
Service	12%	14%	16%	17%	19%	21%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	73%	67%	63%	60%	58%	56%
Software	15%	17%	19%	20%	21%	21%
Service	12%	17%	19%	20%	22%	23%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	48%	48%	45%	42%	40%	38%
Software	44%	46%	47%	48%	49%	49%
Service	7%	7%	8%	10%	11%	13%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
June 1987

1.5 EDA Market Shares

These bullets present Dataquest's analysis of the electronic design automation (EDA) market share measured in total revenue, hardware and software revenue, and workstation shipments. This section contains Figures 1.5-1 through 1.5-4 and Table 1.5-1.

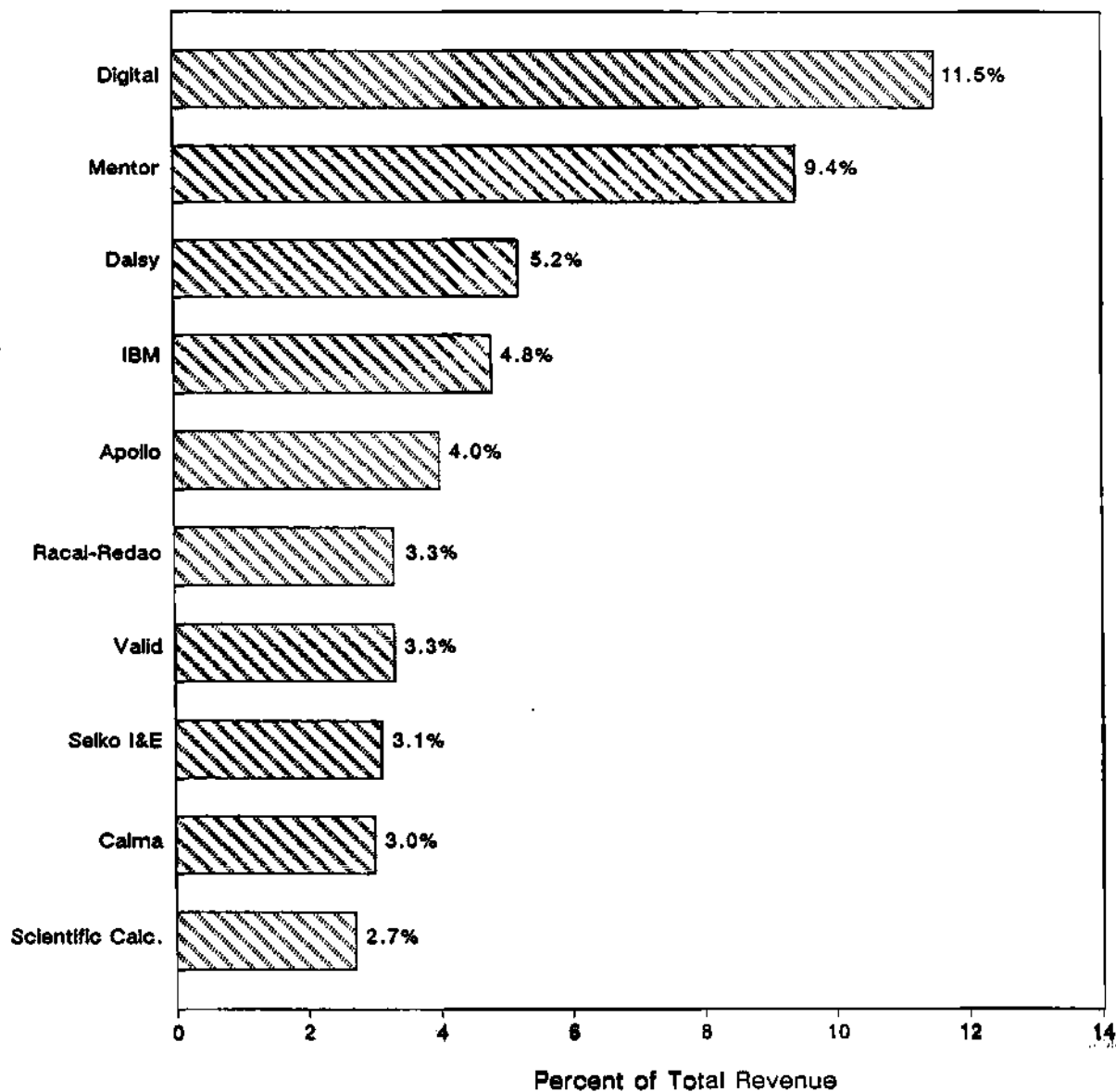
- Digital Equipment is the EDA market leader in terms of total revenue at \$213 million and 11.5 percent market share. It is also the leader in total hardware revenue, with 16.6 percent market share. Dataquest attributes Digital's market position to its continued leadership in engineering computing. The VAX 8000 series and the MicroVAX II systems provide Digital with a strong price/performance range that is well networked and fully compatible.
- Mentor Graphics is the leader in EDA software sales at \$65 million and 12.9 percent market share. It is number two in total EDA revenue, with \$174 million in revenue, and 9.4 percent market, as well as in hardware revenue, with \$86 million and 7.6 percent share. Mentor Graphics was the only member of the ECAE little three (Daisy, Mentor, and Valid) to sustain its profitability and growth in 1986. In addition, Mentor is enjoying increasing success in the areas of IC and PCB layout. Dataquest attributes Mentor's ongoing strength to its early marketing focus and its initial choice of the Apollo platform.
- Daisy Systems ranks third in total EDA revenue, with sales of \$97 million and 5.2 percent market share. It ranks second in software revenue with \$52 million in sales and 10.2 percent market share. Daisy had a difficult 1986, and, as of this writing, it has had five consecutive quarters of losses. The company had one significant layoff and a major management reorganization. Dataquest believes that declining prices at the personal computer level eroded Daisy's margins on its Personal LOGICIAN products, and the general shift to 32-bit technical workstations (e.g., Apollo, Sun, and MicroVAX) cut into the sales of Daisy's proprietary workstations. This, coupled with Daisy's failure to port its major products to the MicroVAX, led to a very difficult year.
- IBM was the leader in total unit shipments in 1986, with approximately 10,890 workstation shipments, most of which were personal computers. Overall, IBM was the fourth-largest EDA supplier, with \$88 million in revenue and 4.8 percent market share. The majority of this revenue was in the hardware category, where IBM was the number three hardware supplier, with 6.7 percent market share. IBM plays an important role in EDA and clearly represents a significant number of seats in the field. However, Dataquest believes that personal computer clones are reducing IBM's revenue and market share. In addition, IBM does not enjoy the same position in software that it does in other markets.

- Apollo was the number five company overall in EDA, and the fourth-largest hardware vendor, with \$74 million in total revenue. Apollo was the leader by far in overall technical workstation shipments, especially when its direct shipments (2,885 units) were added to those of its primary OEMs (Mentor Graphics and Racal Redac).
- It is important to note that three of the top five EDA suppliers were, in fact, hardware suppliers, indicating that direct sales by computer manufacturers to the EDA end user are a significant part of this market. The two application vendors in the top five, Daisy and Mentor, have their major base in the ECAE market.
- The next five major vendors in EDA revenue were all primarily application suppliers. These suppliers are well distributed between the different market segments (ECAE, IC layout, and PCB layout), and, while some hold significant share in an individual segment, none holds more than 3.3 percent of the overall EDA market.
 - Racal Redac is number six in the market. Racal Redac is the first company to make the list whose primary market is in PCB layout. It is the number one company in that segment.
 - Valid Logic is number seven. Like Daisy Systems, 1986 was a transitional year for Valid. It ran significant losses and, early in 1987, merged with Telesis.
 - Seiko I&E is number eight, the first Japanese company to make the list. While Seiko's position is partly attributable to yen appreciation, it does, nonetheless, have a significant position in the Japanese IC layout market.
 - Calma, the number nine EDA company, is slowly losing ground in the EDA market. It continues to hold its market position in IC layout, where its GDSII format is still the industry standard, but it is not making major gains overall.
 - Scientific Calculations is in tenth position in the EDA market. Recently acquired by Harris Corporation, it holds a strong position in PCB layout.

- Dataquest stresses the relatively fragmented nature of the EDA market. We believe that this may be a permanent feature of the market. Although full-line suppliers may continue to grow at a healthy pace, diverging technology and service needs will constantly create niche opportunities. These niche opportunities will be filled by smaller organizations that may not have significant market share but may be quite profitable. Evidence of this fragmented market is indicated by the following facts:
 - Over 100 companies currently participate in the market.
 - The top ten companies account for only roughly 50 percent of total revenue.
 - Only one company, Digital, has over 10 percent total market share. Mentor has 9 percent, and the balance of the companies each have about 5 percent or less of the market.
 - Hardware market share concentration is significantly higher than software concentration, especially if OEM business is accounted for.

Figure 1.5-1

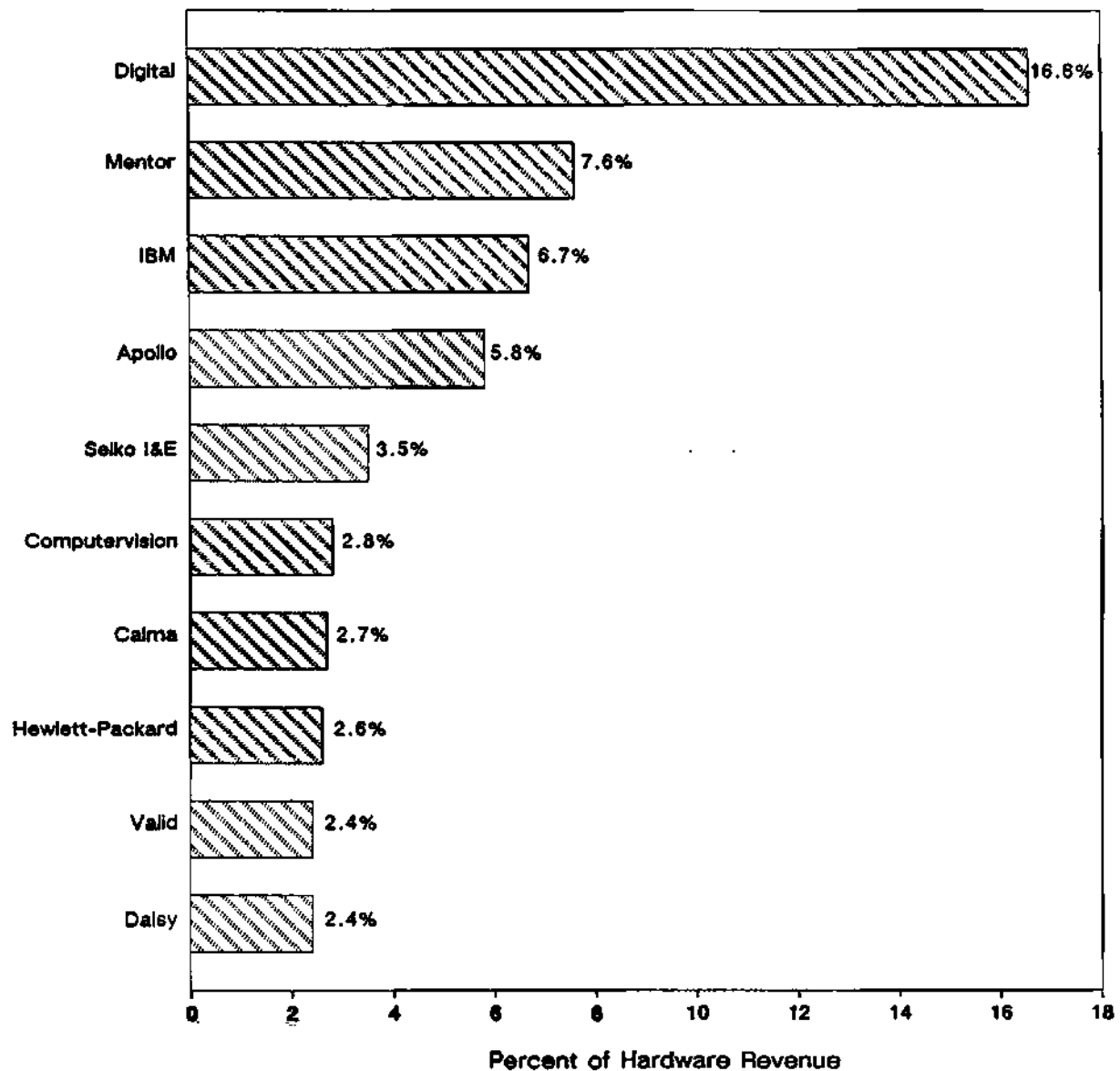
Electronic Design Automation
1986 Worldwide Market Share
Total Revenue



Source: Dataquest
June 1987

Figure 1.5-2

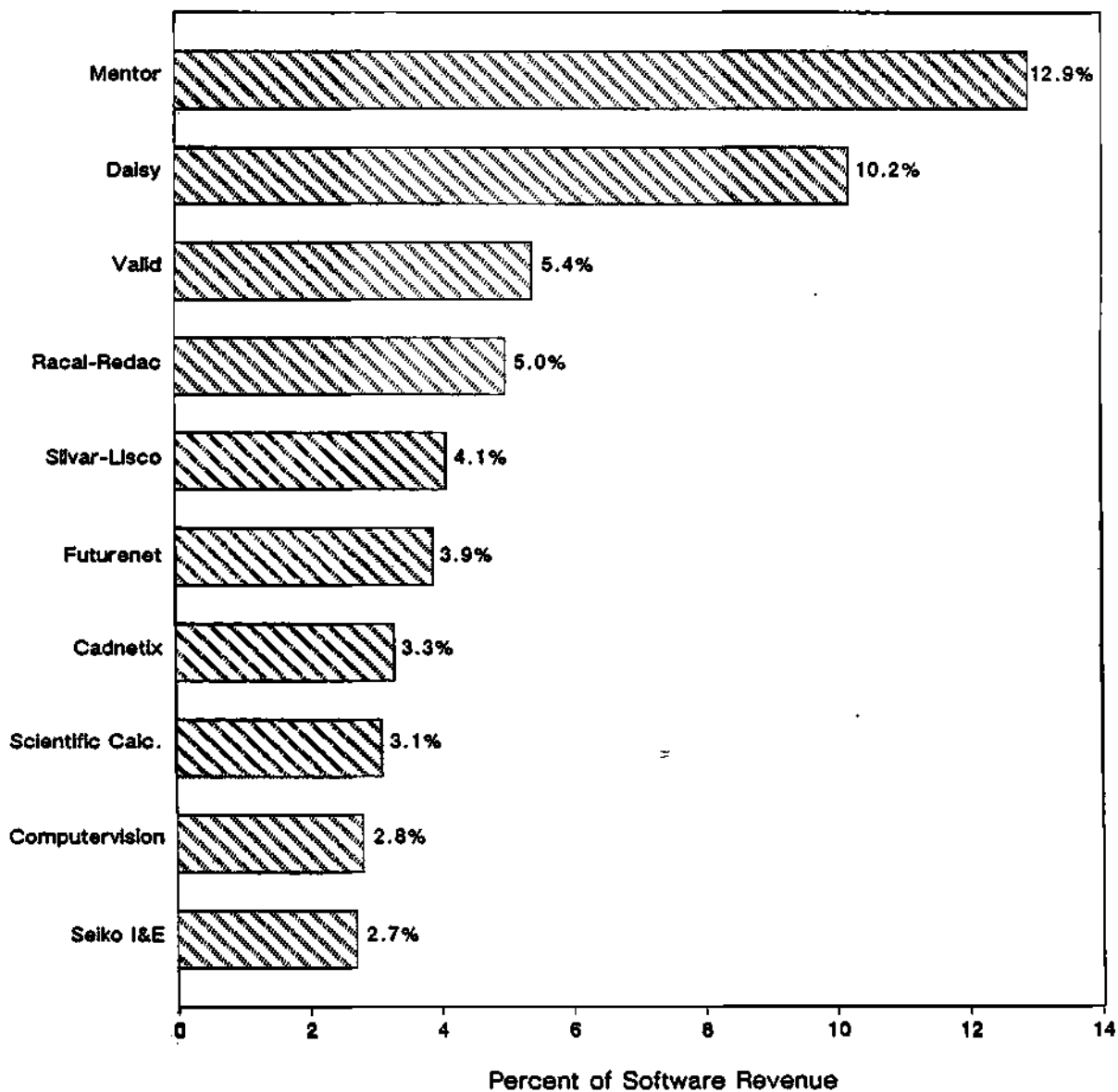
**Electronic Design Automation
1986 Worldwide Market Share
Hardware Revenue**



Source: Dataquest
June 1987

Figure 1.5-3

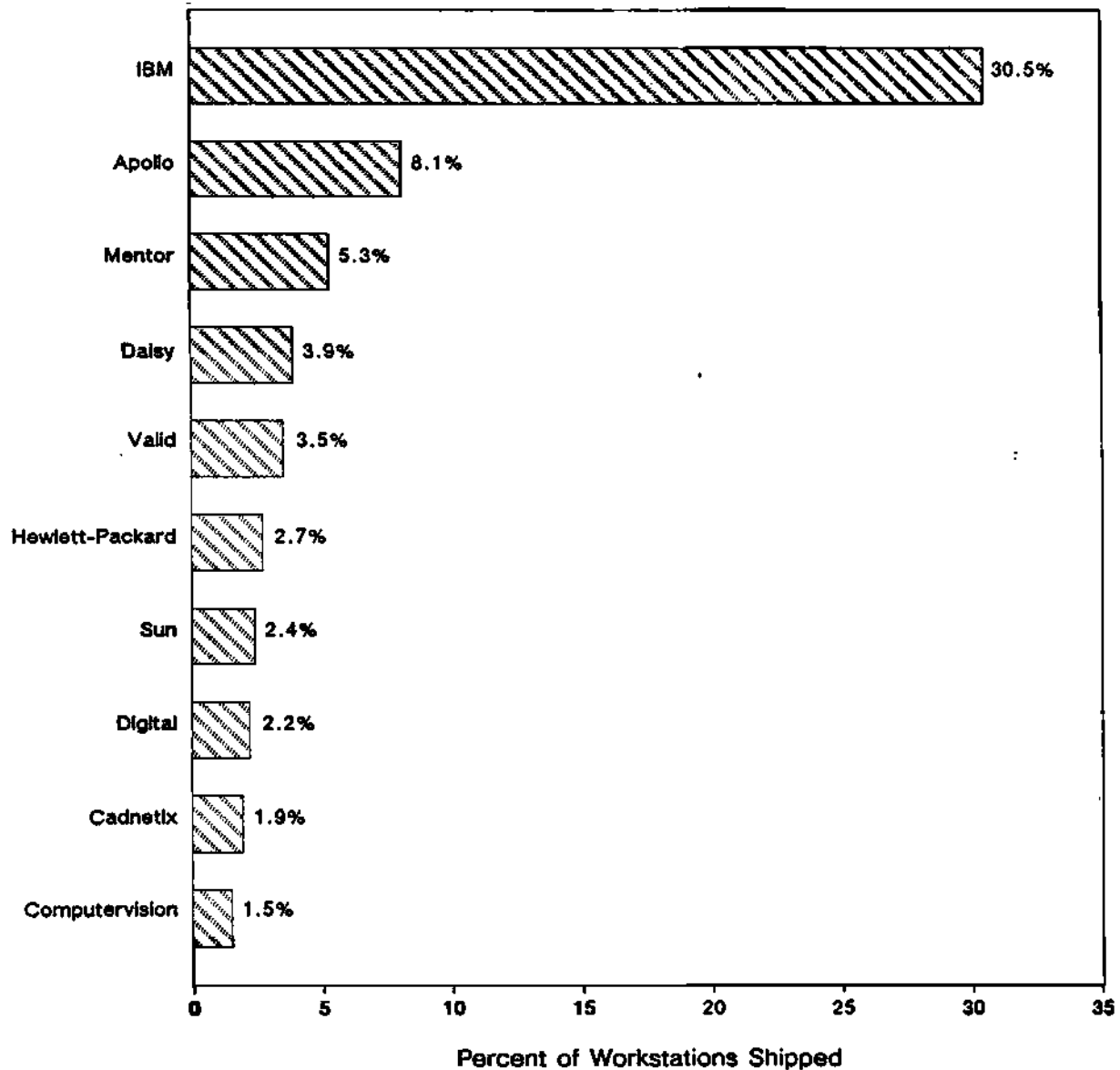
Electronic Design Automation
1986 Worldwide Market Share
Software Revenue



Source: Dataquest
June 1987

Figure 1.5-4

**Electronic Design Automation
1986 Worldwide Market Share
Workstation Revenue**



Source: Dataquest
June 1987

Table 1.5-1

**Electronic Design Automation
1986 Worldwide Market Share
(Millions of Dollars/Actual Units)**

Company *****					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Digital	213	188	0	779	11.5%	16.6%	.0%	2.2%
Mentor	174	86	65	1,900	9.4%	7.6%	12.9%	5.3%
Daisy	97	28	52	1,400	5.2%	2.4%	10.2%	3.9%
IBM	88	76	5	10,890	4.8%	6.7%	1.0%	30.5%
Apollo	74	65	0	2,885	4.0%	5.8%	.0%	8.1%
Racal-Redac	61	27	25	470	3.3%	2.4%	5.0%	1.3%
Valid	61	28	27	1,260	3.3%	2.4%	5.4%	3.5%
Seiko I&E	57	39	14	371	3.1%	3.5%	2.7%	1.0%
Calma	55	30	13	507	3.0%	2.7%	2.5%	1.4%
Scientific Calc.	50	19	16	154	2.7%	1.7%	3.1%	.4%
Computervision	49	32	14	517	2.7%	2.8%	2.8%	1.5%
Hewlett-Packard	42	30	8	949	2.3%	2.6%	1.6%	2.7%
Cadnetix	38	17	17	670	2.0%	1.5%	3.3%	1.9%
Zuken	32	16	13	319	1.7%	1.4%	2.6%	.9%
Calay	30	19	8	240	1.6%	1.7%	1.7%	.7%
NEC	25	16	7	461	1.3%	1.4%	1.4%	1.3%
Silvar-Lisco	24	0	21	0	1.3%	.0%	4.1%	.0%
Futurenet	24	1	20	400	1.3%	.1%	3.9%	1.1%
Zycad	20	18	0	0	1.1%	1.6%	.0%	.0%
Fujitsu	20	13	6	138	1.1%	1.1%	1.1%	.4%
Sun	18	16	0	855	1.0%	1.4%	.0%	2.4%
Control Data	18	11	4	281	1.0%	.9%	.7%	.8%
Intergraph	18	10	5	123	1.0%	.9%	.9%	.3%
Sharp System Products	17	11	5	95	.9%	.9%	1.0%	.3%
Applicon	17	12	3	221	.9%	1.1%	.5%	.6%
Tektronix	16	7	7	210	.9%	.6%	1.4%	.6%
Hitachi	13	8	5	57	.7%	.7%	1.0%	.2%
Telesis	13	8	4	170	.7%	.7%	.9%	.5%
Toshiba	5	4	0	36	.3%	.4%	.1%	.1%
Otsukashokai	4	2	1	303	.2%	.2%	.3%	.9%
Autodesk	2	0	2	0	.1%	.0%	.4%	.0%
Hitachi Zosen	1	1	0	16	.1%	.1%	.1%	.0%
Mitsubishi Electric	1	1	0	6	.1%	.1%	.0%	.0%
Other Companies	473	293	139	8,896	25.6%	25.9%	27.5%	25.0%
All Far East-Based Companies	216	133	69	2,686	11.7%	11.7%	13.6%	7.5%
All European-Based Companies	26	15	9	292	1.4%	1.3%	1.7%	.8%
All Hardware Companies	619	560	0	22,247	33.5%	49.4%	.0%	62.4%
All Turnkey & SW Companies	1,231	574	506	13,406	66.5%	50.6%	100.0%	37.6%
All Companies	1,851	1,134	506	35,653	100.0%	100.0%	100.0%	100.0%

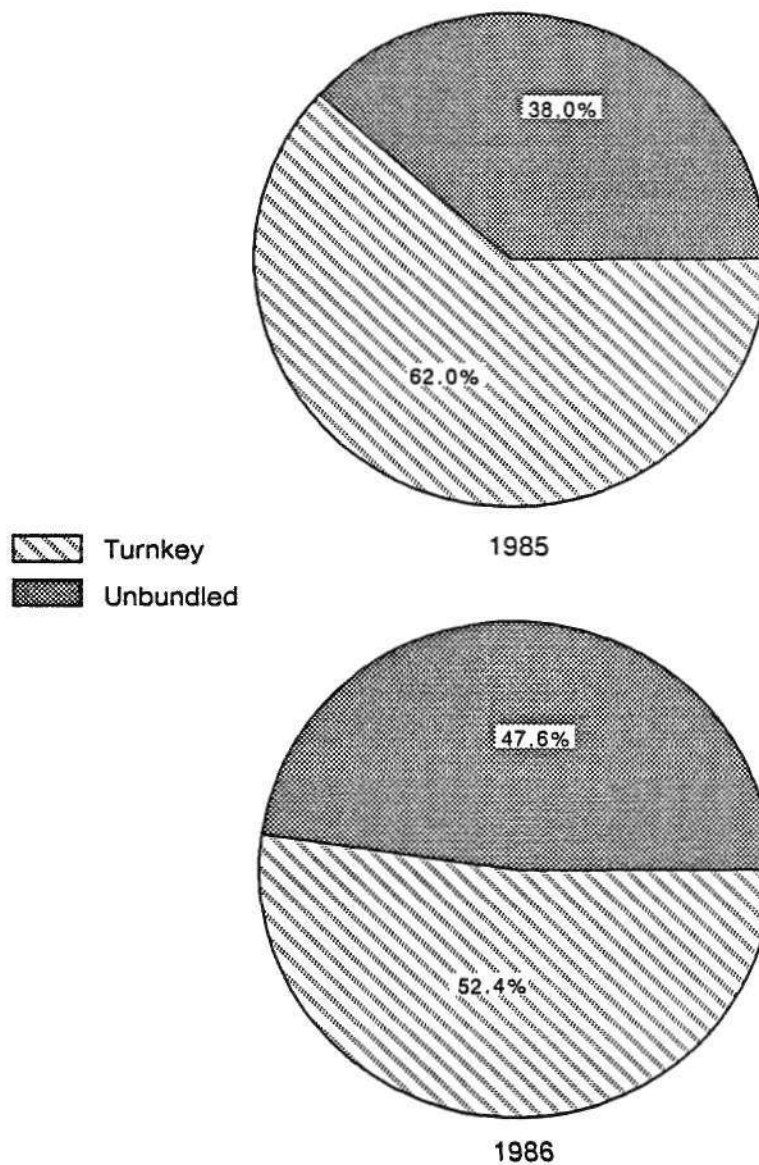
Source: Dataquest
June 1987

These bullets present the EDA market share by turnkey versus unbundled product deliveries. This section contains Figure 1.5-5 and Table 1.5-2.

- From 1985 to 1986, turnkey system revenue actually decreased 1.6 percent, whereas unbundled sales increased 46.1 percent.
- Unbundled revenue grew from 38 percent to 47.6 percent of total revenue. Correspondingly, turnkey sales dropped 62 percent to 52.4 percent.
- This shift was true across both hardware and software sales.
- Unbundled system shipments now represent 62.4 percent of total EDA system shipments.
- Dataquest believes that his shift away from turnkey systems toward unbundled systems reflects the general maturation of the EDA market. As user investment in EDA increases, and as the level of penetration rises, Dataquest believes that:
 - End users will purchase their hardware directly from the supplier to obtain the best possible prices.
 - Hardware suppliers will want to deal directly with major end users since they represent an increasing piece of their revenue.
 - End users will make their software purchases directly from the software vendor to obtain the best price and will purchase software from multiple vendors in order to create the best possible design solution.

Figure 1.5-5

Electronic Design Automation
Turnkey Versus Unbundled
(Percentage of Revenue)



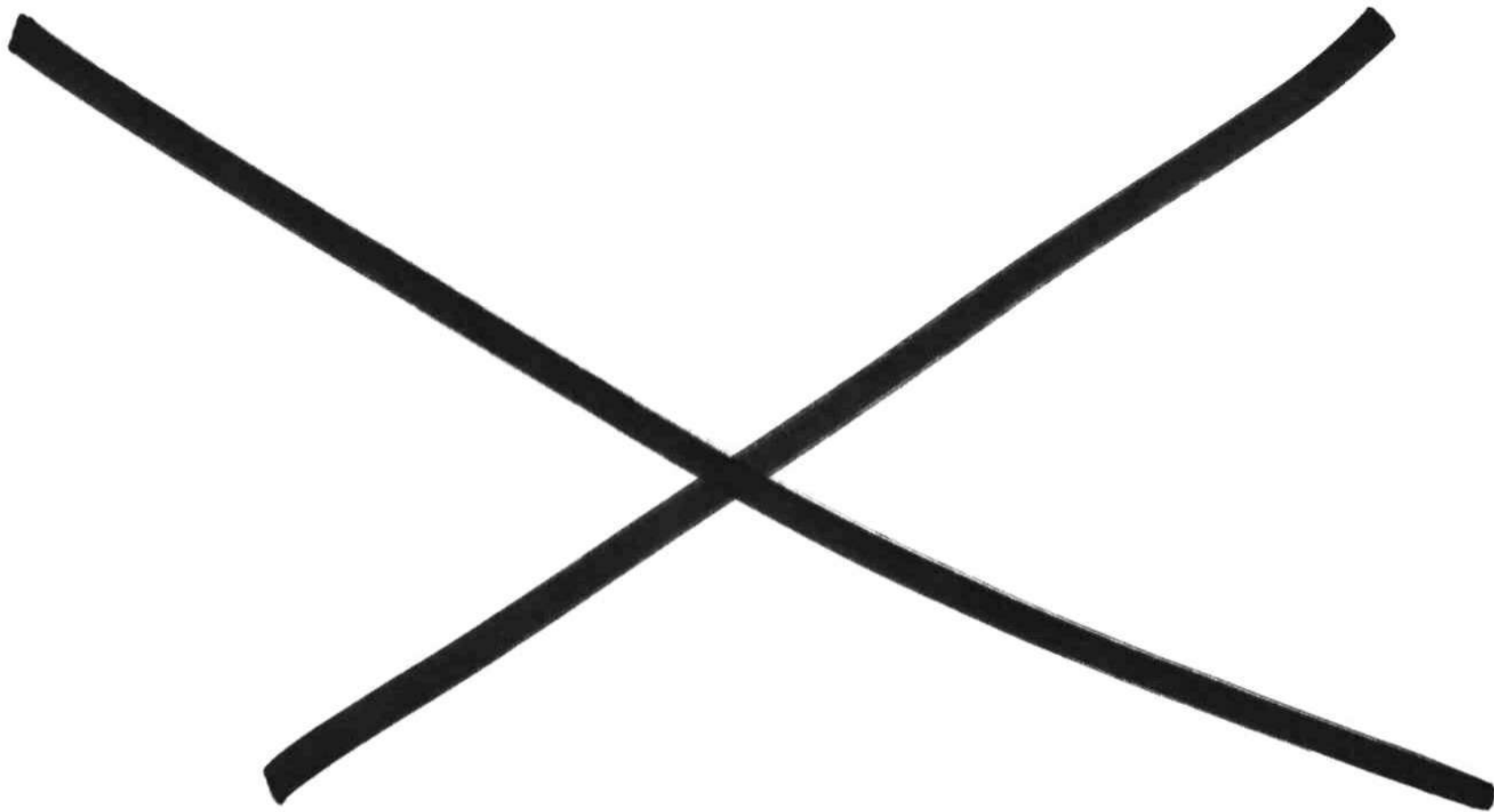
Source: Dataquest
June 1987

Table 1.5-2

**Electronic Design Automation
Turnkey Versus Unbundled
(Millions of Dollars/Actual Units)**

	1985	1986	CAGR	Market Share	
	====	====	====	====	====
Total Hardware and Software Revenue					
Turnkey	870	859	-1.3%	62.0%	52.4%
Unbundled	534	780	46.1%	38.0%	47.6%
Total	1,405	1,640	16.7%	100.0%	100.0%
Hardware Revenue					
Turnkey	544	574	5.5%	55.0%	50.6%
Unbundled	444	560	26.0%	45.0%	49.4%
Total	988	1,134	14.7%	100.0%	100.0%
Software Revenue					
Turnkey	326	285	-12.6%	78.4%	56.4%
Unbundled	90	221	145.8%	21.6%	43.6%
Total	416	506	21.6%	100.0%	100.0%
Workstation Shipments					
Turnkey	11,555	13,406	16.0%	46.4%	37.6%
Unbundled	13,359	22,247	66.5%	53.6%	62.4%
Total	24,915	35,653	43.1%	100.0%	100.0%

Source: Dataquest
June 1987



2.1 ECAE Definitions

The electronic computer-aided engineering (ECAE) segment refers to CAD/CAM hardware and software products that are typically used in the engineering or design phase of electronic products (as opposed to the physical layout phase). ECAE applications address design creation, verification and analysis, test, documentation, and data base management tasks. ECAE products are generally used by electrical engineers. Because of significant differences between the marketing and product strategies for ECAE, IC layout, and PCB layout, Dataquest continues to differentiate and segment the electronic CAD/CAM market in this manner. Therefore, ECAE by definition does not include layout.

What serves to connect ECAE to layout applications is a netlist—a logical or functional description of an integrated circuit (IC), printed circuit board (PCB), electronic system, or product. This type of output is used to analyze the performance or functionality of the circuit and is also used in another product design phase to manually or automatically create the physical layout. A netlist is not the only output of an ECAE system. Other critical ECAE output can consist of test patterns, bonding diagrams, and design documentation, for example.

ECAE products address the following design phases and tasks, and may include the functionalities listed and defined below.

ARCHITECTURAL/CONCEPTUAL

- *Architectural/conceptual*—During the architectural/conceptual stage, an electronic product requirement is translated from a concept into a functional specification. During schematic capture, this specification becomes a circuit design. This circuit design can then be verified, simulated, tested, documented, and stored in a data base. The finished design can then be implemented as either an IC or a PCB during the layout or physical design stage.
- *Architectural tools/synthesis*—These tools are used to specify, at a high level, what a circuit will do and how it will be implemented in terms of functional blocks and their interrelationships; *synthesis* or *logic synthesis* refers to tools that automatically generate or synthesize a schematic design from this architectural definition.

Schematic Capture

- *Schematic capture*—During the entry stage of the design process, a functional description becomes an actual logic diagram or design. The most frequently used tool for design entry on ECAE workstations is schematic capture.
- *Capture or schematic capture*—This is an automated graphic design entry method that allows a designer to define the logic of a circuit and to create a schematic drawing or design. After creating the schematic, detailed design documentation in either graphic or netlist form can be produced. The process of netlist production is known as *netlist extraction (NLE)*.

- *PLD programmers*—ECAE systems used to define the logic of a programmable logic device (PLD), a type of semicustom application-specific integrated circuit (ASIC).

Verification and Analysis

- *Verification and analysis*—ECAE includes an entire class of tools that are used, after design creation, to evaluate the electronic behavioral characteristics of a design.
- *Behavioral simulation*—This is the simulation of ICs or systems that are based on high-level models, as opposed to gate, transistor, or switch level models. Behavioral models may be of an entire section of the IC or system (e.g., I/O management) or of a specific complex component (e.g., a microprocessor or register).
- *Circuit simulation*—This is the simulation of an IC at the switch, transistor or device level. This is the most accurate form of IC verification. The best known of the circuit simulators is *SPICE*, originally invented at the University of California at Berkeley, and now available in the public domain or in enhanced forms from several commercial suppliers.
- *Electrical rule checking (ERC) or logic design rule checking (LDRC)*—This is making sure that the logic design conforms to known process limitations (e.g., maximum fanout from a component).
- *Hardware modelers*—This is special-purpose peripheral hardware that enables a new circuit design to incorporate existing, real-world circuitry in its simulation.
- *Logic simulation*—This ECAE software is used to verify the logic and timing behavior of a digital electronic design.
- *Mixed-level simulation*—This simulation is performed simultaneously at the behavioral, device, and physical model level.
- *Mixed-mode simulation*—This is the simulation of an electronic design that contains both analog and digital circuits.
- *Simulation accelerators*—These special-purpose computers are used to perform logic or fault simulation at speeds unattainable on workstations.
- *Timing analysis or verification*—This is behavioral evaluation of a circuit design that examines signal delays and determines if signals arrive at predicted times.

Test

- *Test*—These ECAE software applications are used to create the test patterns that will be used to test the actual product during manufacture. Electronic test products include pattern editing, pattern generation, and fault grading or simulation.
- *Automatic test pattern generation (ATPG)*—These are tools that automatically produce fault tests from a specific circuit description.
- *Fault grading/simulation*—This is used to evaluate or grade the quality of a test pattern relative to a design. Quality is determined by the measure of the coverage of the test vectors (i.e., what percentage of time will the patterns identify potential errors in a given circuit).
- *Test pattern editing and generation*—These tools are used to manually create and edit the test vectors used by fault tests.
- *Testability analysis*—These are tools used to evaluate the quality of a design in terms of its ultimate testability.

Documentation

- *Documentation*—An integral part of ECAE is the graphic and textual documentation of designs. ECAE includes the class of special-purpose software used to document electronic designs.

Design Data Base Management

- *Design data base management*—This class of products underlies all the stages of the ECAE design process. These tools are used, for example, to provide revision controls on design files or to maintain standard symbol or parts libraries to be used by all designers on a project. Also included are design support tools, such as design libraries.

2.2 ECAE Executive Summary

This summary highlights the key points and analyses discussed throughout this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the ECAE applications segment.

- Dataquest estimates the ECAE market represented \$917 million in 1986, up 13 percent from \$808 million in 1985.
- The ECAE market is forecast to grow 12 percent in 1987 to more than \$1 billion, but long-term growth is slowing as these tools are absorbed into the engineering workplace.
- The ECAE market is forecast to grow from \$917 million in 1986 to \$1.3 billion in 1991, representing a 7 percent CAGR.
- Dataquest estimates that 22,566 ECAE workstations were shipped in 1986. The 1987 workstation shipments will grow 22 percent to 27,600 and are expected to reach 36,800 units in 1991, growing at a 10 percent CAGR.
- The average selling price per seat for all platform types is expected to decline at a 10 percent CAGR, from \$30,800 in 1986 to \$18,000 in 1991. The greatest overall decrease over time will occur in the price per seat of technical workstations, which we expect to decline at a 13 percent CAGR, from the current \$42,300 to \$20,600 in 1991.
- In 1986, the personal computer continued its impact in the ECAE market, accounting for 63 percent of ECAE workstation shipments, but for only 21 percent of overall ECAE revenue.
- Technical workstations, which accounted for 44 percent of all ECAE revenue in 1986 and 32 percent of all workstations shipped, are forecast to comprise 57 percent of all ECAE revenue in 1991 and half of all workstations shipped.
- Dataquest anticipates continued consolidation and retrenching among ECAE vendors, with company roles and product offerings being redefined to adjust to the high number of vendors.

2.3 ECAE Market Overview

HISTORY

Overview

One of the major trends in the entire CAD/CAM market is toward providing computer-aided engineering (CAE) applications. CAE is used by engineers of all disciplines to automate the engineering and analysis phase of any product's design cycle. For instance, mechanical engineers apply CAE to their design tasks using applications such as stress analysis, kinematics, and finite element analysis.

Vendors addressing the needs of electrical engineers have made such a significant impact on the way in which electronic products are designed, as well as on CAD products themselves, that we differentiate CAE for electrical engineers from all other CAE applications. Hence, Dataquest uses the term ECAE to refer to electronic computer-aided engineering applications.

Because ECAE and physical layout functions can be highly integrated, especially with automatic layout dependent on ECAE data, it is impossible to completely separate the two applications. Electronic product design does not end with logic design. Therefore, it is important to note the following regarding Dataquest's ECAE segmentation:

- The ECAE estimates and forecasts are for systems with ECAE applications only.
- The ECAE section refers to functionality, as opposed to the design's ultimate implementation as either an integrated circuit or a printed circuit board. ECAE products can be used to front-end either IC or PCB design.

The Evolution of the Market

The focus of electronic CAD/CAM vendors prior to 1981 was primarily physical layout applications for both ICs and PCBs. The ECAE segment of the CAD/CAM industry began with the introduction of the first commercially available ECAE products from Daisy Systems, Mentor Graphics, and Valid Logic in 1981—products that automate the engineering design process for engineers.

The original product lines of the early ECAE vendors consisted of basic schematic capture, i.e., the ability to draw the electrical schematics, or logic diagram, of an electronic product primarily for documentation purposes. Shortly after its introduction, schematic capture grew to encompass logic design, with various forms of analysis, simulation, and verification.

Dataquest defines logic design as schematic capture combined with the ability to associate electrical parameters with graphic schematic symbols, thus driving analysis and simulation. Logic design is the more comprehensive of the two applications because it maintains electrical information as regards power, timing, and performance.

The electronic CAD/CAM market evolved to encompass ECAE. Companies with physical layout products as their original entry into the EDA market have also expanded their product functionality to include logic design. Automated logic design as a productivity tool has enjoyed widespread acceptance by engineers.

The continuing need of electrical engineers to increase productivity—to make the design cycle more efficient while the same time shortening it—continued to be addressed by the 1986 ECAE market in products that extended logic design to include other productivity tools, such as test and analysis. Recently, in order to meet the challenge of more full-line suppliers, many ECAE vendors have extended or plan to extend their product functionality to include the physical design of ICs and PCBs integrated with ECAE functionality. Dataquest believes that product lines of leading ECAE companies will grow further to address the demands of the larger system-engineering market for integrated IC/PCB design.

THE PRESENT

1986: A Year of Transition

Nineteen eighty-six was a year of dramatic slowdown in the ECAE market, a market that since its beginning has known only uninterrupted growth. The ECAE segment grew only 14 percent in 1986, sharply down from 83 percent in 1985. Last year ECAE was overcrowded with competitors seeking to overcome price erosion by struggling to increase sales volume, and in a weakened U.S. electronics market, at that.

The results of this slowdown were dramatic:

- Significant merger/acquisition activity (e.g., Valid-Telesis, Zycad-Silicon Solutions, Silicon Compilers-Silicon Design Labs)
- Approximately 25 companies either leaving the CAD/CAM market entirely or filing as business failures
- Tightening of venture funding
- Key alliance strategies

The resulting market consolidation finds fewer but stronger vendors, increasing cooperation between survivors, and diminishing opportunities for start-ups. The ECAE market, in short, is maturing. Other factors playing a major role in last year's slowdown are the following:

- Smarter buyers demanding integration and promised functionality
- Corporate CAD/CAM strategies impacting purchase decisions
- Too many vendors, particularly low-cost, low-funded vendors, offering schematic capture

Dataquest believes, however, that the real story of what happened to the ECAE market in 1986 is directly related to what happened to hardware in 1986.

Large-scale acceptance of the IBM PC and direct user purchases of the high-performance 386 and 68020-based workstations that appeared in 1986 favored unbundling of software and hardware. This trend toward unbundled sales exposed the real value of both hardware and software, particularly schematic capture software. Both workstation and application prices were pressured sharply downward. Behind this trend lay the reality that the ECAE market, as part of the maturation process, had shifted from being technology-driven to being a user-driven market.

Smarter Buyers

Dataquest believes that the undelivered promises of the ECAE vendors, in regard to integration and such functions as simulation, has resulted in both shrewder and more conservative users. This situation is compounded by growing user experience with ECAE products. For example, users bought simulation capability they cannot access because it is not as easy to use as was promised, because library models are not available, or because the requisite system performance is just not there.

Users now understand that no one vendor can supply a totally integrated and complete solution for all their design problems. Users no longer want to hear about integration; they now require it. Because of the lack of integrated solutions, users have come to regard standard hardware as the integrative base to which they can add third-party software and solve their own design problems. This move toward platform standardization is particularly evident in purchases by larger, corporate CAD/CAM end users seeking to centralize design activity within their organizations.

Corporate CAD/CAM Strategies

For an increasing number of companies, CAD/CAM/CIM (computer-integrated manufacturing) represents a strategic, corporate-level commitment, in which much more emphasis is placed on overall design process integration and productivity than on isolated design solutions for individual personnel. Typically, in larger organizations, development is divided between engineering and CAD groups for product design and physical layout, respectively. The design product needs of these two sets of end users varies accordingly.

System engineering, because it needs to manage a complex design process that involves many different types of engineering (e.g., software design, hardware design, and I/O design), tends to regard choice of design tools more as a management problem than a performance-driven issue. On the other hand, CAD departments primarily concentrate on performance in the sense of getting jobs done quickly. CAD departments were the first CAD users, purchasing large proprietary systems that supported physical design well but had little connectivity with other design tasks such as logic design, analysis, and documentation.

System engineers have shown more concern with design methodology and, consequently, favor tools supporting company-wide design standards and practices. Specific demands of system engineers are as follows:

- To own their own design data, complete with revision control and full documentation, so that they can leverage previous design experiences on whichever system is ultimately used and despite design personnel changes that might occur
- To share resources and data across applications, particularly in the case of large corporate engineering groups that support multiple users requiring design, layout, test, analysis, manufacturing, documentation, and project management functions
- To integrate state-of-the-art solutions on their own systems as soon as these become available
- To use off-the-shelf, standard, as opposed to proprietary, hardware, so as not to preclude interactive, on-line software engineering tasks
- To negotiate directly with hardware manufacturers so as to obtain optimal volume purchase and service discounts

Corporate-wide design automation plans demand shared resources. The new corporate CAD/CAM/CIM consciousness is directly responsible for 1986's dramatic shift away from proprietary design systems and toward applications on standard, general-purpose

hardware platforms. Dataquest believes that, for all these reasons, engineering rather than CAD departments will increasingly dominate corporate purchase decisions. Conservative corporate purchase criteria tend to favor the well-managed full-line or niche supplier.

Too Many Vendors

Today's ECAE market, however, is highly fragmented, with vendors ranging from low-cost, PC-based software suppliers to simulation accelerator vendors, hardware modeler vendors, and major computer manufacturers. In 1986, for example, Dataquest estimates that more than 80 vendors were marketing a schematic capture package. These products varied widely with regard to the degree of electrical connectivity and integration within the entire design process, i.e., with other design tasks, such as simulation or physical layout.

Today, with its availability from widespread alternative sources, schematic capture is referred to as a commodity. Over the past two years, prices for this ECAE software package experienced severe price erosion, especially for low-end, PC-based schematic capture. However, Dataquest believes that both market fragmentation and price erosion heightens the need for full-line vendors to provide solutions addressing the entire design process and to pursue alliances with both the niche and hardware suppliers in the market.

Innovative product development will continue to occur. However, we believe that it will become more difficult for the mass vendor market to exploit innovations because of current product implementations. For example, once a data structure and data base are implemented and installed in the customer base, it becomes nearly impossible to change that structure to take advantage of an integrated, single-point data base. Although we believe that all EDA segments, including ECAE, will remain fragmented throughout the decade, we also believe that opportunities will continually open up for both full-line and niche vendors.

STRATEGIC ISSUES

Not only does the maturing ECAE market consist of full-line and niche players, but also of standard hardware platform vendors who are applying strong competitive pressure from the market's high end. These three classes of ECAE vendor are briefly described below:

- Full-line application suppliers consist of companies such as Cadnetix, Daisy, FutureNet, Mentor, and Valid that market and support a complete range of EDA products to end users.

- Niche players, in contrast, develop and market individual products that address limited applications. These are suppliers, such as ECAD, HHB Systems, IKOS, LSI Logic, Trimeter, and Zycad, seeking to expand their product base.
- Standard hardware vendors supply the workstations and systems on which either or both niche and full-line suppliers' products may run. These are systems suppliers, such as Apollo, Digital Equipment Corporation, Hewlett-Packard, IBM, and Sun. These companies are coming into the market with unclear strategies relative to the end user.

Each class of vendor, faced with a maturing ECAE market, is examining some degree of strategic realignment in order to deal with the competition.

Full-Line ECAE Strategies

Severe price pressure and competition on full-line suppliers in the ECAE market, for example, is now coming from both the high and low ends of the market spectrum, i.e., from the large corporate players (Digital, HP, and IBM) entering the marketplace and from low-cost, PC-based software. In light of this wide-ranging competition, full-line suppliers may need to reposition themselves strategically, meaning:

- Porting from proprietary to standard hardware, operating systems, and data formats
- Returning to a more core business focus
- Concentrating on customer service and support activities
- Delivering on promises
- Forming alliances with niche and hardware suppliers, as opposed to pursuing strategies based on either niche or hardware product development

Hardware Vendor Strategies

The CAD/CAM strategies of large system companies such as Digital, HP, and IBM are just not clear at this time. These vendors have the choice of remaining hardware suppliers (i.e., integration paradigms for a number of third-party solutions) or of attempting to become full-line suppliers themselves. In the latter case, the challenge for these companies would be to manage a complex juggling act of hardware and application sales and support with state-of-the-art solutions development. In addition to remaining competitive in the workstation market, they would need to supply everything to everybody on an ongoing basis. However, the trend in corporate CAD/CAM purchasing toward industry-standard hardware is fueling the ambitions of this class of company.

At this time, HP, through its Ceracor acquisition and DesignCenter products, perhaps is more of a full-line supplier than either IBM or Digital. IBM does offer a limited amount of EDA software through its CIEDS program. Digital, however, with its large number of trading partners and other third-party agreements, directly sells no EDA products. The names Digital and IBM are ubiquitous in this marketplace. In this market, these companies seemingly could play any role at any moment they choose.

The presence of these large computer manufacturers both in the market and in the installed base itself threaten the key account strategies of the full-line ECAE suppliers. The large system houses already have the experience of dealing with several major EDA end users, and can leverage these relationships to supply workstations and, in some cases, applications.

The popularity of the IBM PC in the ECAE market and direct sales to end users by workstation vendors like Apollo, Digital, and Sun resulted in price erosion and forced full-line ECAE companies to unbundle products and readjust their marketing strategies. Cooperative marketing, comarketing, and referenced sales agreements between full-line suppliers and workstation vendors now proliferate. The lower-priced, high-performance 386 and 68020-based workstations also forced down the price of proprietary hardware.

This situation caused many ECAE vendors to either reevaluate or totally abandon product strategies based solely on hardware. Solutions vendors simply do not possess the resources to compete against systems houses. Dataquest believes, however, that there is a corollary to this rule: workstation vendors may possess the resources, but they lack the solutions focus necessary to support the end users' application needs.

Niche Companies Strategies

On the other hand, niche company products often compete head-to-head with offerings from full-line suppliers; for instance, HHB Systems' CATS hardware modeler competes with Valid's RealChip product.

Niche companies typically address a wider range of products and technologies than full-line suppliers. The following are product development areas that typically fall outside full-line suppliers' application capabilities and therefore may be best addressed by niche companies:

- Low-cost products
- Leading-edge technologies
- Products that bridge technology and service

To survive in a market overcrowded with vendors and look-alike products, niche companies need to broaden their product bases by offering related, supporting products; by moving into other niche areas; or by becoming more full line.

Two examples of niche strategies are as follows: leading ASIC supplier LSI Logic also participates as a vendor in the ECAE market. LSI markets a front-end logic design entry tool for LSI's gate array line. In 1986, LSI faced not only a tight semiconductor market, but also a highly compressed ECAE market. LSI redefined its market position by marketing not only additional simulation capability to end users, but by also marketing LSI gate-array library development tools and support to other ECAE vendors, and thus indirectly to potential ASIC customers. ECAD Incorporated, a niche supplier of simulation, design rule checking/electrical rule checking (DRC/ERC), and other post-processing packages, now offers symbolic IC layout, a second example of exploring additional niche opportunities in order to broaden product lines.

Despite the maturation of the ECAE market, the electrical engineering community continues to demonstrate an insatiable appetite for ECAE applications software, as all ECAE vendors push the limits of technology and R&D to deliver solutions.

OPPORTUNITIES

Given the strategic business differences between ECAE vendors, there are new product directions that best support each strategy; there are also company types that can best pursue particular product opportunities. However, we believe that the overall theme of application trends is not focused on product features but on increased scope. ECAE products are becoming an integrated set of design management tools that incorporate not only more design tasks but also better analysis capabilities. The result is a design management system—one that meets the needs of a project with many aspects and requirements.

Full-Line Product Opportunities

Given the differing strategies between niche and full-line suppliers, full-line suppliers are best able to distribute and support the design environment. We believe that data management and design environment support products such as documentation are best addressed by full-line vendors, although we can envision a niche company providing a bridged, multivendor design environment. The opportunities and requirements for next-generation full-line vendors are:

- Integrative design data base with both hierarchical and full design, library, documentation, and project management
- Links to back-end layout
- Integration and interactivity between every phase of design

- Easy user integration of third-party tools
- Easy-to-use simulation integrated with both logic libraries and schematic capture
- Rule-based systems
- Integration of alternative design approaches, perhaps including some from niche suppliers
- Migration path to full system design
- Higher-level design entry (e.g., logic synthesis) with links to analysis tools
- Design floor planning tool

Whatever product strategy a full-line supplier pursues, the products must form part of a well-integrated base—a stable and manageable design environment still open to adding the special applications where niche companies excel.

Niche Product Opportunities

Dataquest believes that development efforts for niche suppliers in the ECAE market are directed in general toward low-cost products, leading-edge technologies, and products that bridge technology and service—ECAE products such as:

- Design libraries
- Application accelerators
- Hardware modelers
- Low-cost schematic capture
- Low-cost pattern editing
- Architectural-level design tools
- Test-pattern generators
- Links between design entry and test

HARDWARE

ECAE emerged out of a need for products that solved electrical engineers' design problems. However, only with the emergence of microprocessor-based technical workstations could this need be met.

The availability of technical workstations revolutionized the entire EDA market, including its design solutions and existing price and profit structures. Had pioneering companies such as Apollo, Daisy, Sun, and Valid not developed the hardware vehicle, the ECAE revolution might have been delayed for another three years—until the IBM PC.

Dataquest distinguishes between hardware and application issues of the market. It is the application products that meet user needs; the hardware products are the vehicle by which these applications are delivered. Users buy neither hardware nor software: they buy solutions to design problems. These solutions are combinations of hardware and software.

However, hardware technology is changing underlying applications strategies. The major cause of this is the PC. The major effect is a dramatic shift in computational alignment—aligning the particular application requirements with the capabilities of the computer. This shift has brought about yet another layer of hardware to the ECAE environment—the application accelerator, which decreases the time involved to complete one or more applications.

The hardware platforms on which ECAE software run are radically changing the availability and feasibility of design automation for the mass end-user market. Listed below are the major causes of this change:

- Personal computers and coprocessors
- Application accelerators
- Decreasing technical workstation prices
- High-end technical workstation systems

In all cases, price and performance are paramount. The trend, however, is toward the division of labor between the networked system resources and the personal or desktop design system. To manage this change, we believe that a very flexible and profit-oriented management style is required for the following reasons:

- Downward-revised revenue goals due to lower average selling prices
- Higher unit volumes required to meet revenue goals

- Revised distribution strategies due to higher volumes
- Revised support strategies due to larger installed bases and lower average selling prices
- Increased competition due to less formidable barriers to entry

Two years ago, personal computers were barely considered a design automation alternative. Today, they threaten the very existence of the original ECAE platform—the technical workstation. We do not believe that technical workstations will be made obsolete by PCs (with or without coprocessors). We believe that what is occurring is just natural evolution.

It is a simple lesson of supply-and-demand economics. Dataquest believes that the end-user market will continue to force prices down across the board, especially where higher prices are unwarranted. End users will also continue to force increased performance at a fair price and only when applications require it.

The PC is not a corporate resource able to be shared. Networked or not, it remains an underutilized and, for certain implementations, underpowered, resource. While the PC can boost the productivity of an individual engineer, it remains an isolated member of a design team. Because Dataquest believes that design automation decisions increasingly are being made at higher corporate levels than the individual engineer's level, and because of inherent data storage and handling limitations of the 16- or 32-bit PC running DOS, we believe that users will choose the technical workstation if prices are relatively even.

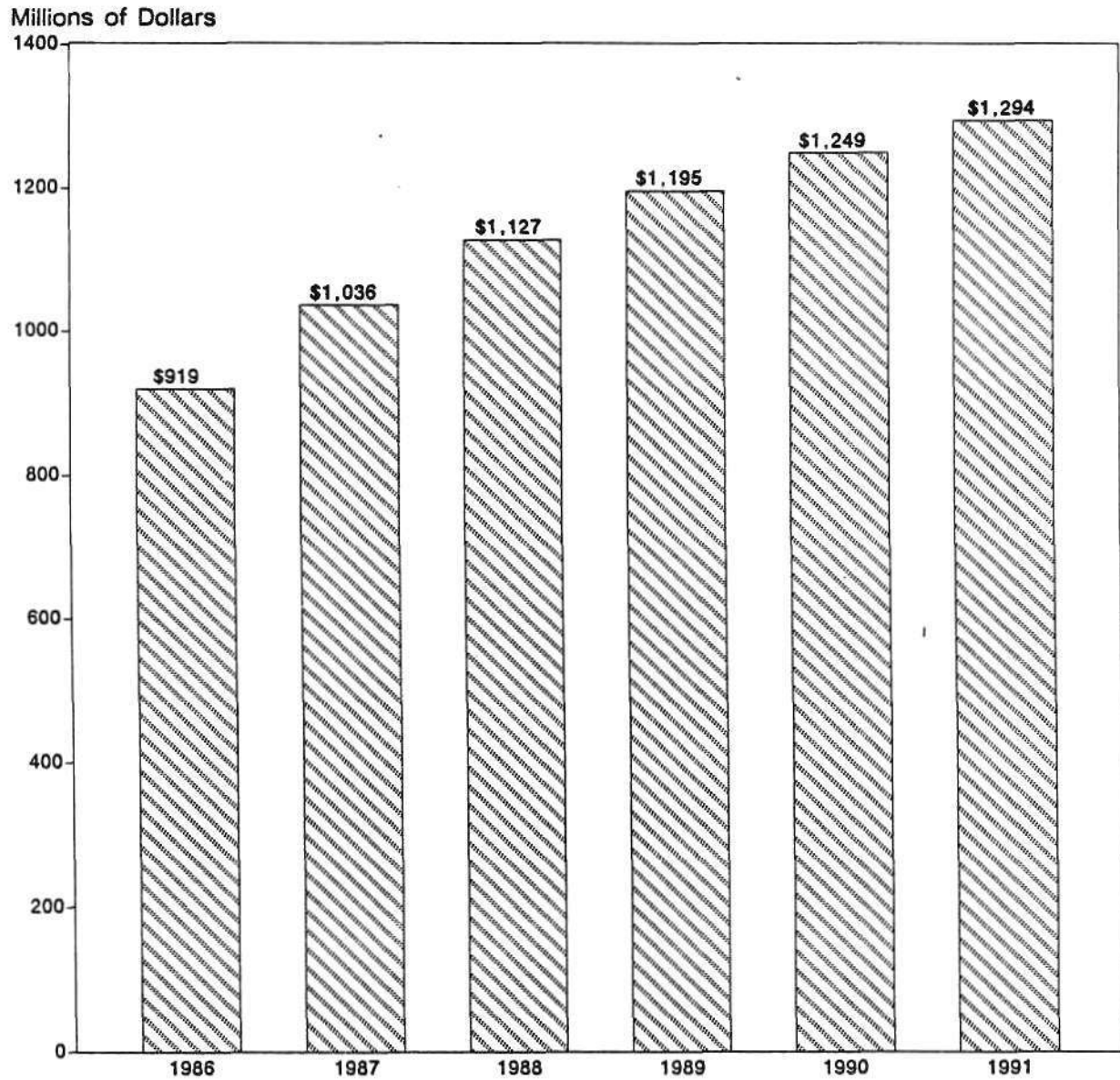
2.4 ECAE Forecasts

These bullets present Dataquest's forecast and analysis for the total electronic CAE (ECAE) market for all regions and platforms. This section contains Figures 2.4-1 and 2.4-2 and Table 2.4-1.

- The ECAE market segment, worth an estimated \$971 million in 1986, is forecast to grow to \$1.3 billion in 1991, a compound annual growth rate (CAGR) of 7 percent.
- Dataquest estimates that ECAE revenue will increase 6 percent in 1987, topping \$1 billion.
- An estimated 22,566 ECAE workstations shipped in 1986. Shipments are expected to reach 36,800 units in 1990, growing at a 10 percent CAGR.
- ECAE workstation shipments will grow to 27,600 in 1987, representing a 22 percent increase over 1986.

Figure 2.4-1

ECAE Worldwide Forecast
Revenue



Source: Dataquest
June 1987

Figure 2.4-2

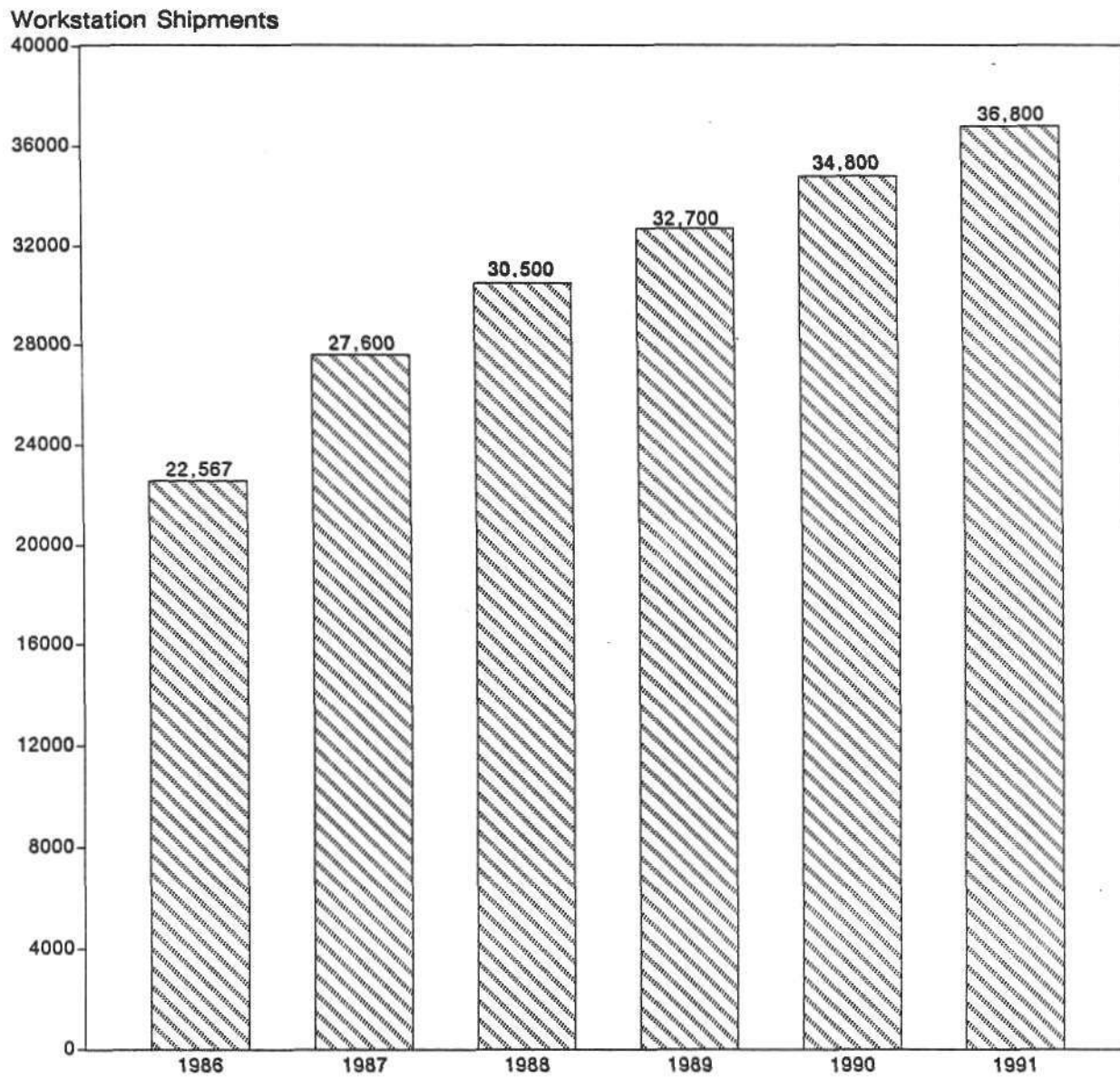
ECAE Worldwide Forecast
ShipmentsSource: Dataquest
June 1987

Table 2.4-1

**ECAE Worldwide Forecast
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
Total Market							
Revenue	919	1,036	1,127	1,195	1,249	1,294	7.1%
Systems	22,935	28,050	31,050	33,300	35,400	37,450	10.3%
Workstations	22,567	27,600	30,500	32,700	34,800	36,800	10.3%

Source: Dataquest
June 1987

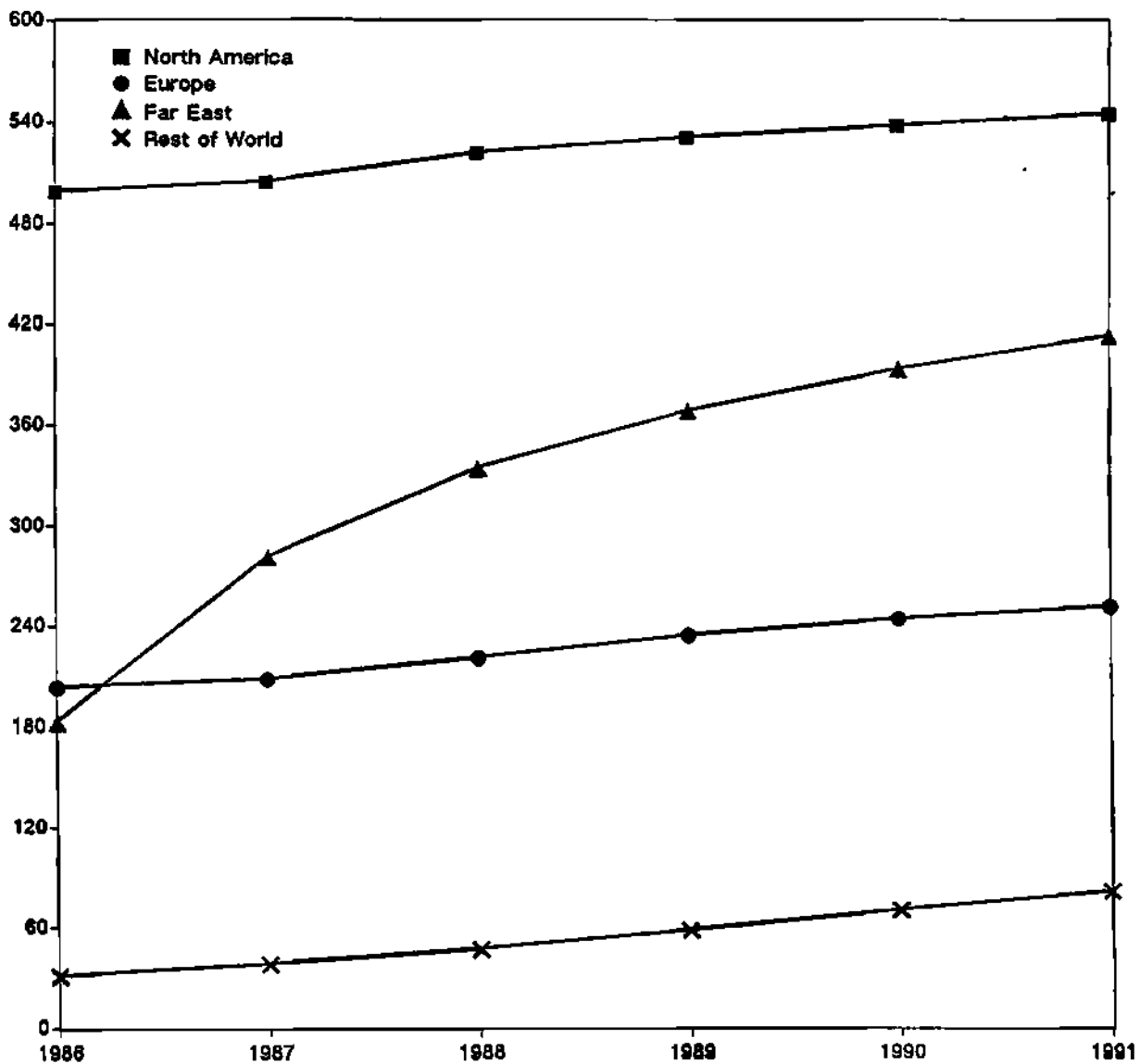
These bullets present Dataquest's forecast and analysis of the ECAE market, segmented by region. This section contains Figures 2.4-3 and 2.4-4 and Tables 2.4-2 and 2.4-3.

- North America is expected to continue its lead in regional ECAE consumption through 1991, although the growth of this market is exhibiting signs of slowing due to increased penetration.
- We estimate that 1986 North American revenue was \$497 million and that it will grow to \$532 million in 1991, a 1.4 percent CAGR. Significantly, North American revenue in 1987 will reach \$501 million, representing only a 1.0 percent increase.
- European revenue was \$204 million in 1986 and is forecast to reach \$252 million in 1991, growing at a 4.0 percent CAGR. In 1987, European revenue is forecast at \$209 million, representing a 2.5 percent increase.
- The Far Eastern ECAE segment represented \$184 million in 1986 and is forecast to grow at an 18 percent CAGR, to reach \$415 million in 1991.
- Rest of the world (ROW) accounted for \$32 million in 1986, less than 3 percent of that year's ECAE revenue. We estimate that this region will grow to \$82 million in 1991, a 21 percent CAGR.
- We believe that North America, with 54 percent of the total ECAE market, may be declining as the largest consumer of ECAE products for the following two reasons:
 - An increasing market penetration of design automation tools in general, and specifically of design entry tools
 - A general economic slowdown in the U.S. electronics markets
- The Far East, with 20 percent of worldwide consumption, is forecast to increase at an 18 percent CAGR because of previous lack of penetration and resultant pent-up demand. American technology has never been cheaper in Japan, due to recent devaluation of the U.S. dollar. This may offset Japanese concerns about slowing U.S. markets.
- We expect Europe to maintain a fairly constant 20 to 22 percent of worldwide consumption.

Figure 2.4-3

ECAE Regional Forecast
Revenue

Millions of Dollars



Source: Dataquest
June 1987

Figure 2.4-4

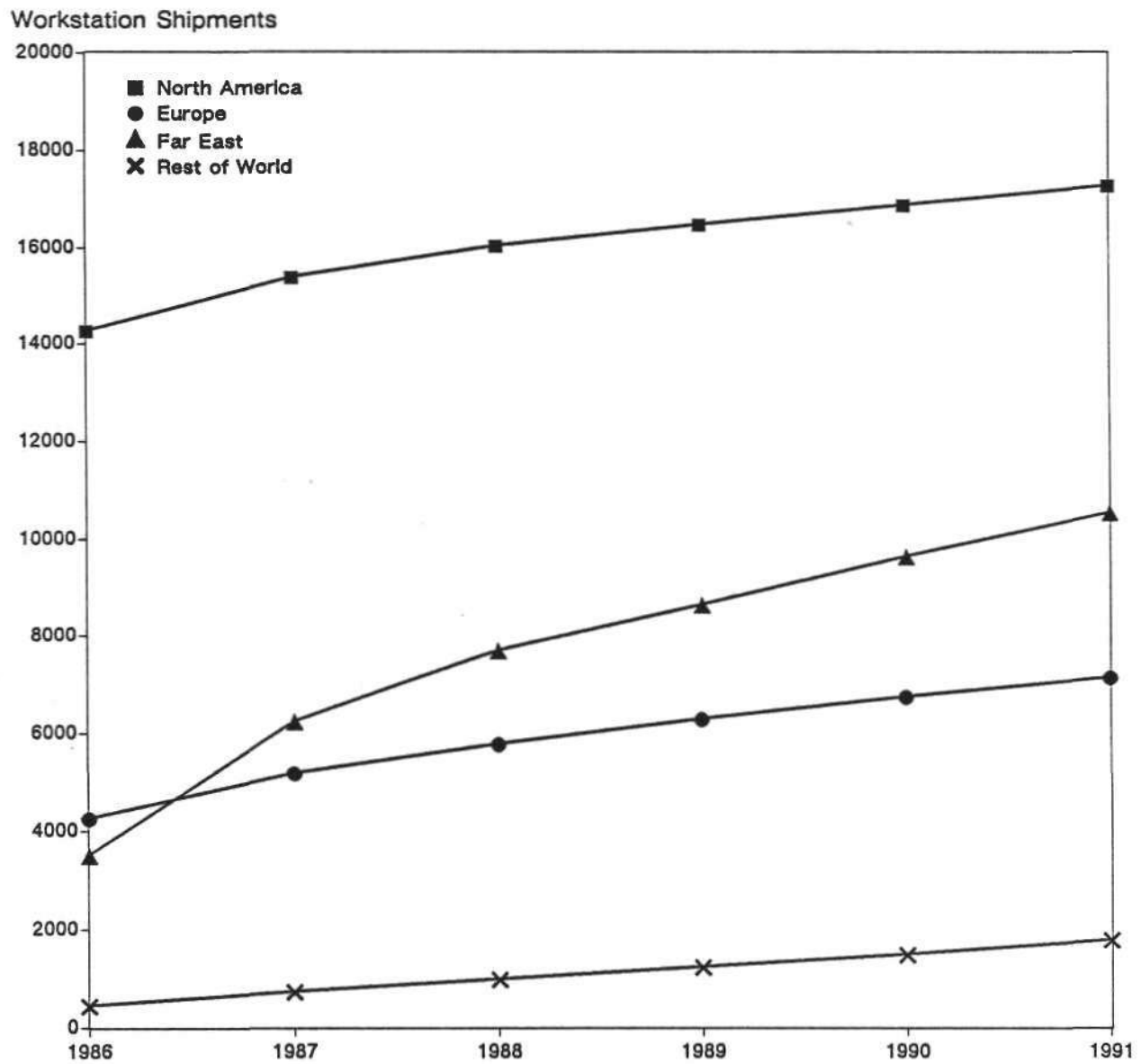
ECAE Regional Forecast
ShipmentsSource: Dataquest
June 1987

Table 2.4-2

ECAE Regional Forecast
(Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	919	1,036	1,127	1,195	1,249	1,294	7.1%
Systems	22,935	28,050	31,050	33,300	35,400	37,450	10.3%
Workstations	22,567	27,600	30,500	32,700	34,800	36,800	10.3%
North America							
Revenue	500	506	523	532	539	546	1.8%
Systems	14,516	15,700	16,400	16,850	17,250	17,650	4.0%
Workstations	14,288	15,400	16,050	16,500	16,900	17,300	3.9%
Europe							
Revenue	204	209	222	235	245	252	4.3%
Systems	4,358	5,300	5,850	6,400	6,850	7,250	10.7%
Workstations	4,277	5,200	5,800	6,300	6,750	7,150	10.8%
Far East							
Revenue	184	282	335	369	394	414	17.6%
Systems	3,544	6,300	7,750	8,750	9,750	10,700	24.7%
Workstations	3,534	6,250	7,700	8,650	9,650	10,550	24.4%
Rest of World							
Revenue	32	39	48	59	71	82	20.8%
Systems	516	800	1,050	1,300	1,600	1,850	29.1%
Workstations	469	750	1,000	1,250	1,500	1,800	30.9%

Source: Dataquest
June 1987

Table 2.4-3

**ECAE Regional Forecast
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
North America						
Revenue	54%	49%	46%	44%	43%	42%
Systems	63%	56%	53%	51%	49%	47%
Workstations	63%	56%	53%	50%	49%	47%
Europe						
Revenue	22%	20%	20%	20%	20%	20%
Systems	19%	19%	19%	19%	19%	19%
Workstations	19%	19%	19%	19%	19%	19%
Far East						
Revenue	20%	27%	30%	31%	32%	32%
Systems	15%	22%	25%	26%	28%	29%
Workstations	16%	23%	25%	26%	28%	29%
Rest of World						
Revenue	3%	4%	4%	5%	6%	6%
Systems	2%	3%	3%	4%	5%	5%
Workstations	2%	3%	3%	4%	4%	5%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the ECAE market segmented by platform. This section contains Figures 2.4-5 and 2.4-6 and Tables 2.4-4 and 2.4-5.

- Approximately 22,566 ECAE workstation units shipped in 1986. We estimate shipments will grow at a 10 percent CAGR, to 36,800 workstations in 1991.
- Technical workstation revenue in 1986 was \$404 million and will grow at an estimated 13 percent CAGR, to reach \$728 million in 1991.
- Technical workstation shipments totaled 7,450 units in 1986 and are forecast to reach 18,500 units in 1991, growing at a CAGR of 20 percent.
- Revenue from host-dependent systems was \$316 million in 1986 and is forecast to decline to \$285 million in 1991, decreasing at a CAGR of 2 percent.
- Host-dependent workstation shipments totaled 789 units in 1986 and are forecast to increase at a 3 percent CAGR, to 900 units in 1991.
- PC revenue in 1986 was \$197 million, which is expected to reach \$269 million in 1991, a CAGR of 6 percent.
- PC shipments totaled 14,327 units in 1986 and are forecast to grow at a 4 percent CAGR, to reach 17,400 units in 1991.
- Host-dependent products play a limited role in the ECAE segment for two reasons:
 - Price sensitivity and price elasticity market requirements
 - Distributed processing requirements demanding equal performance for all users
- The primary ECAE role of the PC will be in schematics entry products, with limited local analysis capabilities.
- PCs with application-specific hardware add-ons (i.e., coprocessors) will be capable of assuming more computationally intensive tasks.
- Networking, communications, and design data base management are key issues with the large number of distributed systems.
- We believe that the growth of technical workstation systems will continually increase as a result of continuing improvements in price/performance ratios, i.e., a decrease in average selling prices (ASPs).
- Host-dependent systems will be used for batch analysis jobs and relieved of interactive graphics applications.

Figure 2.4-5

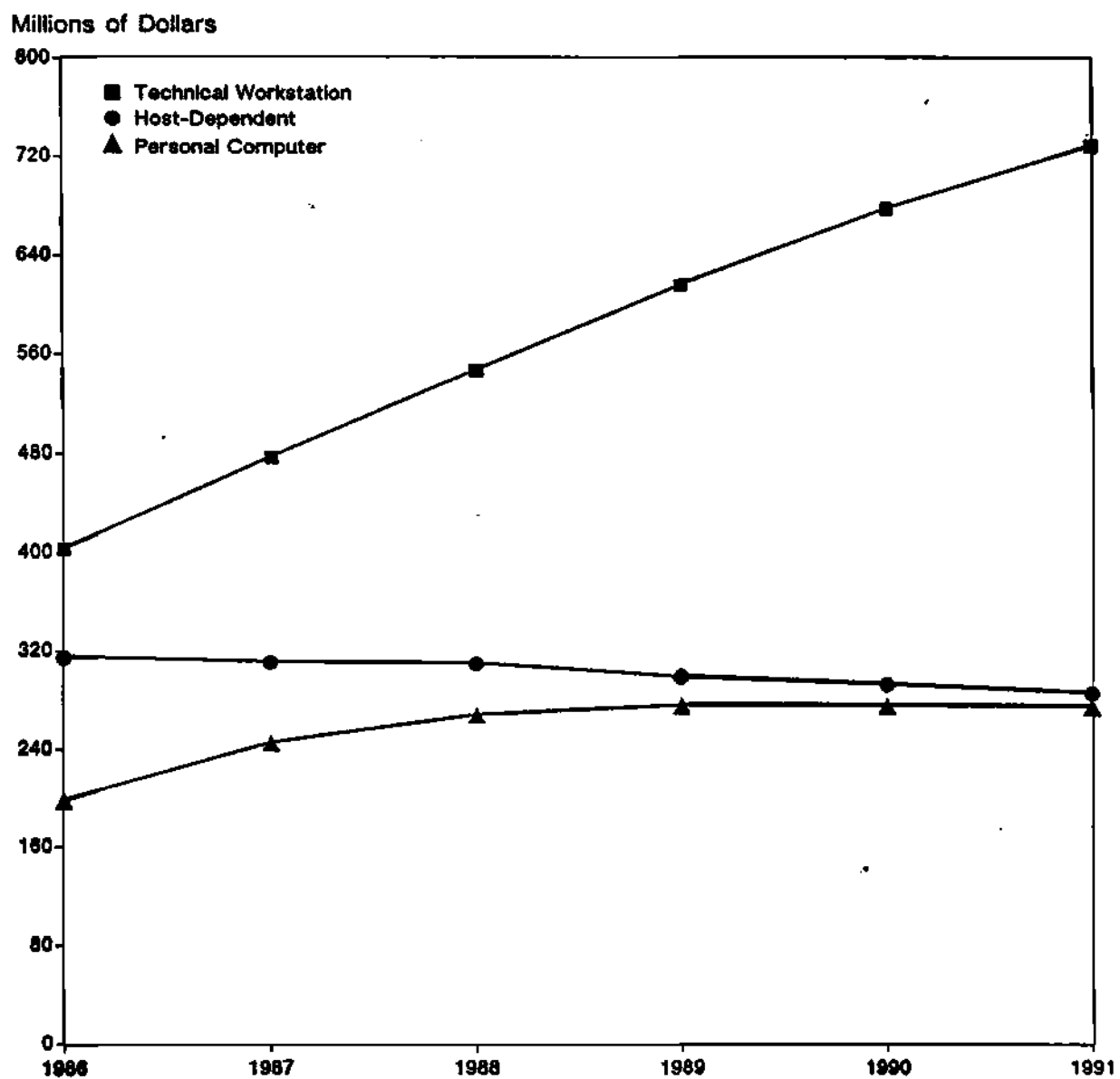
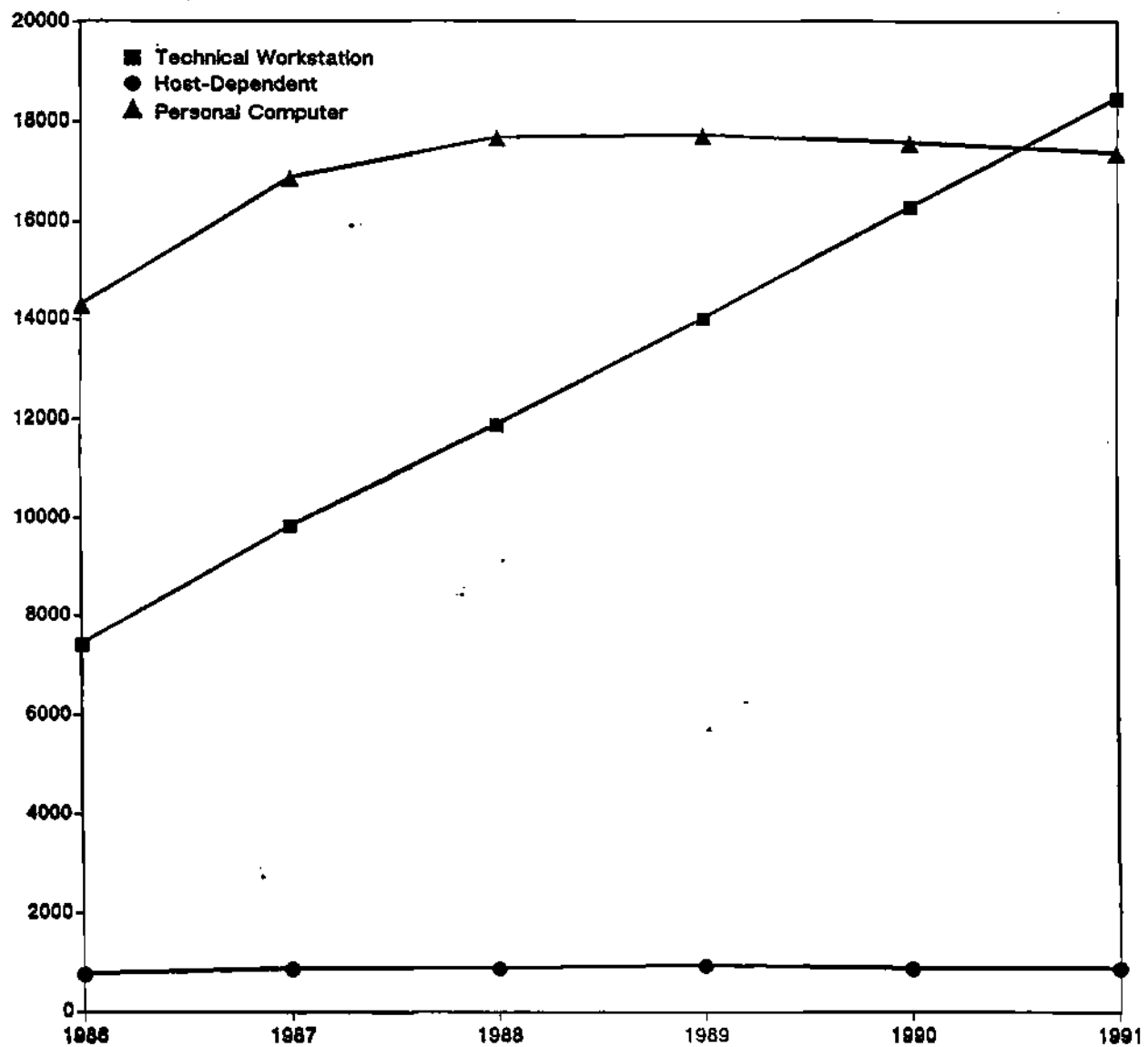
ECAE Worldwide Forecast by Platform
RevenueSource: Dataquest
June 1987

Figure 2.4-6

ECAE Worldwide Forecast by Platform
Shipments

Workstation Shipments



Source: Dataquest
June 1987

Table 2.4-4

**ECAE Worldwide Forecast by Platform
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	919	1,036	1,127	1,195	1,249	1,294	7.1%
Systems	22,935	28,050	31,050	33,300	35,400	37,450	10.3%
Workstations	22,567	27,600	30,500	32,700	34,800	36,800	10.3%
Technical Workstation							
Revenue	404	478	548	617	679	730	12.5%
Systems	7,450	9,850	11,900	14,050	16,300	18,500	20.0%
Workstations	7,450	9,850	11,900	14,050	16,300	18,500	20.0%
Host-Dependent							
Revenue	316	312	311	300	294	287	-1.9%
Systems	1,157	1,350	1,500	1,500	1,500	1,500	5.3%
Workstations	789	900	900	950	900	900	2.7%
Personal Computer							
Revenue	199	246	269	277	277	276	6.8%
Systems	14,327	16,900	17,700	17,750	17,600	17,400	4.0%
Workstations	14,327	16,900	17,700	17,750	17,600	17,400	4.0%

Source: Dataquest
June 1987

Table 2.4-5

**ECAE Worldwide Forecast by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	----	----	----	----	----	----
Technical Workstation						
Revenue	44%	46%	49%	52%	54%	56%
Systems	32%	35%	38%	42%	46%	49%
Workstations	33%	36%	39%	43%	47%	50%
Host-Dependent						
Revenue	34%	30%	28%	25%	23%	22%
Systems	5%	5%	5%	5%	4%	4%
Workstations	3%	3%	3%	3%	3%	2%
Personal Computer						
Revenue	22%	24%	24%	23%	22%	21%
Systems	62%	60%	57%	53%	50%	46%
Workstations	63%	61%	58%	54%	51%	47%

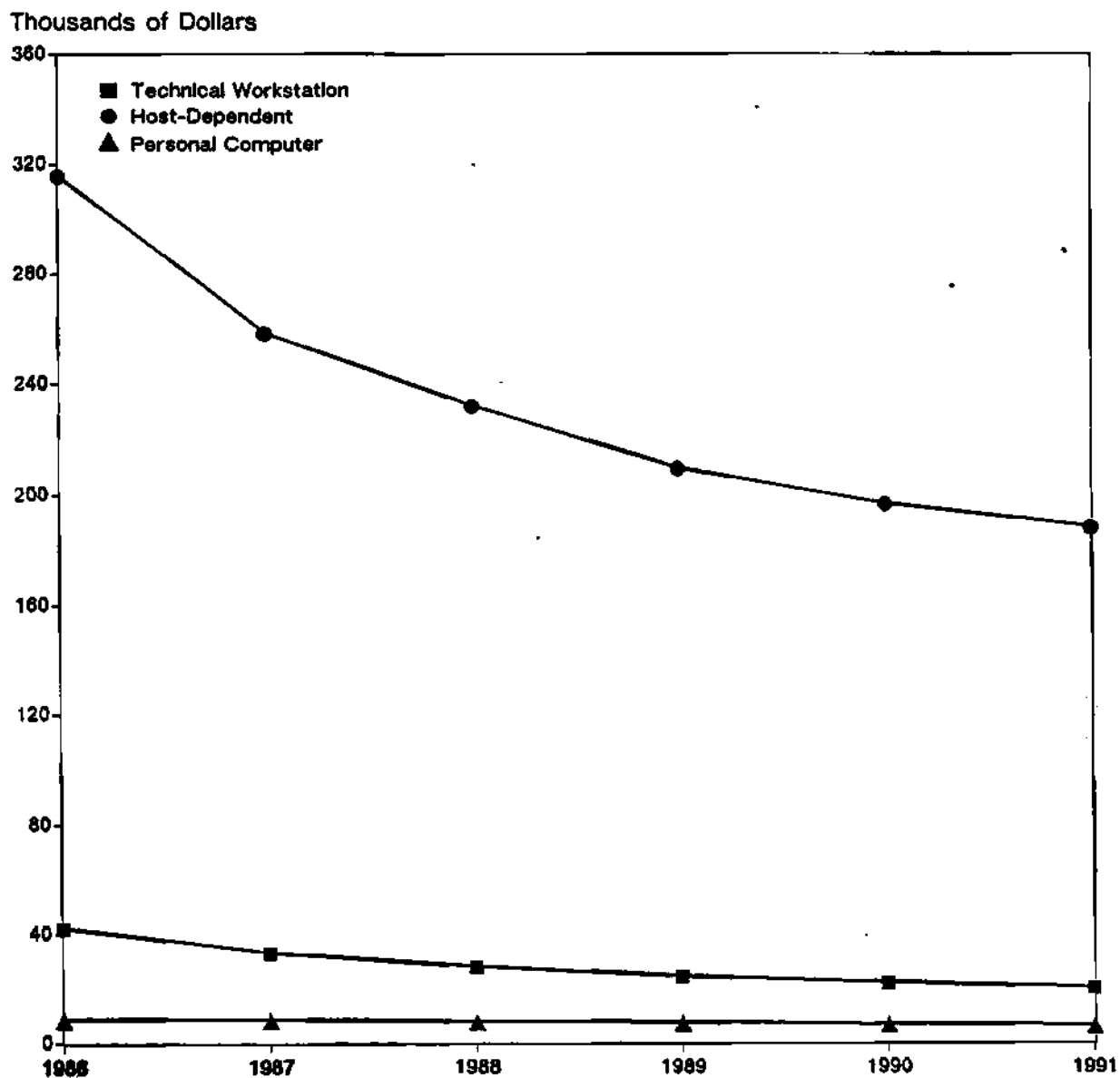
Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the average price per seat by platform for the ECAE market. This section contains Figure 2.4-7 and Table 2.4-6.

- We expect the ASP per seat for all platform types to decline from \$30,800 in 1986 to \$18,100 in 1991, decreasing at a 10 percent CAGR as a result of both the large number of vendors offering ECAE capability and the industry-wide shift toward lower-cost workstations.
- We expect a 13 percent decrease in the ASP per technical workstation seat, from \$42,300 in 1986 to \$20,600 in 1991. We believe that this will be a consequence of the introduction of lower-cost technical workstations, as well as of a sharp decline in the price of design entry software, which we believe has become almost a commodity item in the ECAE market.
- Consistent with this shift, the ASP per seat for host-dependent systems will decline at a CAGR of 10 percent, from \$316,300 in 1986 to \$188,900 in 1991, according to our estimates. We also believe that the price/performance advantages of technical workstations and the popularity of personal computers are eroding the market for, and the price of, host-dependent ECAE workstations.
- We expect a 6 percent decline in the ASP per seat for personal computers, from \$9,100 to \$6,700 in 1991. This will be the slowest decline for all platform types and will be a result of the unique design data management, computational, and communications requirements this application imposes on the personal computer.

Figure 2.4-7

ECAE Worldwide Average Price per Seat by Platform



Source: Dataquest
June 1987

Table 2.4-6

**ECAE Worldwide Average Price per Seat by Platform
(Thousands of Dollars)**

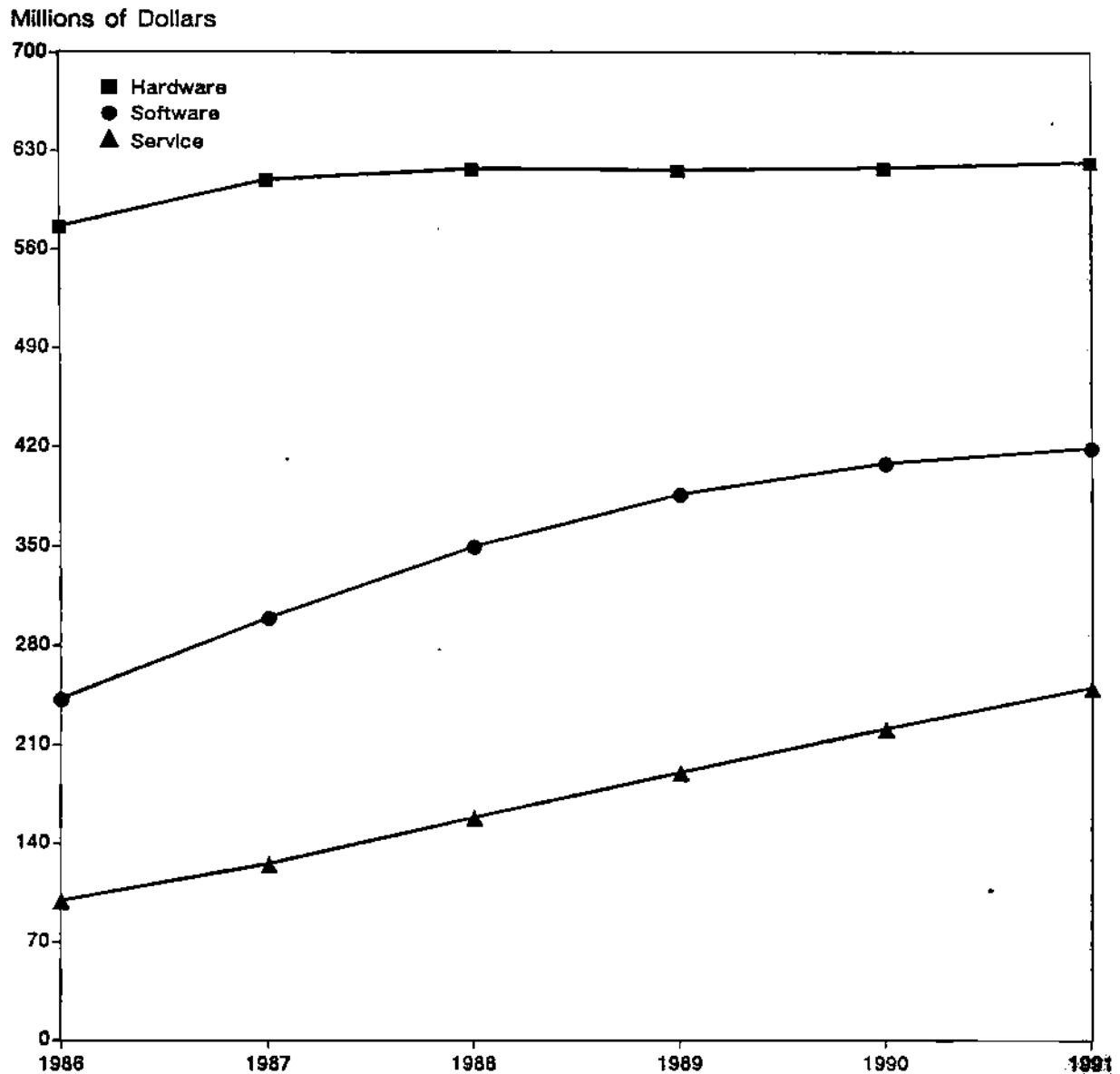
	1986	1987	1988	1989	1990	1991	CAGR
	----	----	----	----	----	----	----
All Product Types	30.8	25.6	22.8	20.8	19.2	18.0	-10.2%
Technical Workstation	42.3	33.5	28.2	24.7	22.3	20.5	-13.5%
Host-Dependent	316.3	258.7	232.4	209.9	197.1	188.9	-9.8%
Personal Computer	9.1	8.8	8.3	7.7	7.1	6.7	-5.9%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the ECAE market segmented by revenue source for each platform. This section contains Figure 2.4-8 and Tables 2.4-7 and 2.4-8.

- Dataquest estimates that 1986 hardware revenue for all platform types was \$577 million and forecasts it to grow to \$625 million in 1991, at a 2 percent CAGR. In terms of total ECAE revenue, we expect hardware revenue to decline from 63 percent in 1986 to 49 percent in 1991.
- Software revenue accounted for \$241 million in 1986, which represented 26 percent of total ECAE revenue. By 1991, Dataquest estimates that software revenue will grow to \$405 million, at an 11 percent CAGR. Software will represent 32 percent of total ECAE revenue in 1991. We believe that this shift reflects increased emphasis on applications and data base management issues rather than on hardware platforms, which are becoming standardized.
- We expect ECAE service revenue to grow at the greatest rate, from \$99 million in 1986 to \$252 million in 1991, a 21 percent CAGR. Service revenue in 1986 represented 11 percent of total ECAE revenue, and we estimate that in 1991, it will constitute 20 percent of total ECAE revenue. We believe that this growth in service revenue reflects response to strong user demand for increased application and integration support.

Figure 2.4-8
ECAE Worldwide Revenue Sources



Source: Dataquest
June 1987

Table 2.4-7

**ECAE Worldwide Revenue Sources by Platform
(Millions of Dollars)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
All Platforms							
Hardware	577	610	618	617	619	623	1.6%
Software	243	300	350	387	409	420	11.5%
Service	100	126	159	191	222	251	20.3%
Total	919	1,036	1,127	1,195	1,249	1,294	7.1%
Technical Workstation							
Hardware	233	261	279	301	324	347	8.3%
Software	123	152	184	211	228	237	14.1%
Service	49	66	85	105	126	146	24.5%
Total	404	478	548	617	679	730	12.5%
Host-Dependent							
Hardware	244	225	210	190	176	165	-7.6%
Software	37	47	53	56	58	59	9.5%
Service	35	41	48	54	59	64	12.8%
Total	316	312	311	300	294	287	-1.9%
Personal Computer							
Hardware	100	124	129	126	118	112	2.2%
Software	83	102	113	120	122	124	8.3%
Service	16	20	26	32	37	41	21.2%
Total	199	246	269	277	277	276	6.8%

Source: Dataquest
June 1987

Table 2.4-8

**ECAE Worldwide Revenue Sources by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	****	****	****	****	****	****
All Platforms						
Hardware	63%	59%	55%	52%	50%	48%
Software	26%	29%	31%	32%	33%	32%
Service	11%	12%	14%	16%	18%	19%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	58%	55%	51%	49%	48%	47%
Software	30%	32%	34%	34%	34%	32%
Service	12%	14%	16%	17%	19%	20%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	77%	72%	68%	63%	60%	57%
Software	12%	15%	17%	19%	20%	20%
Service	11%	13%	15%	18%	20%	22%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	50%	51%	48%	45%	43%	40%
Software	42%	41%	42%	43%	44%	45%
Service	8%	8%	10%	11%	13%	15%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
June 1987

2.5 ECAE Market Shares

These bullets present Dataquest's analysis of the electronic CAE (ECAE) market share measured in total revenue, hardware and software revenue, and workstation shipments. This section contains Figures 2.5-1 through and 2.5-4 and Table 2.5-1.

- Mentor Graphics continued to lead the ECAE market in both 1986 total revenue (16 percent) and software revenue (24 percent). Dataquest ranks Mentor second in share of hardware revenue (13 percent) and third in number of workstations shipped. Dataquest attributes Mentor's continuing success to the company's early application and marketing focus, and initial choice of industry standard hardware (i.e., Apollo).
- Digital ranked second overall and first in ECAE hardware revenue (20 percent). Although Digital does not directly market any EDA software, its products are pervasive in the EDA market. Most notable of these are the 86XX and 88XX series and the MicroVAX II technical workstation, which are distributed by a number of ECAE vendors. Among these vendors are Calma, Daisy, FutureNet, Silvar-Lisco, Tektronix-CAE, and Valid.
- IBM, while leading in workstation units shipped (31 percent), due to the popularity of its personal computer for design entry tasks, ranked fourth in hardware revenue (7 percent) and sixth in the overall market, accounting for only 5 percent of all ECAE revenue.
- Daisy Systems, second in 1986 ECAE software revenue (17 percent), ranked third in overall revenue with an 8 percent market share in 1986. Daisy ended the year fourth in workstation shipments (5 percent) and sixth in hardware revenue (4 percent). The popularity of Daisy's lower-priced, personal computer-based Personal Logician, coupled with the trend toward standard hardware, eroded sales of its higher-priced proprietary hardware-based products. Recently, Daisy also has been involved in management reorganization.
- Dataquest ranks Valid Logic as third in 1986 ECAE software revenue, but as fifth in overall share of market. Valid recently acquired printed circuit board (PCB) layout vendor Telesis Systems, and is currently undergoing reorganization under new management.
- FutureNet held fourth place in software sales for the year, accounting for 7 percent of ECAE software revenue. FutureNet ranked ninth in overall market share (2 percent). The company announced that it is porting its personal computer-based software to Digital's technical workstations, as a second platform. We believe that this may well represent a direct response to low-end, low-priced schematic capture products entering the market and driving software prices sharply downward.

- Of the top ten ECAE market revenue performers, five computer manufacturers collectively captured 30 percent of total 1986 ECAE revenue, led by second-place Digital Equipment Corporation (Digital) with 14 percent. The other companies with their market share and rank are as follows: Apollo (6 percent), fourth; IBM (5 percent), sixth; Seiko I&E (3 percent), seventh; and NEC (2 percent), tenth. Several of these companies do not sell ECAE software, which demonstrates the impact on the market of direct purchases from standard hardware vendors.
- Dataquest ranks Zycad eighth in the total 1986 ECAE market, with 2 percent market share. Zycad also ranked eighth in ECAE hardware revenue (2 percent). Zycad's 1986 sales revenue includes sales of Silicon Solutions, another simulation accelerator company acquired by Zycad in fourth quarter 1986.
- Given the trend toward direct purchase from standard hardware vendors and away from turnkey vendors, Dataquest expects the 1987 ECAE market to be increasingly dominated by system manufacturers such as Apollo, Digital, Fujitsu, Hewlett-Packard, Hitachi, IBM, NEC, Seiko, and Sun. We see no end to the fragmented nature of this market in 1987. Rather, we anticipate an increase in the number of ECAE vendors, particularly low-end software vendors offering viable, low-cost design solutions, in order to apply price pressure on the already embattled turnkey companies.
- The expansion of the ECAE market has created a number of opportunities for companies with niche product strategies. Given the virtual commodity status of schematic capture, the focus of ECAE niche opportunities consists of other application products. Dataquest believes that these niche products will generally address conceptual-level design, support the design process and environment, and enhance design accuracy and reliability (i.e., test and analysis tools). Products that we believe offer the greatest opportunity thus include the following:
 - Design libraries
 - Hardware modelers
 - Logic synthesis
 - Simulation
 - Simulation accelerators
 - Test automation

Figure 2.5-1

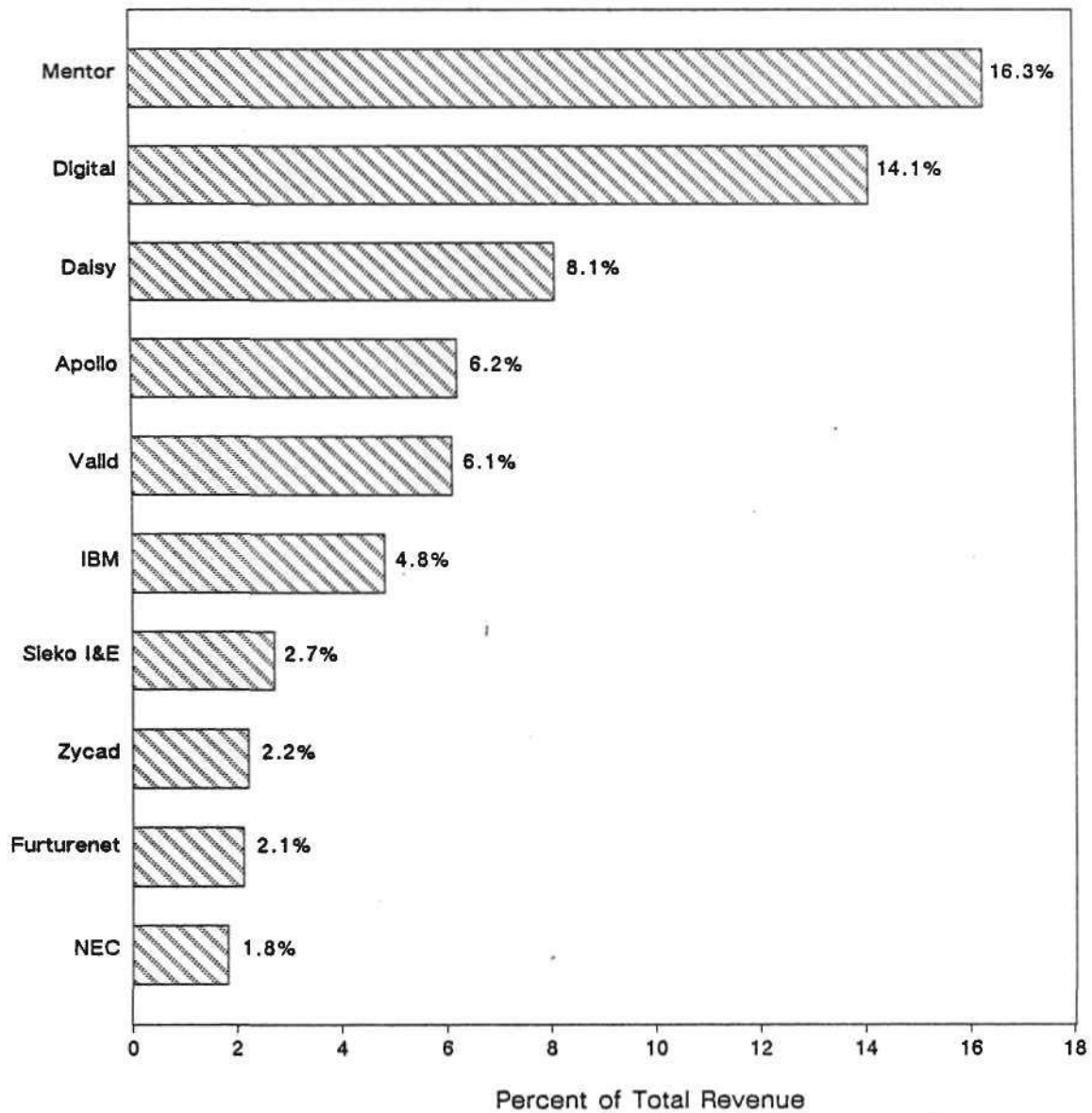
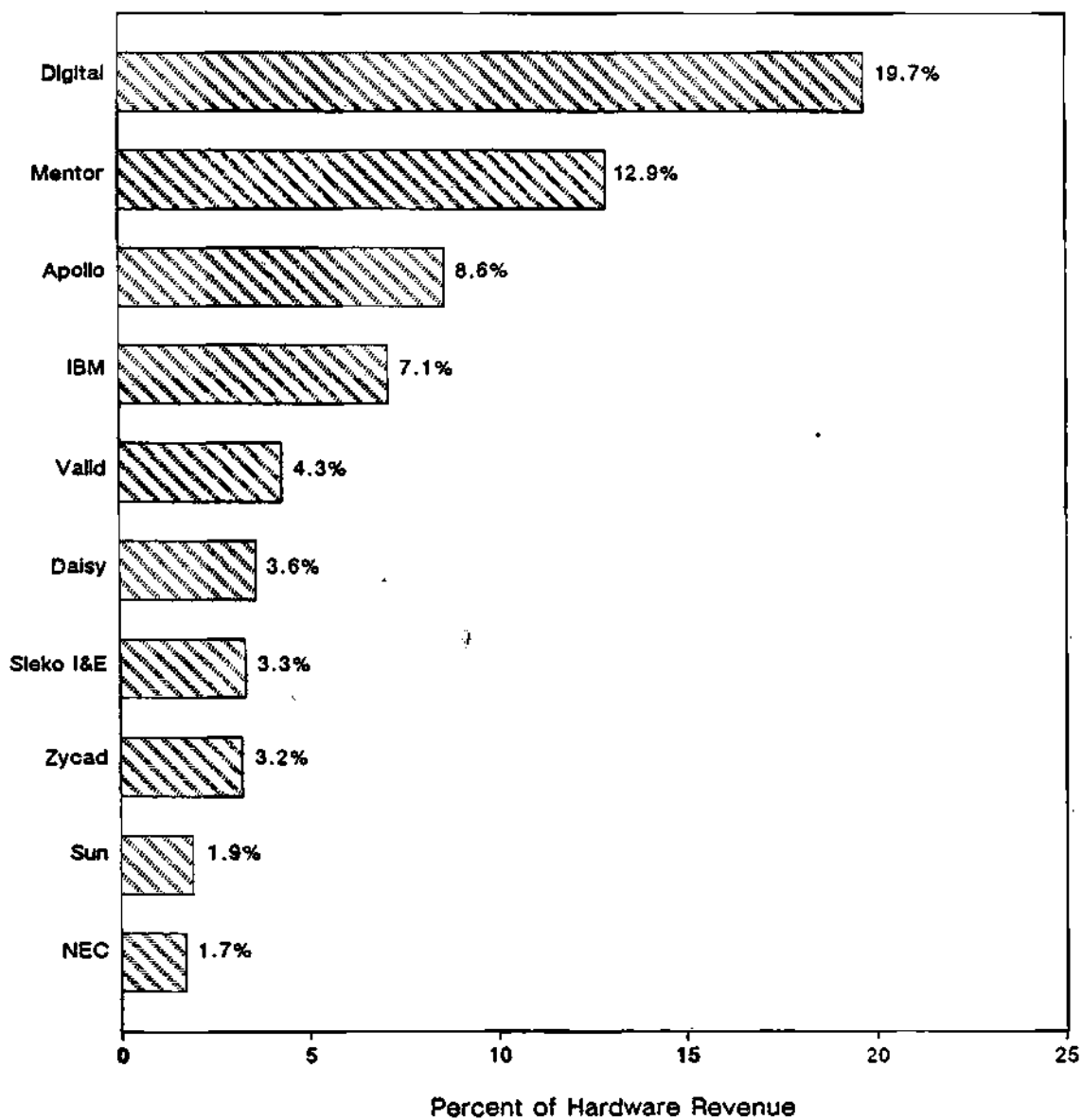
ECAE 1986 Worldwide Market Share
Total RevenueSource: Dataquest
June 1987

Figure 2.5-2

ECAE 1986 Worldwide Market Share
Hardware Revenue



Source: Dataquest
June 1987

Figure 2.5-3

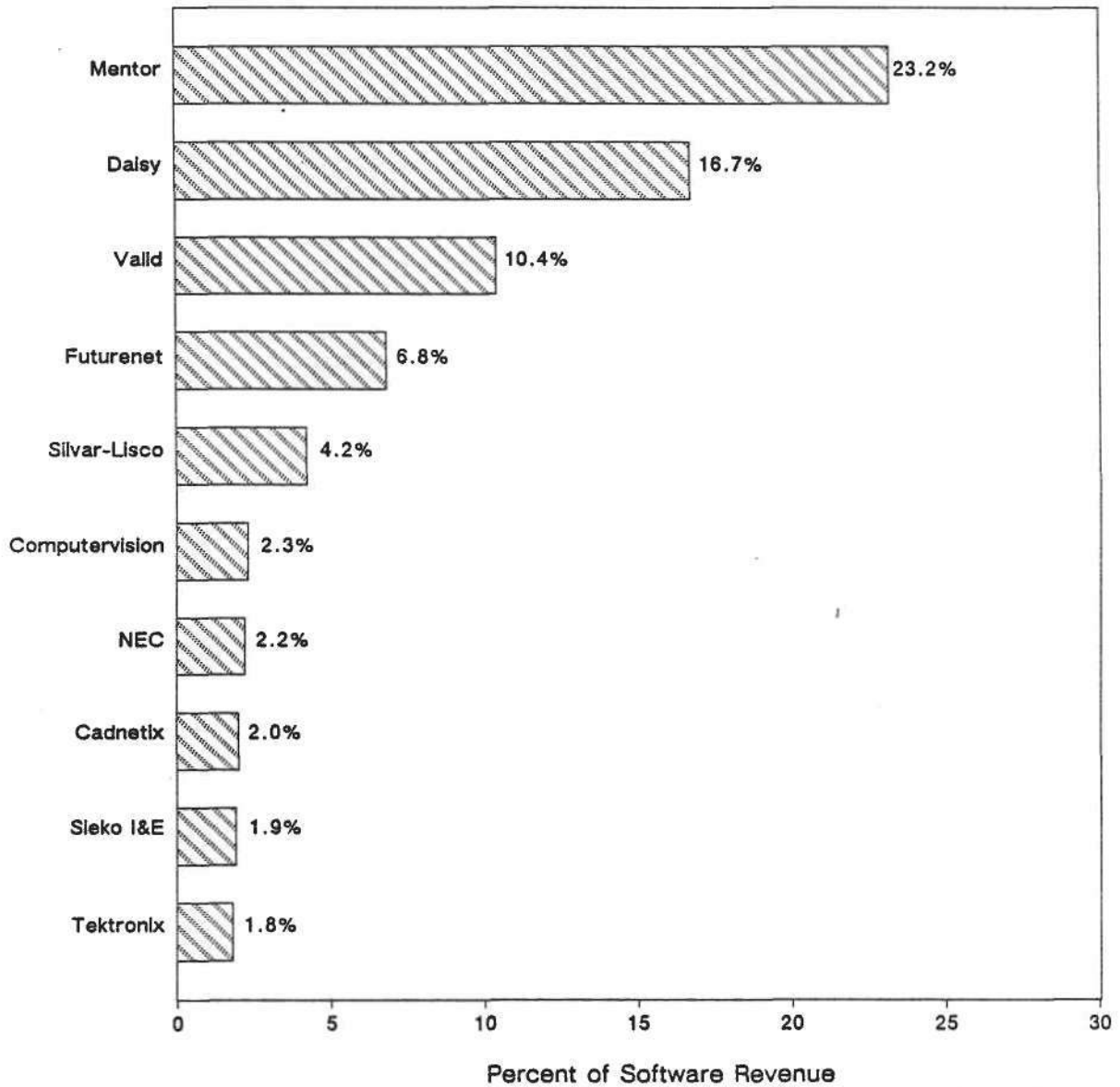
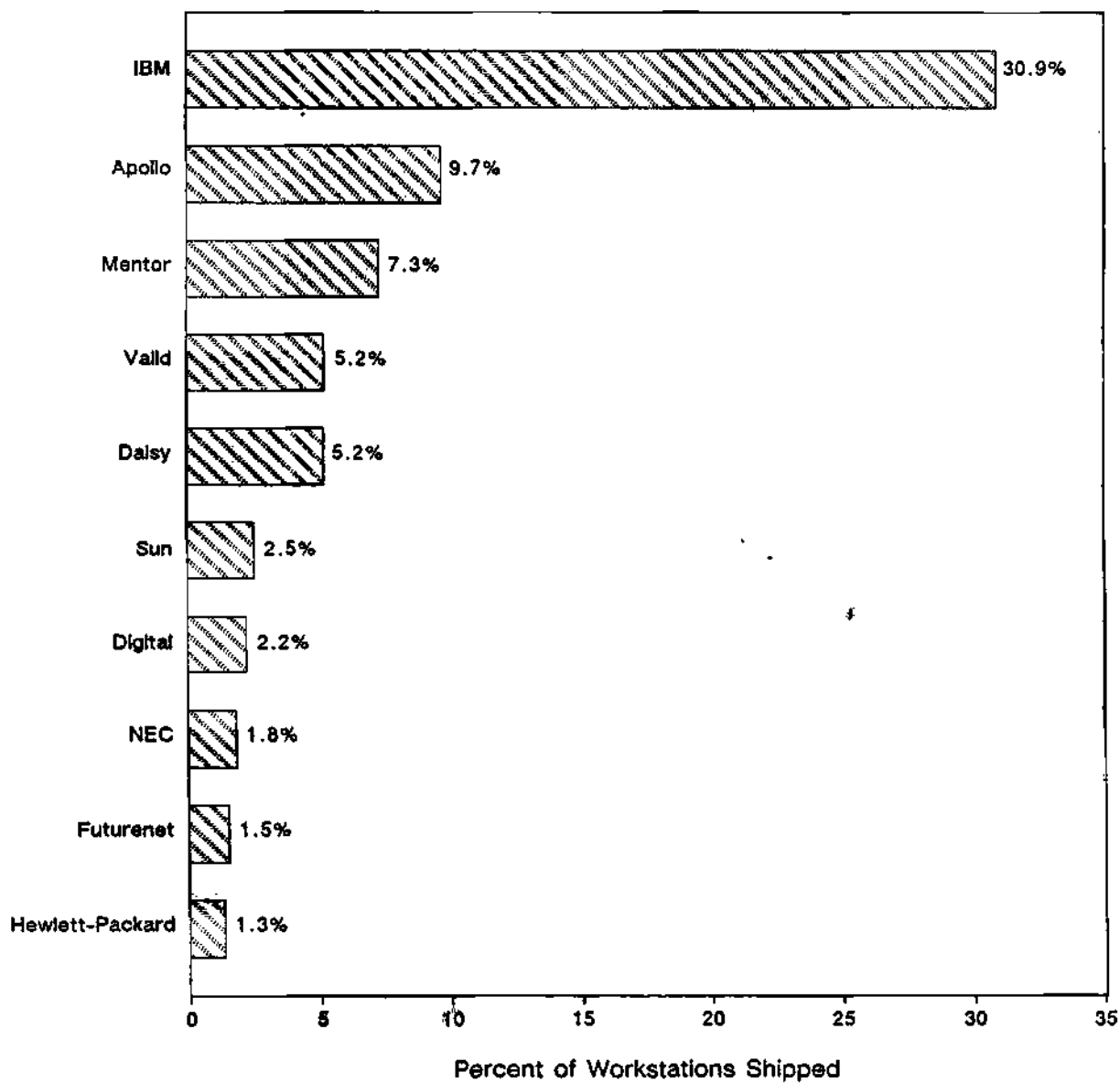
ECAE 1986 Worldwide Market Share
Software RevenueSource: Dataquest
June 1987

Figure 2.5-4

ECAE 1986 Worldwide Market Share
Workstation Shipments



Source: Dataquest
June 1987

Table 2.5-1

ECAE 1986 Worldwide Market Share
(Millions of Dollars/Actual Units)

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	150	74	56	1,658	16.3%	12.9%	23.2%	7.3%
Digital	129	114	0	504	14.1%	19.7%	.0%	2.2%
Daisy	74	20	41	1,167	8.1%	3.6%	16.7%	5.2%
Apollo	57	50	0	2,197	6.2%	8.6%	.0%	9.7%
Valid	56	25	25	1,174	6.1%	4.3%	10.4%	5.2%
IBM	44	41	1	6,974	4.8%	7.1%	.6%	30.9%
Seiko I&E	25	19	5	225	2.7%	3.3%	1.9%	1.0%
Zycad	20	18	0	0	2.2%	3.2%	.0%	.0%
Futurenet	20	1	16	341	2.1%	.1%	6.8%	1.5%
NEC	16	10	5	401	1.8%	1.7%	2.2%	1.8%
Computervision	15	9	6	159	1.6%	1.5%	2.3%	.7%
Sun	12	11	0	570	1.3%	1.9%	.0%	2.5%
Silvar-Lisco	12	0	10	0	1.3%	.0%	4.2%	.0%
Cadnetix	11	5	5	244	1.2%	.9%	2.0%	1.1%
Hewlett-Packard	11	8	2	289	1.2%	1.4%	.8%	1.3%
Tektronix	10	4	4	128	1.0%	.7%	1.8%	.6%
Fujitsu	7	4	2	62	.7%	.7%	.8%	.3%
Intergraph	6	3	2	43	.6%	.5%	.7%	.2%
Hitachi	5	3	2	20	.6%	.5%	.8%	.1%
Calma	4	2	1	75	.4%	.3%	.4%	.3%
Racal-Redac	2	1	1	24	.3%	.1%	.5%	.1%
Otsukashokai	2	1	1	202	.3%	.2%	.4%	.9%
Zuken	2	1	1	30	.3%	.2%	.4%	.1%
Telesis	2	1	1	27	.2%	.2%	.3%	.1%
Scientific Calc.	2	0	1	0	.2%	.0%	.4%	.0%
Other Companies	225	151	55	6,053	24.4%	26.2%	22.4%	26.8%
All Far East-Based Companies	65	42	18	1,380	7.0%	7.3%	7.5%	6.1%
All European-Based Companies	0	0	0	4	.0%	.0%	.0%	.0%
All Hardware Companies	386	349	0	15,641	42.0%	60.5%	.0%	69.3%
All Turnkey & SW Companies	533	228	243	6,926	58.0%	39.5%	100.0%	30.7%
All Companies	919	577	243	22,567	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

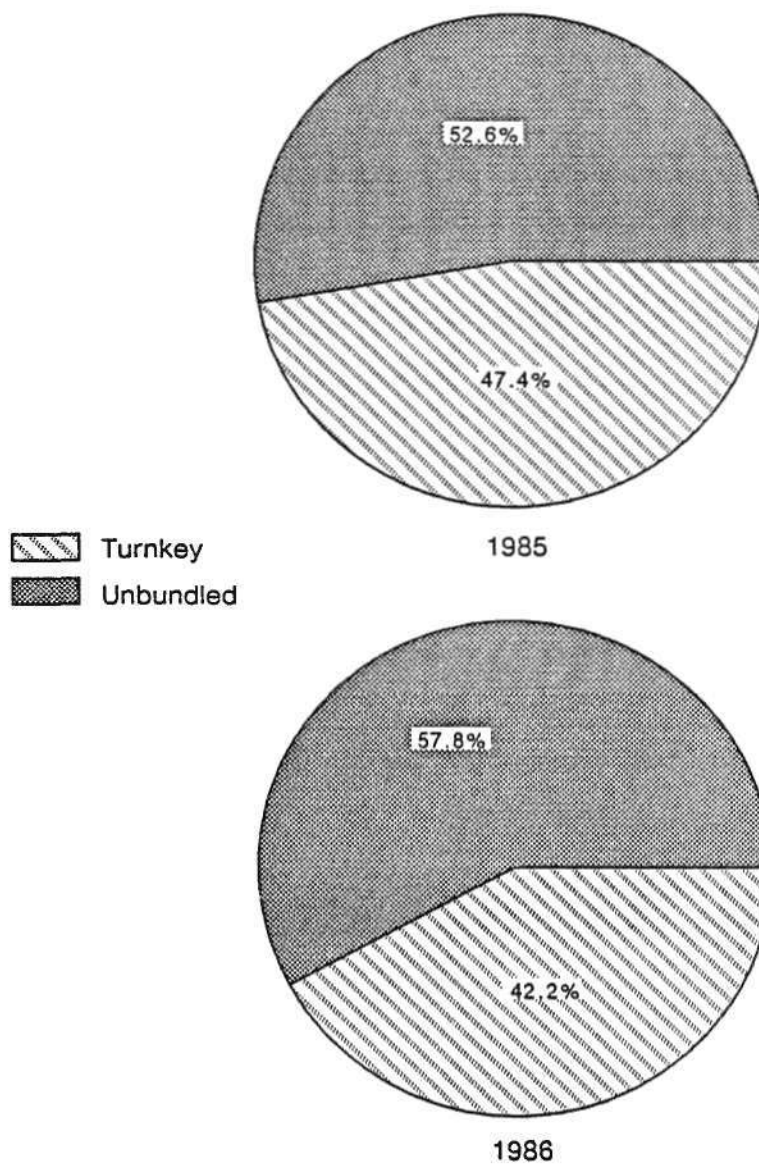
These bullets present the ECAE market share by turnkey versus unbundled product deliveries. This section contains Figure 2.5-5 and Table 2.5-2.

- Sales of unbundled ECAE design systems are growing rapidly, increasing 20 percent from 1985 to 1986, while bundled sales declined 2 percent. In absolute dollars, unbundled systems accounted for \$471 million, or 58 percent of the 1986 ECAE market, versus \$347 million, or 42 percent, for bundled systems. Dataquest believes this trend is caused by a combination of the following three factors:
 - End users choosing to purchase industry standard hardware directly from the manufacturer
 - The popularity of the IBM-PC in general, specifically in the ECAE market for design entry and documentation, and nonengineering tasks such as word-processing, administrative, and spreadsheet applications
 - The widespread availability of schematic capture, especially of low-cost schematic capture running on the PC
- Approximately half of ECAE software revenue derives from unbundled sales. Unbundled ECAE software revenue increased from \$58 million, or 28 percent of the 1985 ECAE market, to \$122 million, or 51 percent of the 1986 market, representing a 111 percent increase. Sales of bundled ECAE software actually declined 22 percent over the past year. Both phenomena, we believe, resulted from the entrance of low-cost PC-based schematic capture into the market and from the emergence of industry standard platforms as the hardware of choice.
- Approximately 60 percent of all ECAE hardware revenue is derived from unbundled sales, versus 40 percent of 1986 hardware revenue from bundled sales. However, bundled ECAE hardware revenue increased 13 percent from 1985 to 1986, while unbundled hardware revenue increased by only 5 percent. This resulted from the high cost of and increasing demand for ECAE peripheral hardware such as simulation accelerators and hardware modelers, which play a unique role in this market. These products provide vendors selling bundled solutions with an additional source of hardware revenue.
- Shipments of unbundled workstations outnumbered those of bundled by a ratio of more than two to one, but unbundled hardware revenue exceeded bundled revenue by only three to two. Dataquest believes that two factors explain this. First is the IBM-PC's popularity for schematic design entry. The PC is both less expensive and more easily cost-justified than the higher-priced engineering workstation, which, we believe, is usually purchased on a per-project rather than per-engineer basis. Secondly, the bundled design environment is dominated by higher-priced hardware, including proprietary hardware products, such as simulation accelerators and hardware modelers.

- Dataquest believes that low-priced PCs and lower-priced, high-performance technical workstations entering the 1986 marketplace have eroded standard hardware price markups by turnkey vendors and have forced drastic price reductions among vendors of proprietary hardware. These lower hardware prices have exposed the true cost of ECAE design entry software, accelerating software price erosion as well.
- Dataquest believes that simulation is playing an increasing central role in ECAE at both software and hardware levels. Simulation represents both the core value and promise of ECAE tools, and increasingly needs to be integrated into all vendors' design and layout environments. The growing user demand for simulation peripheral hardware, such as accelerators and hardware modelers, will somewhat counterbalance the effect of declining workstation prices on ECAE hardware revenue. However, the trend toward lower overall average price per engineering seat will require that these products become distributed network resources with an average per seat cost more acceptable to users.

Figure 2.5-5

ECAE—Turnkey versus Unbundled
(Percentage of Revenue)



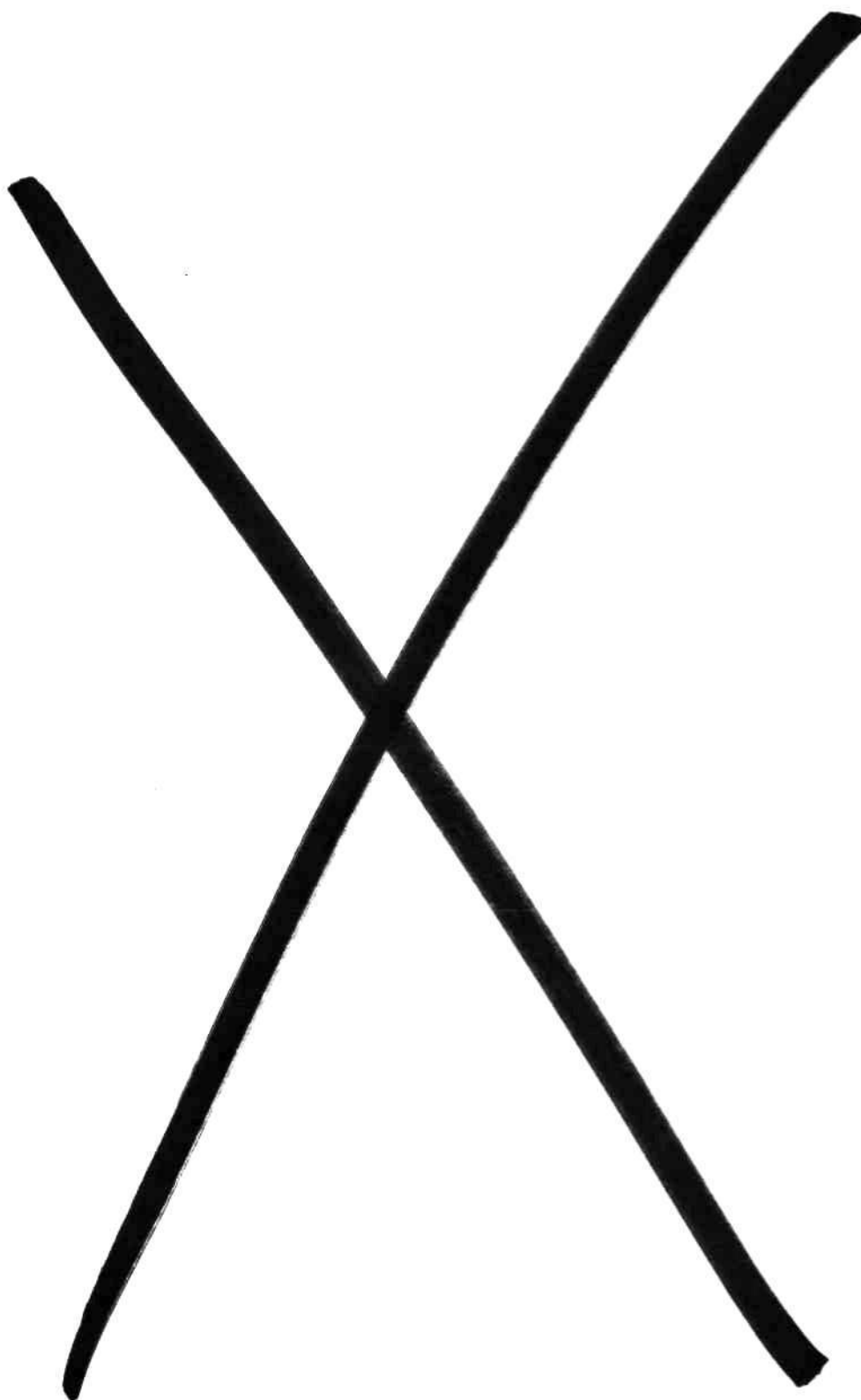
Source: Dataquest
June 1987

Table 2.5-2

**ECAE—Turnkey versus Unbundled
(Millions of Dollars/Actual Units)**

	1985	1986	CAGR	Market Share	
	****	****	****	****	****
Total Hardware and Software Revenue					
Turnkey	352	346	-1.7%	47.4%	42.2%
Unbundled	392	473	20.9%	52.6%	57.8%
Total	744	820	10.2%	100.0%	100.0%
Hardware Revenue					
Turnkey	201	228	13.3%	37.6%	39.5%
Unbundled	334	349	4.5%	62.4%	60.5%
Total	535	577	7.8%	100.0%	100.0%
Software Revenue					
Turnkey	151	119	-21.7%	72.4%	48.8%
Unbundled	58	125	115.2%	27.6%	51.2%
Total	209	243	16.2%	100.0%	100.0%
Workstation Shipments					
Turnkey	5,298	6,926	30.7%	32.8%	30.7%
Unbundled	10,835	15,641	44.4%	67.2%	69.3%
Total	16,133	22,567	39.9%	100.0%	100.0%

Source: Dataquest
June 1987



3.1 IC Layout Definitions

The integrated circuit (IC) layout market segment consists of products used during the physical design phase to create and validate physical implementations of integrated circuits. IC layout tools include polygon editors for the creation of geometric data, symbolic editors, placement and routing (gate array, cell and block), and DRC/ERC (design rule checking/electrical rule checking) verification tools. By definition, an IC CAD system's output is the physical description of an IC design that is used to create the necessary fabrication mask for manufacturing.

Dataquest references two distinct classes of IC layout design methodology: handcrafted and automatic. Handcrafted IC design methodologies are used for products on which a layout designer manually creates the physical description of the circuit. Handcrafted design methodologies require extensive graphics editing capabilities, regardless of whether the transistor representations used during layout are symbolic or geometric.

By contrast, automatic IC design methodologies are used for products that automatically create mask data, without the manual intervention of a layout designer. Included in this subsegment are gate array or cell-based place-and-route products, silicon compilers, and programmable logic array (PLA) compilers. The feature that distinguishes handcrafted IC design methodologies from automatic ones is the integration and close coupling of the logical and physical circuit descriptions. The scope of the IC layout segment includes the design tasks, products, and methodologies listed and defined below:

- *Automated IC design* refers to an IC design methodology in which all parts of a chip are automatically generated.
- *Back-annotation* is a postlayout process in which the actual wire-length data derived from the completed layout replaces the statistically estimated delay information used during prelayout simulation.
- *Block placement and routing* is an IC design methodology for the interconnection of large blocks in a design. The blocks can be made up of compiled cells or handcrafted custom blocks. A special placer positions the blocks to minimize the routing distances and optimize the IC performance. These are then connected by a router or routers that can support the block topology.
- *Cell-based placement and routing* is an IC design methodology that allows the creation of ICs or blocks within ICs from predefined cells that are placed and then routed together to create a logic function.
- *Gate array placement and routing* is a type of application-specific integrated circuit (ASIC) design methodology or product that assembles and then interconnects predefined gates and other primitive elements, manually or automatically, by interconnecting the transistors using one or more layers of metal. The gate array itself is a predefined pattern of transistors that the semiconductor supplier prefabricates on wafers.

- *Layout verification* includes *design rule checking (DRC)*, *electrical rule checking (ERC)*, and *netlist comparison*.
 - *Design rule checking (DRC)* is a design task for verifying that an IC (or board) layout meets known fabrication tolerances, or spacing checks, (e.g., trace-to-trace spacing, via adjacency, or trace-to-via spacing).
 - *Electrical rule checking (ERC)* is the verification of known electrical rules for the technology and identification of violations (e.g., opens, shorts, and floating nodes).
 - *Netlist comparison* means verifying that the final layout corresponds to the original design prior to layout (also known as *netlist* versus *layout*).
- *Manual polygon-level geometry creation and editing* is a type of handcrafted layout IC design methodology or product in which elements are graphically described, positioned, and interconnected one by one, according to specific manufacturing rules.
- *Programmable logic array (PLA) compilation* is a product or design methodology that automatically generates the layout data of a PLA.
- *Spacing and compaction* is the automated process of optimizing the silicon surface utilization of a given IC design.
- *Symbolic layout and editing* is a type of IC layout design methodology or product in which symbolic representations of elements are used to specify and approximate actual placement and routing conditions.

Dataquest differentiates electronic design automation (EDA) products based on a system's output: either logical/functional netlists or physical descriptions. With the development and acceptance of automatic IC layout products—and these by definition include close coupling and integration of logical or functional descriptions with physical descriptions—IC layout products may include ECAE functionality. Depending on the nature of the product and the degree of integration, an automatic IC layout product may also include the ability to describe the chip's functionality. This description may consist of gate, functional, architectural, or language level representation.

3.2 IC Layout Executive Summary

This summary highlights the key points and analyses presented in this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the ECAE applications segment.

- Dataquest estimates the 1986 IC layout market at \$281 million, up 17 percent from \$240 million in 1985.
- IC layout revenue will grow 18 percent in 1987, to \$333 million.
- Dataquest anticipates that the IC layout market segment will grow to \$465 million between 1986 and 1991, at an 11 percent compound annual growth rate (CAGR).
- In 1986, 2,517 IC layout workstation units were shipped. Annual units shipped are expected to reach 3,800 in 1991, a 9 percent CAGR.
- We expect the average selling price per seat to decrease by a 15 percent CAGR from \$79,400 to \$35,000 between 1986 and 1991, an indication of the impact lower-priced technical workstations are having on the market.
- Top IC layout vendors and their 1986 overall market share were Calma (13 percent), Digital (12 percent), Seiko I&E (10 percent), Mentor (6 percent), and Silvar-Lisco (4 percent). Top vendors in other categories and their 1986 market share were Silvar-Lisco, first in IC software sales (12 percent); Digital, first in IC hardware revenue (18 percent); and Apollo, first in number of workstations shipped (15 percent).
- Dataquest believes that the IC layout market is moving rapidly toward unbundling both software and hardware. Our data revealed a 152 percent increase in unbundled IC software revenue during 1986, and a 106 percent increase in unbundled IC layout hardware revenue.
- Dataquest believes that the IC layout market is showing signs of fragmentation among a larger number of vendors and of slowing down, as evidenced by the smaller market share of leading vendors. Total market revenue increased 20 percent in 1986, whereas sales by market leaders declined 39 percent from the 1985 figure.
- The scope of IC layout products has shifted from high-priced, host-dependent, polygon-pusher systems to lower-priced, technical workstation-based systems that are linked with front-end design and that provide some degree of automatic layout.
- A definite methodological change in IC design is occurring, a movement away from hand-crafted design to automatic design, which includes automatic placement and routing and, increasingly, silicon compilation. More automation is necessitated by the combination of increasing chip complexity and shrinking time to market, as well as by the growing number of systems engineers beginning to design ICs.

3.2 IC Layout Executive Summary

- Dataquest believes that design alternatives that address the entire flow and shared nature of the design process and focus on solutions to users' problems are essential for vendors selling IC layout products.
- As the number of design alternatives increases, the IC layout market is becoming crowded with vendors, implying that:
 - Traditional vendors' market share positions continue to be challenged and threatened.
 - There is a shift from proprietary platforms to standard hardware platforms.
 - Relationships with silicon manufacturers, particularly for library and process-rule support, are increasingly more critical for IC, and, specifically, for ASIC design.
 - Product lines need to be broad and deep to keep pace with IC alternatives. This means that vendors will have to offer the user the choice of design methodology or a combination of methodologies, whether manual, cell- or compiler-based, as part of their total offering.

3.3 IC Layout Market Overview

HISTORY

Overview

Unlike any other CAD/CAM application, IC layout is required for integrated circuit product design. No very large-scale integrated circuits (VLSI) can be designed without the use of some form of electronic design automation. The sophistication, complexity, and capabilities of IC design tools have developed and evolved in response to changes in the nature and complexity of integrated circuits themselves.

IC layout systems evolved from the relatively simple digitizing systems of the early 1970s to the "polygon-pushers" (with full manual geometric editing functionality) of the late 1970s and early 1980s. Although these products are still in use, they increasingly compete with and are being replaced by highly sophisticated and highly automated IC design products. Newer design methodologies for application-specific integrated circuits (ASICs) are today driving both semiconductor and IC layout markets. User demand for increased design automation and a reduced time to market is evidenced by the fact that both silicon compilers and automatic placement and routing are beginning to enter and to impact this market.

Evolution of the Market

The first wave of IC layout products was initially dominated by product offerings from Applicon, Calma, and Computervision with their "polygon-pushing" manual editing systems, and later from Silvar-Lisco with batch placement and routing software. This set of vendors dominated the IC layout market, focusing primarily on enhancements to manual editing or mask geometries, rather than on extending product functionality to front-end design tasks.

Second-wave design automation companies were specifically formed to address electronic CAE applications. By providing integrated front-end CAE solutions on lower-priced technical workstations, the new CAE companies were able to take advantage of the pricing umbrella created by the high system prices of traditional vendors and to chip away at their customer bases. Thus began the erosion of the traditional IC layout vendors' market share.

The high degrees of expertise and knowledge required to develop ASIC design and layout tools brought about yet another wave of companies—both semiconductor companies and other IC layout vendors—entering the IC layout segment. These third-wave vendors include companies like Silicon Compilers Inc., Silicon Design Labs, SDA, and VLSI Technology Incorporated (VT). They provide highly automated systems based on alternative IC design methods, particularly for gate array and cell-based design. These systems incorporate automatic placement and routing with higher-level, cell-based and silicon compilation design techniques, and collectively present a formidable challenge to IC layout software from Daisy Systems, Mentor Graphics, Silvar-Lisco, and Valid Logic.

THE PRESENT

1986: A Year of Transition

In 1986, third-wave challengers began to erode the market share of both traditional and second-wave IC layout vendors, but the overall market for all IC design tools is slowing. Dataquest attributes this slowdown to a number of factors:

- Downturns both in the semiconductor industry (the primary IC layout target market) and in the electronics industry in general, which resulted in a slowdown in capital spending
- A large existing installed base among the original target market, IC designers
- Growing sophistication of end users resulting in longer purchase cycles
- New tools that require a change of methodology and design data base but that lack immediate productivity benefits
- Market fragmentation and depressed prices resulting from a large number of vendors offering highly competitive IC layout solutions
- Slower sales cycle to a new class of ASIC designer, namely, systems engineers, who are as yet unfamiliar with IC design requirements; and to seasoned IC designers who are reluctant to modify their own design methods.

Types of IC Layout Companies

Dataquest recognizes three distinct groups of companies that offer IC layout solutions. These groups are listed below, with a representative sample of companies in each classification:

- Traditional
 - Applicon
 - Calma
 - Computervision
 - Daisy Systems

- Mentor Graphics
- Silvar-Lisco
- Valid Logic
- Functionality Challengers
 - Lattice Logic
 - SDA
 - Seattle Silicon Corporation
 - Silicon Compilers Incorporated
 - Silicon Design Labs
 - Tangent
- Semiconductor Companies
 - Gould-AMI
 - LSI Logic
 - VLSI Technology

Each type of company offers its users distinct, although sometimes overlapping, advantages and disadvantages as described in Table 3.3-1.

Table 3.3-1
Strengths and Weaknesses of
IC Layout Companies by Classification

Company Type	Strengths	Weaknesses
Traditional	Large installed base Some CAE integration Some automatic layout PG interfaces Assorted methodologies Mature and stabilized products Foundry interfaces Hardware platforms	Error-prone manual design entry Proprietary hardware Task vs. process-oriented Test and analysis integration
Functionality Challengers	Test and analysis integration ASIC focus High-level design entry What-if analysis Automatic layout Design and behavioral library integration Relative ease of use Process vs. task-oriented	Young, evolving products Unfamiliar methodologies Design libraries/flexibility Silicon area efficiency
Semiconductor	Process expertise CAE integration Manufacturability guarantees	Process dependent Few manufacturing alternatives Design security High NRE (nonrecurring engineering costs)

Source: Dataquest
June 1987

DESIGN

Methodology Alternatives

As the number of IC layout vendors has increased, so has the choice of available design methods. The IC layout market has evolved from one commercially available methodology—manual editing—to a variety of design methods. The market continues to explore and develop products for new design methodologies. In general, any company

considering entering the IC layout market and developing an IC layout tool must provide an automated solution with productivity benefits clearly defined relative to the costs of learning and integrating these tools into the design environment. For example, the ability both to capture design expertise and to leverage it in subsequent designs is of clear value to end users.

The choice of design methodology is attributable in part to the trend toward ASIC design, as well as to evolving layout techniques within traditional semiconductor design. Dataquest tracks three major IC design methodologies:

Manual Editing

Manual editing is a method of individually designing ICs layer by layer and polygon by polygon. Chips thus created are known as handcrafted, or manually generated full-custom ICs.

Automatic Placement and Routing

Automatic placement and routing methodology refers to systems that are closely coupled to front-end tools and that accomplish automatic placement. An example would be the physical placement of the parts list that is generated by the schematic design and that is then routed, either automatically or semiautomatically. Chips created by automatic placement and routing techniques are usually either gate arrays or cell-based ICs such as standard cells.

Silicon Compilation

Silicon compilation is an automated IC design technique that automatically creates, assembles, simulates, and routes cells. A compiler generator system first generates the contents of circuit cells or modules (usually from a high-level language description) and then automatically places and routes these cells to create a unique IC layout.

Each of these methodologies offers users relative degrees of automation, integration, process dependence, and creativity. While Dataquest recognizes that the IC layout market is broad enough to accommodate all three design methods, we also believe that users are moving away from manual design methods to those that offer more automatic design techniques. The reasons for this shift differ, depending on the type of user.

MARKETS

Users and Automatic IC Layout

Dataquest believes that it is necessary for automated IC layout vendors to distinguish between users on the basis of relative silicon expertise. We identify two distinct classes of IC layout tools users: IC designers and system engineers. Each type of user has unique priorities and needs that can affect requirements for IC layout systems and choice of design methodology. These issues are also driving both ASICs and automated IC design (see Table 3.3-2).

Table 3.3-2

User Issues Driving Automatic IC Layout

IC Designer	System Engineer
Increasing chip complexity (Gate-count and process technology requirements)	Limited in-house silicon expertise
Declining time to market: minimize redesigns and silicon revisions	Declining time to market: quick turnaround on prototypes and in-house control of design project and process (design cost control and security)
Need to update or leverage previous design experiences	First-time ASIC designers
Design reliability	Design manufacturability
Greater productivity per designer	Greater level of systems integration per design (more functionality per design)
Silicon area utilization	Cost per part

Source: Dataquest
June 1987

IC Designer Market

IC designers are the engineers who physically design ICs in semiconductor companies, in the ASIC divisions of semiconductor companies, in ASIC houses, or (less frequently) in system companies. These designers rank among the most silicon-sophisticated end users because they already understand ASIC process technology and design, as well as CAE. Because of this expertise, the primary concern of IC designers is not as much methodology as decreasing the layout design bottleneck. IC designers look for automated layout and layout analysis tools that address and improve the entire process of design rather than individual discrete design tasks. Dataquest believes that the tools desired by the IC designer market include the following features:

- Hierarchal data bases
- Logic, transistor, test, and layout integration
- Interactive place, route, simulation, and analysis
- Improved graphics and processing performance
- Project management and revision control
- Physical as well as behavioral model libraries
- Ability to mix methodologies on the same chip or across projects

Additionally, Dataquest believes that engineers do not remain content with current-generation tools and will want to expand their tools to add more state-of-the-art products as these become available. Consequently, we foresee the opportunity for an entire class of design environment products and services to facilitate and support this type of integration, independent of the original system supplier.

System Engineering Market

Dataquest believes that, as silicon manufacturers increasingly come to rely on users and user-owned design systems to perform layout, more and more system engineers will become involved with IC layout. System engineers typically perform front-end tasks such as logic design; that is, they specify a circuit's functionality via design specifications and create the design using schematic editing. System engineers increasingly believe them-

selves capable of layout design tasks. However, we believe that a large-scale shift to ASIC design will occur only as turnkey, mostly push-button IC design systems begin to appear. We believe that system engineers, in order to move into ASIC design, will demand a comprehensive set of tools with the following features:

- Push-button ease of use
- Process independence
- Guarantees of manufacturability
- Front-to-back integration
- User-controlled layout
- Cross-disciplinary data bases

System engineers are experienced logic designers but are only novice IC designers. As a group, they are reluctant to change design methodology without immediate productivity benefits. Automated IC design tools that facilitate the engineers' move into IC layout need to accommodate their current methodology, i.e., schematic capture. This could mean schematics created as output documentation for designs entered via menu or form; or schematics created by logic synthesis techniques; or systems that allow some degree of schematic design or redesign. In any event, these tools must guarantee both the reliability and the manufacturability of the circuits designed on them.

In order to satisfy systems engineering's demand for full system design and to address the broader systems market, future applications products, especially for PCBs, will have to interface with IC products at some level. This interface would allow the pins, power requirements, and performance of the custom IC to be integrated and simulated during printed circuit board design. Dataquest believes that the prime candidates to address this phenomenon will be companies that already have both custom IC and PCB applications product lines. This is due to the large development, support, and marketing efforts required of each application.

ASICs

Strong user demand for ASICs continues to drive the IC layout market. Dataquest believes that, of all IC layout opportunities, ASIC design continues to represent significant growth potential for both IC layout vendors and ASIC suppliers. ASIC design complexity, coupled with the almost legendary shortage of IC designers and a shrinking time to market, has created a vast market opportunity for automated IC layout tools. Electronic design automation (EDA) vendors are attempting to transfer the ASIC design process from IC designer to system engineer.

Offering knowledge-based, highly automated design and layout tools affords EDA companies the strategic possibility of extending the potential customer base beyond IC, ASIC, and systems houses into the larger general manufacturing marketplace. To accomplish this, these new tools will require increased cooperation between vendors of ICs and vendors of IC layout tools. Design libraries and process technology rules must coincide if user-created layout designs are to carry guarantees of ultimate manufacturability.

Dataquest also believes it essential that design automation tools for the ASIC market keep pace with major trends in ASIC technology. New products will be evaluated by prospective users not simply in terms of price, but also by what type of ASIC technology these products support. While users evaluate ASIC design tools, they will also be weighing the cost of a particular ASIC technology in relation to alternative processes from other suppliers.

Today's designer is presented with a broad spectrum of choices. Each method represents a trade-off between design time and development cost. At one extreme are full-custom ICs that require handcrafted layouts. In this method, silicon area is minimized at the expense of development cost. Generally, the full-custom method is used in very high-volume applications where chip cost is the critical factor. At the other extreme are quick-to-program PLAs that can be designed in a matter of a day or days, but that also use silicon area less efficiently than handcrafted ICs. The result of poor silicon efficiency is higher production costs. Between these extremes are gate arrays and cell-based structures.

The role of the ASIC supplier in all this is to deliver prototypes and production parts on time and budget, regardless of technology. CAE tools are used to make sure that the prototypes work reliably and are manufacturable. This assurance enables the designer both to take advantage of quick-turnaround prototyping and to control nonrecurring engineering (NRE) costs and other design costs.

The ASIC market and the ASIC design tool market are extremely competitive. Companies wishing to compete successfully in them must provide very reliable silicon design services, as well as strong design tools to support that service. The minimum requirements for ASIC design tools are very stringent.

Dataquest believes that, as all electronic design segments improve in terms of user acceptance, human engineering, connectivity, performance, and functionality, design data bases for both integrated circuits and printed circuits will merge into one data base. We believe that ASICs are the primary reason that this phenomenon will occur.

Third-Party Opportunities

We believe that due to large R&D investments and expenses required for IC layout product development, more and more niche products will appear and succeed in the marketplace. Niche products may take the form of layout methodology, routing, layout verification, or interfaces between IC design cycles.

Dataquest believes that most niche companies will opt for third-party distribution agreements out of necessity due to large distribution expenses. However, we do not believe that a third-party agreement with any one particular company is a long-term competitive advantage for the mainstream IC layout vendor, because of:

- The nature of niche companies and their need for distribution alternatives
- The fact that competitors will soon have the same product, or at least the same functionality, thus negating any advantage

HARDWARE PLATFORMS

Hardware platforms have begun to play an important role in penetrating the end-user market. As recently as three years ago, almost 100 percent of IC layout systems shipments were based on host-dependent architectures. (Refer to section 3.4.1 for Dataquest forecasts and an analysis of the IC layout segment by product type.)

Technical Workstations

With the introduction of technical workstations for IC applications came the inherent benefits listed below:

- Lower incremental cost, thus more affordability
- Distributed processing, thus maintaining constant performance levels regardless of the number of users (except in the case of large file transfers)
- Computational alignment, thus delegating design responsibilities according to system performance capabilities

Nearly all of the functionality challengers offer technical workstation product architectures, as do most semiconductor challengers. In response to competition, Calma and Computervision now offer technical workstations in addition to their traditional host-dependent systems.

Dataquest believes that technical workstations will continue to play an increasing role in IC layout applications; however, we recognize that they are not without the following limitations:

- Technical workstations are inadequate for batch-oriented tasks, such as placement and routing or design rule checking/electrical rule checking (DRC/ERC) of large circuits.
- Technical workstations are slow when transferring large design files between engineers and layout designers.

Host-Dependent Systems

Although host-dependent systems will continue to be used for IC design, Dataquest estimates that by 1991 they will account for only 14 percent of all IC layout systems shipped, which is a decline from 26 percent in 1986. We believe that host-dependent products will be used mainly as computational engines, especially for automatic layout applications. However, with the introduction of high-performance technical workstations from Apollo, Digital Equipment Corporation, IBM, and Sun, Dataquest believes that there remain very few host-dependent alternatives except for IBM and its 4300 and 308X series.

Personal Computers

Dataquest believes that due to 32-bit IC-design bases with extensive graphics and storage requirements, personal computers will not play a major role in the IC layout segment. Furthermore, due to the design process itself, it is difficult to partition the design into sizes small enough to be managed by personal computers.

We believe that the present role of the personal computer is limited to the design or compilation of programmable logic arrays (PLAs). This is because these devices are typically small enough to be handled by a personal computer.

There are undoubtedly isolated cases where it is possible to efficiently run IC layout programs on a PC. However, because the value of the software disproportionately exceeds the value of the hardware, we do not believe that vendors will be able to receive an adequate return on their R&D, support, marketing, and sales investments to justify pursuing the PC as a viable hardware alternative.

Although Dataquest recognizes that there will always be exceptions, we believe that the majority of ICs will not be physically designed on a PC, even though their logic design could be done on a PC.

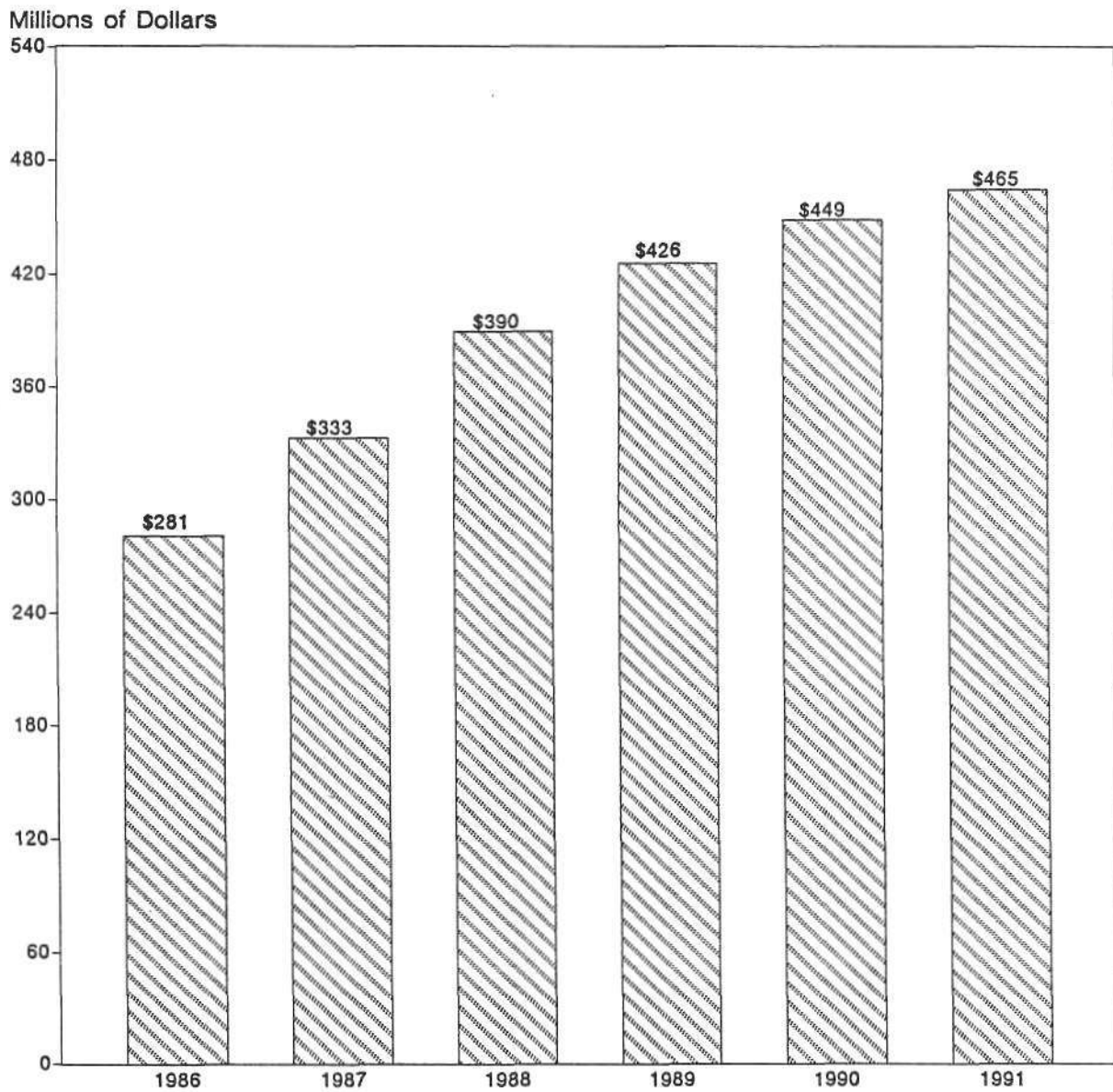
3.4 IC Layout Forecasts

These bullets present Dataquest's forecast and analysis for the total IC layout market for all regions and platforms. This section contains Figures 3.4-1 and 3.4-2 and Table 3.4-1.

- Dataquest estimates the 1986 IC layout market at \$281 million, up 17 percent from \$240 million in 1985.
- Dataquest forecasts that IC layout revenue will grow 19 percent in 1987, to reach \$333 million.
- Dataquest forecasts that the IC layout market segment will grow to \$465 million in 1991, at an 11 percent compound annual growth rate (CAGR).
- Dataquest estimates that IC layout workstation shipments in 1986 were 2,315 units; annual shipments are expected to reach 3,800 units in 1991, growing at a 9 percent CAGR.

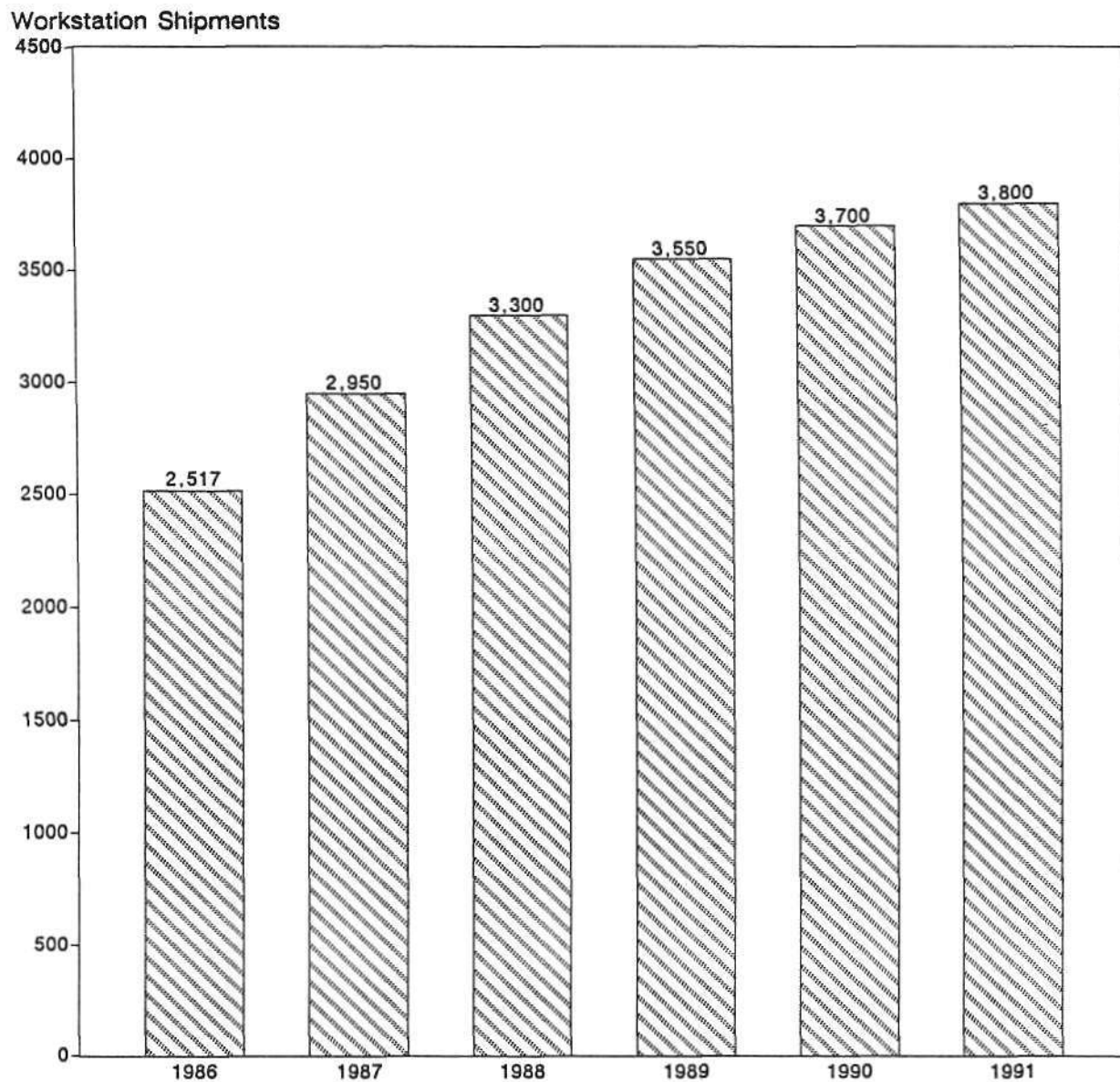
Figure 3.4-1

IC Layout Worldwide Forecast
Revenue



Source: Dataquest
June 1987

Figure 3.4-2

IC Layout Worldwide Forecast
ShipmentsSource: Dataquest
June 1987

3.4 IC Layout Forecasts

Table 3.4-1

**IC Layout Worldwide Forecast
(Millions of Dollars/Actual Units)**

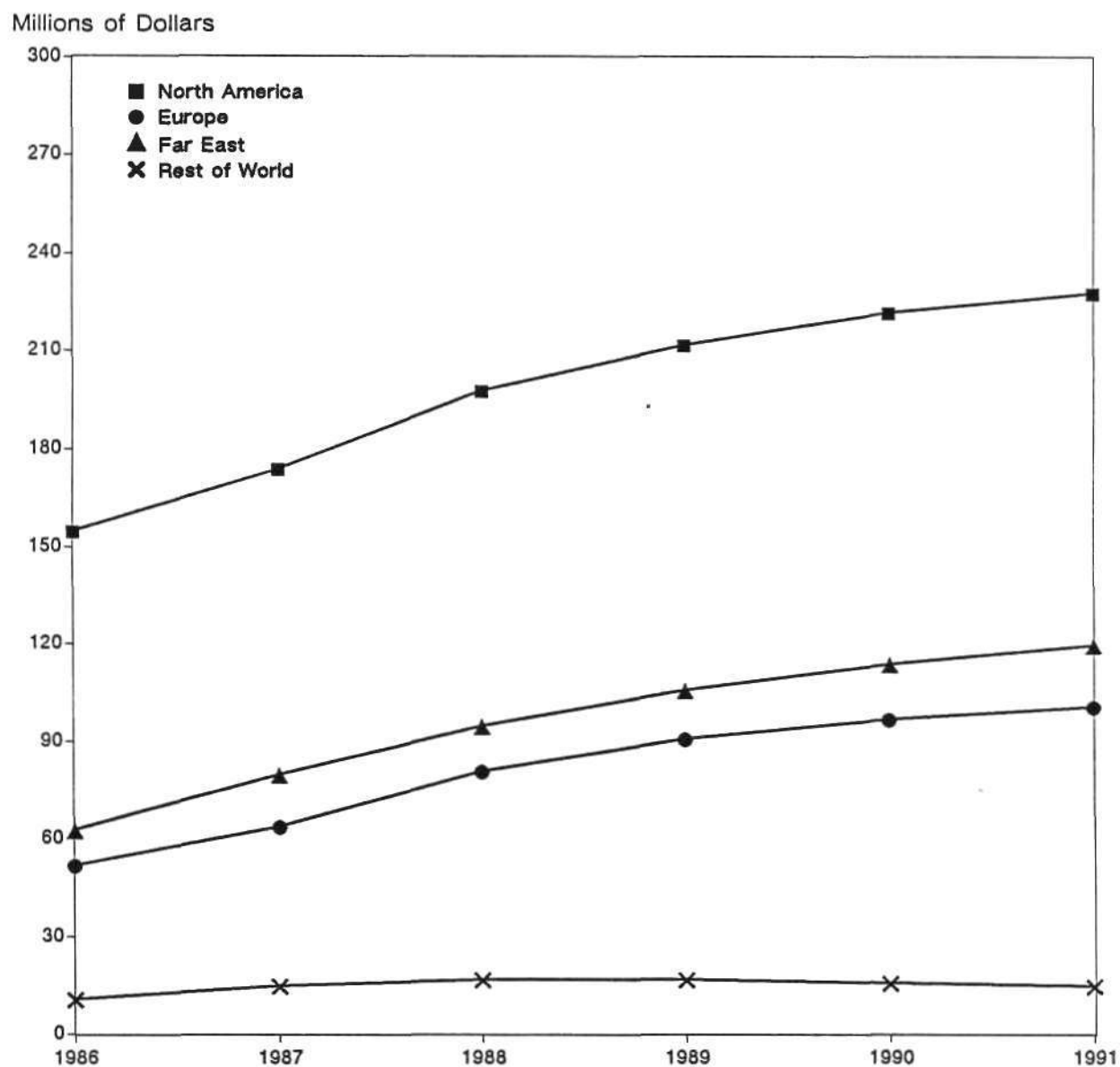
	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	281	333	390	426	449	465	10.6%
Systems	2,315	2,750	3,150	3,400	3,600	3,700	9.8%
Workstations	2,517	2,950	3,300	3,550	3,700	3,800	8.5%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the IC layout market, segmented by region. This section contains Figures 3.4-3 and 3.4-4 and Tables 3.4-2 and 3.4-3.

- North American IC layout revenue was \$155 million in 1986 and is forecast to grow to \$228 million in 1991, at a 10 percent CAGR. North American workstation consumption was 1,395 units, or 55 percent of the total workstations shipped in 1986. We estimate that North American workstation shipments are growing at a 6 percent CAGR and will reach 1,850 units, or 49 percent of the total IC layout workstations shipped in 1991.
- In 1986, European IC layout revenue was \$52 million and, growing at a CAGR of 14 percent, is expected to reach \$101 million in 1991. European workstation consumption was 541 units, or 21 percent of the workstations shipped in 1986. We estimate that workstation shipments are growing at an 11 percent CAGR and will reach 900 units or 24 percent of the total IC layout workstations shipped in 1991.
- The Far East continues to be the fastest-growing region for IC layout. Far East IC layout revenue was \$63 million in 1986 and is forecast to grow to \$120 million in 1991, at a 14 percent CAGR. The Far East consumed 474 workstations or 19 percent of those shipped in 1986. We estimate that workstation shipments are growing at an 11 percent CAGR, to reach 800 units, or 21 percent of the total IC layout workstations shipped in 1991.
- The rest of the world (ROW) consumed \$11 million worth of IC layout in 1986, and we forecast revenue to grow at a 7 percent CAGR, to reach \$15 million in 1991. ROW consumed 107 workstations or 4 percent of those shipped in 1986. We estimate that workstation shipments are growing at a 19 percent CAGR and will reach 250 units, or 7 percent of the total IC layout workstations shipped in 1991.
- Dataquest believes that North America will continue to dominate consumption of IC layout systems through 1991, with an average of 50 percent of worldwide shipments.
- Far East workstation consumption, with 22 percent of worldwide shipments, is forecast to increase at the greatest rate (an 11 percent CAGR through 1991), partly in reaction to the high price of domestic workstations in Japan. As U.S.-based suppliers penetrate the Japanese market with lower-cost solutions, Japanese average selling prices should decline and IC layout sales increase.
- Although the majority of vendors are actively establishing non-U.S. marketing organizations if they have not already done so, Dataquest does not anticipate any major shifts in current worldwide consumption of IC layout systems, basically due to the distribution of IC manufacturers and consumption of ICs.
- We expect Europe to maintain a fairly constant 24 percent of worldwide shipments and consumption.

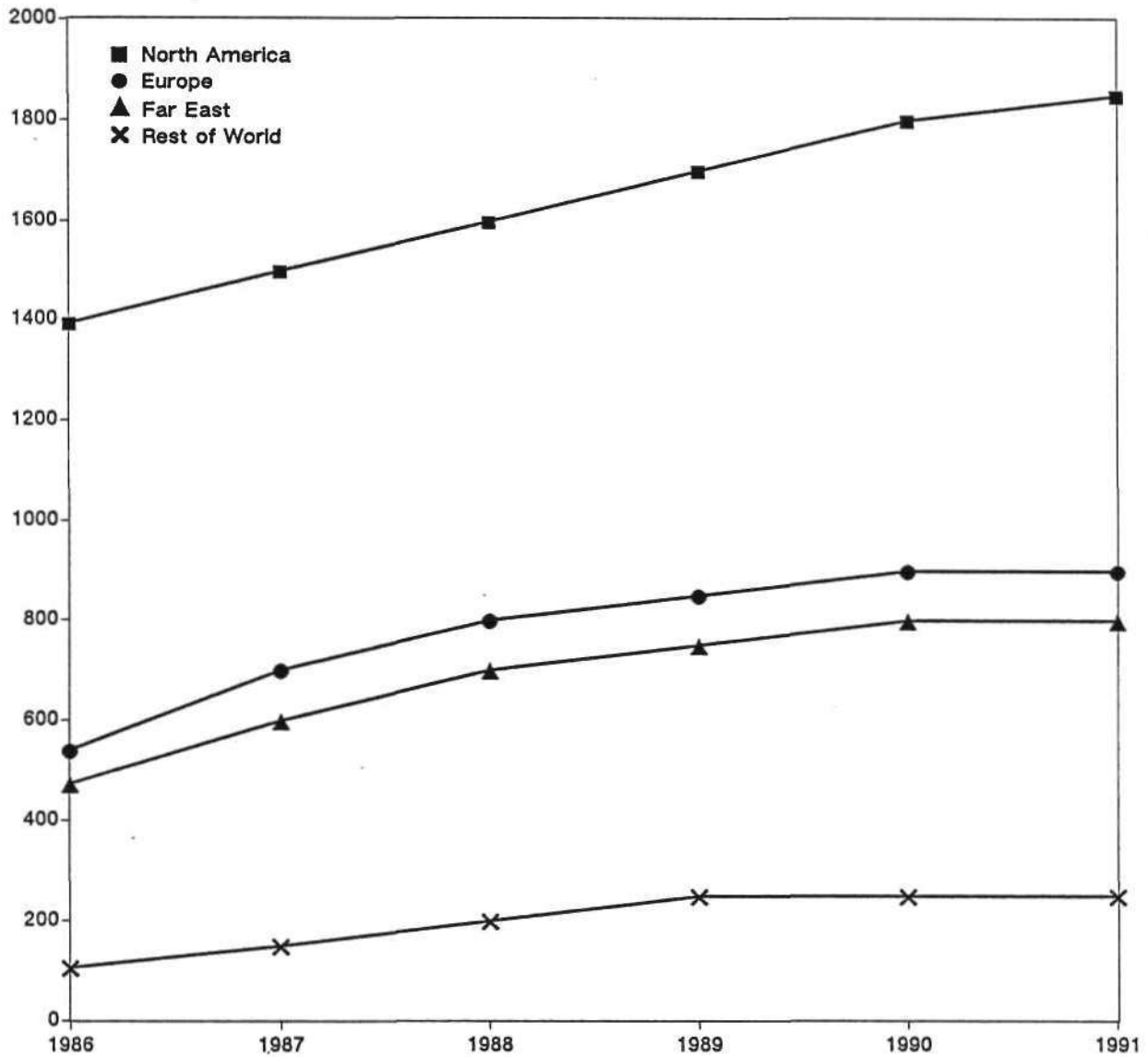
Figure 3.4-3
IC Layout Regional Forecast
Revenue



Source: Dataquest
June 1987

Figure 3.4-4
IC Layout Regional Forecast
Shipments

Workstation Shipments



Source: Dataquest
June 1987

3.4 IC Layout Forecasts

Table 3.4-2

**IC Layout Regional Forecast
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	281	333	390	426	449	465	10.6%
Systems	2,315	2,750	3,150	3,400	3,600	3,700	9.8%
Workstations	2,517	2,950	3,300	3,550	3,700	3,800	8.6%
North America							
Revenue	155	174	198	212	222	228	8.0%
Systems	1,294	1,400	1,550	1,650	1,750	1,800	6.8%
Workstations	1,395	1,500	1,600	1,700	1,800	1,850	5.8%
Europe							
Revenue	52	64	81	91	97	101	14.4%
Systems	502	650	750	800	850	850	11.1%
Workstations	541	700	800	850	900	900	10.7%
Far East							
Revenue	63	80	95	106	114	120	13.7%
Systems	411	550	650	700	750	800	14.2%
Workstations	474	600	700	750	800	800	11.0%
Rest of World							
Revenue	11	15	17	17	16	15	7.1%
Systems	108	150	200	250	250	250	18.3%
Workstations	107	150	200	250	250	250	18.5%

Source: Dataquest
June 1987

Table 3.4-3

**IC Layout Regional Forecast
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
North America						
Revenue	55%	52%	51%	50%	49%	49%
Systems	56%	51%	49%	49%	49%	49%
Workstations	55%	51%	48%	48%	49%	49%
Europe						
Revenue	18%	19%	21%	21%	22%	22%
Systems	22%	24%	24%	24%	24%	23%
Workstations	21%	24%	24%	24%	24%	24%
Far East						
Revenue	23%	24%	24%	25%	25%	26%
Systems	18%	20%	21%	21%	21%	22%
Workstations	19%	20%	21%	21%	22%	21%
Rest of World						
Revenue	4%	5%	4%	4%	4%	3%
Systems	5%	5%	6%	7%	7%	7%
Workstations	4%	5%	6%	7%	7%	7%

Source: Dataquest
June 1987

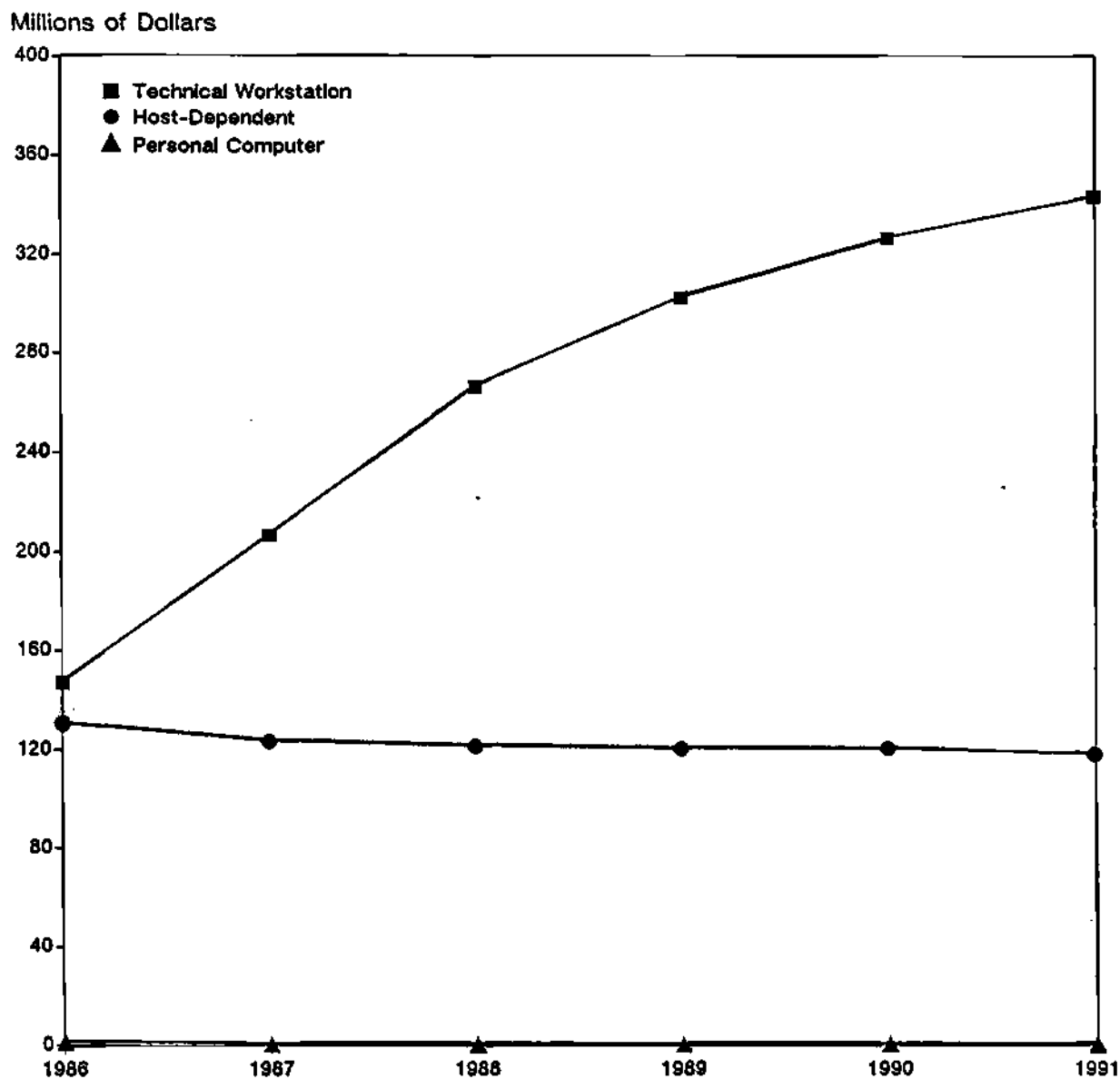
These bullets present Dataquest's forecast and analysis of the IC layout market segmented by platform. This section contains Figures 3.4-5 and 3.4-6 and Tables 3.4-4 and 3.4-5.

- Approximately 2,517 IC layout workstation units shipped in 1986 and, with growth at a 9 percent CAGR, we estimate that 3,800 workstations will be shipped in 1991.
- Technical workstation revenue was \$148 million in 1986 and is forecast to reach \$344 million in 1991, growing at an 18 percent CAGR.
- Approximately 1,603 technical workstations were shipped in 1986. The forecast is for 2,900 workstations to ship in 1991, a 13 percent CAGR.
- Host-dependent revenue was \$131 million in 1986, which is forecast to decrease at a 2 percent CAGR through 1991, declining to \$119 million.
- Host-dependent workstation shipments were 657 in 1986 and are forecast to decrease at a 4 percent CAGR to 550 units shipped in 1991.
- Personal computer revenue was \$2 million in 1986 and, declining at a 2 percent CAGR, is forecast at \$1 million in 1991.
- An estimated 257 personal computers for IC layout were shipped in 1986. This figure is expected to reach 350 units in 1991, growing at a 6 percent CAGR.
- Technical workstation shipments have surpassed host-dependent systems for the past two years due to lower costs per seat and less CPU degradation when performing graphics-intensive tasks.
- Revenue of technical workstation products surpassed host-dependent revenue in 1986 due to lower cost per seat.
- Host-dependent systems will continue to be used due to large, computation-intensive processing requirements.
- Host-dependent systems' primary application will be design programs and methodologies that do not require extensive interactivity and that can run in background mode.
- Personal computers will not be a major factor because of the inherent computation-intensive design tasks and large data bases. Dataquest believes that in IC design, the role of the PC will be limited to compilation of PLAs.

- For the foreseeable future, personal computers will be used to serve as front-end (ECAE) logic design entry systems for ICs, not for actual physical layout.
- Workstation performance, and, specifically, CPU and graphics performance, remain critical issues. Available disk drive and memory space are a prerequisite of IC design because of the large libraries and data bases involved. IC design graphics requirements, while not as intensive as the high-resolution graphics required by mechanical or solids modeling applications, still need near to real-time display and response speeds.

Figure 3.4-5

IC Layout Worldwide Forecast by Platform
Revenue

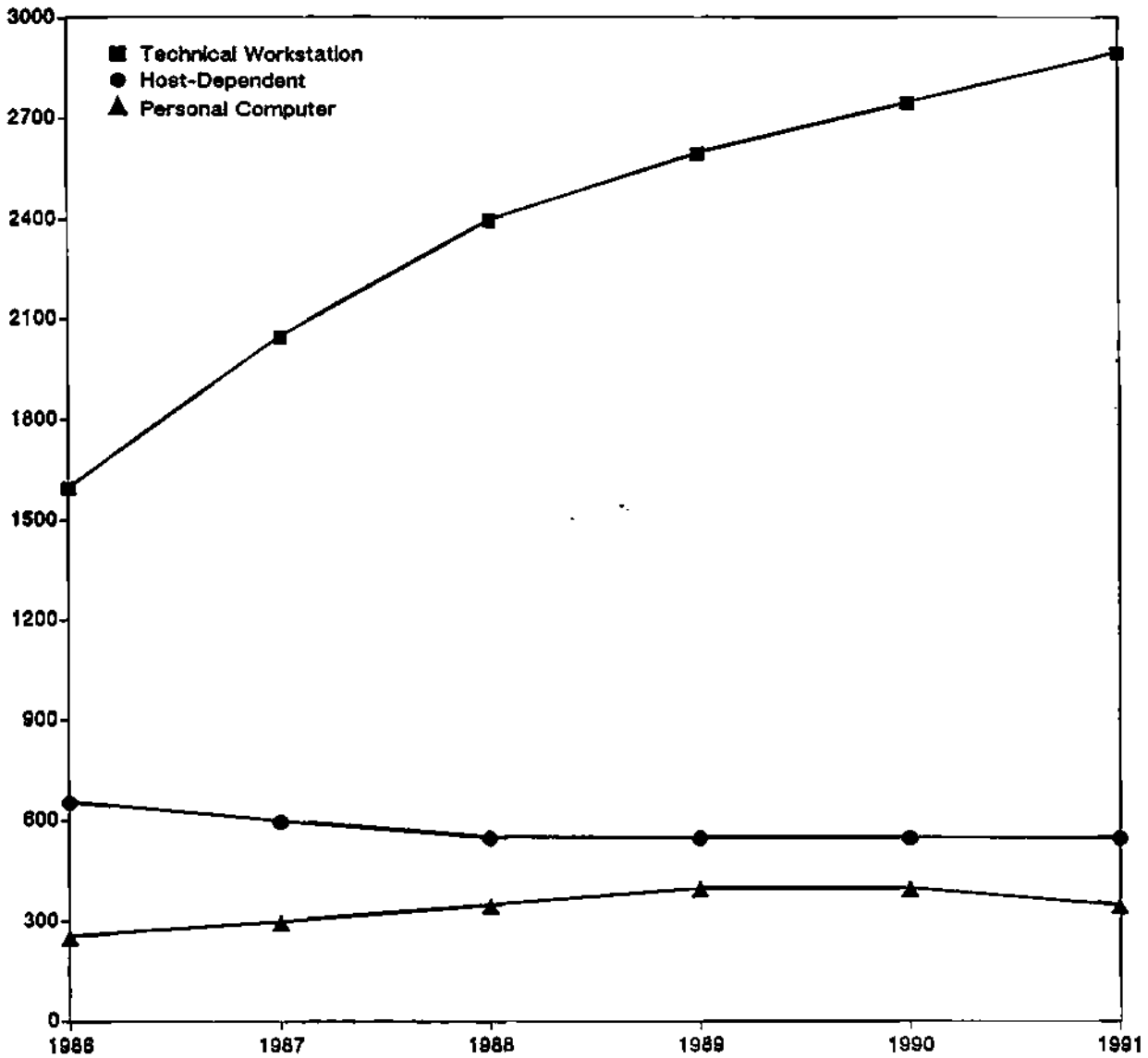


Source: Dataquest
June 1987

Figure 3.4-6

IC Layout Worldwide Forecast by Platform
Shipments

Workstation Shipments

Source: Dataquest
June 1987

3.4 IC Layout Forecasts

Table 3.4-4

IC Layout Worldwide Forecast by Platform (Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	=====
Total Market							
Revenue	281	333	390	426	449	465	10.6%
Systems	2,315	2,750	3,150	3,400	3,600	3,700	9.8%
Workstations	2,517	2,950	3,300	3,550	3,700	3,800	8.6%
Technical Workstation							
Revenue	148	207	267	303	327	344	18.4%
Systems	1,603	2,050	2,400	2,600	2,750	2,900	12.6%
Workstations	1,603	2,050	2,400	2,600	2,750	2,900	12.6%
Host-Dependent							
Revenue	131	124	122	121	121	119	-1.9%
Systems	455	400	400	400	450	450	-.2%
Workstations	657	600	550	550	550	550	-3.5%
Personal Computer							
Revenue	2	1	1	1	1	1	-1.7%
Systems	257	300	350	400	400	350	6.4%
Workstations	257	300	350	400	400	350	6.4%

Source: Dataquest
June 1987

Table 3.4-5

**IC Layout Worldwide Forecast by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
Technical Workstation						
Revenue	53%	62%	68%	71%	73%	74%
Systems	69%	75%	76%	76%	76%	78%
Workstations	64%	69%	73%	73%	74%	76%
Host-Dependent						
Revenue	47%	37%	31%	28%	27%	26%
Systems	20%	15%	13%	12%	13%	12%
Workstations	26%	20%	17%	15%	15%	14%
Personal Computer						
Revenue	1%	0%	0%	0%	0%	0%
Systems	11%	11%	11%	12%	11%	9%
Workstations	10%	10%	11%	11%	11%	9%

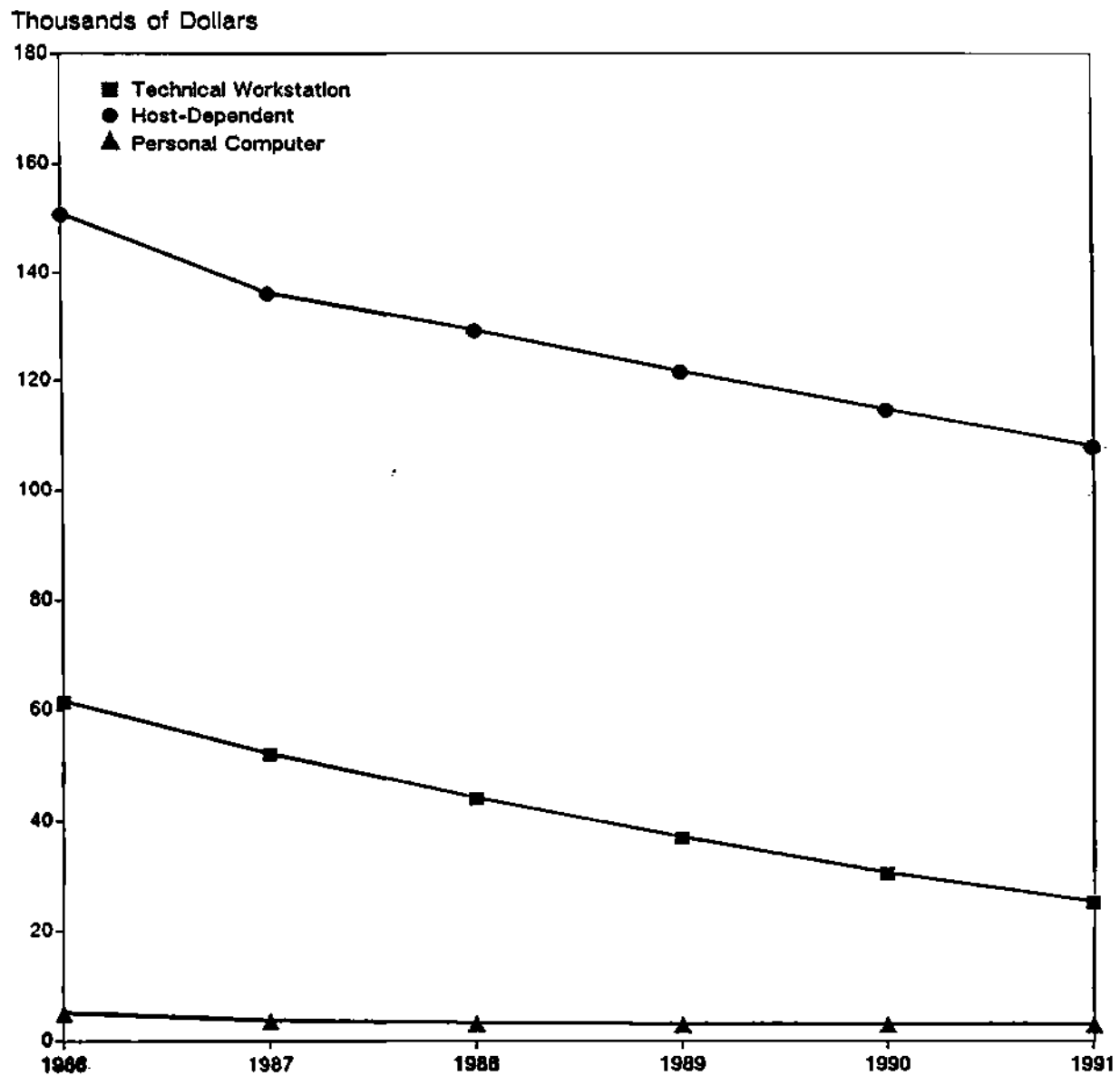
Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the average price per seat by platform for the IC layout market. This section contains Figure 3.4-7 and Table 3.4-6.

- The average price per seat (APPS) for all IC layout platform types is expected to decline from \$79,400 to \$35,000, more than any other EDA application, at a 15 percent CAGR between 1986 and 1991. This decline reflects, in part, the sophisticated and complex nature of IC design software and its high component cost balanced by the steep price erosion occurring in hardware. Dataquest also believes that the 1986 APPS is high due to yen-denominated sales in the Japanese market, which are keeping the worldwide APPS at a high level. As U.S. suppliers continue to penetrate the Japanese market with lower-cost solutions, Dataquest believes the IC layout APPS will begin to drop.
- The 7 percent decline in APPS for host-dependent systems is actually largest in absolute dollars, from \$151,100 in 1986 to a predicted \$108,300 in 1991. This reflects the decline of host-dependent hardware and the industry-wide preference for lower-cost technical workstations, together with the continuing necessity for this platform type in full-custom IC design.
- The decline in APPS is expected to be a 16 percent CAGR for technical workstations, decreasing between 1986 and 1991 from an average of \$61,800 in 1986 to \$25,500 in 1991.
- The expected 10 percent decline in APPS for personal computer systems from \$5,300 in 1986 to \$3,100 in 1991 reflects this platform's limited applicability in IC design.

Figure 3.4-7

IC Layout Worldwide Average Price Per Seat by Platform



Source: Dataquest
June 1987

Table 3.4-6

IC Layout Worldwide Average Price Per Seat by Platform
(Thousands of Dollars)

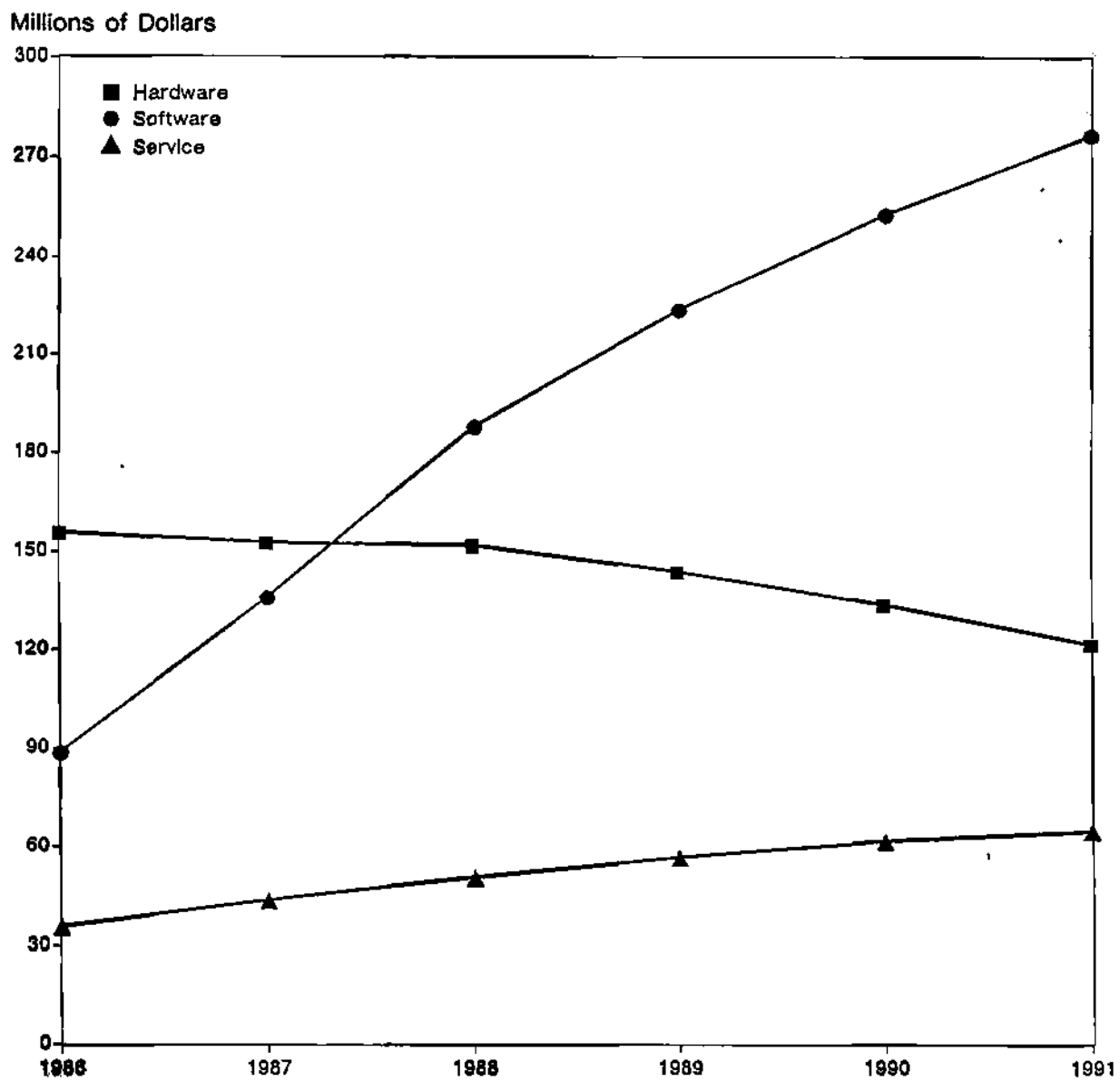
	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
All Product Types	79.4	64.1	54.4	46.7	40.2	35.0	-15.1%
Technical Workstation	61.8	52.3	44.3	37.2	30.7	25.5	-16.2%
Host-Dependent	151.1	136.4	129.4	121.9	114.9	108.3	-6.5%
Personal Computer	5.3	3.9	3.4	3.2	3.1	3.1	-10.2%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis of the IC layout market segmented by revenue source for each platform. This section contains Figure 3.4-8 and Tables 3.4-7 and 3.4-8.

- Dataquest forecasts that hardware revenue which accounted for \$156 million, or 56 percent of total revenue in 1986, will decline at a 5 percent CAGR to \$122 million, or 26 percent of total IC layout revenue in 1991.
- We expect software revenue, which was \$89 million, or 32 percent of total IC layout revenue in 1986, to grow at a 26 percent CAGR, to \$277 million, or 60 percent of 1991's total revenue. Dataquest believes that this shift reflects the need for additional applications and functionality continuing well beyond the saturation point in terms of IC layout seats.
- We believe that, growing at a 13 percent CAGR, IC layout service revenue will nearly double from 1986 to 1991, going from \$36 to \$65 million, due to, among many reasons, the increasing application support required for ASIC design.

Figure 3.4-8
IC Layout Worldwide Revenue Sources



Source: Dataquest
June 1987

Table 3.4-7

**IC Layout Worldwide Revenue Sources by Platform
(Millions of Dollars)**

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
All Platforms							
Hardware	156	153	152	144	134	122	-4.8%
Software	89	136	188	224	253	277	25.5%
Service	36	44	51	57	62	65	12.9%
Total	281	333	390	426	449	465	10.6%
Technical Workstation							
Hardware	64	76	81	79	73	65	.4%
Software	65	108	155	187	213	234	29.3%
Service	20	23	30	36	41	45	18.2%
Total	148	207	267	303	327	344	18.4%
Host-Dependent							
Hardware	91	76	69	64	60	56	-9.3%
Software	24	28	32	37	41	44	12.5%
Service	16	21	21	21	20	20	4.3%
Total	131	124	122	121	121	119	-1.9%
Personal Computer							
Hardware	1	1	1	1	1	1	-3.0%
Software	0	0	0	0	0	0	-11.1%
Service	0	0	0	0	0	0	55.2%
Total	2	1	1	1	1	1	-1.7%

Source: Dataquest
June 1987

Table 3.4-8

**IC Layout Worldwide Revenue Sources by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
All Platforms						
Hardware	56%	46%	39%	34%	30%	26%
Software	32%	41%	48%	53%	56%	60%
Service	13%	13%	13%	13%	14%	14%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	43%	37%	30%	26%	22%	19%
Software	44%	52%	58%	62%	65%	68%
Service	13%	11%	11%	12%	13%	13%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	69%	61%	57%	53%	50%	47%
Software	19%	22%	26%	30%	34%	37%
Service	12%	17%	17%	17%	17%	16%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	85%	86%	84%	82%	82%	80%
Software	12%	9%	10%	10%	8%	7%
Service	1%	6%	8%	10%	12%	13%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
June 1987

3.5 IC Layout Market Shares

These bullets present Dataquest's analysis of the IC layout market share measured in total revenue, hardware, and software revenue, and workstation shipments. This section contains Figures 3.5-1 through 3.5-4 and Table 3.5-1.

- Traditional IC layout market leader, Calma, ranked first in overall revenue with a nearly 13 percent share. Calma ranked second in workstation units shipped (12 percent), second in software revenue (9 percent), and second in hardware revenue (13 percent). Calma's GDSII workstations remain the industry standard because of their familiarity to layout designers and their stability, robustness, and large installed base.
- Standard cell and gate array automatic place-and-route design software gave Silvar-Lisco first place in 1986 IC layout software revenue. The software company rated fifth place, with 4 percent, in overall market share.
- Digital Equipment Corporation, which sells no IC layout software, ranked first (18.0 percent) in 1986 hardware revenue, but accounted for only 1.9 percent of all IC layout workstations shipped. This discrepancy points to sales of Digital host computers, an indication of the extreme CPU horsepower required for such IC design tasks as DRC/ERC and routing.
- Apollo ranked first in number of workstations shipped, with 15 percent of all IC layout workstations shipped, followed in order by Calma (12 percent), Sun (8 percent), and IBM (7 percent). The products of software market leaders Silvar-Lisco and Mentor run on Apollo workstations. Apollo shipments, when combined with those of Mentor, an Apollo distributor, actually accounted for a major share (22 percent) of all workstations shipped, or 550 units. This number is almost double the number shipped by Calma, its nearest competitor in workstations shipped.
- Four computer manufacturers were among 1986's top 10 overall market leaders in total revenue: Digital (12 percent), second; Seiko I&E (10 percent), third; Apollo (4 percent), sixth; and Control Data (2 percent), ninth. Some of these companies do not sell IC layout software, which demonstrates the impact on the market of direct purchases from hardware vendors.
- Mentor Graphics rated fourth in 1986 overall market share with 6 percent of total IC layout revenue. It also ranked fifth in number of workstations shipped (7 percent), fourth in software revenue (7 percent), and sixth in hardware revenue (5 percent).
- Daisy Systems ranked fifth (6 percent) in software sales, seventh in overall market share, and eighth (4 percent) in number of workstations shipped.
- Applicon, the number two overall market leader in 1984, ranked eleventh in 1986 hardware revenue and is no longer among the top 10 IC layout software vendors.

3.5 IC Layout Market Shares

- As the market has moved toward higher degrees of automation and integration, Dataquest believes that the market shares of all vendors will be smaller and the market fragmented among many more IC layout vendors.
- Recent market entrants, SCI, SDL, SDA, Seattle Silicon, Tangent, and VTI, offer highly automated IC design systems based on cell-based and compiler methodology with tightly coupled front-end design functionality. Collectively, these newer vendors are beginning to take market share away from both traditional vendors and also from Daisy, Mentor, and Valid. (Their IC design software products may help offset hardware margin losses due to direct sales of standard hardware.)
- Dataquest believes that increasing chip complexity will keep the average IC layout system price higher than for any other EDA application.
- As the market moves toward fragmentation and saturation, niche opportunities are appearing. Niche strategies in this market segment center on products that address layout methodology, routing, layout verification, or interfaces between IC design cycles. We expect new product announcements that incorporate more automatic layout functionality and tightly coupled front-end design functions from virtually all IC layout vendors. Dataquest believes that most niche companies will opt for third-party distribution agreements out of necessity, due to prohibitive distribution expenses, as well as the large installed base.

Figure 3.5-1

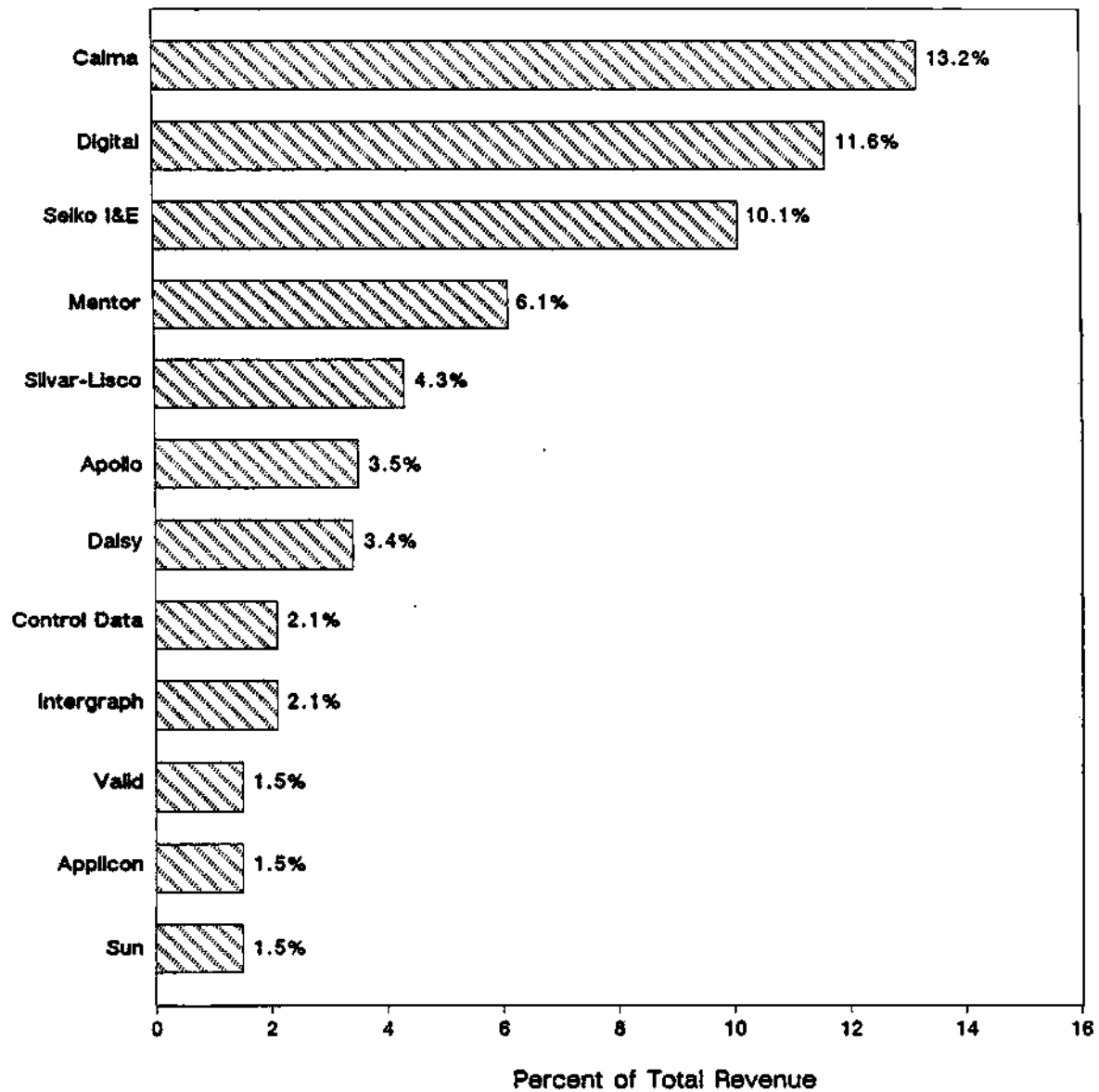
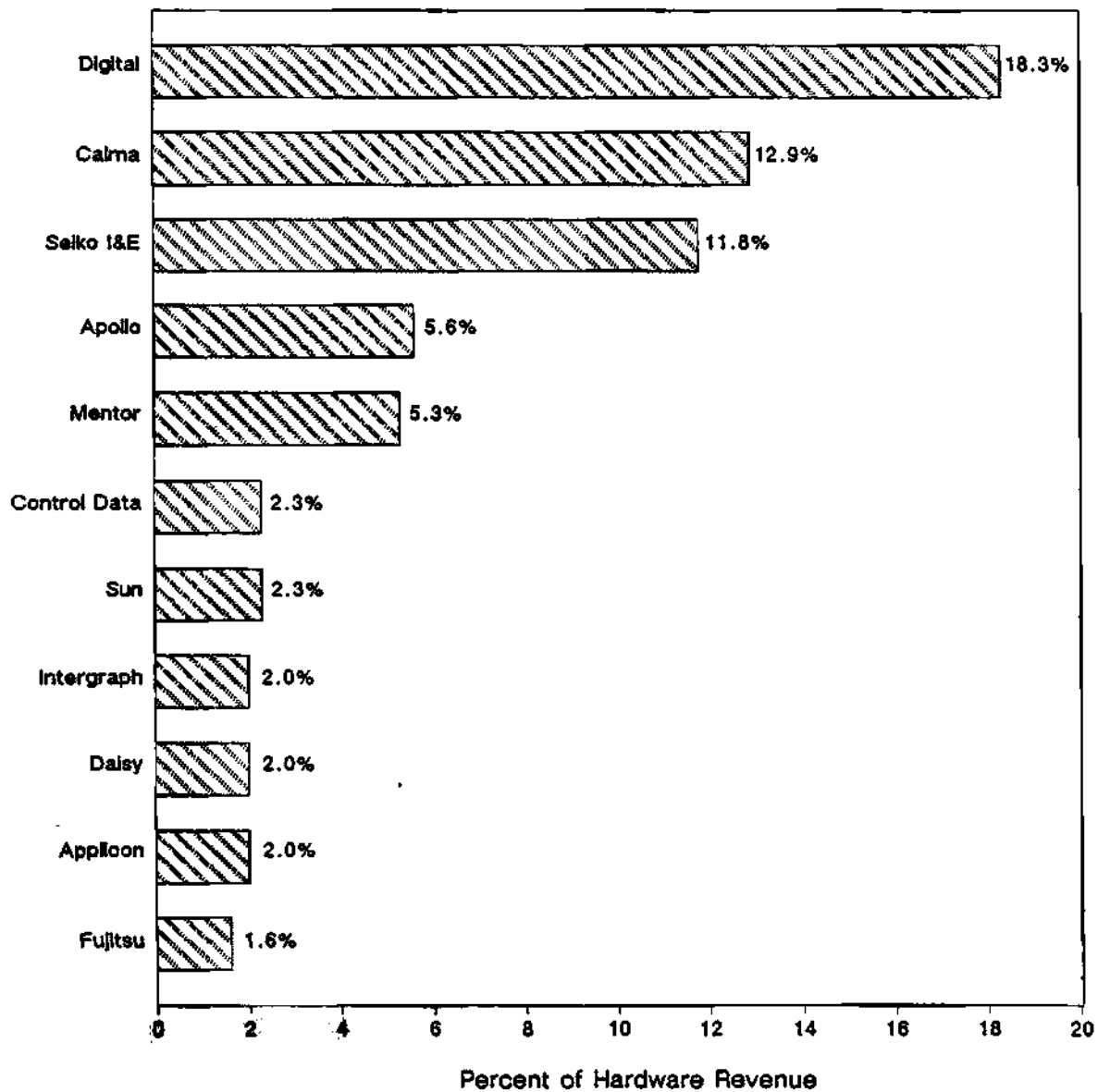
**IC Layout—1986 Worldwide Market Share
Total Revenue**Source: Dataquest
June 1987

Figure 3.5-2

IC Layout—1986 Worldwide Market Share
Hardware Revenue



Source: Dataquest
June 1987

Figure 3.5-3

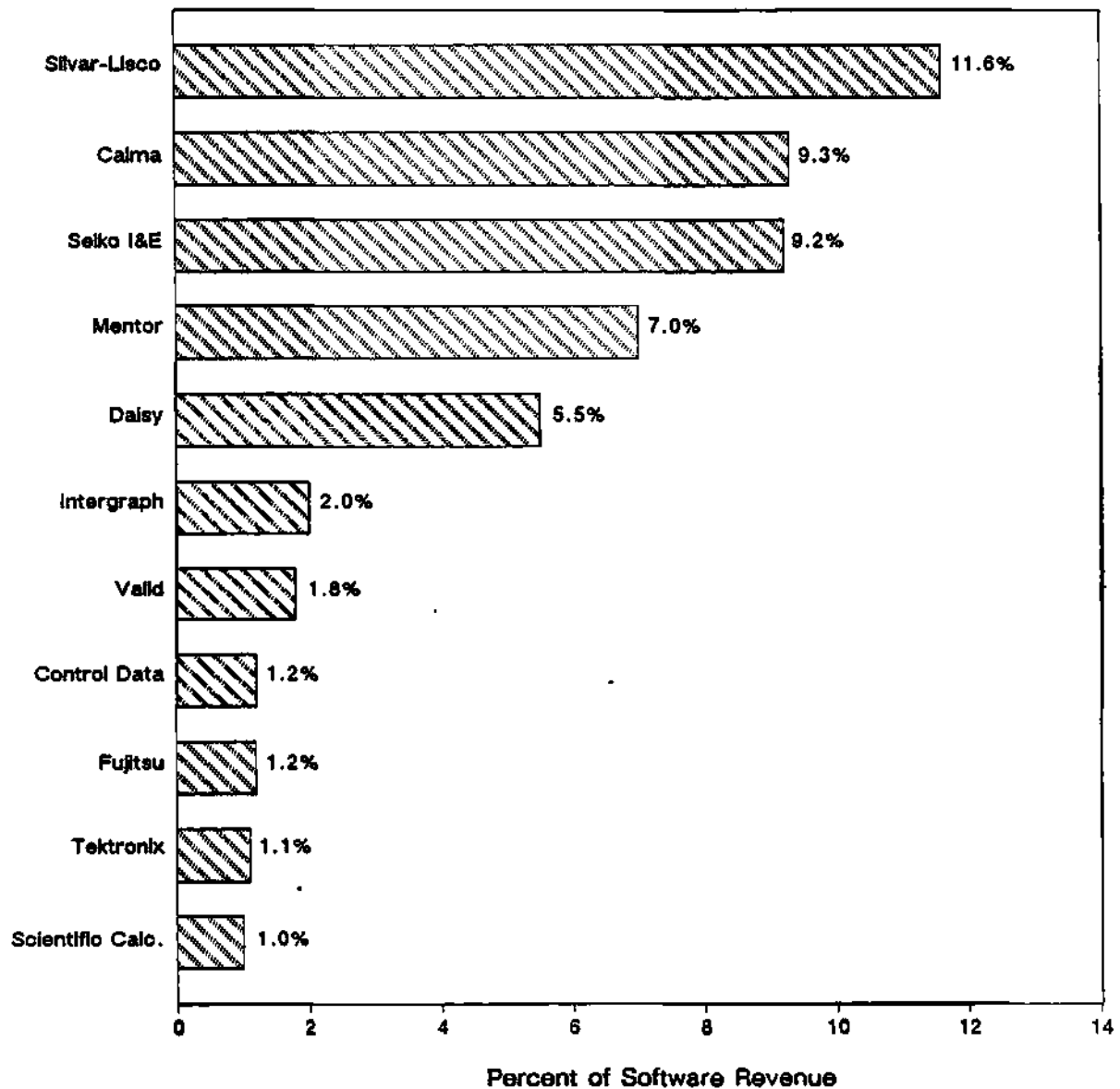
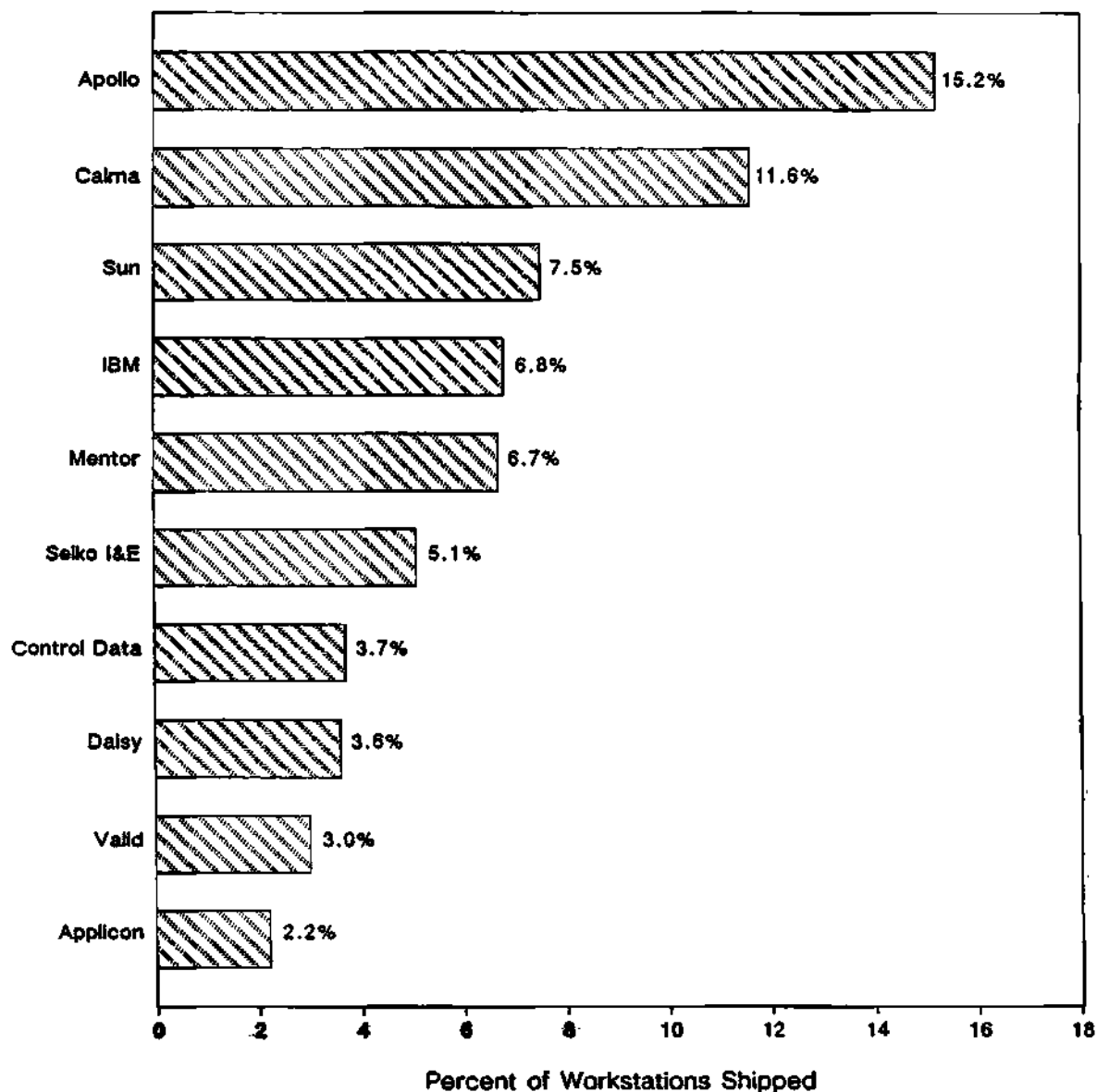
IC Layout—1986 Worldwide Market Share
Software RevenueSource: Dataquest
June 1987

Figure 3.5-4

IC Layout—1986 Worldwide Market Share
Workstation Shipments



Source: Dataquest
June 1987

Table 3.5-1

**IC Layout—1986 Worldwide Market Share
(Millions of Dollars/Actual Units)**

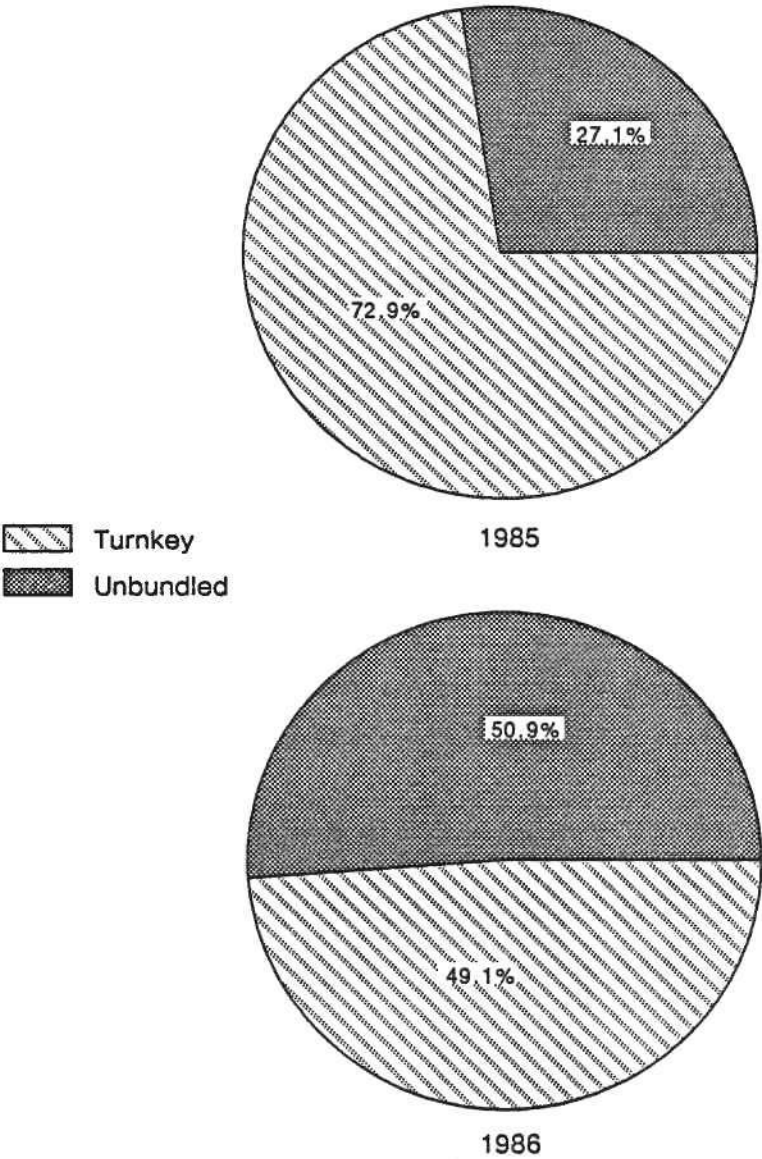
Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Calma	37	20	8	291	13.2%	12.9%	9.3%	11.6%
Digital	32	29	0	47	11.6%	18.3%	.0%	1.9%
Seiko I&E	28	18	8	129	10.1%	11.8%	9.2%	5.1%
Mentor	17	8	6	168	6.1%	5.3%	7.0%	6.7%
Silvar-Lisco	12	0	10	0	4.3%	.0%	11.6%	.0%
Apollo	10	9	0	382	3.5%	5.6%	.0%	15.2%
Daisy	10	3	5	90	3.4%	2.0%	5.5%	3.6%
Control Data	6	4	1	94	2.1%	2.3%	1.2%	3.7%
Intergraph	6	3	2	43	2.1%	2.0%	2.0%	1.7%
Valid	4	2	2	75	1.5%	1.4%	1.8%	3.0%
Applicon	4	3	1	55	1.5%	2.0%	.8%	2.2%
Sun	4	4	0	190	1.5%	2.3%	.0%	7.5%
Fujitsu	4	3	1	20	1.4%	1.6%	1.2%	.8%
Tektronix	2	1	1	29	.9%	.7%	1.1%	1.2%
Scientific Calc.	2	1	1	2	.7%	.4%	1.0%	.1%
Hewlett-Packard	1	1	0	11	.4%	.5%	.2%	.4%
IBM	1	1	0	171	.3%	.6%	.0%	6.8%
Racal-Redac	1	0	0	4	.2%	.2%	.2%	.1%
Other Companies	99	47	42	673	35.2%	30.1%	47.7%	26.7%
All Far East-Based Companies	33	21	10	152	11.8%	13.7%	10.9%	6.0%
All European-Based Companies	0	0	0	41	.0%	.0%	.0%	1.6%
All Hardware Companies	89	79	0	1,183	31.7%	51.0%	.0%	47.0%
All Turnkey & SW Companies	192	76	89	1,333	68.3%	49.0%	100.0%	53.0%
All Companies	281	156	89	2,517	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

These bullets present the IC layout market share by turnkey versus unbundled deliveries. This section contains Figure 3.5-5 and Table 3.5-2.

- Dataquest believes that the IC layout market is moving rapidly toward unbundling of both software and hardware. The 1986 data revealed the most dramatic evidence of this—revenue for unbundled IC software increased 153 percent from 1985.
- Sales of unbundled IC layout design systems are also growing rapidly, having increased 121 percent from 1985 to 1986, and from 27 percent of combined hardware and software revenue to 51 percent. By contrast, turnkey system sales declined 21 percent during the same period.
- In 1986, unbundled systems sales accounted for \$125 million, versus \$120 million for turnkey systems, whereas in 1985 unbundled system sales totaled only \$57 million, versus \$152 million for turnkey systems. Dataquest believes this shift is due primarily because end users choose to purchase industry standard hardware platforms and IC design software directly from the manufacturer of each, instead of from turnkey vendors.
- Approximately half the IC layout software revenue derives from unbundled sales. Unbundled IC software revenue increased from \$18 million, or 25 percent of the 1985 IC layout market, to \$45 million, or 51 percent of the 1986 market. As mentioned above, this change represents a 152 percent increase.
- Sales of bundled IC design software declined by 18 percent over the past year. We believe that the decline in workstation prices has exposed the value of IC software, and that IC design software will remain high, thus applying further downward pressure on workstation ASPs.
- Approximately half of all IC layout hardware revenue is now derived from unbundled sales. Turnkey IC layout hardware revenue decreased 23 percent from 1985 to 1986, from \$99 million to \$76 million, while unbundled hardware revenue increased 106 percent, from \$39 million to \$79 million during the same period.
- Despite the general trend toward unbundling, shipments of turnkey workstations still outnumbered those of unbundled 53 percent to 47 percent. However, Dataquest believes that, based on the 114 percent increase of shipments of unbundled workstations in 1986, 1987 unbundled shipments will equal or surpass those of turnkey workstations.

Figure 3.5-5
IC Layout—Turnkey versus Unbundled
(Percentage of Revenue)



Source: Dataquest
June 1987

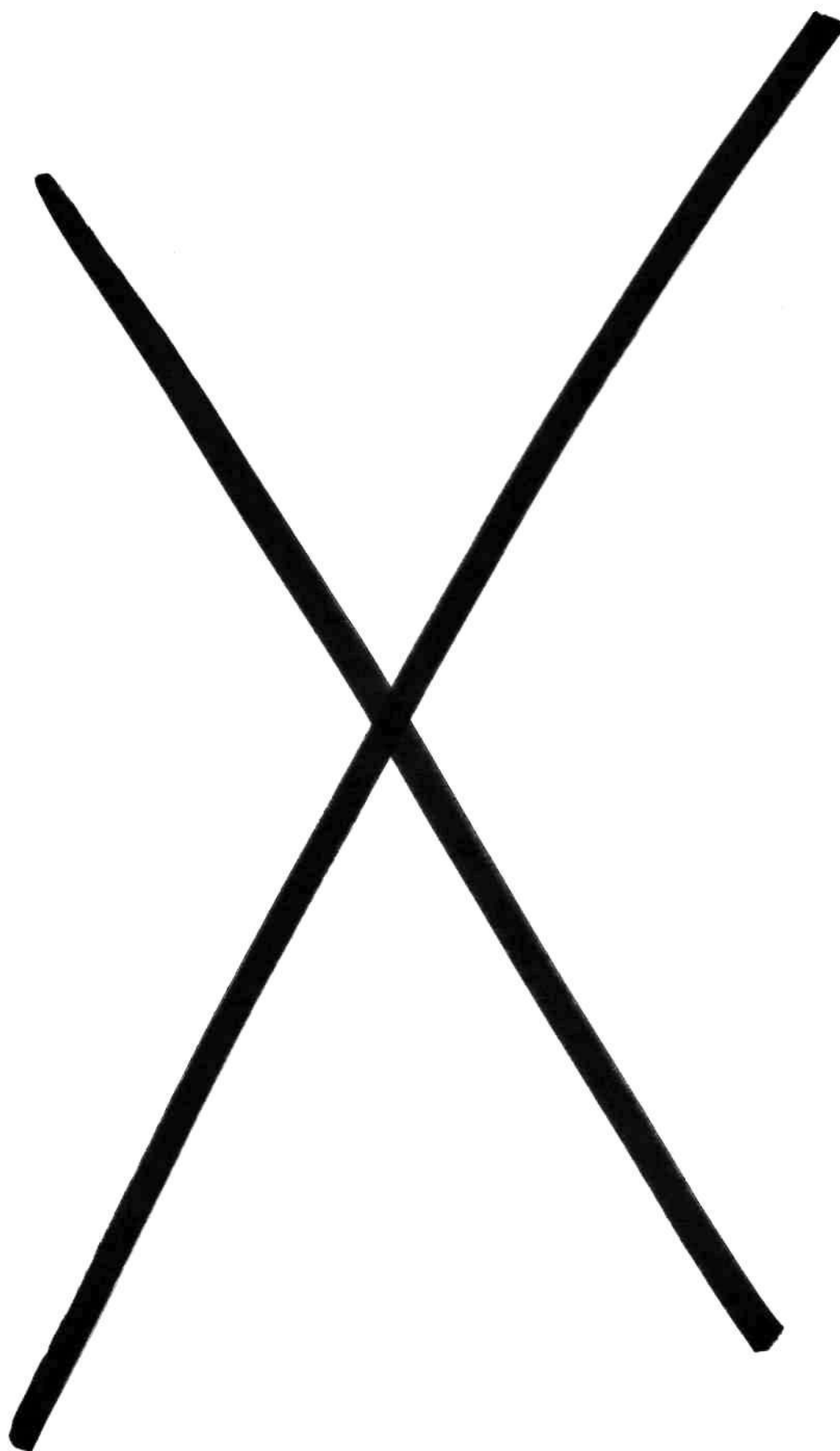
3.5 IC Layout Market Shares

Table 3.5-2

IC Layout—Turnkey versus Unbundled
(Millions of Dollars/Actual Units)

	1985	1986	CAGR	Market Share	
	****	****	****	1985 ****	1986 ****
Total Hardware and Software Revenue					
Turnkey	152	120	-20.8%	72.9%	49.1%
Unbundled	57	125	120.8%	27.1%	50.9%
Total	208	245	17.7%	100.0%	100.0%
Hardware Revenue					
Turnkey	99	76	-22.6%	71.9%	49.0%
Unbundled	39	79	106.1%	28.1%	51.0%
Total	137	156	13.6%	100.0%	100.0%
Software Revenue					
Turnkey	53	44	-17.4%	74.7%	49.2%
Unbundled	18	45	152.5%	25.3%	50.8%
Total	71	89	25.5%	100.0%	100.0%
Workstation Shipments					
Turnkey	1,611	1,333	-17.2%	74.5%	53.0%
Unbundled	552	1,183	114.3%	25.5%	47.0%
Total	2,163	2,517	16.3%	100.0%	100.0%

Source: Dataquest
June 1987



4.1 PCB Layout Definitions

The printed circuit board (PCB) layout market encompasses tools that are used during the physical design phase to create and validate the data that will be used to manufacture the printed circuit board. PCB layout systems are primarily used by draftspersons or engineers. By definition, the primary output of a PCB layout system is CAM data, such as photoplotter tapes, numeric control tapes, or solder mask information.

However, many board layout systems are now bundled within electronic CAE (ECAE) applications used in the engineering process. These applications include schematic capture, simulation, and fault grading. For forecasting purposes, PCB layout revenue includes any dollars associated with ECAE applications that are sold as part of a bundled PCB layout and design station.

PCB layout applications that are tracked include:

- Manual layout and editing. This includes tools that are used for drafting and editing tasks, such as drawing the board outline, placement of components and routing of nets by hand, and creation of component libraries.
- Automatic routers. These are tools that interconnect the nets on a board without human intervention. Specialized routers, such as emitter-coupled logic (ECL) or microwave routers, are included in this category.
- Design rule checking (DRC). DRC packages are used to post-process the final layout of a board to make sure that it conforms to known manufacturing tolerances, such as trace-to-trace spacing.
- Automatic placement. These tools position components on the board by optimizing them according to specific predefined objectives. Such objectives can include minimization of routing interconnection, routability, or critical paths.
- Routing accelerators. These are special-purpose hardware that is used to speed up the routing process.
- Analysis packages. These include software applications used to analyze board layouts for specific characteristics, such as electromagnetic properties (cross talk, noise, or ringing), thermal patterns, or reliability.
- CAM interfaces. These are tools used to transfer data from the layout system to manufacturing systems (numeric control output, and Gerber and photoplotter tapes).
- Surface-mount technology and devices (SMT and SMD). This is a board manufacturing and IC packaging methodology where the pins of the package are connected to the surface of the board, as opposed to through-hole methodologies where the component's pins are inserted into holes that have been drilled into the board.

4.2 PCB Layout Executive Summary

This executive summary highlights the key points discussed throughout this chapter. Please refer to the chapter in its entirety for a comprehensive analysis of the PCB layout applications segment.

- The PCB layout market was \$651 million in 1986 and is forecast to grow to \$916 million in 1991, a compound annual growth rate (CAGR) of 7.1 percent.
- The PCB layout market is expected to grow to \$743 million in 1987, a 14.1 percent increase. This is considerably less than the 25.0 percent growth in 1986 and the 35.0 percent growth in 1985.
- Dataquest expects workstation unit shipments to still be relatively strong. In 1986, workstation shipments were 10,569. These are expected to grow at a 10.1 percent CAGR to 17,100 in 1991. In 1987, shipments are expected to rise 24.9 percent, to 13,200.
- However, Dataquest believes that strong workstation shipments will be offset by the declining average price per seat. The average price per seat was \$49,600 in 1986 and is forecast to drop at a negative CAGR of 9.4 percent to \$30,300 in 1991.
- Regionally, the Far East and Europe will remain the strongest areas at respective CAGRs of 12.5 percent and 4.7 percent in revenue from 1986 to 1991. North American revenue, while still the largest part of the market (41 percent in 1986), will grow at only a 4.6 percent CAGR.
- Dataquest believes that the decline in revenue growth rates indicates that the PCB layout market is mature, and that 1986 was a key transitional year. Dataquest views the following events and trends as pointing toward the maturation of the market:
 - Penetration at existing user sites is very high.
 - The opportunities for major technological innovations are small.
 - The opportunities for new entrants are very limited.

When these three factors, along with steady price erosion, are taken together, they point toward a mature, replacement market rather than a growth, expansion market.

4.3 PCB Layout Market Overview

HISTORY

The printed circuit board (PCB) layout market, now is almost 20 years old, was one of the first places where electronic design automation (EDA) technology was applied. Today, it is a \$651 million market that we expect will continue to enjoy a healthy but moderate 7.1 percent compound annual growth rate (CAGR) through 1991.

PCB layout suppliers and products have gone through a long process of evolution and change. Much like the EDA market, the PCB market's expansion and evolution has been largely sustained by the dynamics between customers, technology, price, and suppliers.

But PCB layout, because it is the last major design stage before product manufacture, has also been heavily affected by technology developments from other areas. Integrated circuit technologies (microprocessors and application-specific devices), surface-mount manufacturing techniques, robotics, and, indeed, EDA itself (electronic CAE (ECAE) and IC layout) have all had a direct impact on PCB layout systems.

PCB layout is both a funnel and a bridge. It acts as a funnel through which all the other technologies—application-specific IC (ASIC), VLSI, and surface-mount technology (SMT)—must pass. It acts as a bridge between the engineering and IC design automation world and manufacturing. As such, a PCB layout system must be able to take into account all the peculiarities and requirements of all the different technologies, but also be closely linked with other design automation and manufacturing systems.

Given this unique pressure to keep pace with other technologies, as well as the basic dynamics of the market, PCB layout systems and suppliers have undergone steady change. Dataquest identifies the following stages in the PCB layout market:

- Early 1970s—Companies such as Calma and Computervision supplied artwork-only systems. These systems were substitutes for mylar and tape, and allowed draftspersons to manually place and route component symbols and traces. These systems were primarily host-dependent systems with higher performance graphics. They cost in excess of \$150,000 per user.
- Late 1970s—Existing suppliers, as well as specialized niche entrants, began to offer automated routers and netlist-driven, correct-by-construction editing. These more automated systems offered significant improvements in accuracy (i.e., the layout had to correspond to the original netlist), but the routing capabilities were still marginal. The routers were complex to use, loosely linked with the rest of the system, and often gave poor results. These systems were still host based, and a complete system cost more than \$500,000.

- Early 1980s—Technical workstation-based systems from companies such as Racal-Redac and Scientific Calculations took the manual editing technologies developed in the 1970s and put them on a much lower cost platform. These systems cost from \$90,000 to \$150,000 per station.
- 1983—Several new entrants, notably Case Technology and Personal CAD (PCAD) Systems, put PCB layout on a personal computer. While limited to manual editing tasks, these systems were capable of handling simple boards, and cost less than \$20,000.
- 1985—The ECAE companies—Daisy, Mentor, and Valid—and new entrants such as Cadnetix introduced next-generation workstation-based layout systems. Not only did these systems put automatic placement-and-routing on the workstation, but they were also designed to handle advanced technology problems such as surface-mount design (SMD) and fine-line etching. These systems were intended to be closely coupled with ECAE tools. Finally, Cadnetix and others also introduced routing accelerators that were designed to have mainframe routing capabilities at a significantly lower price. These new stations cost less than \$100,000.
- 1985/1986—Personal computer-based systems with automatic placement-and-routing and surface-mount design capabilities were introduced. From a functionality standpoint, they had most of the features available on the higher-end stations, the major difference being the limits on board density and number of components. These systems cost less than \$20,000.

The trend in the marketplace has clearly been toward increasing levels of functionality and automation on steadily lower-priced technical workstations and personal computers, coupled with routing accelerators for computation-intensive tasks. All of these systems handle a range of new technologies: large pin-count VLSI components, 300-package PCBs, ASICs, ECAE, and surface-mount (or mixed SMT/through-hole) manufacture.

The steady pressure to improve price/performance and the constant technology injection have resulted in an extremely competitive environment. Existing suppliers, with their installed bases of older equipment and software, have had difficulty keeping pace with the demand for more advanced but lower-priced systems. This has created opportunities for new entrants at both the high end of the market (e.g., Cadnetix, Daisy, and Mentor Graphics) and at the low end (e.g., Case and PCAD). The result is that the market is unusually dynamic, given its relative age.

1986—A YEAR OF TRANSITION

For the one segment that in principle was the most mature in a maturing market, PCB layout was one of the few bright spots in 1986. While the rest of the EDA market had roughly 18 percent revenue growth in 1986, PCB layout had 25 percent growth. And in Europe, one of the healthiest EDA regions, PCB layout was the fastest growing segment, rising from \$134 million to \$191 million, a 42 percent increase.

In spite of this relatively strong performance, Dataquest believes that 1986 was the year the PCB layout market made the transition to maturity. By maturity, Dataquest means that the size, structure, and trends of the PCB layout market are well established and not likely to change in the immediate future. Dataquest believes that this maturity can be characterized by four major factors:

- Technology trends are very clearly defined.
- User penetration is high.
- Prices are declining and revenue growth is slow.
- The potential for new entrants is very limited.

When taken together, these four factors define a mature market that is expanding very slowly, primarily among existing users. It is most decidedly not an expanding, growth opportunity. As such, competition between suppliers is likely to be extremely intense as they fight for the available market.

Technology Trends

The technology trends for PCB layout are well known. They point toward integration, enhancements, and revisions of current products rather than major innovation. Successful products may not necessarily be the most advanced, but rather the most robust and stable.

Dataquest has identified three major technology trends driving PCB layout systems:

- Surface-mount design
- ASIC
- Design automation and manufacturing systems

PCB layout systems must have functionality across the entire system to handle these technologies. In other words, manual editing, libraries, routers, and CAM interfaces must all be capable of handling a given technology (e.g., SMT).

Surface Mount

Surface-mount design is the most significant trend in PCB layout systems today. An increasing number of users are doing multilayer, surface-mount design. As is shown in Table 4.3-1, according to a Dataquest user survey, more than 26 percent of the designs done today employ some level of SMT.

SMT and associated fine-line etching techniques impose a range of requirements on a PCB layout system. The manual editing system must easily support component placement on both sides of the board, blind and buried vias, swapping between pin and SMT versions of a component, and insertion/editing of test points. Routers must be able to space traces on a much tighter grid or be gridless. Specialized CAM interfaces may be required, particularly in the case of proprietary SMT processes. Last but not least, the physical data base must be able to support SMT design without exceeding the memory capacity of the hardware.

Table 4.3-1

Percentage of Boards with ASICs and SMD

	% SMD	% ASICs
Aerospace	31%	23%
Automotive	26%	38%
Communications	26%	36%
Computer	33%	42%
Industrial	43%	38%
Semiconductor	15%	42%
Service Centers	15%	28%
Other	34%	41%
Total	26%	33%

Source: Dataquest
June 1987

ASIC Components

The next major shift in technology that will have an impact on PCB layout is ASIC. As Table 4.3-1 indicates, more than 33 percent of current designs include an ASIC component. Dataquest believes that designers will use ASICs to reduce the total component and board count of a system, rather than that of a given board. However, the number of large pin-count packages on a board, such as microprocessors or ASICs, will increase. In other words, the old view of a board, with rows of 64K DRAMs, TTL components, and an occasional microprocessor, is rapidly vanishing. Instead, the typical board of the future will have a few rows of 4-megabyte DRAMs, several off-the-shelf VLSI components, and a few ASICs.

This change in the profile of the typical board will have several effects. First, it will require enhancements to placement-and-routing tools to account efficiently for the increase in large pin-count packages on a board. In principle, this should be similar to the block placement-and-routing tools now found in IC layout systems. Second, mechanisms should be in place to make it simple and efficient for users to create special libraries for their ASIC components. For example, while the package may be the same as for other VLSI, the pin and component names vary from design to design, and must be assigned according to the semicustom vendor's bonding and naming conventions.

Design and Manufacturing Automation

The final major technology that must be factored into PCB layout system design is the automation of the electronic engineering process and manufacturing. Not only must PCB layout systems be closely integrated with other automation systems (e.g., shared logic and layout data bases), but the actual board layout tools must produce designs that fit the other systems' capabilities (e.g., board placements that are easily handled by pick-and-place robots).

At the integration level, the increasing use of automation in all aspects of electronics product design and manufacture necessitates close links between PCB layout and the other tools and systems employed. On the front end, a growing percentage of board designers uses some form of ECAE, such as schematic capture and simulation. Linkages between ECAE and PCB layout that are now required include netlist in, back-annotation to schematics and simulation, and engineering change capabilities (incremental netlist). On the back end, reliable and open CAM interfaces to a range of potential systems, including Gerber, photoplot, and drill hole, are an absolute requirement.

At the layout level, the increasing sophistication and complexity of the manufacturing process demands PCB layouts that are "manufacturable." It is no longer sufficient just to meet known design rules. The final layout should anticipate and accommodate problems such as optimal solder shapes, pick-and-place tools, SMD test, or preferred methods for etching traces. This implies that vendors should supply tools that analyze boards for manufacturability and enforce manufacturing rules during placement-and-routing, and special editors to improve a board's layout prior to manufacture.

Experienced, Established Users

The next major force that is stabilizing the PCB layout market and pushing it into maturity is an established, experienced user base. It is not at all surprising that PCB layout users, as one of the oldest EDA markets, should be among the most sophisticated and demanding of the user segments. Indeed, when Dataquest speaks of known technology requirements, it is because the users clearly understand the types of boards they will be building and the tools that will be required.

Dataquest believes that the PCB layout user base can be characterized by two major factors:

- Very high levels of penetration
- Productivity-driven needs and expectations

Taken together, these two factors describe a mature, replacement market rather than a growth market. Users already have a large investment in equipment and will replace it only if there is a decided advantage to doing so.

High Levels of Penetration

Dataquest believes that the level of penetration at existing PCB layout user sites is very high. Although there may be some additional sites created by new companies or organizations, the majority of the potential market has already made a sizable investment in PCB layout tools.

Figure 4.3-1 and Table 4.3-2 illustrate penetration and investment at existing user sites. The level of penetration, or number of workstations per user, for layout designers is 38 percent, and in some industry segments, as high as 37 to 55 percent. This translates into an average dollar investment per layout designer of \$285,000. Moreover, the dollar figures and numbers of tubes per engineer do not even begin to describe the investment that has been made in user training and library development, and embedded in existing designs. When this type of investment gets added to the dollars directly spent on CAD tools, the degree of customer commitment to current solutions may well exceed \$500,000 per designer.

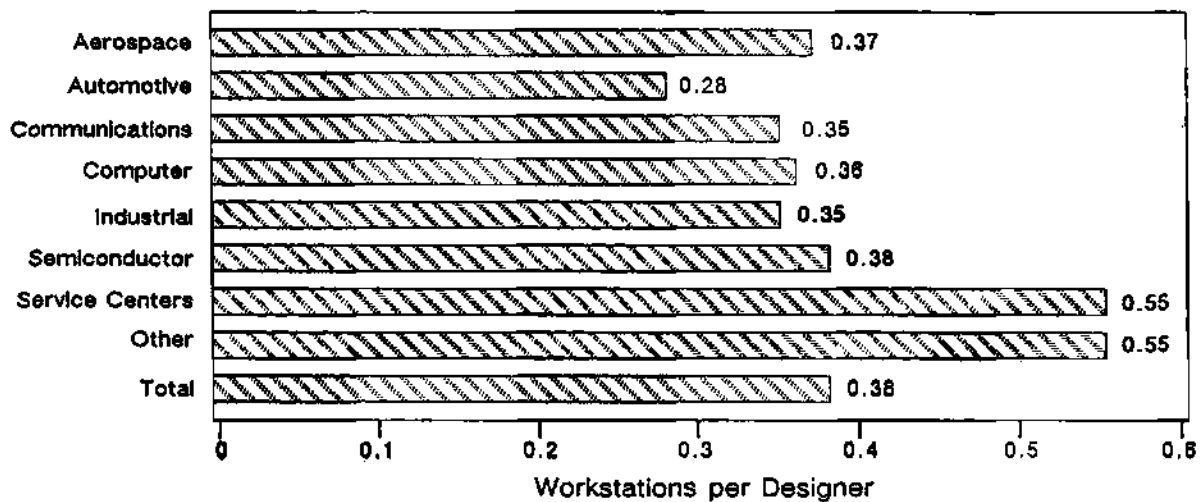
Given this high level of penetration and investment, the PCB layout market is in large measure a replacement market that will tend to favor existing suppliers, so long as they keep up with customer needs. In order to induce churn in the installed base, vendors must offer significant productivity or technical enhancements. This is doubly true for new vendors that wish to displace existing suppliers.

Productivity-Driven Needs

Within this installed base of PCB users, customer expectations and needs are fundamentally productivity driven. Customers are interested in tools that enable them to perform their layouts efficiently and quickly, provided the tools meet their technology requirements.

Figure 4.3-1

**PCB Layout
Designer Penetration**



Source: Dataquest
June 1987

Table 4.3-2

**Average Investment per Designer
(Thousands of Dollars)**

	Per Designer
Aerospace	\$ 281
Automotive	\$ 3
Communications	\$ 149
Computers	\$ 222
Industrial	\$ 736
Semiconductor	\$1,444
Service Bureau	\$ 133
Other	\$ 114
Total	\$ 285

Source: Dataquest
June 1987

Figures 4.3-2 and 4.3-3 illustrate current user attitudes toward physical layout systems. User likes were productivity-oriented factors: ease of use, performance, and automated routing. User dislikes are almost an exact mirror of the likes (or mirror and rotation): poor performance, bad automated routing, and difficulty of use. Users' satisfaction or dissatisfaction is hinged on how productive their tools actually are.

Accordingly, users' willingness to switch from their existing tools to another system will have to be productivity driven. Higher performance, better routing, and ease of use are all examples of key dimensions where new layout systems must outperform existing systems in order to win in the market.

Declining Prices and Slow Revenue Growth

The third major factor contributing to the maturity of the PCB layout market is the steady decline of prices and revenue growth. With the advent of technical workstation-based systems and the proliferation of low-cost but usable personal computer based-systems, the average price per seat has dropped significantly. This in turn has slowed the rate of revenue growth.

Figures 4.3-4 and 4.3-5 show the average price per seat revenue and total PCB layout revenue, respectively. As Figure 4.3-4 shows, the average price per seat has dropped by more than 50 percent from 1982 to 1986. Revenue, on the other hand, enjoyed a minor growth spurt in 1984, principally due to the personal computer and technical workstation, but has since slowed down considerably.

Dataquest forecasts that this trend of slowing revenue growth and declining prices will continue into the future. From 1986 to 1991, Dataquest is forecasting only a 7 percent CAGR from the current revenue base of \$651 million. In sum, the PCB layout market is not growing dynamically in terms of total revenue.

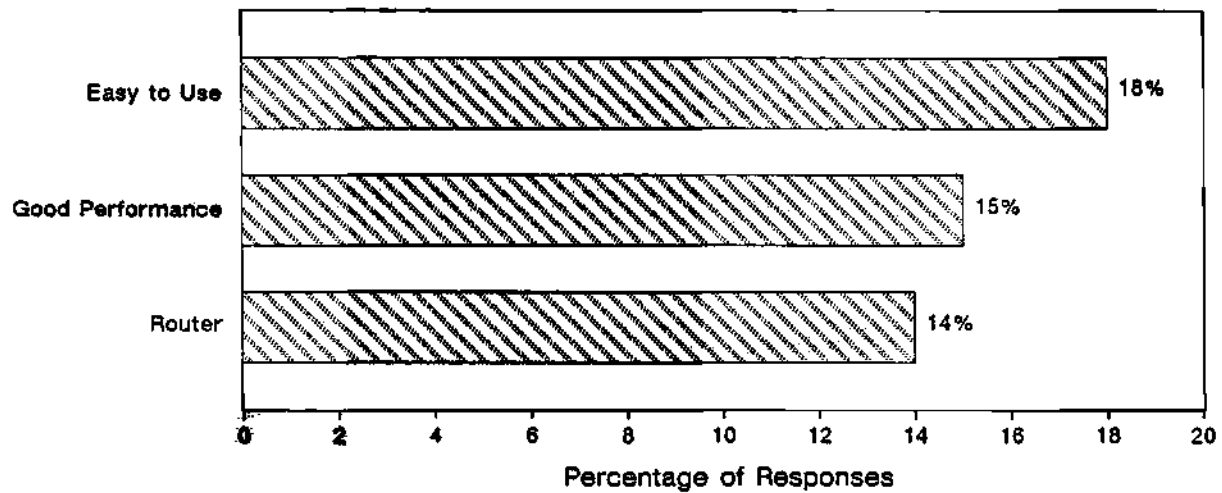
Limited Opportunities for New Entrants

As of this writing, there are over 75 suppliers of PCB layout systems, according to Dataquest's estimates. Of these companies, fewer than 10 actually make more than \$20 million directly from this segment. Finally, as was noted in the previous discussion, penetration of the total potential market is very high, the total market's size is not growing rapidly, and the demand for major technological innovations is not great.

Under these conditions, Dataquest believes that it would be very difficult for a new entrant to establish itself and gain market share. Even the vendors that came into the market two years ago, such as Daisy and Mentor, have found it to be fairly slow going, as their products have had to mature enough to be competitive.

Figure 4.3-2

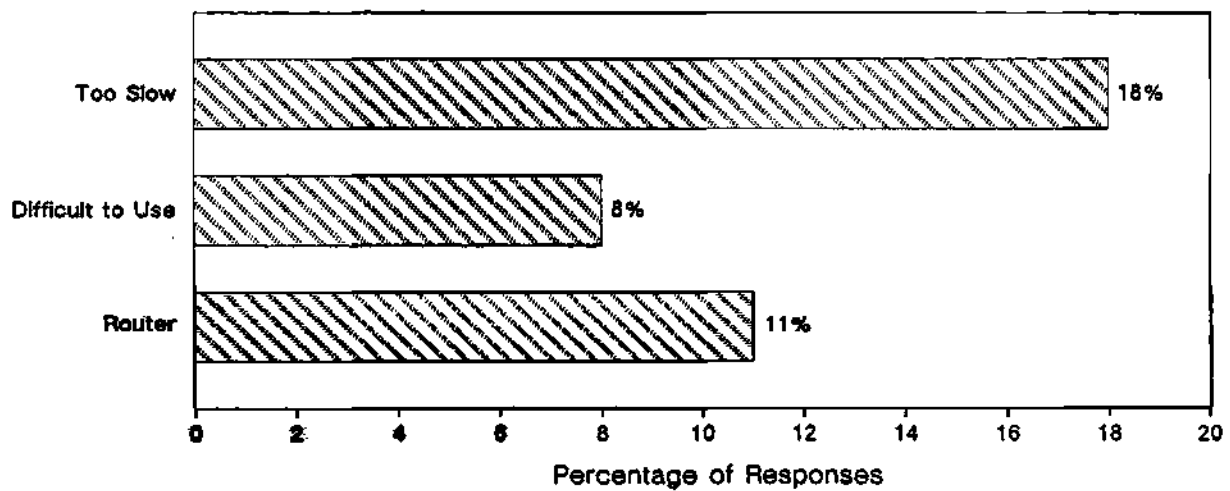
Physical Layout Likes



Source: Dataquest
June 1987

Figure 4.3-3

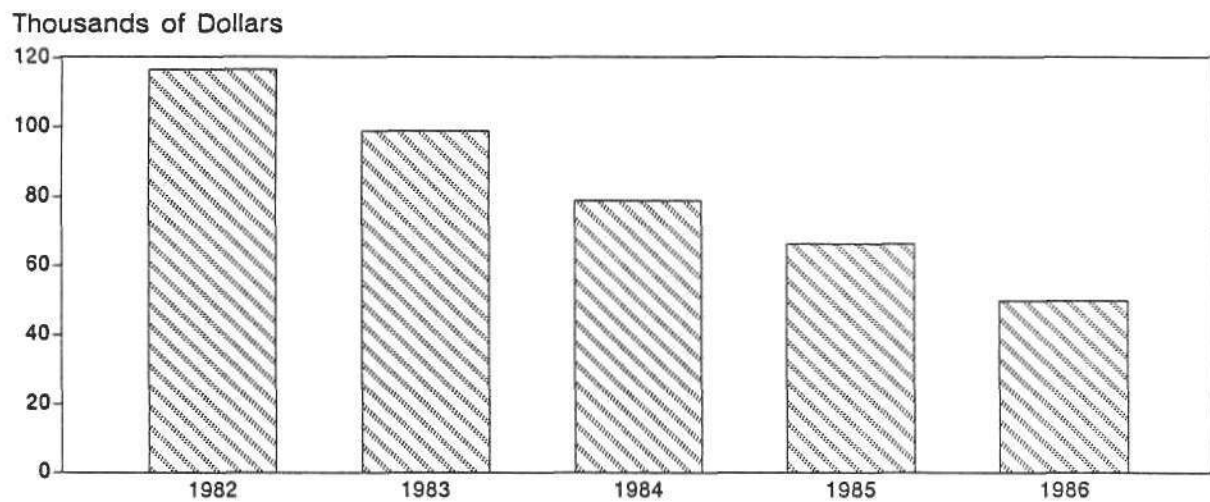
Physical Layout Dislikes



Source: Dataquest
June 1987

Figure 4.3-4

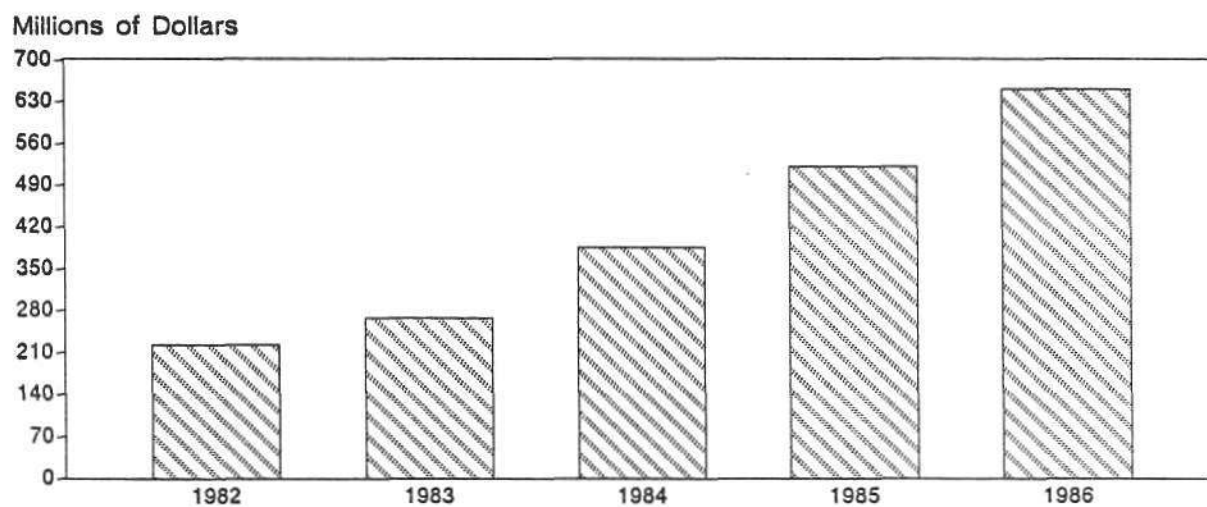
PCB Layout
Average Price per Seat



Source: Dataquest
June 1987

Figure 4.3-5

Physical Layout Revenue



Source: Dataquest
June 1987

The more likely scenario is that the suppliers that are already established will dominate the market in its maturing years. Younger entrants, like Cadnetix, Daisy, and Mentor, will compete with older organizations, such as Computervision, Racal-Redac, and Scientific Calculations, for market share. On the one hand, the older companies may be able to tap customer loyalty in their installed bases to protect their market share. Newer companies, on the other hand, may be able to offer some performance or technology advantage to gain share.

In either case, all the present suppliers will find operation in a mature market to be very competitive. While it is not a zero-sum game (i.e., a market where one company gains only at another's expense), it does not have the expansive growth to allow all participants to increase their revenue. In a mature market, revenue gains and profitability are rare commodities.

PRODUCT OPPORTUNITIES

Mature markets generally do not lend themselves to major product opportunities, though this is not to say that opportunities do not exist. While in the main, the rule for PCB layout is "back to basics," there are continuing needs for new tools that provide additional productivity gains.

As is the case in the EDA market at large, Dataquest segments PCB layout opportunities into full-line and niche products. Full-line products are complete PCB layout stations. Niche products are specialized tools that are usually provided by smaller companies that sell that class of product exclusively, or, in some cases, by the complete station companies.

Full-Line Product Opportunities

For suppliers of complete PCB design stations, the major opportunity is to deliver the products that were originally promised, and deliver them in working order. As was noted before, the technology needs of the PCB market are well defined. The primary task for companies that want to participate in this market is to deliver the tools, market and sell them, and provide strong service and support.

Nonetheless, certain areas of product development merit special consideration for full-line suppliers. Two primary areas of note are integration and manufacturing. Integration products include data base management tools, user interfaces, and design management tools that enable users to tailor a PCB layout station to their own needs. This could involve adding a specialized router or analysis package, or creating special CAM links. Manufacturing products are specialized stations that help transfer designs from the layout department to the manufacturing organizations. This could involve specialized editors or additional CPU power to perform post-processing tasks. However, even integration and manufacturing product opportunities are really only extensions of the current generation of PCB design tools.

Niche Opportunities

Outside of the mainstream PCB design stations, several exciting areas for product development are now emerging. Two major areas are layout analysis and next-generation automatic placement-and-routing.

In the area of analysis, users are very interested in packages that help them evaluate their boards prior to release to manufacturing. Types of analysis that are currently being explored include: thermal (heat distribution), manufacturability (fit with robot requirements), electromagnetic (cross talk, noise, and ringing), and reliability (probability of component failure). All these types of analysis can help the user determine the viability of his or her board before it actually goes into field testing.

In the area of automatic placement-and-routing, there is constant room for improvement. Today's measure of routing quality is level of completion. However, completion rates only start to measure the quality of a route in terms of overall board or individual net performance. Users' lack of satisfaction with their current routers suggests there is ample room for improvement. The realm of PCB placement holds equal potential, particularly in the area of rule-based placement. Most automatic placement algorithms today optimize only wire length. Not only is total wire length a poor measure of routability, but optimizing wire length may also result in a board that cannot be manufactured. Next-generation placers that anticipate the thermal and electromagnetic characteristics, manufacturability, and reliability of a board represent another opportunity in the market.

HARDWARE PLATFORMS

Developments in hardware platforms have contributed significantly to the evolution of the PCB layout market. The advent of personal computers and technical workstations reduced the average price of a system significantly, but may also have set in motion permanent price erosion in the the value of PCB layout applications.

Dataquest believes that the technical workstation will be the platform of choice for PCB layout over the long term. Technical workstations have the performance at the graphics and processing level to meet the major needs of most users. Given current trends in terms of price and performance, technical workstations are likely to retain these advantages for some time to come.

Personal computers will still be important in terms of total unit sales, but due to limits in terms of memory management (e.g., 16-bit and segmented memory), customers will tend to switch to low-cost technical workstations. As data base complexity rises, the personal computer's limitations will become increasingly apparent. Complicated SMD boards and next-generation placement-and-routing will require 32-bit processing capabilities.

The host computer will remain an important part of the PCB layout environment. CPU-intensive tasks such as post-processing, routing, and network services (such as archival printing and plotting) will all be deferred to the host. However, the host's role as an editing station may indeed have come to an end.

Dataquest believes that special-purpose hardware such as routing accelerators will remain very important in the near term. Routing nodes clearly have a price/performance edge over host-based systems. However, in the long term, high-performance workstations with 10- to 20-mip processing capability may displace special-purpose hardware. While it is possible to imagine that accelerators will also improve in performance, the general-purpose functionality of a high-performance workstation should make it very attractive to the typical user.

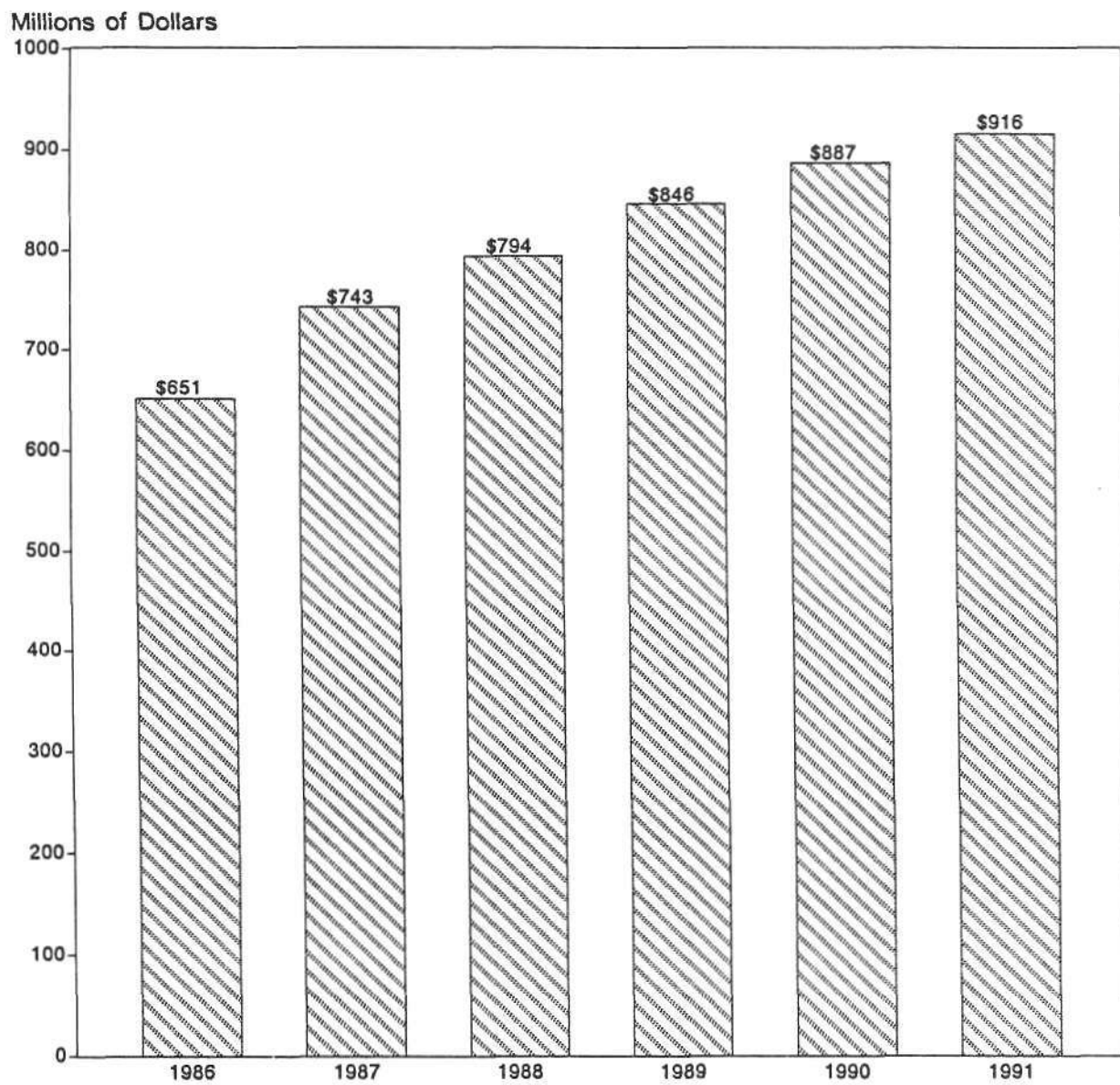
4.4 PCB Layout Forecasts

These bullets present Dataquest's forecast and analysis for the total PCB layout market for all regions and platforms. This section contains Figures 4.4-1 and 4.4-2 and Table 4.4-1.

- The PCB layout market was an estimated \$651 million in 1986 and is forecast to grow to \$916 million in 1991, a 7.1 percent CAGR.
- Dataquest forecasts that the market will grow to \$743 million in 1987, a growth rate of only 14.0 percent.
- Workstation shipments in 1986 were 10,569, and are forecast to grow to 13,200 in 1987, an increase of 25.0 percent. The CAGR through 1991 is expected to be 11.5 percent, with shipments rising to 17,100.

Figure 4.4-1

PCB Layout Worldwide Forecast
Revenue



Source: Dataquest
June 1987

Figure 4.4-2

PCB Layout Worldwide Forecast Shipments

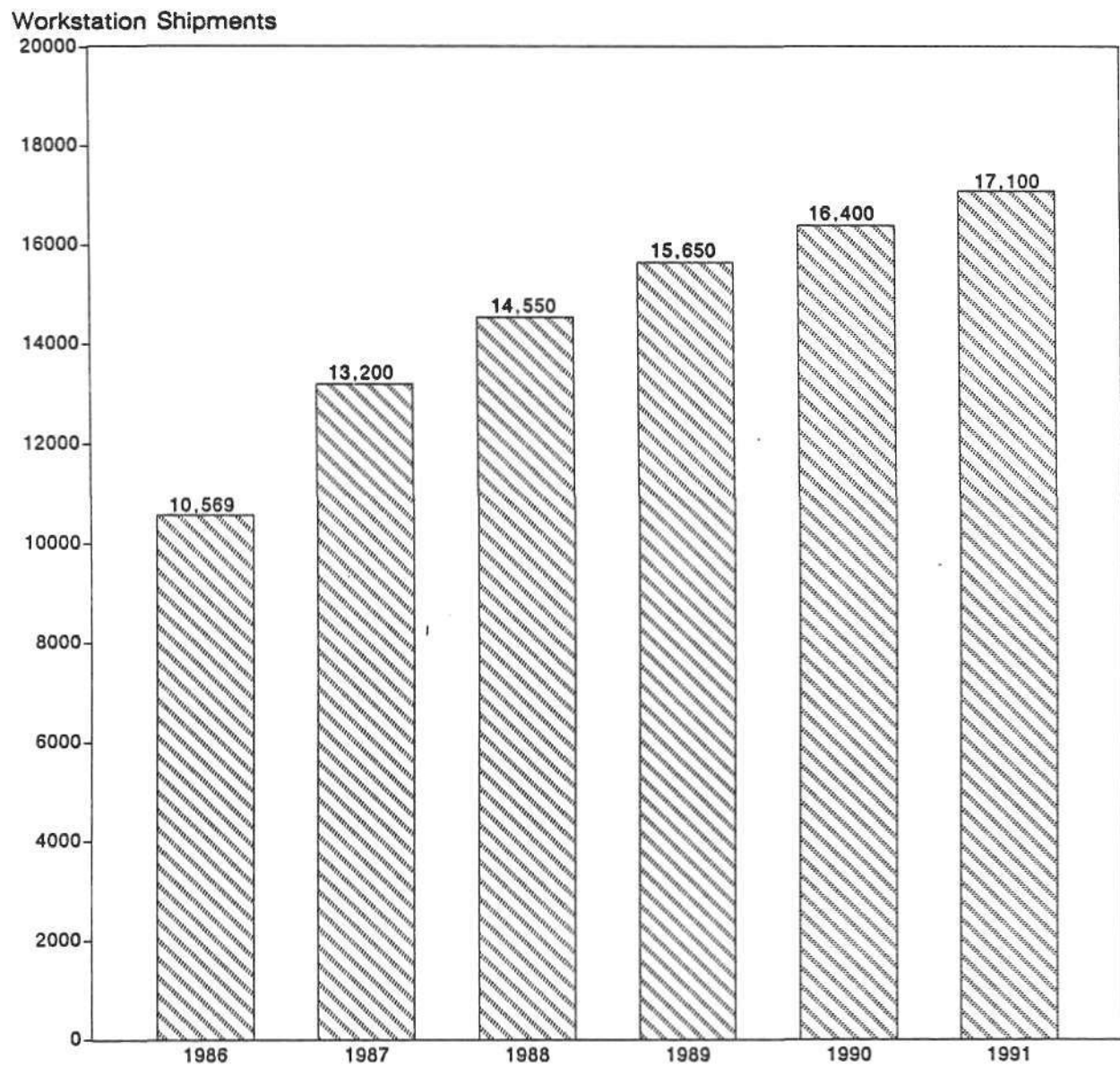
Source: Dataquest
June 1987

Table 4.4-1

**PCB Layout Worldwide Forecast
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	651	743	794	846	887	916	7.1%
Systems	9,437	12,000	13,450	14,650	15,450	16,250	11.5%
Workstations	10,569	13,200	14,550	15,650	16,400	17,100	10.1%

Source: Dataquest
June 1987

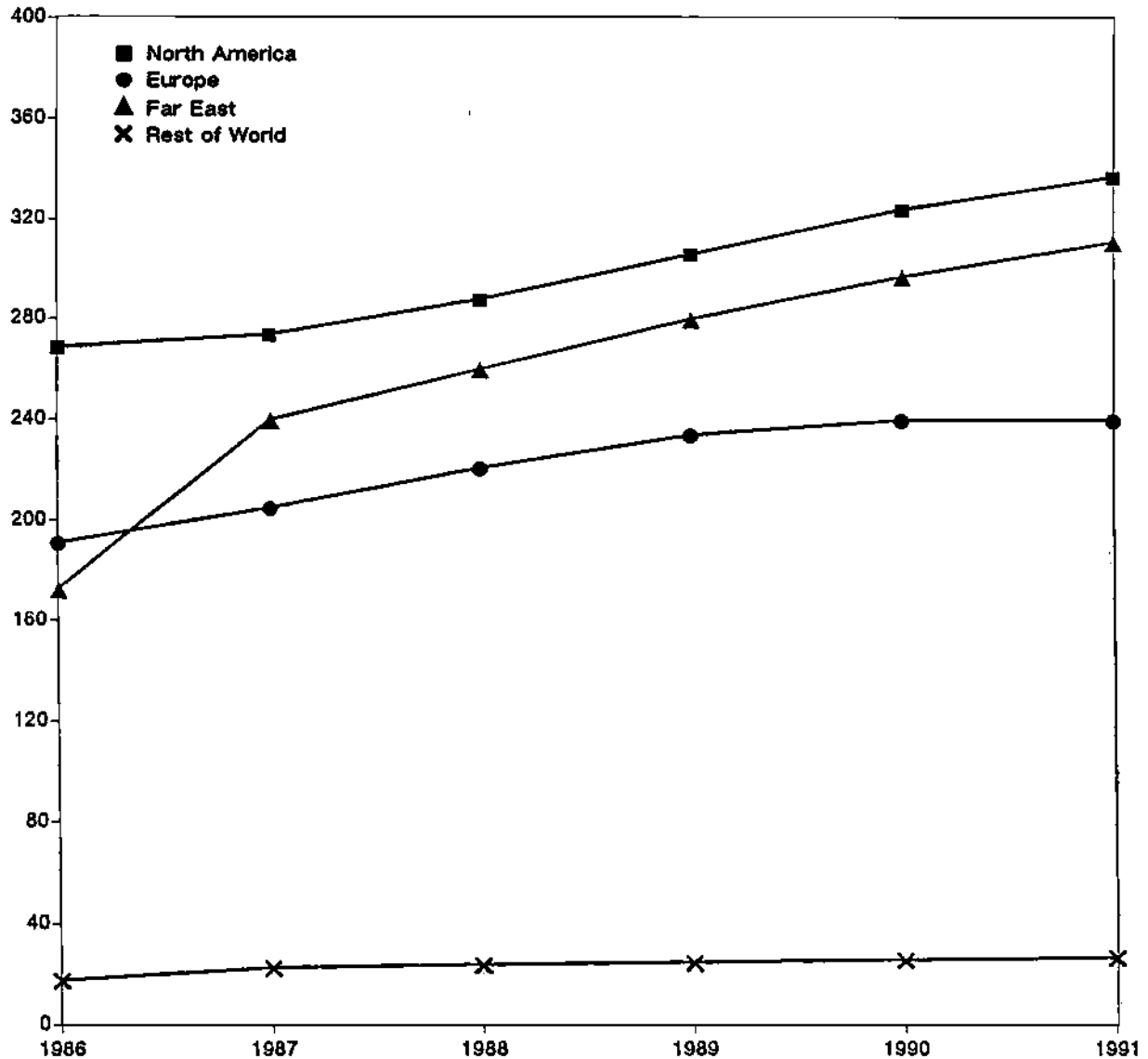
These bullets present Dataquest's forecast and analysis for the total PCB layout market segmented by regions. This section contains Figures 4.4-3 and 4.4-4 and Tables 4.4-2 and 4.4-3.

- North American revenue was \$269 million and is expected to have a CAGR of only 4.6 percent, increasing to \$337 million in 1991, the slowest growth rate for any region.
- North American revenue is forecast to grow to \$274 million in 1987, an increase of only 2.0 percent.
- North America represents 41.0 percent of the PCB market but will decline to 37.0 percent as a result of its relatively slow growth.
- In 1986, the European revenue of \$191 million was 29.0 percent of the total worldwide revenue. It is forecast to increase at a 4.7 percent CAGR to \$240 million in 1991, representing 26.0 percent of the total market.
- Dataquest forecasts that European revenue will rise 7.0 percent in 1987 to \$205 million, continuing the strong growth it experienced in 1986.
- Dataquest expects the Far East to be one of the two strongest growth markets. Revenue in 1986 was \$173 million, 27.0 percent of the worldwide total, and is expected to rise to \$311 million in 1991, a 12.5 percent CAGR and 34.0 percent of the worldwide total. In 1987, revenue is expected to grow 39.0 percent.
- ROW accounted for 3.0 percent of total revenue at \$18 million, but it is expected to have a relatively healthy CAGR of 8.5 percent through 1991.
- Dataquest believes that as the Far East and European markets rise as a percent of the total market and the United States declines, PCB vendors will have to adopt a balanced sales strategy and also meet the buying criteria of an international customer base. Corporate stability, reputation, service, and support are as important as product content.

Figure 4.4-3

PCB Layout Regional Forecast
Revenue

Millions of Dollars

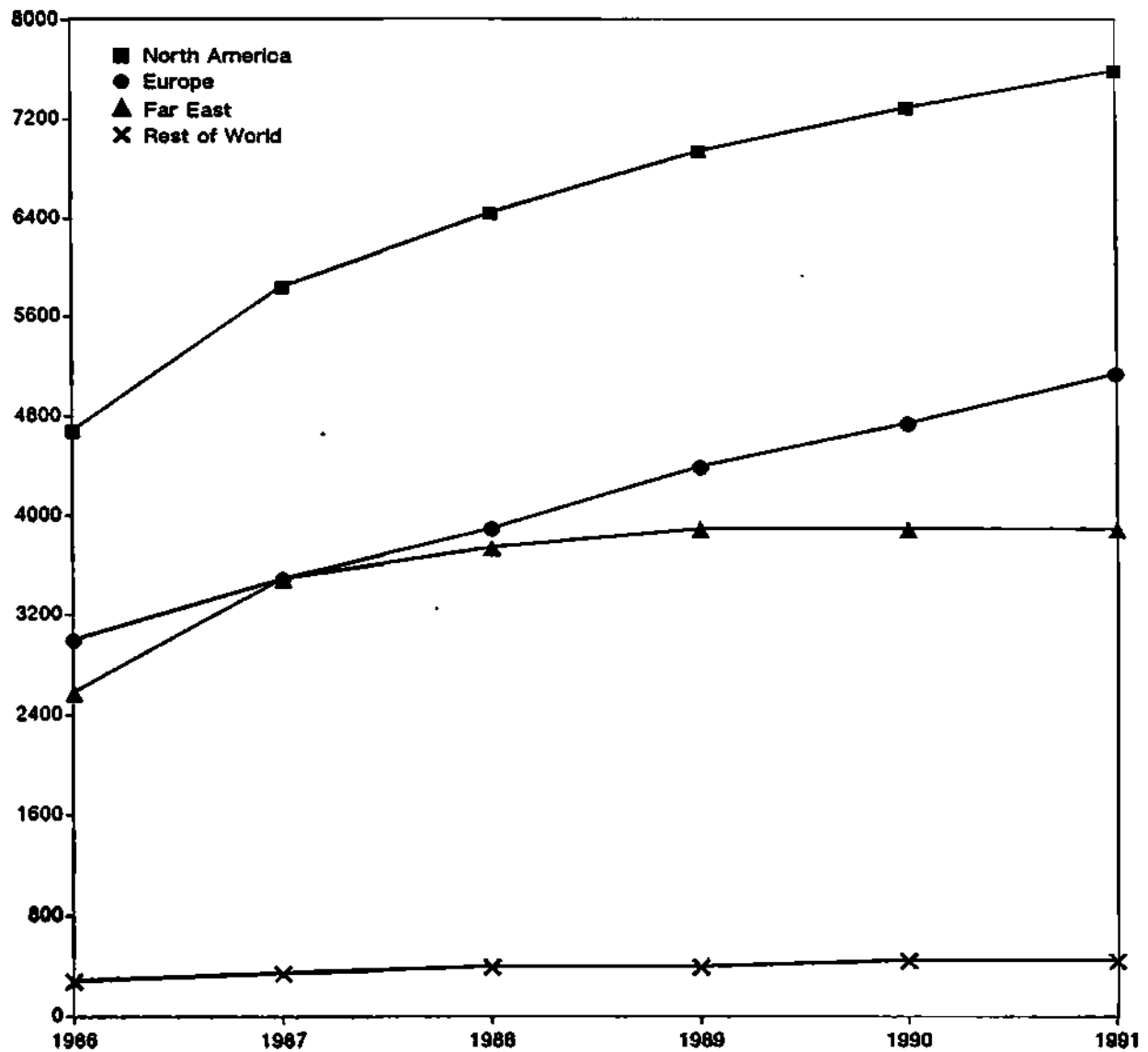


Source: Dataquest
June 1987

Figure 4.4-4

PCB Layout Regional Forecast
Shipments

Workstation Shipments

Source: Dataquest
June 1987

4.4 PCB Layout Forecasts

Table 4.4-2

PCB Layout Regional Forecast (Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
Total Market							
Revenue	651	743	794	846	887	916	7.1%
Systems	9,437	12,000	13,450	14,650	15,450	16,250	11.5%
Workstations	10,569	13,200	14,550	15,650	16,400	17,100	10.1%
North America							
Revenue	269	274	288	306	324	337	4.6%
Systems	4,324	5,550	6,200	6,750	7,100	7,450	11.5%
Workstations	4,694	5,850	6,450	6,950	7,300	7,600	10.1%
Europe							
Revenue	191	205	221	234	240	240	4.7%
Systems	2,773	3,300	3,750	4,250	4,650	5,050	12.7%
Workstations	3,001	3,500	3,900	4,400	4,750	5,150	11.4%
Far East							
Revenue	173	240	260	280	297	311	12.5%
Systems	2,062	2,800	3,050	3,200	3,250	3,300	9.9%
Workstations	2,586	3,500	3,750	3,900	3,900	3,900	8.6%
Rest of World							
Revenue	18	23	24	25	26	27	8.5%
Systems	278	350	400	400	400	450	10.1%
Workstations	288	350	400	400	450	450	9.3%

Source: Dataquest
June 1987

Table 4.4-3

**PCB Layout Regional Forecast
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	=====	=====	=====	=====	=====	=====
North America						
Revenue	41%	37%	36%	36%	36%	37%
Systems	46%	46%	46%	46%	46%	46%
Workstations	44%	44%	44%	44%	45%	44%
Europe						
Revenue	29%	28%	28%	28%	27%	26%
Systems	29%	28%	28%	29%	30%	31%
Workstations	28%	27%	27%	28%	29%	30%
Far East						
Revenue	27%	32%	33%	33%	34%	34%
Systems	22%	23%	23%	22%	21%	20%
Workstations	24%	27%	26%	25%	24%	23%
Rest of World						
Revenue	3%	3%	3%	3%	3%	3%
Systems	3%	3%	3%	3%	3%	3%
Workstations	3%	3%	3%	3%	3%	3%

Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis for the total PCB layout market segmented by platform. This section contains Figures 4.4-5 and 4.4-6 and Table 4.4-4 and 4.4-5.

- In 1986, workstation shipments were 10,569 units and are forecast to increase to 17,100 units in 1991, a 10.1 percent CAGR.
- Technical workstation shipments were 3,637 units, representing 34.0 percent of total unit shipments. However, technical workstation revenue was \$286 million, representing 44.0 percent of the total PCB market.
- Technical workstation revenue and shipments are expected to have the highest growth rates for all platform types. Unit shipments are forecast have a 21.0 percent CAGR, to 9,450 units in 1991. Revenue is expected to have a 13.8 percent CAGR, to \$546 million in 1991. That year, technical workstations will represent 60.0 percent of total revenue and 55.0 percent of total shipments.
- Host-dependent workstation shipments were 1,978 units, representing 19.0 percent of total unit shipments. However, host-dependent revenue was \$289 million, representing 44.0 percent of the total PCB layout market.
- Host-dependent revenue and shipments are expected to have the slowest growth rates for all platform types. Unit shipments are forecast to decline at a negative CAGR of 3.0 percent, to 1,700 units in 1991. Revenue is also expected to decline at a negative CAGR of 1.0 percent, to \$273 million in 1991. Host-dependent systems in 1991 will represent 30.0 percent of total revenue and 10.0 percent of total shipments.
- Personal computer shipments were 4,954 units, representing 47.0 percent of total workstation shipments. Revenue was only \$76 million, representing 12.0 percent of the total PCB layout market.
- Technical workstation revenue and shipments are expected to have moderate growth rates. Unit shipments are forecast to have a 21.0 percent CAGR, to 9,450 units in 1991. Revenue is expected to have a 13.8 percent CAGR, to \$546 million in 1991. That year, technical workstations will represent 60.0 percent of total revenue and 55.0 percent of total shipments.
- Dataquest believes that this shift toward the technical workstation and away from the personal computer and host-dependent systems reflects the following major trends:
 - The increasing CPU power of the technical workstation
 - The demand for 32-bit applications over 16-bit tools
 - The declining price of technical workstations

Taken together, these factors tend to limit personal computers to documentation and design entry tasks, and host-dependent systems to network server roles.

Figure 4.4-5

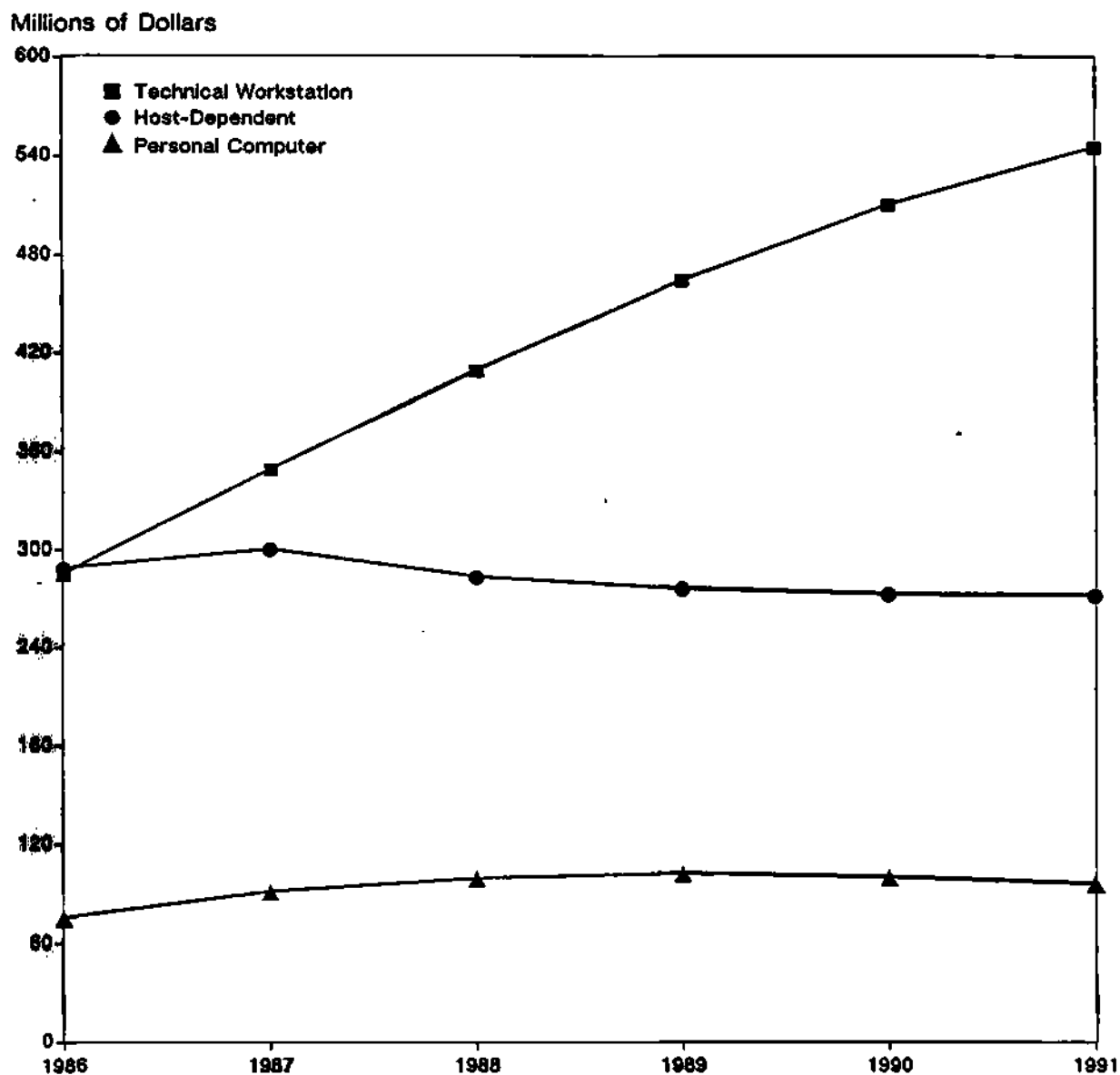
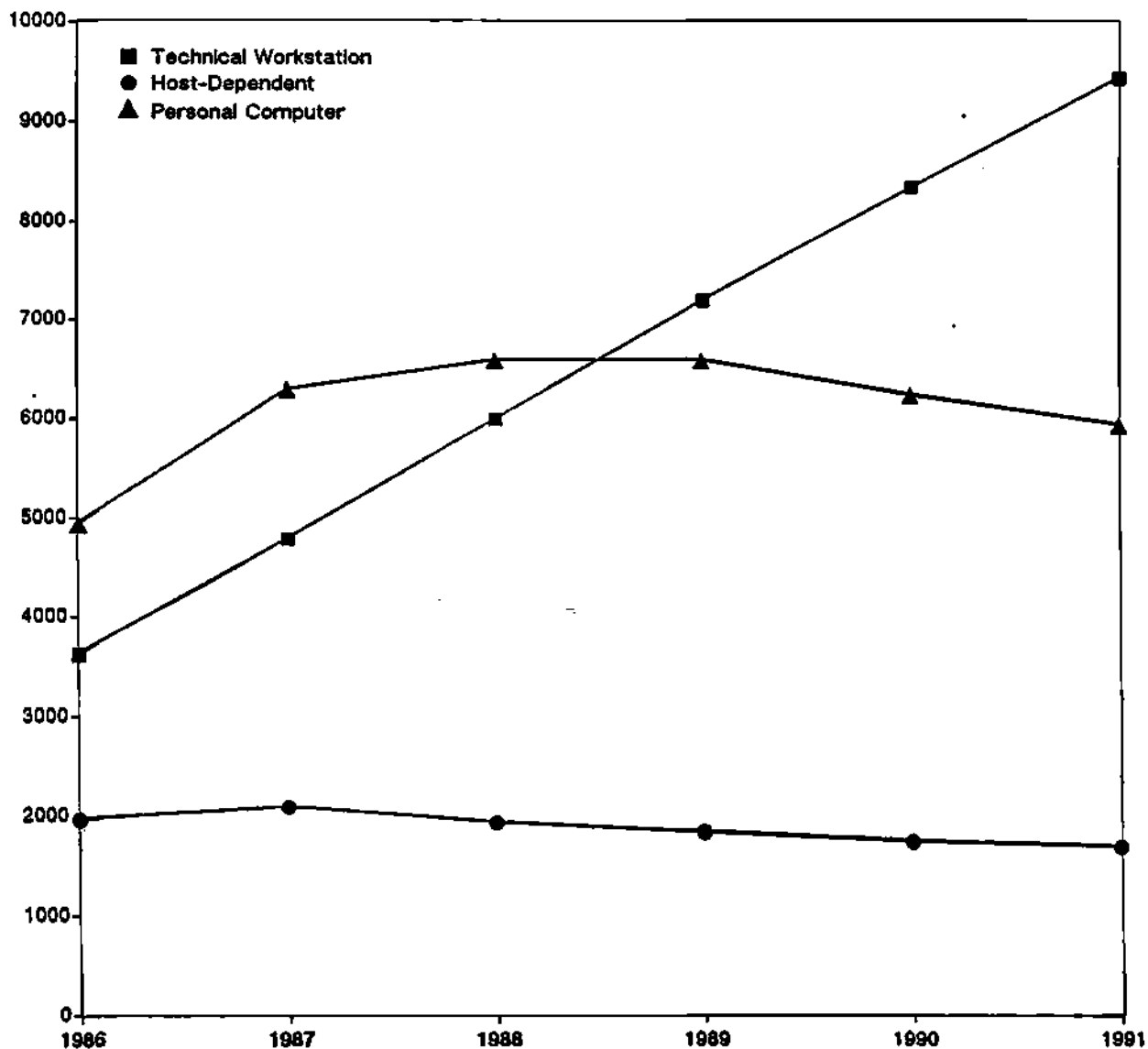
PCB Layout Worldwide Forecast by Platform
RevenueSource: Dataquest
June 1987

Figure 4.4-6

PCB Layout Worldwide Forecast by Platform Shipments

Workstation Shipments



Source: Dataquest
June 1987

Table 4.4-4

PCB Layout Worldwide Forecast by Platform
(Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	=====	=====	=====	=====	=====	=====	=====
Total Market							
Revenue	651	743	794	846	887	916	7.1%
Systems	9,437	12,000	13,450	14,650	15,450	16,250	11.5%
Workstations	10,569	13,200	14,550	15,650	16,400	17,100	10.1%
Technical Workstation							
Revenue	286	350	410	465	511	546	13.8%
Systems	3,637	4,800	6,000	7,200	8,350	9,450	21.0%
Workstations	3,637	4,800	6,000	7,200	8,350	9,450	21.0%
Host-Dependent							
Revenue	289	301	284	277	274	273	-1.2%
Systems	845	850	850	850	850	850	.1%
Workstations	1,978	2,100	1,950	1,850	1,750	1,700	-3.0%
Personal Computer							
Revenue	76	92	100	103	101	97	5.1%
Systems	4,954	6,300	6,600	6,600	6,250	5,950	3.7%
Workstations	4,954	6,300	6,600	6,600	6,250	5,950	3.7%

Source: Dataquest
June 1987

Table 4.4-5

**PCB Layout Worldwide Forecast by Platform
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
Technical Workstation						
Revenue	44%	47%	52%	55%	58%	60%
Systems	39%	40%	45%	49%	54%	58%
Workstations	34%	36%	41%	46%	51%	55%
Host-Dependent						
Revenue	44%	40%	36%	33%	31%	30%
Systems	9%	7%	6%	6%	6%	5%
Workstations	19%	16%	13%	12%	11%	10%
Personal Computer						
Revenue	12%	12%	13%	12%	11%	11%
Systems	52%	53%	49%	45%	40%	37%
Workstations	47%	48%	45%	42%	38%	35%

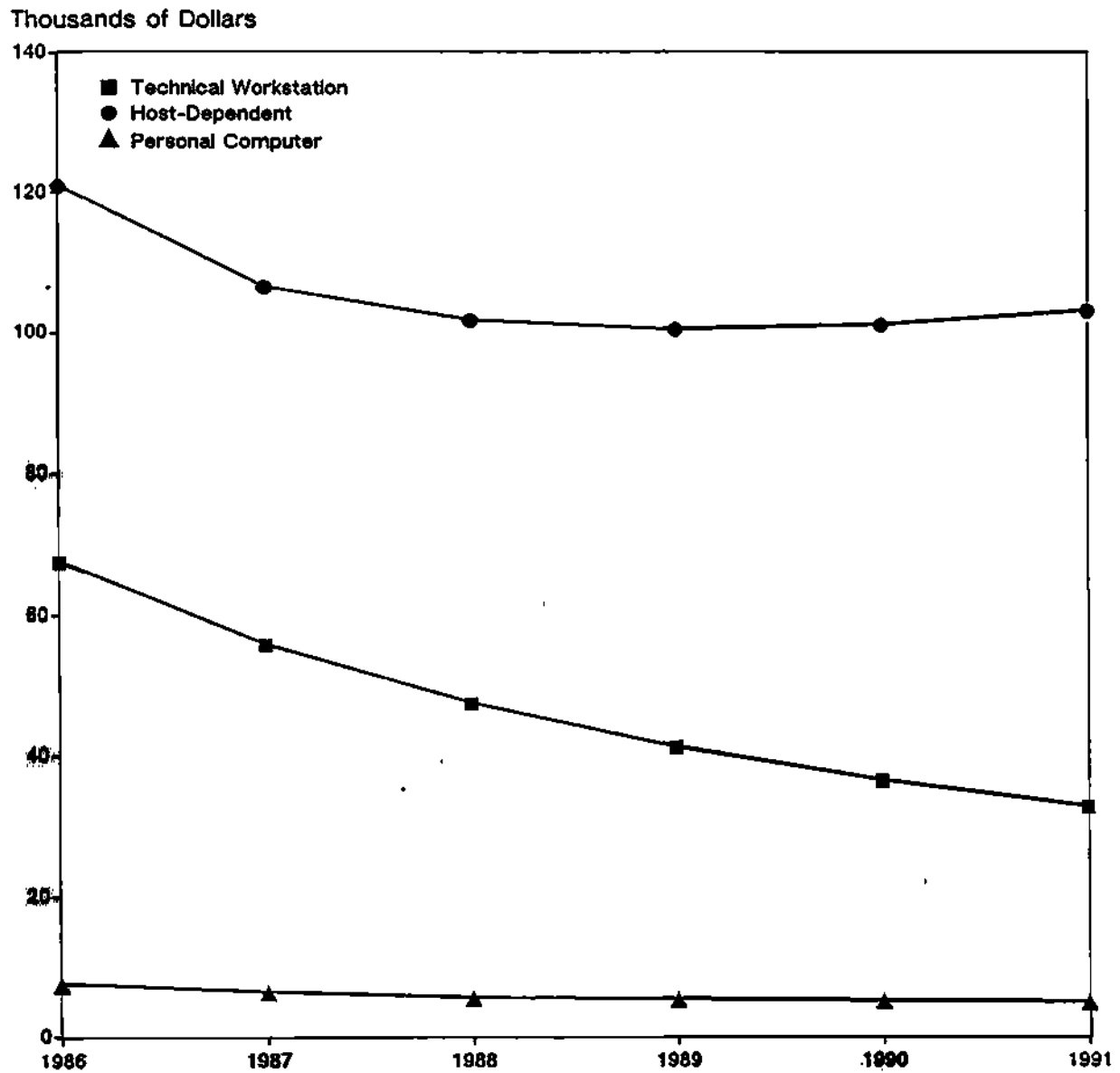
Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis for the average price per seat by platform for the PCB layout market. This section contains Figure 4.4-7 and Table 4.4-6.

- For all PCB layout product types worldwide, the average price per seat (APPS) was \$49,600 in 1986. It is forecast to decline at a negative CAGR of 9.4 percent, to \$30,300 in 1991. In 1987, the APPS is expected to be \$40,300, a decrease of 19.0 percent.
- The technical workstation APPS was \$67,700 in 1986. It is forecast to have the sharpest decline, at a negative CAGR of 13.4 percent, to \$33,000 in 1991. In 1987, the APPS is expected to be \$56,000, a decrease of 17.0 percent.
- The host-dependent APPS was \$121,200 in 1986. It is forecast to decline steadily at a negative CAGR of 3.1 percent, to \$103,300 in 1991. In 1987, the APPS is expected to be \$106,700, a decrease of 12.0 percent.
- Personal computer APPS was \$7,700 in 1986 and is forecast to decline at a negative CAGR of 7.9 percent, to \$5,100 in 1991. The APPS in 1987 is expected to be \$6,500.
- Dataquest believes that these price declines will be driven by steady price erosion in both hardware and software. Basic applications such as manual editing have already dropped below the \$1,000 price point, and, given fixed functionality, prices can only continue to fall. Prices can be held upward only by increases in product functionality or performance.

Figure 4.4-7

PCB Layout Worldwide Average Price per Seat by Platform



Source: Dataquest
June 1987

Table 4.4-6

**PCB Layout Worldwide Average Price per Seat by Platform
(Thousands of Dollars)**

	1986	1987	1988	1989	1990	1991	CAGR
	----	----	----	----	----	----	----
All Product Types	49.6	40.3	36.0	33.3	31.6	30.3	-9.4%
Technical Workstation	67.7	56.0	47.6	41.4	36.7	33.0	-13.4%
Host-Dependent	121.2	106.7	101.9	100.6	101.3	103.3	-3.1%
Personal Computer	7.7	6.5	5.8	5.5	5.3	5.1	-7.9%

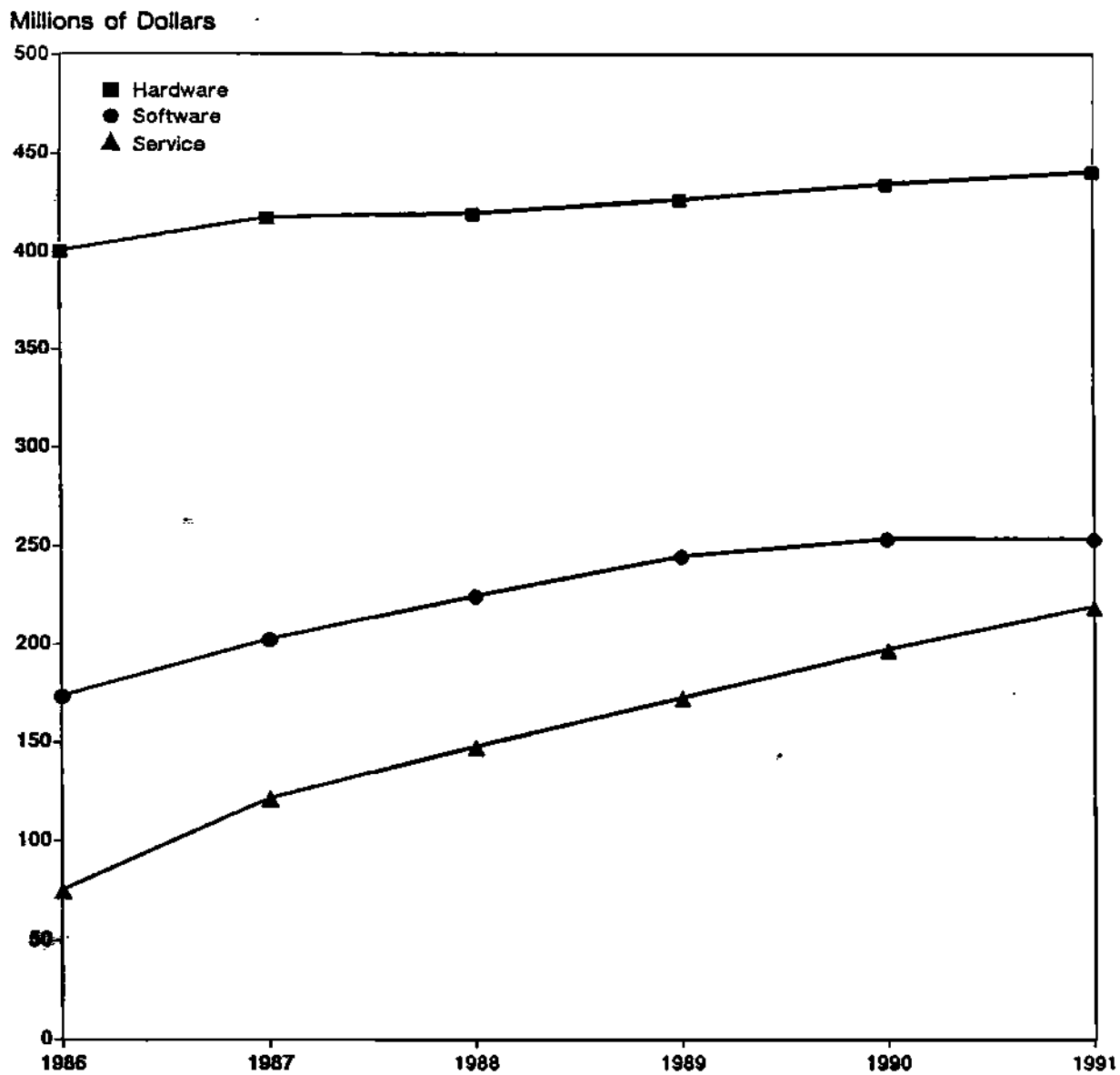
Source: Dataquest
June 1987

These bullets present Dataquest's forecast and analysis for the total PCB layout market segmented by revenue source for each platform. This section contains Figure 4.4-8 and Tables 4.4-7 and 4.4-8.

- Hardware revenue was approximately \$401 million in 1986, or roughly 62.0 percent of the total PCB revenue. Hardware revenue overall will have a CAGR of only 1.9 percent through 1991. This will amount to \$441 million, or only 48.0 percent of the total 1991 revenue.
- Software and service revenue is forecast to have the strongest growth. In 1986, revenue for software and service was \$174 million and \$76 million, respectively. Software revenue is expected to have a 7.9 percent CAGR, to \$254 million in 1991, while service revenue will have a 23.8 percent CAGR, to \$220 million.
- Dataquest believes that the growth of service and software revenue reflect the steady maturation of the PCB market. Not only are hardware prices falling, but large installed customer bases also require increasing levels of support, training, and service. Moreover, as penetration increases, the demand for more hardware declines, while the demand to add more software to the same system starts to rise.

Figure 4.4-8

PCB Layout Revenue Sources—Worldwide



Source: Dataquest
June 1987

Table 4.4-7

**PCB Layout Revenue Sources by Platform—Worldwide
(Millions of Dollars)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
All Platforms							
Hardware	401	418	420	427	435	441	1.9%
Software	174	203	226	245	254	254	7.9%
Service	76	122	148	173	198	220	23.8%
Total	651	743	794	846	887	916	7.1%
Technical Workstation							
Hardware	168	192	212	229	243	254	8.5%
Software	85	99	117	135	147	152	12.2%
Service	33	59	80	101	121	141	33.9%
Total	286	350	410	465	511	546	13.8%
Host-Dependent							
Hardware	201	190	172	164	160	158	-4.6%
Software	50	51	48	46	43	41	-3.8%
Service	38	60	64	68	71	73	13.9%
Total	289	301	284	277	274	273	-1.2%
Personal Computer							
Hardware	32	36	35	34	32	30	-1.5%
Software	39	53	61	64	64	61	9.4%
Service	5	3	4	5	5	6	4.6%
Total	76	92	100	103	101	97	5.1%

Source: Dataquest
June 1987

Table 4.4-8

**PCB Layout Revenue Sources by Platform—Worldwide
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
All Platforms						
Hardware	62%	56%	53%	51%	49%	48%
Software	27%	27%	29%	29%	29%	28%
Service	12%	16%	19%	20%	22%	24%
Total	100%	100%	100%	100%	100%	100%
Technical Workstation						
Hardware	59%	55%	52%	49%	48%	46%
Software	30%	28%	29%	29%	29%	28%
Service	11%	17%	19%	22%	24%	26%
Total	100%	100%	100%	100%	100%	100%
Host-Dependent						
Hardware	69%	63%	61%	59%	58%	58%
Software	17%	17%	17%	16%	16%	15%
Service	13%	20%	23%	24%	26%	27%
Total	100%	100%	100%	100%	100%	100%
Personal Computer						
Hardware	42%	39%	35%	33%	31%	31%
Software	52%	58%	61%	63%	63%	63%
Service	6%	3%	4%	4%	5%	6%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest
June 1987

4.5 PCB Layout Market Shares

These bullets present Dataquest's analysis of the PCB layout market share measured in total revenue, hardware and software revenue, and workstation shipments. This section contains Figures 4.5-1 through 4.5-4 and Table 4.5-1.

- **Racal-Redac is the PCB layout market leader for both total and software revenue. Its total revenue was \$58 million, or 8.9 percent of the market, and its software revenue was 24 million, or 13.7 percent of the market. The company ranked third in hardware revenue. Dataquest attributes Racal-Redac's position to four major factors:**
 - An early commitment to the Apollo workstation and the PC
 - A large installed base of customers
 - A commitment to keeping pace with technology
 - The heavy international component of the company's business
- **Digital Equipment is the PCB layout market hardware revenue leader at \$46 million, or an 11.3 percent market share. This makes the company the second largest PCB layout vendor, with a 7.9 percent market share. Dataquest attributes Digital's market position to its continued leadership in engineering computing. The VAX 8000 series and the MicroVAX II systems provide it with a strong price/performance range that is well networked and integrated.**
- **Scientific Calculations' \$147 million in revenue gives it the rank of third in total revenue, with a 7.1 percent market share. It is the second largest software supplier, with \$14 million in revenue and a 7.9 percent market share. Like Racal-Redac, Scientific Calculations is an established player in PCB layout and has a large installed base of customers. The company was recently acquired by Harris Corporation, although this has not resulted in any immediate changes in strategic direction.**
- **IBM was the leader in total unit shipments in 1986, with approximately 3,745 workstations shipped. However, the majority of these systems were personal computers. Overall, IBM was the fourth largest PCB layout supplier, with \$43 million in revenue and a 6.6 percent market share. The majority of this revenue was in the hardware category, where IBM was ranked second, with an 8.6 percent market share. Although IBM plays an important role in PCB layout and clearly represents a significant number of seats in the field, Dataquest believes that personal computer clones are reducing IBM's revenue and market share.**
- **Another traditional CAD player, Computervision, ranked fifth in overall market share at 5.3 percent and \$35 million in revenue. Again, Computervision is an established player in the market, with technologically competitive products and a large installed base of users.**

4.5 PCB Layout Market Shares

- It is important to note that two of the top five EDA suppliers were, in fact, hardware suppliers, indicating that direct sales by computer manufacturers to EDA end users are a significant part of this market. The three application vendors in the top five, Racal-Redac, Scientific Calculations, and Computervision, have their major EDA base in the PCB layout market.
- The next five major vendors in the PCB layout market, with the exception of HP, were all primarily application suppliers. In addition, four of the five were established players. Only Cadnetix is a relative newcomer in the market.
 - Calay is number six in the market. Calay, which markets exclusively in the PCB layout area, has recently undergone management and ownership changes.
 - Hewlett-Packard is number seven. PCB layout is HP's strongest segment in the EDA market, primarily because of its strong application set in this area.
 - Zuken is number eight, and the first Japanese company to make the list. While Zuken's position is partly attributable to yen appreciation, the company is the leader in the Far East PCB layout market.
 - Cadnetix, the number nine company, is the youngest member of the top ten and has the fastest software revenue growth rate of any of these companies. Cadnetix, with a very strong set of applications, is the leader in routing acceleration.
 - Sharp System Products, another Japanese company, is ranked tenth worldwide. It is the leader in technical workstation-based PBC layout systems in the Far East.
- Dataquest would like to stress the relatively fragmented nature of the PCB layout market. We believe that fragmentation may be a permanent feature of this market. While full-line suppliers may continue to grow at a healthy pace, diverging technology and service needs will constantly create niche opportunities. These niche opportunities will be filled by smaller organizations that may not have significant market share but may be quite profitable. Evidence of this fragmented market is indicated by the fact that:
 - Over 76 companies currently participate in the market.
 - The top 10 companies account for only about 56.0 percent of total revenue.
 - None of the vendors has more than a 10.0 percent market share overall. Only Digital and Racal-Redac have more than a 10.0 percent market share in hardware and software revenue, respectively.

Figure 4.5-1

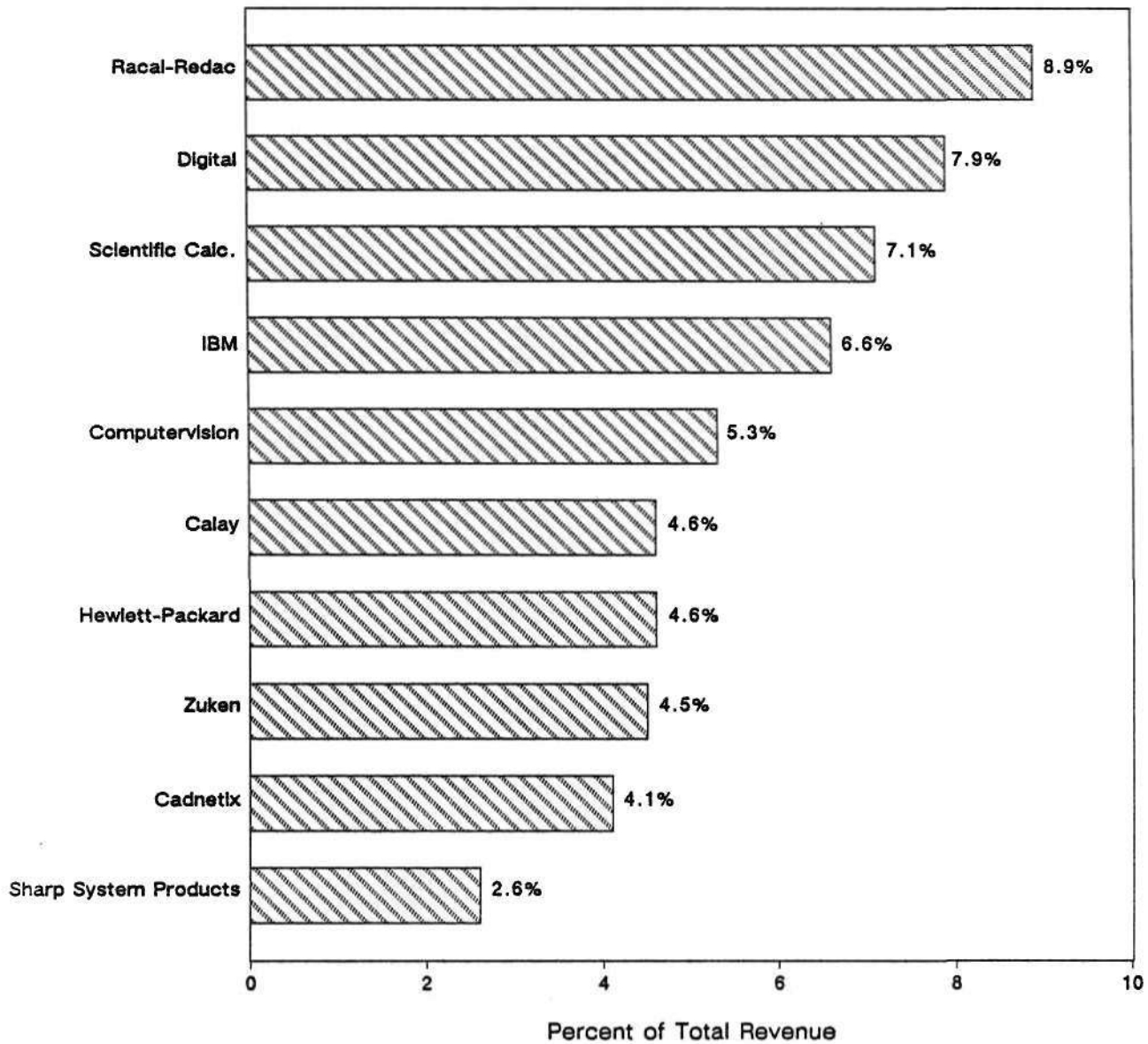
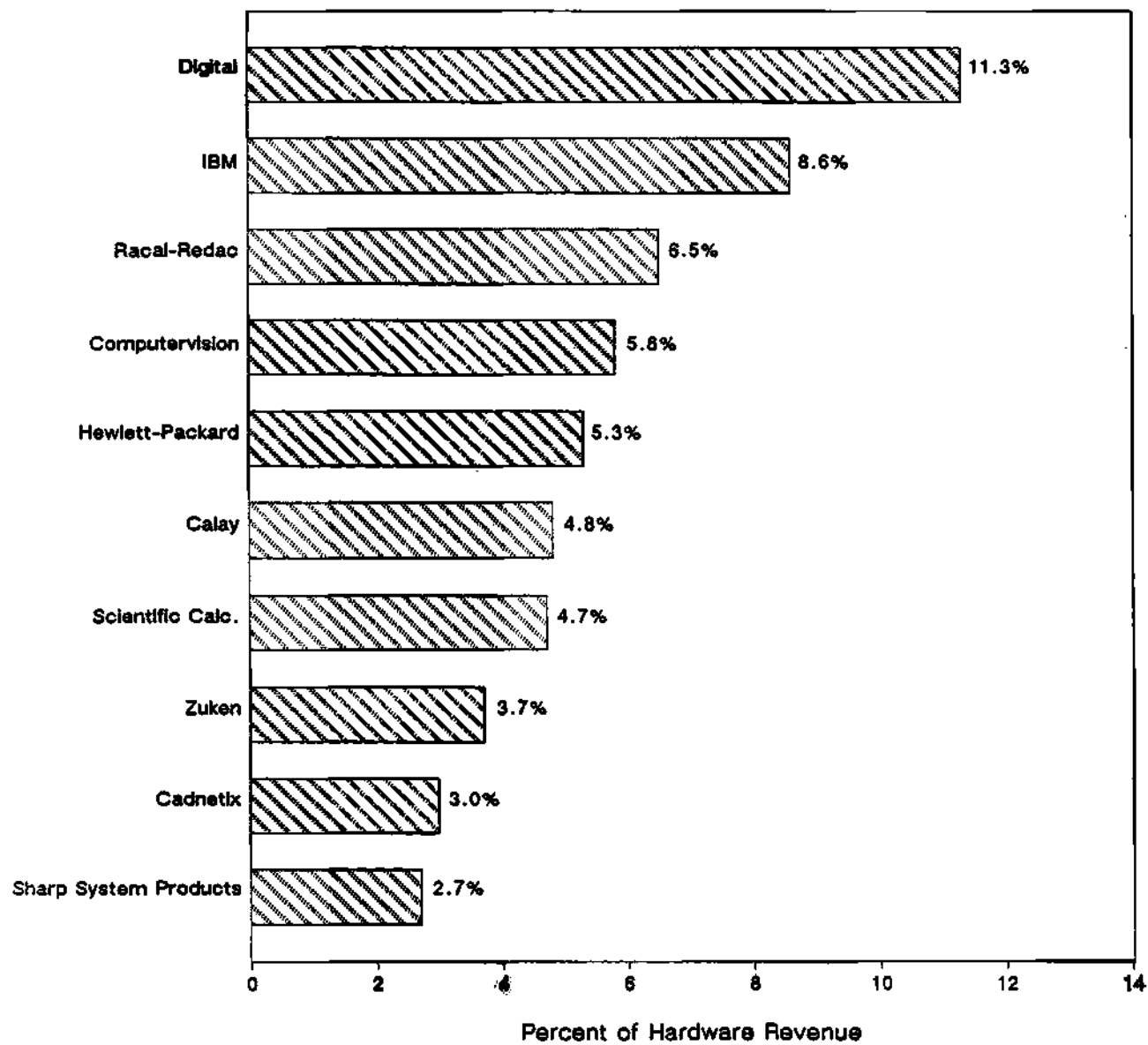
**PCB Layout 1986 Worldwide Market Share
(Total Revenue)**Source: Dataquest
June 1987

Figure 4.5-2

PCB Layout 1986 Worldwide Market Share
(Hardware Revenue)



Source: Dataquest
June 1987

Figure 4.5-3

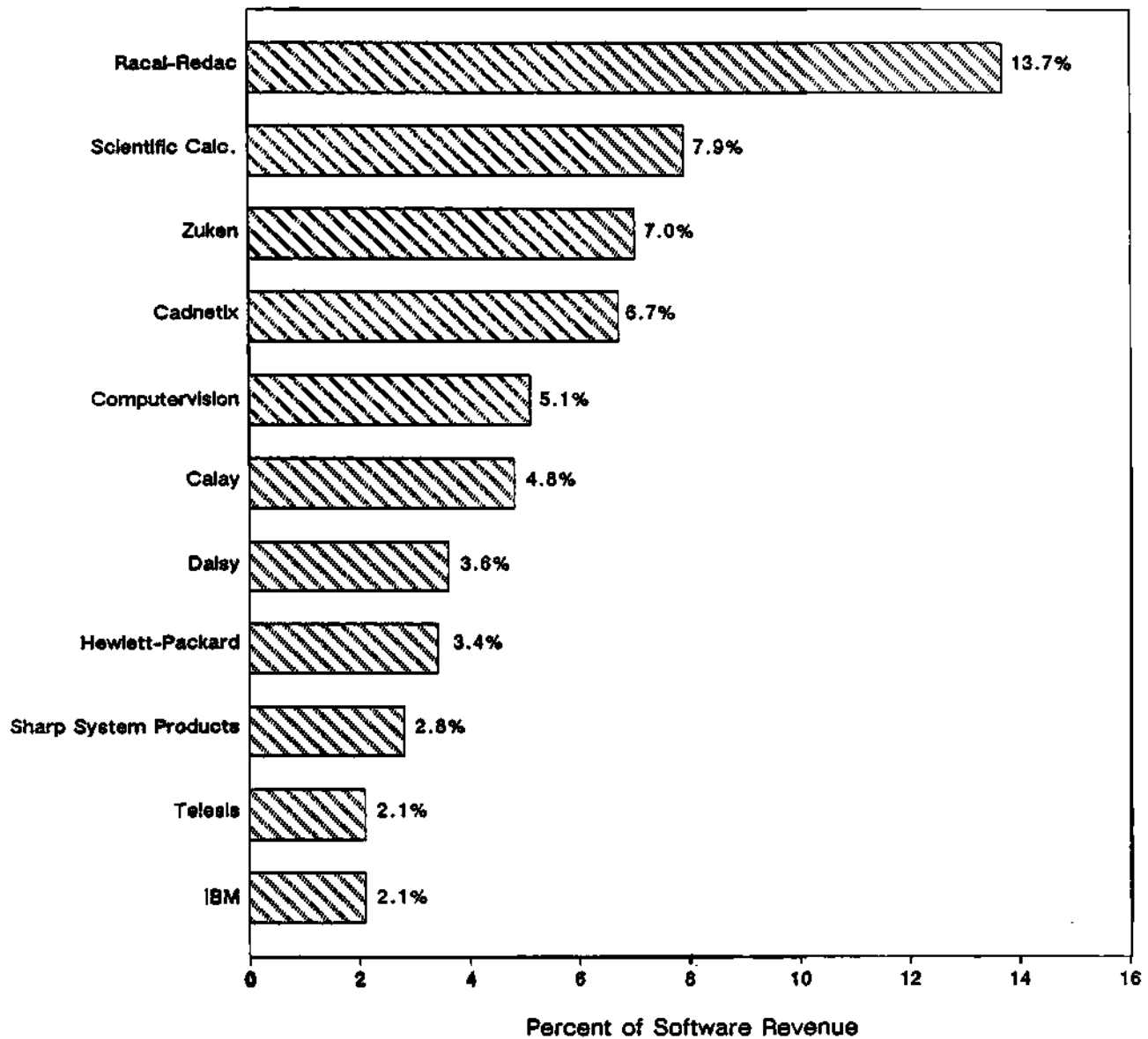
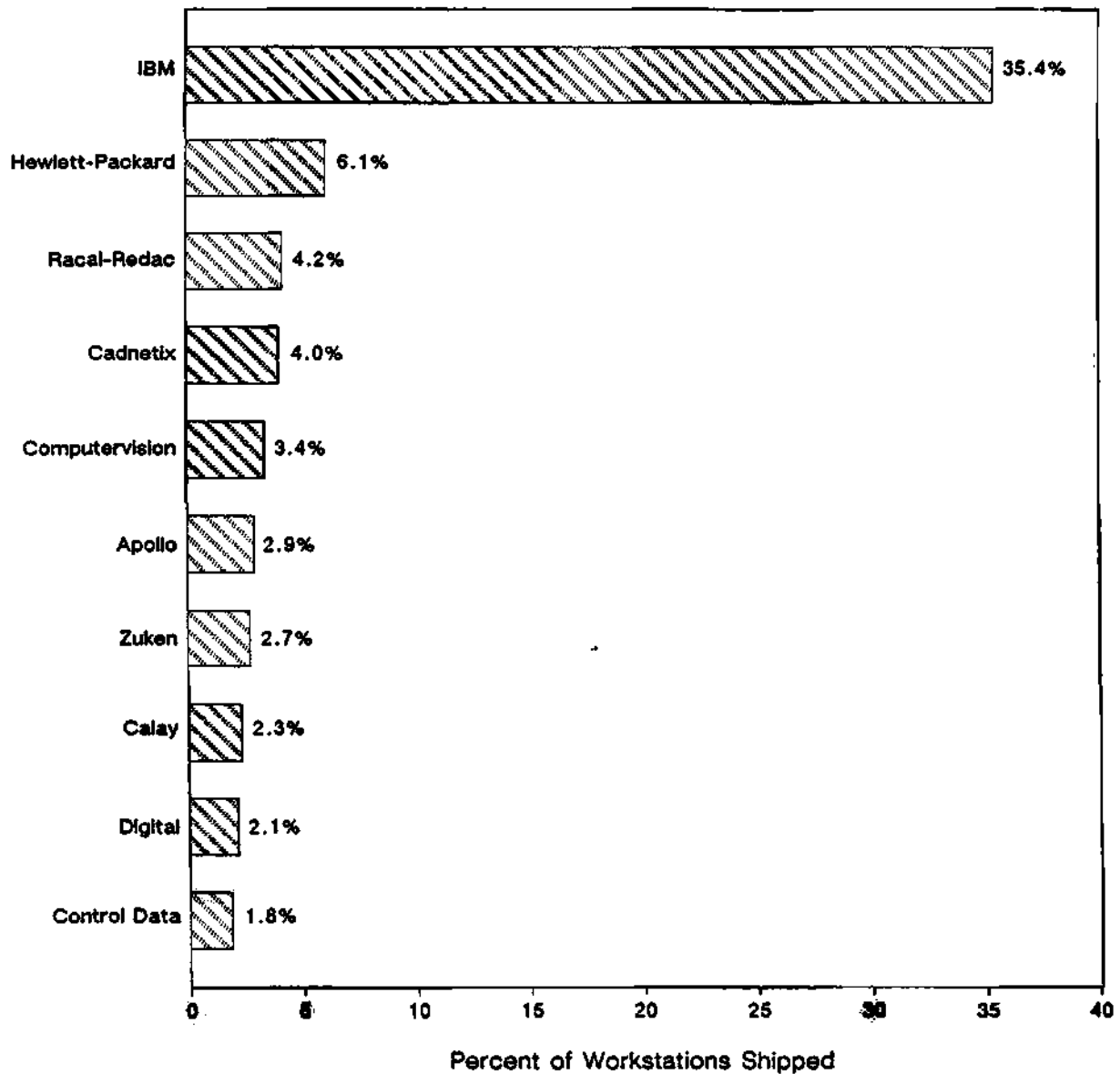
**PCB Layout 1986 Worldwide Market Share
(Software Revenue)**Source: Dataquest
June 1987

Figure 4.5-4

PCB Layout 1986 Worldwide Market Share
(Workstation Shipments)



Source: Dataquest
June 1987

Table 4.5-1

PCB Layout 1986 Worldwide Market Share
(Millions of Dollars/Actual Units)

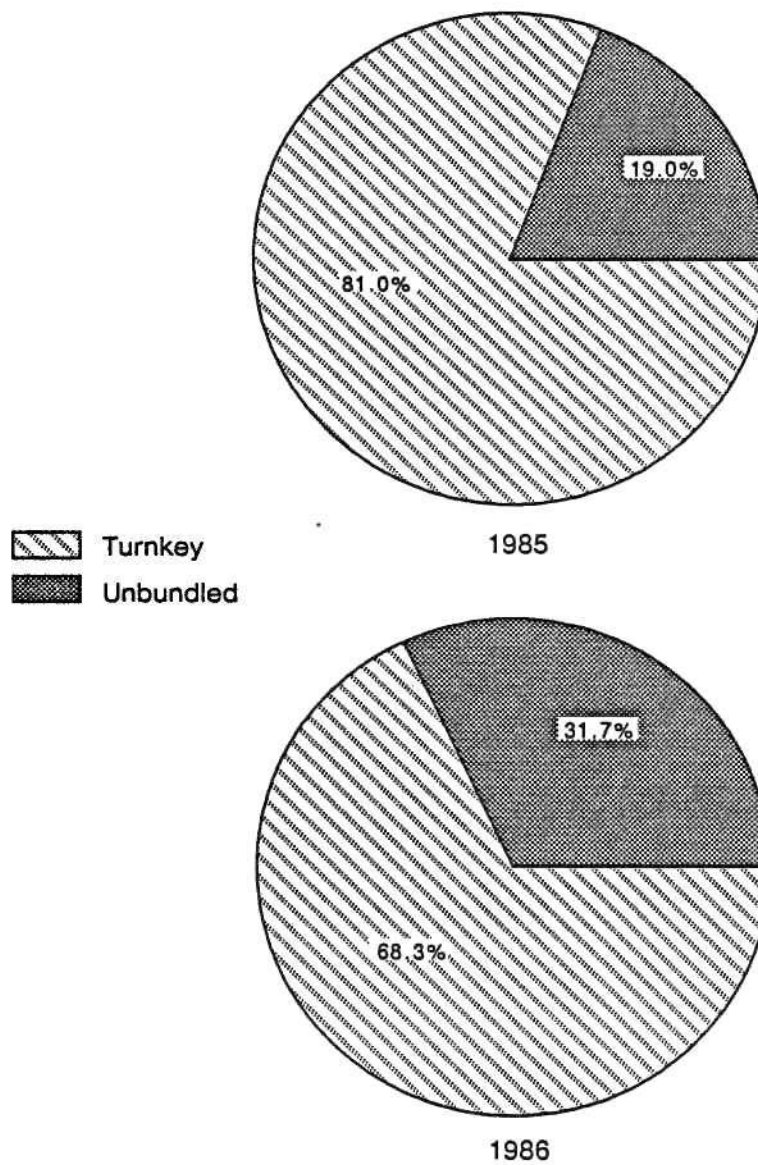
Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Racal-Redac	58	26	24	443	8.9%	6.5%	13.7%	4.2%
Digital	52	46	0	227	7.9%	11.3%	.0%	2.1%
Scientific Calc.	47	19	14	152	7.1%	4.7%	7.9%	1.4%
IBM	43	35	4	3,745	6.6%	8.6%	2.1%	35.4%
Computervision	35	23	9	358	5.3%	5.8%	5.1%	3.4%
Calay	30	19	8	240	4.6%	4.8%	4.8%	2.3%
Hewlett-Packard	30	21	6	650	4.6%	5.3%	3.4%	6.1%
Zuken	29	15	12	290	4.5%	3.7%	7.0%	2.7%
Cadnetix	26	12	12	426	4.1%	3.0%	6.7%	4.0%
Sharp System Products	17	11	5	95	2.6%	2.7%	2.8%	.9%
Calma	15	8	3	141	2.3%	2.0%	1.9%	1.3%
Daisy	13	4	6	143	1.9%	1.0%	3.6%	1.4%
Applicon	12	9	2	166	1.9%	2.3%	1.2%	1.6%
Control Data	12	7	3	187	1.9%	1.8%	1.4%	1.8%
Telesis	11	7	4	143	1.7%	1.7%	2.1%	1.4%
Fujitsu	9	6	3	56	1.4%	1.5%	1.5%	.5%
NEC	9	6	2	60	1.3%	1.6%	.9%	.6%
Hitachi	8	5	3	37	1.3%	1.2%	1.8%	.3%
Apollo	8	7	0	306	1.2%	1.7%	.0%	2.9%
Mentor	7	3	3	74	1.1%	.8%	1.5%	.7%
Intergraph	6	4	1	37	.9%	.9%	.7%	.4%
Toshiba	5	4	0	36	.8%	1.0%	.3%	.3%
Futurenet	4	0	3	59	.6%	.1%	2.0%	.6%
Tektronix	4	2	2	52	.6%	.5%	1.0%	.5%
Seiko I&E	3	2	1	17	.5%	.5%	.6%	.2%
Sun	2	2	0	95	.3%	.5%	.0%	.9%
Autodesk	2	0	2	0	.3%	.0%	1.1%	.0%
Hitachi Zosen	1	1	0	16	.2%	.2%	.3%	.2%
Mitsubishi Electric	1	1	0	6	.2%	.2%	.1%	.1%
Otsukashokai	1	1	0	101	.2%	.2%	.3%	1.0%
Valid	1	0	0	11	.1%	.1%	.1%	.1%
Silver-Lisco	0	0	0	0	.0%	.0%	.1%	.0%
Other Companies	149	95	42	2,170	23.0%	23.7%	24.1%	20.5%
All Far East-Based Companies	119	69	41	1,155	18.2%	17.3%	23.5%	10.9%
All European-Based Companies	25	15	9	246	3.9%	3.7%	5.0%	2.3%
All Hardware Companies	144	131	0	5,423	22.2%	32.7%	.0%	51.3%
All Turnkey & SW Companies	507	270	174	5,146	77.8%	67.3%	100.0%	48.7%
All Companies	651	401	174	10,569	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

These bullets present the PCB layout market share by turnkey versus unbundled product deliveries. This section contains Figure 4.5-5 and Table 4.5-2.

- From 1985 to 1986, turnkey system revenue increased only 7.2 percent, whereas unbundled sales increased 111.8 percent.
- Unbundled revenue grew from 19.0 percent to 31.7 percent of total revenue. Correspondingly, turnkey sales dropped from 81.0 percent to 68.3 percent.
- This shift was true across both hardware and software sales, although unbundled software sales enjoyed the most significant growth.
- Unbundled system shipments now represent 51.3 percent of total PCB layout system shipments.
- Dataquest believes that the move away from turnkey toward unbundled systems reflects the general maturation of the PCB layout market and the shift toward general-purpose hardware. As user investment in PCB increases, and as the level of penetration rises, Dataquest believes that:
 - End users will purchase their hardware directly from suppliers to obtain the best possible prices.
 - Hardware suppliers will want to deal directly with major end users, as they represent an increasing portion of their revenue sources.
 - End users will make their software purchases directly from software vendors to obtain the best price. They will purchase software from more than one vendor in order to create the best possible design solution.

Figure 4.5-5
PCB Layout—Turnkey versus Unbundled
(Percentage of Revenue)



Source: Dataquest
June 1987

Table 4.5-2

PCB Layout—Turnkey versus Unbundled
(Millions of Dollars/Actual Units)

	1985	1986	CAGR	Market Share	
	====	====	====	1985 =====	1986 =====
Total Hardware and Software Revenue					
Turnkey	366	393	7.2%	81.0%	68.3%
Unbundled	86	182	111.8%	19.0%	31.7%
Total	452	575	27.1%	100.0%	100.0%
Hardware Revenue					
Turnkey	244	270	10.4%	77.2%	67.3%
Unbundled	72	131	82.4%	22.8%	32.7%
Total	316	401	26.8%	100.0%	100.0%
Software Revenue					
Turnkey	122	123	.8%	89.7%	70.7%
Unbundled	14	51	263.4%	10.3%	29.3%
Total	136	174	27.9%	100.0%	100.0%
Workstation Shipments					
Turnkey	4,646	5,146	10.8%	70.2%	48.7%
Unbundled	1,972	5,423	174.9%	29.8%	51.3%
Total	6,619	10,569	59.7%	100.0%	100.0%

Source: Dataquest
June 1987



Forecast Data Base Introduction

STRUCTURE OF THE FORECAST DATA BASE

For these research notebooks, the forecast data base is structured in three parts. Each part is found in one of the following appendices:

- Appendix A—History and forecast data, containing five years each of history and forecasts, segmented by application, region, and platform
- Appendix B—Market share data for all companies with total company CAD/CAM revenue of \$15 million or more, segmented by application, region, and platform
- Appendix C—Five years of history for all U.S. companies with CAD/CAM revenue of \$15 million or more, segmented by application only

Each applications binder contains its own Appendix A and Appendix B. Appendix C, for all companies and all applications, is found only in the *Industry Overview* notebook.

Information in the appendices is presented in table format only. This data is intended to cover all possible market segmentation. Please refer to the applications modules and the *Industry Overview* for Dataquest's analysis and interpretation of the data.

Definitions of forecasting terms can be found in the glossary located behind the Appendix G tab. A list of companies and countries contained in the data base and a description of forecasting methodology can be found in the section, "Introduction to the Service," that appears in each binder.

The forecast data base hierarchy is reflected in each of the reports. Appendix A and Appendix B are organized as follows:

- Application—All, mechanical, facilities design, mapping, electronic design automation, electronic CAE, IC layout, and PCB layout
 - Region—Worldwide, North America, Europe, Far East, and Rest of World (ROW)
 - Platform—All, technical workstation, host-dependent, and personal computer

COMPANIES

Dataquest measures what the end-user markets buy from companies selling CAD/CAM products. We count only the vendor revenue that is the direct result of selling to end users. Therefore, we do not report revenue from companies that sell products to another company for resale. Although we collect OEM data, we do not count or report OEM-related revenue in our consolidated figures. In this way, we avoid double counting.

REPORTING CHANGES FROM 1985 TO 1986

In order to best serve our clients' needs, we continue to expand the scope of how we report on the CAD/CAM market. For the current reports, dated June 1987, the changes noted in the following subsections have been made.

Hardware Companies

During 1986, it became even more apparent than in previous years that companies selling computer products directly to users have an impact on both the end-user markets and the traditional turnkey vendors. In order to capture this data and analyze the impact and trends, Dataquest now includes in our market shares and consolidations companies that manufacture computers and sell directly to users. Companies in this segment include, for example, Apollo, Digital, and Sun. We have taken precautions to avoid double counting, as most of these companies also distribute products through OEM channels.

We have captured revenue and shipment data for companies in this category for the years 1982 through 1986. Therefore, historical figures for these years is higher in the reports dated June 1987 than in previously published reports.

Market Shares

To best reflect the dynamic CAD/CAM market and the multiplicity of CAD/CAM solutions, Dataquest also changed the way in which we measure market shares. We now report market shares not only for total CAD/CAM revenue and workstation shipments, but also for individual hardware and software revenue. In this way, we can fairly measure the share of a company that sells software only, comparing its revenue to the revenue derived from the value of software from a turnkey system vendor. All market share reports reflect this new format.

In our market share tables, we also reflect the share of all turnkey versus hardware-only solutions. In this way, we can measure and analyze the trend toward unbundling turnkey solutions and the impact of computer companies on turnkey companies.

Non-U.S.-Based Companies

Analyzing the CAD/CAM market on a worldwide basis is as important as understanding each region individually. Because non-U.S.-based companies typically are strong in their respective regions, particularly in the Far East, Dataquest now includes all companies, regardless of region, in its market share analysis. Only companies with total revenue of at least \$15 million are shown. All other companies are consolidated into "Other Companies."

Regional Market Share

Now included in our market share reports are shares of regional companies at a consolidated level. For example, our tables now indicate the impact of all Far East-based companies not only on the Far East region, but also on the world, as presented in the worldwide tables.

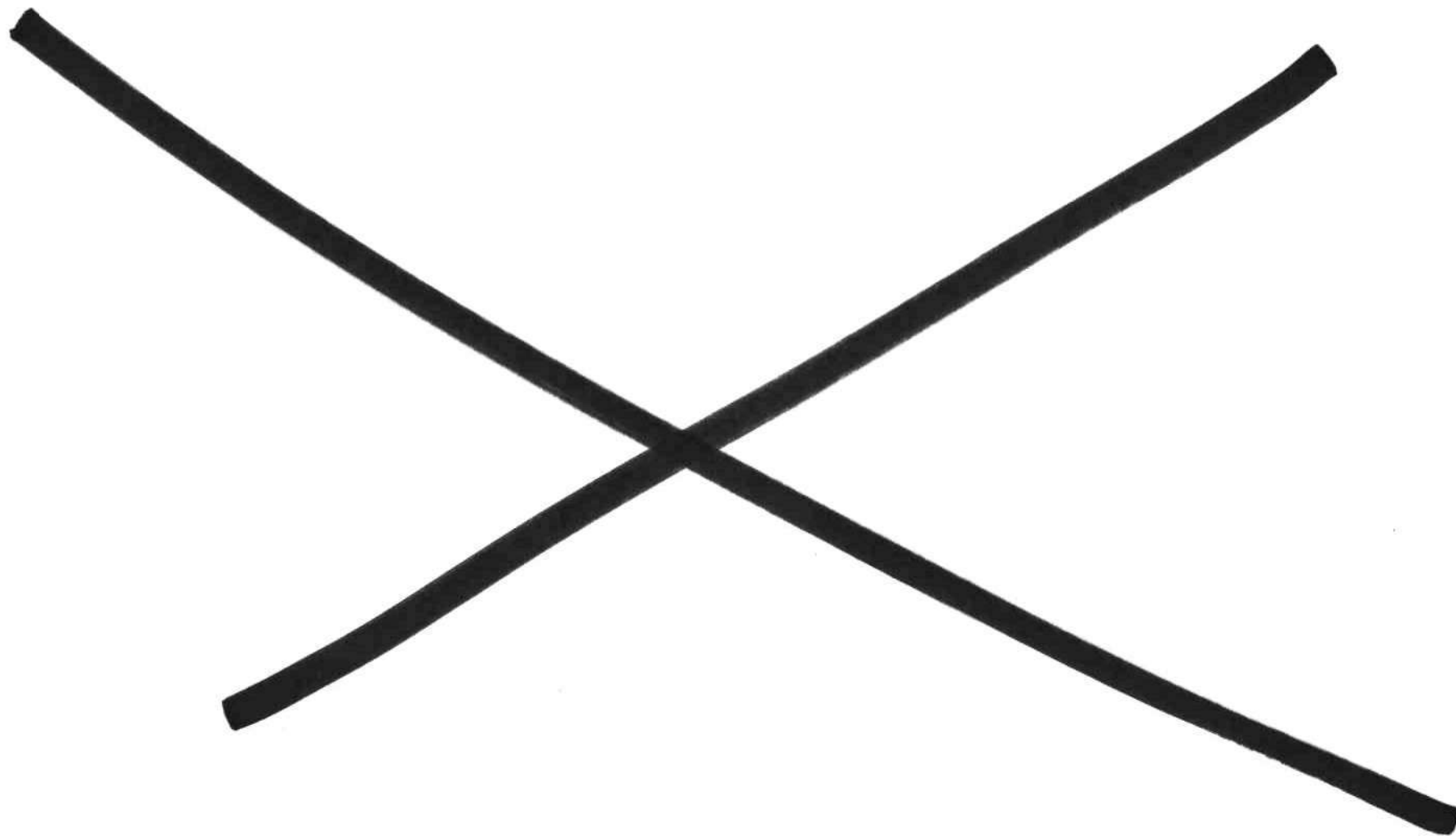
Pricing

Average price per seat (APPS) data are now reported in Appendix A for each of the applications binders. In this way, clients can more easily view and understand Dataquest's trends and forecasts for the APPS for each of the applications, regions, and platforms. All pricing data is shown in the form of APPS, reflecting the cost to access a CAD/CAM system rather than the average selling price itself. The difference between the two is most readily seen in the host-dependent platform, where the APPS is calculated by dividing the average selling price by the average number of workstations per system.

Segment Name Changes

We have changed the name of several segments in order to better reflect the contents of a given segment. The following list indicates the new segment name and its corresponding previous name.

New	Old
Facilities Design (FD)	Architectural, Engineering, and Construction (AEC)
Electronic Design Automation (EDA)	Electronic CAD/CAM (ECAD)
Electronic CAE (ECAE)	Electronic Design Automation (EDA)
IC Layout	Integrated Circuit CAD/CAM
PCB Layout	Printed Circuit Board CAD/CAM
Technical Workstation	Standalone Workstation



Appendix A—Forecast

INTRODUCTION

Appendix A is Dataquest's ten-year CAD/CAM market window. The tables contained in this section represent our estimates for the years 1982 through 1986, and our forecasts for 1987 through 1991. Each table is a consolidation of all the companies contained in our data base model for each applicable segment.

Please refer to "Introduction to the Service" for a complete list of companies, forecasting methodologies, and caveats. Forecasting terms and definitions can be found in the glossary behind the Appendix G tab.

Appendix A is structured as follows:

- Application
 - Region
 - Platform

TABLE NUMBER: A.1-1
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	1,190	2,834	12,922	22,885	34,686	42,800	47,650	51,350	54,450	57,350	132%	11%
Workstation Shipments	2,708	4,545	14,893	24,915	35,653	43,750	48,350	51,900	54,900	57,700	90%	10%
CPU Installed Base	3,762	6,596	19,518	42,403	77,089	119,200	165,300	212,550	259,900	306,050	113%	32%
Workstation Installed Base	9,722	14,266	29,160	54,074	89,727	132,150	178,150	225,150	272,050	317,600	74%	29%
PRICING DATA (Thousands of Dollars)												
Average System Price	285.2	170.0	73.0	57.3	40.9	33.4	29.3	26.6	24.5	22.9	-38%	-11%
Average Price per Seat	125.3	106.0	63.3	52.6	39.8	32.7	28.9	26.3	24.3	22.8	-25%	-11%
REVENUE DATA												
CPU Revenue	NA	NA	NA	485	592	603	595	582	570	558	NA	-1%
Workstation Revenue	NA	NA	NA	308	355	374	376	374	368	361	NA	0%
Software Revenue	NA	NA	NA	469	506	639	764	856	916	951	NA	13%
Peripheral Revenue	NA	NA	NA	196	187	204	218	232	249	268	NA	7%
Service Revenue	45	65	105	168	211	292	358	422	482	537	47%	21%
Total Revenue	384	547	1,048	1,569	1,851	2,112	2,312	2,466	2,585	2,674	48%	8%
Increase over Prior Year	NA	42%	92%	50%	18%	14%	9%	7%	5%	3%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-2
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	104	2,007	5,909	8,720	12,691	16,650	20,250	23,900	27,450	30,850	232%	19%
Workstation Shipments	104	2,007	5,996	8,720	12,691	16,650	20,250	23,900	27,450	30,850	232%	19%
CPU Installed Base	104	2,111	8,020	16,740	29,430	45,900	65,800	88,000	112,450	138,350	310%	36%
Workstation Installed Base	104	2,111	8,107	16,827	29,517	46,000	65,850	88,100	112,550	138,400	310%	36%
PRICING DATA (Thousands of Dollars)												
Average System Price	61.6	65.9	58.3	66.8	52.1	42.3	35.8	31.1	27.5	24.8	-4%	-14%
Average Price per Seat	61.6	65.9	57.5	66.8	52.1	42.3	35.8	31.1	27.5	24.8	-4%	-14%
REVENUE DATA												
CPU Revenue	NA	NA	NA	131	188	211	226	238	245	250	NA	6%
Workstation Revenue	NA	NA	NA	131	187	211	226	238	245	250	NA	6%
Software Revenue	NA	NA	NA	289	273	358	457	534	588	622	NA	18%
Peripheral Revenue	NA	NA	NA	88	90	106	119	134	149	166	NA	13%
Service Revenue	0	10	26	73	101	148	195	242	289	333	NA	27%
Total Revenue	6	142	371	671	838	1,035	1,224	1,386	1,516	1,621	238%	14%
Increase over Prior Year	NA	2123%	160%	81%	25%	23%	18%	13%	9%	7%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-3
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	1,086	828	1,240	1,681	2,458	2,650	2,750	2,800	2,800	2,800	23%	3%
Workstation Shipments	2,604	2,538	3,125	3,711	3,425	3,550	3,450	3,300	3,200	3,100	7%	-2%
CPU Installed Base	3,658	4,485	5,726	7,407	9,865	12,050	14,250	16,300	18,200	19,900	28%	15%
Workstation Installed Base	9,618	12,156	15,281	18,991	22,416	24,900	27,050	28,800	30,250	31,350	24%	7%
PRICING DATA (Thousands of Dollars)												
Average System Price	306.6	422.3	433.7	347.6	239.5	202.2	176.6	161.1	150.7	143.5	-6%	-10%
Average Price per Seat	127.8	137.7	172.1	157.4	171.9	149.5	141.6	134.6	130.8	128.7	8%	-6%
REVENUE DATA												
CPU Revenue	NA	NA	NA	300	344	318	294	272	257	245	NA	-7%
Workstation Revenue	NA	NA	NA	123	107	89	75	64	55	48	NA	-15%
Software Revenue	NA	NA	NA	103	111	125	133	138	142	143	NA	5%
Peripheral Revenue	NA	NA	NA	103	84	83	82	82	83	86	NA	0%
Service Revenue	45	55	77	92	89	122	133	143	151	157	19%	12%
Total Revenue	378	404	615	712	736	737	717	699	688	679	18%	-2%
Increase over Prior Year	NA	7%	52%	16%	3%	0%	-3%	-3%	-1%	-1%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-4
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Worldwide
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	5,772	12,484	19,538	23,500	24,650	24,700	24,250	23,750	NA	4%
Workstation Shipments	0	0	5,772	12,484	19,538	23,500	24,650	24,700	24,250	23,750	NA	4%
CPU Installed Base	0	0	5,772	18,256	37,794	61,200	85,250	108,250	129,250	147,800	NA	31%
Workstation Installed Base	0	0	5,772	18,256	37,794	61,200	85,250	108,250	129,250	147,800	NA	31%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	10.5	11.6	8.7	8.1	7.5	7.0	6.6	6.2	NA	-7%
Average Price per Seat	.0	.0	10.5	11.6	8.7	8.1	7.5	7.0	6.6	6.2	NA	-7%
REVENUE DATA												
CPU Revenue	NA	NA	NA	54	60	73	75	72	67	63	NA	1%
Workstation Revenue	NA	NA	NA	54	60	73	75	72	67	63	NA	1%
Software Revenue	NA	NA	NA	77	122	155	175	184	187	185	NA	9%
Peripheral Revenue	NA	NA	NA	5	13	15	16	16	16	16	NA	5%
Service Revenue	0	0	2	4	20	22	30	36	42	47	NA	18%
Total Revenue	0	0	62	186	276	339	370	382	380	374	NA	6%
Increase over Prior Year	NA	NA	NA	199%	49%	23%	9%	3%	-0%	-1%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-5
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	635	1,832	9,435	15,493	20,134	22,650	24,150	25,250	26,100	26,900	137%	6%
Workstation Shipments	1,537	2,790	10,639	16,597	20,377	22,750	24,100	25,150	25,950	26,750	91%	6%
CPU Installed Base	2,014	3,846	13,281	28,774	48,908	71,150	94,400	117,350	139,550	160,450	122%	27%
Workstation Installed Base	5,938	8,728	19,367	35,964	56,340	78,350	101,100	123,550	145,200	165,500	76%	24%
PRICING DATA (Thousands of Dollars)												
Average System Price	307.0	154.9	62.2	48.4	33.4	25.7	22.1	19.7	18.2	17.1	-43%	-13%
Average Price per Seat	126.8	101.7	55.2	45.2	33.0	25.6	22.1	19.8	18.3	17.2	-29%	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	266	301	254	235	218	206	198	NA	-8%
Workstation Revenue	NA	NA	NA	175	168	145	135	128	123	120	NA	-7%
Software Revenue	NA	NA	NA	284	254	332	395	439	468	485	NA	14%
Peripheral Revenue	NA	NA	NA	121	90	86	87	88	92	98	NA	2%
Service Revenue	25	38	67	100	110	136	157	176	194	210	44%	14%
Total Revenue	220	322	654	913	924	954	1,009	1,050	1,084	1,111	43%	4%
Increase over Prior Year	NA	46%	103%	40%	1%	3%	6%	4%	3%	2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-6
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	104	1,372	4,232	5,746	6,784	7,900	9,000	10,150	11,250	12,300	184%	13%
Workstation Shipments	104	1,372	4,232	5,746	6,784	7,900	9,000	10,150	11,250	12,300	184%	13%
CPU Installed Base	104	1,476	5,708	11,454	18,238	26,000	34,800	44,050	53,800	63,750	264%	28%
Workstation Installed Base	104	1,476	5,708	11,454	18,238	26,000	34,800	44,050	53,800	63,750	264%	28%
PRICING DATA (Thousands of Dollars)												
Average System Price	61.6	63.6	59.1	62.3	46.2	37.0	31.0	26.8	23.9	21.7	-7%	-14%
Average Price per Seat	61.6	63.6	59.1	62.3	46.2	37.0	31.0	26.8	23.9	21.7	-7%	-14%
REVENUE DATA												
CPU Revenue	NA	NA	NA	78	92	87	87	86	86	86	NA	-1%
Workstation Revenue	NA	NA	NA	78	91	87	87	86	86	86	NA	-1%
Software Revenue	NA	NA	NA	184	138	180	229	265	290	306	NA	17%
Peripheral Revenue	NA	NA	NA	56	41	44	46	49	53	58	NA	7%
Service Revenue	0	7	19	43	53	70	86	101	116	129	NA	19%
Total Revenue	6	94	269	414	415	468	534	588	631	665	184%	10%
Increase over Prior Year	NA	1369%	186%	53%	0%	13%	14%	10%	7%	5%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-7
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	531	460	708	879	1,276	1,300	1,300	1,300	1,300	1,300	25%	0%
Workstation Shipments	1,433	1,418	1,911	1,983	1,519	1,400	1,300	1,200	1,150	1,150	1%	-5%
CPU Installed Base	1,910	2,370	3,078	3,957	5,233	6,300	7,300	8,250	9,100	9,850	29%	13%
Workstation Installed Base	5,834	7,253	9,164	11,147	12,665	13,450	14,050	14,450	14,750	14,900	21%	3%
PRICING DATA (Thousands of Dollars)												
Average System Price	355.0	427.2	413.4	336.8	222.0	177.6	151.1	134.6	123.6	115.7	-11%	-12%
Average Price per Seat	131.5	138.5	153.2	149.3	186.5	162.9	154.1	143.6	136.5	131.6	9%	-7%
REVENUE DATA												
CPU Revenue	NA	NA	NA	149	179	143	127	112	101	93	NA	-12%
Workstation Revenue	NA	NA	NA	58	46	33	26	21	18	15	NA	-20%
Software Revenue	NA	NA	NA	55	52	68	73	76	78	79	NA	9%
Peripheral Revenue	NA	NA	NA	63	47	37	36	35	35	35	NA	-6%
Service Revenue	25	31	47	54	47	57	59	61	62	64	17%	6%
Total Revenue	214	228	340	374	370	338	322	305	294	286	15%	-5%
Increase over Prior Year	NA	7%	49%	10%	-1%	-9%	-5%	-5%	-4%	-3%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-8
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: North America
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	4,495	8,868	12,074	13,450	13,800	13,800	13,550	13,300	NA	2%
Workstation Shipments	0	0	4,495	8,868	12,074	13,450	13,800	13,800	13,550	13,300	NA	2%
CPU Installed Base	0	0	4,495	13,363	25,437	38,850	52,250	65,050	76,650	86,850	NA	28%
Workstation Installed Base	0	0	4,495	13,363	25,437	38,850	52,250	65,050	76,650	86,850	NA	28%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	9.7	10.8	6.2	4.7	3.9	3.6	3.4	3.3	NA	-12%
Average Price per Seat	.0	.0	9.7	10.8	6.2	4.7	3.9	3.6	3.4	3.3	NA	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	39	31	25	22	20	19	19	NA	-9%
Workstation Revenue	NA	NA	NA	39	31	25	22	20	19	19	NA	-9%
Software Revenue	NA	NA	NA	44	64	84	93	98	100	100	NA	9%
Peripheral Revenue	NA	NA	NA	2	3	5	5	5	5	5	NA	12%
Service Revenue	0	0	0	2	9	10	12	14	16	17	NA	13%
Total Revenue	0	0	44	125	138	148	153	157	160	160	NA	3%
Increase over Prior Year	NA	NA	NA	183%	11%	7%	3%	3%	2%	0%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-9
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	31	788	2,140	4,514	7,633	9,200	10,400	11,450	12,350	13,150	295%	11%
Workstation Shipments	58	1,329	2,499	4,913	7,819	9,350	10,500	11,550	12,400	13,200	241%	11%
CPU Installed Base	49	837	2,976	7,490	15,124	24,200	34,300	44,950	55,800	66,550	320%	34%
Workstation Installed Base	91	1,420	3,918	8,832	16,650	25,800	35,900	46,500	57,250	67,900	268%	32%
PRICING DATA (Thousands of Dollars)												
Average System Price	525.4	165.0	84.4	66.9	43.6	32.7	26.9	22.9	20.0	17.7	-46%	-16%
Average Price per Seat	284.7	97.8	72.3	61.5	42.6	32.2	26.7	22.8	19.9	17.7	-38%	-16%
REVENUE DATA												
CPU Revenue	NA	NA	NA	115	131	114	107	101	95	90	NA	-7%
Workstation Revenue	NA	NA	NA	68	84	82	78	74	70	66	NA	-5%
Software Revenue	NA	NA	NA	110	136	170	211	242	259	267	NA	14%
Peripheral Revenue	NA	NA	NA	41	40	44	45	46	48	49	NA	4%
Service Revenue	2	19	23	44	56	68	83	98	111	122	139%	17%
Total Revenue	18	149	203	365	447	478	524	560	582	594	123%	6%
Increase over Prior Year	NA	721%	37%	79%	22%	7%	10%	7%	4%	2%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-10
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	525	1,187	1,673	3,535	4,900	6,000	7,050	8,050	8,950	NA	20%
Workstation Shipments	0	525	1,274	1,673	3,535	4,900	6,000	7,050	8,050	8,950	NA	20%
CPU Installed Base	0	525	1,712	3,385	6,921	11,750	17,650	24,250	31,500	39,050	NA	41%
Workstation Installed Base	0	525	1,799	3,472	7,008	11,850	17,750	24,350	31,550	39,100	NA	41%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	69.9	52.9	77.6	56.0	41.9	33.3	27.2	22.7	19.3	NA	-19%
Average Price per Seat	.0	69.9	49.3	77.6	56.0	41.9	33.3	27.2	22.7	19.3	NA	-19%
REVENUE DATA												
CPU Revenue	NA	NA	NA	30	55	61	61	60	58	55	NA	0%
Workstation Revenue	NA	NA	NA	30	55	61	61	60	58	55	NA	0%
Software Revenue	NA	NA	NA	62	84	107	138	163	178	187	NA	17%
Peripheral Revenue	NA	NA	NA	19	26	31	33	35	36	38	NA	8%
Service Revenue	0	3	6	18	31	44	58	71	83	93	NA	25%
Total Revenue	0	39	68	150	250	303	351	389	413	428	NA	11%
Increase over Prior Year	NA	NA	74%	120%	66%	21%	16%	11%	6%	3%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-11
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	31	263	301	403	467	400	400	400	400	400	97%	-3%
Workstation Shipments	58	804	573	802	653	550	500	500	450	450	83%	-7%
CPU Installed Base	49	312	613	1,016	1,483	1,850	2,200	2,500	2,750	3,000	135%	15%
Workstation Installed Base	91	895	1,468	2,270	2,922	3,350	3,700	3,950	4,200	4,350	138%	8%
PRICING DATA (Thousands of Dollars)												
Average System Price	525.4	354.7	365.3	345.8	223.1	174.1	146.1	129.0	117.3	108.9	-19%	-13%
Average Price per Seat	284.7	116.0	192.1	173.7	159.8	130.5	120.0	111.5	106.1	102.5	-13%	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	75	67	45	38	33	30	28	NA	-16%
Workstation Revenue	NA	NA	NA	29	19	12	9	7	6	5	NA	-25%
Software Revenue	NA	NA	NA	24	21	27	30	32	33	34	NA	10%
Peripheral Revenue	NA	NA	NA	21	12	12	10	10	10	10	NA	-4%
Service Revenue	2	16	17	25	19	20	20	21	21	21	82%	2%
Total Revenue	18	109	127	172	138	115	107	103	100	98	66%	-7%
Increase over Prior Year	NA	504%	16%	36%	-20%	-17%	-6%	-4%	-3%	-2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-12
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Europe
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	*****	*****
UNIT SHIPMENT DATA												
CPU Shipments	0	0	651	2,438	3,631	3,900	4,000	4,000	3,900	3,800	NA	1%
Workstation Shipments	0	0	651	2,438	3,631	3,900	4,000	4,000	3,900	3,800	NA	1%
CPU Installed Base	0	0	651	3,089	6,720	10,600	14,500	18,200	21,550	24,450	NA	29%
Workstation Installed Base	0	0	651	3,089	6,720	10,600	14,500	18,200	21,550	24,450	NA	29%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	11.8	13.6	8.5	5.8	4.6	4.2	4.0	3.9	NA	-14%
Average Price per Seat	.0	.0	11.8	13.6	8.5	5.8	4.6	4.2	4.0	3.9	NA	-14%
REVENUE DATA												
CPU Revenue	NA	NA	NA	9	10	9	7	7	7	6	NA	-8%
Workstation Revenue	NA	NA	NA	9	10	9	7	7	7	6	NA	-8%
Software Revenue	NA	NA	NA	23	31	37	43	47	47	46	NA	8%
Peripheral Revenue	NA	NA	NA	2	3	2	2	2	2	2	NA	-10%
Service Revenue	0	0	0	1	6	5	5	6	7	8	NA	4%
Total Revenue	0	0	8	42	59	61	65	68	69	68	NA	3%
Increase over Prior Year	NA	NA	NA	427%	40%	2%	8%	5%	1%	-1%		

Source: Dataquest
June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-13
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Far East
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	18	204	1,194	2,530	6,017	9,650	11,450	12,700	13,750	14,800	326%	20%
Workstation Shipments	34	383	1,567	3,032	6,595	10,350	12,150	13,300	14,350	15,300	274%	18%
CPU Installed Base	29	233	1,426	3,957	9,973	19,500	30,750	42,650	55,050	67,450	332%	47%
Workstation Installed Base	54	436	2,004	5,036	11,631	21,800	33,600	45,950	58,700	71,350	284%	44%
PRICING DATA (Thousands of Dollars)												
Average System Price	525.9	313.2	135.8	95.4	60.2	50.7	45.9	42.7	39.8	37.3	-42%	-9%
Average Price per Seat	284.9	167.0	103.4	79.6	54.9	47.1	43.3	40.7	38.2	36.1	-34%	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	96	126	207	225	235	239	241	NA	14%
Workstation Revenue	NA	NA	NA	61	92	135	150	156	157	156	NA	11%
Software Revenue	NA	NA	NA	73	112	123	141	153	161	167	NA	8%
Peripheral Revenue	NA	NA	NA	30	52	65	76	86	96	106	NA	15%
Service Revenue	1	7	14	22	39	71	99	125	151	175	150%	35%
Total Revenue	11	71	176	271	420	602	690	755	805	845	151%	15%
Increase over Prior Year	NA	564%	149%	54%	55%	43%	15%	9%	7%	5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-14
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Far East
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	110	460	1,125	1,860	3,050	4,100	5,250	6,350	7,500	NA	32%
Workstation Shipments	0	110	460	1,125	1,860	3,050	4,100	5,250	6,350	7,500	NA	32%
CPU Installed Base	0	110	570	1,695	3,555	6,550	10,600	15,600	21,450	28,000	NA	51%
Workstation Installed Base	0	110	570	1,695	3,555	6,550	10,600	15,600	21,450	28,000	NA	51%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	75.4	63.9	78.2	71.5	60.5	52.7	46.2	40.8	36.7	NA	-12%
Average Price per Seat	.0	75.4	63.9	78.2	71.5	60.5	52.7	46.2	40.8	36.7	NA	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	21	35	56	69	79	86	92	NA	22%
Workstation Revenue	NA	NA	NA	21	34	56	69	79	86	92	NA	22%
Software Revenue	NA	NA	NA	41	49	64	80	92	102	109	NA	18%
Peripheral Revenue	NA	NA	NA	12	22	28	36	44	51	60	NA	22%
Service Revenue	0	1	1	10	15	30	45	61	77	93	NA	44%
Total Revenue	0	9	31	100	155	234	298	354	403	446	NA	24%
Increase over Prior Year	NA	NA	245%	222%	55%	51%	27%	19%	14%	11%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.1-15
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Far East
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	18	94	205	373	531	700	800	800	850	900	132%	11%
Workstation Shipments	34	273	579	875	1,109	1,450	1,450	1,450	1,450	1,400	139%	5%
CPU Installed Base	29	123	328	702	1,233	1,900	2,600	3,250	3,950	4,600	156%	30%
Workstation Installed Base	54	326	906	1,781	2,890	4,200	5,450	6,550	7,600	8,500	171%	24%
PRICING DATA (Thousands of Dollars)												
Average System Price	525.9	590.9	606.5	372.6	313.7	280.8	253.9	235.8	221.9	212.4	-12%	-8%
Average Price per Seat	284.9	203.9	215.1	158.9	150.2	139.7	135.6	133.4	133.7	134.8	-15%	-2%
REVENUE DATA												
CPU Revenue	NA	NA	NA	70	72	111	111	111	112	112	NA	9%
Workstation Revenue	NA	NA	NA	35	38	40	36	32	29	27	NA	-7%
Software Revenue	NA	NA	NA	22	38	28	27	27	27	27	NA	-6%
Peripheral Revenue	NA	NA	NA	18	22	29	31	33	35	37	NA	10%
Service Revenue	1	6	11	11	19	33	42	49	55	60	110%	26%
Total Revenue	11	62	136	154	189	242	247	252	258	262	105%	7%
Increase over Prior Year	NA	480%	120%	13%	23%	28%	2%	2%	2%	1%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-16
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Far East
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	528	1,032	3,626	5,900	6,600	6,650	6,550	6,400	NA	12%
Workstation Shipments	0	0	528	1,032	3,626	5,900	6,600	6,650	6,550	6,400	NA	12%
CPU Installed Base	0	0	528	1,560	5,186	11,050	17,500	23,800	29,650	34,850	NA	46%
Workstation Installed Base	0	0	528	1,560	5,186	11,050	17,500	23,800	29,650	34,850	NA	46%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	15.2	14.0	17.2	17.5	17.1	16.2	14.8	13.8	NA	-4%
Average Price per Seat	.0	.0	15.2	14.0	17.2	17.5	17.1	16.2	14.8	13.8	NA	-4%
REVENUE DATA												
CPU Revenue	NA	NA	NA	5	19	40	45	45	41	38	NA	14%
Workstation Revenue	NA	NA	NA	5	19	40	45	45	41	38	NA	14%
Software Revenue	NA	NA	NA	9	25	31	34	33	32	31	NA	4%
Peripheral Revenue	NA	NA	NA	1	7	8	10	10	10	10	NA	6%
Service Revenue	0	0	1	0	5	8	12	16	19	22	NA	36%
Total Revenue	0	0	9	17	76	126	146	149	143	138	NA	13%
Increase over Prior Year	NA	NA	NA	93%	335%	67%	16%	2%	-4%	-4%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-17
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	505	10	153	347	902	1,350	1,650	1,950	2,250	2,500	16%	23%
Workstation Shipments	1,080	42	189	373	863	1,300	1,600	1,900	2,200	2,450	-5%	23%
CPU Installed Base	1,671	1,681	1,834	2,181	3,084	4,300	5,850	7,600	9,550	11,600	17%	30%
Workstation Installed Base	3,639	3,682	3,871	4,243	5,106	6,200	7,550	9,150	10,900	12,800	9%	20%
PRICING DATA (Thousands of Dollars)												
Average System Price	234.3	387.7	89.4	50.2	57.4	42.3	36.2	32.3	29.6	27.5	-30%	-14%
Average Price per Seat	109.7	95.3	72.3	46.8	60.0	44.0	37.6	33.4	30.5	28.2	-14%	-14%
REVENUE DATA												
CPU Revenue	NA	NA	NA	8	34	27	28	29	29	29	NA	-3%
Workstation Revenue	NA	NA	NA	5	12	12	14	16	18	19	NA	10%
Software Revenue	NA	NA	NA	3	4	13	17	23	27	31	NA	51%
Peripheral Revenue	NA	NA	NA	3	4	9	10	12	13	15	NA	28%
Service Revenue	17	1	1	3	7	16	19	23	26	30	-20%	34%
Total Revenue	136	5	15	20	61	78	88	101	114	124	-18%	15%
Increase over Prior Year	NA	-96%	202%	36%	200%	28%	14%	14%	12%	9%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-18
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	29	175	512	850	1,150	1,450	1,750	2,050	NA	32%
Workstation Shipments	0	0	29	175	512	850	1,150	1,450	1,750	2,050	NA	32%
CPU Installed Base	0	0	29	205	717	1,550	2,700	4,100	5,700	7,500	NA	60%
Workstation Installed Base	0	0	29	205	717	1,550	2,700	4,100	5,700	7,500	NA	60%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	72.3	38.7	31.6	28.8	27.1	25.8	24.8	24.1	NA	-5%
Average Price per Seat	.0	.0	72.3	38.7	31.6	28.8	27.1	25.8	24.8	24.1	NA	-5%
REVENUE DATA												
CPU Revenue	NA	NA	NA	2	7	8	10	12	15	17	NA	20%
Workstation Revenue	NA	NA	NA	2	7	8	10	12	15	17	NA	20%
Software Revenue	NA	NA	NA	1	2	7	9	13	17	20	NA	59%
Peripheral Revenue	NA	NA	NA	1	1	4	5	7	9	11	NA	61%
Service Revenue	0	0	0	1	2	4	7	10	13	17	NA	48%
Total Revenue	0	0	2	8	19	30	41	55	68	81	NA	34%
Increase over Prior Year	NA	NA	NA	269%	138%	58%	39%	32%	25%	19%		

Source: Dataquest
June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-19
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	505	10	25	26	183	200	250	250	250	200	-22%	2%
Workstation Shipments	1,080	42	62	51	144	150	150	150	150	150	-40%	1%
CPU Installed Base	1,671	1,681	1,707	1,732	1,916	2,050	2,150	2,300	2,400	2,450	3%	5%
Workstation Installed Base	3,639	3,682	3,743	3,794	3,939	3,900	3,900	3,800	3,750	3,650	2%	-2%
PRICING DATA (Thousands of Dollars)												
Average System Price	234.3	387.7	415.2	377.5	187.9	141.3	118.5	104.5	95.8	89.9	-5%	-14%
Average Price per Seat	109.7	95.3	171.2	190.1	238.8	185.6	160.8	144.0	133.3	124.8	21%	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	5	26	19	17	16	14	12	NA	-15%
Workstation Revenue	NA	NA	NA	2	4	5	4	3	3	2	NA	-15%
Software Revenue	NA	NA	NA	1	1	3	3	3	3	3	NA	36%
Peripheral Revenue	NA	NA	NA	2	3	5	5	5	5	4	NA	5%
Service Revenue	17	1	1	2	4	12	12	12	13	13	-29%	23%
Total Revenue	136	5	12	11	39	43	41	39	37	34	-27%	-3%
Increase over Prior Year	NA	-96%	138%	-3%	246%	10%	-5%	-4%	-6%	-8%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.1-20
 TITLE: History and Forecast
 APPLICATION: Electronic Design Automation
 REGION: Rest of World
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	98	146	207	250	250	250	250	250	NA	4%
Workstation Shipments	0	0	98	146	207	250	250	250	250	250	NA	4%
CPU Installed Base	0	0	98	244	451	700	950	1,200	1,450	1,650	NA	30%
Workstation Installed Base	0	0	98	244	451	700	950	1,200	1,450	1,650	NA	30%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	10.2	6.1	5.5	4.4	3.9	3.7	3.6	3.6	NA	-8%
Average Price per Seat	.0	.0	10.2	6.1	5.5	4.4	3.9	3.7	3.6	3.6	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	1	0	0	0	0	0	NA	-5%
Workstation Revenue	NA	NA	NA	0	1	0	0	0	0	0	NA	-5%
Software Revenue	NA	NA	NA	0	1	3	5	6	7	7	NA	42%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	13%
Total Revenue	0	0	1	1	3	5	6	7	8	9	NA	28%
Increase over Prior Year	NA	NA	NA	-4%	164%	79%	35%	20%	10%	5%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-1
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	293	1,490	9,372	16,414	22,935	28,050	31,050	33,300	35,400	37,450	197%	10%
Workstation Shipments	363	1,600	9,234	16,133	22,567	27,600	30,500	32,700	34,800	36,800	181%	10%
CPU Installed Base	332	1,822	11,194	27,608	50,543	78,500	109,000	140,000	171,150	201,700	251%	32%
Workstation Installed Base	441	2,040	11,274	27,407	49,974	77,500	107,400	137,900	168,450	198,500	226%	32%
PRICING DATA (Thousands of Dollars)												
Average System Price	185.6	91.7	43.7	41.6	30.3	25.2	22.4	20.4	18.9	17.7	-36%	-10%
Average Price per Seat	150.1	85.4	44.4	42.3	30.8	25.6	22.8	20.8	19.2	18.0	-33%	-10%
REVENUE DATA												
CPU Revenue	NA	NA	NA	283	315	320	314	301	291	281	NA	-2%
Workstation Revenue	NA	NA	NA	135	164	182	189	192	194	195	NA	4%
Software Revenue	NA	NA	NA	240	243	300	350	387	409	420	NA	12%
Peripheral Revenue	NA	NA	NA	117	98	107	115	123	134	147	NA	8%
Service Revenue	5	11	32	67	100	126	159	191	222	251	114%	20%
Total Revenue	59	148	442	808	919	1,036	1,127	1,195	1,249	1,294	99%	7%
Increase over Prior Year	NA	150%	199%	83%	14%	13%	9%	6%	5%	4%		

Source: Dataquest
June 1987

TABLE NUMBER: A.2-2
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	104	1,389	4,193	5,438	7,450	9,850	11,900	14,050	16,300	18,500	191%	20%
Workstation Shipments	104	1,389	4,193	5,438	7,450	9,850	11,900	14,050	16,300	18,500	191%	20%
CPU Installed Base	104	1,493	5,686	11,124	18,574	28,400	40,300	53,550	68,250	84,000	266%	35%
Workstation Installed Base	104	1,493	5,686	11,124	18,574	28,400	40,300	53,550	68,250	84,000	266%	35%
PRICING DATA (Thousands of Dollars)												
Average System Price	61.6	61.0	52.3	59.2	42.3	33.5	28.2	24.7	22.3	20.5	-9%	-13%
Average Price per Seat	61.6	61.0	52.3	59.2	42.3	33.5	28.2	24.7	22.3	20.5	-9%	-13%
REVENUE DATA												
CPU Revenue	NA	NA	NA	72	94	105	111	118	125	131	NA	7%
Workstation Revenue	NA	NA	NA	72	94	105	111	118	125	131	NA	7%
Software Revenue	NA	NA	NA	168	123	152	184	211	228	237	NA	14%
Peripheral Revenue	NA	NA	NA	48	44	51	57	65	74	85	NA	14%
Service Revenue	0	6	14	31	49	66	85	105	126	146	NA	25%
Total Revenue	6	90	233	364	404	478	548	617	679	730	182%	13%
Increase over Prior Year	NA	1309%	158%	56%	11%	18%	15%	13%	10%	8%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.2-3
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	189	100	405	820	1,157	1,350	1,500	1,500	1,500	1,500	57%	5%
Workstation Shipments	259	210	267	539	789	900	900	950	900	900	32%	3%
CPU Installed Base	228	328	734	1,554	2,711	4,000	5,350	6,650	7,900	9,000	86%	27%
Workstation Installed Base	337	547	814	1,353	2,142	2,950	3,750	4,500	5,200	5,850	59%	22%
PRICING DATA (Thousands of Dollars)												
Average System Price	253.7	517.4	354.2	310.5	215.8	170.2	144.2	128.4	118.5	111.8	-4%	-12%
Average Price per Seat	185.7	246.4	536.8	472.7	316.3	258.7	232.4	209.9	197.1	188.9	14%	-10%
REVENUE DATA												
CPU Revenue	NA	NA	NA	166	175	159	144	126	113	101	NA	-10%
Workstation Revenue	NA	NA	NA	18	24	21	19	18	16	15	NA	-9%
Software Revenue	NA	NA	NA	25	37	47	53	56	58	59	NA	10%
Peripheral Revenue	NA	NA	NA	66	45	45	47	46	47	49	NA	2%
Service Revenue	5	6	18	33	35	41	48	54	59	64	65%	13%
Total Revenue	53	58	161	307	316	312	311	300	294	287	56%	-2%
Increase over Prior Year	NA	9%	180%	90%	3%	-1%	-0%	-3%	-2%	-2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-4
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Worldwide
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	4,774	10,156	14,327	16,900	17,700	17,750	17,600	17,400	NA	4%
Workstation Shipments	0	0	4,774	10,156	14,327	16,900	17,700	17,750	17,600	17,400	NA	4%
CPU Installed Base	0	0	4,774	14,930	29,258	46,150	63,350	79,800	95,050	108,650	NA	30%
Workstation Installed Base	0	0	4,774	14,930	29,258	46,150	63,350	79,800	95,050	108,650	NA	30%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	9.7	10.5	9.1	8.8	8.3	7.7	7.1	6.7	NA	-6%
Average Price per Seat	.0	.0	9.7	10.5	9.1	8.8	8.3	7.7	7.1	6.7	NA	-6%
REVENUE DATA												
CPU Revenue	NA	NA	NA	45	46	57	59	57	53	49	NA	2%
Workstation Revenue	NA	NA	NA	45	46	57	59	57	53	49	NA	2%
Software Revenue	NA	NA	NA	47	83	102	113	120	122	124	NA	8%
Peripheral Revenue	NA	NA	NA	2	9	11	12	12	12	13	NA	8%
Service Revenue	0	0	1	3	16	20	26	32	37	41	NA	21%
Total Revenue	0	0	47	136	199	246	269	277	277	276	NA	7%
Increase over Prior Year	NA	NA	NA	189%	46%	24%	9%	3%	-0%	-0%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.2-5
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	225	1,167	7,143	11,948	14,516	15,700	16,400	16,850	17,250	17,650	184%	4%
Workstation Shipments	262	1,232	7,079	11,749	14,288	15,400	16,050	16,500	16,900	17,300	172%	4%
CPU Installed Base	246	1,413	8,556	20,504	35,020	50,650	66,650	82,100	96,850	110,550	246%	26%
Workstation Installed Base	304	1,536	8,615	20,364	34,652	50,000	65,700	80,800	95,250	108,700	227%	26%
PRICING DATA (Thousands of Dollars)												
Average System Price	157.5	81.7	39.0	35.9	25.0	20.0	17.2	15.2	14.0	13.1	-37%	-12%
Average Price per Seat	134.9	77.4	39.4	36.5	25.4	20.4	17.6	15.5	14.3	13.3	-34%	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	167	169	151	137	123	113	106	NA	-9%
Workstation Revenue	NA	NA	NA	87	85	74	67	63	61	59	NA	-7%
Software Revenue	NA	NA	NA	160	134	167	192	209	219	224	NA	11%
Peripheral Revenue	NA	NA	NA	76	56	50	50	50	51	54	NA	-1%
Service Revenue	3	8	21	41	54	65	76	86	95	103	106%	14%
Total Revenue	38	104	300	511	500	506	523	532	539	546	90%	2%
Increase over Prior Year	NA	170%	189%	71%	-2%	1%	3%	2%	1%	1%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-6
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	*****	*****
UNIT SHIPMENT DATA												
CPU Shipments	104	1,112	3,174	3,639	4,047	4,500	4,950	5,400	5,900	6,400	150%	10%
Workstation Shipments	104	1,112	3,174	3,639	4,047	4,500	4,950	5,400	5,900	6,400	150%	10%
CPU Installed Base	104	1,216	4,390	8,030	12,076	16,550	21,500	26,450	31,550	36,700	228%	25%
Workstation Installed Base	104	1,216	4,390	8,030	12,076	16,550	21,500	26,450	31,550	36,700	228%	25%
PRICING DATA (Thousands of Dollars)												
Average System Price	61.6	60.3	52.0	56.5	39.8	30.4	24.6	20.9	18.4	16.6	-10%	-16%
Average Price per Seat	61.6	60.3	52.0	56.5	39.8	30.4	24.6	20.9	18.4	16.6	-10%	-16%
REVENUE DATA												
CPU Revenue	NA	NA	NA	45	49	43	40	38	37	37	NA	-6%
Workstation Revenue	NA	NA	NA	45	49	43	40	38	37	37	NA	-6%
Software Revenue	NA	NA	NA	112	66	75	88	98	103	106	NA	10%
Peripheral Revenue	NA	NA	NA	31	22	21	21	21	22	24	NA	2%
Service Revenue	0	5	11	20	27	33	38	43	47	52	NA	14%
Total Revenue	6	72	176	234	213	215	227	239	248	255	140%	4%
Increase over Prior Year	NA	1028%	144%	33%	-9%	1%	5%	5%	4%	3%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-7
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	121	55	222	443	639	750	850	850	850	800	52%	5%
Workstation Shipments	158	119	158	244	411	500	500	500	500	500	27%	4%
CPU Installed Base	142	196	418	862	1,501	2,200	3,000	3,700	4,400	5,000	80%	27%
Workstation Installed Base	200	320	478	722	1,133	1,600	2,000	2,450	2,800	3,150	54%	23%
PRICING DATA (Thousands of Dollars)												
Average System Price	240.2	517.0	350.2	319.7	218.6	170.2	143.8	128.2	118.5	112.2	-2%	-12%
Average Price per Seat	183.1	236.8	491.5	580.4	340.2	265.9	239.7	213.7	197.5	187.0	17%	-11%
REVENUE DATA												
CPU Revenue	NA	NA	NA	88	96	89	81	70	62	55	NA	-10%
Workstation Revenue	NA	NA	NA	8	12	12	11	10	9	8	NA	-6%
Software Revenue	NA	NA	NA	17	24	34	38	41	42	43	NA	12%
Peripheral Revenue	NA	NA	NA	44	31	25	26	26	26	27	NA	-3%
Service Revenue	3	3	10	19	20	23	27	31	34	37	60%	13%
Total Revenue	32	32	88	175	183	183	184	177	172	170	55%	-1%
Increase over Prior Year	NA	-2%	178%	100%	4%	-0%	1%	-4%	-3%	-2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-8
 TITLE: History and forecast
 APPLICATION: Electronic CAE
 REGION: North America
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	3,747	7,866	9,830	10,450	10,600	10,600	10,500	10,400	NA	1%
Workstation Shipments	0	0	3,747	7,866	9,830	10,450	10,600	10,600	10,500	10,400	NA	1%
CPU Installed Base	0	0	3,747	11,613	21,442	31,900	42,150	51,950	60,900	68,850	NA	26%
Workstation Installed Base	0	0	3,747	11,613	21,442	31,900	42,150	51,950	60,900	68,850	NA	26%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	9.6	10.4	6.3	4.7	3.8	3.4	3.2	3.2	NA	-13%
Average Price per Seat	.0	.0	9.6	10.4	6.3	4.7	3.8	3.4	3.2	3.2	NA	-13%
REVENUE DATA												
CPU Revenue	NA	NA	NA	35	25	19	16	15	14	14	NA	-11%
Workstation Revenue	NA	NA	NA	35	25	19	16	15	14	14	NA	-11%
Software Revenue	NA	NA	NA	31	44	58	66	71	73	75	NA	11%
Peripheral Revenue	NA	NA	NA	1	3	4	3	3	3	4	NA	6%
Service Revenue	0	0	0	2	7	9	11	12	14	15	NA	16%
Total Revenue	0	0	36	102	104	108	112	116	119	121	NA	3%
Increase over Prior Year	NA	NA	NA	182%	2%	4%	3%	4%	3%	2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-9
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	19	244	1,313	2,978	4,358	5,300	5,850	6,400	6,850	7,250	289%	11%
Workstation Shipments	38	272	1,261	2,922	4,277	5,200	5,800	6,300	6,750	7,150	225%	11%
CPU Installed Base	30	274	1,587	4,565	8,923	14,200	19,950	25,950	32,000	37,950	316%	34%
Workstation Installed Base	59	331	1,592	4,514	8,791	14,000	19,650	25,550	31,550	37,450	249%	34%
PRICING DATA (Thousands of Dollars)												
Average System Price	530.4	113.9	56.0	51.5	33.9	24.0	19.0	15.9	14.0	12.7	-50%	-18%
Average Price per Seat	265.2	102.4	58.3	52.5	34.5	24.4	19.3	16.1	14.2	12.9	-40%	-18%
REVENUE DATA												
CPU Revenue	NA	NA	NA	69	64	54	48	43	40	38	NA	-10%
Workstation Revenue	NA	NA	NA	28	34	34	31	29	28	27	NA	-4%
Software Revenue	NA	NA	NA	52	62	74	90	104	112	117	NA	14%
Peripheral Revenue	NA	NA	NA	24	20	20	19	19	20	21	NA	1%
Service Revenue	1	2	6	16	25	28	34	40	45	50	122%	15%
Total Revenue	11	30	80	183	204	209	222	235	245	252	107%	4%
Increase over Prior Year	NA	166%	169%	129%	12%	2%	6%	6%	4%	3%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-10
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	217	614	1,059	1,930	2,700	3,250	3,750	4,250	4,700	NA	19%
Workstation Shipments	0	217	614	1,059	1,930	2,700	3,250	3,750	4,250	4,700	NA	19%
CPU Installed Base	0	217	831	1,890	3,819	6,500	9,750	13,350	17,150	21,150	NA	41%
Workstation Installed Base	0	217	831	1,890	3,819	6,500	9,750	13,350	17,150	21,150	NA	41%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	62.9	48.6	66.4	41.2	28.7	21.7	17.5	14.8	12.9	NA	-21%
Average Price per Seat	.0	62.9	48.6	66.4	41.2	28.7	21.7	17.5	14.8	12.9	NA	-21%
REVENUE DATA												
CPU Revenue	NA	NA	NA	16	23	25	23	22	22	21	NA	-2%
Workstation Revenue	NA	NA	NA	16	23	25	23	22	22	21	NA	-2%
Software Revenue	NA	NA	NA	35	34	45	58	69	77	81	NA	19%
Peripheral Revenue	NA	NA	NA	11	11	12	12	12	13	14	NA	4%
Service Revenue	0	0	2	7	13	17	22	26	31	34	NA	21%
Total Revenue	0	14	32	79	106	123	138	153	163	170	NA	10%
Increase over Prior Year	NA	NA	126%	150%	34%	16%	13%	10%	7%	4%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-11
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	19	27	108	226	231	200	250	200	200	200	86%	-3%
Workstation Shipments	38	55	56	171	149	150	150	150	150	150	41%	0%
CPU Installed Base	30	57	165	392	623	800	1,000	1,200	1,400	1,550	114%	20%
Workstation Installed Base	59	114	170	341	490	600	750	800	900	1,000	70%	15%
PRICING DATA (Thousands of Dollars)												
Average System Price	530.4	517.3	349.0	291.4	197.0	152.3	128.1	113.9	105.1	99.3	-22%	-13%
Average Price per Seat	265.2	258.7	670.8	386.9	304.9	238.0	213.5	189.8	175.2	165.5	4%	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	46	35	23	19	16	14	13	NA	-18%
Workstation Revenue	NA	NA	NA	5	5	3	3	2	2	2	NA	-15%
Software Revenue	NA	NA	NA	6	8	10	11	12	12	13	NA	10%
Peripheral Revenue	NA	NA	NA	13	6	7	6	6	6	6	NA	1%
Service Revenue	1	2	5	9	7	7	8	8	9	9	62%	5%
Total Revenue	11	16	42	79	60	50	47	45	44	43	52%	-6%
Increase over Prior Year	NA	41%	169%	88%	-25%	-17%	-5%	-5%	-3%	-2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-12
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Europe
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	0	0	591	1,693	2,197	2,350	2,400	2,400	2,400	2,350	NA	1%
Workstation Shipments	0	0	591	1,693	2,197	2,350	2,400	2,400	2,400	2,350	NA	1%
CPU Installed Base	0	0	591	2,284	4,481	6,850	9,200	11,400	13,450	15,250	NA	28%
Workstation Installed Base	0	0	591	2,284	4,481	6,850	9,200	11,400	13,450	15,250	NA	28%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	10.2	10.1	10.3	6.7	5.0	4.4	4.1	4.0	NA	-17%
Average Price per Seat	.0	.0	10.2	10.1	10.3	6.7	5.0	4.4	4.1	4.0	NA	-17%
REVENUE DATA												
CPU Revenue	NA	NA	NA	7	6	6	5	4	4	4	NA	-8%
Workstation Revenue	NA	NA	NA	7	6	6	5	4	4	4	NA	-8%
Software Revenue	NA	NA	NA	11	20	19	21	22	23	24	NA	3%
Peripheral Revenue	NA	NA	NA	0	3	1	1	1	1	1	NA	-17%
Service Revenue	0	0	0	1	5	4	5	6	6	7	NA	7%
Total Revenue	0	0	6	24	39	36	37	38	39	39	NA	0%
Increase over Prior Year	NA	NA	NA	303%	60%	-7%	1%	3%	2%	2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-13
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Far East
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	11	76	802	1,294	3,544	6,300	7,750	8,750	9,750	10,700	322X	25X
Workstation Shipments	22	92	784	1,274	3,534	6,250	7,700	8,650	9,650	10,550	254X	24X
CPU Installed Base	18	94	896	2,190	5,734	12,000	19,700	28,000	36,900	46,100	325X	52X
Workstation Installed Base	35	127	911	2,184	5,719	11,950	19,550	27,800	36,550	45,650	257X	52X
PRICING DATA (Thousands of Dollars)												
Average System Price	531.2	162.1	65.3	71.4	44.3	37.4	34.4	32.1	29.5	27.3	-46X	-9X
Average Price per Seat	265.6	134.0	66.9	72.5	44.4	37.7	34.7	32.4	29.9	27.7	-36X	-9X
REVENUE DATA												
CPU Revenue	NA	NA	NA	43	62	99	112	117	119	118	NA	14X
Workstation Revenue	NA	NA	NA	18	39	68	83	90	93	95	NA	19X
Software Revenue	NA	NA	NA	28	46	54	60	61	61	59	NA	5X
Peripheral Revenue	NA	NA	NA	15	19	32	39	46	53	60	NA	25X
Service Revenue	1	1	4	9	17	28	41	54	68	81	129X	37X
Total Revenue	7	13	57	105	184	282	335	369	394	414	130X	18X
Increase over Prior Year	NA	101X	330X	84X	76X	53X	19X	10X	7X	5X		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-14
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Far East
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	60	388	630	1,150	2,050	2,900	3,850	4,800	5,800	NA	38%
Workstation Shipments	0	60	388	630	1,150	2,050	2,900	3,850	4,800	5,800	NA	38%
CPU Installed Base	0	60	448	1,078	2,228	4,300	7,200	10,900	15,350	20,550	NA	56%
Workstation Installed Base	0	60	448	1,078	2,228	4,300	7,200	10,900	15,350	20,550	NA	56%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	67.3	60.1	68.2	57.1	48.7	42.3	37.3	33.3	30.1	NA	-12%
Average Price per Seat	.0	67.3	60.1	68.2	57.1	48.7	42.3	37.3	33.3	30.1	NA	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	10	18	32	41	49	55	60	NA	27%
Workstation Revenue	NA	NA	NA	10	18	32	41	49	55	60	NA	27%
Software Revenue	NA	NA	NA	21	22	28	32	34	34	33	NA	8%
Peripheral Revenue	NA	NA	NA	7	10	16	21	27	33	39	NA	30%
Service Revenue	0	0	1	4	7	14	21	29	39	48	NA	46%
Total Revenue	0	4	24	48	76	121	155	187	216	241	NA	26%
Increase over Prior Year	NA	NA	505%	95%	60%	60%	28%	21%	15%	12%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.2-15
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Far East
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	11	16	67	135	189	250	300	300	350	350	103%	13%
Workstation Shipments	22	32	49	115	180	200	200	200	200	200	68%	2%
CPU Installed Base	18	34	101	236	425	650	950	1,200	1,500	1,750	122%	33%
Workstation Installed Base	35	67	116	231	410	600	800	1,000	1,150	1,300	85%	26%
PRICING DATA (Thousands of Dollars)												
Average System Price	531.2	518.2	376.1	312.7	244.2	201.4	173.2	153.7	139.9	129.9	-18%	-12%
Average Price per Seat	265.6	259.1	519.1	367.5	257.2	251.8	230.9	219.6	216.9	216.5	-1%	-3%
REVENUE DATA												
CPU Revenue	NA	NA	NA	29	30	36	34	31	29	27	NA	-2%
Workstation Revenue	NA	NA	NA	4	7	5	5	4	4	4	NA	-9%
Software Revenue	NA	NA	NA	2	5	2	3	3	3	3	NA	-14%
Peripheral Revenue	NA	NA	NA	8	6	10	11	11	12	13	NA	18%
Service Revenue	1	1	3	4	6	8	10	11	12	13	75%	19%
Total Revenue	7	9	28	47	53	61	62	61	61	60	69%	2%
Increase over Prior Year	NA	39%	209%	67%	12%	15%	2%	-2%	0%	-2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-16
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Far East
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	0	0	347	529	2,204	3,950	4,550	4,600	4,600	4,550	NA	16%
Workstation Shipments	0	0	347	529	2,204	3,950	4,550	4,600	4,600	4,550	NA	16%
CPU Installed Base	0	0	347	876	3,081	7,050	11,550	15,900	20,050	23,800	NA	51%
Workstation Installed Base	0	0	347	876	3,081	7,050	11,550	15,900	20,050	23,800	NA	51%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	10.6	13.7	20.5	20.9	20.5	19.5	17.5	16.1	NA	-5%
Average Price per Seat	.0	.0	10.6	13.7	20.5	20.9	20.5	19.5	17.5	16.1	NA	-5%
REVENUE DATA												
CPU Revenue	NA	NA	NA	4	15	32	38	37	34	31	NA	17%
Workstation Revenue	NA	NA	NA	4	15	32	38	37	34	31	NA	17%
Software Revenue	NA	NA	NA	5	18	24	25	25	24	24	NA	5%
Peripheral Revenue	NA	NA	NA	0	4	6	8	8	8	8	NA	18%
Service Revenue	0	0	0	0	4	6	10	14	17	19	NA	39%
Total Revenue	0	0	4	10	55	100	118	121	117	113	NA	16%
Increase over Prior Year	NA	NA	NA	142%	461%	83%	19%	2%	-3%	-3%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.2-17
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	39	2	114	194	516	800	1,050	1,300	1,600	1,850	91%	29%
Workstation Shipments	40	4	110	188	469	750	1,000	1,250	1,500	1,800	85%	31%
CPU Installed Base	39	41	155	350	866	1,650	2,700	3,950	5,450	7,050	117%	52%
Workstation Installed Base	42	46	156	344	813	1,550	2,550	3,750	5,150	6,700	110%	52%
PRICING DATA (Thousands of Dollars)												
Average System Price	77.7	521.5	42.3	42.3	53.4	39.5	33.5	30.1	27.7	26.0	-9%	-13%
Average Price per Seat	74.8	260.8	43.7	43.7	58.9	42.7	35.7	31.8	28.9	26.9	-6%	-15%
REVENUE DATA												
CPU Revenue	NA	NA	NA	5	19	16	17	18	18	19	NA	-0%
Workstation Revenue	NA	NA	NA	2	6	6	8	10	12	14	NA	20%
Software Revenue	NA	NA	NA	0	1	5	8	12	17	20	NA	80%
Peripheral Revenue	NA	NA	NA	2	2	6	7	8	10	11	NA	38%
Service Revenue	0	0	0	1	4	5	8	11	14	17	159%	37%
Total Revenue	3	1	5	9	32	39	48	59	71	82	79%	21%
Increase over Prior Year	NA	-61%	330%	78%	247%	22%	22%	24%	20%	15%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-18
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	17	110	323	600	800	1,050	1,350	1,650	NA	39%
Workstation Shipments	0	0	17	110	323	600	800	1,050	1,350	1,650	NA	39%
CPU Installed Base	0	0	17	127	450	1,050	1,850	2,900	4,150	5,600	NA	66%
Workstation Installed Base	0	0	17	127	450	1,050	1,850	2,900	4,150	5,600	NA	66%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	62.2	28.8	27.2	26.0	25.1	24.4	23.8	23.4	NA	-3%
Average Price per Seat	.0	.0	62.2	28.8	27.2	26.0	25.1	24.4	23.8	23.4	NA	-3%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	4	5	7	9	11	13	NA	27%
Workstation Revenue	NA	NA	NA	1	4	5	7	9	11	13	NA	27%
Software Revenue	NA	NA	NA	0	1	4	6	10	14	17	NA	103%
Peripheral Revenue	NA	NA	NA	1	0	2	3	5	7	9	NA	87%
Service Revenue	0	0	0	0	1	2	4	6	9	12	NA	59%
Total Revenue	0	0	1	4	10	18	28	39	52	64	NA	45%
Increase over Prior Year	NA	NA	NA	232%	187%	80%	50%	42%	33%	24%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-19
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	39	2	8	15	98	100	150	150	150	100	26%	0%
Workstation Shipments	40	4	4	9	50	50	50	50	50	50	6%	0%
CPU Installed Base	39	41	49	65	162	300	400	500	650	700	43%	34%
Workstation Installed Base	42	46	50	59	109	150	200	300	350	400	27%	30%
PRICING DATA (Thousands of Dollars)												
Average System Price	77.7	521.5	352.1	306.0	187.0	136.1	110.1	95.5	86.6	80.9	25%	-15%
Average Price per Seat	74.8	260.8	669.1	509.7	367.2	272.2	220.2	191.0	173.2	161.8	49%	-15%
REVENUE DATA												
CPU Revenue	NA	NA	NA	3	15	11	10	9	7	6	NA	-17%
Workstation Revenue	NA	NA	NA	0	2	1	1	1	1	1	NA	-10%
Software Revenue	NA	NA	NA	0	0	1	1	1	1	1	NA	43%
Peripheral Revenue	NA	NA	NA	1	2	3	3	3	3	3	NA	9%
Service Revenue	0	0	0	1	2	3	4	4	5	5	132%	17%
Total Revenue	3	1	3	5	21	19	18	18	17	15	61%	-6%
Increase over Prior Year	NA	-61%	158%	71%	291%	-7%	-5%	-3%	-5%	-9%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.2-20
 TITLE: History and Forecast
 APPLICATION: Electronic CAE
 REGION: Rest of World
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	89	69	96	100	100	100	100	100	NA	1%
Workstation Shipments	0	0	89	69	96	100	100	100	100	100	NA	1%
CPU Installed Base	0	0	89	158	254	350	450	550	650	750	NA	24%
Workstation Installed Base	0	0	89	158	254	350	450	550	650	750	NA	24%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	11.2	4.9	5.4	4.3	3.9	3.7	3.6	3.6	NA	-8%
Average Price per Seat	.0	.0	11.2	4.9	5.4	4.3	3.9	3.7	3.6	3.6	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-8%
Workstation Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-8%
Software Revenue	NA	NA	NA	0	0	1	1	1	2	2	NA	34%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	26%
Total Revenue	0	0	1	0	1	1	2	2	2	2	NA	19%
Increase over Prior Year	NA	NA	NA	-66%	179%	39%	28%	18%	9%	5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-3
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Worldwide
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	193	202	322	268	455	400	400	400	450	450	24%	-0%
Workstation Shipments	669	576	905	831	657	600	550	550	550	550	-0%	-3%
CPU Installed Base	987	1,190	1,512	1,780	2,235	2,550	2,800	3,050	3,300	3,500	23%	9%
Workstation Installed Base	3,337	3,913	4,818	5,649	6,306	6,600	6,750	6,900	6,950	7,000	17%	2%
PRICING DATA (Thousands of Dollars)												
Average System Price	464.2	553.5	500.2	374.0	218.1	195.5	175.7	158.3	142.6	128.5	-17%	-10%
Average Price per Seat	134.0	194.4	178.2	120.6	151.1	136.4	129.4	121.9	114.9	108.3	3%	-6%
REVENUE DATA												
CPU Revenue	NA	NA	NA	42	60	51	48	47	45	44	NA	-6%
Workstation Revenue	NA	NA	NA	30	21	16	12	9	7	4	NA	-28%
Software Revenue	NA	NA	NA	32	24	28	32	37	41	44	NA	12%
Peripheral Revenue	NA	NA	NA	13	10	9	8	8	8	8	NA	-6%
Service Revenue	13	14	21	20	16	21	21	21	20	20	5%	4%
Total Revenue	102	126	182	133	131	124	122	121	121	119	6%	-2%
Increase over Prior Year	NA	23%	44%	-27%	-1%	-5%	-2%	-1%	-1%	-1%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-4
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Worldwide
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	0	168	257	300	350	400	400	350	NA	6%
Workstation Shipments	0	0	0	168	257	300	350	400	400	350	NA	6%
CPU Installed Base	0	0	0	168	424	750	1,100	1,450	1,800	2,100	NA	38%
Workstation Installed Base	0	0	0	168	424	750	1,100	1,450	1,800	2,100	NA	38%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	.0	13.4	5.3	3.9	3.4	3.2	3.1	3.1	NA	-10%
Average Price per Seat	.0	.0	.0	13.4	5.3	3.9	3.4	3.2	3.1	3.1	NA	-10%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	1	1	1	1	1	1	NA	-4%
Workstation Revenue	NA	NA	NA	1	1	1	1	1	1	1	NA	-4%
Software Revenue	NA	NA	NA	1	0	0	0	0	0	0	NA	-11%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	55%
Total Revenue	0	0	0	2	2	1	1	1	1	1	NA	-2%
Increase over Prior Year	NA	NA	NA	NA	-37%	-7%	3%	1%	-1%	-5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-5
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	154	182	552	1,001	1,294	1,400	1,550	1,650	1,750	1,800	70%	7%
Workstation Shipments	523	443	956	1,330	1,395	1,500	1,600	1,700	1,800	1,850	28%	6%
CPU Installed Base	745	928	1,480	2,481	3,775	5,050	6,400	7,750	9,150	10,450	50%	23%
Workstation Installed Base	2,555	2,998	3,954	5,284	6,678	7,900	9,150	10,400	11,650	12,850	27%	14%
PRICING DATA (Thousands of Dollars)												
Average System Price	457.3	381.6	198.2	114.3	80.8	62.2	50.5	42.0	35.4	30.3	-35%	-18%
Average Price per Seat	134.8	157.0	114.5	86.0	75.0	58.4	48.2	40.5	34.4	29.7	-14%	-17%
REVENUE DATA												
CPU Revenue	NA	NA	NA	34	45	39	36	34	33	31	NA	-7%
Workstation Revenue	NA	NA	NA	29	23	21	19	17	14	12	NA	-13%
Software Revenue	NA	NA	NA	51	54	79	106	123	137	148	NA	23%
Peripheral Revenue	NA	NA	NA	16	12	11	10	10	9	8	NA	-7%
Service Revenue	10	10	16	21	20	24	26	28	28	29	18%	7%
Total Revenue	81	79	125	146	155	174	198	212	222	228	18%	8%
Increase over Prior Year	NA	-2%	58%	17%	6%	13%	14%	7%	5%	3%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-6
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	46	350	791	919	1,050	1,150	1,250	1,300	1,400	NA	9%
Workstation Shipments	0	46	350	791	919	1,050	1,150	1,250	1,300	1,400	NA	9%
CPU Installed Base	0	46	396	1,187	2,106	3,100	4,150	5,200	6,300	7,400	NA	29%
Workstation Installed Base	0	46	396	1,187	2,106	3,100	4,150	5,200	6,300	7,400	NA	29%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	93.5	72.8	77.2	57.5	46.0	36.8	29.4	23.6	18.8	NA	-20%
Average Price per Seat	.0	93.5	72.8	77.2	57.5	46.0	36.8	29.4	23.6	18.8	NA	-20%
REVENUE DATA												
CPU Revenue	NA	NA	NA	13	13	14	13	12	11	9	NA	-7%
Workstation Revenue	NA	NA	NA	13	13	14	13	12	11	9	NA	-7%
Software Revenue	NA	NA	NA	33	40	64	90	106	119	129	NA	26%
Peripheral Revenue	NA	NA	NA	9	6	7	6	6	5	5	NA	-7%
Service Revenue	0	0	2	9	12	12	15	16	18	19	NA	10%
Total Revenue	0	4	28	74	85	110	137	152	163	171	NA	15%
Increase over Prior Year	NA	NA	534%	167%	15%	30%	24%	11%	7%	5%		

Source: Dataquest
June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-7
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	154	136	203	152	255	200	200	200	250	250	13%	-0%
Workstation Shipments	523	397	606	480	355	300	300	300	250	250	-9%	-7%
CPU Installed Base	745	882	1,084	1,236	1,490	1,650	1,750	1,850	1,950	2,050	19%	7%
Workstation Installed Base	2,555	2,952	3,558	4,038	4,393	4,500	4,500	4,500	4,450	4,450	15%	0%
PRICING DATA (Thousands of Dollars)												
Average System Price	457.3	479.3	414.6	347.3	200.8	180.7	162.7	146.4	131.8	118.6	-19%	-10%
Average Price per Seat	134.8	164.3	138.6	109.6	143.9	127.3	120.6	114.2	108.3	102.5	2%	-7%
REVENUE DATA												
CPU Revenue	NA	NA	NA	21	32	25	23	22	22	22	NA	-8%
Workstation Revenue	NA	NA	NA	16	10	8	6	4	3	2	NA	-27%
Software Revenue	NA	NA	NA	18	13	15	16	17	18	19	NA	7%
Peripheral Revenue	NA	NA	NA	7	6	4	4	4	4	4	NA	-8%
Service Revenue	10	10	14	12	8	12	12	11	10	10	-5%	3%
Total Revenue	81	75	97	72	69	64	61	59	58	56	-4%	-4%
Increase over Prior Year	NA	-7%	30%	-27%	-3%	-8%	-5%	-3%	-2%	-2%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-8
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: North America
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	0	58	121	150	200	200	200	200	NA	11%
Workstation Shipments	0	0	0	58	121	150	200	200	200	200	NA	11%
CPU Installed Base	0	0	0	58	179	350	500	700	850	1,000	NA	41%
Workstation Installed Base	0	0	0	58	179	350	500	700	850	1,000	NA	41%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	.0	11.5	5.5	4.1	3.5	3.3	3.2	3.1	NA	-11%
Average Price per Seat	.0	.0	.0	11.5	5.5	4.1	3.5	3.3	3.2	3.1	NA	-11%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-3%
Workstation Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-3%
Software Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-8%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	55%
Total Revenue	0	0	0	1	1	1	1	1	1	1	NA	-1%
Increase over Prior Year	NA	NA	NA	NA	7%	0%	3%	1%	-1%	-5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-9
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	5	50	135	288	502	650	750	800	850	850	222%	11%
Workstation Shipments	8	131	217	381	541	700	800	850	900	900	185%	11%
CPU Installed Base	7	57	192	481	982	1,600	2,300	3,000	3,750	4,450	241%	35%
Workstation Installed Base	13	145	361	742	1,283	1,900	2,650	3,350	4,100	4,750	214%	30%
PRICING DATA (Thousands of Dollars)												
Average System Price	523.5	416.7	232.6	128.3	65.7	50.4	40.6	33.9	28.9	25.0	-40%	-18%
Average Price per Seat	299.5	157.9	145.1	97.1	61.0	47.8	39.0	32.9	28.2	24.6	-33%	-17%
REVENUE DATA												
CPU Revenue	NA	NA	NA	12	15	15	14	14	13	13	NA	-4%
Workstation Revenue	NA	NA	NA	9	7	8	8	7	6	5	NA	-9%
Software Revenue	NA	NA	NA	16	18	32	47	59	66	71	NA	32%
Peripheral Revenue	NA	NA	NA	5	3	4	4	4	4	3	NA	-0%
Service Revenue	0	4	5	7	8	6	7	8	9	10	132%	5%
Total Revenue	3	24	36	48	52	64	81	91	97	101	109%	14%
Increase over Prior Year	NA	806%	48%	33%	7%	24%	26%	13%	6%	4%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-10
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	6	76	203	337	450	550	600	650	650	NA	14%
Workstation Shipments	0	6	76	203	337	450	550	600	650	650	NA	14%
CPU Installed Base	0	6	82	285	622	1,050	1,600	2,150	2,750	3,250	NA	39%
Workstation Installed Base	0	6	82	285	622	1,050	1,600	2,150	2,750	3,250	NA	39%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	45.0	85.7	82.3	45.5	36.4	29.1	23.3	18.6	14.9	NA	-20%
Average Price per Seat	.0	45.0	85.7	82.3	45.5	36.4	29.1	23.3	18.6	14.9	NA	-20%
REVENUE DATA												
CPU Revenue	NA	NA	NA	4	4	5	5	5	4	4	NA	-2%
Workstation Revenue	NA	NA	NA	4	4	5	5	5	4	4	NA	-2%
Software Revenue	NA	NA	NA	9	12	24	38	48	54	58	NA	37%
Peripheral Revenue	NA	NA	NA	3	2	2	3	2	2	2	NA	0%
Service Revenue	0	0	1	2	4	3	5	5	6	7	NA	11%
Total Revenue	0	1	7	20	26	40	55	65	70	74	NA	24%
Increase over Prior Year	NA	NA	1095%	176%	29%	55%	40%	18%	8%	5%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-11
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	----	----
UNIT SHIPMENT DATA												
CPU Shipments	5	44	60	46	88	100	100	100	100	100	108%	3%
Workstation Shipments	8	125	141	138	127	100	100	100	100	100	98%	-5%
CPU Installed Base	7	51	111	156	244	300	400	450	500	600	141%	20%
Workstation Installed Base	13	139	280	418	545	650	700	800	850	900	154%	11%
PRICING DATA (Thousands of Dollars)												
Average System Price	523.5	467.7	419.0	422.4	196.1	176.5	158.8	143.0	128.6	115.8	-22%	-10%
Average Price per Seat	299.5	163.3	176.9	139.5	136.2	124.3	117.7	111.6	105.6	100.1	-18%	-6%
REVENUE DATA												
CPU Revenue	NA	NA	NA	9	11	9	9	9	9	9	NA	-5%
Workstation Revenue	NA	NA	NA	6	3	3	2	2	1	1	NA	-24%
Software Revenue	NA	NA	NA	6	6	8	9	11	12	13	NA	17%
Peripheral Revenue	NA	NA	NA	3	2	2	2	2	2	2	NA	-1%
Service Revenue	0	3	4	5	4	3	3	3	3	3	93%	-4%
Total Revenue	3	24	29	27	26	24	25	26	27	27	75%	1%
Increase over Prior Year	NA	783%	22%	-6%	-6%	-6%	4%	4%	3%	2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-12
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Europe
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	0	40	77	100	100	100	100	100	NA	5%
Workstation Shipments	0	0	0	40	77	100	100	100	100	100	NA	5%
CPU Installed Base	0	0	0	40	116	200	300	400	500	600	NA	39%
Workstation Installed Base	0	0	0	40	116	200	300	400	500	600	NA	39%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	.0	25.1	5.3	4.0	3.4	3.3	3.2	3.2	NA	-10%
Average Price per Seat	.0	.0	.0	25.1	5.3	4.0	3.4	3.3	3.2	3.2	NA	-10%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-5%
Workstation Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-5%
Software Revenue	NA	NA	NA	1	0	0	0	0	0	0	NA	-24%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	38%
Total Revenue	0	0	0	1	0	0	0	0	0	0	NA	-2%
Increase over Prior Year	NA	NA	NA	NA	-60%	-12%	3%	3%	0%	-5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-13
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Far East
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	3	23	98	271	411	550	650	700	750	800	250%	14%
Workstation Shipments	5	54	179	406	474	600	700	750	800	800	215%	11%
CPU Installed Base	4	27	125	396	807	1,350	1,950	2,550	3,200	3,850	271%	37%
Workstation Installed Base	8	62	241	646	1,121	1,700	2,300	2,950	3,650	4,250	247%	31%
PRICING DATA (Thousands of Dollars)												
Average System Price	521.9	1135.2	539.7	130.3	128.5	105.4	91.4	79.9	69.1	60.3	-30%	-14%
Average Price per Seat	298.5	481.9	294.5	87.1	111.4	95.7	85.1	75.4	65.7	57.7	-22%	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	13	19	23	25	25	24	23	NA	3%
Workstation Revenue	NA	NA	NA	11	14	15	16	16	14	13	NA	-2%
Software Revenue	NA	NA	NA	12	17	23	32	39	47	55	NA	27%
Peripheral Revenue	NA	NA	NA	4	7	7	8	9	8	8	NA	3%
Service Revenue	0	1	3	3	6	11	14	18	20	22	158%	29%
Total Revenue	2	27	56	42	63	80	95	106	114	120	152%	14%
Increase over Prior Year	NA	1623%	106%	-25%	51%	26%	20%	11%	7%	6%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-14
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Far East
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	1	46	142	278	400	500	550	600	650	NA	19%
Workstation Shipments	0	1	46	142	278	400	500	550	600	650	NA	19%
CPU Installed Base	0	1	47	189	467	850	1,350	1,850	2,400	2,900	NA	44%
Workstation Installed Base	0	1	47	189	467	850	1,350	1,850	2,400	2,900	NA	44%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	80.9	58.6	101.8	91.6	82.5	72.2	61.3	52.1	NA	-13%
Average Price per Seat	.0	.0	80.9	58.6	101.8	91.6	82.5	72.2	61.3	52.1	NA	-13%
REVENUE DATA												
CPU Revenue	NA	NA	NA	2	7	11	13	13	13	12	NA	10%
Workstation Revenue	NA	NA	NA	2	7	11	13	13	13	12	NA	10%
Software Revenue	NA	NA	NA	4	12	19	26	32	39	45	NA	30%
Peripheral Revenue	NA	NA	NA	1	4	5	6	7	6	6	NA	7%
Service Revenue	0	0	0	1	3	7	10	13	16	18	NA	39%
Total Revenue	0	0	4	10	34	53	68	79	86	92	NA	22%
Increase over Prior Year	NA	NA	NA	132%	261%	53%	30%	15%	9%	7%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-15
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Far East
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	3	22	51	67	77	50	50	50	50	100	130%	5%
Workstation Shipments	5	53	133	201	140	100	100	100	100	100	133%	-7%
CPU Installed Base	4	26	78	144	221	300	350	400	400	450	168%	15%
Workstation Installed Base	8	61	193	395	535	650	700	800	850	900	188%	11%
PRICING DATA (Thousands of Dollars)												
Average System Price	521.9	1187.0	954.2	397.1	315.4	283.8	255.5	230.0	206.9	186.2	-12%	-10%
Average Price per Seat	298.5	491.0	369.2	131.5	173.2	157.7	149.4	141.6	134.1	127.0	-13%	-6%
REVENUE DATA												
CPU Revenue	NA	NA	NA	11	12	12	12	11	11	11	NA	-2%
Workstation Revenue	NA	NA	NA	9	7	4	3	2	2	1	NA	-32%
Software Revenue	NA	NA	NA	7	5	4	6	7	9	10	NA	16%
Peripheral Revenue	NA	NA	NA	3	2	2	2	2	2	2	NA	-5%
Service Revenue	0	1	3	2	3	4	4	4	5	5	112%	10%
Total Revenue	2	27	52	32	29	27	26	27	27	28	106%	-1%
Increase over Prior Year	NA	1623%	91%	-39%	-10%	-7%	-1%	2%	2%	2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-16
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Far East
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	0	63	56	50	50	100	100	50	NA	-2%
Workstation Shipments	0	0	0	63	56	50	50	100	100	50	NA	-2%
CPU Installed Base	0	0	0	63	119	200	250	350	400	450	NA	30%
Workstation Installed Base	0	0	0	63	119	200	250	350	400	450	NA	30%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	.0	8.5	5.0	3.7	3.2	3.1	2.9	3.0	NA	-10%
Average Price per Seat	.0	.0	.0	8.5	5.0	3.7	3.2	3.1	2.9	3.0	NA	-10%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-7%
Workstation Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-7%
Software Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	NA
Total Revenue	0	0	0	1	0	0	0	0	0	0	NA	-2%
Increase over Prior Year	NA	NA	NA	NA	-47%	-10%	4%	0%	0%	-4%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-17
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	31	1	9	39	108	150	200	250	250	250	36%	18%
Workstation Shipments	133	1	25	47	107	150	200	250	250	250	-5%	19%
CPU Installed Base	231	231	240	280	387	550	700	900	1,100	1,300	14%	27%
Workstation Installed Base	761	762	787	834	941	1,050	1,200	1,400	1,550	1,650	5%	12%
PRICING DATA (Thousands of Dollars)												
Average System Price	484.4	490.2	357.1	90.6	86.0	68.2	56.6	47.7	41.5	36.0	-35%	-16%
Average Price per Seat	114.5	320.5	132.6	76.2	86.6	69.1	57.9	48.6	42.2	36.6	-7%	-16%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	6	6	6	6	5	5	NA	-4%
Workstation Revenue	NA	NA	NA	1	2	3	3	3	2	2	NA	-2%
Software Revenue	NA	NA	NA	1	1	2	3	3	3	3	NA	30%
Peripheral Revenue	NA	NA	NA	1	1	1	2	2	1	1	NA	9%
Service Revenue	2	0	0	1	1	3	3	4	4	4	-8%	24%
Total Revenue	17	0	4	4	11	15	17	17	16	15	-11%	7%
Increase over Prior Year	NA	-98%	1203%	16%	150%	39%	9%	1%	-2%	-6%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-18
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	0	28	70	100	150	200	200	200	NA	24%
Workstation Shipments	0	0	0	28	70	100	150	200	200	200	NA	24%
CPU Installed Base	0	0	0	28	98	200	350	550	700	850	NA	54%
Workstation Installed Base	0	0	0	28	98	200	350	550	700	850	NA	54%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	20.8	59.9	37.9	34.1	30.7	27.7	24.9	22.4	NA	-10%
Average Price per Seat	.0	.0	20.8	59.9	37.9	34.1	30.7	27.7	24.9	22.4	NA	-10%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	1	1	2	2	2	2	NA	10%
Workstation Revenue	NA	NA	NA	0	1	1	2	2	2	2	NA	10%
Software Revenue	NA	NA	NA	1	1	1	2	2	2	1	NA	19%
Peripheral Revenue	NA	NA	NA	0	0	1	1	1	1	1	NA	26%
Service Revenue	0	0	0	0	1	1	1	1	2	2	NA	32%
Total Revenue	0	0	0	2	3	5	6	7	7	7	NA	18%
Increase over Prior Year	NA	NA	NA	9700%	65%	55%	28%	12%	3%	-1%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.3-19
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	31	1	9	4	36	50	50	50	50	50	3%	7%
Workstation Shipments	133	1	25	12	35	50	50	50	50	50	-28%	8%
CPU Installed Base	231	231	240	244	280	300	350	350	400	400	5%	7%
Workstation Installed Base	761	762	787	798	833	850	800	800	800	750	2%	-2%
PRICING DATA (Thousands of Dollars)												
Average System Price	484.4	490.2	375.1	447.9	185.7	167.1	150.5	135.5	121.8	109.5	-21%	-10%
Average Price per Seat	114.5	320.5	134.7	160.0	190.0	175.9	167.2	150.6	135.3	121.7	13%	-9%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	5	5	5	4	4	3	NA	-7%
Workstation Revenue	NA	NA	NA	1	1	1	1	1	1	0	NA	-24%
Software Revenue	NA	NA	NA	0	0	1	1	2	2	2	NA	43%
Peripheral Revenue	NA	NA	NA	0	1	1	1	1	1	1	NA	-2%
Service Revenue	2	0	0	0	1	2	2	2	2	2	-18%	19%
Total Revenue	17	0	4	2	8	10	10	10	9	8	-18%	1%
Increase over Prior Year	NA	-98%	1197%	-38%	226%	33%	0%	-6%	-7%	-10%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.3-20
 TITLE: History and Forecast
 APPLICATION: IC Layout
 REGION: Rest of World
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	0	8	3	0	0	0	0	0	NA	-100%
Workstation Shipments	0	0	0	8	3	0	0	0	0	0	NA	-100%
CPU Installed Base	0	0	0	8	10	0	0	0	0	50	NA	37%
Workstation Installed Base	0	0	0	8	10	0	0	0	0	50	NA	37%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	.0	7.9	7.8	3.4	2.9	2.8	2.8	2.9	NA	-18%
Average Price per Seat	.0	.0	.0	7.9	7.8	3.4	2.9	2.8	2.8	2.9	NA	-18%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	0%
Workstation Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	0%
Software Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	NA
Total Revenue	0	0	0	0	0	0	0	0	0	0	NA	-20%
Increase over Prior Year	NA	NA	NA	NA	-50%	-67%	0%	0%	0%	0%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-1
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	703	1,089	2,755	4,871	9,437	12,000	13,450	14,650	15,450	16,250	91%	11%
Workstation Shipments	1,676	2,315	4,283	6,619	10,569	13,200	14,550	15,650	16,400	17,100	58%	10%
CPU Installed Base	2,442	3,531	6,287	11,157	20,594	32,200	44,950	58,250	71,500	84,350	70%	33%
Workstation Installed Base	5,944	8,260	12,542	19,161	29,730	42,050	55,450	69,150	82,700	95,600	50%	26%
PRICING DATA (Thousands of Dollars)												
Average System Price	277.6	209.8	122.2	90.0	55.5	44.4	38.9	35.6	33.5	31.9	-33%	-10%
Average Price per Seat	116.5	98.7	78.6	66.2	49.6	40.3	36.0	33.3	31.6	30.3	-19%	-9%
REVENUE DATA												
CPU Revenue	NA	NA	NA	140	191	200	200	202	204	206	NA	1%
Workstation Revenue	NA	NA	NA	123	144	145	142	140	138	135	NA	-1%
Software Revenue	NA	NA	NA	149	174	203	226	245	254	254	NA	8%
Peripheral Revenue	NA	NA	NA	53	66	73	78	85	93	101	NA	9%
Service Revenue	27	39	49	69	76	122	148	173	198	220	29%	24%
Total Revenue	223	267	385	521	651	743	794	846	887	916	31%	7%
Increase over Prior Year	NA	20%	44%	35%	25%	14%	7%	7%	5%	3%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-2
 TITLE: History and forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	564	1,245	2,118	3,637	4,800	6,000	7,200	8,350	9,450	NA	21%
Workstation Shipments	0	564	1,332	2,118	3,637	4,800	6,000	7,200	8,350	9,450	NA	21%
CPU Installed Base	0	564	1,809	3,927	7,564	12,300	18,050	24,700	32,050	39,900	NA	39%
Workstation Installed Base	0	564	1,896	4,014	7,651	12,350	18,100	24,750	32,150	39,950	NA	39%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	76.0	72.0	81.7	67.7	56.0	47.6	41.4	36.7	33.0	NA	-13%
Average Price per Seat	.0	76.0	67.3	81.7	67.7	56.0	47.6	41.4	36.7	33.0	NA	-13%
REVENUE DATA												
CPU Revenue	NA	NA	NA	40	68	76	83	88	91	93	NA	7%
Workstation Revenue	NA	NA	NA	40	67	76	83	88	91	93	NA	7%
Software Revenue	NA	NA	NA	74	85	99	117	135	147	152	NA	12%
Peripheral Revenue	NA	NA	NA	26	33	40	47	54	61	68	NA	15%
Service Revenue	0	4	9	29	33	59	80	101	121	141	NA	34%
Total Revenue	0	47	99	202	286	350	410	465	511	546	NA	14%
Increase over Prior Year	NA	NA	109%	105%	41%	22%	17%	14%	10%	7%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-3
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	703	525	513	593	845	850	850	850	850	850	5%	0%
Workstation Shipments	1,676	1,751	1,953	2,341	1,978	2,100	1,950	1,850	1,750	1,700	4%	-3%
CPU Installed Base	2,442	2,967	3,480	4,073	4,918	5,550	6,100	6,600	7,050	7,400	19%	9%
Workstation Installed Base	5,944	7,696	9,649	11,989	13,968	15,350	16,550	17,400	18,100	18,550	24%	6%
PRICING DATA (Thousands of Dollars)												
Average System Price	277.6	353.6	454.8	386.9	283.5	254.9	233.8	221.4	213.6	208.2	1%	-6%
Average Price per Seat	116.5	106.0	119.4	98.0	121.2	106.7	101.9	100.6	101.3	103.3	1%	-3%
REVENUE DATA												
CPU Revenue	NA	NA	NA	92	109	108	101	99	99	100	NA	-2%
Workstation Revenue	NA	NA	NA	75	62	53	43	37	33	29	NA	-14%
Software Revenue	NA	NA	NA	46	50	51	48	46	43	41	NA	-4%
Peripheral Revenue	NA	NA	NA	25	29	29	28	28	28	29	NA	0%
Service Revenue	27	34	38	39	38	60	64	68	71	73	9%	14%
Total Revenue	223	220	271	272	289	301	284	277	274	273	7%	-1%
Increase over Prior Year	NA	-1%	23%	0%	6%	4%	-6%	-2%	-1%	-1%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-4
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Worldwide
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	998	2,160	4,954	6,300	6,600	6,600	6,250	5,950	NA	4%
Workstation Shipments	0	0	998	2,160	4,954	6,300	6,600	6,600	6,250	5,950	NA	4%
CPU Installed Base	0	0	998	3,158	8,112	14,350	20,800	26,950	32,400	37,100	NA	36%
Workstation Installed Base	0	0	998	3,158	8,112	14,350	20,800	26,950	32,400	37,100	NA	36%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	14.0	16.7	7.7	6.5	5.8	5.5	5.3	5.1	NA	-8%
Average Price per Seat	.0	.0	14.0	16.7	7.7	6.5	5.8	5.5	5.3	5.1	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	8	14	16	16	15	14	13	NA	-1%
Workstation Revenue	NA	NA	NA	8	14	16	16	15	14	13	NA	-1%
Software Revenue	NA	NA	NA	28	39	53	61	64	64	61	NA	9%
Peripheral Revenue	NA	NA	NA	2	4	4	4	4	4	3	NA	-2%
Service Revenue	0	0	1	1	5	3	4	5	5	6	NA	5%
Total Revenue	0	0	15	47	76	92	100	103	101	97	NA	5%
Increase over Prior Year	NA	NA	NA	213%	61%	22%	9%	3%	-2%	-4%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-5
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	256	482	1,740	2,544	4,324	5,550	6,200	6,750	7,100	7,450	103%	11%
Workstation Shipments	751	1,115	2,604	3,518	4,694	5,850	6,450	6,950	7,300	7,600	58%	10%
CPU Installed Base	1,023	1,505	3,246	5,789	10,113	15,450	21,350	27,500	33,600	39,450	77%	31%
Workstation Installed Base	3,079	4,194	6,798	10,316	15,010	20,400	26,300	32,300	38,300	43,950	49%	24%
PRICING DATA (Thousands of Dollars)												
Average System Price	347.6	246.4	114.1	81.4	47.4	32.6	27.8	25.3	24.1	23.3	-39%	-13%
Average Price per Seat	118.3	106.6	76.3	58.9	43.7	30.9	26.8	24.6	23.6	22.9	-22%	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	65	86	65	61	61	61	61	NA	-7%
Workstation Revenue	NA	NA	NA	59	59	50	48	48	49	49	NA	-4%
Software Revenue	NA	NA	NA	73	66	87	97	106	112	114	NA	11%
Peripheral Revenue	NA	NA	NA	29	22	25	26	29	32	35	NA	10%
Service Revenue	12	20	30	38	35	47	55	62	70	78	31%	17%
Total Revenue	101	139	229	256	269	274	288	306	324	337	28%	5%
Increase over Prior Year	NA	38%	65%	12%	5%	2%	5%	6%	6%	4%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-6
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	213	709	1,316	1,818	2,350	2,950	3,500	4,050	4,500	NA	20%
Workstation Shipments	0	213	709	1,316	1,818	2,350	2,950	3,500	4,050	4,500	NA	20%
CPU Installed Base	0	213	922	2,238	4,055	6,400	9,200	12,400	15,950	19,650	NA	37%
Workstation Installed Base	0	213	922	2,238	4,055	6,400	9,200	12,400	15,950	19,650	NA	37%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	74.4	84.1	69.6	54.8	45.5	39.3	35.0	32.0	29.7	NA	-12%
Average Price per Seat	.0	74.4	84.1	69.6	54.8	45.5	39.3	35.0	32.0	29.7	NA	-12%
REVENUE DATA												
CPU Revenue	NA	NA	NA	20	30	30	33	36	38	40	NA	6%
Workstation Revenue	NA	NA	NA	20	29	30	33	36	38	40	NA	6%
Software Revenue	NA	NA	NA	39	32	42	52	61	68	71	NA	17%
Peripheral Revenue	NA	NA	NA	16	12	16	19	22	25	29	NA	19%
Service Revenue	0	2	6	14	14	25	33	42	50	59	NA	32%
Total Revenue	0	18	66	106	118	143	170	197	220	240	NA	15%
Increase over Prior Year	NA	NA	275%	61%	11%	22%	19%	16%	12%	9%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-7
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	256	269	284	284	382	300	250	250	250	250	11%	-8%
Workstation Shipments	751	902	1,147	1,258	753	600	500	450	400	350	0%	-14%
CPU Installed Base	1,023	1,292	1,576	1,859	2,242	2,450	2,600	2,700	2,750	2,800	22%	5%
Workstation Installed Base	3,079	3,981	5,128	6,386	7,139	7,400	7,500	7,500	7,450	7,300	23%	0%
PRICING DATA (Thousands of Dollars)												
Average System Price	347.6	382.6	462.1	358.1	242.0	193.6	164.6	146.1	133.7	125.3	-9%	-12%
Average Price per Seat	118.3	114.2	114.2	80.8	122.9	98.3	88.0	82.2	79.2	78.1	1%	-9%
REVENUE DATA												
CPU Revenue	NA	NA	NA	41	51	29	23	19	17	16	NA	-21%
Workstation Revenue	NA	NA	NA	35	24	14	10	7	6	5	NA	-28%
Software Revenue	NA	NA	NA	21	14	19	19	18	17	17	NA	3%
Peripheral Revenue	NA	NA	NA	12	10	8	6	5	5	5	NA	-13%
Service Revenue	12	18	24	23	18	21	20	19	18	17	12%	-1%
Total Revenue	101	121	155	128	118	91	78	69	64	60	4%	-13%
Increase over Prior Year	NA	21%	28%	-18%	-7%	-23%	-15%	-11%	-8%	-6%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-8
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: North America
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	748	944	2,124	2,850	3,000	3,000	2,850	2,700	NA	5%
Workstation Shipments	0	0	748	944	2,124	2,850	3,000	3,000	2,850	2,700	NA	5%
CPU Installed Base	0	0	748	1,692	3,816	6,650	9,600	12,400	14,900	17,000	NA	35%
Workstation Installed Base	0	0	748	1,692	3,816	6,650	9,600	12,400	14,900	17,000	NA	35%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	10.7	14.7	6.0	4.8	4.3	4.1	4.0	4.0	NA	-8%
Average Price per Seat	.0	.0	10.7	14.7	6.0	4.8	4.3	4.1	4.0	4.0	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	4	6	5	5	5	5	5	NA	-4%
Workstation Revenue	NA	NA	NA	4	6	5	5	5	5	5	NA	-4%
Software Revenue	NA	NA	NA	13	20	26	27	27	27	25	NA	5%
Peripheral Revenue	NA	NA	NA	1	0	1	1	1	1	1	NA	61%
Service Revenue	0	0	0	0	2	1	1	2	2	2	NA	-1%
Total Revenue	0	0	8	22	34	39	40	40	40	38	NA	2%
Increase over Prior Year	NA	NA	NA	180%	50%	16%	3%	0%	-2%	-5%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-9
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	7	494	692	1,248	2,773	3,300	3,750	4,250	4,650	5,050	339%	13%
Workstation Shipments	11	926	1,021	1,610	3,001	3,500	3,900	4,400	4,750	5,150	303%	11%
CPU Installed Base	12	505	1,197	2,445	5,218	8,450	12,050	16,000	20,050	24,150	361%	36%
Workstation Installed Base	18	944	1,965	3,575	6,576	9,900	13,600	17,550	21,650	25,750	336%	31%
PRICING DATA (Thousands of Dollars)												
Average System Price	514.0	164.9	109.4	89.6	54.9	43.2	36.5	31.2	27.2	23.7	-43%	-15%
Average Price per Seat	339.8	88.0	74.1	69.4	50.7	40.9	35.1	30.3	26.6	23.2	-38%	-14%
REVENUE DATA												
CPU Revenue	NA	NA	NA	34	52	46	45	43	42	39	NA	-5%
Workstation Revenue	NA	NA	NA	30	42	40	39	38	37	35	NA	-4%
Software Revenue	NA	NA	NA	42	56	65	74	80	81	79	NA	7%
Peripheral Revenue	NA	NA	NA	12	17	20	22	23	24	25	NA	8%
Service Revenue	0	13	12	20	23	34	42	49	56	62	174%	22%
Total Revenue	4	95	87	134	191	205	221	234	240	240	159%	5%
Increase over Prior Year	NA	2122%	-8%	54%	42%	8%	8%	6%	2%	0%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-10
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	302	498	411	1,268	1,700	2,200	2,700	3,150	3,600	NA	23%
Workstation Shipments	0	302	585	411	1,268	1,700	2,200	2,700	3,150	3,600	NA	23%
CPU Installed Base	0	302	800	1,211	2,479	4,150	6,300	8,750	11,600	14,600	NA	43%
Workstation Installed Base	0	302	887	1,298	2,566	4,250	6,350	8,850	11,650	14,700	NA	42%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	75.4	53.3	104.1	81.2	64.2	51.5	41.8	34.3	28.4	NA	-19%
Average Price per Seat	.0	75.4	45.4	104.1	81.2	64.2	51.5	41.8	34.3	28.4	NA	-19%
REVENUE DATA												
CPU Revenue	NA	NA	NA	11	27	31	33	33	32	31	NA	2%
Workstation Revenue	NA	NA	NA	11	27	31	33	33	32	31	NA	2%
Software Revenue	NA	NA	NA	18	38	38	43	46	48	48	NA	5%
Peripheral Revenue	NA	NA	NA	6	13	16	18	20	21	22	NA	12%
Service Revenue	0	2	3	9	13	24	31	39	46	52	NA	31%
Total Revenue	0	25	30	52	119	140	158	171	180	184	NA	9%
Increase over Prior Year	NA	NA	19%	75%	130%	18%	12%	9%	5%	2%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-11
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	7	192	134	131	148	100	100	100	100	100	111%	-8%
Workstation Shipments	11	624	376	493	377	300	250	250	200	200	140%	-12%
CPU Installed Base	12	203	337	468	616	700	800	850	900	900	170%	8%
Workstation Installed Base	18	642	1,018	1,511	1,887	2,100	2,250	2,350	2,400	2,450	219%	5%
PRICING DATA (Thousands of Dollars)												
Average System Price	514.0	305.6	354.5	413.4	279.8	211.9	173.5	149.8	134.5	124.2	-14%	-15%
Average Price per Seat	339.8	94.0	126.3	109.5	110.3	83.8	72.2	65.6	62.0	60.3	-25%	-11%
REVENUE DATA												
CPU Revenue	NA	NA	NA	21	21	12	10	8	7	7	NA	-21%
Workstation Revenue	NA	NA	NA	18	12	6	4	3	2	2	NA	-30%
Software Revenue	NA	NA	NA	12	8	9	9	9	9	9	NA	3%
Peripheral Revenue	NA	NA	NA	5	4	3	3	2	2	2	NA	-15%
Service Revenue	0	11	8	11	8	10	10	10	9	9	111%	2%
Total Revenue	4	70	56	66	52	41	35	32	30	28	87%	-12%
Increase over Prior Year	NA	1540%	-20%	18%	-20%	-21%	-14%	-10%	-7%	-5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-12
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Europe
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	60	706	1,356	1,450	1,450	1,450	1,400	1,350	NA	-0%
Workstation Shipments	0	0	60	706	1,356	1,450	1,450	1,450	1,400	1,350	NA	-0%
CPU Installed Base	0	0	60	766	2,123	3,550	5,000	6,350	7,600	8,600	NA	32%
Workstation Installed Base	0	0	60	766	2,123	3,550	5,000	6,350	7,600	8,600	NA	32%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	27.8	21.4	5.7	4.6	4.1	3.9	3.8	3.8	NA	-8%
Average Price per Seat	.0	.0	27.8	21.4	5.7	4.6	4.1	3.9	3.8	3.8	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	2	4	3	2	2	2	2	NA	-10%
Workstation Revenue	NA	NA	NA	2	4	3	2	2	2	2	NA	-10%
Software Revenue	NA	NA	NA	12	11	17	22	24	24	23	NA	16%
Peripheral Revenue	NA	NA	NA	1	0	1	1	1	1	1	NA	48%
Service Revenue	0	0	0	0	2	0	1	1	1	1	NA	-9%
Total Revenue	0	0	2	17	20	24	28	30	30	29	NA	8%
Increase over Prior Year	NA	NA	NA	745%	17%	21%	19%	7%	-1%	-5%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-13
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Far East
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	4	105	294	965	2,062	2,800	3,050	3,200	3,250	3,300	366%	10%
Workstation Shipments	7	237	605	1,353	2,586	3,500	3,750	3,900	3,900	3,900	344%	9%
CPU Installed Base	7	112	406	1,371	3,433	6,150	9,100	12,100	14,900	17,500	373%	39%
Workstation Installed Base	11	248	852	2,205	4,791	8,200	11,750	15,200	18,500	21,500	360%	35%
PRICING DATA (Thousands of Dollars)												
Average System Price	514.8	243.1	193.9	117.9	73.7	70.1	65.2	63.4	63.7	64.1	-38%	-3%
Average Price per Seat	340.4	108.0	94.2	84.1	58.8	55.7	53.0	52.3	53.1	54.1	-36%	-2%
REVENUE DATA												
CPU Revenue	NA	NA	NA	40	44	84	89	93	97	101	NA	18%
Workstation Revenue	NA	NA	NA	32	38	52	51	50	49	48	NA	5%
Software Revenue	NA	NA	NA	33	49	46	49	52	53	53	NA	1%
Peripheral Revenue	NA	NA	NA	12	25	26	28	31	35	38	NA	8%
Service Revenue	0	5	6	10	16	33	43	54	63	72	185%	35%
Total Revenue	3	30	63	125	173	240	260	280	297	311	188%	13%
Increase over Prior Year	NA	1110%	109%	97%	39%	39%	8%	8%	6%	5%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-14
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Far East
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	49	26	354	432	550	700	850	950	1,050	NA	19%
Workstation Shipments	0	49	26	354	432	550	700	850	950	1,050	NA	19%
CPU Installed Base	0	49	75	429	860	1,400	2,100	2,850	3,700	4,600	NA	40%
Workstation Installed Base	0	49	75	429	860	1,400	2,100	2,850	3,700	4,600	NA	40%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	86.7	90.5	103.9	90.4	81.0	74.3	69.3	65.6	62.8	NA	-7%
Average Price per Seat	.0	86.7	90.5	103.9	90.4	81.0	74.3	69.3	65.6	62.8	NA	-7%
REVENUE DATA												
CPU Revenue	NA	NA	NA	9	9	13	15	17	19	20	NA	17%
Workstation Revenue	NA	NA	NA	9	9	13	15	17	19	20	NA	17%
Software Revenue	NA	NA	NA	16	14	17	22	26	29	31	NA	17%
Peripheral Revenue	NA	NA	NA	4	8	7	8	10	12	15	NA	14%
Service Revenue	0	1	0	6	4	10	14	18	23	27	NA	45%
Total Revenue	0	5	2	42	44	60	74	89	102	113	NA	21%
Increase over Prior Year	NA	NA	-52%	1679%	5%	34%	24%	20%	15%	11%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-15
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Far East
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	****	****	****	****	****	****	****	****	****	****	****	****
UNIT SHIPMENT DATA												
CPU Shipments	4	56	87	172	265	400	400	450	450	450	179%	11%
Workstation Shipments	7	188	398	559	789	1,100	1,100	1,100	1,100	1,100	230%	7%
CPU Installed Base	7	63	150	322	586	950	1,300	1,700	2,050	2,350	204%	32%
Workstation Installed Base	11	199	596	1,156	1,945	2,950	3,950	4,800	5,650	6,300	267%	27%
PRICING DATA (Thousands of Dollars)												
Average System Price	514.8	379.3	580.1	410.0	363.0	331.8	310.4	295.4	284.7	276.9	-8%	-5%
Average Price per Seat	340.4	113.6	126.4	126.0	121.8	117.2	115.5	115.7	117.3	120.1	-23%	-0%
REVENUE DATA												
CPU Revenue	NA	NA	NA	29	31	64	66	69	72	74	NA	19%
Workstation Revenue	NA	NA	NA	22	24	31	28	26	24	22	NA	-2%
Software Revenue	NA	NA	NA	13	28	21	19	18	16	15	NA	-12%
Peripheral Revenue	NA	NA	NA	7	14	17	18	19	21	22	NA	9%
Service Revenue	0	4	6	5	11	22	28	33	38	42	158%	32%
Total Revenue	3	25	56	75	108	154	159	165	170	174	156%	10%
Increase over Prior Year	NA	914%	120%	35%	43%	43%	3%	4%	3%	3%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-16
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Far East
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	181	440	1,365	1,850	1,950	1,950	1,850	1,750	NA	5%
Workstation Shipments	0	0	181	440	1,365	1,850	1,950	1,950	1,850	1,750	NA	5%
CPU Installed Base	0	0	181	621	1,986	3,800	5,700	7,550	9,200	10,600	NA	40%
Workstation Installed Base	0	0	181	621	1,986	3,800	5,700	7,550	9,200	10,600	NA	40%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	23.9	15.1	12.4	10.7	9.7	8.9	8.4	8.1	NA	-8%
Average Price per Seat	.0	.0	23.9	15.1	12.4	10.7	9.7	8.9	8.4	8.1	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	5	8	8	7	7	6	NA	6%
Workstation Revenue	NA	NA	NA	1	5	8	8	7	7	6	NA	6%
Software Revenue	NA	NA	NA	4	7	7	8	8	8	7	NA	1%
Peripheral Revenue	NA	NA	NA	1	3	2	2	2	2	2	NA	-15%
Service Revenue	0	0	1	0	1	1	2	2	3	3	NA	24%
Total Revenue	0	0	5	7	21	26	27	27	26	24	NA	3%
Increase over Prior Year	NA	NA	NA	42%	193%	26%	4%	-1%	-5%	-6%		

Source: Dataquest
 June 1987

Appendix A Forecasts

TABLE NUMBER: A.4-17
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: All Platforms
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	436	8	29	114	278	350	400	400	400	450	-11%	10%
Workstation Shipments	907	37	53	138	288	350	400	400	450	450	-25%	9%
CPU Installed Base	1,401	1,409	1,438	1,552	1,830	2,100	2,400	2,700	3,000	3,250	7%	12%
Workstation Installed Base	2,836	2,874	2,927	3,065	3,353	3,550	3,800	4,000	4,250	4,400	4%	6%
PRICING DATA (Thousands of Dollars)												
Average System Price	230.1	345.3	186.5	49.6	53.5	36.5	32.2	30.8	29.8	29.2	-31%	-11%
Average Price per Seat	110.5	72.1	102.8	40.9	51.7	35.5	31.4	30.2	29.3	28.8	-17%	-11%
REVENUE DATA												
CPU Revenue	NA	NA	NA	2	9	5	5	5	5	5	NA	-10%
Workstation Revenue	NA	NA	NA	2	4	3	3	3	3	3	NA	-4%
Software Revenue	NA	NA	NA	1	2	5	6	7	8	8	NA	30%
Peripheral Revenue	NA	NA	NA	1	1	2	2	2	2	2	NA	13%
Service Revenue	15	1	0	1	2	8	8	8	8	8	-40%	34%
Total Revenue	115	3	6	7	18	23	24	25	26	27	-37%	9%
Increase over Prior Year	NA	-97%	72%	13%	168%	31%	4%	5%	3%	2%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-18
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: Technical Workstation
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	----	----	----	----	----	----	----	----	----	----	-----	-----
UNIT SHIPMENT DATA												
CPU Shipments	0	0	12	38	119	150	200	200	200	200	NA	11%
Workstation Shipments	0	0	12	38	119	150	200	200	200	200	NA	11%
CPU Installed Base	0	0	12	50	169	300	500	700	850	1,050	NA	44%
Workstation Installed Base	0	0	12	50	169	300	500	700	850	1,050	NA	44%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	89.2	52.2	39.7	34.9	32.9	31.9	31.4	31.2	NA	-5%
Average Price per Seat	.0	.0	89.2	52.2	39.7	34.9	32.9	31.9	31.4	31.2	NA	-5%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	2	2	2	2	2	2	NA	3%
Workstation Revenue	NA	NA	NA	1	2	2	2	2	2	2	NA	3%
Software Revenue	NA	NA	NA	1	1	2	2	1	1	1	NA	8%
Peripheral Revenue	NA	NA	NA	0	0	1	1	1	1	2	NA	31%
Service Revenue	0	0	0	0	1	1	1	2	2	3	NA	35%
Total Revenue	0	0	1	2	5	6	7	8	9	10	NA	13%
Increase over Prior Year	NA	NA	NA	127%	126%	19%	15%	12%	10%	8%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-19
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: Host-Dependent
 UNITS: Millions of Dollars/Actual Units

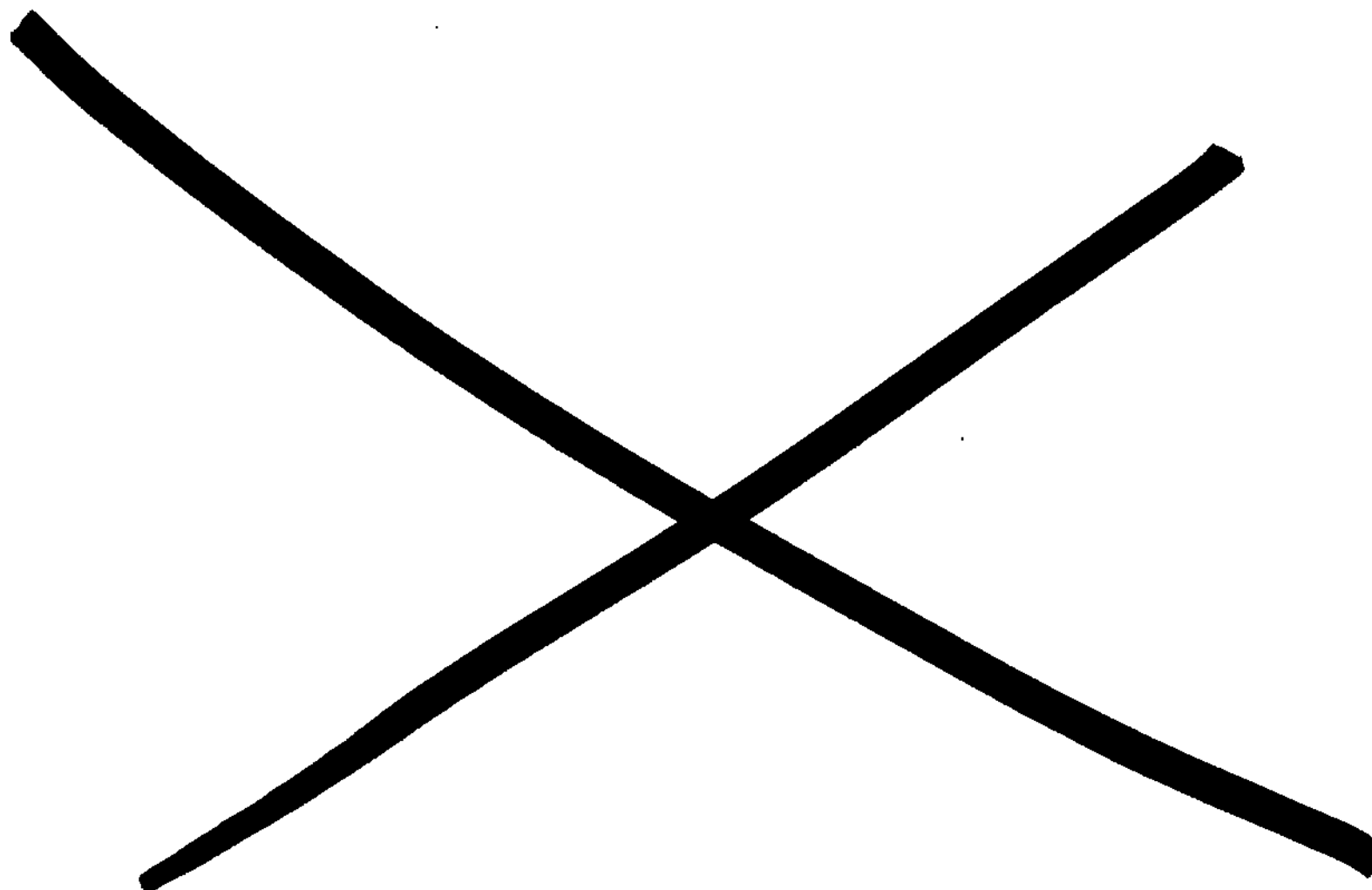
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	436	8	9	6	50	50	50	50	50	50	-42%	0%
Workstation Shipments	907	37	33	30	60	50	50	50	50	50	-49%	-3%
CPU Installed Base	1,401	1,409	1,417	1,424	1,474	1,450	1,450	1,400	1,350	1,350	1%	-2%
Workstation Installed Base	2,836	2,874	2,906	2,937	2,996	2,900	2,850	2,700	2,600	2,500	1%	-4%
PRICING DATA (Thousands of Dollars)												
Average System Price	230.1	345.3	513.9	506.4	191.2	131.8	111.1	102.5	98.6	96.7	-5%	-13%
Average Price per Seat	110.5	72.1	136.1	104.5	160.1	109.8	94.5	88.9	87.3	87.4	10%	-11%
REVENUE DATA												
CPU Revenue	NA	NA	NA	1	7	3	3	3	3	3	NA	-16%
Workstation Revenue	NA	NA	NA	1	2	2	1	1	1	1	NA	-14%
Software Revenue	NA	NA	NA	1	0	1	1	1	1	1	NA	21%
Peripheral Revenue	NA	NA	NA	0	1	1	1	1	1	1	NA	-1%
Service Revenue	15	1	0	1	1	7	6	6	6	5	-47%	35%
Total Revenue	115	3	5	4	11	14	12	12	11	11	-45%	-0%
Increase over Prior Year	NA	-97%	42%	-23%	193%	26%	-9%	-5%	-5%	-4%		

Source: Dataquest
 June 1987

TABLE NUMBER: A.4-20
 TITLE: History and Forecast
 APPLICATION: PCB Layout
 REGION: Rest of World
 PLATFORM: Personal Computer
 UNITS: Millions of Dollars/Actual Units

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
UNIT SHIPMENT DATA												
CPU Shipments	0	0	9	70	109	150	150	150	150	150	NA	7%
Workstation Shipments	0	0	9	70	109	150	150	150	150	150	NA	7%
CPU Installed Base	0	0	9	79	187	350	500	650	750	900	NA	37%
Workstation Installed Base	0	0	9	79	187	350	500	650	750	900	NA	37%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	.0	7.0	5.5	4.4	4.0	3.8	3.7	3.6	NA	-8%
Average Price per Seat	.0	.0	.0	7.0	5.5	4.4	4.0	3.8	3.7	3.6	NA	-8%
REVENUE DATA												
CPU Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-3%
Workstation Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	-3%
Software Revenue	NA	NA	NA	0	1	3	4	5	5	6	NA	45%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	NA
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	0%
Total Revenue	0	0	0	1	2	3	4	5	6	6	NA	32%
Increase over Prior Year	NA	NA	NA	NA	177%	107%	39%	21%	11%	5%		

Source: Dataquest
 June 1987



Appendix B—Market Share

INTRODUCTION

Appendix B presents Dataquest's market share estimates for the CAD/CAM industry. It is against Dataquest's corporate policy to publish or release individual forecasts for any company.

Please refer to "Introduction to the Service" for information on forecasting methodologies, companies contained within the data base, and caveats. Forecasting terms and definitions can be found in the glossary located behind the Appendix G tab.

We have tried to segment the market share data in as many meaningful ways as possible. As the Forecast Data Base binder tends to be quite large by nature, we have limited Appendix B to the following structure:

- Application
 - Region
 - Platform

Each market share analysis section includes data by total CAD/CAM revenue, hardware and software revenue, and workstation shipments. The sum of hardware plus software revenue does not equal total revenue because we did not include revenue derived from servicing CAD/CAM systems for these market share analyses.

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Appendix B Market Shares

TABLE NUMBER: B.1-1
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	213	188	0	779	11.5%	16.6%	.0%	2.2%
Mentor	174	86	65	1,900	9.4%	7.6%	12.9%	5.3%
Daisy	97	28	52	1,400	5.2%	2.4%	10.2%	3.9%
IBM	88	76	5	10,890	4.8%	6.7%	1.0%	30.5%
Apollo	74	65	0	2,885	4.0%	5.8%	.0%	8.1%
Racal-Redac	61	27	25	470	3.3%	2.4%	5.0%	1.3%
Valid	61	28	27	1,260	3.3%	2.4%	5.4%	3.5%
Seiko I&E	57	39	14	371	3.1%	3.5%	2.7%	1.0%
Calma	55	30	13	507	3.0%	2.7%	2.5%	1.4%
Scientific Calc.	50	19	16	154	2.7%	1.7%	3.1%	.4%
Computervision	49	32	14	517	2.7%	2.8%	2.8%	1.5%
Hewlett-Packard	42	30	8	949	2.3%	2.6%	1.6%	2.7%
Cadnetix	38	17	17	670	2.0%	1.5%	3.3%	1.9%
Zuken	32	16	13	319	1.7%	1.4%	2.6%	.9%
Calay	30	19	8	240	1.6%	1.7%	1.7%	.7%
NEC	25	16	7	461	1.3%	1.4%	1.4%	1.3%
Silvar-Lisco	24	0	21	0	1.3%	.0%	4.1%	.0%
Futurenet	24	1	20	400	1.3%	.1%	3.9%	1.1%
Zycad	20	18	0	0	1.1%	1.6%	.0%	.0%
Fujitsu	20	13	6	138	1.1%	1.1%	1.1%	.4%
Sun	18	16	0	855	1.0%	1.4%	.0%	2.4%
Control Data	18	11	4	281	1.0%	.9%	.7%	.8%
Intergraph	18	10	5	123	1.0%	.9%	.9%	.3%
Sharp System Products	17	11	5	95	.9%	.9%	1.0%	.3%
Applicon	17	12	3	221	.9%	1.1%	.5%	.6%
Tektronix	16	7	7	210	.9%	.6%	1.4%	.6%
Hitachi	13	8	5	57	.7%	.7%	1.0%	.2%
Telesis	13	8	4	170	.7%	.7%	.9%	.5%

(Continued)

Appendix B Market Shares

TABLE NUMBER: B.1-1 (Continued)
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Toshiba	5	4	0	36	.3%	.4%	.1%	.1%
Otsukashokai	4	2	1	303	.2%	.2%	.3%	.9%
Autodesk	2	0	2	0	.1%	.0%	.4%	.0%
Hitachi Zosen	1	1	0	16	.1%	.1%	.1%	.0%
Mitsubishi Electric	1	1	0	6	.1%	.1%	.0%	.0%
Other Companies	473	293	139	8,896	25.6%	25.9%	27.5%	25.0%
All Far East-Based Companies	216	133	69	2,686	11.7%	11.7%	13.6%	7.5%
All European-Based Companies	26	15	9	292	1.4%	1.3%	1.7%	.8%
All Hardware Companies	619	560	0	22,247	33.5%	49.4%	.0%	62.4%
All Turnkey & SW Companies	1,231	574	506	13,406	66.5%	50.6%	100.0%	37.6%
All Companies	1,851	1,134	506	35,653	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-2
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	171	86	63	1,900	20.4%	18.5%	23.1%	15.0%
Apollo	74	65	0	2,885	8.9%	14.1%	.0%	22.7%
Valid	55	26	24	1,141	6.6%	5.6%	8.8%	9.0%
Daisy	52	16	26	512	6.2%	3.5%	9.6%	4.0%
Racal-Redac	50	27	15	470	5.9%	5.9%	5.7%	3.7%
Hewlett-Packard	42	30	8	949	5.0%	6.5%	3.0%	7.5%
Computervision	40	28	10	450	4.8%	6.0%	3.8%	3.5%
Calma	35	18	10	390	4.2%	3.8%	3.6%	3.1%
Digital	35	31	0	779	4.2%	6.7%	.0%	6.1%
Cadnetix	30	17	10	670	3.6%	3.7%	3.6%	5.3%
Calay	30	19	8	240	3.6%	4.2%	3.1%	1.9%
Seiko I&E	23	14	8	89	2.7%	2.9%	2.8%	.7%
Sun	18	16	0	855	2.2%	3.5%	.0%	6.7%
Scientific Calc.	14	5	5	35	1.7%	1.0%	1.8%	.3%
Intergraph	14	7	4	98	1.6%	1.5%	1.5%	.8%
Telesis	11	7	4	91	1.3%	1.5%	1.4%	.7%
Sharp System Products	10	6	4	53	1.2%	1.2%	1.4%	.4%
Tektronix	8	3	4	94	1.0%	.7%	1.4%	.7%
Silver-Lisco	8	0	7	0	.9%	.0%	2.4%	.0%
NEC	7	5	2	81	.9%	1.0%	.7%	.6%
Zuken	2	1	1	30	.3%	.3%	.3%	.2%
IBM	1	1	0	12	.2%	.2%	.2%	.1%
Control Data	1	1	0	13	.2%	.1%	.2%	.1%
Autodesk	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	106	36	59	782	12.6%	7.7%	21.7%	6.2%
All Far East-Based Companies	56	32	20	301	6.7%	7.0%	7.3%	2.4%
All European-Based Companies	22	13	8	230	2.7%	2.8%	2.8%	1.8%
All Hardware Companies	133	117	0	4,713	15.8%	25.1%	.0%	37.1%
All Turnkey & SW Companies	706	348	273	7,977	84.2%	74.9%	100.0%	62.9%
All Companies	838	465	273	12,691	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.1-3
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Digital	178	157	0	0	24.2%	29.3%	.0%	.0%
Scientific Calc.	35	15	9	119	4.7%	2.7%	8.5%	3.5%
IBM	33	23	4	324	4.4%	4.3%	3.6%	9.5%
Zuken	29	15	12	290	4.0%	2.8%	11.0%	8.5%
Zycad	20	18	0	0	2.8%	3.4%	.0%	.0%
Calms	20	12	3	116	2.7%	2.3%	2.6%	3.4%
Fujitsu	19	12	5	108	2.6%	2.3%	4.8%	3.2%
Silvar-Lisco	17	0	14	0	2.3%	.0%	12.8%	.0%
Applicon	17	12	3	221	2.2%	2.3%	2.4%	6.5%
Control Data	16	10	3	268	2.2%	1.9%	2.6%	7.8%
Hitachi	13	8	5	57	1.8%	1.4%	4.5%	1.7%
NEC	12	9	2	80	1.6%	1.6%	1.9%	2.3%
Seiko I&E	8	6	1	53	1.1%	1.2%	1.3%	1.6%
Tektronix	8	4	3	116	1.1%	.7%	2.9%	3.4%
Sharp System Products	7	5	1	42	.9%	1.0%	1.0%	1.2%
Computervision	6	4	1	28	.8%	.7%	.7%	.8%
Toshiba	4	4	0	32	.6%	.7%	.4%	.9%
Intergraph	4	3	1	25	.6%	.5%	.5%	.7%
Hitachi Zosen	1	1	0	16	.2%	.1%	.4%	.5%
Mitsubishi Electric	1	1	0	6	.2%	.2%	.2%	.2%
Other Companies	287	218	42	1,523	39.0%	40.6%	37.6%	44.5%
All Far East-Based Companies	106	66	32	779	14.4%	12.3%	29.0%	22.7%
All European-Based Companies	3	2	1	53	.4%	.3%	1.1%	1.6%
All Hardware Companies	406	362	0	1,308	55.1%	67.6%	.0%	38.2%
All Turnkey & SM Companies	330	174	111	2,116	44.9%	32.4%	100.0%	61.8%
All Companies	736	536	111	3,425	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.1-4
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
IBM	54	53	1	10,554	19.5%	39.7%	.6%	54.0%
Daisy	45	11	26	888	16.2%	8.3%	20.9%	4.5%
Seiko I&E	26	19	5	229	9.3%	14.5%	3.9%	1.2%
Futurenet	24	1	20	400	8.6%	.8%	16.3%	2.0%
Racal-Redac	11	0	10	0	4.2%	.0%	8.1%	.0%
Cadnetix	8	0	7	0	2.7%	.0%	5.6%	.0%
NEC	6	3	3	300	2.2%	2.1%	2.3%	1.5%
Valid	6	2	3	119	2.0%	1.3%	2.7%	.6%
Computervision	4	1	3	39	1.3%	.4%	2.6%	.2%
Otsukashokai	4	2	1	303	1.3%	1.6%	1.1%	1.6%
Mentor	2	0	2	0	.9%	.0%	1.7%	.0%
Telesis	2	1	1	79	.8%	1.0%	.6%	.4%
Autodesk	2	0	2	0	.7%	.0%	1.5%	.0%
Scientific Calc.	2	0	1	0	.5%	.0%	.9%	.0%
Fujitsu	1	0	0	30	.2%	.3%	.1%	.2%
Toshiba	1	1	0	4	.2%	.4%	.0%	.0%
Control Data	0	0	0	0	.1%	.0%	.2%	.0%
Calma	0	0	0	1	.0%	.0%	.0%	.0%
Other Companies	80	39	38	6,592	29.2%	29.6%	31.0%	33.7%
All Far East-Based Companies	54	35	17	1,606	19.7%	26.0%	13.6%	8.2%
All European-Based Companies	0	0	0	9	.1%	.2%	.0%	.0%
All Hardware Companies	81	81	0	16,226	29.2%	60.6%	.0%	83.0%
All Turnkey & SW Companies	195	52	122	3,312	70.8%	39.4%	100.0%	17.0%
All Companies	276	133	122	19,538	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-5
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	119	105	0	436	12.9%	18.8%	.0%	2.1%
Mentor	101	49	38	1,246	10.9%	8.7%	14.9%	6.1%
IBM	48	43	3	6,535	5.2%	7.7%	1.0%	32.1%
Daisy	43	12	23	630	4.7%	2.2%	9.2%	3.1%
Apollo	38	34	0	1,481	4.1%	6.0%	.0%	7.3%
Scientific Calc.	34	13	11	105	3.7%	2.4%	4.2%	.5%
Calma	33	18	8	304	3.5%	3.2%	3.0%	1.5%
Cadnetix	32	15	14	576	3.5%	2.7%	5.6%	2.8%
Valid	28	13	12	585	3.0%	2.3%	4.9%	2.9%
Computervision	21	13	6	229	2.2%	2.4%	2.4%	1.1%
Zycad	19	17	0	0	2.0%	3.0%	.0%	.0%
Futurenet	17	1	14	334	1.9%	.2%	5.6%	1.6%
Hewlett-Packard	16	11	3	381	1.7%	2.0%	1.1%	1.9%
Calay	15	12	2	128	1.6%	2.1%	.9%	.6%
Tektronix	14	6	6	178	1.5%	1.1%	2.3%	.9%
Silvar-Lisco	13	0	11	0	1.4%	.0%	4.3%	.0%
Intergraph	13	7	3	88	1.4%	1.3%	1.3%	.4%
Sun	11	10	0	513	1.2%	1.7%	.0%	2.5%
Racal-Redac	11	5	4	115	1.2%	.9%	1.8%	.6%
Control Data	11	6	2	169	1.2%	1.2%	.9%	.8%
Applicon	10	7	2	148	1.1%	1.3%	.6%	.7%
Telesis	9	6	3	119	1.0%	1.0%	1.2%	.6%
Autodesk	1	0	1	0	.1%	.0%	.5%	.0%
Other Companies	266	156	87	6,077	28.8%	27.9%	34.2%	29.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	354	321	0	14,370	38.3%	57.3%	.0%	70.5%
All Turnkey & SW Companies	570	239	254	6,007	61.7%	42.7%	100.0%	29.5%
All Companies	924	560	254	20,377	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.1-6
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	99	49	36	1,246	23.9%	21.7%	26.5%	18.4%
Apollo	38	34	0	1,481	9.2%	15.0%	.0%	21.8%
Cadnetix	26	15	8	576	6.2%	6.7%	6.1%	8.5%
Valid	25	12	11	530	6.1%	5.4%	7.9%	7.8%
Daisy	23	7	12	230	5.6%	3.3%	8.5%	3.4%
Calma	21	11	6	242	5.2%	4.8%	4.4%	3.6%
Digital	20	17	0	436	4.8%	7.8%	.0%	6.4%
Computervision	18	12	5	204	4.3%	5.5%	3.3%	3.0%
Hewlett-Packard	16	11	3	381	3.8%	5.1%	2.1%	5.6%
Calay	15	12	2	128	3.6%	5.2%	1.6%	1.9%
Sun	11	10	0	513	2.7%	4.4%	.0%	7.6%
Intergraph	10	5	3	70	2.3%	2.3%	2.1%	1.0%
Scientific Calc.	9	3	3	24	2.3%	1.4%	2.5%	.3%
Racal-Redac	9	5	3	115	2.1%	2.2%	2.0%	1.7%
Telesis	8	5	3	64	1.9%	2.2%	1.9%	.9%
Tektronix	7	3	3	80	1.6%	1.2%	2.3%	1.2%
Silver-Lisco	4	0	3	0	.9%	.0%	2.4%	.0%
Control Data	1	0	0	9	.2%	.2%	.2%	.1%
IBM	1	0	0	7	.2%	.2%	.2%	.1%
Autodesk	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	54	12	36	448	13.0%	5.5%	26.0%	6.6%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	71	63	0	2,537	17.2%	28.1%	.0%	37.4%
All Turnkey & SW Companies	344	161	138	4,247	82.8%	71.9%	100.0%	62.6%
All Companies	415	224	138	6,784	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-7
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Digital	100	88	0	0	26.9%	32.3%	.0%	.0%
Scientific Calc.	23	10	6	81	6.3%	3.7%	12.4%	5.3%
Zycad	19	17	0	0	5.0%	6.2%	.0%	.0%
IBM	15	11	2	154	4.0%	4.0%	3.7%	10.2%
Calma	11	7	2	61	3.1%	2.7%	3.1%	4.0%
Applicon	10	7	2	148	2.7%	2.7%	3.1%	9.7%
Control Data	10	6	2	161	2.6%	2.2%	3.4%	10.6%
Silvar-Lisco	9	0	8	0	2.4%	.0%	14.8%	.0%
Tektronix	7	3	3	99	1.8%	1.2%	5.3%	6.5%
Intergraph	3	2	0	18	.8%	.7%	.8%	1.2%
Computervision	1	1	0	7	.4%	.3%	.4%	.5%
Other Companies	162	119	27	790	43.8%	44.0%	52.9%	52.0%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	227	203	0	732	61.4%	74.7%	.0%	48.2%
All Turnkey & SW Companies	143	69	52	787	38.6%	25.3%	100.0%	51.8%
All Companies	370	272	52	1,519	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-8
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
IBM	33	32	0	6,373	23.5%	49.6%	.6%	52.8%
Daisy	20	5	11	400	14.5%	7.8%	17.8%	3.3%
Futurenet	17	1	14	334	12.5%	1.4%	22.2%	2.8%
Cadnetix	6	0	6	0	4.7%	.0%	9.1%	.0%
Valid	3	1	2	55	1.9%	1.3%	2.3%	.5%
Racal-Redac	2	0	2	0	1.5%	.0%	2.7%	.0%
Computervision	2	0	1	18	1.2%	.4%	2.2%	.1%
Mentor	2	0	1	0	1.2%	.0%	2.2%	.0%
Telesis	1	1	1	55	1.1%	1.4%	.8%	.5%
Autodesk	1	0	1	0	.9%	.0%	1.9%	.0%
Scientific Calc.	1	0	1	0	.7%	.0%	1.1%	.0%
Control Data	0	0	0	0	.2%	.0%	.3%	.0%
Calma	0	0	0	1	.0%	.0%	.0%	.0%
Other Companies	50	25	24	4,838	36.1%	38.1%	36.7%	40.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	55	55	0	11,101	39.9%	85.8%	.0%	91.9%
All Turnkey & SW Companies	83	9	64	973	60.1%	14.2%	100.0%	8.1%
All Companies	138	64	64	12,074	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-9
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Racal-Redac	46	21	19	310	10.3%	8.1%	14.0%	4.0%
Daisy	43	12	23	630	9.7%	4.9%	17.1%	8.1%
Digital	43	38	0	156	9.6%	14.7%	.0%	2.0%
Mentor	41	20	16	512	9.2%	7.8%	11.4%	6.5%
Computervision	24	16	7	267	5.4%	6.1%	5.3%	3.4%
IBM	22	19	2	2,430	5.0%	7.4%	1.2%	31.1%
Valid	21	10	10	438	4.8%	3.8%	7.1%	5.6%
Hewlett-Packard	19	13	3	453	4.2%	5.3%	2.5%	5.8%
Scientific Calc.	14	5	4	43	3.1%	2.1%	3.2%	.6%
Apollo	13	12	0	516	3.0%	4.6%	.0%	6.6%
Calay	13	6	6	96	3.0%	2.5%	4.3%	1.2%
Silvar-Lisco	9	0	8	0	2.1%	.0%	5.8%	.0%
Applicon	6	4	1	61	1.3%	1.7%	.7%	.8%
Control Data	5	3	1	83	1.2%	1.2%	.8%	1.1%
Calma	5	2	1	38	1.1%	.8%	.6%	.5%
Intergraph	4	2	1	28	.9%	.9%	.8%	.4%
Sun	4	3	0	171	.8%	1.3%	.0%	2.2%
Futurenet	3	0	3	59	.7%	.1%	1.9%	.8%
Cadnetix	3	1	1	54	.7%	.5%	1.0%	.7%
Telesis	3	2	1	36	.6%	.7%	.7%	.5%
Tektronix	2	1	1	32	.5%	.4%	.8%	.4%
Zycad	1	1	0	0	.3%	.4%	.0%	.0%
Autodesk	0	0	0	0	.1%	.0%	.3%	.0%
Other Companies	100	63	28	1,334	22.5%	24.7%	20.7%	17.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	26	15	9	292	5.8%	5.8%	6.5%	3.7%
All Hardware Companies	122	110	0	4,185	27.3%	43.2%	.0%	53.5%
All Turnkey & SW Companies	325	145	136	3,634	72.7%	56.8%	100.0%	46.5%
All Companies	447	255	136	7,819	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-10
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Mentor	41	20	15	512	16.2%	14.7%	17.8%	14.5%
Recal-Redac	37	21	12	310	15.0%	15.3%	13.8%	8.8%
Daisy	23	7	12	230	9.4%	5.5%	14.0%	6.5%
Computervision	21	14	5	238	8.2%	10.7%	6.3%	6.7%
Valid	19	9	8	396	7.7%	6.6%	10.1%	11.2%
Hewlett-Packard	19	13	3	453	7.5%	10.0%	4.0%	12.8%
Apollo	13	12	0	516	5.3%	8.7%	.0%	14.6%
Calay	13	6	6	96	5.3%	4.7%	7.0%	2.7%
Digital	7	6	0	156	2.8%	4.6%	.0%	4.4%
Scientific Calc.	4	1	1	10	1.6%	1.0%	1.7%	.3%
Sun	4	3	0	171	1.5%	2.4%	.0%	4.8%
Intergraph	3	2	1	22	1.2%	1.2%	1.1%	.6%
Silvar-Lisco	3	0	2	0	1.1%	.0%	2.8%	.0%
Cadnetix	2	1	1	54	1.0%	1.0%	.9%	1.5%
Calma	2	1	0	16	1.0%	.7%	.4%	.5%
Telesis	2	1	1	19	.9%	1.1%	.9%	.5%
Tektronix	1	0	1	14	.5%	.4%	.7%	.4%
IBM	1	0	0	5	.2%	.2%	.2%	.1%
Control Data	0	0	0	3	.1%	.1%	.1%	.1%
Other Companies	34	15	15	241	13.4%	11.2%	18.1%	6.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	22	13	8	230	9.0%	9.6%	8.9%	6.5%
All Hardware Companies	25	22	0	891	10.1%	16.4%	.0%	25.2%
All Turnkey & SW Companies	225	113	84	2,644	89.9%	83.6%	100.0%	74.8%
All Companies	250	135	84	3,535	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-11
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	36	31	0	0	25.9%	32.0%	.0%	.0%
Scientific Calc.	10	4	3	33	7.0%	4.2%	12.6%	5.1%
IBM	10	7	1	99	6.9%	7.1%	5.8%	15.1%
Silvar-Lisco	7	0	6	0	4.7%	.0%	26.3%	.0%
Applicon	6	4	1	61	4.2%	4.3%	4.6%	9.4%
Control Data	5	3	1	80	3.6%	3.1%	4.2%	12.3%
Calma	3	1	0	22	1.9%	1.1%	1.9%	3.3%
Computervision	2	1	0	8	1.2%	1.0%	1.0%	1.3%
Zycad	1	1	0	0	.9%	1.1%	.0%	.0%
Tektronix	1	1	0	17	.9%	.6%	2.3%	2.7%
Intergraph	1	1	0	6	.7%	.6%	.7%	.9%
Other Companies	58	44	9	326	42.1%	44.8%	40.5%	50.0%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	3	2	1	53	2.2%	1.7%	6.1%	8.2%
All Hardware Companies	82	73	0	264	59.5%	74.6%	.0%	40.5%
All Turnkey & SW Companies	56	25	21	388	40.5%	25.4%	100.0%	59.5%
All Companies	138	98	21	653	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-12
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Daisy	20	5	11	400	33.9%	22.5%	37.2%	11.0%
IBM	12	12	0	2,326	20.4%	53.0%	.8%	64.1%
Racal-Redac	9	0	7	0	14.6%	.0%	24.0%	.0%
Futurenet	3	0	3	59	5.2%	.7%	8.2%	1.6%
Computervision	2	0	2	21	3.3%	1.2%	5.4%	.6%
Valid	2	1	1	42	3.3%	2.8%	3.7%	1.1%
Mentor	1	0	1	0	1.2%	.0%	1.9%	.0%
Cadnetix	1	0	1	0	1.0%	.0%	1.7%	.0%
Telesis	0	0	0	17	.8%	1.3%	.5%	.5%
Autodesk	0	0	0	0	.7%	.0%	1.4%	.0%
Scientific Calc.	0	0	0	0	.7%	.0%	.9%	.0%
Control Data	0	0	0	0	.2%	.0%	.3%	.0%
Other Companies	9	4	4	767	14.8%	18.5%	14.0%	21.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	9	.5%	.9%	.2%	.2%
All Hardware Companies	15	15	0	3,029	25.4%	67.9%	.0%	83.4%
All Turnkey & SW Companies	44	7	31	601	74.6%	32.1%	100.0%	16.6%
All Companies	59	22	31	3,631	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.1-13
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Seiko I&E	57	39	14	371	13.5%	14.6%	12.4%	5.6%
Digital	32	28	0	117	7.6%	10.5%	.0%	1.8%
Zuken	32	16	13	319	7.5%	6.0%	11.7%	4.8%
Mentor	31	18	12	143	7.5%	6.5%	10.5%	2.2%
NEC	25	16	7	461	5.9%	6.0%	6.2%	7.0%
Fujitsu	20	13	6	138	4.7%	4.8%	4.9%	2.1%
Sharp System Products	17	11	5	95	4.0%	4.0%	4.4%	1.4%
IBM	16	13	1	1,763	3.9%	4.9%	.7%	26.7%
Apollo	15	13	0	592	3.6%	5.0%	.0%	9.0%
Calma	14	8	3	134	3.4%	3.0%	3.0%	2.0%
Hitachi	13	8	5	57	3.2%	2.8%	4.5%	.9%
Valid	11	5	5	225	2.6%	1.8%	4.4%	3.4%
Daisy	10	3	5	140	2.3%	1.0%	4.6%	2.1%
Hewlett-Packard	6	4	2	81	1.4%	1.5%	1.5%	1.2%
Toshiba	5	4	0	36	1.2%	1.6%	.4%	.5%
Computervision	4	2	1	16	.9%	.9%	.7%	.2%
Otsukashokai	4	2	1	303	.9%	.8%	1.2%	4.6%
Racal-Redac	3	1	1	33	.8%	.5%	1.2%	.5%
Futurenet	3	0	3	0	.7%	.0%	2.4%	.0%
Sun	3	2	0	128	.7%	.9%	.0%	1.9%
Cadnetix	2	1	1	40	.5%	.4%	.9%	.6%
Scientific Calc.	2	1	1	6	.5%	.3%	.6%	.1%
Silvar-Lisco	2	0	2	0	.5%	.0%	1.6%	.0%
Calay	2	1	0	13	.4%	.4%	.2%	.2%
Hitachi Zosen	1	1	0	16	.3%	.3%	.4%	.2%
Mitsubishi Electric	1	1	0	6	.3%	.4%	.2%	.1%
Telesis	1	1	0	12	.2%	.2%	.3%	.2%
Control Data	1	1	0	14	.2%	.2%	.2%	.2%

(Continued)

Appendix B Market Shares

TABLE NUMBER: 8.1-13 (Continued)
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Applicon	0	0	0	7	.1%	.1%	.1%	.1%
Zycad	0	0	0	0	.1%	.1%	.0%	.0%
Autodesk	0	0	0	0	.0%	.0%	.1%	.0%
Other Companies	86	56	23	1,327	20.4%	20.6%	20.6%	20.1%
All Far East-Based Companies	216	133	69	2,686	51.6%	49.4%	61.4%	40.7%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	95	85	0	2,969	22.6%	31.7%	.0%	45.0%
All Turnkey & SW Companies	325	184	112	3,625	77.4%	68.3%	100.0%	55.0%
All Companies	420	269	112	6,595	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-14
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	31	18	12	143	20.3%	19.2%	24.0%	7.7%
Seiko I&E	23	14	8	89	14.6%	14.9%	15.7%	4.8%
Apollo	15	13	0	592	9.9%	14.7%	.0%	31.8%
Sharp System Products	10	6	4	53	6.5%	6.1%	7.7%	2.8%
Valid	10	5	4	204	6.4%	5.0%	9.0%	11.0%
Calma	9	5	3	107	6.1%	5.2%	5.5%	5.7%
NEC	7	5	2	81	4.6%	5.1%	4.1%	4.3%
Hewlett-Packard	6	4	2	81	3.9%	4.4%	3.5%	4.4%
Digital	5	5	0	117	3.4%	5.1%	.0%	6.3%
Daisy	5	2	3	51	3.4%	1.8%	5.4%	2.8%
Sun	3	2	0	128	1.8%	2.7%	.0%	6.9%
Racal-Redac	3	1	1	33	1.7%	1.6%	1.6%	1.8%
Zuken	2	1	1	30	1.5%	1.4%	1.8%	1.6%
Cadnetix	2	1	1	40	1.2%	1.1%	1.2%	2.2%
Calay	2	1	0	13	1.0%	1.3%	.5%	.7%
Computervision	1	1	0	4	.8%	.7%	.7%	.2%
Silvar-Lisco	1	0	1	0	.6%	.0%	1.8%	.0%
Telesis	1	0	0	6	.5%	.5%	.5%	.3%
Scientific Calc.	1	0	0	1	.4%	.2%	.4%	.1%
Control Data	0	0	0	1	.0%	.0%	.0%	.0%
Other Companies	18	8	8	87	11.6%	9.1%	16.6%	4.7%
All Far East-Based Companies	56	32	20	301	36.4%	35.5%	40.7%	16.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	24	21	0	870	15.6%	23.3%	.0%	46.8%
All Turnkey & SW Companies	131	70	49	989	84.4%	76.7%	100.0%	53.2%
All Companies	155	91	49	1,860	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-15
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
	-----	-----	-----	-----	-----	-----	-----	-----
Zuken	29	15	12	290	15.5%	11.3%	32.4%	26.1%
Digital	27	24	0	0	14.1%	17.8%	.0%	.0%
Fujitsu	19	12	5	108	10.1%	9.4%	14.1%	9.7%
Hitachi	13	8	5	57	7.1%	5.7%	13.3%	5.2%
NEC	12	9	2	80	6.2%	6.5%	5.7%	7.2%
Seiko I&E	8	6	1	53	4.4%	4.9%	3.7%	4.8%
IBM	8	5	1	68	4.2%	3.6%	2.2%	6.1%
Sharp System Products	7	5	1	42	3.6%	3.9%	3.0%	3.8%
Calma	5	3	1	27	2.6%	2.4%	1.9%	2.4%
Toshiba	4	4	0	32	2.3%	2.8%	1.1%	2.9%
Computervision	3	2	0	12	1.5%	1.4%	1.1%	1.1%
Scientific Calc.	1	1	0	5	.7%	.4%	1.0%	.4%
Hitachi Zosen	1	1	0	16	.7%	.5%	1.2%	1.4%
Mitsubishi Electric	1	1	0	6	.7%	.7%	.6%	.5%
Silvar-Lisco	1	0	1	0	.5%	.0%	2.3%	.0%
Control Data	1	1	0	13	.4%	.4%	.4%	1.2%
Applicon	0	0	0	7	.3%	.3%	.2%	.7%
Zycad	0	0	0	0	.2%	.3%	.0%	.0%
Other Companies	47	37	6	292	24.7%	27.8%	15.2%	26.3%
All Far East-Based Companies	106	66	32	779	55.9%	49.9%	85.4%	70.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	61	55	0	197	32.3%	41.2%	.0%	17.8%
All Turnkey & SW Companies	128	78	38	912	67.7%	58.8%	100.0%	82.2%
All Companies	189	132	38	1,109	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-16
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Seiko I&E	26	19	5	229	33.8%	42.3%	18.9%	6.3%
IBM	8	8	0	1,695	11.1%	18.5%	.0%	46.7%
NEC	6	3	3	300	8.0%	6.1%	10.9%	8.3%
Daisy	4	1	3	89	5.9%	2.4%	10.0%	2.4%
Otsukashokai	4	2	1	303	4.8%	4.5%	5.4%	8.4%
Futurenet	3	0	3	0	4.0%	.0%	10.6%	.0%
Valid	1	0	1	21	1.3%	.7%	2.3%	.6%
Fujitsu	1	0	0	30	.9%	.9%	.7%	.8%
Toshiba	1	1	0	4	.9%	1.2%	.2%	.1%
Racal-Redac	1	0	1	0	.8%	.0%	2.0%	.0%
Cadnetix	0	0	0	0	.6%	.0%	1.6%	.0%
Telesis	0	0	0	6	.2%	.2%	.2%	.2%
Autodesk	0	0	0	0	.2%	.0%	.5%	.0%
Scientific Calc.	0	0	0	0	.1%	.0%	.2%	.0%
Control Data	0	0	0	0	.0%	.0%	.0%	.0%
Calma	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	21	11	9	949	27.5%	23.2%	36.4%	26.2%
All Far East-Based Companies	54	35	17	1,606	71.8%	75.8%	65.3%	44.3%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	9	9	0	1,902	12.5%	20.8%	.0%	52.4%
All Turnkey & SW Companies	66	36	25	1,724	87.5%	79.2%	100.0%	47.6%
All Companies	76	46	25	3,626	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-17
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	19	17	0	70	31.7%	34.1%	.0%	8.1%
Apollo	8	7	0	296	12.6%	13.5%	.0%	34.3%
Calma	3	2	1	31	5.5%	3.8%	19.8%	3.6%
Hewlett-Packard	1	1	0	34	2.4%	2.1%	6.5%	4.0%
IBM	1	1	0	162	1.9%	2.1%	1.3%	18.8%
Racal-Redac	1	1	0	12	1.8%	1.0%	11.6%	1.3%
Intergraph	1	1	0	7	1.5%	1.1%	6.0%	.8%
Sun	1	1	0	43	1.5%	1.7%	.0%	5.0%
Control Data	1	1	0	14	1.5%	1.1%	4.3%	1.6%
Valid	1	0	0	13	1.0%	.6%	7.0%	1.4%
Computervision	0	0	0	5	.8%	.6%	3.5%	.6%
Futurenet	0	0	0	7	.6%	.0%	7.5%	.8%
Applicon	0	0	0	5	.5%	.5%	1.3%	.6%
Calay	0	0	0	3	.5%	.5%	1.0%	.3%
Telesis	0	0	0	3	.5%	.3%	2.0%	.4%
Silvar-Lisco	0	0	0	0	.4%	.0%	5.0%	.0%
Zycad	0	0	0	0	.3%	.4%	.0%	.0%
Autodesk	0	0	0	0	.2%	.0%	2.8%	.0%
Other Companies	21	18	1	159	34.7%	36.7%	20.4%	18.4%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	49	43	0	724	80.3%	87.6%	.0%	83.8%
All Turnkey & SW Companies	12	6	4	139	19.7%	12.4%	100.0%	16.2%
All Companies	61	49	4	863	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-18
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Apollo	8	7	0	296	40.5%	46.4%	.0%	57.8%
Digital	3	3	0	70	16.9%	19.3%	.0%	13.7%
Calma	2	1	1	25	11.6%	7.8%	31.6%	4.8%
Hewlett-Packard	1	1	0	34	7.7%	7.2%	13.3%	6.7%
Sun	1	1	0	43	4.9%	5.7%	.0%	8.4%
Racal-Redac	1	1	0	12	4.8%	3.5%	14.3%	2.3%
Intergraph	1	0	0	5	3.8%	2.6%	10.7%	1.0%
Valid	1	0	0	11	2.9%	1.9%	12.8%	2.2%
Computervision	0	0	0	5	2.2%	2.0%	5.6%	.9%
Calay	0	0	0	3	1.6%	1.6%	2.0%	.5%
Telesis	0	0	0	2	1.2%	1.0%	3.6%	.4%
Control Data	0	0	0	1	.4%	.2%	1.0%	.1%
Silver-Lisco	0	0	0	0	.4%	.0%	3.1%	.0%
IBM	0	0	0	0	.1%	.0%	.0%	.0%
Other Companies	0	0	0	6	1.0%	.9%	2.0%	1.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	12	10	0	415	63.1%	72.3%	.0%	81.0%
All Turnkey & SW Companies	7	4	2	97	36.9%	27.7%	100.0%	19.0%
All Companies	19	14	2	512	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-19
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	16	14	0	0	40.9%	41.5%	.0%	.0%
Calma	1	1	0	6	2.9%	2.2%	23.3%	4.3%
Control Data	1	1	0	13	2.1%	1.5%	19.2%	9.3%
Applicon	0	0	0	5	.8%	.7%	6.8%	3.4%
IBM	0	0	0	3	.8%	.7%	5.5%	2.3%
Intergraph	0	0	0	1	.6%	.4%	4.1%	.9%
Zycad	0	0	0	0	.5%	.5%	.0%	.0%
Silver-Lisco	0	0	0	0	.4%	.0%	19.2%	.0%
Computervision	0	0	0	0	.1%	.1%	.0%	.1%
Other Companies	20	18	0	115	50.9%	52.4%	21.9%	79.7%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	36	32	0	115	91.3%	93.9%	.0%	79.7%
All Turnkey & SW Companies	3	2	1	29	8.7%	6.1%	100.0%	20.3%
All Companies	39	34	1	144	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.1-20
 TITLE: 1986 Market Share
 APPLICATION: Electronic Design Automation
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
IBM	1	1	0	159	32.0%	75.5%	.8%	76.7%
Futurenet	0	0	0	7	14.2%	1.9%	23.3%	3.4%
Racal-Redac	0	0	0	0	8.3%	.0%	14.0%	.0%
Autodesk	0	0	0	0	4.3%	.0%	8.5%	.0%
Valid	0	0	0	1	2.4%	1.9%	2.3%	.6%
Telesis	0	0	0	2	2.0%	1.9%	.8%	.8%
Computervision	0	0	0	0	1.6%	.0%	2.3%	.2%
Control Data	0	0	0	0	.8%	.0%	.8%	.0%
Other Companies	1	0	1	38	34.4%	18.9%	47.3%	18.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	194	37.9%	92.5%	.0%	93.7%
All Turnkey & SW Companies	2	0	1	13	62.1%	7.5%	100.0%	6.3%
All Companies	3	1	1	207	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.2-1
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	150	74	56	1,658	16.3%	12.9%	23.2%	7.3%
Digital	129	114	0	504	14.1%	19.7%	.0%	2.2%
Daisy	74	20	41	1,167	8.1%	3.6%	16.7%	5.2%
Apollo	57	50	0	2,197	6.2%	8.6%	.0%	9.7%
Valid	56	25	25	1,174	6.1%	4.3%	10.4%	5.2%
IBM	44	41	1	6,974	4.8%	7.1%	.6%	30.9%
Seiko I&E	25	19	5	225	2.7%	3.3%	1.9%	1.0%
Zycad	20	18	0	0	2.2%	3.2%	.0%	.0%
Futurenet	20	1	16	341	2.1%	.1%	6.8%	1.5%
NEC	16	10	5	401	1.8%	1.7%	2.2%	1.8%
Computervision	15	9	6	159	1.6%	1.5%	2.3%	.7%
Sun	12	11	0	570	1.3%	1.9%	.0%	2.5%
Silvar-Lisco	12	0	10	0	1.3%	.0%	4.2%	.0%
Cadnetix	11	5	5	244	1.2%	.9%	2.0%	1.1%
Hewlett-Packard	11	8	2	289	1.2%	1.4%	.8%	1.3%
Tektronix	10	4	4	128	1.0%	.7%	1.8%	.6%
Fujitsu	7	4	2	62	.7%	.7%	.8%	.3%
Intergraph	6	3	2	43	.6%	.5%	.7%	.2%
Hitachi	5	3	2	20	.6%	.5%	.8%	.1%
Calma	4	2	1	75	.4%	.3%	.4%	.3%
Racal-Redac	2	1	1	24	.3%	.1%	.5%	.1%
Otsukashokai	2	1	1	202	.3%	.2%	.4%	.9%
Zuken	2	1	1	30	.3%	.2%	.4%	.1%
Telesis	2	1	1	27	.2%	.2%	.3%	.1%
Scientific Calc.	2	0	1	0	.2%	.0%	.4%	.0%
Other Companies	225	151	55	6,053	24.4%	26.2%	22.4%	26.8%
All Far East-Based Companies	65	42	18	1,380	7.0%	7.3%	7.5%	6.1%
All European-Based Companies	0	0	0	4	.0%	.0%	.0%	.0%
All Hardware Companies	386	349	0	15,641	42.0%	60.5%	.0%	69.3%
All Turnkey & SW Companies	533	228	243	6,926	58.0%	39.5%	100.0%	30.7%
All Companies	919	577	243	22,567	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.2-2
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	147	74	54	1,658	36.4%	31.9%	44.2%	22.3%
Apollo	57	50	0	2,197	14.0%	21.4%	.0%	29.5%
Valid	50	23	22	1,055	12.5%	10.0%	18.0%	14.2%
Daisy	30	9	15	279	7.4%	4.0%	12.2%	3.7%
Digital	26	23	0	504	6.4%	9.8%	.0%	6.8%
Sun	12	11	0	570	3.0%	4.7%	.0%	7.7%
Computervision	12	8	3	130	3.0%	3.6%	2.6%	1.7%
Hewlett-Packard	11	8	2	289	2.7%	3.4%	1.7%	3.9%
Cadnetix	9	5	3	244	2.2%	2.2%	2.4%	3.3%
NEC	7	5	2	81	1.8%	2.0%	1.6%	1.1%
Tektronix	7	3	3	85	1.7%	1.2%	2.6%	1.1%
Intergraph	6	3	2	43	1.5%	1.3%	1.4%	.6%
Silvar-Lisco	4	0	3	0	.9%	.0%	2.6%	.0%
Calma	3	2	1	72	.9%	.8%	.8%	1.0%
Zuken	2	1	1	30	.6%	.6%	.7%	.4%
Telesis	2	1	1	15	.4%	.5%	.5%	.2%
Racal-Redac	1	1	0	24	.4%	.4%	.4%	.3%
IBM	0	0	0	4	.1%	.1%	.1%	.0%
Other Companies	17	6	10	173	4.3%	2.4%	8.4%	2.3%
All Far East-Based Companies	11	7	3	120	2.6%	2.8%	2.7%	1.6%
All European-Based Companies	0	0	0	4	.1%	.1%	.1%	.1%
All Hardware Companies	98	86	0	3,396	24.1%	37.0%	.0%	45.6%
All Turnkey & SW Companies	307	147	123	4,054	75.9%	63.0%	100.0%	54.4%
All Companies	404	233	123	7,450	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-3
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Digital	103	91	0	0	32.7%	37.3%	.0%	.0%
Zycad	20	18	0	0	6.5%	7.5%	.0%	.0%
IBM	9	7	1	96	3.0%	2.7%	3.1%	12.1%
Silver-Lisco	8	0	7	0	2.6%	.0%	18.9%	.0%
Fujitsu	6	4	2	32	1.9%	1.6%	4.5%	4.1%
Hitachi	5	3	2	20	1.6%	1.2%	5.2%	2.6%
NEC	3	2	1	20	1.0%	.9%	1.5%	2.5%
Tektronix	3	1	1	44	.9%	.6%	3.1%	5.5%
Calma	0	0	0	1	.1%	.0%	.1%	.2%
Other Companies	157	118	24	576	49.8%	48.2%	63.6%	73.0%
All Far East-Based Companies	14	9	4	73	4.5%	3.7%	11.2%	9.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	230	205	0	559	72.8%	84.0%	.0%	70.9%
All Turnkey & SW Companies	86	39	37	230	27.2%	16.0%	100.0%	29.1%
All Companies	316	244	37	789	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-4
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Daisy	45	11	26	888	22.5%	11.1%	30.8%	6.2%
IBM	35	34	0	6,875	17.4%	34.3%	.2%	48.0%
Seiko I&E	25	19	5	225	12.6%	18.8%	5.7%	1.6%
Futurenet	20	1	16	341	9.9%	.9%	19.8%	2.4%
NEC	6	3	3	300	3.0%	2.8%	3.4%	2.1%
Valid	6	2	3	119	2.8%	1.8%	3.9%	.8%
Computervision	3	0	2	29	1.4%	.4%	2.8%	.2%
Otsukashokai	2	1	1	202	1.2%	1.4%	1.1%	1.4%
Mentor	2	0	2	0	1.2%	.0%	2.4%	.0%
Cadnetix	2	0	2	0	1.1%	.0%	2.4%	.0%
Scientific Calc.	2	0	1	0	.8%	.0%	1.3%	.0%
Racal-Redac	1	0	1	0	.5%	.0%	1.0%	.0%
Fujitsu	1	0	0	30	.3%	.4%	.2%	.2%
Telesis	0	0	0	13	.2%	.2%	.1%	.1%
Calma	0	0	0	1	.0%	.0%	.0%	.0%
Other Companies	50	28	21	5,304	25.1%	28.0%	24.8%	37.0%
All Far East-Based Companies	40	27	11	1,187	20.0%	26.7%	13.0%	8.3%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	58	58	0	11,686	29.2%	58.1%	.0%	81.6%
All Turnkey & SW Companies	141	42	83	2,642	70.8%	41.9%	100.0%	18.4%
All Companies	199	100	83	14,327	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-5
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Mentor	84	40	32	1,074	16.8%	12.9%	23.6%	7.5%
Digital	72	64	0	282	14.5%	20.5%	.0%	2.0%
Daisy	33	9	18	525	6.7%	3.0%	13.6%	3.7%
Apollo	28	25	0	1,099	5.7%	8.0%	.0%	7.7%
IBM	28	27	1	4,732	5.6%	8.6%	.6%	33.1%
Valid	26	12	12	540	5.2%	3.7%	8.7%	3.8%
Zycad	19	17	0	0	3.7%	5.4%	.0%	.0%
Futurenet	14	1	11	285	2.8%	.2%	8.5%	2.0%
Cadnetix	10	4	4	210	1.9%	1.4%	3.2%	1.5%
Tektronix	8	3	4	109	1.6%	1.1%	2.7%	.8%
Silvar-Lisco	7	0	6	0	1.5%	.0%	4.7%	.0%
Sun	7	7	0	342	1.5%	2.1%	.0%	2.4%
Computervision	6	4	2	71	1.2%	1.2%	1.8%	.5%
Intergraph	4	2	1	31	.8%	.7%	.9%	.2%
Hewlett-Packard	4	3	1	104	.8%	.9%	.5%	.7%
Calma	2	1	1	47	.4%	.4%	.5%	.3%
Telesis	1	1	1	19	.3%	.3%	.4%	.1%
Scientific Calc.	1	0	1	0	.2%	.0%	.5%	.0%
Racal-Redac	0	0	0	4	.1%	.0%	.2%	.0%
Other Companies	143	92	40	4,814	28.7%	29.6%	29.7%	33.7%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	225	205	0	11,128	45.1%	65.9%	.0%	77.9%
All Turnkey & SW Companies	274	106	134	3,159	54.9%	34.1%	100.0%	22.1%
All Companies	500	311	134	14,288	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-6
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company	Total				Market Share			
	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	82	40	30	1,074	38.6%	33.5%	46.0%	26.5%
Apollo	28	25	0	1,099	13.3%	20.8%	.0%	27.1%
Valid	23	11	10	485	10.9%	8.9%	15.5%	12.0%
Digital	14	13	0	282	6.8%	10.6%	.0%	7.0%
Daisy	13	4	7	125	6.3%	3.5%	10.3%	3.1%
Cadnetix	8	4	3	210	3.7%	3.7%	3.8%	5.2%
Sun	7	7	0	342	3.5%	5.4%	.0%	8.5%
Tektronix	6	2	3	72	2.7%	1.9%	4.1%	1.8%
Computervision	5	4	1	58	2.3%	2.9%	2.0%	1.4%
Intergraph	4	2	1	31	2.0%	1.9%	1.9%	.8%
Hewlett-Packard	4	3	1	104	1.8%	2.3%	1.0%	2.6%
Silvar-Lisco	2	0	2	0	1.0%	.0%	2.9%	.0%
Calma	2	1	1	46	1.0%	.9%	.9%	1.1%
Telesis	1	1	0	10	.6%	.7%	.6%	.3%
Racal-Redac	0	0	0	4	.1%	.1%	.1%	.1%
IBM	0	0	0	2	.1%	.1%	.1%	.1%
Other Companies	11	3	7	102	5.2%	2.7%	10.8%	2.5%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	52	46	0	1,791	24.3%	38.0%	.0%	44.3%
All Turnkey & SW Companies	161	74	66	2,256	75.7%	62.0%	100.0%	55.7%
All Companies	213	120	66	4,047	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-7
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	58	51	0	0	31.6%	36.7%	.0%	.0%
Zycad	19	17	0	0	10.2%	12.1%	.0%	.0%
Silvar-Lisco	5	0	4	0	2.8%	.0%	18.3%	.0%
IBM	4	3	1	44	2.3%	2.2%	2.3%	10.7%
Tektronix	2	1	1	37	1.3%	.8%	4.1%	9.0%
Other Companies	95	67	18	330	51.7%	48.1%	75.3%	80.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	129	115	0	313	70.5%	82.6%	.0%	76.2%
All Turnkey & SW Companies	54	24	24	98	29.5%	17.4%	100.0%	23.8%
All Companies	183	139	24	411	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-8
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
IBM	24	23	0	4,686	22.6%	44.7%	.3%	47.7%
Daisy	20	5	11	400	19.3%	9.5%	25.9%	4.1%
Futurenet	14	1	11	285	13.3%	1.4%	25.9%	2.9%
Valid	3	1	2	55	2.5%	1.6%	3.4%	.6%
Cadnetix	2	0	2	0	1.9%	.0%	3.9%	.0%
Mentor	2	0	1	0	1.6%	.0%	3.2%	.0%
Computervision	1	0	1	13	1.2%	.3%	2.4%	.1%
Scientific Calc.	1	0	1	0	1.0%	.0%	1.6%	.0%
Telesis	0	0	0	9	.2%	.3%	.2%	.1%
Racal-Redac	0	0	0	0	.2%	.0%	.3%	.0%
Calma	0	0	0	1	.0%	.0%	.0%	.0%
Other Companies	38	22	15	4,382	36.2%	42.2%	32.9%	44.6%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	45	45	0	9,024	43.1%	85.8%	.0%	91.8%
All Turnkey & SW Companies	59	7	44	806	56.9%	14.2%	100.0%	8.2%
All Companies	104	52	44	9,830	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-9
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	34	17	13	441	16.8%	14.1%	21.0%	10.3%
Daisy	33	9	18	525	16.4%	7.9%	29.5%	12.3%
Digital	26	23	0	101	12.7%	19.4%	.0%	2.4%
Valid	20	9	9	411	9.6%	7.5%	14.3%	9.6%
Apollo	11	10	0	439	5.5%	8.5%	.0%	10.3%
IBM	9	8	0	1,245	4.4%	7.0%	.8%	29.1%
Computervision	7	4	3	83	3.6%	3.7%	4.5%	1.9%
Hewlett-Packard	6	5	1	172	3.1%	3.9%	1.9%	4.0%
Silvar-Lisco	4	0	3	0	1.9%	.0%	5.4%	.0%
Sun	2	2	0	114	1.2%	1.8%	.0%	2.7%
Futurenet	2	0	2	50	1.2%	.1%	3.3%	1.2%
Racal-Redac	2	1	1	18	.9%	.5%	1.6%	.4%
Tektronix	1	1	1	19	.7%	.5%	1.1%	.5%
Intergraph	1	1	0	10	.7%	.6%	.6%	.2%
Zycad	1	1	0	0	.6%	.9%	.0%	.0%
Cadnetix	1	0	0	19	.4%	.4%	.6%	.5%
Telesis	0	0	0	6	.2%	.2%	.2%	.1%
Scientific Calc.	0	0	0	0	.2%	.0%	.5%	.0%
Calma	0	0	0	3	.2%	.1%	.1%	.1%
Other Companies	40	27	9	620	19.6%	22.9%	14.7%	14.5%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	4	.1%	.1%	.2%	.1%
All Hardware Companies	74	67	0	2,468	36.4%	57.1%	.0%	57.7%
All Turnkey & SW Companies	130	50	62	1,808	63.6%	42.9%	100.0%	42.3%
All Companies	204	117	62	4,277	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.2-10
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Mentor	34	17	12	441	31.9%	28.6%	36.0%	22.9%
Valid	18	8	8	369	16.7%	14.1%	22.5%	19.1%
Daisy	13	4	7	125	12.7%	7.3%	19.6%	6.5%
Apollo	11	10	0	439	10.7%	17.3%	.0%	22.8%
Hewlett-Packard	6	5	1	172	6.0%	8.0%	3.3%	8.9%
Computervision	6	4	2	67	5.5%	7.1%	4.4%	3.5%
Digital	5	5	0	101	4.9%	7.9%	.0%	5.2%
Sun	2	2	0	114	2.3%	3.7%	.0%	5.9%
Intergraph	1	1	0	10	1.3%	1.2%	1.2%	.5%
Silvar-Lisco	1	0	1	0	1.1%	.0%	2.9%	.0%
Racal-Redac	1	1	0	18	1.1%	1.1%	1.0%	.9%
Tektronix	1	0	0	13	1.0%	.7%	1.4%	.7%
Cadnetix	1	0	0	19	.7%	.7%	.7%	1.0%
Telesis	0	0	0	3	.4%	.4%	.3%	.2%
Calma	0	0	0	1	.2%	.1%	.1%	.1%
IBM	0	0	0	1	.1%	.2%	.1%	.1%
Other Companies	4	1	2	35	3.4%	1.6%	6.5%	1.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	4	.3%	.3%	.3%	.2%
All Hardware Companies	20	17	0	685	18.6%	30.0%	.0%	35.5%
All Turnkey & SW Companies	86	40	34	1,245	81.4%	70.0%	100.0%	64.5%
All Companies	106	58	34	1,930	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-11
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
	=====	=====	=====	=====	=====	=====	=====	=====
Digital	21	18	0	0	34.7%	40.4%	.0%	.0%
Silvar-Lisco	3	0	2	0	4.6%	.0%	31.0%	.0%
IBM	3	2	0	28	4.6%	4.4%	4.6%	18.9%
Zycad	1	1	0	0	2.1%	2.5%	.0%	.0%
Tektronix	0	0	0	7	.7%	.5%	2.4%	4.4%
Calma	0	0	0	1	.3%	.2%	.4%	1.0%
Other Companies	32	24	5	113	53.1%	52.1%	61.6%	75.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	46	41	0	113	77.8%	91.6%	.0%	75.8%
All Turnkey & SW Companies	13	4	8	36	22.2%	8.4%	100.0%	24.2%
All Companies	60	45	8	149	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-12
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Daisy	20	5	11	400	51.5%	34.4%	57.8%	18.2%
IBM	6	6	0	1,215	15.9%	42.1%	.4%	55.3%
Futurenet	2	0	2	50	6.3%	.8%	10.2%	2.3%
Valid	2	1	1	42	5.0%	4.3%	5.7%	1.9%
Computervision	1	0	1	15	3.7%	1.4%	6.3%	.7%
Racal-Redac	1	0	1	0	1.9%	.0%	3.2%	.0%
Mentor	1	0	1	0	1.8%	.0%	3.0%	.0%
Scientific Calc.	0	0	0	0	1.1%	.0%	1.5%	.0%
Cadnetix	0	0	0	0	.5%	.0%	.8%	.0%
Telesis	0	0	0	3	.2%	.3%	.1%	.1%
Other Companies	5	2	2	472	12.3%	16.7%	11.1%	21.5%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	8	8	0	1,670	21.3%	57.2%	.0%	76.0%
All Turnkey & SW Companies	31	6	20	528	78.7%	42.8%	100.0%	24.0%
All Companies	39	15	20	2,197	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-13
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Mentor	31	18	12	143	17.1%	14.5%	25.5%	4.0%
Seiko I&E	25	19	5	225	13.6%	15.5%	10.2%	6.4%
Digital	19	17	0	76	10.6%	14.1%	.0%	2.1%
NEC	16	10	5	401	8.9%	8.0%	11.6%	11.3%
Apollo	11	10	0	439	6.2%	8.2%	.0%	12.4%
Valid	10	5	5	211	5.5%	3.7%	9.9%	6.0%
Daisy	7	2	4	117	4.1%	1.7%	8.8%	3.3%
IBM	7	6	0	927	3.7%	4.8%	.5%	26.2%
Fujitsu	7	4	2	62	3.6%	3.5%	4.0%	1.8%
Hitachi	5	3	2	20	2.8%	2.4%	4.2%	.6%
Futurenet	3	0	3	0	1.6%	.0%	5.9%	.0%
Otsukashokai	2	1	1	202	1.3%	1.1%	2.0%	5.7%
Zuken	2	1	1	30	1.3%	1.1%	1.9%	.8%
Sun	2	2	0	86	1.0%	1.3%	.0%	2.4%
Computervision	1	1	0	4	.6%	.5%	.7%	.1%
Calma	1	0	0	21	.5%	.4%	.6%	.6%
Cadnetix	1	0	0	15	.4%	.3%	.7%	.4%
Silvar-Lisco	1	0	1	0	.3%	.0%	1.2%	.0%
Hewlett-Packard	1	0	0	6	.3%	.3%	.3%	.2%
Zycad	0	0	0	0	.2%	.3%	.0%	.0%
Telesis	0	0	0	2	.1%	.1%	.1%	.1%
Racal-Redac	0	0	0	1	.1%	.0%	.1%	.0%
Scientific Calc.	0	0	0	0	.0%	.0%	.1%	.0%
Other Companies	30	22	5	547	16.3%	18.2%	11.6%	15.5%
All Far East-Based Companies	65	42	18	1,380	35.2%	34.9%	39.7%	39.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	57	51	0	1,611	30.9%	41.9%	.0%	45.6%
All Turnkey & SW Companies	127	70	46	1,923	69.1%	58.1%	100.0%	54.4%
All Companies	184	121	46	3,534	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-14
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Mentor	31	18	12	143	41.3%	37.6%	52.7%	12.4%
Apollo	11	10	0	439	14.9%	21.4%	.0%	38.2%
Valid	9	4	4	190	11.9%	9.0%	17.9%	16.5%
NEC	7	5	2	81	9.4%	9.9%	8.9%	7.0%
Digital	4	3	0	76	5.1%	7.3%	.0%	6.6%
Daisy	3	1	2	28	3.9%	2.0%	6.8%	2.4%
Zuken	2	1	1	30	3.0%	2.8%	3.9%	2.6%
Sun	2	2	0	86	2.4%	3.5%	.0%	7.4%
Computervision	1	1	0	4	1.6%	1.3%	1.5%	.4%
Calma	1	0	0	20	1.2%	1.0%	1.2%	1.8%
Hewlett-Packard	1	0	0	6	.7%	.8%	.7%	.6%
Cadnetix	1	0	0	15	.7%	.7%	.8%	1.3%
Silvar-Lisco	0	0	0	0	.4%	.0%	1.2%	.0%
Telesis	0	0	0	1	.2%	.2%	.2%	.1%
Racal-Redac	0	0	0	1	.1%	.1%	.1%	.1%
Other Companies	2	1	1	32	3.3%	2.7%	4.2%	2.8%
All Far East-Based Companies	11	7	3	120	14.1%	14.1%	14.7%	10.4%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	18	15	0	622	23.1%	33.1%	.0%	54.0%
All Turnkey & SW Companies	59	31	22	529	76.9%	66.9%	100.0%	46.0%
All Companies	76	47	22	1,150	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.2-15
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
	=====	=====	=====	=====	=====	=====	=====	=====
Digital	16	14	0	0	29.3%	32.6%	.0%	.0%
Fujitsu	6	4	2	32	11.2%	9.3%	30.9%	17.8%
Hitachi	5	3	2	20	9.8%	6.9%	35.9%	11.4%
NEC	3	2	1	20	5.9%	5.5%	10.6%	11.2%
IBM	2	1	0	23	4.3%	3.3%	4.5%	12.6%
Zycaid	0	0	0	0	.8%	.9%	.0%	.0%
Silvar-Lisco	0	0	0	0	.6%	.0%	5.0%	.0%
Other Companies	20	17	1	84	38.2%	41.6%	13.0%	47.0%
All Far East-Based Companies	14	9	4	73	26.9%	21.6%	77.5%	40.4%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	35	31	0	84	65.6%	73.8%	.0%	47.0%
All Turnkey & SW Companies	18	11	5	95	34.4%	26.2%	100.0%	53.0%
All Companies	53	42	5	180	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-16
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Seiko I&E	25	19	5	225	45.7%	57.5%	25.6%	10.2%
NEC	6	3	3	300	11.1%	8.5%	15.2%	13.6%
IBM	5	5	0	905	8.2%	13.8%	.0%	41.0%
Daisy	4	1	3	89	8.2%	3.4%	13.9%	4.0%
Futurenet	3	0	3	0	5.5%	.0%	14.8%	.0%
Otsukashokai	2	1	1	202	4.4%	4.2%	5.0%	9.2%
Valid	1	0	1	21	1.8%	1.0%	3.2%	1.0%
Fujitsu	1	0	0	30	1.2%	1.3%	1.0%	1.4%
Cadnetix	0	0	0	0	.3%	.0%	.7%	.0%
Scientific Calc.	0	0	0	0	.1%	.0%	.2%	.0%
Racal-Redac	0	0	0	0	.1%	.0%	.2%	.0%
Telesis	0	0	0	1	.0%	.1%	.1%	.0%
Calma	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	7	3	4	431	13.4%	10.3%	20.2%	19.5%
All Far East-Based Companies	40	27	11	1,187	72.8%	81.7%	59.0%	53.8%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	5	5	0	905	8.2%	13.8%	.0%	41.0%
All Turnkey & SW Companies	50	28	18	1,300	91.8%	86.2%	100.0%	59.0%
All Companies	55	33	18	2,204	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-17
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Digital	12	10	0	45	36.6%	37.7%	.0%	9.7%
Apollo	6	5	0	220	17.8%	18.3%	.0%	46.9%
Sun	1	1	0	29	1.9%	2.0%	.0%	6.1%
Valid	1	0	0	12	1.8%	1.0%	25.0%	2.5%
IBM	0	0	0	70	1.4%	1.5%	1.0%	14.9%
Intergraph	0	0	0	2	1.0%	.6%	8.7%	.5%
Futurenet	0	0	0	6	.9%	.1%	23.1%	1.3%
Calma	0	0	0	5	.7%	.4%	5.8%	1.0%
Hewlett-Packard	0	0	0	6	.7%	.6%	3.8%	1.3%
Zycaid	0	0	0	0	.6%	.7%	.0%	.0%
Computervision	0	0	0	2	.5%	.3%	4.8%	.4%
Racal-Redac	0	0	0	0	.2%	.1%	2.9%	.1%
Telesis	0	0	0	1	.2%	.1%	1.0%	.1%
Other Companies	11	10	0	72	35.9%	36.9%	24.0%	15.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	29	26	0	433	92.4%	96.1%	.0%	92.5%
All Turnkey & SW Companies	2	1	1	35	7.6%	3.9%	100.0%	7.5%
All Companies	32	27	1	469	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-18
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Apollo	6	5	0	220	55.5%	59.2%	.0%	68.0%
Digital	2	2	0	45	22.9%	24.3%	.0%	14.1%
Sun	1	1	0	29	6.1%	6.4%	.0%	8.8%
Valid	1	0	0	11	4.9%	2.9%	45.1%	3.3%
Intergraph	0	0	0	2	3.0%	1.9%	17.6%	.7%
Calma	0	0	0	5	2.2%	1.3%	11.8%	1.5%
Hewlett-Packard	0	0	0	6	2.2%	1.8%	7.8%	1.8%
Computervision	0	0	0	1	1.2%	.8%	5.9%	.4%
Telesis	0	0	0	0	.4%	.2%	2.0%	.1%
Racal-Redac	0	0	0	0	.3%	.2%	2.0%	.1%
IBM	0	0	0	0	.1%	.0%	.0%	.0%
Other Companies	0	0	0	4	1.3%	1.0%	7.8%	1.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	9	8	0	297	85.4%	90.8%	.0%	92.1%
All Turnkey & SW Companies	1	1	1	26	14.6%	9.2%	100.0%	7.9%
All Companies	10	8	1	323	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-19
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Digital	9	8	0	0	45.0%	44.8%	.0%	.0%
Zycad	0	0	0	0	1.0%	1.0%	.0%	.0%
IBM	0	0	0	1	.4%	.4%	7.7%	1.9%
Other Companies	11	10	0	49	53.6%	53.8%	92.3%	98.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	20	18	0	49	98.0%	98.6%	.0%	98.1%
All Turnkey & SW Companies	0	0	0	1	2.0%	1.4%	100.0%	1.9%
All Companies	21	18	0	50	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.2-20
 TITLE: 1986 Market Share
 APPLICATION: Electronic CAE
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
IBM	0	0	0	69	36.8%	70.8%	.0%	71.9%
Futurenet	0	0	0	6	30.5%	4.2%	60.0%	6.3%
Valid	0	0	0	1	6.3%	4.2%	7.5%	1.2%
Computervision	0	0	0	0	3.2%	.0%	5.0%	.3%
Racal-Redac	0	0	0	0	2.1%	.0%	5.0%	.0%
Telesis	0	0	0	0	1.1%	.0%	.0%	.3%
Other Companies	0	0	0	19	20.0%	20.8%	22.5%	19.9%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	0	0	0	87	45.3%	91.7%	.0%	91.1%
All Turnkey & SW Companies	1	0	0	8	54.7%	8.3%	100.0%	8.9%
All Companies	1	0	0	96	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-1
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company	Total				Market Share			
	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Calma	37	20	8	291	13.2%	12.9%	9.3%	11.6%
Digital	32	29	0	47	11.6%	18.3%	.0%	1.9%
Seiko I&E	28	18	8	129	10.1%	11.8%	9.2%	5.1%
Mentor	17	8	6	168	6.1%	5.3%	7.0%	6.7%
Silvar-Lisco	12	0	10	0	4.3%	.0%	11.6%	.0%
Apollo	10	9	0	382	3.5%	5.6%	.0%	15.2%
Daisy	10	3	5	90	3.4%	2.0%	5.5%	3.6%
Control Data	6	4	1	94	2.1%	2.3%	1.2%	3.7%
Intergraph	6	3	2	43	2.1%	2.0%	2.0%	1.7%
Valid	4	2	2	75	1.5%	1.4%	1.8%	3.0%
Applicon	4	3	1	55	1.5%	2.0%	.8%	2.2%
Sun	4	4	0	190	1.5%	2.3%	.0%	7.5%
Fujitsu	4	3	1	20	1.4%	1.6%	1.2%	.8%
Tektronix	2	1	1	29	.9%	.7%	1.1%	1.2%
Scientific Calc.	2	1	1	2	.7%	.4%	1.0%	.1%
Hewlett-Packard	1	1	0	11	.4%	.5%	.2%	.4%
IBM	1	1	0	171	.3%	.6%	.0%	6.8%
Racal-Redac	1	0	0	4	.2%	.2%	.2%	.1%
Other Companies	99	47	42	673	35.2%	30.1%	47.7%	26.7%
All Far East-Based Companies	33	21	10	152	11.8%	13.7%	10.9%	6.0%
All European-Based Companies	0	0	0	41	.0%	.0%	.0%	1.6%
All Hardware Companies	89	79	0	1,183	31.7%	51.0%	.0%	47.0%
All Turnkey & SW Companies	192	76	89	1,333	68.3%	49.0%	100.0%	53.0%
All Companies	281	156	89	2,517	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-2
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Calma	23	11	6	212	15.4%	17.9%	9.7%	13.2%
Seiko I&E	20	12	7	75	13.5%	18.9%	10.4%	4.7%
Mentor	17	8	6	168	11.5%	13.1%	9.7%	10.5%
Apollo	10	9	0	382	6.7%	13.6%	.0%	23.8%
Daisy	10	3	5	90	6.5%	4.8%	7.5%	5.6%
Intergraph	6	3	2	43	4.0%	4.8%	2.7%	2.7%
Valid	4	2	2	75	2.9%	3.5%	2.5%	4.7%
Sun	4	4	0	190	2.8%	5.7%	.0%	11.9%
Silvar-Lisco	4	0	3	0	2.6%	.0%	5.2%	.0%
Digital	2	1	0	47	1.1%	2.3%	.0%	3.0%
Hewlett-Packard	1	1	0	11	.8%	1.3%	.3%	.7%
Racal-Redac	1	0	0	4	.4%	.5%	.3%	.2%
Tektronix	0	0	0	3	.3%	.3%	.3%	.2%
Control Data	0	0	0	3	.2%	.2%	.2%	.2%
Other Companies	46	8	33	257	31.2%	13.0%	51.2%	16.0%
All Far East-Based Companies	21	12	7	78	13.9%	19.4%	10.8%	4.9%
All European-Based Companies	0	0	0	41	.0%	.0%	.0%	2.6%
All Hardware Companies	16	14	0	647	11.0%	22.5%	.0%	40.3%
All Turnkey & SW Companies	132	49	65	957	89.0%	77.5%	100.0%	59.7%
All Companies	148	64	65	1,603	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-3
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	31	27	0	0	23.5%	29.8%	.0%	.0%
Calma	14	9	2	78	10.8%	9.6%	8.4%	11.9%
Seiko I&E	8	6	1	53	6.4%	7.1%	5.8%	8.1%
Silvar-Lisco	8	0	7	0	6.3%	.0%	28.9%	.0%
Control Data	5	3	1	91	4.1%	3.8%	3.7%	13.8%
Applicon	4	3	1	55	3.1%	3.3%	2.8%	8.4%
Fujitsu	4	3	1	20	3.0%	2.8%	4.5%	3.0%
Scientific Calc.	2	1	1	2	1.5%	.6%	3.5%	.3%
Tektronix	2	1	1	26	1.5%	1.0%	3.2%	4.0%
Other Companies	52	38	9	330	39.6%	42.0%	38.3%	50.3%
All Far East-Based Companies	13	9	3	73	9.5%	9.9%	11.2%	11.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	71	64	0	280	54.4%	70.2%	.0%	42.7%
All Turnkey & SW Companies	60	27	24	377	45.6%	29.8%	100.0%	57.3%
All Companies	131	91	24	657	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-4
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
IBM	1	1	0	171	56.7%	67.2%	.0%	66.7%
Control Data	0	0	0	0	8.7%	.0%	50.0%	.0%
Other Companies	1	0	0	86	34.7%	32.8%	50.0%	33.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	257	85.3%	100.0%	.0%	100.0%
All Turnkey & SW Companies	0	0	0	0	14.7%	.0%	100.0%	.0%
All Companies	2	1	0	257	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-5
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Calma	22	12	5	172	14.1%	15.1%	9.4%	12.3%
Digital	18	16	0	27	11.7%	19.8%	.0%	1.9%
Mentor	14	7	5	135	8.8%	8.3%	9.3%	9.6%
Silvar-Lisco	5	0	5	0	3.5%	.0%	8.7%	.0%
Apollo	5	4	0	191	3.2%	5.4%	.0%	13.7%
Daisy	4	1	2	41	2.8%	1.7%	4.1%	2.9%
Intergraph	4	2	1	31	2.7%	2.8%	2.3%	2.2%
Control Data	4	2	1	57	2.3%	2.7%	1.3%	4.1%
Applicon	2	2	0	37	1.6%	2.3%	.7%	2.6%
Sun	2	2	0	114	1.6%	2.7%	.0%	8.2%
Tektronix	2	1	1	25	1.3%	1.2%	1.6%	1.8%
Valid	2	1	1	39	1.3%	1.4%	1.2%	2.8%
Scientific Calc.	1	0	1	2	.9%	.5%	1.1%	.1%
IBM	0	0	0	80	.3%	.5%	.0%	5.8%
Hewlett-Packard	0	0	0	4	.2%	.3%	.1%	.3%
Racal-Redac	0	0	0	1	.1%	.1%	.1%	.0%
Other Companies	67	29	32	440	43.5%	35.4%	60.1%	31.6%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	49	44	0	624	31.8%	54.5%	.0%	44.7%
All Turnkey & SW Companies	105	37	54	771	68.2%	45.5%	100.0%	55.3%
All Companies	155	81	54	1,395	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-6
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Calma	14	7	4	131	16.2%	21.2%	9.8%	14.2%
Mentor	14	7	5	135	16.1%	20.3%	12.5%	14.6%
Apollo	5	4	0	191	5.8%	13.2%	.0%	20.8%
Daisy	4	1	2	41	5.1%	4.2%	5.5%	4.4%
Intergraph	4	2	1	31	5.0%	6.8%	3.1%	3.3%
Sun	2	2	0	114	2.9%	6.6%	.0%	12.4%
Valid	2	1	1	39	2.3%	3.5%	1.5%	4.2%
Silvar-Lisco	2	0	1	0	1.9%	.0%	3.5%	.0%
Digital	1	1	0	27	1.1%	2.4%	.0%	2.9%
Tektronix	0	0	0	3	.5%	.5%	.5%	.3%
Hewlett-Packard	0	0	0	4	.4%	.8%	.2%	.4%
Control Data	0	0	0	3	.3%	.4%	.2%	.3%
Racal-Redac	0	0	0	1	.1%	.2%	.1%	.1%
Other Companies	36	7	25	202	42.1%	19.9%	63.2%	22.0%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	9	8	0	346	10.2%	23.1%	.0%	37.7%
All Turnkey & SW Companies	76	25	40	573	89.8%	76.9%	100.0%	62.3%
All Companies	85	33	40	919	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-7
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Digital	17	15	0	0	24.9%	32.0%	.0%	.0%
Calma	8	5	1	42	11.7%	11.0%	8.6%	11.7%
Silvar-Lisco	4	0	3	0	5.5%	.0%	24.2%	.0%
Control Data	3	2	1	54	4.7%	4.4%	4.1%	15.3%
Applicon	2	2	0	37	3.6%	3.9%	3.0%	10.4%
Tektronix	2	1	1	22	2.4%	1.6%	4.9%	6.3%
Scientific Calc.	1	0	1	2	2.0%	.8%	4.3%	.4%
Other Companies	31	22	7	198	45.3%	46.2%	50.9%	55.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	40	36	0	157	57.8%	75.6%	.0%	44.2%
All Turnkey & SW Companies	29	12	13	198	42.2%	24.4%	100.0%	55.8%
All Companies	69	47	13	355	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-8
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
IBM	0	0	0	80	53.3%	66.7%	.0%	66.7%
Control Data	0	0	0	0	9.3%	.0%	42.9%	.0%
Other Companies	0	0	0	40	37.3%	33.3%	57.1%	33.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	121	80.0%	100.0%	.0%	100.0%
All Turnkey & SW Companies	0	0	0	0	20.0%	.0%	100.0%	.0%
All Companies	1	1	0	121	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.3-9
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	6	6	0	9	12.6%	21.8%	.0%	1.8%
Silvar-Lisco	5	0	4	0	9.9%	.0%	24.2%	.0%
Dalet	4	1	2	41	8.4%	5.3%	12.2%	7.5%
Mentor	3	2	1	34	6.6%	6.3%	7.0%	6.2%
Calma	3	1	1	25	6.5%	5.2%	2.8%	4.6%
Apollo	2	2	0	76	3.8%	6.6%	.0%	14.1%
Control Data	2	1	0	27	3.2%	4.0%	1.7%	5.0%
Valid	1	1	1	23	2.9%	2.6%	3.6%	4.3%
Applicon	1	1	0	15	2.8%	4.0%	1.3%	2.8%
Intergraph	1	1	0	10	2.6%	2.7%	2.2%	1.8%
Sun	1	1	0	38	1.6%	2.7%	.0%	7.0%
Hewlett-Packard	1	0	0	7	1.2%	1.8%	.7%	1.3%
Scientific Calc.	1	0	0	1	1.1%	.6%	1.3%	.1%
Racal-Redac	0	0	0	3	.9%	1.0%	.8%	.5%
Tektronix	0	0	0	4	.7%	.6%	.8%	.8%
IBM	0	0	0	51	.5%	1.0%	.0%	9.5%
Other Companies	18	9	7	134	34.7%	33.8%	41.1%	24.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	41	.0%	.0%	.0%	7.7%
All Hardware Companies	18	16	0	264	35.0%	61.6%	.0%	48.9%
All Turnkey & SW Companies	34	10	18	276	65.0%	38.4%	100.0%	51.1%
All Companies	52	26	18	541	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-10
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Daisy	4	1	2	41	17.0%	14.2%	18.3%	12.1%
Mentor	3	2	1	34	13.3%	16.9%	10.6%	10.0%
Apollo	2	2	0	76	7.7%	17.9%	.0%	22.7%
Calma	2	1	0	11	6.3%	6.7%	2.0%	3.2%
Silver-Lisco	2	0	1	0	6.0%	.0%	10.9%	.0%
Valid	1	1	1	23	5.8%	7.0%	5.4%	7.0%
Intergraph	1	1	0	10	5.2%	7.2%	3.4%	2.9%
Sun	1	1	0	38	3.2%	7.4%	.0%	11.3%
Hewlett-Packard	1	0	0	7	2.5%	4.8%	1.0%	2.0%
Racal-Redac	0	0	0	3	1.8%	2.7%	1.2%	.8%
Digital	0	0	0	9	1.3%	3.0%	.0%	2.8%
Tektronix	0	0	0	0	.3%	.3%	.3%	.1%
Other Companies	8	1	6	43	29.6%	12.0%	47.0%	12.9%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	41	.0%	.0%	.0%	12.3%
All Hardware Companies	3	3	0	131	12.8%	29.8%	.0%	38.8%
All Turnkey & SW Companies	22	7	12	206	87.2%	70.2%	100.0%	61.2%
All Companies	26	10	12	337	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-11
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	6	5	0	0	24.1%	33.7%	.0%	.0%
Silvar-Lisco	4	0	3	0	14.0%	.0%	51.4%	.0%
Calma	2	1	0	14	6.8%	4.4%	4.4%	11.3%
Control Data	2	1	0	27	6.4%	6.5%	4.7%	21.5%
Applicon	1	1	0	15	5.6%	6.6%	4.1%	12.1%
Scientific Calc.	1	0	0	1	2.2%	1.0%	4.1%	.5%
Tektronix	0	0	0	4	1.1%	.9%	2.0%	3.1%
Other Companies	10	8	2	65	39.9%	47.0%	29.3%	51.5%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	14	13	0	56	56.2%	79.9%	.0%	44.6%
All Turnkey & SW Companies	11	3	6	70	43.8%	20.1%	100.0%	55.4%
All Companies	26	16	6	127	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: 8.3-12
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
IBM	0	0	0	51	58.1%	68.4%	.0%	66.7%
Control Data	0	0	0	0	9.3%	.0%	75.0%	.0%
Other Companies	0	0	0	26	32.6%	31.6%	25.0%	33.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	0	0	0	77	88.4%	100.0%	.0%	100.0%
All Turnkey & SW Companies	0	0	0	0	11.6%	.0%	100.0%	.0%
All Companies	0	0	0	77	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-13
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Seiko I&E	28	18	8	129	44.6%	45.7%	48.5%	27.1%
Calma	10	5	2	76	15.2%	13.3%	13.3%	16.0%
Digital	5	4	0	7	7.7%	10.6%	.0%	1.5%
Fujitsu	4	3	1	20	6.3%	6.4%	6.5%	4.2%
Apollo	2	2	0	76	3.1%	4.3%	.0%	16.1%
Silver-Lisco	1	0	1	0	2.1%	.0%	7.1%	.0%
Daisy	1	0	0	9	1.5%	.7%	2.9%	1.9%
Valid	1	0	0	12	1.2%	.9%	2.0%	2.5%
Sun	1	1	0	29	1.0%	1.3%	.0%	6.0%
Control Data	0	0	0	5	.5%	.4%	.3%	1.0%
IBM	0	0	0	38	.3%	.4%	.0%	7.9%
Applicon	0	0	0	2	.2%	.2%	.1%	.4%
Hewlett-Packard	0	0	0	0	.2%	.2%	.2%	.0%
Scientific Calc.	0	0	0	0	.1%	.0%	.2%	.0%
Racal-Redac	0	0	0	0	.0%	.0%	.1%	.0%
Other Companies	10	6	3	72	15.7%	15.4%	17.5%	15.2%
All Far East-Based Companies	33	21	10	152	52.2%	52.8%	57.6%	32.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	14	13	0	215	22.0%	31.0%	.0%	45.4%
All Turnkey & SW Companies	49	28	17	259	78.0%	69.0%	100.0%	54.6%
All Companies	63	40	17	474	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-14
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Seiko I&E	20	12	7	75	58.1%	63.6%	55.6%	27.1%
Calma	6	3	2	58	17.6%	16.3%	14.2%	20.7%
Apollo	2	2	0	76	5.7%	9.2%	.0%	27.5%
Daisy	1	0	0	9	2.8%	1.6%	4.0%	3.3%
Valid	1	0	0	12	2.2%	1.9%	2.8%	4.3%
Silvar-Lisco	1	0	1	0	2.0%	.0%	4.9%	.0%
Sun	1	1	0	29	1.8%	2.9%	.0%	10.3%
Digital	0	0	0	7	.7%	1.2%	.0%	2.6%
Hewlett-Packard	0	0	0	0	.3%	.4%	.2%	.0%
Racal-Redac	0	0	0	0	.1%	.1%	.1%	.1%
Control Data	0	0	0	0	.1%	.1%	.1%	.1%
Other Companies	3	1	2	11	8.6%	2.9%	18.1%	4.0%
All Far East-Based Companies	21	12	7	78	59.8%	65.3%	57.4%	28.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	3	3	0	117	8.6%	13.8%	.0%	42.0%
All Turnkey & SW Companies	31	16	12	161	91.4%	86.2%	100.0%	58.0%
All Companies	34	19	12	278	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-15
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Seiko I&E	8	6	1	53	29.0%	30.3%	30.1%	38.0%
Digital	5	4	0	0	16.1%	19.2%	.0%	.0%
Fujitsu	4	3	1	20	13.8%	12.1%	23.5%	14.3%
Calma	4	2	1	18	12.4%	10.8%	10.9%	13.0%
Silver-Lisco	1	0	1	0	2.3%	.0%	12.8%	.0%
Control Data	0	0	0	5	.9%	.8%	.9%	3.2%
Applicon	0	0	0	2	.4%	.4%	.4%	1.3%
Scientific Calc.	0	0	0	0	.3%	.1%	.9%	.1%
Other Companies	7	6	1	42	24.0%	26.2%	16.2%	30.1%
All Far East-Based Companies	13	9	3	73	43.6%	42.4%	58.0%	52.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	11	10	0	42	37.4%	45.4%	.0%	30.1%
All Turnkey & SW Companies	18	12	5	98	62.6%	54.6%	100.0%	69.9%
All Companies	29	21	5	140	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-16
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
IBM	0	0	0	38	65.5%	64.3%	ERR	66.7%
Control Data	0	0	0	0	3.4%	.0%	ERR	.0%
Other Companies	0	0	0	19	31.0%	35.7%	ERR	33.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	ERR	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	ERR	.0%
All Hardware Companies	0	0	0	56	96.6%	100.0%	ERR	100.0%
All Turnkey & SW Companies	0	0	0	0	3.4%	.0%	ERR	.0%
All Companies	0	0	0	56	100.0%	100.0%	ERR	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-17
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	3	3	0	4	26.7%	29.9%	.0%	4.0%
Calma	2	1	1	18	20.3%	14.6%	58.4%	16.4%
Apollo	1	1	0	38	9.0%	10.1%	.0%	35.8%
Intergraph	0	0	0	2	2.8%	1.9%	10.1%	2.1%
Control Data	0	0	0	5	2.7%	2.1%	5.6%	4.5%
Silver-Lisco	0	0	0	0	2.2%	.0%	22.5%	.0%
Sun	0	0	0	10	1.9%	2.1%	.0%	8.9%
Aplicon	0	0	0	1	.7%	.7%	1.1%	1.2%
Valid	0	0	0	1	.4%	.4%	2.2%	.6%
Hewlett-Packard	0	0	0	0	.2%	.2%	.0%	.2%
IBM	0	0	0	2	.1%	.2%	.0%	1.6%
Racal-Redac	0	0	0	0	.1%	.0%	.0%	.1%
Other Companies	4	3	0	26	32.8%	37.8%	.0%	24.7%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	8	7	0	80	70.5%	80.1%	.0%	75.0%
All Turnkey & SW Companies	3	2	1	27	29.5%	19.9%	100.0%	25.0%
All Companies	11	9	1	107	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-18
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Calma	1	1	0	13	43.3%	33.8%	69.0%	19.1%
Apollo	1	1	0	38	30.3%	40.4%	.0%	54.9%
Intergraph	0	0	0	2	9.6%	7.5%	15.5%	3.3%
Sun	0	0	0	10	6.5%	8.5%	.0%	13.7%
Digital	0	0	0	4	4.6%	6.1%	.0%	6.1%
Silvar-Lisco	0	0	0	0	2.2%	.0%	10.3%	.0%
Valid	0	0	0	1	1.2%	1.4%	3.4%	.9%
Control Data	0	0	0	0	.6%	.5%	1.7%	.3%
Hewlett-Packard	0	0	0	0	.6%	.9%	.0%	.3%
Racal-Redac	0	0	0	0	.3%	.0%	.0%	.1%
Other Companies	0	0	0	1	.6%	.9%	.0%	1.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	53	42.1%	55.9%	.0%	75.9%
All Turnkey & SW Companies	2	1	1	17	57.9%	44.1%	100.0%	24.1%
All Companies	3	2	1	70	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-19
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****	Total Revenue *****	Hardware Revenue *****	Software Revenue *****	Wkstns Shipped *****
Digital	3	2	0	0	36.2%	38.0%	.0%	.0%
Calma	1	1	0	4	10.7%	8.3%	38.7%	12.2%
Control Data	0	0	0	5	3.5%	2.7%	12.9%	13.1%
Silver-Lisco	0	0	0	0	2.2%	.0%	45.2%	.0%
Applicon	0	0	0	1	1.0%	.9%	3.2%	3.5%
Other Companies	4	3	0	25	46.3%	50.2%	.0%	71.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	6	6	0	25	82.5%	88.1%	.0%	71.2%
All Turnkey & SW Companies	1	1	0	10	17.5%	11.9%	100.0%	28.8%
All Companies	8	6	0	35	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.3-20
 TITLE: 1986 Market Share
 APPLICATION: IC Layout
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Control Data	0	0	0	0	33.3%	.0%	ERR	.0%
IBM	0	0	0	2	33.3%	100.0%	ERR	66.5%
Other Companies	0	0	0	1	33.3%	.0%	ERR	33.5%
All Far East-Based Companies	0	0	0	0	.0%	.0%	ERR	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	ERR	.0%
All Hardware Companies	0	0	0	3	66.7%	100.0%	ERR	100.0%
All Turnkey & SW Companies	0	0	0	0	33.3%	.0%	ERR	.0%
All Companies	0	0	0	3	100.0%	100.0%	ERR	100.0%

Source: Dataquest
 June 1987

Appendix B Market Shares

TABLE NUMBER: 8.4-1
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Racal-Redac	58	26	24	443	8.9%	6.5%	13.7%	4.2%
Digital	52	46	0	227	7.9%	11.3%	.0%	2.1%
Scientific Calc.	47	19	14	152	7.1%	4.7%	7.9%	1.4%
IBM	43	35	4	3,745	6.6%	8.6%	2.1%	35.4%
Computervision	35	23	9	358	5.3%	5.8%	5.1%	3.4%
Calay	30	19	8	240	4.6%	4.8%	4.8%	2.3%
Hewlett-Packard	30	21	6	650	4.6%	5.3%	3.4%	6.1%
Zuken	29	15	12	290	4.5%	3.7%	7.0%	2.7%
Cadnetix	26	12	12	426	4.1%	3.0%	6.7%	4.0%
Sharp System Products	17	11	5	95	2.6%	2.7%	2.8%	.9%
Calma	15	8	3	141	2.3%	2.0%	1.9%	1.3%
Daisy	13	4	6	143	1.9%	1.0%	3.6%	1.4%
Applicon	12	9	2	166	1.9%	2.3%	1.2%	1.6%
Control Data	12	7	3	187	1.9%	1.8%	1.4%	1.8%
Telesis	11	7	4	143	1.7%	1.7%	2.1%	1.4%
Fujitsu	9	6	3	56	1.4%	1.5%	1.5%	.5%
NEC	9	6	2	60	1.3%	1.6%	.9%	.6%
Hitachi	8	5	3	37	1.3%	1.2%	1.8%	.3%
Apollo	8	7	0	306	1.2%	1.7%	.0%	2.9%
Mentor	7	3	3	74	1.1%	.8%	1.5%	.7%
Intergraph	6	4	1	37	.9%	.9%	.7%	.4%
Toshiba	5	4	0	36	.8%	1.0%	.3%	.3%
Futurenet	4	0	3	59	.6%	.1%	2.0%	.6%
Tektronix	4	2	2	52	.6%	.5%	1.0%	.5%
Seiko I&E	3	2	1	17	.5%	.5%	.6%	.2%
Sun	2	2	0	95	.3%	.5%	.0%	.9%
Autodesk	2	0	2	0	.3%	.0%	1.1%	.0%
Hitachi Zosen	1	1	0	16	.2%	.2%	.3%	.2%

(Continued)

Appendix B Market Shares

TABLE NUMBER: B.4-1 (Continued)
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Mitsubishi Electric	1	1	0	6	.2%	.2%	.1%	.1%
Otsukashokai	1	1	0	101	.2%	.2%	.3%	1.0%
Valid	1	0	0	11	.1%	.1%	.1%	.1%
Silver-Lisco	0	0	0	0	.0%	.0%	.1%	.0%
Other Companies	149	95	42	2,170	23.0%	23.7%	24.1%	20.5%
All Far East-Based Companies	119	69	41	1,155	18.2%	17.3%	23.5%	10.9%
All European-Based Companies	25	15	9	246	3.9%	3.7%	5.0%	2.3%
All Hardware Companies	144	131	0	5,423	22.2%	32.7%	.0%	51.3%
All Turnkey & SW Companies	507	270	174	5,146	77.8%	67.3%	100.0%	48.7%
All Companies	651	401	174	10,569	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-2
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Racal-Redac	48	26	15	443	16.7%	15.6%	17.4%	12.2%
Calay	30	19	8	240	10.5%	11.5%	9.8%	6.6%
Hewlett-Packard	30	21	6	650	10.5%	12.6%	7.0%	17.9%
Computervision	28	19	7	320	9.7%	11.5%	8.5%	8.8%
Cadnetix	21	12	7	426	7.4%	7.2%	8.0%	11.7%
Scientific Calc.	14	5	5	35	4.9%	2.8%	5.9%	1.0%
Daisy	13	4	6	143	4.4%	2.4%	7.4%	3.9%
Sharp System Products	10	6	4	53	3.5%	3.3%	4.4%	1.5%
Telesis	9	6	3	77	3.3%	3.4%	3.7%	2.1%
Calma	9	5	3	105	3.2%	2.7%	3.0%	2.9%
Apollo	8	7	0	306	2.7%	4.1%	.0%	8.4%
Digital	8	7	0	227	2.7%	4.1%	.0%	6.2%
Mentor	7	3	3	74	2.4%	2.0%	3.0%	2.0%
Seiko I&E	3	2	1	13	.9%	1.0%	1.1%	.4%
Sun	2	2	0	95	.7%	1.1%	.0%	2.6%
Intergraph	2	1	1	13	.6%	.6%	.6%	.4%
IBM	1	1	0	9	.4%	.3%	.4%	.2%
Control Data	1	0	0	10	.3%	.3%	.4%	.3%
Tektronix	1	0	0	6	.3%	.2%	.4%	.2%
Valid	1	0	0	11	.2%	.2%	.3%	.3%
Silvar-Lisco	0	0	0	0	.0%	.0%	.1%	.0%
Autodesk	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	42	22	16	351	14.7%	13.1%	18.7%	9.7%
All Far East-Based Companies	25	14	10	103	8.8%	8.0%	11.3%	2.8%
All European-Based Companies	22	13	7	184	7.7%	7.6%	8.7%	5.1%
All Hardware Companies	19	16	0	671	6.5%	9.8%	.0%	18.4%
All Turnkey & SW Companies	268	152	85	2,966	93.5%	90.2%	100.0%	81.6%
All Companies	286	168	85	3,637	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-3
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Worldwide
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Digital	44	39	0	0	15.2%	19.3%	.0%	.0%
Scientific Calc.	33	14	9	117	11.3%	7.0%	17.3%	5.9%
Zuken	29	15	12	290	10.1%	7.5%	24.6%	14.6%
IBM	23	16	3	228	8.1%	8.1%	5.8%	11.5%
Applicon	12	9	2	166	4.3%	4.5%	4.1%	8.4%
Control Data	11	7	2	177	3.8%	3.3%	4.0%	8.9%
Fujitsu	9	6	3	56	3.2%	3.0%	5.2%	2.8%
NEC	9	6	2	60	3.0%	3.2%	3.2%	3.0%
Hitachi	8	5	3	37	2.9%	2.3%	6.2%	1.9%
Sharp System Products	7	5	1	42	2.3%	2.6%	2.2%	2.1%
Computervision	6	4	1	28	2.1%	1.8%	1.6%	1.4%
Calma	6	4	1	36	2.0%	1.7%	1.6%	1.8%
Toshiba	4	4	0	32	1.5%	1.8%	.8%	1.6%
Intergraph	4	3	1	25	1.4%	1.4%	1.2%	1.2%
Tektronix	3	2	1	46	1.1%	.8%	2.6%	2.3%
Hitachi Zosen	1	1	0	16	.5%	.3%	.9%	.8%
Mitsubishi Electric	1	1	0	6	.4%	.5%	.5%	.3%
Silver-Lisco	0	0	0	0	.1%	.0%	.3%	.0%
Other Companies	77	62	9	617	26.8%	30.9%	17.8%	31.2%
All Far East-Based Companies	79	48	25	633	27.4%	23.9%	51.0%	32.0%
All European-Based Companies	3	2	1	53	1.0%	.8%	2.6%	2.7%
All Hardware Companies	104	94	0	469	36.1%	46.6%	.0%	23.7%
All Turnkey & SW Companies	185	107	50	1,510	63.9%	53.4%	100.0%	76.3%
All Companies	289	201	50	1,978	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-6
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					Market Share			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Cadnetix	18	10	6	367	15.4%	14.7%	18.3%	20.2%
Calay	15	12	2	128	12.7%	16.3%	6.9%	7.1%
Computervision	13	9	3	146	10.7%	12.5%	10.2%	8.0%
Hewlett-Packard	12	8	2	273	9.9%	11.9%	6.6%	15.0%
Scientific Calc.	9	3	3	24	8.1%	4.5%	10.6%	1.3%
Racal-Redac	9	5	3	110	7.2%	6.6%	8.2%	6.0%
Telesis	7	4	2	54	5.6%	5.7%	6.8%	2.9%
Daisy	6	2	3	64	4.8%	2.5%	8.9%	3.5%
Calma	6	3	2	65	4.7%	3.9%	4.9%	3.6%
Apollo	5	4	0	191	4.2%	6.1%	.0%	10.5%
Digital	4	4	0	127	3.7%	5.4%	.0%	7.0%
Mentor	3	2	1	37	2.9%	2.4%	4.0%	2.0%
Intergraph	1	1	0	9	1.1%	.9%	1.2%	.5%
Sun	1	1	0	57	1.0%	1.5%	.0%	3.1%
Tektronix	1	0	0	5	.6%	.4%	1.0%	.3%
IBM	1	0	0	5	.5%	.5%	.6%	.3%
Control Data	1	0	0	6	.5%	.4%	.6%	.3%
Valid	0	0	0	6	.2%	.2%	.3%	.3%
Autodesk	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	7	3	4	144	6.0%	3.7%	11.1%	7.9%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	11	10	0	399	9.4%	13.7%	.0%	21.9%
All Turnkey & SW Companies	107	61	32	1,419	90.6%	86.3%	100.0%	78.1%
All Companies	118	71	32	1,818	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-7
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: North America
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Digital	25	22	0	0	20.9%	25.4%	.0%	.0%
Scientific Calc.	22	10	6	80	18.7%	11.3%	41.2%	10.6%
IBM	11	8	1	110	9.0%	9.1%	9.6%	14.6%
Applicon	7	5	1	111	6.3%	6.4%	8.4%	14.7%
Control Data	7	4	1	106	5.5%	4.7%	8.5%	14.1%
Calma	3	2	0	20	2.7%	2.4%	3.2%	2.6%
Intergraph	3	2	0	18	2.5%	2.3%	3.1%	2.4%
Tektronix	3	1	1	39	2.3%	1.5%	7.7%	5.2%
Computervision	1	1	0	7	1.2%	.9%	1.3%	.9%
Other Companies	36	31	2	262	30.8%	35.9%	17.0%	34.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	58	52	0	262	49.4%	61.3%	.0%	34.8%
All Turnkey & SW Companies	60	33	14	491	50.6%	38.7%	100.0%	65.2%
All Companies	118	85	14	753	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-10
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Racal-Redac	36	20	11	290	30.2%	29.2%	29.4%	22.8%
Computervision	15	10	4	171	12.4%	15.3%	10.1%	13.4%
Calay	13	6	6	96	11.1%	9.5%	15.6%	7.6%
Hewlett-Packard	12	8	2	273	9.9%	12.5%	5.6%	21.6%
Daisy	6	2	3	64	4.8%	2.6%	7.5%	5.1%
Scientific Calc.	4	1	1	10	3.3%	2.0%	3.7%	.8%
Mentor	3	2	1	37	2.9%	2.5%	3.4%	2.9%
Telesis	2	1	1	16	1.7%	1.8%	1.7%	1.3%
Cadnetix	2	1	1	34	1.4%	1.4%	1.5%	2.7%
Digital	2	1	0	45	1.3%	2.0%	.0%	3.6%
Calma	1	0	0	4	.5%	.4%	.3%	.3%
Sun	0	0	0	19	.3%	.5%	.0%	1.5%
Intergraph	0	0	0	3	.3%	.3%	.3%	.2%
IBM	0	0	0	3	.3%	.3%	.3%	.3%
Control Data	0	0	0	3	.2%	.2%	.3%	.2%
Valid	0	0	0	3	.2%	.2%	.2%	.3%
Tektronix	0	0	0	1	.1%	.1%	.2%	.1%
Silvar-Lisco	0	0	0	0	.1%	.0%	.2%	.0%
Other Companies	22	13	7	163	18.9%	19.2%	19.7%	12.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	22	13	7	184	18.7%	18.9%	19.6%	14.5%
All Hardware Companies	2	2	0	75	1.9%	2.9%	.0%	5.9%
All Turnkey & SW Companies	117	66	38	1,193	98.1%	97.1%	100.0%	94.1%
All Companies	119	68	38	1,268	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-11
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
-----	-----	-----	-----	-----	-----	-----	-----	-----
Scientific Calc.	9	4	2	33	17.4%	10.8%	32.2%	8.7%
Digital	9	8	0	0	16.8%	21.0%	.0%	.0%
IBM	7	5	1	70	13.0%	13.5%	11.7%	18.7%
Applicon	4	3	1	46	8.3%	8.7%	9.6%	12.2%
Control Data	3	2	1	53	6.2%	5.5%	8.0%	14.1%
Computervision	2	1	0	8	3.2%	2.6%	2.9%	2.2%
Intergraph	1	1	0	6	1.8%	1.7%	1.9%	1.5%
Calma	1	0	0	6	1.3%	.8%	1.3%	1.5%
Tektronix	0	0	0	7	.9%	.6%	2.5%	1.8%
Silvar-Lisco	0	0	0	0	.3%	.0%	2.0%	.0%
Other Companies	16	13	2	148	30.8%	34.8%	27.9%	39.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	3	2	1	53	5.7%	4.6%	17.0%	14.1%
All Hardware Companies	21	19	0	95	40.1%	51.3%	.0%	25.1%
All Turnkey & SW Companies	31	18	8	282	59.9%	48.7%	100.0%	74.9%
All Companies	52	37	8	377	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-12
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Europe
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Racal-Redac	8	0	7	0	39.8%	.0%	61.7%	.0%
IBM	6	5	0	1,060	28.5%	73.8%	1.7%	78.1%
Futurenet	1	0	1	9	3.1%	.5%	4.6%	.6%
Computervision	1	0	0	5	2.6%	1.0%	3.9%	.4%
Autodesk	0	0	0	0	2.1%	.0%	3.8%	.0%
Cadnetix	0	0	0	0	2.1%	.0%	3.5%	.0%
Telesis	0	0	0	14	1.9%	3.3%	1.1%	1.0%
Control Data	0	0	0	0	.4%	.0%	.5%	.0%
Other Companies	4	2	2	269	19.5%	21.4%	19.1%	19.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	9	1.5%	2.9%	.5%	.6%
All Hardware Companies	6	6	0	1,283	32.2%	87.4%	.0%	94.6%
All Turnkey & SW Companies	13	1	11	74	67.8%	12.6%	100.0%	5.4%
All Companies	20	7	11	1,356	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-13
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company *****	Total Hardware Software Wkstns				----- Market Share -----			
	Revenue *****	Revenue *****	Revenue *****	Shipped *****	Revenue *****	Revenue *****	Revenue *****	Shipped *****
Zuken	29	15	12	290	16.9%	13.9%	24.9%	11.2%
Sharp System Products	17	11	5	95	9.7%	10.0%	9.9%	3.7%
IBM	9	7	1	798	5.4%	6.6%	1.2%	30.9%
Fujitsu	9	6	3	56	5.3%	5.6%	5.2%	2.2%
NEC	9	6	2	60	5.0%	5.9%	3.2%	2.3%
Hitachi	8	5	3	37	4.8%	4.3%	6.3%	1.4%
Digital	8	7	0	34	4.5%	6.3%	.0%	1.3%
Hewlett-Packard	5	4	2	75	3.1%	3.3%	3.1%	2.9%
Toshiba	5	4	0	36	3.0%	3.9%	1.0%	1.4%
Calma	4	2	1	37	2.2%	2.0%	1.8%	1.4%
Seiko I&E	3	2	1	17	1.9%	1.9%	2.1%	.7%
Racal-Redac	3	1	1	32	1.8%	1.3%	2.5%	1.2%
Computervision	3	2	0	12	1.6%	1.7%	.8%	.5%
Apollo	2	2	0	76	1.1%	1.6%	.0%	3.0%
Scientific Calc.	2	1	1	6	1.1%	.7%	1.1%	.2%
Cadnetix	2	1	1	26	.9%	.7%	1.4%	1.0%
Calay	2	1	0	13	.9%	1.1%	.4%	.5%
Hitachi Zosen	1	1	0	16	.8%	.6%	1.0%	.6%
Mitsubishi Electric	1	1	0	6	.7%	.9%	.5%	.2%
Daisy	1	0	1	14	.7%	.4%	1.3%	.6%
Otsukashokai	1	1	0	101	.7%	.6%	.9%	3.9%
Telesis	1	0	0	10	.5%	.4%	.5%	.4%
Control Data	1	0	0	9	.3%	.3%	.2%	.4%
Applicon	0	0	0	6	.2%	.3%	.1%	.2%
Sun	0	0	0	14	.2%	.3%	.0%	.6%
Autodesk	0	0	0	0	.1%	.0%	.3%	.0%
Valid	0	0	0	2	.1%	.0%	.1%	.1%
Other Companies	46	27	15	708	26.4%	25.4%	30.1%	27.4%

(Continued)

Appendix B Market Shares

TABLE NUMBER: B.4-13 (Continued)
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
All Far East-Based Companies	119	69	41	1,155	68.7%	64.4%	82.9%	44.7%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	24	22	0	1,143	13.9%	20.4%	.0%	44.2%
All Turnkey & SW Companies	149	86	49	1,443	86.1%	79.6%	100.0%	55.8%
All Companies	173	108	49	2,586	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-14
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Sharp System Products	10	6	4	53	22.7%	21.8%	26.2%	12.3%
Hewlett-Packard	5	4	2	75	12.2%	13.8%	10.6%	17.3%
Seiko I&E	3	2	1	13	6.0%	6.2%	6.3%	3.1%
Racal-Redac	2	1	1	32	5.6%	5.3%	5.4%	7.4%
Calma	2	1	1	29	5.5%	4.8%	4.8%	6.7%
Apollo	2	2	0	76	4.4%	6.7%	.0%	17.7%
Calay	2	1	0	13	3.4%	4.5%	1.5%	3.0%
Cadnetix	1	1	0	26	2.9%	2.8%	2.9%	5.9%
Daisy	1	0	1	14	2.8%	1.6%	4.4%	3.3%
Digital	1	1	0	34	2.6%	4.0%	.0%	7.9%
Telesis	1	0	0	5	1.5%	1.6%	1.5%	1.2%
Scientific Calc.	1	0	0	1	1.3%	.7%	1.4%	.3%
Sun	0	0	0	14	.7%	1.1%	.0%	3.3%
Valid	0	0	0	2	.2%	.2%	.3%	.4%
Control Data	0	0	0	0	.1%	.1%	.1%	.1%
Other Companies	13	6	5	44	28.2%	25.0%	34.5%	10.1%
All Far East-Based Companies	25	14	10	103	56.5%	52.4%	67.0%	23.8%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	4	3	0	132	8.1%	12.4%	.0%	30.6%
All Turnkey & SW Companies	41	23	14	300	91.9%	87.6%	100.0%	69.4%
All Companies	44	26	14	432	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-15
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
=====	=====	=====	=====	=====	=====	=====	=====	=====
Zuken	29	15	12	290	27.2%	21.6%	44.2%	36.7%
Fujitsu	9	6	3	56	8.6%	8.7%	9.3%	7.1%
NEC	9	6	2	60	8.0%	9.2%	5.7%	7.6%
Hitachi	8	5	3	37	7.7%	6.7%	11.1%	4.7%
Sharp System Products	7	5	1	42	6.2%	7.4%	4.0%	5.3%
Digital	7	6	0	0	6.1%	8.4%	.0%	.0%
IBM	6	3	1	45	5.3%	4.9%	2.1%	5.7%
Toshiba	4	4	0	32	4.1%	5.3%	1.5%	4.1%
Computervision	3	2	0	12	2.6%	2.6%	1.4%	1.5%
Calma	1	1	0	9	1.3%	1.3%	.7%	1.1%
Hitachi Zosen	1	1	0	16	1.2%	1.0%	1.7%	2.0%
Scientific Calc.	1	1	0	5	1.2%	.8%	1.2%	.6%
Mitsubishi Electric	1	1	0	6	1.2%	1.4%	.9%	.8%
Control Data	1	0	0	9	.5%	.5%	.4%	1.1%
Applicon	0	0	0	6	.3%	.4%	.2%	.7%
Other Companies	20	14	4	165	18.3%	19.9%	15.5%	20.9%
All Far East-Based Companies	79	48	25	633	73.5%	69.2%	91.5%	80.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	16	14	0	71	14.6%	20.3%	.0%	8.9%
All Turnkey & SW Companies	92	55	28	718	85.4%	79.7%	100.0%	91.1%
All Companies	108	69	28	789	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-16
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Far East
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
IBM	4	4	0	752	18.0%	29.6%	.0%	55.1%
Otsukashokai	1	1	0	101	5.8%	5.5%	6.4%	7.4%
Seiko I&E	1	1	0	4	3.2%	4.0%	1.8%	.3%
Toshiba	1	1	0	4	3.2%	4.3%	.8%	.3%
Racal-Redac	1	0	0	0	2.6%	.0%	6.6%	.0%
Cadnetix	0	0	0	0	1.5%	.0%	4.1%	.0%
Autodesk	0	0	0	0	.6%	.0%	1.8%	.0%
Telesis	0	0	0	5	.6%	.6%	.6%	.3%
Control Data	0	0	0	0	.0%	.0%	.1%	.0%
Other Companies	13	7	6	499	64.4%	56.1%	77.8%	36.6%
All Far East-Based Companies	15	8	6	419	70.0%	62.4%	81.5%	30.7%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	5	5	0	941	22.5%	37.0%	.0%	68.9%
All Turnkey & SW Companies	16	8	7	425	77.5%	63.0%	100.0%	31.1%
All Companies	21	13	7	1,365	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-17
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: All Platforms
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company	Total				Market Share			
	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Digital	5	4	0	20	26.2%	29.8%	.0%	7.1%
Hewlett-Packard	1	1	0	28	6.7%	6.3%	10.7%	9.7%
Racal-Redac	1	0	0	11	5.9%	3.5%	21.0%	3.9%
Apollo	1	1	0	38	5.5%	6.2%	.0%	13.3%
Calma	1	1	0	9	5.0%	3.6%	10.2%	3.0%
IBM	1	1	0	91	3.9%	4.4%	2.0%	31.5%
Control Data	1	0	0	9	3.4%	2.5%	5.9%	3.2%
Computervision	0	0	0	4	1.9%	1.7%	4.4%	1.3%
Intergraph	0	0	0	2	1.7%	1.5%	2.9%	.7%
Calay	0	0	0	3	1.7%	1.7%	2.0%	.9%
Applicon	0	0	0	4	1.4%	1.3%	2.0%	1.3%
Telesis	0	0	0	3	1.3%	1.0%	3.4%	1.0%
Autodesk	0	0	0	0	.6%	.0%	5.4%	.0%
Sun	0	0	0	5	.6%	.7%	.0%	1.6%
Futurenet	0	0	0	1	.4%	.0%	2.9%	.4%
Valid	0	0	0	0	.1%	.0%	.0%	.0%
Other Companies	6	5	1	61	33.8%	35.7%	27.3%	21.0%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	12	10	0	210	64.8%	75.5%	.0%	73.0%
All Turnkey & SW Companies	6	3	2	78	35.2%	24.5%	100.0%	27.0%
All Companies	18	14	2	288	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-18
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Technical Workstation
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company *****					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
*****	*****	*****	*****	*****	*****	*****	*****	*****
Hewlett-Packard	1	1	0	28	22.3%	22.4%	25.3%	23.5%
Apollo	1	1	0	38	18.2%	22.1%	.0%	32.0%
Racal-Redac	1	0	0	11	16.0%	12.3%	31.0%	9.3%
Digital	1	1	0	20	13.0%	15.9%	.0%	17.1%
Calma	1	0	0	7	10.4%	7.5%	18.4%	5.6%
Calay	0	0	0	3	5.6%	5.9%	4.6%	2.1%
Computervision	0	0	0	3	5.6%	5.7%	9.2%	2.9%
Telesis	0	0	0	2	3.5%	3.1%	6.9%	1.3%
Sun	0	0	0	5	1.9%	2.6%	.0%	4.0%
Intergraph	0	0	0	1	1.7%	1.3%	3.4%	.6%
Control Data	0	0	0	0	.9%	.5%	1.1%	.4%
IBM	0	0	0	0	.2%	.0%	.0%	.1%
Valid	0	0	0	0	.2%	.0%	.0%	.1%
Other Companies	0	0	0	1	.6%	.8%	.0%	1.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	2	2	0	65	33.6%	41.4%	.0%	54.2%
All Turnkey & SW Companies	4	2	1	55	66.4%	58.6%	100.0%	45.8%
All Companies	5	4	1	119	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-19
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Host-Dependent
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
Digital	4	3	0	0	36.4%	37.3%	.0%	.0%
Control Data	1	0	0	9	5.0%	3.5%	34.5%	14.8%
Calma	0	0	0	2	3.0%	2.3%	17.2%	3.4%
Applicon	0	0	0	4	2.3%	1.9%	13.8%	6.2%
ISM	0	0	0	2	2.1%	1.8%	10.3%	3.9%
Intergraph	0	0	0	1	2.0%	1.6%	10.3%	2.2%
Computervision	0	0	0	0	.3%	.2%	.0%	.3%
Other Companies	5	5	0	41	48.9%	51.3%	13.8%	69.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	9	8	0	41	84.8%	88.6%	.0%	69.2%
All Turnkey & SW Companies	2	1	0	18	15.2%	11.4%	100.0%	30.8%
All Companies	11	9	0	60	100.0%	100.0%	100.0%	100.0%

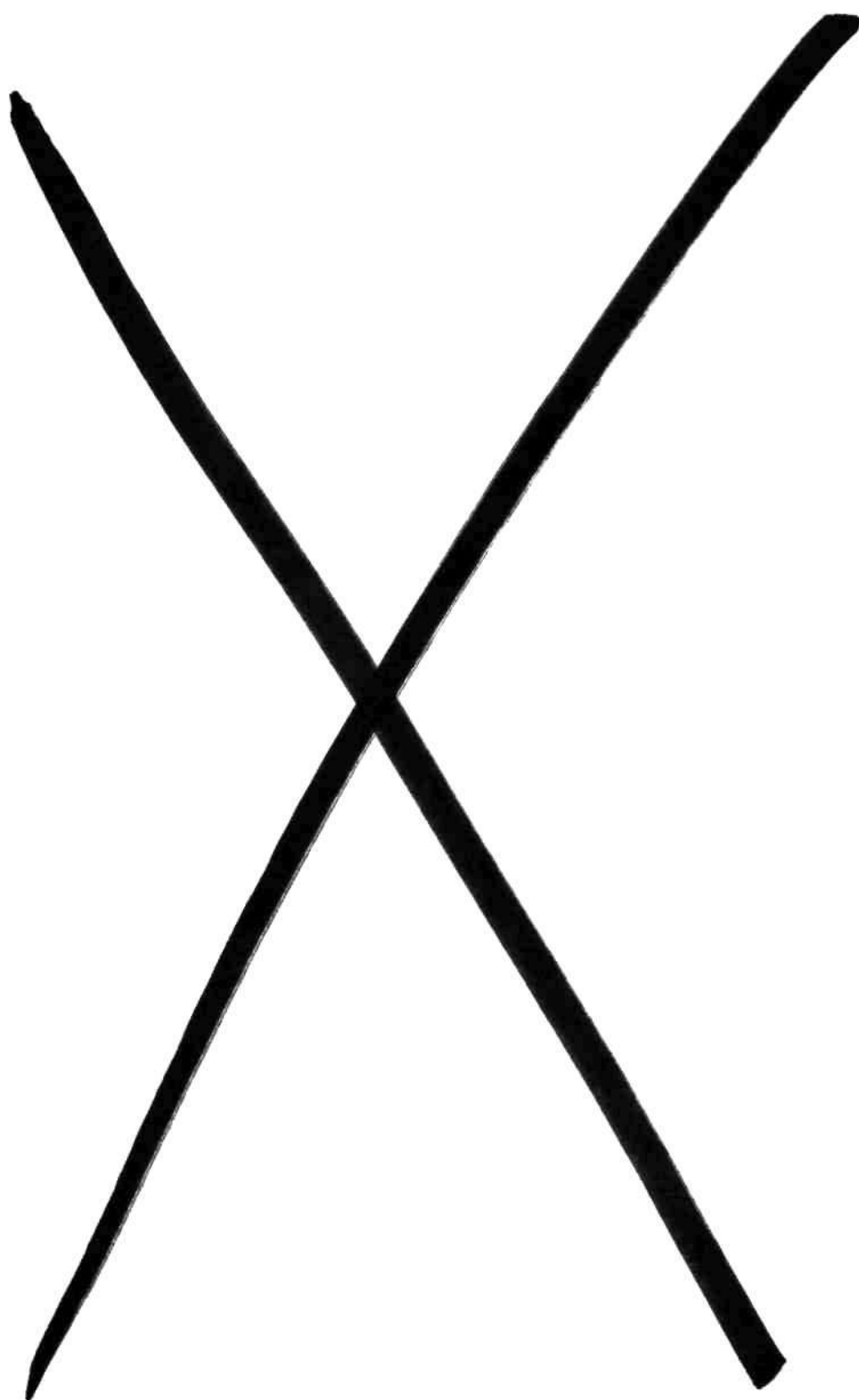
Source: Dataquest
June 1987

Appendix B Market Shares

TABLE NUMBER: B.4-20
 TITLE: 1986 Market Share
 APPLICATION: PCB Layout
 PLATFORM: Personal Computer
 REGION: Rest of World
 UNITS: Millions of Dollars/Actual Units

Company =====					----- Market Share -----			
	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====	Total Revenue =====	Hardware Revenue =====	Software Revenue =====	Wkstns Shipped =====
IBM	0	0	0	88	29.0%	78.6%	1.1%	81.2%
Racal-Redac	0	0	0	0	12.3%	.0%	18.0%	.0%
Autodesk	0	0	0	0	7.1%	.0%	12.4%	.0%
Futurenet	0	0	0	1	4.5%	.0%	6.7%	.9%
Telesis	0	0	0	1	2.6%	3.6%	1.1%	1.2%
Computervision	0	0	0	0	.6%	.0%	1.1%	.1%
Control Data	0	0	0	0	.6%	.0%	1.1%	.0%
Other Companies	1	0	1	18	43.2%	17.9%	58.4%	16.6%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	104	32.9%	92.9%	.0%	95.9%
All Turnkey & SW Companies	1	0	1	5	67.1%	7.1%	100.0%	4.1%
All Companies	2	1	1	109	100.0%	100.0%	100.0%	100.0%

Source: Dataquest
June 1987



Appendix G—Glossary

DATAQUEST CAD/CAM GLOSSARY

accelerator. Hardware used to increase throughput by decreasing processing time. An accelerator may be in the form of a plug-in board or a self-contained, standalone unit used in a network.

AEC. Architecture, engineering, and construction. See *facilities design*.

analog. Denotes the dominant component type, function(s), or circuit characteristics of a particular design. May include software-generated analog test instruments, such as oscilloscopes.

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

ASIC. Application-specific integrated circuit.

average price per seat. The price a buyer pays for accessing a workstation or a CAD/CAM seat. (In the case of host-dependent systems, the system price takes into account the average workstation price and the average number of workstations per system. In the case of a technical workstation and personal computer-based workstation, there is a 1:1 ratio between the price of the system and the price of the workstation.)

average system selling price. The price a buyer pays for a CAD/CAM system, workstation, and all of the system's peripherals and software. (In the case of technical workstations and personal computer-based workstations, there is a 1:1 ratio between the price of the system and the price of the workstation.)

behavioral simulation. Simulation of ICs or systems that are based on high-level models, as opposed to gate, transistor, or switch-level models. Behavioral models can be of an entire section of an IC or system (e.g., I/O management) or of a specific complex component (e.g., a microprocessor or register).

block place and route. An IC design methodology for interconnecting large blocks in a design. The blocks can be made up of smaller cells or handcrafted custom blocks. A special placer positions the blocks to minimize the routing distances and optimize the IC performance. The blocks are then connected by a router or routers that takes into account the block topology.

bundled software revenue. The value of a turnkey system that is associated with application-related software.

CAD. Computer-aided design. The use of a computer for automated product design.

CAM. Computer-aided manufacturing. See *manufacturing automation*.

cell-based IC. An IC design methodology that allows creation of ICs or blocks within ICs from predefined cells that are placed and then routed together to create logic functions. See *block place and route*.

channel type. Identifies how CAD/CAM systems reach the end user; distinguishes the various distribution channels and marketing arrangements used when selling CAD/CAM systems.

circuit simulation. The process of simulating an IC at the switch, transistor, or device level. This is the most accurate form of IC verification. The best-known circuit simulator is SPICE, which was invented at Berkeley and is now available in the public domain. It is also available in enhanced forms from several suppliers.

compound annual growth rate (CAGR). Determines the average compound rate of growth over a specified period. (The formula used to calculate CAGR is $((\text{future value}/\text{present value}) \text{ raised to the power of } (1/\text{number of years})) - 1$.)

contours. Digital terrain modeling software.

CPU installed base. The installed base of CPUs at the end of a given year, minus any system retirements. (This element takes into account current year system shipments, estimated current year system retirements, and previous year system population.)

CPU revenue. The portion of revenue derived from a system sale that is related to the value of the CPU. (In the case of technical workstations and personal computer-based workstations, CPU revenue and workstation revenue are equal.)

CPUs shipped. The unit number of systems shipped. (In the case of technical workstations and personal computers, there is a 1:1 ratio of systems shipped and workstations shipped.)

custom IC. A handcrafted IC that has been constructed for a specific use by designing at the polygon level.

dealer. A tier in the distribution channel that sells products that are typically developed by another company to users.

design rule checking. The process of verifying that an IC or board layout meets known fabrication tolerances. Examples of such tolerances or rules include trace-to-trace spacing, via adjacency, or trace-to-via spacing.

DRC/ERC. Design rule check/electrical rule check.

design service. An organization that creates and/or executes CAD designs for external customers.

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

distributor. Includes distributors, dealers, value-added resellers, and value-added dealers.

drafting. 1. Software for creating dimensioned detail drawings of a mechanical component or facility; used from conception through manufacturing or construction. 2. In mapping, software for capture and editing of map surface details, including graphic and text data.

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

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

electrical. Creation of a diagram of the logical arrangement of hardware in an electrical circuit/system using conventional component symbols.

electrical rule checking. A term used to describe two distinct types of design verification. ERC can refer to verifying that a final layout corresponds to the original design that was done prior to layout (netlist vs. layout). It can also refer to making sure that a logic design conforms to known process limitations (e.g., maximum fanout from a component). This second process is also called logic design rule checking (LDRC).

electronic testing. ECAE software applications used to create the test patterns that will be used during the manufacture of a product. Electronic test products include pattern editing, pattern generation, and fault grading or simulation.

Europe. Includes Benelux countries, France, United Kingdom, West Germany, Italy, Scandinavian countries, and the rest of Europe.

FEM/FEA. Finite element modeling/finite element analysis.

facilities design. Also known as *facilities design/management*. The use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and others associated with these disciplines to aid in designing buildings, power plants, process plants, ships, and other types of nondiscrete entities.

Far East. Includes Hong Kong, Japan, Korea, People's Republic of China (PRC), Singapore, and Taiwan.

fault simulation. Also referred to as fault grading. A fault simulator is used to evaluate or grade the quality of test patterns relative to a design. Quality is determined by a measure of the coverage of the test vectors (i.e., the percent of the time that the patterns will identify potential errors in a circuit).

finite element analysis. Method for determining the structural integrity of a mechanical design by analyzing a finite element model to determine a structure's strength, safety, or performance characteristics. Typical applications include stress analysis, vibration analysis, acoustics, electromagnetics, and fluid/structure interaction.

finite element modeling. Creation of a mathematical model to represent a mechanical design by subdividing the design model into smaller and simpler elements, such as triangles or bricks, which are interconnected. The finite element model is composed of all interconnected elements, attributes such as material and thickness, as well as boundary conditions and loads.

flat pattern. The design and unfolding of a three-dimensional design of a sheet metal part.

gate array. Software tools used to create ASICs. The gate array itself is a predefined pattern of transistors that a semiconductor supplier prefabricates on wafers. It is customized for users by interconnecting the transistors using one or more layers of metal.

GIS. Geographical information systems. A data base management system for mapping applications; provides for analysis of geographically related information using topological mathematics.

group technology. A coding and classification system for combining similar, often-used parts into families to allow groups of similar parts to be retrieved, processed, and fabricated in an efficient, economical batch mode.

hardware revenue. The sum of revenue derived from the sale of CPUs, workstations, and peripherals.

HVAC. Heating, ventilation, and air-conditioning design and analysis.

host-dependent. A shared logic system in which the external workstations' functions are dependent on a host computer.

hybrids. A hybrid is made by putting several integrated circuit dies and/or passive components into a single package and interconnecting the dies inside of the package.

IC layout. Software tools that are used to create and validate physical implementations of an integrated circuit. IC layout tools include polygon editors for creating geometric data, symbolic editors, placement and routing (gate array, cell and block), and DRC/ERC verification tools.

image processing. A variety of techniques for processing pictorial information by computer.

increase over prior year. Total revenue percent change over the prior year's total revenue. (The formula used for this calculation is (present year revenue minus previous year revenue) divided by previous year revenue.)

indirect channels. The sale of CAD/CAM equipment through independent dealers and distributors that do not contribute significant development or integration to the product. This channel is typically used for sales of personal computer-based CAD/CAM systems. Examples of indirect CAD/CAM suppliers include Businessland, ComputerLand, and National CAD Pro.

input devices. A variety of data entry devices, such as mice, digitizers, or scanners, that allow users to communicate with CAD/CAM systems.

kinematics. An MCAE process for plotting or animating the motion of parts in a design. Kinematics simulation allows the motion of mechanisms to be studied for interference, acceleration, and force.

logic simulation. ECAE software that verifies the logic and timing behavior of a digital electronic design.

manufacturing automation. Use of a computer to aid and improve a manufacturing process.

map conversion. Software that converts existing hard-copy maps to a computer data base.

mapping. Computer-aided tools that allow geographically related data to be captured, edited, analyzed, and managed. Typical users are civil and utility engineers, geophysicists, and geologists.

mechanical testing. Software that combine and compare simulated test data with laboratory test data for further analysis prior to manufacture; includes modal analysis.

mechanical. Mechanical CAD/CAM is the application of computer-aided tools to design, analyze, document, and manufacture discrete parts, components, and assemblies.

mechanisms. Software that models machinery capable of mechanical action. See *kinematics*.

mold design/analysis. Typically means design of plastic injection molds and analysis of material flow; can also include design and analysis of molds for any material.

nesting. Arrangement of multiple parts on a larger sheet or plate for optimum use of material.

nonturnkey channels. These channels allow users to pick and choose individual system components (e.g., computers, software, etc.) and perform system integration to assemble complete CAD/CAM systems. Examples of vendors who sell components directly to end users include software vendors such as Futurenet, MacNeal-Schwendler, and PDA Engineering. Examples of nonturnkey hardware vendors include Apollo, Digital Equipment, and IBM.

North America. Includes the United States, Canada, and Mexico.

numerical control. A technique of simulating the operation of a machine tool. Also the process that generates the data or tapes necessary to guide a machine tool in the manufacture of a part.

output devices. A variety of devices, such as plotters and printers, that make hard copies of designs, documentation, or analysis created on a CAD system.

PCB layout. Products that are used to create the layout of the traces and components to be placed on a printed circuit board.

penetration. The amount of the total available market (TAM) that is using a CAD/CAM system. It is expressed as either a ratio of the number of users per system or as a percent of TAM using a system.

PLD. Programmable logic device. A type of application-specific IC that is user programmable rather than mask programmable. The function of a PLD is determined by blowing fuse links or programming memory devices to create the desired interconnections between the fixed logic elements on the device.

peripherals revenue. The value of all peripherals of a system sale. (Peripherals include all hardware except the CPU itself and any associated workstations.)

personal computer. A single-user computer whose resident operating system is either a version of DOS or IBM's OS/2. Graphics and networked communications are optional features rather than integrated capabilities.

pipng. Software for design and analysis of a facility's pipe network.

production planning. Software used to plan for all factory resources of a manufacturing company.

rest of world. Includes territories not included in North America, Europe, or the Far East.

robotics. Programs for controlling robots.

schematic capture. Automated graphic design entry method that allows a designer to define the logic of a circuit to create a schematic design. Following schematic capture, a netlist (list of logic components and their logical connections) can be produced.

server. A hardware device attached to a network to facilitate sharing or managing resources.

service revenue. Revenue derived from the service and support of CAD/CAM systems. (Service revenue does not include revenue from the portions of a company's business related to service bureaus or product designs.)

shipment. Shipment estimates include only products actually delivered to paying customers, not the total number manufactured (the backlog).

silicon compilation. IC design methodology that employs high-level specifications to automatically generate the mask tooling as output. A silicon compiler is a layout system; silicon compilation is a design method.

software revenue. The sum of bundled and unbundled software revenue.

solid modeling. Representation of all the external and internal geometry of a part, allowing the solid nature of an object to be represented in a computer. Solid models are constructed in two ways: using primitive building blocks (constructive solid geometry) and/or using boundary definitions (boundary representation).

specification/assessment. Software that allows definition of high-level behavioral and performance characteristics of an electronic product.

structural. Software for modeling and analysis of the integrity of a structure.

subsurfaces. Software that generates models of the earth's crust; typical applications include geological exploration and seismic modeling.

surface-mount design. Design methodology that supports designs using surface-mount devices (SMDs). SMD is a type of IC package that can be attached to the surface of a PC board, as opposed to through-hole mounted devices.

system. Comprises many parts, including the computer, operating system, peripherals, graphics devices, and application software. (The lowest common denominator of a system is that it contains the CPU that runs the operating system. By this definition, technical workstations and personal computer-based workstations are also counted as systems.)

system revenue. Revenue derived from system sales. (System revenue does not include service revenue. System revenue is the sum of CPU revenue, workstation revenue, bundled software revenue, and peripherals revenue.)

technical publications. Software to create product information in a format suitable for use outside of the engineering and manufacturing environments. Products provide for merging of text and graphics; typical applications include operating/maintenance manuals and technical illustrations.

technical workstation. A single-user workstation that has a resident virtual operating system, multitasking capabilities, networked communications support, and integrated graphics. A technical workstation's operating system is typically UNIX, VMS, or DOMAIN.

third-party software. Software sold directly to end users or resellers, as opposed to software that is a part of a turnkey system.

three-dimensional. A representation of the surface or edges of a design that contains X, Y, and Z coordinates.

total available market (TAM). The universe of technical professionals that could benefit from the use of a CAD/CAM system.

total revenue. Total CAD/CAM-related revenue received, measured in U.S. dollars. (It is the sum of system revenue and service revenue. Total revenue as reported does not include revenue that a company may receive from products that are sold to another company for resale (OEM revenue).)

total workstations shipped. The sum of workstations shipped.

turnkey channels. The sale of a complete CAD/CAM system, including computers, graphic workstations, operating systems, applications software, and any applicable peripherals. A turnkey sale also typically provides full system support, including system maintenance, product training, and software or applications support. Turnkey vendors essentially act as systems integrators by integrating the various components into complete systems. Examples of turnkey CAD/CAM vendors include Computervision, Daisy Systems, IBM, Intergraph, Mentor, and Prime Computer.

turnkey. A complete CAD/CAM system that includes a computer, a graphics workstation, an operating system, application software, and any applicable peripherals. A turnkey sale also typically provides full system support, including system maintenance, product training, and software for applications support.

unbundled software. See *third-party software*.

unbundled software revenue. Revenue derived from the sale of software only, or software that is not sold as part of a turnkey system. (Unbundled software is sold by software-only companies as well as by a growing number of turnkey companies.)

utilities. Software optimized for utility networks. Typical users are electric and telephone companies.

workstation installed base. The workstation installed base at the end of a given year, less any workstation retirements. (This element takes into account current year workstation shipments and retirements and the previous year workstation installed base.)

workstation revenue. Revenue derived from the sale of workstations that are used to graphically create, analyze, or manipulate designs. In the case of technical workstations and personal computers, CPU revenue and workstation revenue are equal.

workstations shipped. The total number of workstations shipped as parts of systems. (In the case of technical workstations and personal computer-based workstations, there is a 1:1 ratio of system shipments and workstation shipments.)



THIS SECTION WAS NOT READY IN TIME FOR PUBLICATION.
IT WILL BE MAILED AS SOON AS IT BECOMES AVAILABLE.