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# CAD/CAM Industry Service Facilities Design and Mapping Applications

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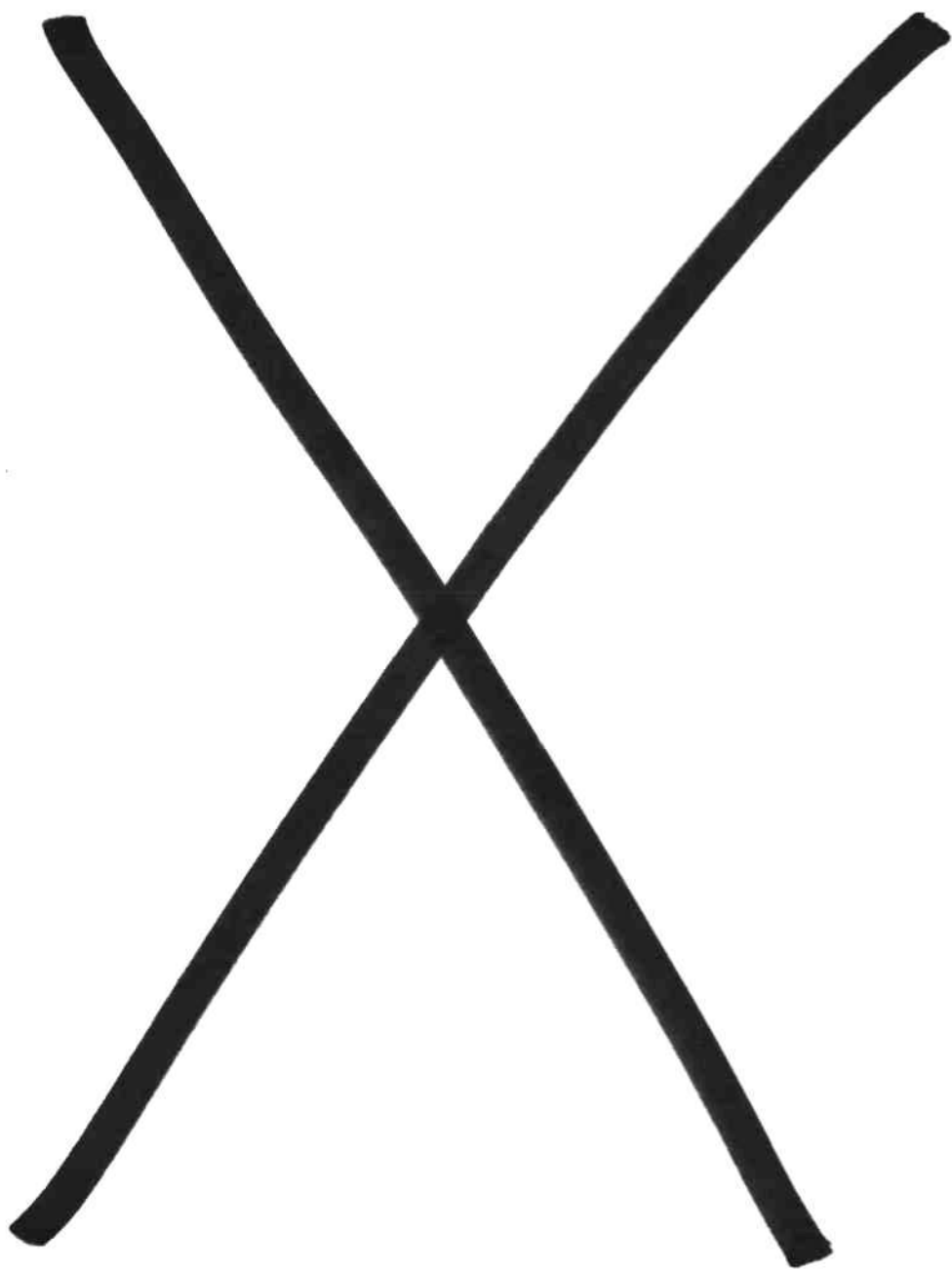
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IBM Corporation  
MacNeal-Schwendler Corporation  
McDonnell Douglas Automation Company  
Mentor Graphics Corporation  
PDA Engineering  
Personal CAD Systems, Incorporated  
Prime Computer, Incorporated  
Racal-Redac Limited  
Scientific Calculations, 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**

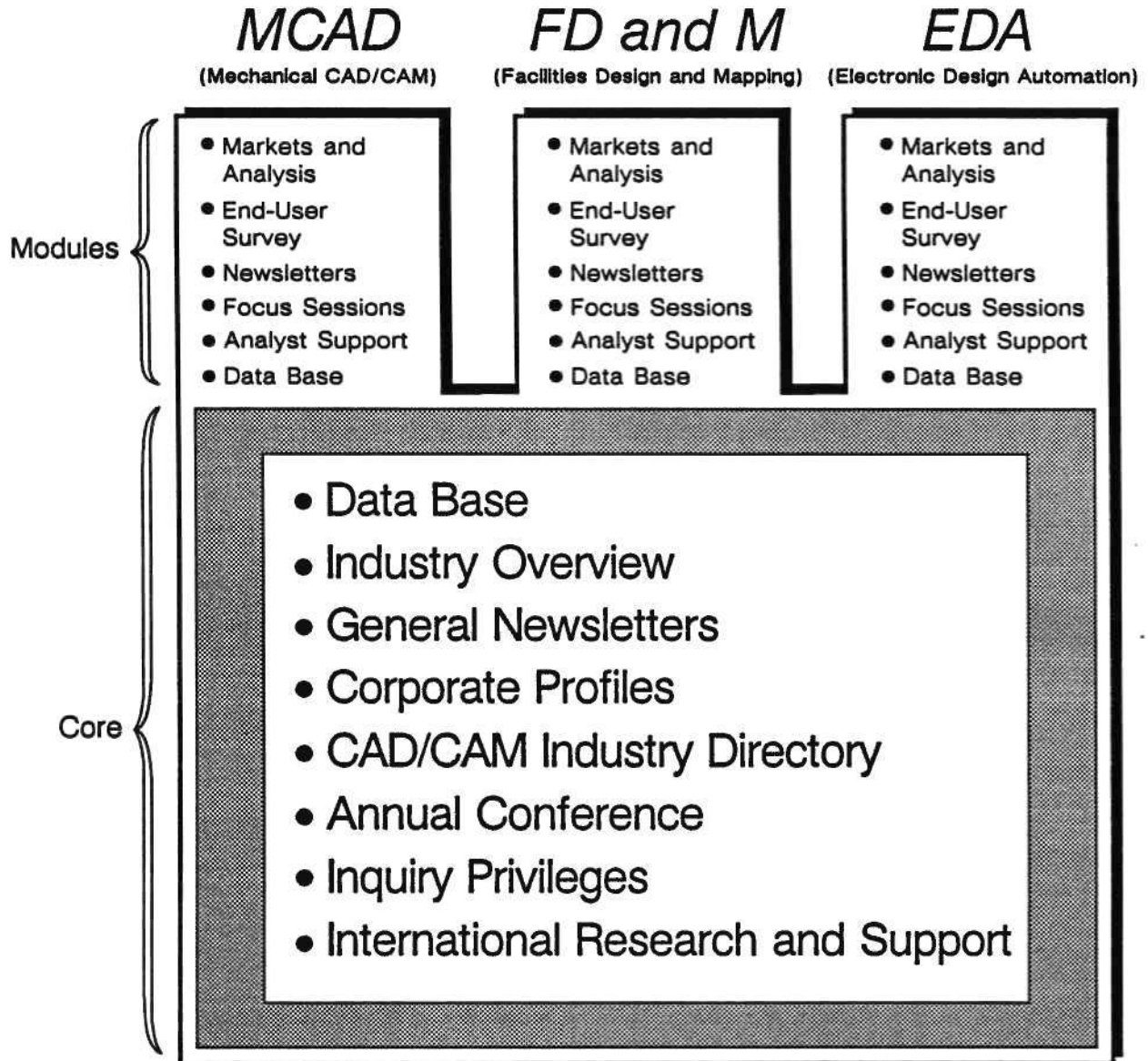
The core service is provided to all CCIS clients and contains information and analyses relevant to all CAD/CAM industry participants. The core service is supported by a staff of industry and research experts. It consists of the following elements:

- *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*

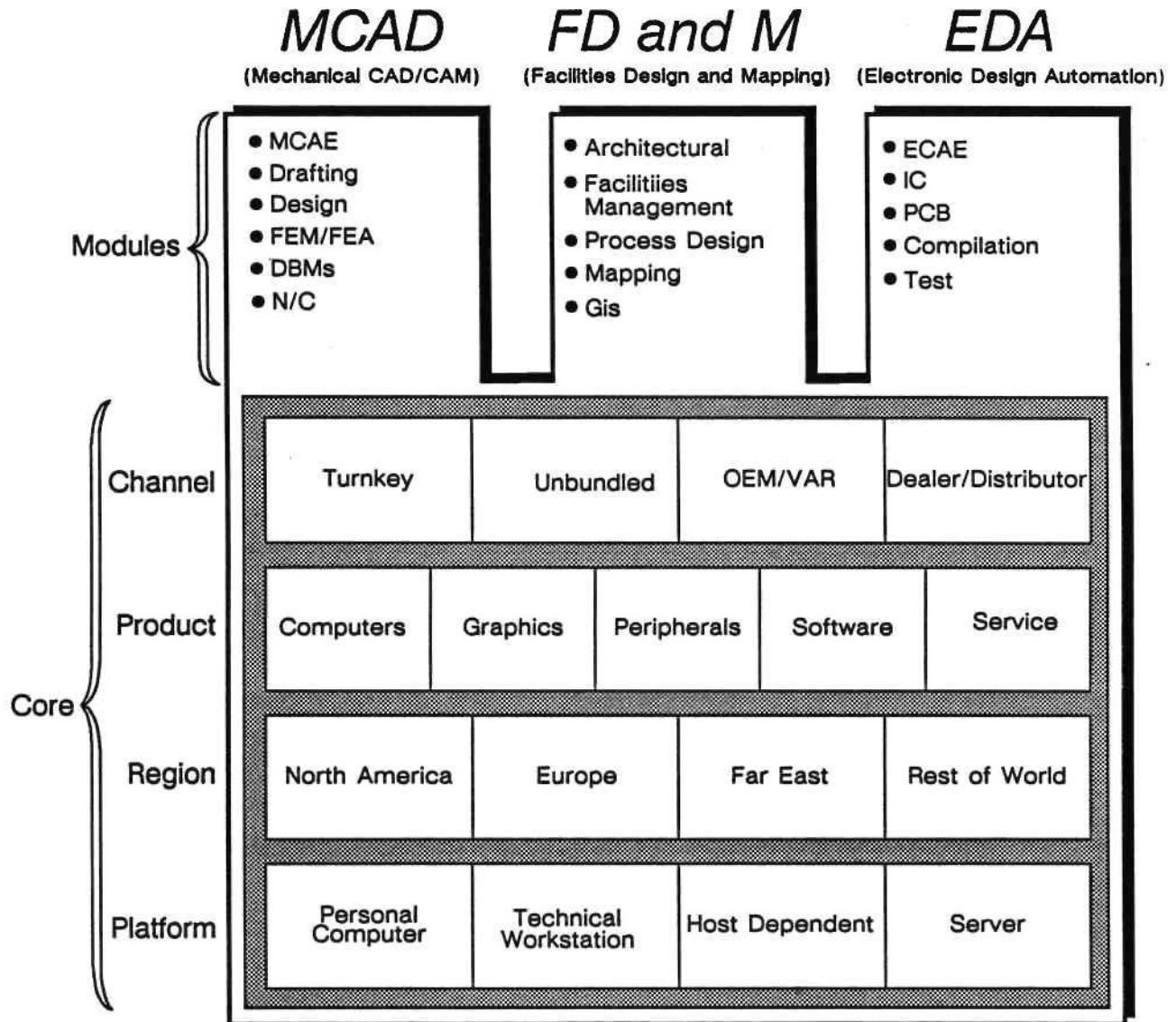
Each application module contains information and analyses particular to the specific application, including newsletters and other event-driven publications, market overview, market shares and forecasts, and specialized research and surveys. Each application module is supported by a staff of CCIS analysts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



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

#### Other North American Companies

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

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

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

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

### Far East-Based Companies

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

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

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

#### **European-Based Companies**

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

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

## HOW TO USE THE SERVICE

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

- Research notebooks
- Newsletters
- Inquiry privilege
- Annual conference

### Research Notebooks

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

### *Core Notebooks*

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

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

### *Application Modules*

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

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

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

### Newsletters

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

### Inquiry Privilege

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

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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.





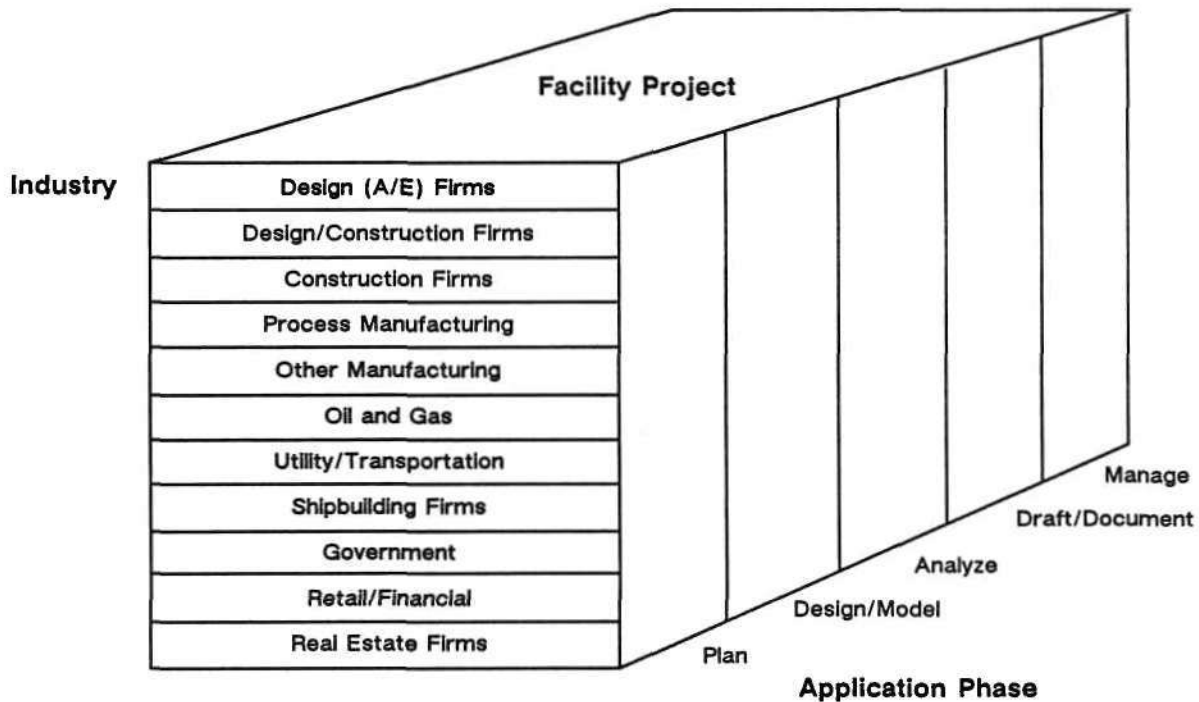
# 1.1 Facilities Design Definitions

The facilities design and management (FD) application segment comprises CAD/CAE products that are used in the prebuild (design), construction, and postbuild (management) phases of a facility project. The most common output from a CAD/CAE system used in this application would be a range of drawings for a facility yet to be built, a facility in the process of being built, or a facility being managed (i.e., architectural floor plans, structural plans, heating, ventilating, and air-conditioning (HVAC) layout, and piping layout).

Figure 1.1-1 shows Dataquest's view of this very diverse application segment, including the major end-user markets and the application phases of a facility project.

**Figure 1.1-1**

**The FD Segment**



Source: Dataquest  
June 1987

## FACILITY

The standard (Webster's) definition for facility reads, "...something that is built, installed, or established to serve a particular purpose." *Engineering News Record (ENR)* uses several specific categories of facility projects as a barometer to measure the health of the design and construction industries from one year to the next. Table 1.1-1 lists those categories of facilities.

Table 1.1-1

### Facility Project Categories

Water Supply	Dams, canals, locks, river channels
Power	Electric/gas utility plants
Manufacturing	All kinds of plants (i.e., process/discrete)
Building	Residential/commercial (offices, shopping centers, hospitals, etc.)
Sewer, Waste	As stated
Transportation	Roads, highways, bridges, railroads, etc.
Pipeline	Oil/gas (including natural gas)
Other	Offshore drilling platforms, ships (and other ocean-going vessels)

Source: ENR Magazine  
Dataquest  
June 1987

## MAJOR MARKETS

As shown in Figure 1.1-1, the FD end-user industries range from the typical design firm (i.e., all architects, or a combination of architects and engineers) to government (i.e., U.S. Navy Command). The engineering professionals and technicians working in these industries are equally diverse in discipline and focus.

Table 1.1-2 lists the various types of professionals that could at some point be involved in a facility project and have use for CAD systems.

Table 1.1-2

## Classification of Professionals

Architect  
Civil/structural engineer  
Civil/site Engineer  
Mechanical engineer  
Surveyor  
Electrical engineer  
Industrial engineer  
Chemical engineer  
Piping engineer  
Petroleum engineer  
Nuclear engineer  
Marine engineer/naval architect  
Related technicians (i.e., designers/draftspersons  
Facility manager

Source: U.S. Census of Population  
Dataquest  
June 1987

## APPLICATION PHASES

The CAD or CAE software used throughout the various phases is equally diverse. Generally, the software has followed along the lines of engineering discipline and focus (i.e., architectural design, structural design/analysis, electrical design, etc.). Thus, numerous programs and special system functionalities are associated with the FD segment. Many of them are listed below including:

- Geometric construction and editing
- Space projections
- Stacking/blocking routines
- Planning/layout
- Equipment/inventory management
- Elevations
- Structural grid/column layouts
- Massing studies
- Stress calculations (analysis)

## **1.1 Facilities Design Definitions**

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- Interference checking
- HVAC design
- Steel detailing
- Electrical schematics
- Piping/plumbing design
- Isometric views
- P & IDs
- Perspective views
- Control diagrams
- Wireframe modeling
- Sectioned views
- On-line graphics programming
- Solid modeling
- Report generation
- FEM/FEA
- Bill of materials generation

Given the depth and complexity of the FD segment (as demonstrated by the breakouts of our model), it is beyond the scope of this section to further define what each of the different types of facility projects would require in terms of CAD system functionality. There are distinct CAD differences from one project to another and in both the prebuild phase and the postbuild phase (termed facility management).

Dataquest will address the CAD requirements for the different types of facility projects in future writings, as part of this chapter.

## 1.2 Facilities Design 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 FD application segment.

- FD CAD/CAM revenue was \$1,005 million in 1986, forecast to decrease 8 percent to \$928 million in 1987 and grow to \$1,803 million in 1991.
- Dataquest expects the FD CAD/CAM market to increase in revenue at a 12 percent compound annual growth rate (CAGR) for the next five years.
- The total number of CAD/CAM workstation units shipped in 1986 was 26,205; Dataquest forecasts 34,000 units to be shipped in 1987 and 70,150 units in 1991.
- Major hurdles have been crossed that were once blocking widespread use of FD CAD tools, i.e., price/performance ratio of hardware tools, display performance, availability of software, and ease of use.
- As the price of hardware continues to drop, more users will continue to look toward CAD as a replacement for manual design methods.
- The effect of the personal computer has been dramatic. Approximately 69 percent of the workstations sold in 1986 were based on PCs.
- Data base management capability will be a crucial factor in the future of FD.
- Mergers and acquisitions can be valuable shortcuts toward improving the relative position of a vendor's total offering. Careful analysis of the many opportunities can avoid a costly or catastrophic detour.

## 1.3 Facilities Design Market Overview

### HISTORY

Until 1983, the FD segment had been affected by three key factors. These included:

- Dominance of the segment by only four CAD vendors
- CAD system usage limited mostly to 2-D drafting applications
- Expensive computing and graphics hardware

The vendors that dominated this application segment included Applicon, Auto-trol, Computervision, and Intergraph. A turnkey, host-dependent system approach prevailed, and Digital Equipment's PDP-11 and VAX computers were featured in the CAD systems of all the vendors (except Computervision). For this reason, we believe that Digital Equipment hardware had been the dominant computing platform in this CAD segment.

In 1982, Auto-trol made history by positioning itself as the first FD CAD vendor to offer products on a technical workstation-based platform. The company announced that it would offer its CAD products on Apollo Computer's first technical workstation products. Late in 1983, GE Calma, a relative newcomer to the FD market, also announced its support of Apollo's workstation products.

Table 1.3-1 shows Dataquest's estimates of the installed base of FD workstations for each of the vendor companies as of year-end 1983 (and the combined totals of all these companies) compared with the total FD installed base. We estimate that the workstation installed base of these four vendors represented 81 percent of the total FD installed base at year-end 1983.

Table 1.3-1

**Year-End 1983 Estimates  
Worldwide FD Workstation Installed Base  
(Thousands of Units)**

Company	Year-End 1983 Installed Base
Applicon	1,030
Auto-trol	1,187
Computervision	1,573
Intergraph	2,495
Total	6,285
Total Installed Base	7,800

Source: Dataquest  
June 1987

### 1.3 Facilities Design Market Overview

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#### Focus on 2-D

All of the early CAD vendors mentioned capitalized on architects' and engineers' needs to generate enormous quantities of detailed construction drawings by offering 2-D systems to automate this stage of a project (labeled the drafting/documentation stage). However, a design process usually starts long before it reaches a draftsman's table. Prior to this point, the project architect and/or engineer has already spent many hours huddled over hand-drawn sketches or plastic miniature-size models, conceptualizing a proposed facility. The drawings that emerge from this stage are usually called concept drawings or (architectural) renderings. There was much disagreement (in both the vendor and end-user communities) surrounding the need for a system with anything more than 2-D (drafting) functionality. We believe though that most users were not ready, for a number of reasons, to tackle the challenge of implementing full-scale (concept design to design documentation) systems even though most of the early vendors had already begun to incorporate much of the necessary functionality. The reasons for this can be identified as hardware, hardware, and hardware; most users in the FD community were not in a position to invest in the computing horsepower needed to drive full-scale design systems.

#### Hardware Expense Prohibitive

Dataquest estimates that in 1983, a four-seat FD turnkey system (minicomputer or technical workstation-based computer) was typically sold for an average price between \$500,000 and \$600,000. The greatest cost associated with this configuration was always hardware (an estimated 70 percent of system price, not including plotters or printers). These price tags automatically eliminated a large portion of the total available market. For instance, the end-user category of design firms (architectural or engineering—A/E), which all of the early vendors were targeting, comprises many small establishments (approximately 65 percent have fewer than 10 employees). Table 1.3-2 shows the distribution of A/E firms in the United States by number of employees.

Table 1.3-2

Distribution of A/E Design Firms—U.S. Only  
(Number of Firms)

	Size of Establishment (Employees)				
	1-9	10-49	50-99	100-499	500+
Architectural Services	24,112	10,972	1,295	866	120

Source: Dun's Marketing



### Size of Investment

A 1984 survey (by *The Profit Center*, a monthly A/E manager and market newsletter published by Birnberg & Associates of Chicago) showed that investment in computer-aided design (CAD) hardware increases dramatically with a firm's size. The average investment in CAD by firm size according to the survey is shown in Table 1.3-3. The likelihood of a firm with less than 100 employees purchasing the hardware (let alone the software) to implement CAD was a long shot in those early days.

Table 1.3-3

#### A/E Investment in CAD Hardware by Size of Firm

Number of Employees	Average Investment
1 - 5	\$ 45,000
6 - 10	\$ 47,188
11 - 25	\$ 84,500
26 - 50	\$109,167
51 - 99	\$380,000
100+	\$688,050

Source: Birnberg & Associates  
Dataquest  
June 1987

### Personal Computer Revolution

The entry of personal computer-based CAD solutions forever changed the FD world. The revolution began in 1984, when one product, AutoCAD from AutoDesk, took the CAD world by storm; we estimate it shipped in excess of 5,000 packages that year.

AutoCAD was quickly adopted by many professionals in this application segment, temporarily bringing the market's focus back again to the world of 2-D (drafting) and away from full-scale 3-D design. A survey conducted by AutoCAD of its installed base in early 1986 revealed that half of all disciplines using AutoCAD fall into the FD classification.

The ability of personal computer-based systems to serve this drawing-intensive application segment has been disputed since the introduction of the first system in 1978. (T & W Systems was actually the first to offer this type of approach.) But it was a short-lived dispute, as more and more functionality (particularly in hardware) was added to this product platform. Between 1984 and 1986, Dataquest believes that nearly 100 PC-based software solutions were made available to the FD segment. We also believe that most of them were developed as "piggyback" solutions for the AutoCAD program. And several of these solutions enlivened the movement toward automating the more complex functions of design and analysis.

#### Traditional Turnkey Vendors' Dominance Wanes in 1984

The market for FD CAD systems expanded in 1984, with the availability of low-cost solutions. This marked a major shift in the overall installed base of workstations. As shown in Table 1.3-4, the four vendors that together had dominated the FD segment through 1983 represented only 37 percent of the total installed base after 1984. Dataquest estimates that 9,530 personal computer workstations were shipped during 1984, which represented 72 percent of the total workstations shipped that year to the FD segment.

Table 1.3-4

Year-End 1984 Estimates  
Worldwide FD Workstation Installed Base  
(Thousands of Units)

Company	Year-End 1984 Installed Base	Year-End 1983 Installed Base
Applicon	1,176	1,030
Auto-trol	1,349	1,187
Computervision	1,696	1,573
Intergraph	3,379	2,495
Total	7,600	6,285
Total Installed Base	20,784	7,800

Source: Dataquest  
June 1987

As 1984 was reaching a close and 1985 approaching, many of the traditional CAD vendors (as well as new CAD vendors) were initiating low-cost system strategies to address a larger available market. The writing was on the wall in 1984. It read:

*LOW-COST SOLUTIONS MEAN MANY MORE BUYERS*

We believe that this statement has never been truer than in the FD segment. As stated previously, 65 percent of A/E design firms have 10 or fewer persons working in them.

#### 1986: PC MANIA AND TRANSITION

Dataquest characterizes the past year in FD as one of PC mania and transition, the latter being largely a result of the former. Many vendors and users alike were caught up in the circumstances surrounding both phenomena.

## The Mania

About the occurrence we have called PC mania, two facts were obvious. Almost every existing vendor and many new vendors were getting into the action, and PC-based FD system shipments increased by almost 50 percent worldwide in 1986, going from an estimated 12,800 system shipments in 1985 to 18,100 in 1986.

By the end of 1986, most of the early vendors (Intergraph, Computervision, etc.) were marketing a PC-based product for FD. Table 1.3-5 lists the top 10 PC vendors of FD software as of 1986, the product(s) that they were selling, and the software revenue they realized from sales of these products.

Table 1.3-5

**Top 10 1986 FD Personal Computer  
CAD Software Companies  
(Millions of Dollars)**

Vendor	Software Name	Estimated 1986 Software Revenue
AutoDesk, Inc.	AE/CAD	\$25.0
Otsukashokai	PC CAD	\$4.0*
VersaCAD	VersaCAD	\$3.0
Point Line Company	Point Line	\$2.6
NEC	CAE Civil/Architecture	\$2.0*
Hitachi	HICAD GM-1000	\$2.0
Calcomp	CADvance	\$1.5
Computervision	Personal Architect	\$1.0
Robo Systems	RoboCAD	\$1.0
Intergraph	MicroIGDS	\$1.0

\*Products sold only in Japan in 1986

Source: Dataquest  
June 1987

Total worldwide FD personal computer-based software revenue was \$53 million in 1986. As shown in Table 1.3-5, no other vendor had as significant an impact in this application segment as AutoDesk, which doubled its revenue in 1986. The role this company has been playing in the CAD market, more specifically the FD market, is unprecedented, and the reasons for its dominance are a matter of much discussion and speculation. In our view, four general factors (beside the relatively low price tag) have contributed to the company's current position. They are:

- Early introduction, leading to the establishment of a strong and broad distribution channel
- Open architecture of its core software, AutoCAD (contributing to the many add-on products developed by third parties)

### 1.3 Facilities Design Market Overview

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- Relative ease of use
- Strong commitment to the FD applications

AutoCAD became dominant so quickly that most of the FD CAD vendors developed an AutoCAD-specific translator known as DXF for translation between different systems and AutoCAD files. Dataquest also took note that in Europe, there was speculation that AutoCAD might replace IGES as the standard method of translation between different CAD systems. It was not clear just how quickly this idea was being adopted, but Dataquest believes that the momentum was building by year-end 1986.

To dispel the notion of its being only a personal computer solution, AutoCAD made a series of announcements in 1986 that its software would be ported to UNIX- and VMS-based platforms. We do not believe that AutoCAD shipped any of the UNIX or VMS products in 1986.

The following facts apply to the leading FD vendors:

- VersaCAD was actually the first company to introduce a PC-based software product (in 1978). The other top 10 companies introduced their products between 1984 and 1986.
- All the vendors use alternative distribution channels (i.e., value-added resellers (VARs) or dealers (VADs)) for their PC-based software products.
- The average price of a PC-based core software product across the top 10 was \$2,500 in 1986. (Computervision's is the most expensive program, with a list price of \$10,800 that includes both 2-D and 3-D capabilities.)
- All top 10 vendors have either introduced 3-D capabilities for personal computers or are planning to announce 3-D modules within the coming months.
- AutoCAD, Point Line, VersaCAD, and Personal Architect were all subjected to an architectural shoot-out session in late 1985, whereby the following labels were attached to the respective products: AutoCAD (broad appeal), Point Line (endless possibilities), VersaCAD (on-the-job training), and Personal Architect (marketing tool).

Dataquest has identified numerous other vendors that manufacture PC-based software products, which for the most part are also sold through alternative distribution channels.

## Transitions

Transition was occurring on both the vendor and end-user fronts in 1986, due in large part to the impact of lower-cost products in this application segment. Here we list the transitions that were most notable in the vendor community during 1986. They included:

- Growth of FD market revenue (on a worldwide scale) slowed to 17 percent in 1986, after several years of more than 40 percent growth. More significantly, growth in North America slowed to 5 percent in 1986, after several high-growth years. Refer to Table A.1-1 in Appendix A for the breakdown of growth figures from year to year.
- Many of the original turnkey vendors were forced to look for alternative distribution strategies to market lower-cost products (PC-based particularly).
- Long-time FD market-share leader Intergraph announced a new hardware platform strategy encompassing not only the manufacture of its own UNIX-based workstations, but also a completely new software strategy that uses object-oriented data base technology for CAD designs.

## CURRENT ENVIRONMENT

Aside from the low-cost issue and all that it entails (e.g., distribution channel decisions), there are currently additional market- and product-related considerations for CAD vendors that participate in the FD segment. Two major considerations are:

- Having flexible enough product offerings to ride out shifts in user requirements
- Data base management

## Shifts in User Requirements

*Engineering News Record* reports regularly on the changing scene of construction planning. One message that is heard consistently throughout the industry concerns the office and commercial building market; ENR observers predict a substantial decline over the next several years in new construction plans. On the more positive side, infrastructure (i.e., roads, highways, bridges) construction plans are booming across the United States and around the world.

With most oil-related and nuclear projects in a holding pattern, in the United States design and/or construction firms that depended on this kind of work are scrambling for new opportunities. In many cases, companies are reorganizing, merging, or acquiring other companies to address the opportunities that exist in other project sectors.

### **1.3 Facilities Design Market Overview**

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The above situations are examples of the dynamics of the facility design and construction industry. CAD vendors that are wary of these dynamics are reaping the rewards, for as stated earlier, the type of CAD products needed for project design differs according to the type of facility being built. Those whose products are tied to any one particular need are probably riding the same choppy wave that affects the users' livelihood. At this stage, many design firms are experiencing the effects of instability in different project segments.

#### **Data Base Management**

In light of the multidisciplinary nature of the FD segment, it is not surprising to find a scenario similar to what exists in the mechanical segment—usually termed “islands of automation.” Many of the CAD products available today solve only one particular piece of the total facility design puzzle.

As many CAD vendors have acknowledged, data base management capability is a critical factor in the growth of the FD segment. Dataquest believes that almost without exception, a user's data base represents the user's most valuable investment in CAD. This is becoming increasingly more evident, since it would contribute greatly to a user's ability to manage a facility after construction. In this capacity, its most vital role would be to provide a user with quick and ready access to accurate and up-to-date information about the facility.

Data base management capabilities have become more sophisticated, providing capabilities to generate bills of materials and other comprehensive reports from the project data base to support related design, purchasing, construction, and facility management activities.

#### **DATAQUEST CALENDAR OF SIGNIFICANT FD ANNOUNCEMENTS**

Dataquest's calendar of significant FD industry announcements made from October 1986 through May 1987 is shown in Table 1.3-6. As reflected in the table, much of the activity in terms of product and marketing announcements centered around none other than the personal computer.

Table 1.3-6

**FD Announcements  
(October 1986 through May 1987)**

Month/Year of Announcement	Description of Announcement
10/86	VersaCAD announced a site licensing program, as opposed to the corporate discount program it had used previously.
10/86	Effective September 1986, Accugraph Corporation became the sole owner of Holguin Corporation. The companies are to operate separately. Their combined revenue is estimated at \$40 million in 1987, according to an Accugraph press release.
10/86	Calcomp preannounced a solids modeling system based on the PC to be introduced at Comdex in Las Vegas. This system, based on a package from ACA, a TelAviv-based concern, is being sold in Europe under the name ARCHPLUS.
10/86	Calcomp announced that projections capability had become part of its CADvance system at no additional cost to the user. This capability provides for isometric, perspective, and oblique projections for wireframe drawings. The price of the CADvance/PROJECTIONS system was \$2,500.
10/86	Calcomp introduced civil design capability, (CDP), aimed at civil engineers and the whole gamut of facility-related builders and designers, and priced at \$10,000.
10/86	Al Moulton replaced Nick Story as president and CEO at Skok Systems.
10/86	The U.S. Fish and Wildlife Service put out a bid for 13 turnkey CAD systems (32-bit workstation-based systems) that use four different kinds of software modules, including architectural modeling/drafting, engineering drawing, and civil design.
11/86	A new micro-based software product was introduced by Eclat, Inc., headed by Ted Charter (ex-Calcomp director), with Dr. Frederick Jones as chairman. Eclat's product is an alphanumeric package to be sold to the FD CAD marketplace as a piggyback program for AutoCAD and VersaCAD.
11/86	A new PC-based CAD system for architectural layout/design was introduced by CADdy Corporation. CADdy is the U.S. subsidiary of Germany's Ziegler Instruments.
11/86	Autodesk announced AutoCAD AEC Mechanical, a product that automates the mechanical aspect of facilities design.

(Continued)

Table 1.3-6 (Continued)

FD Announcements  
(October 1986 through May 1987)

Month/Year of Announcement	Description of Announcement
11/86	Engineered Software, a company out of Tumwater, Washington, announced the release of a PC-based design software for thermal insulation in piping projects. The product, called INS-FLO, sold for \$129.00.
11/86	Transformercad, a Bellingham, Washington, company, introduced a a PC-based parametric modeling product called Synthesis, an AutoCAD piggyback program.
11/86	Skok began to support the Compaq version of the 386.
11/86	IBM reportedly began working on a 3-D-based plant engineering software product in collaboration with Stone & Webster, a large engineering and construction firm.
11/86	The fall forecast presented in ENR magazine indicated a major slowdown in the building industry. The total building market declined 4 percent in 1986, and analysts predicted a 7 percent downturn in 1987. Analysts believed that the presence of relatively stable interest rates was the only thing holding the market together at that point.
11/86	Sigma Design announced support of the 386 processor (on the Compaq version).
11/86	Calcomp announced at Comdex the new solid modeling feature of its PC-based FD CAD system. The software, named Solid Vision, has true 3-D capability and was offered as a standalone product at \$3,500. With CADvance, the 2-D and 2-1/2-D product, it was priced at \$4,995. In addition, the product is totally DXF-compatible, allowing for transfer of drawing information from other 2-D systems.
11/86	Calcomp also announced a new version of its CADvance software, Version 1.30. The architecture was opened up to allow greater ease in integration of application-specific programs.
12/86	Holguin executed an agreement with Cal Poly (the country's largest architectural school) for mutual exchange of collaborative research and consulting services. The agreement resulted in the creation of CAD Research United, which was to be headed by Dr. Jens Pohl.
12/86	Holguin made known its ambitions to become a \$100 million company by 1990 through continued growth, mergers, and acquisitions.

(Continued)



Table 1.3-6 (Continued)

**FD Announcements**  
(October 1986 through May 1987)

Month/Year of Announcement	Description of Announcement
12/86	HOK/CSC released the SPACE software as the heart of its facilities mapping system. At that time the software encompassed both forecasting and inventory capabilities.
12/86	GE Calma announced a reorganization that effectively combined its mechanical and FD units under Hellene Runtagh. Malcolm Davies continued to serve as vice president for both marketing and sales.
12/86	Intergraph announced a product oriented toward civil engineers for the design of storm drainage systems (SDS). It enables engineers to build intelligent models of storm drainage systems and allows for the creation of drawings, schedules, and reports.
1/87	Sigma Design announced an educational grant program.
1/87	CADAM, Inc., was preparing to release version 21.0 of its Plant Design System, which was at 10 beta sites worldwide, including some major engineering, construction, and shipbuilding users.
1/87	Royal Graphics, a new vendor based in San Francisco, emerged with FD software that runs on Silicon Graphics hardware.
1/87	Data General hooked up with BASEnet, an affiliate of the Hensley Group, Ltd., to offer a specialized architectural and engineering-related network. (BASEnet is an acronym for business, architectural, scientific, and engineering network.)
2/87	Sigma Design formally announced its reorganization plan as follows: it is splitting into three divisions, Sigma Products, Sigma Services, and Sigma Distribution, headed by Michael Carroll, Hal Wilson, and Ken Sauter (formerly with CV), respectively. The reorganization came as a result of the company's refocus on the low-end market. Sigma Design's base software then started at \$3,000.
2/87	McDonnell Douglas AEC company announced its Starship/Starfleet line of products based on Digital's VAXstation II/GPX series workstation. The Starship name, given to the combined GPX/GDS offering, sold for a price in the \$40,000 plus range, and supposedly cost about \$30,000 less than a single-seat GDS host-based system.

(Continued)

Table 1.3-6 (Continued)

FD Announcements  
(October 1986 through May 1987)

Month/Year of Announcement	Description of Announcement
3/87	Protrak, Inc., demonstrated a new system called CADPAC (which will probably eventually be called Protrak). This MS-DOS-based offering (shown on the PC AT) for the FD and mechanical markets is currently a 2-D system, but will go to 3-D in midsummer. Its initial price is \$2,500-\$3,000.
3/87	VersaCAD released Version 5.2 of its VersaCAD DESIGN software featuring mass properties and automatic ortho views. The product, called DESIGN 5.2, encompasses orthogonal views. Two-dimensional top, front, and side views can be created automatically from a 3-D model. Direct ASCII file transfer capability has been incorporated into the new release.
3/87	VersaCAD reported having shipped 10,000 units of the DESIGN 3-D module after only 5 months on the market. Also, Algor reportedly took advantage of the new DESIGN package features and interfaced its FEM software to the VersaCAD product.
3/87	Graphics Systems, Inc. (GSI), announced that it has interfaced the space-planning module that it currently markets to the facilities mapping market to VersaCAD, allowing for transfer of stacking/blocking information to VersaCAD drawing files and vice versa (a bidirectional interface capability). The SPACE program is priced at \$444.95, which includes stacking, blocking, program data, programming/report modules, and the choice of either the VersaCAD or an AutoCAD interface.
3/87	Calcomp released Version 1.3 of CADvance, incorporating 50 new features for enhanced use of the system. It is priced at \$2,500 and can be updated by registered users for \$195. It is available through authorized CADVANCE dealers.
3/87	VersaCAD Version 5 became available on Apollo, Sun, and HP Series 300 desktop workstations. The windowing environment is supported on the Sun and the Apollo, and all the machines provide high-resolution color. Text and drawing files (including macros) can be converted from MS-DOS to UNIX machines.
3/87	VersaDATA 5.1 also became available for MS-DOS computers. VersaDATA runs with VersaCAD 5.1 (2-D) and VersaCAD DESIGN.

(Continued)

Table 1.3-6 (Continued)

**FD Announcements**  
(October 1986 through May 1987)

Month/Year of Announcement	Description of Announcement
3/87	VersaCAD announced that it would demonstrate an image capturing, 32-bit processor for technical publications applications at NCGA in Philadelphia. The image capturing capability incorporates AT&T's TARGA 16 graphics board (TRUEVISION Advanced Raster Graphics Adapter) and any standard video camera.
3/87	VersaCAD claims to have shipped approximately 35,000 VersaCAD software programs.
3/87	Eclat began to ship its CD-ROM-based furniture library for facilities management under the name VersaSPEc, since it takes advantage of the new scanning abilities under the VersaCAD platform.
4/87	GE Calma began to make a big push with its project review terminal based on the Graphicon 700 display controller that was announced in mid-1986. The company claims that with the project review terminal, designers of facilities such as power or process plants, commercial buildings, or ships can "walk through" complex 3-D computer models to review designs. This plus a number of other new FD products was announced at the FD show in June.
4/87	Calcomp announced a new marketing organization. The plan is to now use the regional sales representatives as backups (support) for the VAR and VAD organizations rather than as direct sales channels.
4/87	Black & Veatch, an A/E firm out of Missouri, began to offer a drawing conversion software package that provides translation capability between CAD systems. Called the Family of Translators, it gives users the ability to move drawing files or symbol libraries created on one CAD system to a different system.
4/87	Steel 3-D from 3D/EYE became available directly from the company. It was available exclusively thru Auto-trol. Steel 3-D is a program for performing structural analysis and design of frame (bridges, etc.) and building structures. It has a unique interactive graphics interface, making it widely popular in the structural engineering community.

(Continued)

Table 1.3-6 (Continued)

FD Announcements  
(October 1986 through May 1987)

Month/Year of Announcement	Description of Announcement
4/87	Skidmore, Owings, and Merrill (SOM), one of the country's largest A/E companies, and IBM struck an agreement to commercialize SOM's internally developed CAD/CAE software product (SOM-Skyline) for the FD market. SOM-Skyline is to run on IBM's RT series workstations under the UNIX operating system. The release date was not announced; in fact, there was a slight possibility that it would not happen.
5/87	AutoDesk announced version 2.6 of AutoCAD with 3-D capability and transparent commands, which means that pan, zoom, view, etc. can be executed within other commands such as extend or scale. Customers who purchased Version 2.5 on or after March 1, 1987, can upgrade at no charge. Purchasers of AutoCAD before that date are charged \$100.
5/87	Calcomp sold its Systems Division to a German-based firm, Isicad, located in Ellwangen. Isicad is a subsidiary of Isimat, a 30-year-old manufacturing concern. Isicad's president is Jacques Alt.

Source: Dataquest  
June 1987

## 1.4 Facilities Design Forecasts

These bullets present Dataquest's forecast and analysis for the total facilities design market for all regions and platforms. This section contains Figures 1.4-1 and 1.4-2 and Table 1.4-1.

- The FD market segment, worth an estimated \$1.005 billion in 1986, is forecast to grow to \$1.8 billion in 1991, a compound annual growth rate (CAGR) of 12 percent.
- Dataquest estimates that FD revenue will decrease 8 percent in 1987, for total revenue of \$926 million.
- An estimated 26,205 workstations shipped in 1986. Shipments are expected to reach 70,150 in 1991, growing at a 22 percent CAGR.
- Workstation shipments will grow to an estimated 34,000 in 1987, 30 percent more than 1986 shipments.

Figure 1.4-1

Facilities Design Worldwide Forecast Revenue

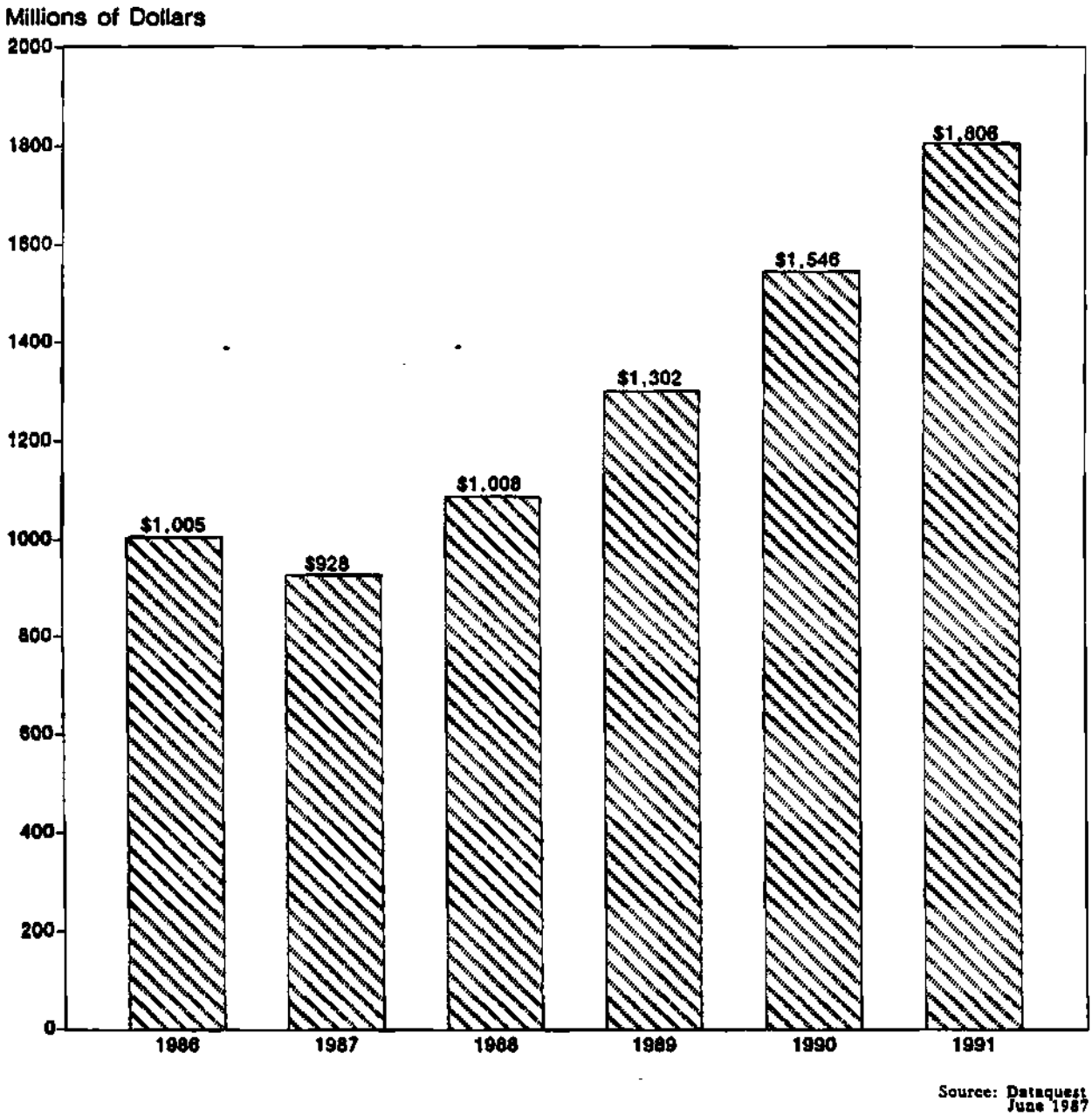
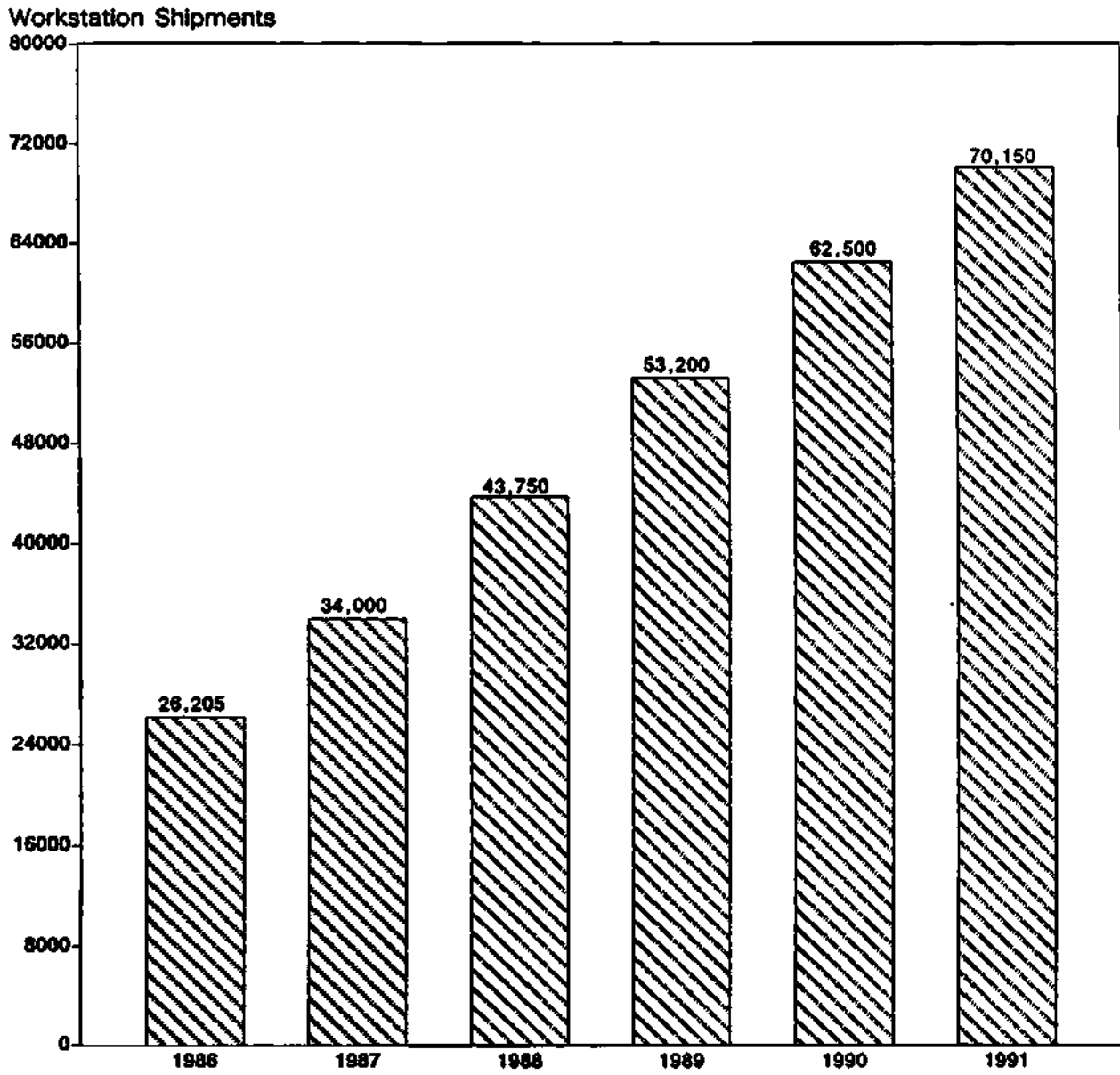


Figure 1.4-2

Facilities Design Worldwide Forecast Shipments



Source: Dataquest  
June 1987

## 1.4 Facilities Design Forecasts

---

Table 1.4-1

**Facilities Design Worldwide Forecast  
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
<b>Total Market</b>							
Revenue	1,005	928	1,088	1,302	1,546	1,806	12.4%
Systems	23,231	30,850	41,100	51,150	60,900	68,900	24.3%
Workstations	26,205	34,000	43,750	53,200	62,500	70,150	21.8%

Source: Dataquest  
June 1987

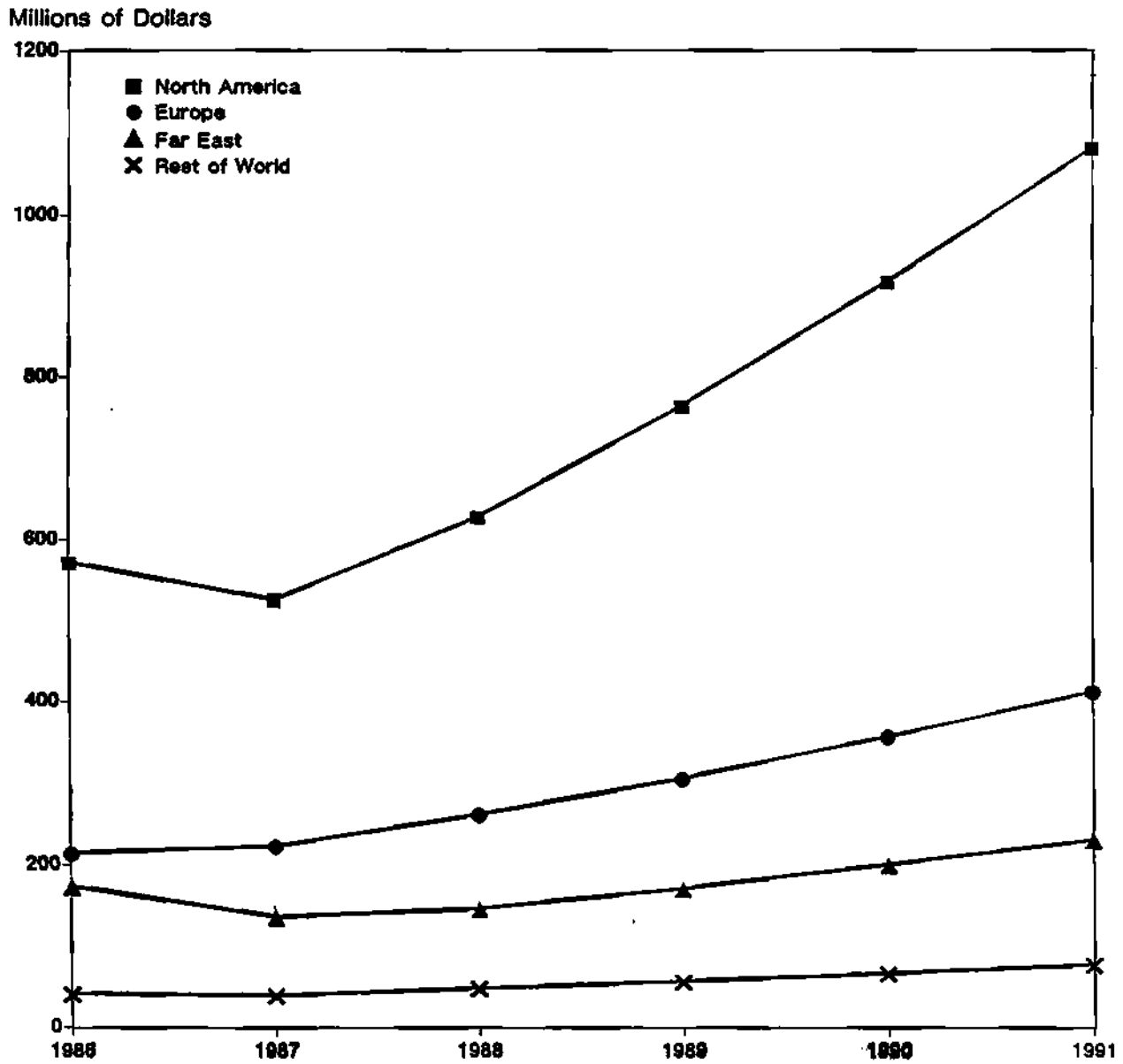


These bullets present Dataquest's forecast and analysis of the facilities design market, segmented by region. This section contains Figures 1.4-3 and 1.4-4 and Tables 1.4-2 and 1.4-3.

- We estimate that 1986 North American revenue was \$572 million and that it will grow at a 14 percent CAGR to \$1.080 billion in 1991. North American revenue in 1987 is forecast at \$525 million, a decrease of 8 percent.
- European revenue was \$215 million in 1986 and is forecast to reach \$412 million in 1991, also growing at a 14 percent CAGR. In 1987, European revenue is forecast at \$224 million, a 4 percent increase.
- The Far Eastern FD segment represented \$175 million in 1986 and is forecast to grow at a 6 percent CAGR to reach \$232 million in 1991.
- Rest of World (ROW) accounted for \$42 million in 1986. We estimate that this region's revenue will grow to \$78 million in 1991 at a 13 percent CAGR.
- Dataquest estimates that the North American and European regions, with 57 percent and 21 percent of 1986 total revenue, respectively, will both increase their percentages of total revenue through 1991. The Far East, however, is estimated to decrease its percentage of total revenue.

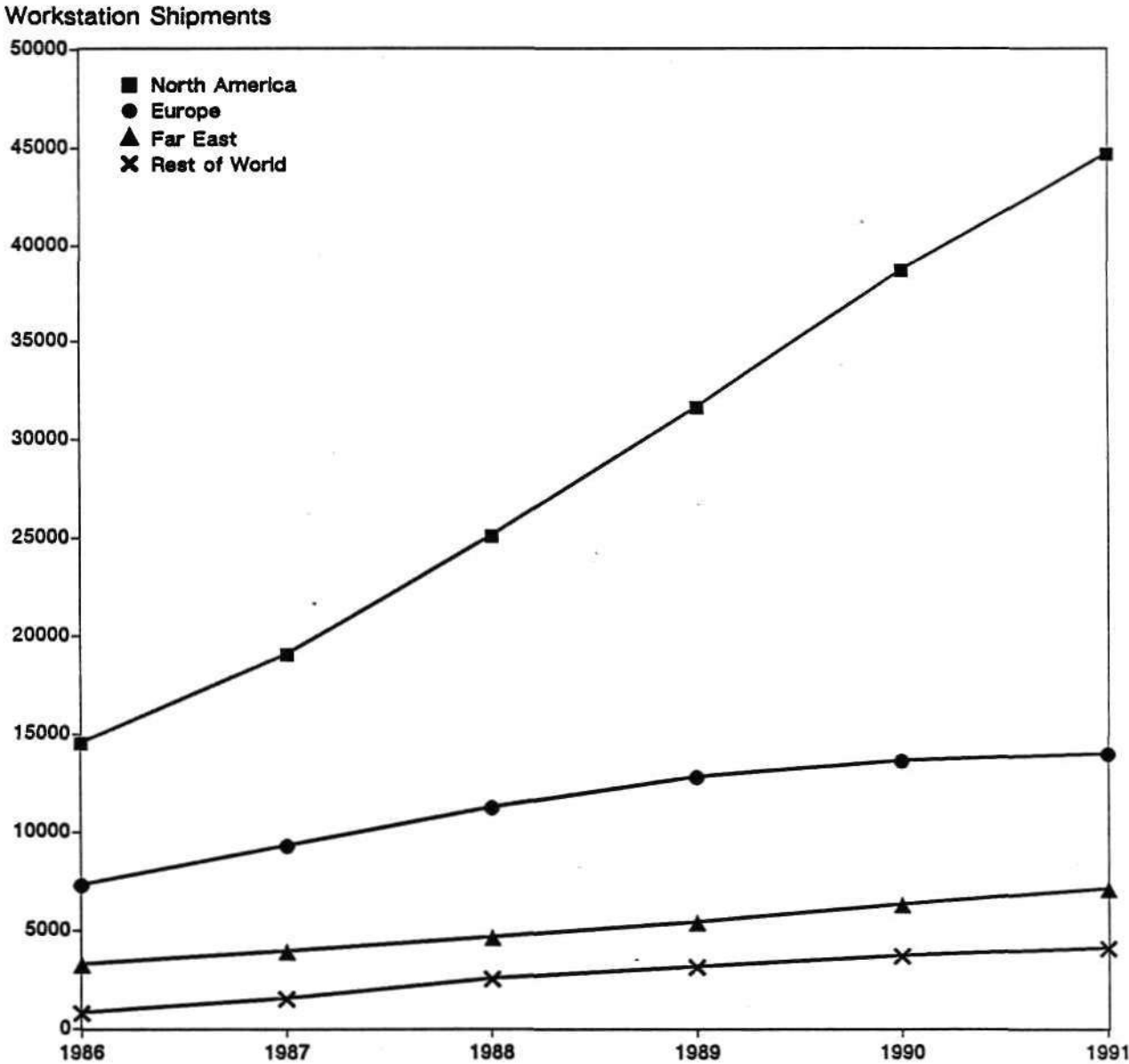
Figure 1.4-3

Facilities Design Regional Forecast Revenue



Source: Dataquest  
June 1987

Figure 1.4-4  
Facilities Design Regional Forecast  
Shipments



Source: Dataquest  
June 1987

## 1.4 Facilities Design Forecasts

Table 1.4-2

### Facilities Design Regional Forecast (Millions of Dollars/Actual Units)

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
<b>Total Market</b>							
Revenue	1,005	928	1,088	1,302	1,546	1,806	12.4%
Systems	23,231	30,850	41,100	51,150	60,900	68,900	24.3%
Workstations	26,205	34,000	43,750	53,200	62,500	70,150	21.8%
<b>North America</b>							
Revenue	573	527	629	766	919	1,083	13.6%
Systems	12,938	17,550	24,050	31,000	38,300	44,550	28.1%
Workstations	14,609	19,100	25,150	31,700	38,750	44,800	25.1%
<b>Europe</b>							
Revenue	215	224	263	307	358	413	13.9%
Systems	6,727	8,400	10,250	11,850	12,750	13,250	14.5%
Workstations	7,382	9,350	11,300	12,850	13,700	14,050	13.7%
<b>Far East</b>							
Revenue	175	137	147	172	202	232	5.8%
Systems	2,830	3,500	4,400	5,250	6,200	7,000	19.9%
Workstations	3,340	4,000	4,700	5,450	6,350	7,150	16.4%
<b>Rest of World</b>							
Revenue	42	40	49	57	67	78	13.1%
Systems	735	1,400	2,400	3,050	3,650	4,100	41.0%
Workstations	875	1,600	2,600	3,200	3,750	4,150	36.5%

Source: Dataquest  
June 1987

Table 1.4-3

**Facilities Design Regional Forecast  
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	****	****	****	****	****	****
<b>North America</b>						
Revenue	57%	57%	58%	59%	59%	60%
Systems	56%	57%	59%	61%	63%	65%
Workstations	56%	56%	57%	60%	62%	64%
<b>Europe</b>						
Revenue	21%	24%	24%	24%	23%	23%
Systems	29%	27%	25%	23%	21%	19%
Workstations	28%	28%	26%	24%	22%	20%
<b>Far East</b>						
Revenue	17%	15%	14%	13%	13%	13%
Systems	12%	11%	11%	10%	10%	10%
Workstations	13%	12%	11%	10%	10%	10%
<b>Rest of World</b>						
Revenue	4%	4%	4%	4%	4%	4%
Systems	3%	5%	6%	6%	6%	6%
Workstations	3%	5%	6%	6%	6%	6%

Source: Dataquest  
June 1987

## 1.4 Facilities Design Forecasts

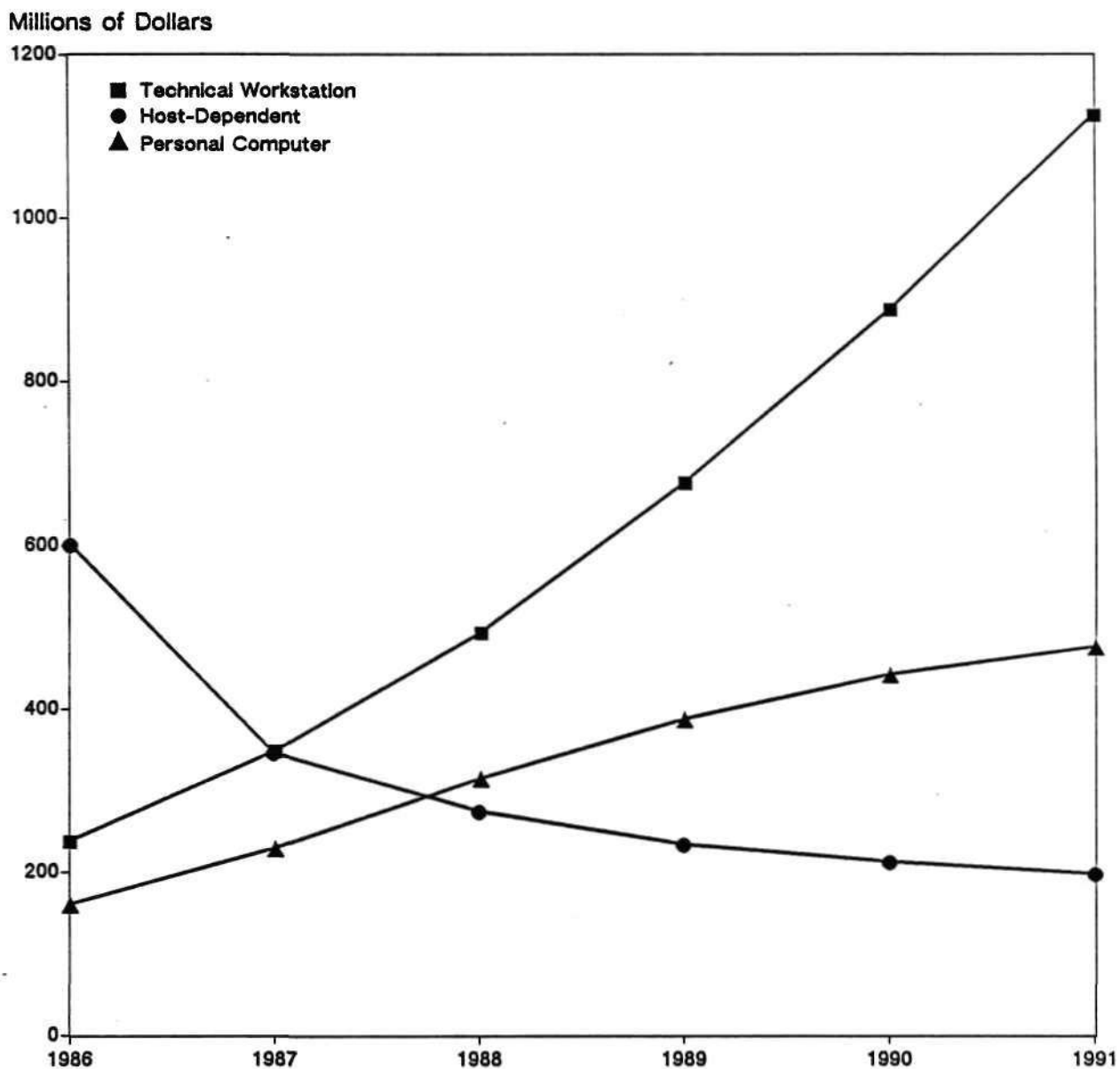
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These bullets present Dataquest's forecast and analysis of the facilities design market segmented by platform. This section contains Figures 1.4-5 and 1.4-6 and Tables 1.4-4 and 1.4-5.

- Approximately 26,205 workstation units shipped in 1986, and we estimate shipments are growing at a 22 percent CAGR to 70,150 workstations in 1991.
- Technical workstation revenue in 1986 was \$240 million. This will grow at an estimated 36 percent CAGR to reach \$1.1 billion in 1991.
- Technical workstation shipments totaled 3,761 units in 1986. They are forecast to reach 20,750 units in 1991, growing at a CAGR of 41 percent.
- Revenue from host-dependent systems was \$604 million in 1986. This is forecast to decline to \$199 million in 1991, decreasing at a negative CAGR of 20 percent.
- Host-dependent workstation shipments totaled 4,264 units in 1986 and are forecast to decrease at a negative CAGR of 5 percent to 1,400 units in 1991.
- PC revenue in 1986 was \$161 million. This is expected to reach \$475 million in 1991, a CAGR of 24 percent.
- PC shipments totaled 18,180 units in 1986. They are forecast to grow at a 21 percent CAGR to reach 48,000 units in 1991.

Figure 1.4-5

Facilities Design Worldwide Forecast by Platform Revenue

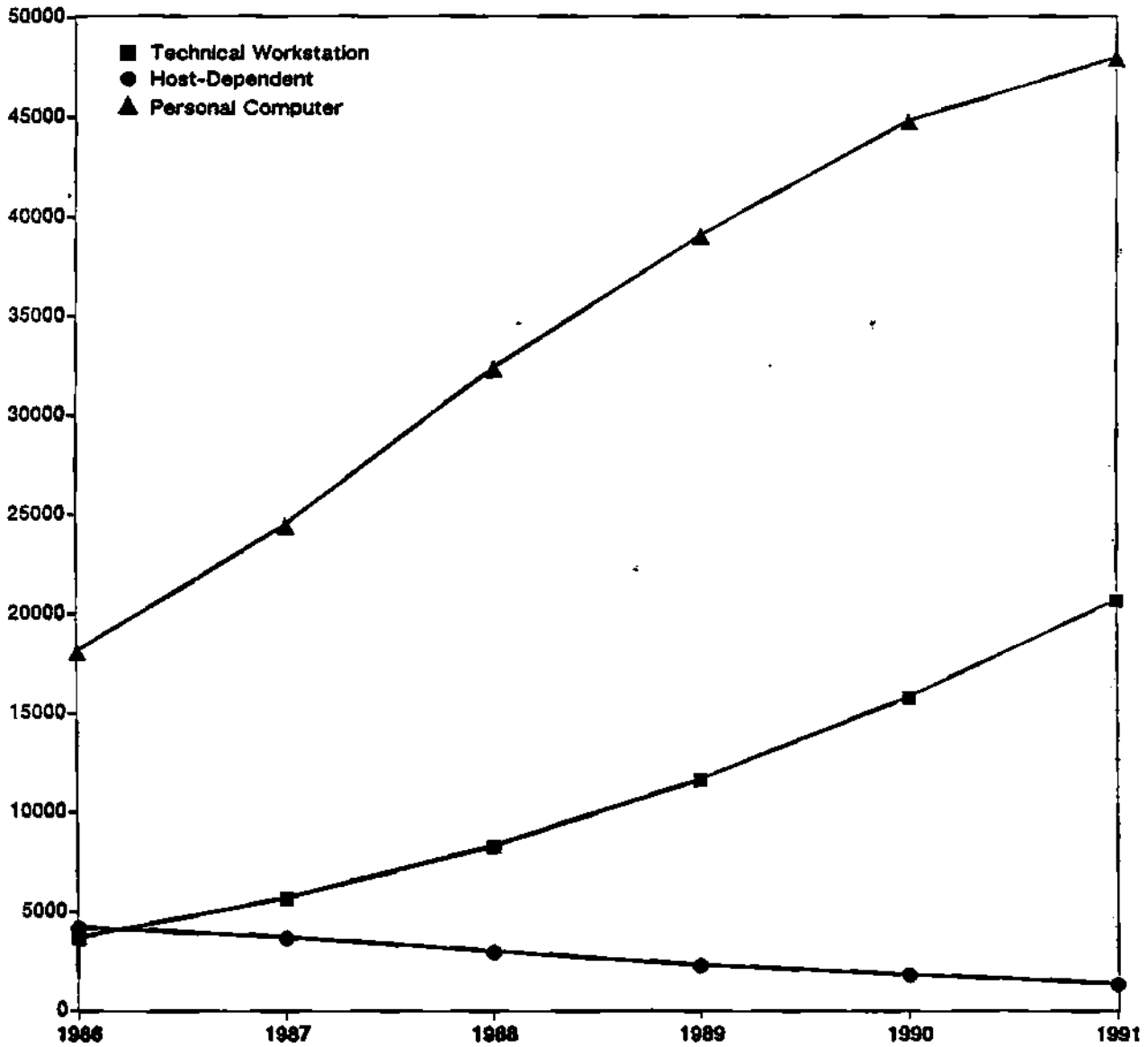


Source: Dataquest  
June 1987

Figure 1.4-6

Facilities Design Worldwide Forecast by Platform Shipments

Workstation Shipments



Source: Dataquest  
June 1987



Table 1.4-4

**Facilities Design Worldwide Forecast by Platform  
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
<b>Total Market</b>							
Revenue	1,005	928	1,088	1,302	1,546	1,806	12.4%
Systems	23,231	30,850	41,100	51,150	60,900	68,900	24.3%
Workstations	26,205	34,000	43,750	53,200	62,500	70,150	21.8%
<b>Technical Workstation</b>							
Revenue	240	350	495	678	889	1,129	36.3%
Systems	3,761	5,750	8,350	11,700	15,850	20,750	40.7%
Workstations	3,761	5,750	8,350	11,700	15,850	20,750	40.7%
<b>Host-Dependent</b>							
Revenue	604	347	276	235	214	199	-19.9%
Systems	1,289	600	400	300	250	200	-31.1%
Workstations	4,264	3,750	3,050	2,350	1,850	1,400	-20.0%
<b>Personal Computer</b>							
Revenue	162	231	316	389	444	478	24.2%
Systems	18,180	24,500	32,400	39,100	44,850	48,000	21.4%
Workstations	18,180	24,500	32,400	39,100	44,850	48,000	21.4%

Source: Dataquest  
June 1987

Table 1.4-5

Facilities Design Worldwide Forecast by Platform  
(Percentage of Total)

	1986	1987	1988	1989	1990	1991
	====	====	====	====	====	====
<b>Technical Workstation</b>						
Revenue	24%	38%	46%	52%	57%	63%
Systems	16%	19%	20%	23%	26%	30%
Workstations	14%	17%	19%	22%	25%	30%
<b>Host-Dependent</b>						
Revenue	60%	37%	25%	18%	14%	11%
Systems	6%	2%	1%	1%	0%	0%
Workstations	16%	11%	7%	4%	3%	2%
<b>Personal Computer</b>						
Revenue	16%	25%	29%	30%	29%	26%
Systems	78%	79%	79%	76%	74%	70%
Workstations	69%	72%	74%	73%	72%	68%

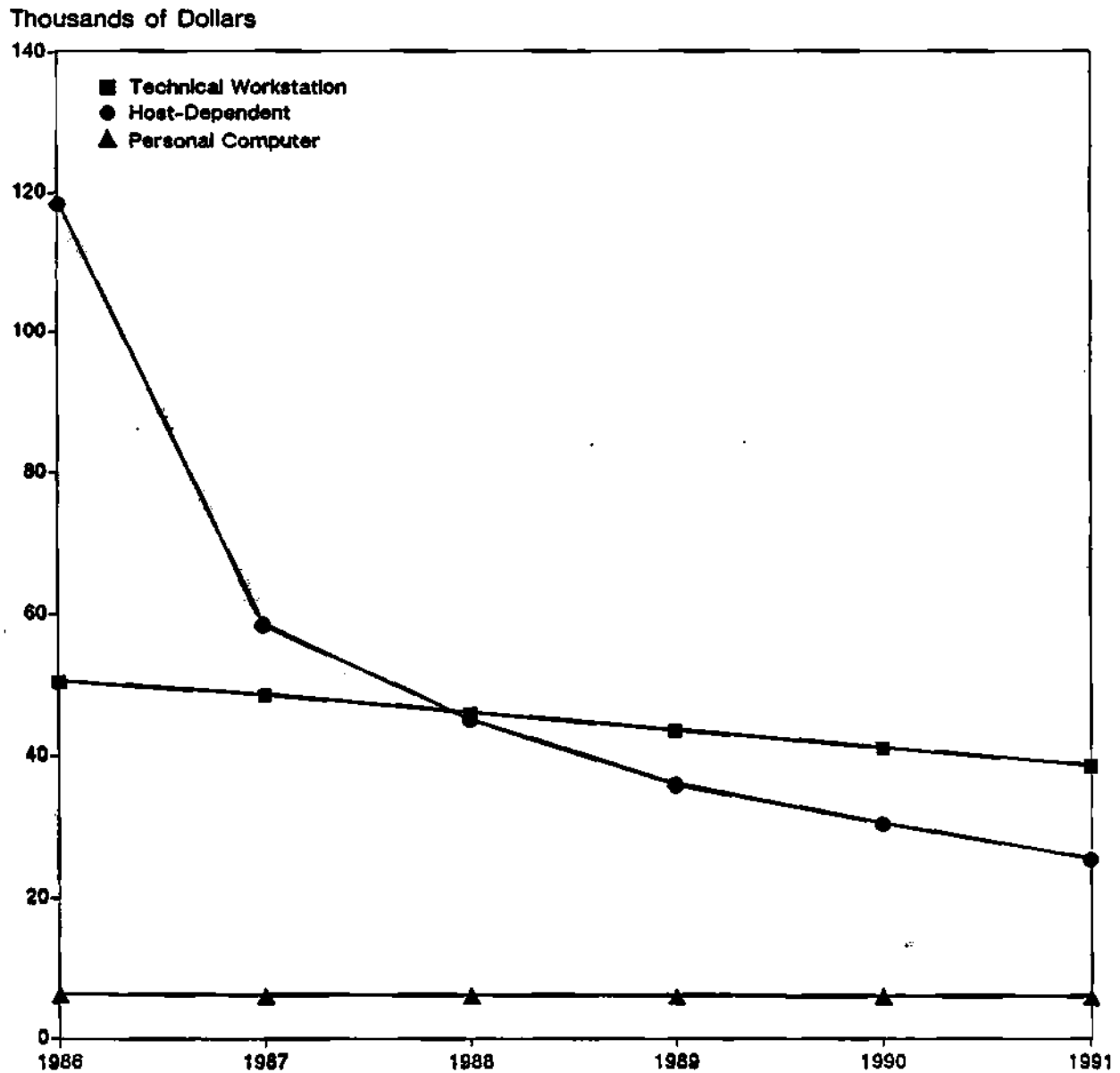
Source: Dataquest  
June 1987

These bullets present Dataquest's forecast and analysis of the average price per seat by platform for the facilities design market. This section contains Figure 1.4-7 and Table 1.4-6.

- We expect the average selling price per seat for all platform types to decline from \$31,000 in 1986 to \$16,000 in 1991, decreasing at a negative CAGR of 12 percent as a result of both the large number of vendors offering FD capability and the industry-wide shift toward lower-cost workstations.
- Because of the introduction of lower-cost technical workstations, we expect a 5 percent a year decrease in the average price per technical workstation seat, from \$50,000 in 1986 to \$38,000 in 1991.
- Consistent with this shift, the average price per seat for host-dependent systems will decline at a negative CAGR of 26 percent from \$119,000 in 1986 to \$26,000 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 FD workstations.
- We expect a 1 percent a year decline in the average price per seat for personal computers, from \$6,400 in 1986 to \$6,100 in 1991.

Figure 1.4-7

Facilities Design Worldwide Average Price per Seat by Platform



Source: Dataquest  
June 1987

Table 1.4-6

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

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
All Product Types	31.1	19.2	16.5	15.8	15.8	16.2	-12.2%
Technical Workstation	50.5	48.6	46.1	43.7	41.2	38.8	-5.1%
Host-Dependent	119.1	58.5	45.1	36.1	30.6	25.7	-26.4%
Personal Computer	6.4	6.3	6.3	6.2	6.1	6.1	-1.0%

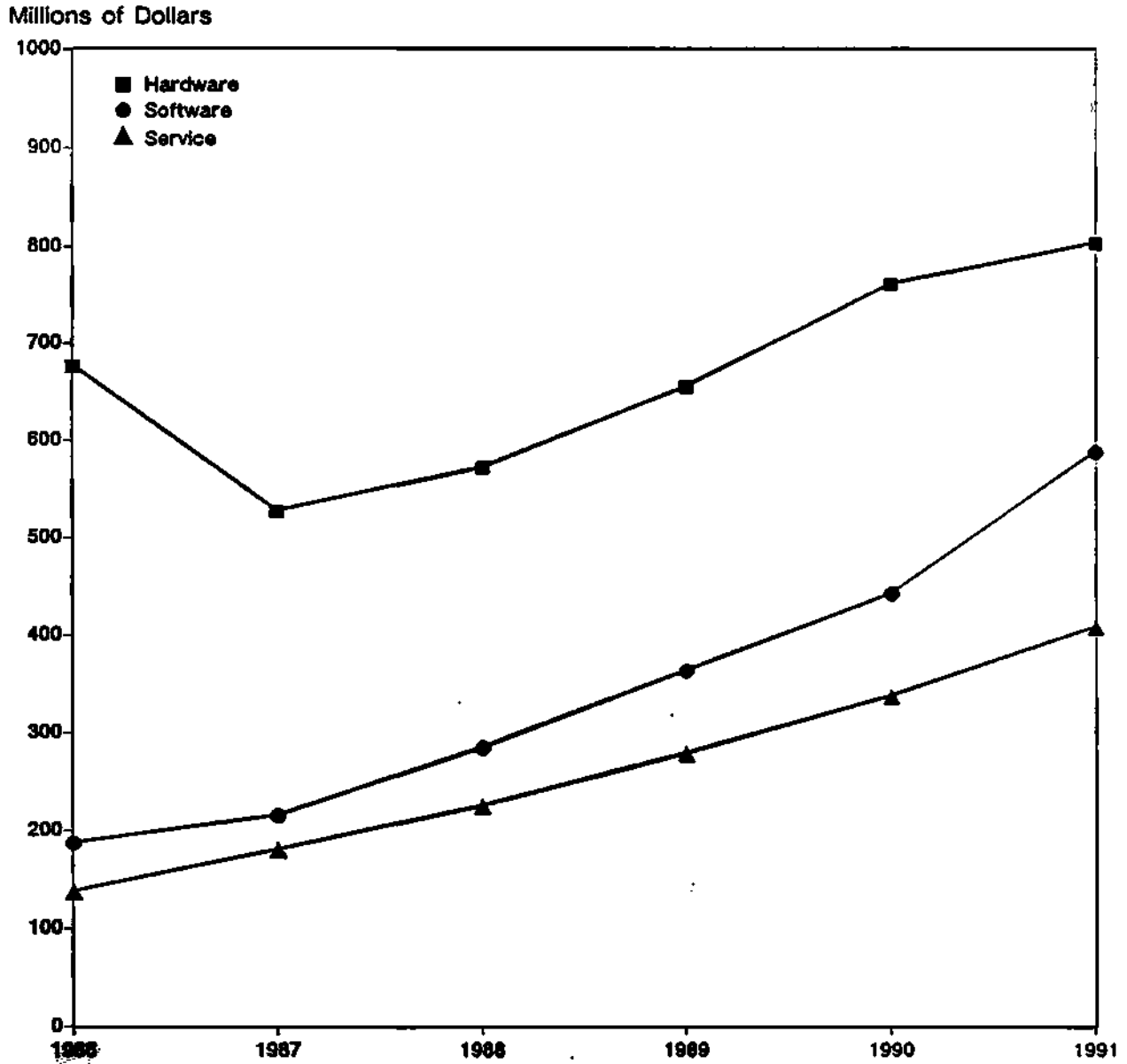
Source: Dataquest  
June 1987

These bullets present Dataquest's forecast and analysis of the facilities design market segmented by revenue source for each platform. This section contains Figure 1.4-8 and Tables 1.4-7 and 1.4-8.

- Dataquest estimates that 1986 hardware revenue for all platform types was \$678 million and forecast it to grow at 3 percent CAGR, to \$805 million in 1991. In terms of total FD revenue, we expect hardware revenue to decline from 67 percent in 1986 to 45 percent in 1991.
- Software revenue accounted for \$188 million in 1986, which was 19 percent of the total FD revenue. By 1991, Dataquest estimates that software revenue will grow to \$588 million at a 26 percent CAGR. Software is forecast to produce 33 percent of the total FD 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 FD service revenue to grow at a 24 percent CAGR from \$139 million in 1986 to \$410 million in 1991. Service revenue in 1986 was 14 percent of the total FD revenue. We estimate that in 1991 it will constitute 23 percent of total FD revenue. We believe that this growth in service revenue reflects response to strong user demand for increased application and integration support.

Figure 1.4-8

Facilities Design Worldwide Revenue Sources



Source: Dataquest  
June 1987

Table 1.4-7

Facilities Design Worldwide Revenue Sources by Platform  
(Millions of Dollars)

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
<b>All Platforms</b>							
Hardware	678	529	574	657	763	805	3.5%
Software	189	217	286	365	444	591	25.7%
Service	139	182	227	280	339	410	24.2%
Total	1,005	928	1,088	1,302	1,546	1,806	12.4%
<b>Technical Workstation</b>							
Hardware	137	201	277	369	471	523	30.7%
Software	60	92	129	176	231	351	42.2%
Service	42	57	89	133	188	255	43.3%
Total	240	350	495	678	889	1,129	36.3%
<b>Host-Dependent</b>							
Hardware	438	190	118	74	49	31	-40.9%
Software	75	38	31	29	32	36	-13.7%
Service	91	119	128	132	133	132	7.7%
Total	604	347	276	235	214	199	-19.9%
<b>Personal Computer</b>							
Hardware	103	138	179	215	244	250	19.5%
Software	53	87	127	160	181	204	30.8%
Service	5	7	10	14	19	23	34.3%
Total	162	231	316	389	444	478	24.2%

Source: Dataquest  
June 1987



Table 1.4-8

**Facilities Design Worldwide Revenue Sources by Platform  
(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	----	----	----	----	----	----
<b>All Platforms</b>						
Hardware	67%	57%	53%	50%	49%	45%
Software	19%	23%	26%	28%	29%	33%
Service	14%	20%	21%	21%	22%	23%
Total	100%	100%	100%	100%	100%	100%
<b>Technical Workstation</b>						
Hardware	57%	58%	56%	54%	53%	46%
Software	25%	26%	26%	26%	26%	31%
Service	18%	16%	18%	20%	21%	23%
Total	100%	100%	100%	100%	100%	100%
<b>Host-Dependent</b>						
Hardware	73%	55%	43%	31%	23%	16%
Software	12%	11%	11%	12%	15%	18%
Service	15%	34%	46%	56%	62%	66%
Total	100%	100%	100%	100%	100%	100%
<b>Personal Computer</b>						
Hardware	64%	60%	57%	55%	55%	52%
Software	33%	38%	40%	41%	41%	43%
Service	3%	3%	3%	4%	4%	5%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest  
June 1987

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## **1.5 Facilities Design Market Shares**

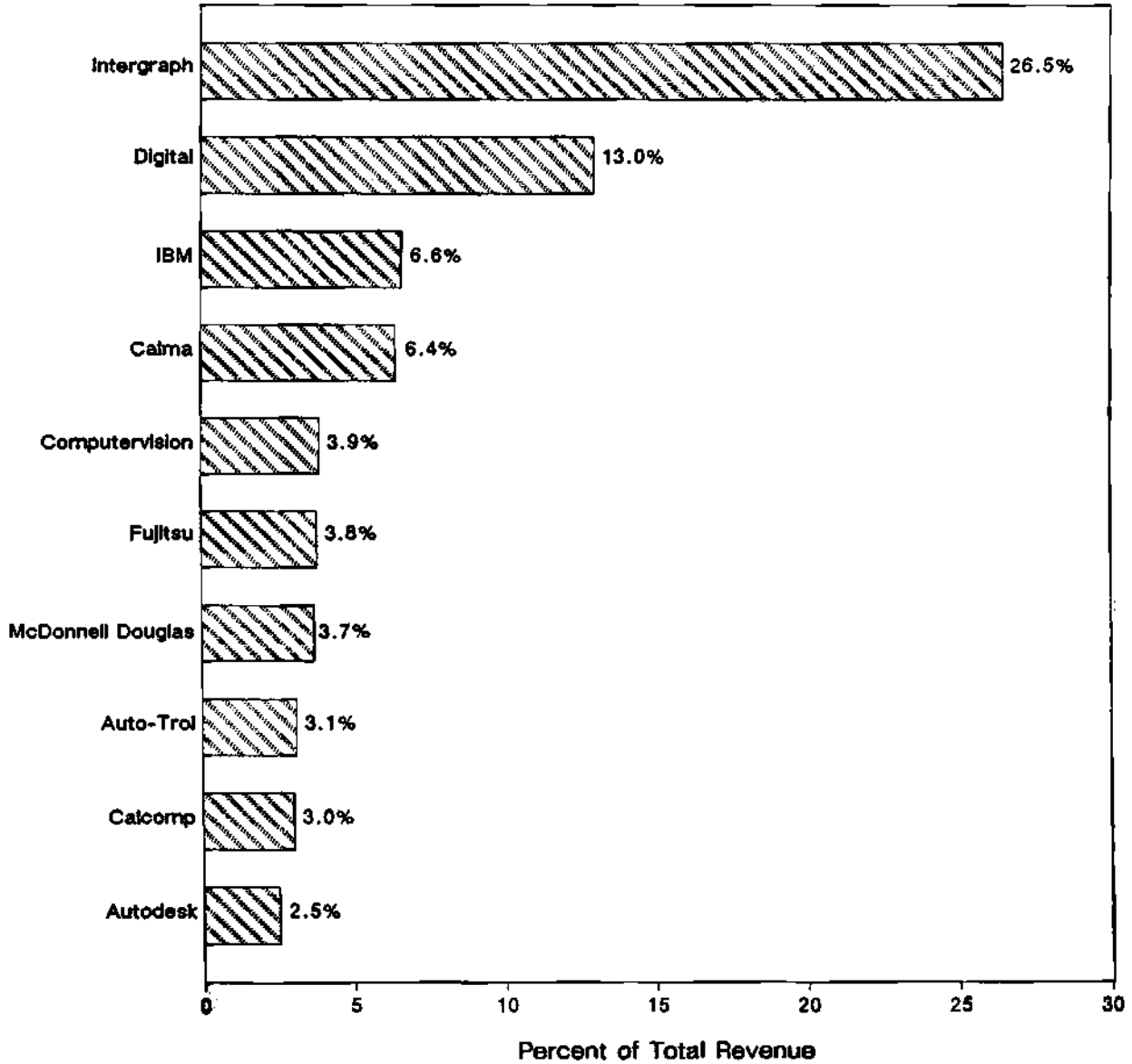
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These bullets present Dataquest's analysis of the facilities design market share measured in total revenue, hardware and software revenue, and workstation shipments. This section contains Figures 1.5-1 through 1.5-4 and Table 1.5-1.

- Intergraph continued to lead the FD market in both 1986 total revenue (27 percent) and software revenue (23 percent). Intergraph also ranks first in share of hardware revenue at 26 percent of the total revenue, and second in number of workstations shipped. Dataquest attributes Intergraph's continuing success to the company's early application and marketing focus, and initial choice of industry standard hardware (i.e., Digital Equipment).
- Digital ranked second overall in total revenue (13 percent) and hardware revenue (17 percent). Its hardware products are pervasive throughout the FD market, most notably its VAX and MicroVAX series processors, which are distributed by a number of FD vendors. Among these are Auto-trol, GE Calma, Intergraph, and McDonnell Douglas.
- IBM placed first in workstation units shipped (22 percent) owing to the popularity of its personal computer. The company ranked third in both hardware revenue (8 percent) and the overall market, (7 percent).
- GE Calma, fourth in overall revenue (6 percent), ranked third in software revenue with an 8 percent market share, and fourth in hardware revenue.
- Significantly, AutoDesk ranked second in software revenue (13 percent) in 1986, behind the leader, Intergraph.
- Of the top 10 revenue performers, 4 computer manufacturers collectively captured 26 percent of the total 1986 FD revenue, led by second-place Digital Equipment Corporation with 13 percent. The other companies, with their market share and rank, are as follows: IBM (7 percent), third; Fujitsu (4 percent), sixth; Prime Computer (2 percent), ninth.
- Given the trend toward direct purchase from standard hardware vendors and away from turnkey vendors, Dataquest expects the 1987 FD market to be increasingly dominated by system manufacturers such as Digital, Fujitsu, and IBM. We see no end to the fragmented nature of this market in 1987. Rather, we anticipate an increase in the number of FD vendors, particularly low-end software vendors offering viable, low-cost solutions.

1.5 Facilities Design Market Shares

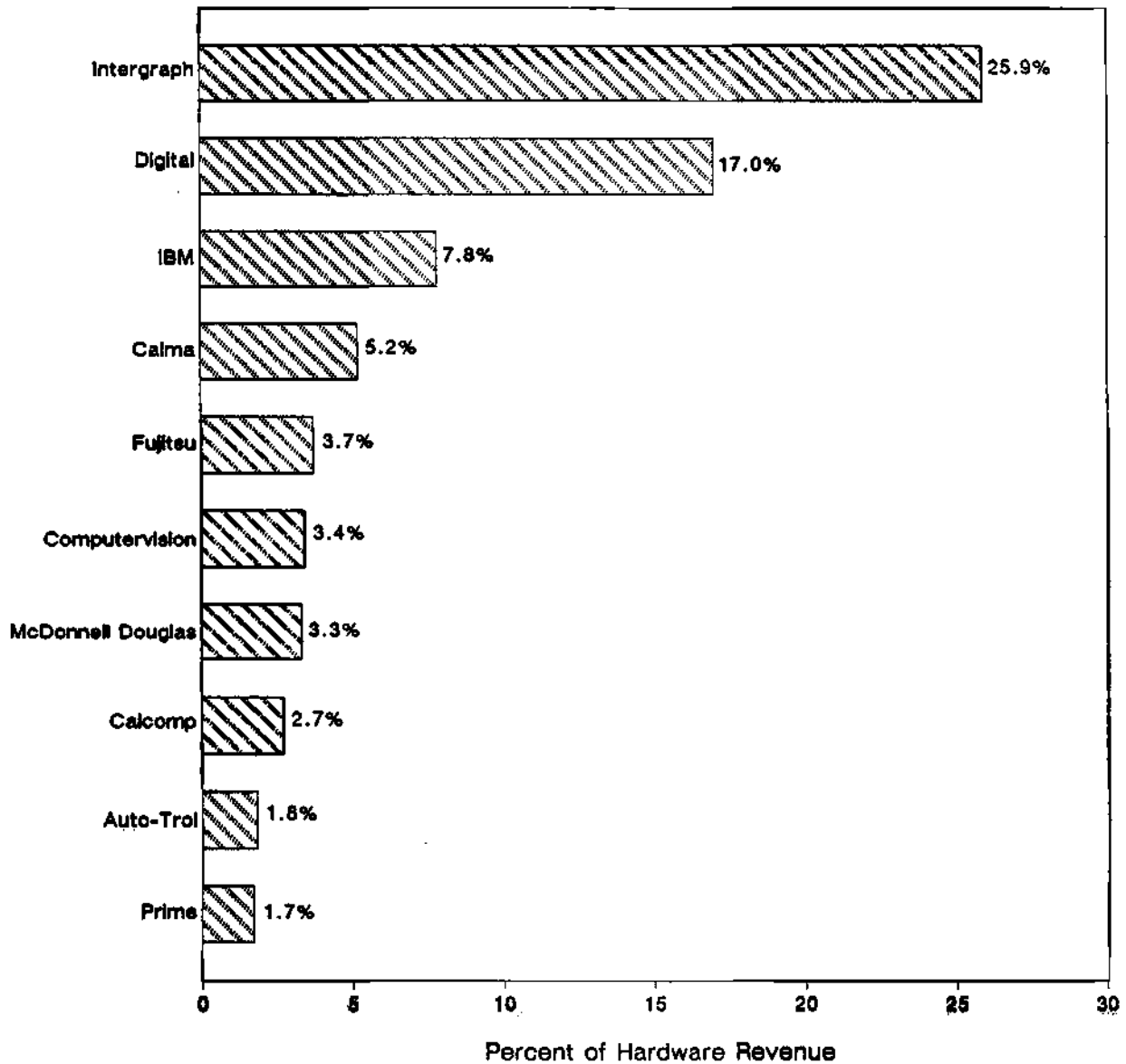
Figure 1.5-1  
Facilities Design 1986 Worldwide Market Share  
Total Revenue



Source: Dataquest  
June 1987

Figure 1.5-2

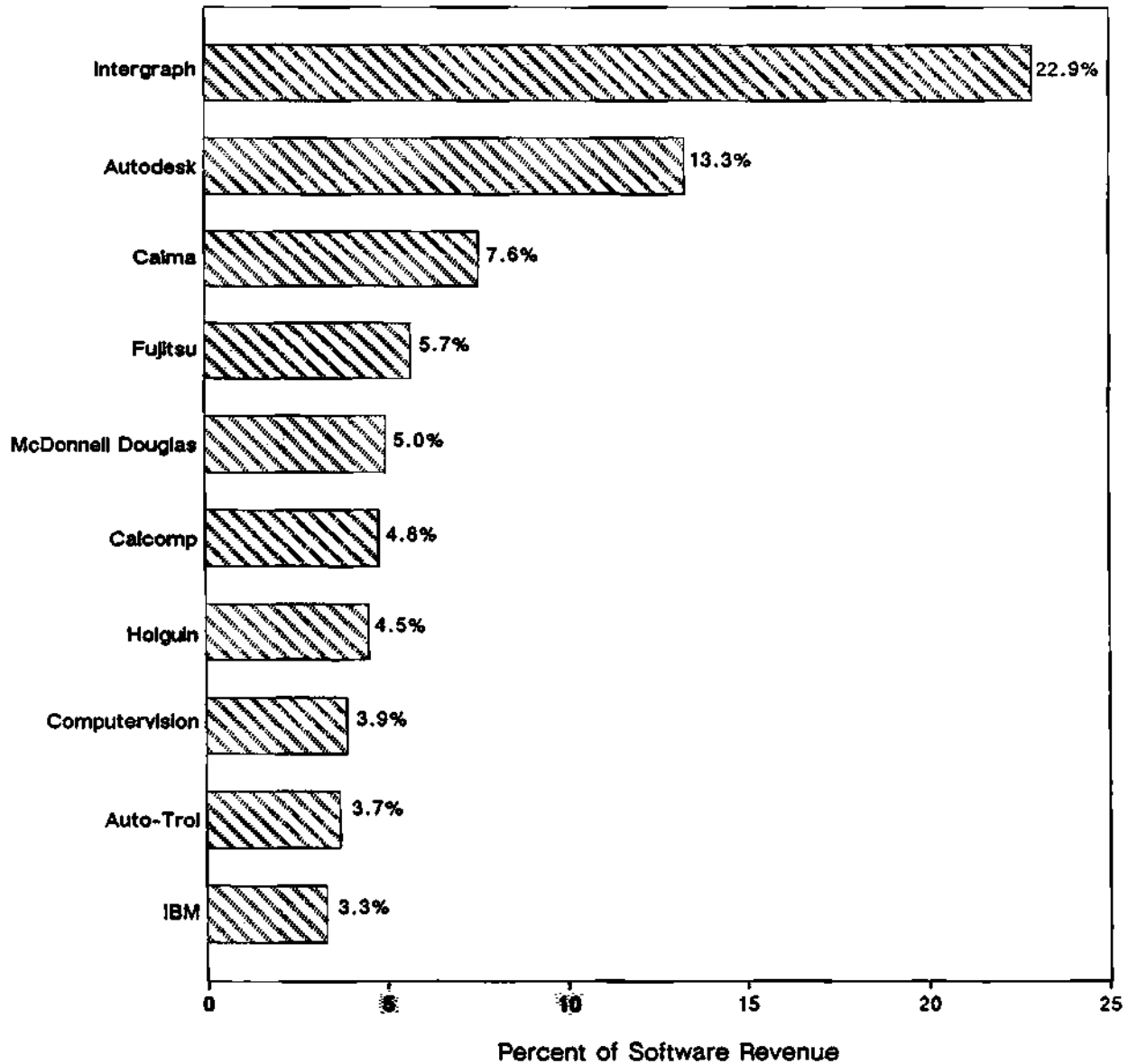
Facilities Design 1986 Worldwide Market Share  
Hardware Revenue



Source: Dataquest  
June 1987

Figure 1.5-3

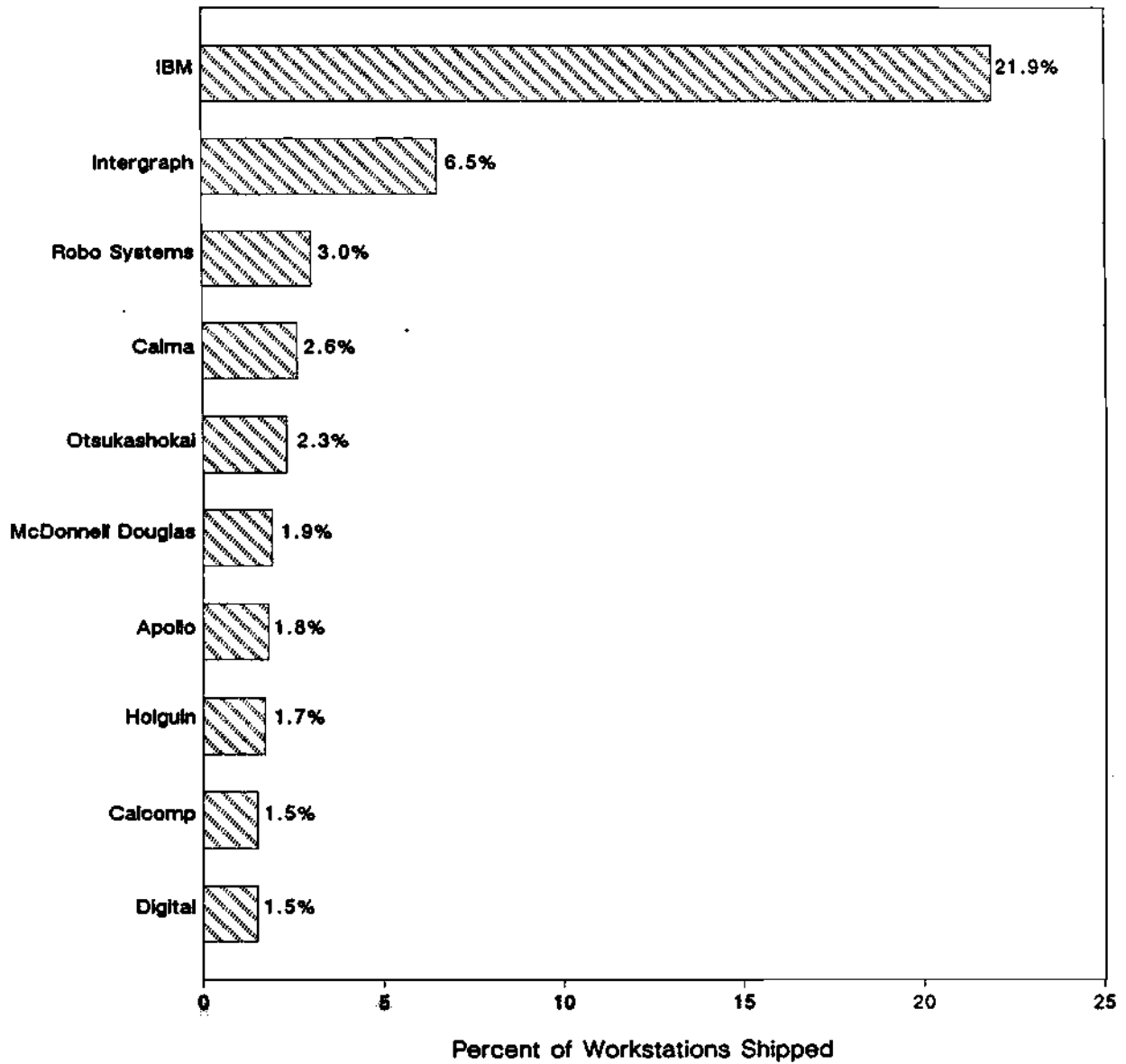
Facilities Design 1986 Worldwide Market Share  
Software Revenue



Source: Dataquest  
June 1987

Figure 1.5-4

Facilities Design 1986 Worldwide Market Share  
Workstation Shipments



Source: Dataquest  
June 1987

1.5 Facilities Design Market Shares

Table 1.5-1

Facilities Design 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
Intergraph	267	175	43	1,692	26.5%	25.9%	22.9%	6.5%
Digital	131	115	0	383	13.0%	17.0%	.0%	1.5%
IBM	67	53	6	5,748	6.6%	7.8%	3.3%	21.9%
Calma	65	35	14	676	6.4%	5.2%	7.6%	2.6%
Computervision	40	23	7	254	3.9%	3.4%	3.9%	1.0%
Fujitsu	38	25	11	228	3.8%	3.7%	5.7%	.9%
McDonnell Douglas	38	22	10	494	3.7%	3.3%	5.0%	1.9%
Auto-Trol	31	12	7	351	3.1%	1.8%	3.7%	1.3%
Calcomp	30	18	9	402	3.0%	2.7%	4.8%	1.5%
Autodesk	25	0	25	0	2.5%	.0%	13.3%	.0%
Prime	19	12	3	167	1.9%	1.7%	1.4%	.6%
Holguin	18	8	9	441	1.8%	1.1%	4.5%	1.7%
NEC	14	9	4	210	1.4%	1.4%	2.2%	.8%
Apollo	12	11	0	478	1.2%	1.6%	.0%	1.8%
Hewlett-Packard	12	8	2	270	1.2%	1.2%	1.2%	1.0%
Hitachi	8	5	3	189	.8%	.7%	1.6%	.7%
Otsukashokai	7	3	4	594	.7%	.4%	2.2%	2.3%
Toshiba	7	6	1	59	.7%	.9%	.3%	.2%
Robo Systems	7	5	1	788	.7%	.7%	.6%	3.0%
Control Data	6	3	2	85	.6%	.5%	.8%	.3%
Mitsubishi Electric	5	3	1	35	.5%	.5%	.5%	.1%
Pafec	3	0	3	0	.3%	.0%	1.4%	.0%
Siemens	3	2	0	16	.2%	.3%	.2%	.1%
Hitachi Zosen	2	1	1	63	.2%	.2%	.4%	.2%
Sun	2	2	0	95	.2%	.3%	.0%	.4%
Mutoh Industries	1	1	0	32	.1%	.1%	.2%	.1%
Seiko I&E	1	1	0	4	.1%	.1%	.1%	.0%
Matra Datavision	1	1	0	3	.1%	.1%	.1%	.0%
Other Companies	150	122	22	12,508	15.0%	18.0%	11.9%	47.7%
All Far East-Based Companies	99	61	31	1,619	9.8%	9.0%	16.2%	6.2%
All European-Based Companies	13	7	5	876	1.3%	1.0%	2.6%	3.3%
All Hardware Companies	268	250	0	17,804	26.7%	36.9%	.0%	67.9%
All Turnkey & SW Companies	737	428	189	8,401	73.3%	63.1%	100.0%	32.1%
All Companies	1,005	678	189	26,205	100.0%	100.0%	100.0%	100.0%

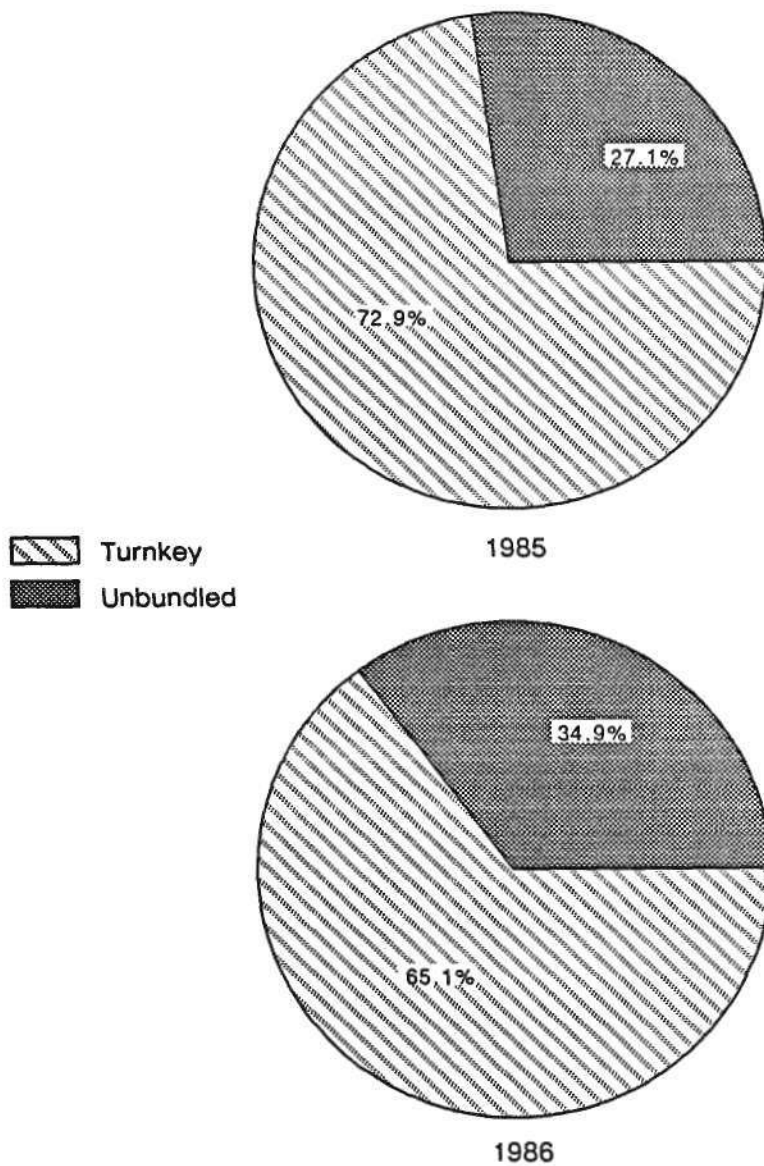
Source: Dataquest  
June 1987

These bullets present the facilities design market share by turnkey versus unbundled product deliveries. This section contains Figure 1.5-5 and Table 1.5-2.

- Sales of unbundled FD systems are growing rapidly, increasing 48 percent between 1985 and 1986, while bundled sales increased only 3 percent. In absolute dollars, unbundled systems accounted for \$302 million, or 35 percent of the 1986 FD market, versus \$564 million, or 65 percent, for bundled systems.
- Approximately 73 percent of FD software revenue is derived from bundled sales, with the remaining 27 percent coming from unbundled sales.
- Approximately 63 percent of all 1986 FD hardware revenue is derived from bundled sales. The remaining 37 percent is from unbundled sales. Bundled FD hardware revenue increased by only 3 percent between 1985 and 1986, whereas unbundled hardware revenue increased by 39 percent.
- Unbundled workstation shipments outnumbered bundled workstation shipments in 1986, which Dataquest attributes to the success of the personal computer in this application market. Unbundled workstation shipments increased by 46 percent in 1986, while bundled shipments slowed to a 3 percent growth rate.



Figure 1.5-5  
Facilities Design Turnkey versus Unbundled  
(Percentage of Revenue)



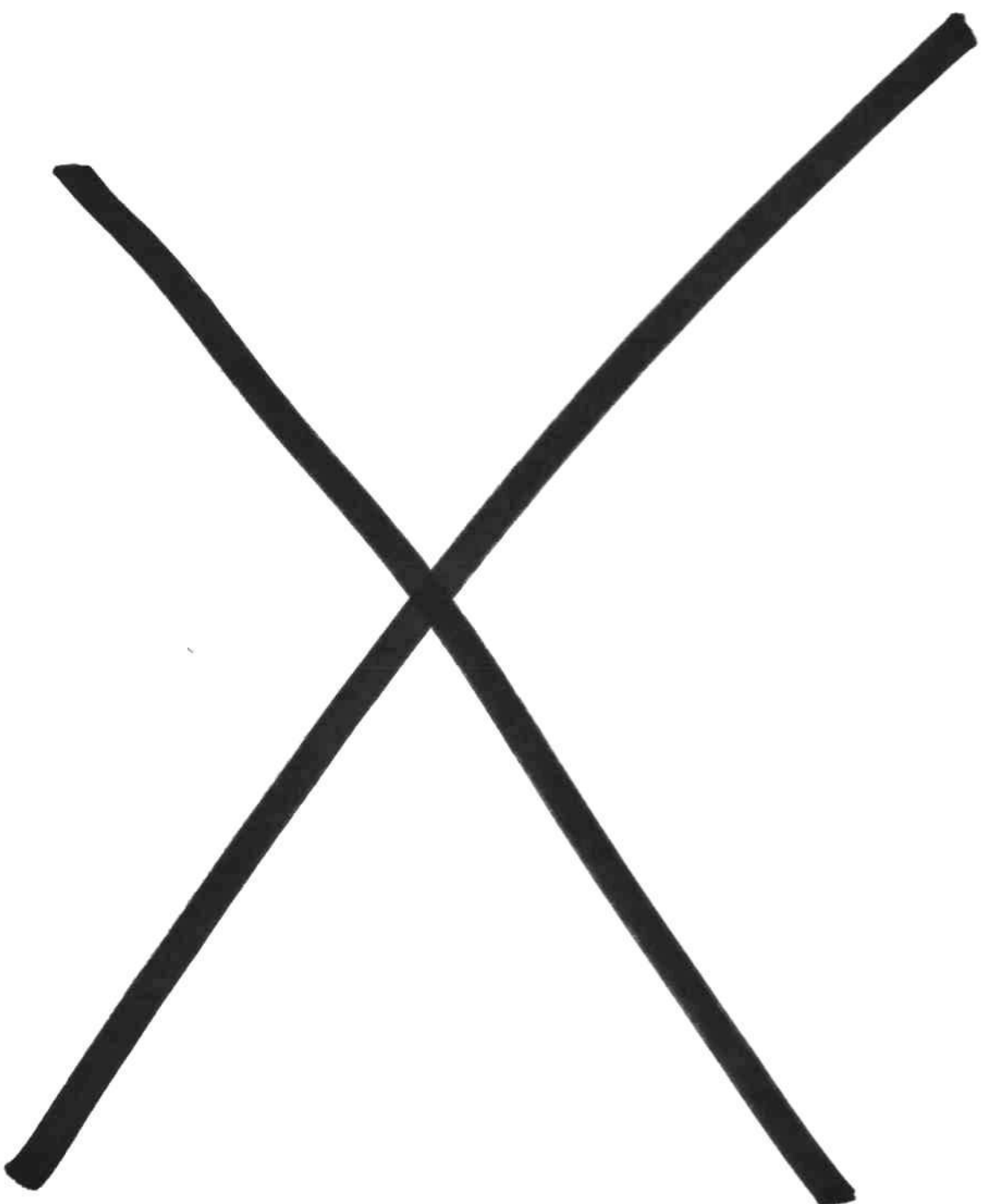
Source: Dataquest  
June 1987

Table 1.5-2

**Facilities Design Turnkey versus Unbundled  
(Millions of Dollars/Actual Units)**

	1985	1986	CAGR	Market Share	
	====	====		====	====
<b>Total Hardware and Software Revenue</b>					
Turnkey	549	564	2.8%	72.9%	65.1%
Unbundled	204	302	48.0%	27.1%	34.9%
Total	753	867	15.1%	100.0%	100.0%
<b>Hardware Revenue</b>					
Turnkey	415	428	3.1%	69.8%	63.1%
Unbundled	180	250	39.1%	30.2%	36.9%
Total	595	678	13.9%	100.0%	100.0%
<b>Software Revenue</b>					
Turnkey	134	136	2.0%	84.5%	72.3%
Unbundled	25	52	112.8%	15.5%	27.7%
Total	158	189	19.2%	100.0%	100.0%
<b>Workstation Shipments</b>					
Turnkey	8,199	8,401	2.5%	40.3%	32.1%
Unbundled	12,158	17,804	46.4%	59.7%	67.9%
Total	20,357	26,205	28.7%	100.0%	100.0%

Source: Dataquest  
June 1987



## 2.1 Mapping Definitions

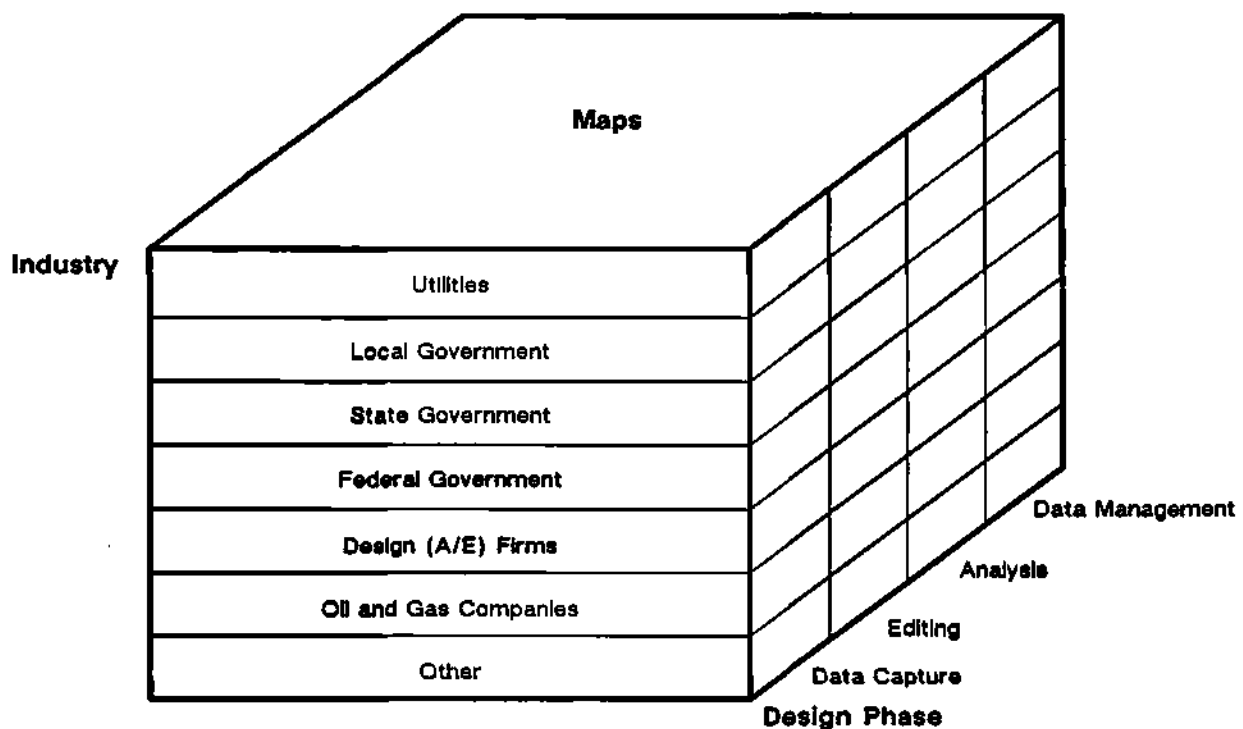
The mapping market segment comprises computer systems that are used to create both cartographic and thematic maps. The functional purpose of the mapping application is to represent spatial data by manipulating them into easily understood graphic formats. Typical computer-generated maps include the following:

- Topographic maps
- Digital elevation models
- Profile and cross-sectional drawings
- Planimetric maps
- Hybrid maps consisting of several different maps
- Slope and slope-aspect maps

Figure 2.1-1 shows Dataquest's view of the mapping segment, including the four phases associated with a computer-based mapping process, and the six major industries that routinely use maps in their respective businesses.

Figure 2.1-1

Mapping Application Model



Source: Dataquest  
June 1987

### APPLICATION DEFINITION

Dataquest finds the definitions that follow to be useful for focusing on the applications addressed by our service.

#### **Cartographic Mapping**

Cartography is the technology of drawing lines and cartographic symbols to depict selected geographic features (such as natural boundaries) of the spherical Earth onto a flat surface. These simple mathematical models are called projections and are the simplest type of map. Cartographers also develop techniques to abstract the multi-dimensional attributes commonly overlaid onto planimetric base maps. A planimetric map is any map that correctly shows the horizontal or plane position of features. Bathymetric and topographic contours from a data base of surveying data or aerial photography, as well as political boundaries, are commonly included as a part of simple base maps to make topographic maps. Virtually all cartographic work today is based on photogrammetry, which is the technology of obtaining quantitative information from photographs.

#### *Computer-Based Cartographic Application*

Computer-aided cartography is most commonly done with vector-based CAD-type systems, and the output is provided by pen plotters. The kind of simple maps that are best represented by CAD systems are planimetric maps with linear features, such as contour lines (or other isolines), boundary lines, transportation networks, supply lines, and hydrographic networks.

#### **Thematic Mapping**

Thematic mapping is the task of placing summary attribute data such as categories or classes onto a base map using shaded isolines. The procedure assigns a hue or texture to a closed polygon that represents a region of study, such as a county or state. Thematic maps depict themes or classes, such as soil or tree types, range of hill-slope angle, or population density. These maps can be used to provide information to a wide spectrum of industries. Mapping is usually done by the researchers or agencies that gather the data or integrate this data into their research problem.

#### *Computer-Based Thematic Application*

Computer-aided thematic mapping is being done more frequently with raster-based graphics or image-processing systems. One of the most common initial tasks is digitizing a line-oriented planimetric base map into a raster-based system. This is usually achieved with a digitizing tablet or scanner interfaced with a software package called a geographic information system (GIS).

### *Geographic Information Systems*

GISs were developed as a method to overlay and combine diverse kinds of data into a single map summarizing geographic, cultural, and scientific attributes. The analog technique was pioneered by Ian McHarg, a well-known landscape architect.

A digital GIS data base is complex, its major task being to integrate information. All GIS data bases have a topological data structure in common. This means an entity and its boundary form a logical unit, and are addressable as such. A typical GIS has line strings, or chains, with each chain having information about what is on either side. This information is then cross-referenced to an attribute file. Because of this topological structure, geographic data analysis, such as the intersection of two maps to produce a third, can be accomplished. As with CAD data bases, logical Boolean operations are usually incorporated into a system. Most GISs are vector-based, allowing for line and point geometry definition.

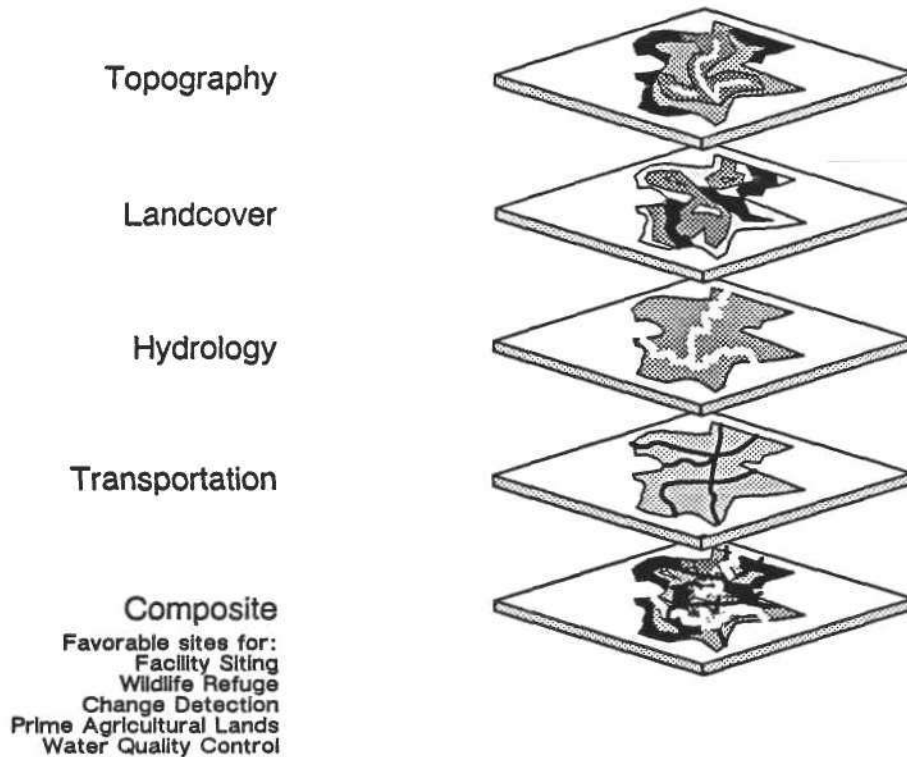
Figure 2.1-2 illustrates the overlay concept of a GIS, showing the power of combining different kinds of map attributes. With a GIS, a variety of uses can be optimized, including the following:

- Land-use analysis and planning
- Natural resource management
- Land-form interpretation
- Census maps and analysis
- Route or corridor selection
- Natural hazard assessment
- Scientific studies
- Military trafficability assessment

Dataquest had previously focused only on the CAD-based, cartographic-related mapping applications. As of 1986, GIS was included in our repertoire of research projects. Therefore, our forecasts now account for both CAD and GIS types of systems.

Figure 2.1-2

Overlay Concept of a GIS



Source: Dataquest  
June 1987

## MAJOR MARKETS

### Federal Government

The federal government, through various agencies such as the U.S. Geological Survey (USGS), the Defense Mapping Agency (DMA), the Central Intelligence Agency (CIA), and the Agency for International Development (AID), is the major producer (and user) of maps in this country. The cartographic division of the USGS has the major responsibility of producing all the civilian topographic maps (planimetric base maps with elevation contours). It also produces limited quantities of specialty maps, such as shaded relief, orthophoto, and slope maps. Additionally, the cartographic division produces all of the USGA geologic maps. The DMA also produces large quantities of maps for the entire world—anywhere U.S. or NATO allies armed forces might be expected to fight or anywhere smart weapons might be deployed. The DMA maintains, among other data bases, an elevation data base called a digital elevation (or terrain) model (DEM) for

virtually the entire world. Apart from an unknown quantity of maps for its internal use, the CIA occasionally publishes maps of foreign countries that the public may purchase. The following is a list developed by the U.S. Department of the Interior of all the federal map publishing and distributing agencies:

- U.S. Bureau of the Census  
Subscriber Service Section (Pubs)  
Administrative Service Division  
Washington, DC 20233
- U.S. Bureau of Indian Affairs  
Office of Public Information  
1951 Constitution Ave. NW.  
Washington, DC 20245
- U.S. Bureau of Land Management  
Office of Public Affairs  
Washington, DC 20240
- U.S. Army Engineer District  
Corps of Engineers, Chicago  
219 South Dearborn St.  
Chicago, IL 60604
- U.S. Army Engineer District  
Corps of Engineers, Louisville  
Post Office Box 59  
Louisville, KY 40201
- U.S. Army Engineer District  
Corps of Engineers, Nashville  
Post Office Box 1070  
Nashville, TN 37202
- U.S. Army Engineer District  
Corps of Engineers, Omaha  
6014 U.S. Post Office  
and Courthouse Bldg.  
Omaha, NE 68102
- U.S. Army Engineer District  
Corps of Engineers, Vicksburg  
Post Office Box 60  
Vicksburg, MS 39180
- Defense Mapping Agency  
Topographic Center  
Attn: Code 55500  
Washington, DC 20315
- Federal Communications  
Communication  
1919 M Street NW.  
Washington, DC 20554
- Federal Power Commission  
Office of Public Information  
825 North Capitol St.  
Washington, DC 20426
- U.S. Forest Service  
Information Office, Rm. 3238  
Post Office Box 2417  
Washington, DC 20013
- U.S. Geological Survey  
Branch of Distribution  
1200 South Eads St.  
Arlington, VA 22202
- U.S. Geological Survey  
Branch of Distribution  
Box 25286, Federal Center  
Denver, CO 80225
- International Boundary  
Commission  
United States and Canada  
425 Eye Street NW., Room 150  
Washington, DC 20536



## 2.1 Mapping Definitions

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- International Boundary and Water Commission  
United States and Mexico,  
United States Section  
Post Office Box 20003  
El Paso, TX 79998
- Interstate Commerce Commission  
Office of Public Information  
Constitution Ave. and  
12th St. NW.  
Washington, DC 20423
- Library of Congress  
Geography and Map Division  
845 South Pickett St.  
Alexandria, VA 22304
- U.S. National Archives and  
Records Service  
Cartographic Archives  
Division (NNS)  
Pennsylvania Ave. at 8th St. NW.  
Washington, DC 20408
- Federal Railroad Administration  
Office of Public Affairs, RPD-1  
400 Seventh Street NW.  
Washington, DC 20590
- U.S. National Climatic Center  
Federal Building  
Asheville, NC 28801
- U.S. National Ocean Survey  
Distribution Division (C-44)  
Riverdale, MD 20840
- U.S. National Park Service  
Office of Public Inquiries,  
Room 1013  
Washington, DC 20240
- U.S. National Weather Service  
Gramax Building  
8060 13th Street  
Silver Spring, MD 20910
- U.S. Soil Conservation Service  
Information Division  
Post Office Box 2890  
Washington, DC 20013
- State Highway Departments  
State Capitals
- Superintendent of Documents  
U.S. Government Printing  
Office  
North Capitol and H Sts. NW.  
Washington, DC 20402
- Tennessee Valley Authority  
Mapping Services Branch  
111 Haney Building  
Chattanooga, TN 37401

### **Other Markets**

Municipal and other local government planning groups' uses of computer-generated maps include street maps, population density maps, road and canal maps, elevation maps, and maps that portray information on water, sanitary, and storm sewer systems. It is essential for some industries such as utilities to maintain accurate records for federal government regulation. These industries also need information such as locations of power transmission lines to be instantly available. Natural resource agencies, regulatory agencies, and landscape architects use maps and geographic information systems for environmental or regional planning and agriculture, wildlife, forestry, and land management. Private industry uses GISs for site and corridor selection and many other applications. The petroleum and gas industry is the single largest civilian user and producer

of proprietary maps. Computer-based systems allow these necessary functions to be rapidly and accurately carried out by personnel not necessarily skilled in cartography or mapping, and are therefore growing rapidly in use.

### **SYSTEM FUNCTIONALITY AND FEATURES**

Two- and three-dimensional graphics are used in computer-generated mapping. Features and functions of systems used in cartographic mapping include the following:

- Input digitization
- Photogrammetric instrument interface
- Complex symbolization
- Survey traverse entry (COGO)
- Aerial triangulation
- Proximal analysis (buffer-zone generation)
- Registration (warping)
- Vector/grid cell conversion
- Polygon overlay/retrieval
- Coordinate transformation
- Edge matching
- Digital terrain modeling
- Representational tables
- Automated scale changes
- Report generation
- Hard-copy output

Dataquest believes that mapping systems are gaining widespread use among the world's cartographers, surveyors, civil engineers, city planners, photogrammetrists, geophysicists, geographers, utilities engineers, and a wide range of others.

## 2.2 Mapping 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 mapping applications segment.

- Dataquest estimates that the mapping market represented \$358 million in 1986, 51 percent more than the \$220 million 1985 market.
- The mapping market is forecast to decrease 8 percent in 1987 to an estimated \$329 million. However, long-term growth will be positive as declining system prices and a stronger imperative to automate attract more buyers.
- The mapping market is forecast to grow from \$358 million in 1986 to \$740 million in 1991, representing a 16 percent compound annual growth rate (CAGR).
- Dataquest estimates that 3,134 mapping workstations shipped in 1986. In 1987, workstation shipments will increase 36 percent to 4,250 and are expected to reach 11,950 units in 1991, a 31 percent CAGR.
- The average selling price per seat for all platform types is expected to decline at a negative CAGR of 18 percent, from \$88,000 in 1986 to \$32,000 in 1991. The greatest overall decrease will occur in the price per seat of host-dependent workstations, which will decline at a negative CAGR of 20 percent, from the current \$126,000 to \$43,000 in 1991.
- In 1986, the personal computer continued its impact on the mapping market to a greater extent than during the previous year, but still accounted for only 26 percent of mapping workstation shipments, and only 4 percent of overall mapping revenue.
- Technical workstations accounted for only 8 percent of all mapping revenue and 14 percent of all workstations shipped in 1986. They are forecast to constitute 52 percent of all mapping revenue in 1991 and 42 percent of all workstations shipped.

## 2.3 Mapping Market Overview

### HISTORY

#### **Interactive Graphics Arrive—Intergraph Becomes a Major Force**

Interactive graphics (CAD) systems for mapping have been sold commercially since the early 1970s. Five vendors, including Intergraph, Computervision, Auto-trol Technology, GE Calma, and Synercom Technology, all introduced systems between 1970 and 1974. All the systems introduced by these vendors provided capabilities mainly for editing, displaying, and plotting maps (which we refer to as map drafting). Synercom Technology introduced a proprietary relational data base module in addition to the graphics software, claiming a close integration between the two modules. Synercom was the first vendor in the mapping market to introduce such a system, and the company retained this position exclusively for the six years following introduction in 1972.

Synercom and Intergraph continued to focus primarily on mapping applications for the remainder of the decade, while the three other early entrants eventually shifted their focus to other applications. Meanwhile, the market continued to grow steadily. Intergraph became the major force during the late 1970s in cartographic mapping applications and the vendor to beat in the 1980s in all mapping-related applications. Dataquest attributes much of Intergraph's success to three factors:

- Its stronghold in the federal markets, which we believe represented the largest purchasing community during the 1970s
- A commitment to standard hardware platforms using Digital Equipment products
- Strength in graphics products, including hardware and software

By 1978, Intergraph had also introduced a proprietary data base management product called DMRS (Data Management and Retrieval System) and a number of other significant products for cartography.

As of December 1980, Intergraph had installed 108 interactive graphics systems for mapping, with the heaviest weighting of installations (57 total) in general mapping. Table 1 shows the breakdown of Intergraph's mapping systems by industry. Dataquest believes most of the systems in the category of map drafting could be equated with government installations.

**Table 1**  
**Intergraph Mapping Installations**  
**(As of December 1980)**

	<b>Number of Systems</b>
<b>General Mapping</b>	57
<b>Petroleum Mapping/Seismic Processing</b>	22
<b>Public Utility Mapping</b>	29
<b>Total</b>	108

Source: Intergraph Prospectus

### **Information Management Requirements Spur New Opportunities**

Information management was gaining greater visibility in the mapping community when the 1980s arrived. Functions such as querying and report generation could be heard in every type of mapping environment. Users began demanding better information-handling capabilities, voicing their need to combine many different types of spatial data for map production and analysis purposes.

Data base management functionality became an issue for vendors that offered both CAD-based mapping systems and GISs.

### **Mapping Information Management Systems (MIMSs)**

MIMSs are essentially interactive (CAD) graphics programs integrated with data base management programs. MIMSs were viewed as crucial for markets that required highly accurate map data bases that would be repeatedly accessed for reporting on subsets of maps or specific information about any one map, and on graphic and nongraphic features within any map. Utility companies, public works departments, and petroleum companies were viewed as large potential users of MIMS.

As previously mentioned, both Synercom and Intergraph had already announced integrated graphics and data management systems. Another major entrant to this market was IBM Corporation, which introduced its MIMS product, DFIS (Distributed Facilities Information System), in 1981. DFIS was announced after nine years of joint development with the Public Service Company of Colorado, so it had a strong leaning initially toward the utility market. In 1985, IBM changed the name to Geographic Facilities Information System (GFIS).

IBM's MIMS offering was further expanded when it signed three cooperative marketing partnerships (CMPs). The CMPs were set up to provide IBM GFIS users with the tools that make GFIS a customized solution for their environment. The marketing partners include:

- **Integrated Information Systems (San Diego, California)**—Solutions for electric utility companies and local government
- **WPS Development, Inc. (Green Bay, Wisconsin)**—Solutions mostly for electric and gas utility companies and some telephone company applications; solutions also for oil exploration
- **United Teleplex (Laguna Hills, California)**—Solutions for transportation (rail and highway) concerns; systems integration for telecommunications firms and municipal governments

GFIS is marketed as an application shell. Users can purchase one of the three CMP products or develop their own application-specific solutions.

Other MIMS products that were announced or available as of May 1987 are shown in Table 2.

### **Geographic Information Systems (GIS)**

One of the most visible proponents of data management within a GIS was the U.S. Census Bureau. The Bureau determined that it needed to strive for greater efficiency and value in its role as an information provider. Prior to the 1980 Census, information was put into digital form, but little or no association existed between information types. The Bureau believed the information gathered could be more useful to decision makers if greater integration and association between data types was established. Immediately following the 1980 Census, plans were implemented for the development of an integrated graphics and data base management system, code-named TIGER (Topologically Integrated Geographic Encoding and Referencing). The target for completion of TIGER is 1989, just in time for the 1990 census, thus representing a 10-year development effort involving many people and an untold investment in computing equipment.

Environmental Systems Research Institute (ESRI) of Redlands, California, was the first company to offer such a product commercially. ESRI announced its system in 1982, which it named ARC/INFO to reflect the focus on information management. The earliest users of ARC/INFO were forestry and other natural resource agencies, and several state and local government groups.

Table 2

Mapping/Information Management Systems  
(Announced/Available as of May 1987)

Vendor Location	MIMS Product	HW Platform(s)
A.C.D.S. Quebec, Canada	CARTO	Variety of UNIX-based workstations
Advanced Geographic Systems Huntington Beach, CA	Accumap	PC AT/Compatibles
A/SA Software, Inc. Austin, TX	A/SA Image	PC AT/Compatibles IBM Mainframes
Diginetics, Inc. Albuquerque, NM	Digimap	Digital VAX/ MicroVAX (VMS)
DKA, Inc. Mill Valley, CA	FMS/AC	PC AT/Compatibles (MS-DOS)
Easinet, Ltd. Sydney, Australia	Easinet	Data General MV Series (AOS)
GeoVision Ottawa, Canada	AMS	Digital VAXstation II/GPX HP9000 Series (Both UNIX)
	RAMS/VX	Digital MicroVAX (VMS)
	Telegraphics	Sperry (UNIX)
Intergraph Corporation Huntsville, AL	IGDS/DMRS	Digital VAX/ MicroVAX (VMS)
	FIDS	Digital VAX/ MicroVAX (VMS)
IBM Corporation/CMPs Armonk, NY	GFIS	IBM Mainframe/ Minicomputers
Synercom Technology Sugar Land, TX	Informap III	Digital VAX/ MicroVAX/GPX (VMS)
Sysscan, Ltd. Kongsberg, Norway	Mapping Information System	Digital VAX/ MicroVAX (VMS)

Source: Dataquest  
June 1987

Other GIS products had been available prior to the ARC/INFO announcement, but only for distribution within the public sector. One of the most widely used products during the 1970s and early 1980s was MOSS, developed by federal agencies for natural resource management applications and distributed by Autometric, Inc., of Fort Collins, Colorado.

Dataquest believes the commercial GIS market has been dominated by ESRI, which we attribute to the company's exclusive focus in this area and long-standing presence as a consultant on environmental concerns. Synercom and Intergraph had introduced GIS-related functionality in 1984 and 1985, respectively. Synercom's product resulted from an agreement to be the exclusive distributor of a Harvard-developed system known as Odyssey, which Synercom decided to market as its Environmental Management Information System (EMIS). Intergraph's proprietary product offering, which it called GPPU (Graphics Polygon Processing Utility), represented only a start for Intergraph. It later announced plans to develop a major GIS offering. Both Synercom's and Intergraph's products were developed to interface with the core interactive graphics capabilities of their respective systems. This approach changed the GIS picture considerably, from that of a batch-oriented, number-crunching process characteristic of the earliest systems to a more interactive visual process.

Table 3 lists GIS offerings that were announced or available as of May 1987.

Table 3

Geographic Information Systems  
(Announced/Available as of May 1987)

Vendor Location	GIS Product Name	Hardware Platform(s)
A.C.D.S. Quebec, Canada	MIME	Variety of UNIX systems
Criterion Systems San Diego, CA	Landtrak	PC AT/Compatibles (MS-DOS)
Computervision Bedford, MA	AIMS	Sun Microsystems (UNIX)
Decision Images Princeton, NJ	Resource	PC AT/Compatibles (MS-DOS)
Delta Systems Fort Collins, CO	DeltaMap	HP 9000, 300/500 Series (UNIX)
ESRI Redlands, CA	ARC/INFO	Digital Equipment (VMS); Prime Computer (PRIMOS); PC AT (MS-DOS) Sun Microsystems (UNIX)

(Continued)



Table 3 (Continued)

Geographic Information Systems  
(Announced/Available as of May 1987)

Vendor Location	GIS Product Name	Hardware Platform(s)
GeoBased Systems Raleigh, NC (MS-DOS)	Strings	Digital VAX/MicroVAX/GPX (VMS); PC AT/Compatibles
GeoVision Ottawa, Canada	GIS	Digital VAX/MICROVAX/ (VMS)
Intergraph Corp. Huntsville, AL	GPPU	Digital VAX/MICROVAX (UNIX)
Kern Instruments Brewster, NY	InfoCAM	Digital VAX/MICROVAX (VMS)
Kork Systems Bangor, ME	Kork Geographic Information System	MICROVAX/VAXstation (VMS)
MPSI, Inc. Tulsa, OK	GIS	IBM Mainframes (MVS,VM) PC AT (DOS)
Synercom Technology Sugar Land, TX	EMIS	Digital's VAX/MicroVAX (VMS)
Terra Mar Mountain View, CA	TerraPak	PC AT/Compatibles (DOS)
Wild Heerbrug Farmingdale, NY	System 9	Sun Microsystems (UNIX)

Source: Dataquest  
June 1987

**PRESENT MARKET CONDITIONS**

**Market Growing Pains Expected**

Revenue for system sales to the mapping market (worldwide) had been increasing at an average of 26 percent per year between 1982 and 1986. However, Dataquest estimates that average revenue growth will be dropping to 16 percent per year between 1987 and 1991, with a decline of 8 percent forecast for 1987. So where revenue was an estimated \$358 million worldwide in 1986, the figure for 1987 is estimated at \$329 million. This includes all sales that would include a turnkey system (hardware,

software, and peripherals), just software, or just computer hardware. The forecast downturn in revenue growth resulted from our consideration of several key trends and issues:

- Transitions—Intergraph and Synercom
- Technology overlap and confusion—MIMS versus GIS
- Declining system prices

### **Transitions—Intergraph and Synercom**

Intergraph's present product transition played a major role in our thinking with regard to the predicted decline in revenue growth. In 1986, the company announced a new hardware platform based on Fairchild Semiconductor's product, code-named Clipper. The Clipper chip has been incorporated into a technical workstation (also called Clipper) to provide full 32-bit functionality, as well as graphics. Intergraph presently has not announced any major mapping offerings on the Clipper workstation, which we believe lends an air of confusion and concern to the mapping market, particularly within Intergraph's large installed base. The software for Clipper is not expected to be released until early 1988.

Synercom Technology has recently completed a major transition, also on the product side, with an overhaul of its core graphics/data management package. Its new product, Informap III, is now positioned to take advantage of distributed computing environments, utilizing the Digital Equipment family of workstations and minicomputers. Synercom is the first vendor to introduce this strategy, which Dataquest believes has been met with less enthusiasm than anticipated by the company.

### **Technology Overlap and Confusion—MIMS versus GIS**

CAD-based MIMSs and GISs are becoming more alike every day. For instance, most GISs now offer better graphics display capability and less of the batch-oriented processing that typified most earlier GIS product offerings. Most GIS offerings now provide capabilities for working with line and point symbology rather than area-only symbology, which limited output to thematic maps (area views shaded with user-selected colors). Dataquest believes these apparent improvements in GISs are significant for users that require a high degree of accuracy and precision in the map documents that are turned out.

While GISs have become more alike in graphics, many MIMSs now incorporate GIS functionality such as the ability to apply topology to the CAD data base. Intergraph is a leading proponent of this approach. The company will be releasing an upgraded version of its earlier GPPU product (see Table 2), which will provide users with topological data-structuring capabilities for a CAD data base. The new version, called EDITOR/ANALYST, will operate only on Intergraph's VMS-based products.

Dataquest believes most vendors are becoming less inclined to distinguish between the two types of systems. Some vendors market GIS as an adjunct to a CAD-based product, while others call what technically is a CAD-based system, a GIS. Either way, we believe a certain level of confusion has been introduced into the prospective buying communities. This confusion is expected to persist at least through the remainder of 1987.

#### **Declining System Prices**

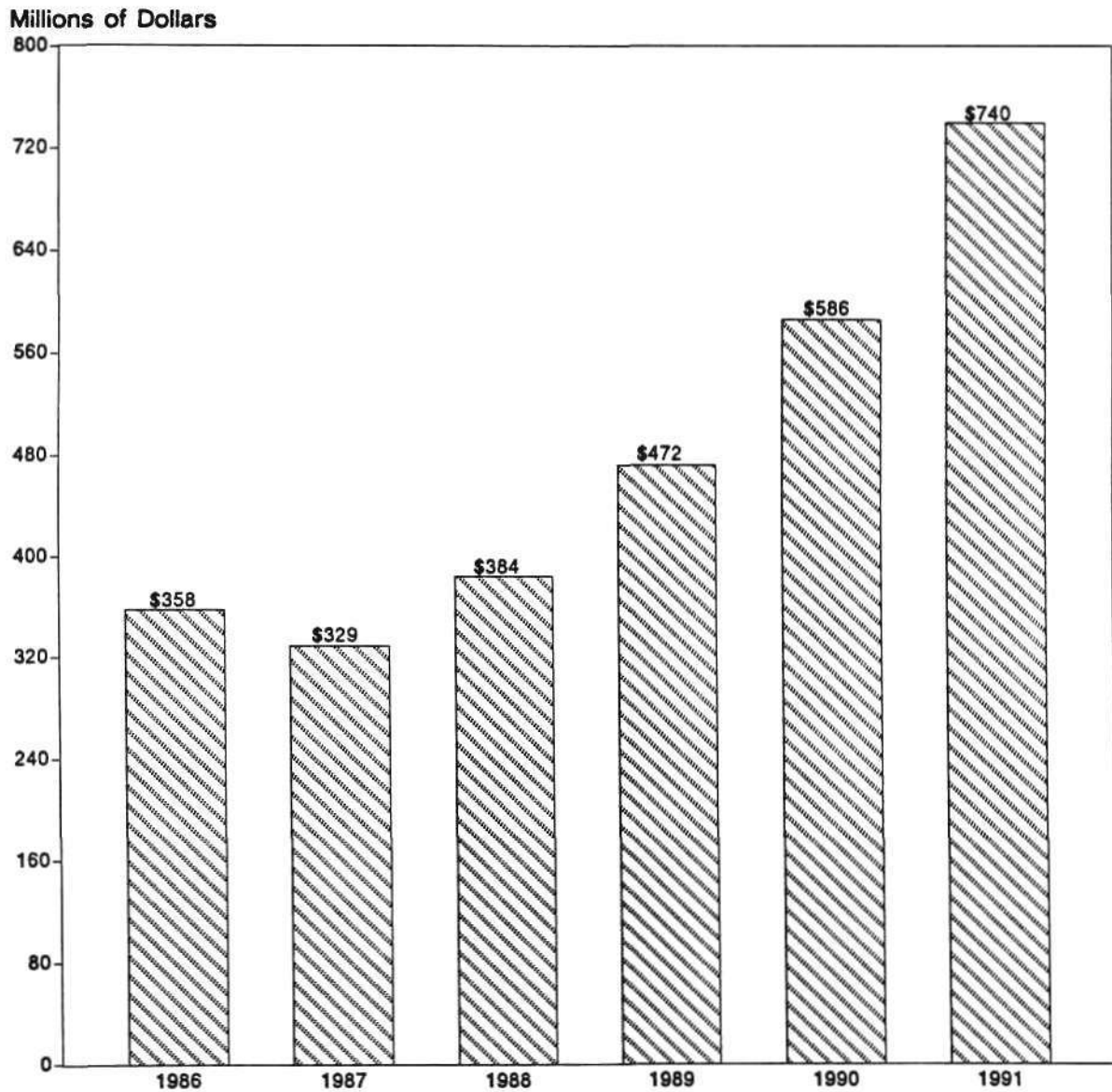
Due to substantial price declines in hardware, many vendors have seen average selling prices of systems fall anywhere from 20 to 50 percent. In 1986, Dataquest has determined that the average price of a mapping system declined approximately 50 percent from 1985 prices. The average selling price of a mapping system in 1985 was approximately \$344,000, whereas in 1986 it was \$157,000. Dataquest is forecasting further price declines in 1987 caused mainly by the continued downward pressure on hardware prices.

## 2.4 Mapping Forecasts

These bullets present Dataquest's forecast and analysis for the total mapping market for all regions and platforms. This section contains Figures 2.4-1 and 2.4-2 and Table 2.4-1.

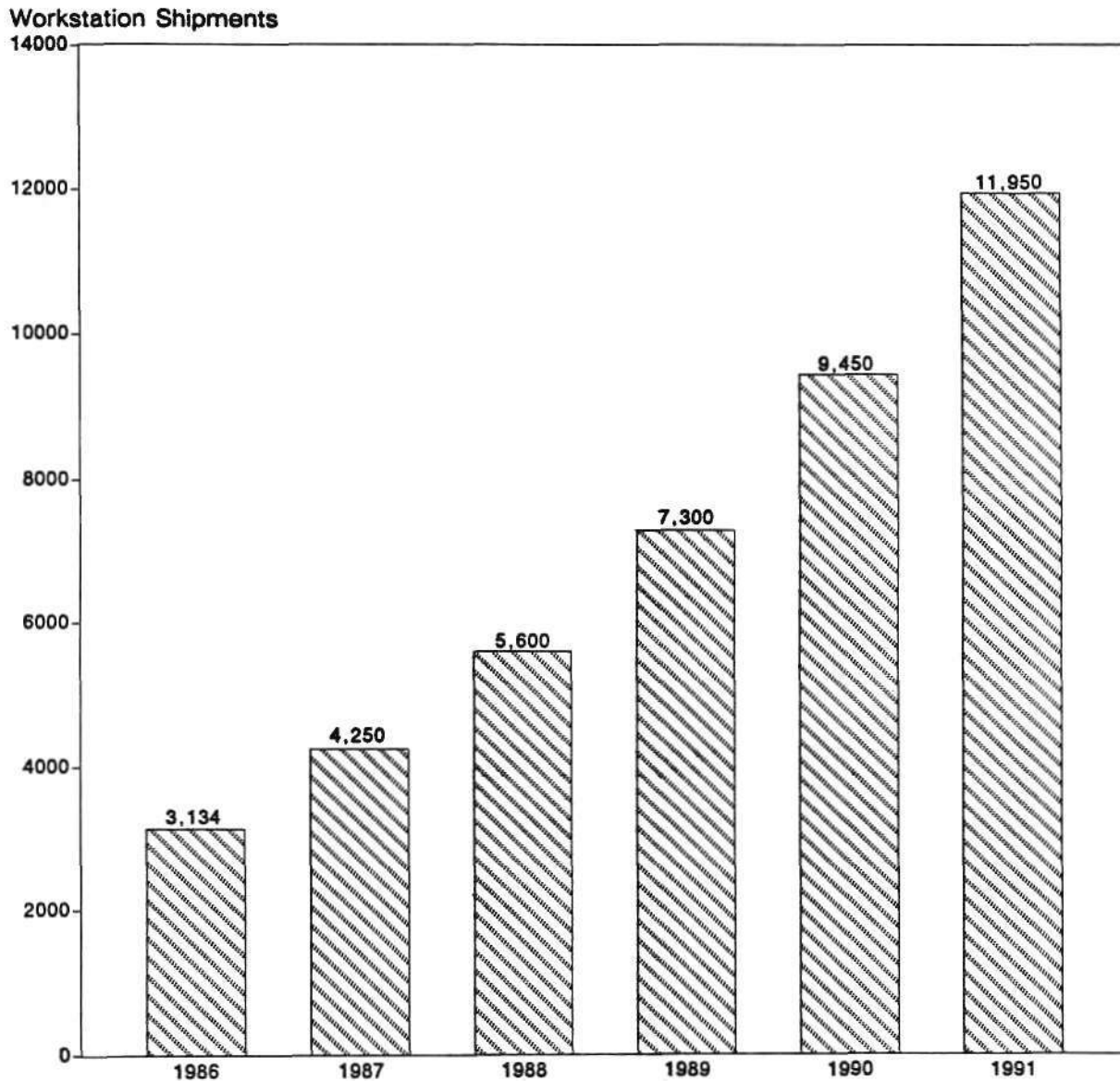
- The mapping market segment, worth an estimated \$358 million in 1986, is forecast to grow to \$740 million in 1991, a compound annual growth rate (CAGR) of 16 percent.
- Dataquest estimates that mapping revenue will decrease 8 percent in 1987 from 1986, for total revenue of \$329 million.
- An estimated 3,134 workstations shipped in 1986. Shipments are expected to reach 11,950 in 1991, a 31 percent CAGR.
- Workstation shipments will grow to 4,250 in 1987, representing a 36 percent increase from 1986.

**Figure 2.4-1**  
**Mapping Worldwide Forecast**  
**Revenue**



Source: Dataquest  
June 1987

**Figure 2.4-2**  
**Mapping Worldwide Forecast**  
**Shipments**



Source: Dataquest  
June 1987

## 2.4 Mapping Forecasts

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**Table 2.4-1**

**Mapping Worldwide Forecast  
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	====	====	====	====	====	====	====
<b>Total Market</b>							
Revenue	358	329	384	472	586	740	15.6%
Systems	1,752	2,500	3,700	5,300	7,350	9,850	41.2%
Workstations	3,134	4,250	5,600	7,300	9,450	11,950	30.7%

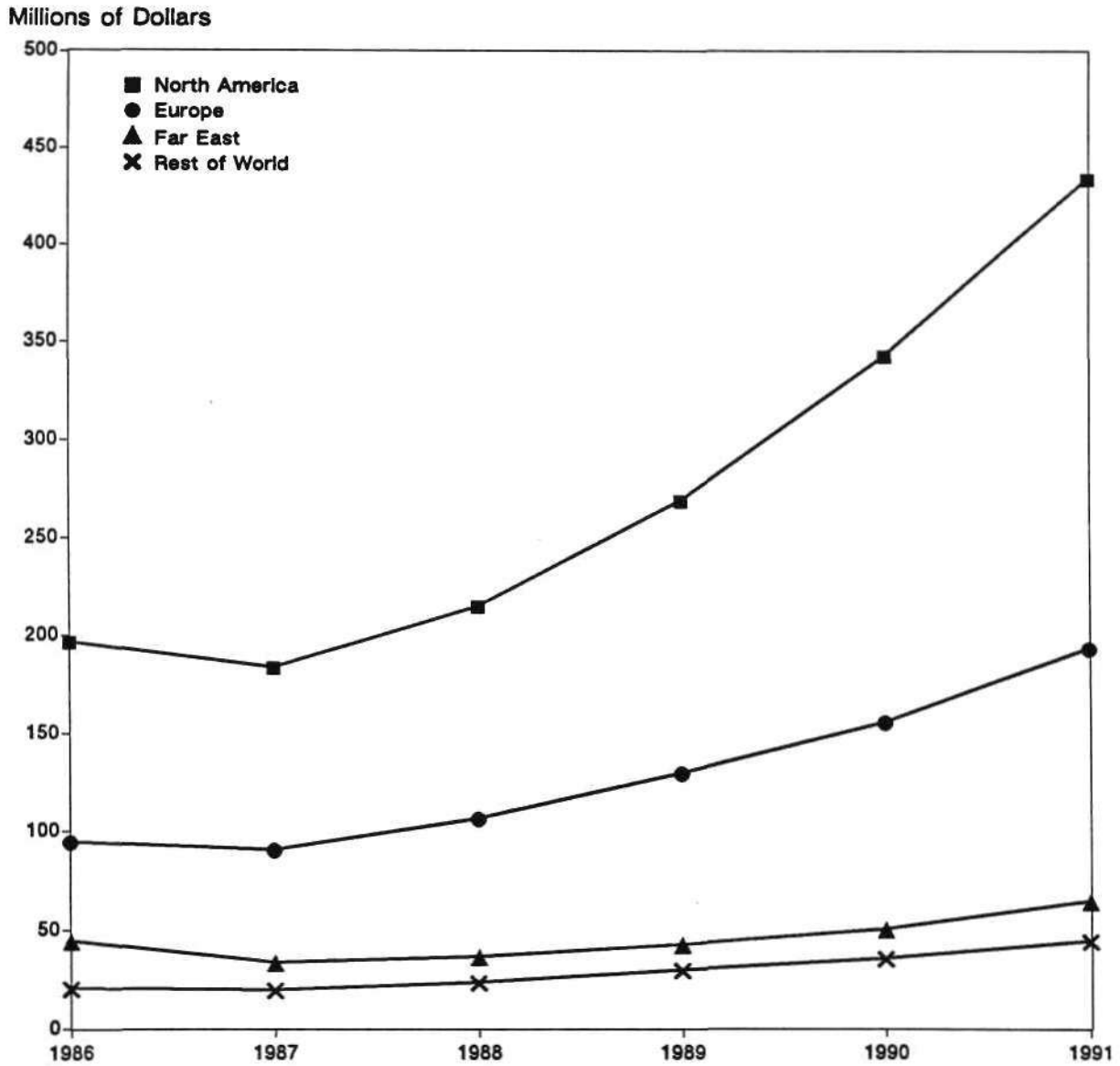
Source: Dataquest  
June 1987

These bullets present Dataquest's forecast and analysis of the mapping market, segmented by region. This section contains Figures 2.4-3 and 2.4-4 and Tables 2.4-2 and 2.4-3.

- We estimate that 1986 North American revenue was \$197 million and that it will grow to \$435 million in 1991, at a 17 percent CAGR. North American revenue in 1987 is forecast at \$184 million, representing a decrease of 7 percent from the 1986 level.
- European revenue was \$95 million in 1986 and is forecast to reach \$194 million in 1991, growing at a 15 percent CAGR. In 1987, European revenue is forecast at \$91 million, representing a 4 percent decrease from 1986 revenue.
- The Far Eastern mapping segment revenue represented \$45 million in 1986 and is forecast to grow at a 7 percent CAGR to reach \$65 million in 1991.
- Rest of World (ROW) accounted for \$21 million in 1986. We estimate that this region will grow to \$45 million in 1991, at a 17 percent CAGR.
- Dataquest estimates that the North American region, with 55 percent of total revenue in 1986, will increase as a percent of total revenue through 1991, whereas Europe and the Far East will decrease as a percent of total revenue during the same period.

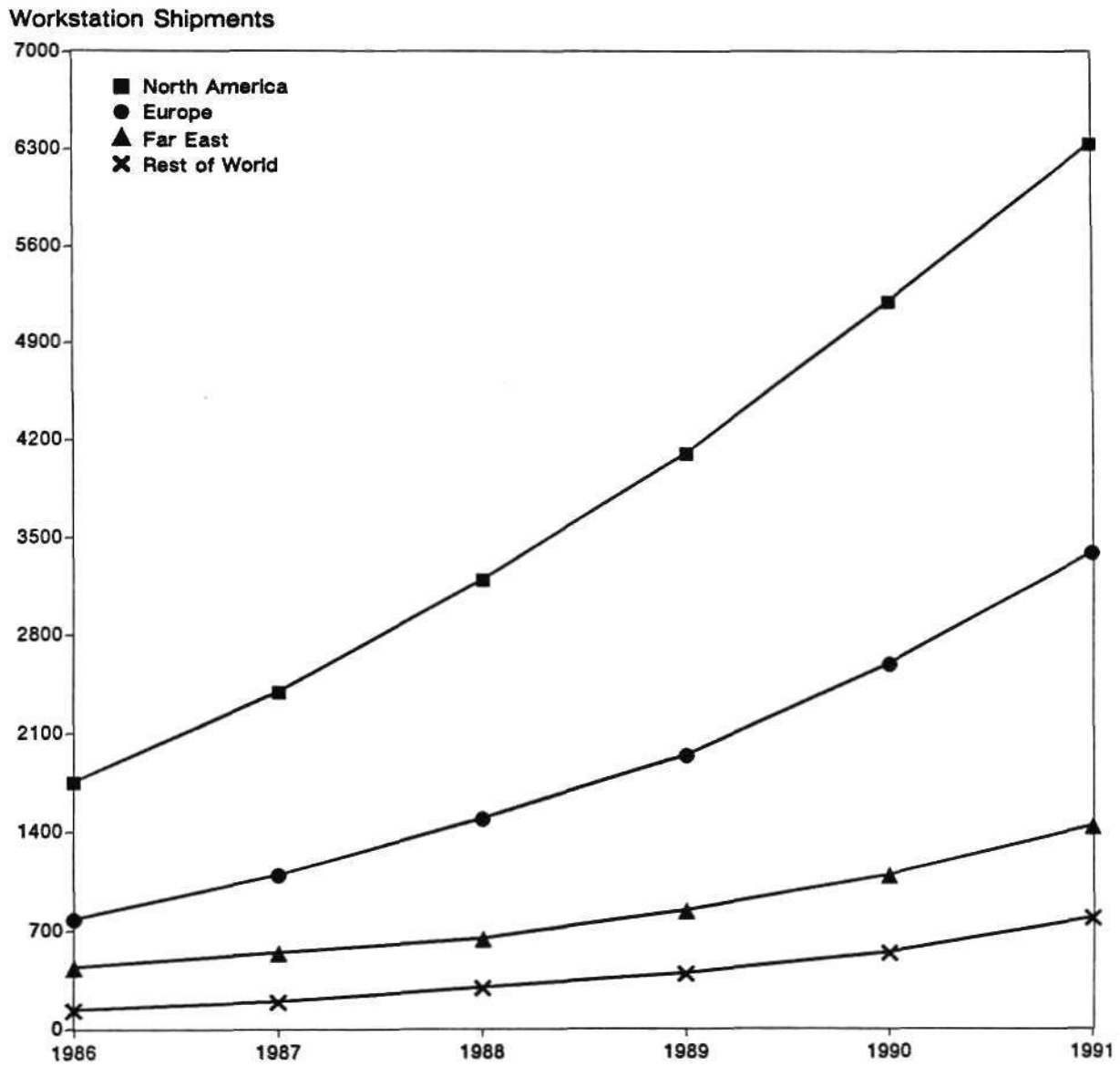


Figure 2.4-3  
Mapping Regional Forecast  
Revenue



Source: Dataquest  
June 1987

**Figure 2.4-4**  
**Mapping Regional Forecast**  
**Shipments**



Source: Dataquest  
 June 1987

## 2.4 Mapping Forecasts

Table 2.4-2

**Mapping Regional Forecast  
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
<b>Total Market</b>							
Revenue	358	329	384	472	586	740	15.6%
Systems	1,752	2,500	3,700	5,300	7,350	9,850	41.2%
Workstations	3,134	4,250	5,600	7,300	9,450	11,950	30.7%
<b>North America</b>							
Revenue	197	184	215	269	343	435	17.2%
Systems	980	1,550	2,350	3,300	4,500	5,750	42.5%
Workstations	1,758	2,400	3,200	4,100	5,200	6,350	29.3%
<b>Europe</b>							
Revenue	95	91	107	130	156	194	15.3%
Systems	423	550	800	1,150	1,600	2,250	39.7%
Workstations	786	1,100	1,500	1,950	2,600	3,400	34.0%
<b>Far East</b>							
Revenue	45	34	37	43	51	65	7.4%
Systems	275	300	450	600	900	1,250	35.4%
Workstations	445	550	650	850	1,100	1,450	26.6%
<b>Rest of World</b>							
Revenue	21	20	24	30	36	45	16.6%
Systems	74	100	150	250	350	600	52.1%
Workstations	145	200	300	400	550	800	40.7%

Source: Dataquest  
June 1987

Table 2.4-3

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

	1986	1987	1988	1989	1990	1991
	****	****	****	****	****	****
<b>North America</b>						
Revenue	55%	56%	56%	57%	58%	59%
Systems	56%	62%	64%	62%	61%	58%
Workstations	56%	56%	57%	56%	55%	53%
<b>Europe</b>						
Revenue	27%	28%	28%	27%	27%	26%
Systems	24%	22%	22%	22%	22%	23%
Workstations	25%	26%	27%	27%	28%	28%
<b>Far East</b>						
Revenue	13%	10%	10%	9%	9%	9%
Systems	16%	12%	12%	11%	12%	13%
Workstations	14%	13%	12%	12%	12%	12%
<b>Rest of World</b>						
Revenue	6%	6%	6%	6%	6%	6%
Systems	4%	4%	4%	5%	5%	6%
Workstations	5%	5%	5%	5%	6%	7%

Source: Dataquest  
June 1987

## **2.4 Mapping Forecasts**

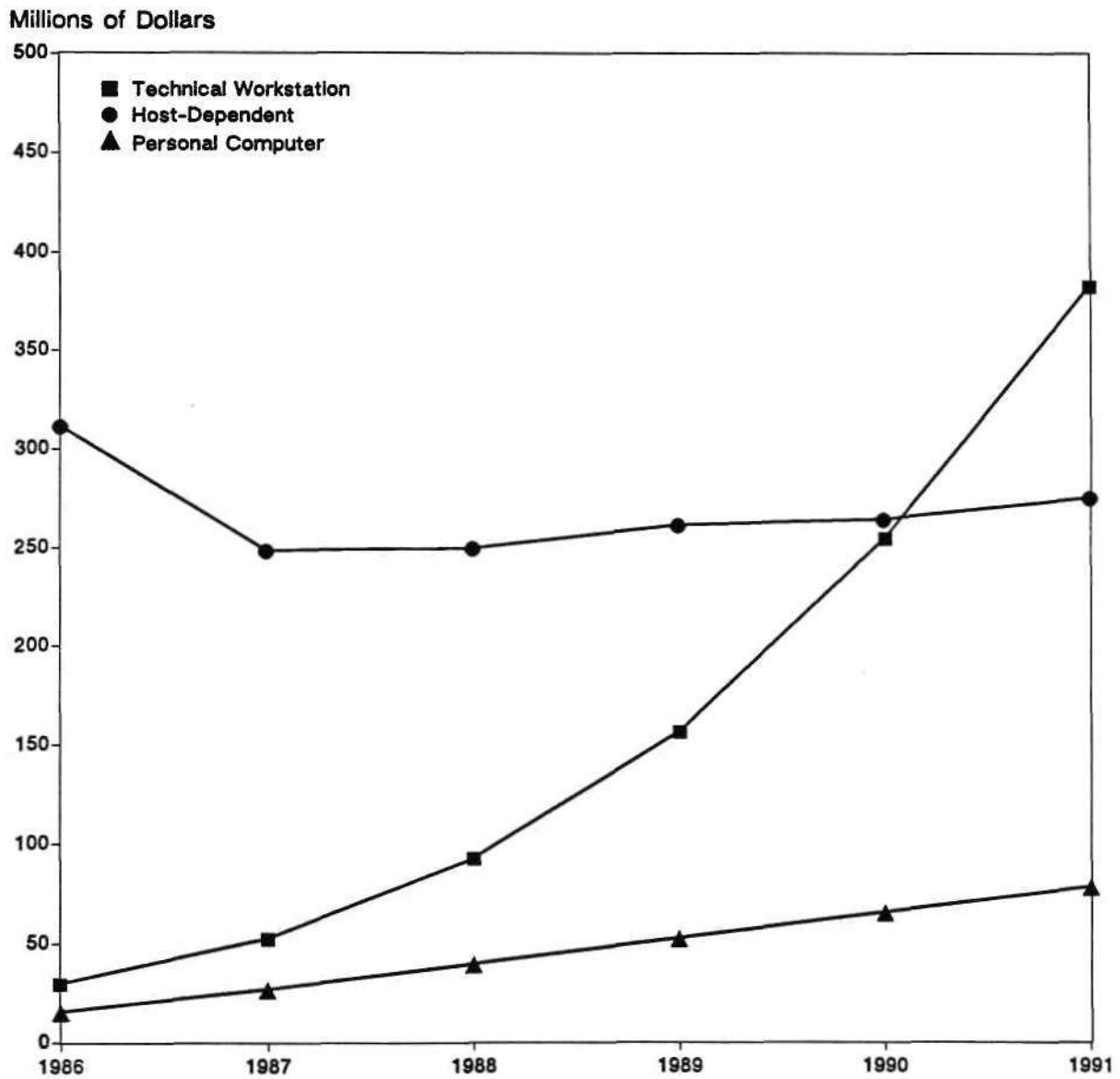
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These bullets present Dataquest's forecast and analysis of the mapping market segmented by platform. This section contains Figures 2.4-5 and 2.4-6 and Tables 2.4-4 and 2.4-5.

- Approximately 3,134 workstation units shipped in 1986, and we estimate shipments are growing at a 31 percent CAGR, to 11,950 workstations in 1991.
- Technical workstation revenue in 1986 was \$30 million and is forecast to grow at an estimated 66 percent CAGR to reach \$384 million in 1991.
- Technical workstation shipments totaled 423 units in 1986. They are forecast to reach 5,050 units in 1991, growing at a CAGR of 64 percent.
- Revenue from host-dependent systems was \$312 million in 1986 and is forecast to decline to \$276 million in 1991, decreasing at a negative CAGR of 2 percent.
- Host-dependent workstation shipments totaled 1,903 units in 1986 and are forecast to increase at a 5 percent CAGR to 2,450 units in 1991.
- PC revenue in 1986 was \$16 million. It is expected to reach \$79 million in 1991, a CAGR of 38 percent.
- PC shipments totaled 807 units in 1986 and are forecast to grow at a 41 percent CAGR to reach 4,500 units in 1991.

Figure 2.4-5

Mapping Worldwide Forecast by Platform Revenue

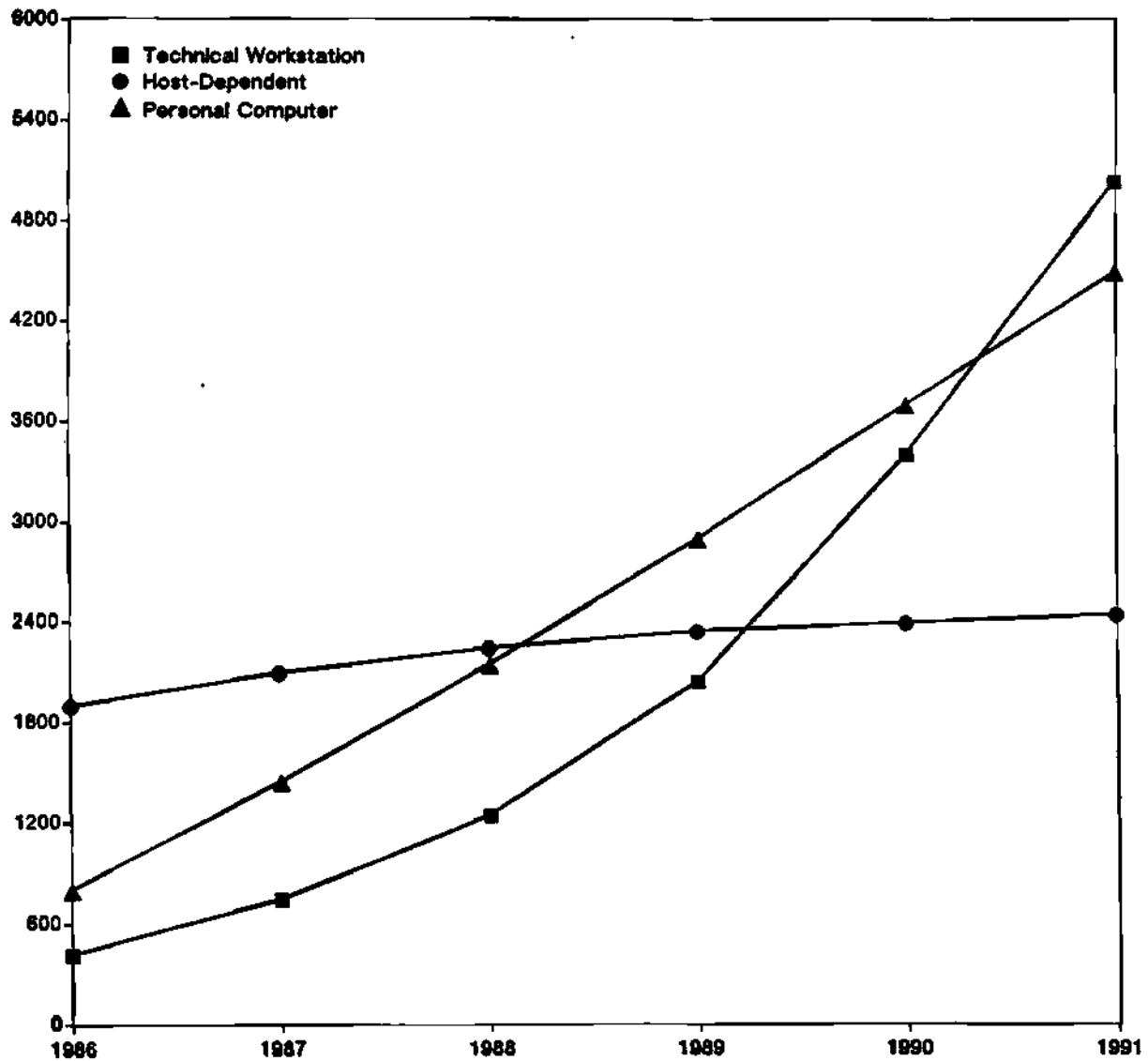


Source: Dataquest  
June 1987

Figure 2.4-6

Mapping Worldwide Forecast by Platform Shipments

Workstation Shipments



Source: Dataquest  
June 1987

Table 2.4-4

**Mapping Worldwide Forecast by Platform  
(Millions of Dollars/Actual Units)**

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
<b>Total Market</b>							
Revenue	358	329	384	472	586	740	15.6%
Systems	1,752	2,500	3,700	5,300	7,350	9,850	41.2%
Workstations	3,134	4,250	5,600	7,300	9,450	11,950	30.7%
<b>Technical Workstation</b>							
Revenue	30	53	93	157	255	384	66.1%
Systems	423	750	1,250	2,050	3,400	5,050	64.2%
Workstations	423	750	1,250	2,050	3,400	5,050	64.2%
<b>Host-Dependent</b>							
Revenue	312	249	250	262	265	276	-2.4%
Systems	521	350	350	350	300	300	-10.5%
Workstations	1,903	2,100	2,250	2,350	2,400	2,450	5.2%
<b>Personal Computer</b>							
Revenue	16	27	40	53	66	79	38.0%
Systems	807	1,450	2,150	2,900	3,700	4,500	41.0%
Workstations	807	1,450	2,150	2,900	3,700	4,500	41.0%

Source: Dataquest  
June 1987



**Table 2.4-5**

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

	1986	1987	1988	1989	1990	1991
	****	****	****	****	****	****
<b>Technical Workstation</b>						
Revenue	8%	16%	24%	33%	44%	52%
Systems	24%	30%	34%	39%	46%	51%
Workstations	14%	18%	22%	28%	36%	42%
<b>Host-Dependent</b>						
Revenue	87%	76%	65%	56%	45%	37%
Systems	30%	14%	9%	7%	4%	3%
Workstations	61%	49%	40%	32%	25%	21%
<b>Personal Computer</b>						
Revenue	4%	8%	10%	11%	11%	11%
Systems	46%	58%	58%	55%	50%	46%
Workstations	26%	34%	38%	40%	39%	38%

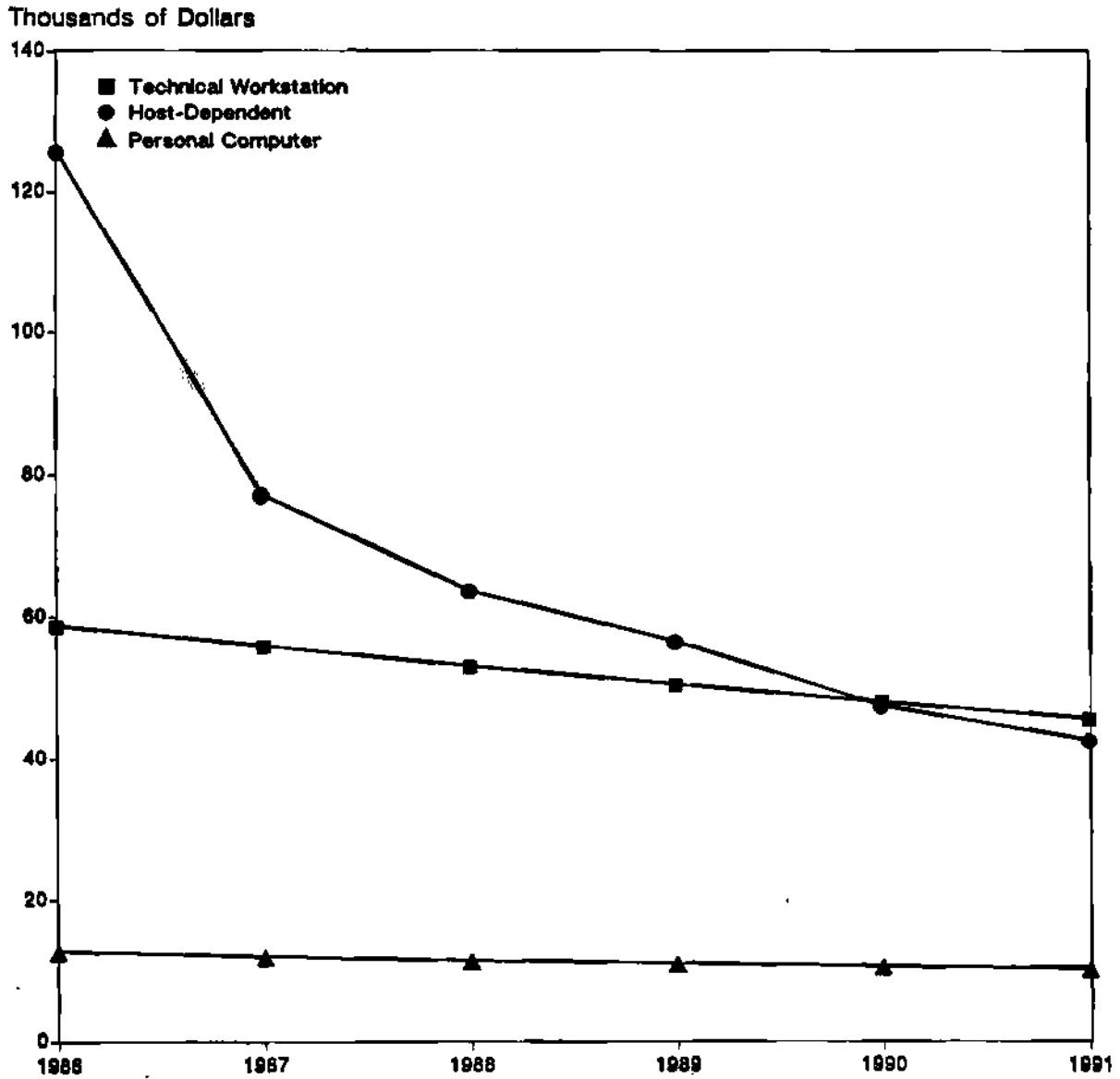
Source: Dataquest  
June 1987

These bullets present Dataquest's forecast and analysis of the average price per seat by platform for the mapping market. This section contains Figure 2.4-7 and Table 2.4-6.

- We expect the average selling price per seat for all platform types to decline from \$88,000 in 1986 to \$32,000 in 1991, decreasing at a negative CAGR of 18 percent, as a result of both the large number of vendors offering mapping capability and the industry-wide shift toward lower-cost workstations.
- We believe that the introduction of lower-cost technical workstations will result in a 5 percent decrease in the average price per technical workstation seat, from \$59,000 in 1986 to \$46,000 in 1991.
- Consistent with this shift, the average price per seat for host-dependent systems will decline at a negative CAGR of 20 percent, from \$126,000 in 1986 to \$43,000 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 both the market for and the price of host-dependent mapping workstations.
- We expect a 4 percent decline in the average price per seat for personal computers, from \$13,000 to \$10,000 in 1991. This will be the slowest decline for all platform types and will be a result of the unique data management, computational, and communications requirements this application imposes on the personal computer.

Figure 2.4-7

Mapping Worldwide Average Price per Seat by Platform



Source: Dataquest  
June 1987

Table 2.4-6

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

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
All Product Types	87.9	51.7	41.6	37.0	33.4	31.8	-18.4%
Technical Workstation	58.8	56.0	53.2	50.6	48.1	45.8	-4.9%
Host-Dependent	126.2	77.3	63.8	56.7	47.6	42.7	-19.5%
Personal Computer	12.8	12.1	11.5	11.1	10.7	10.4	-4.1%

Source: Dataquest  
June 1987

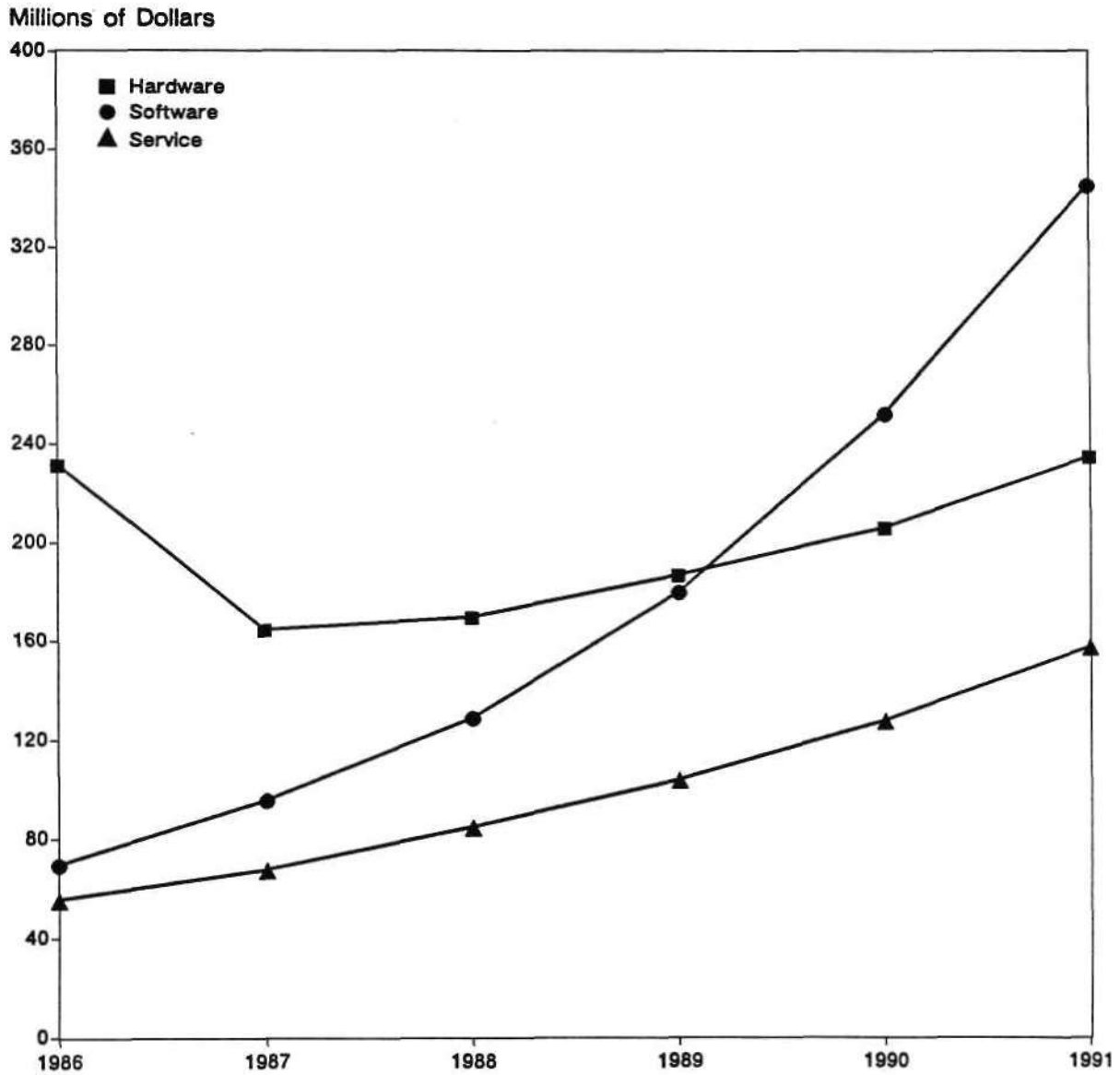
## **2.4 Mapping Forecasts**

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These bullets present Dataquest's forecast and analysis of the mapping 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 \$232 million and forecasts it to grow to \$235 million in 1991 at a 0.3 percent CAGR. In terms of total mapping revenue, we expect hardware revenue to decline from 65 percent in 1986 to 32 percent in 1991.
- Software revenue accounted for \$70 million in 1986, which represented 19 percent of total mapping revenue. By 1991, Dataquest estimates that software revenue will grow to \$346 million, at a 38 percent CAGR. Software is forecast to represent 47 percent of total mapping 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 mapping service revenue to grow at a 23 percent CAGR, from \$56 million in 1986 to \$158 million in 1991. Service revenue in 1986 represented 16 percent of total mapping revenue, which we estimate will increase to 21 percent in 1991. We believe that this growth in service revenue reflects response to strong user demand for increased application and integration support.

Figure 2.4-8  
Mapping Revenue Sources—Worldwide



Source: Dataquest  
June 1987

## 2.4 Mapping Forecasts

Table 2.4-7

**Mapping Revenue Sources by Platform—Worldwide  
(Millions of Dollars)**

	1986	1987	1988	1989	1990	1991	CAGR
	****	****	****	****	****	****	****
<b>All Platforms</b>							
Hardware	232	165	170	187	206	235	.3%
Software	70	96	129	180	252	346	37.8%
Service	56	68	85	104	128	158	23.0%
Total	358	329	384	472	586	740	15.6%
<b>Technical Workstation</b>							
Hardware	18	26	40	62	91	122	46.0%
Software	8	20	41	74	128	205	93.0%
Service	4	7	13	22	36	57	68.5%
Total	30	53	93	157	255	384	66.1%
<b>Host-Dependent</b>							
Hardware	206	125	108	98	81	74	-18.6%
Software	55	64	72	85	98	109	14.8%
Service	51	60	70	79	87	94	12.8%
Total	312	249	250	262	265	276	-2.4%
<b>Personal Computer</b>							
Hardware	8	15	21	27	34	40	38.5%
Software	7	11	16	22	26	32	34.4%
Service	1	1	2	4	5	7	57.0%
Total	16	27	40	53	66	79	38.0%

Source: Dataquest  
June 1987

**Table 2.4-8**  
**Mapping Revenue Sources by Platform—Worldwide**  
**(Percentage of Total)**

	1986	1987	1988	1989	1990	1991
	----	----	----	----	----	----
<b>All Platforms</b>						
Hardware	65%	50%	44%	40%	35%	32%
Software	19%	29%	34%	38%	43%	47%
Service	16%	21%	22%	22%	22%	21%
Total	100%	100%	100%	100%	100%	100%
<b>Technical Workstation</b>						
Hardware	61%	48%	43%	39%	36%	32%
Software	25%	39%	44%	47%	50%	53%
Service	14%	13%	13%	14%	14%	15%
Total	100%	100%	100%	100%	100%	100%
<b>Host-Dependent</b>						
Hardware	66%	50%	43%	37%	31%	27%
Software	17%	26%	29%	32%	37%	39%
Service	16%	24%	28%	30%	33%	34%
Total	100%	100%	100%	100%	100%	100%
<b>Personal Computer</b>						
Hardware	49%	55%	53%	52%	51%	50%
Software	46%	41%	41%	41%	40%	40%
Service	5%	5%	6%	7%	8%	9%
Total	100%	100%	100%	100%	100%	100%

Source: Dataquest  
June 1987



## 2.5 Mapping Market Shares

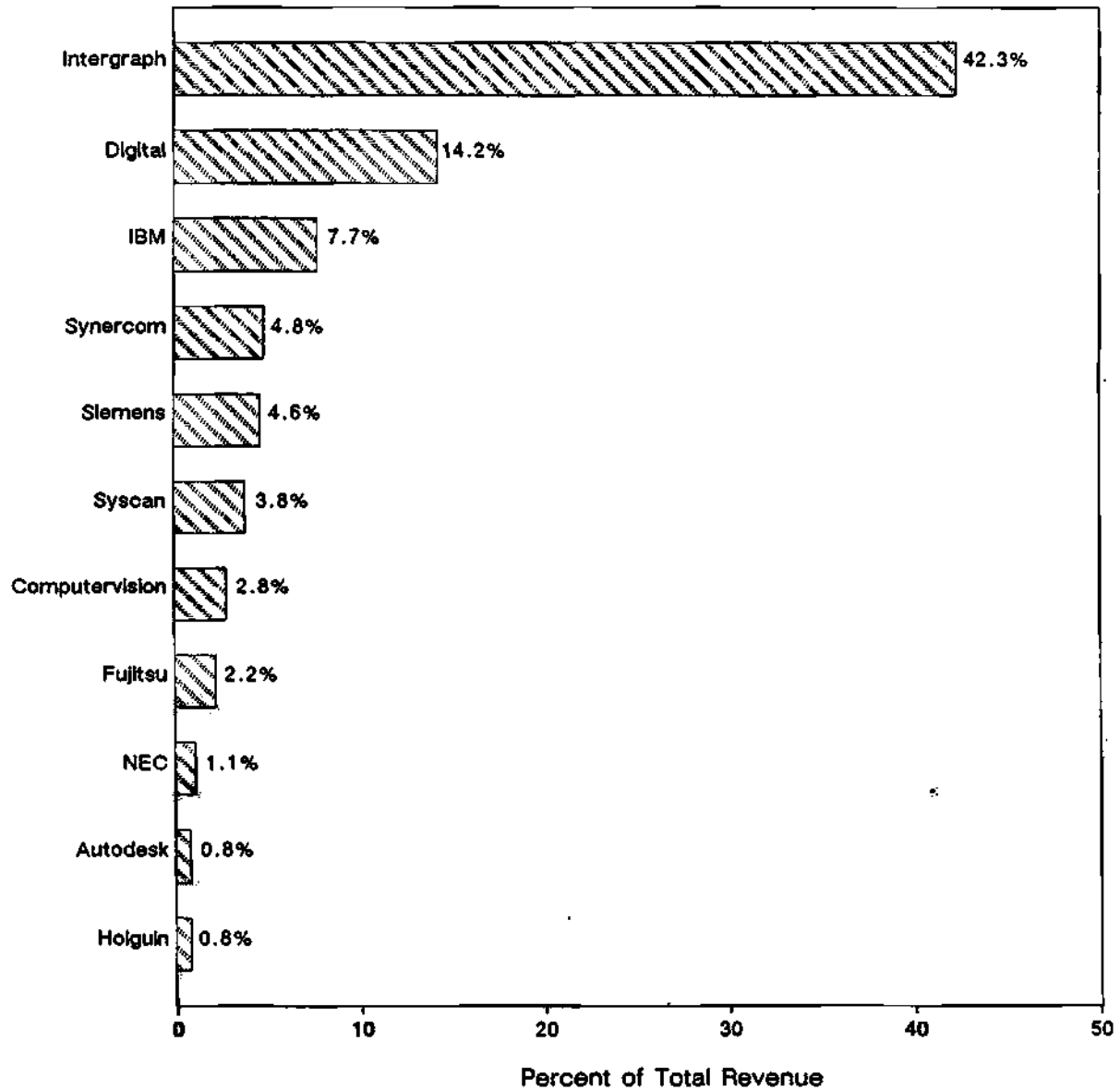
These bullets present Dataquest's analysis of the mapping market share measured in total revenue, hardware and software revenue, and workstation shipments. It contains Figures 2.5-1 through 2.5-4 and Table 2.5-1.

- Intergraph continued to lead the mapping market in both 1986 total revenue (42 percent) and software revenue (35 percent). Intergraph also ranks first in share of hardware revenue (43 percent), and first in number of workstations shipped. Dataquest attributes Intergraph's continuing success to the company's early application and marketing focus, and initial choice of industry-standard hardware (i.e., Digital Equipment).
- Digital ranked second overall and in hardware revenue at 20 percent. Although Digital did not sell any mapping software in 1986, its products are pervasive throughout the mapping market. (Digital announced a data base management software product for mapping toward the end of 1986.) Most notable of these are the VAX and MicroVAX series processors, which are distributed by a number of mapping vendors. Among them are ESRI, GeoVision, Intergraph, Synercom, and Sysscan.
- IBM placed second in workstation units shipped (21 percent) owing to the popularity of its personal computer. The company ranked third in hardware revenue (8 percent) and third in the overall market, accounting for 8 percent of all revenue. IBM also ranked third in software revenue with 5 percent of that market.
- Synercom, second in 1986 mapping software revenue (18 percent), ranked fourth in overall revenue with a 5 percent market share in 1986. Synercom's revenue was derived only from software and service in 1986.
- Siemens ranked third in 1986 mapping hardware revenue, and fifth in overall share of market.
- Of the top 10 revenue performers, 4 computer manufacturers collectively captured 25 percent of the total 1986 mapping revenue, led by second-place Digital Equipment Corporation with 14 percent. The other companies, with their market share and rank, are as follows: IBM (8 percent), third; Fujitsu (2 percent), eighth; and NEC (1 percent), ninth.
- Given the trend toward direct purchase from standard hardware vendors and away from turnkey vendors, Dataquest expects the 1987 mapping market to be increasingly dominated by system manufacturers such as Digital, IBM, and Fujitsu. We see no end to the fragmented nature of this market in 1987. Rather, we anticipate an increase in the number of mapping vendors, particularly low-end software vendors offering viable, low-cost solutions.

## 2.5 Mapping Market Shares

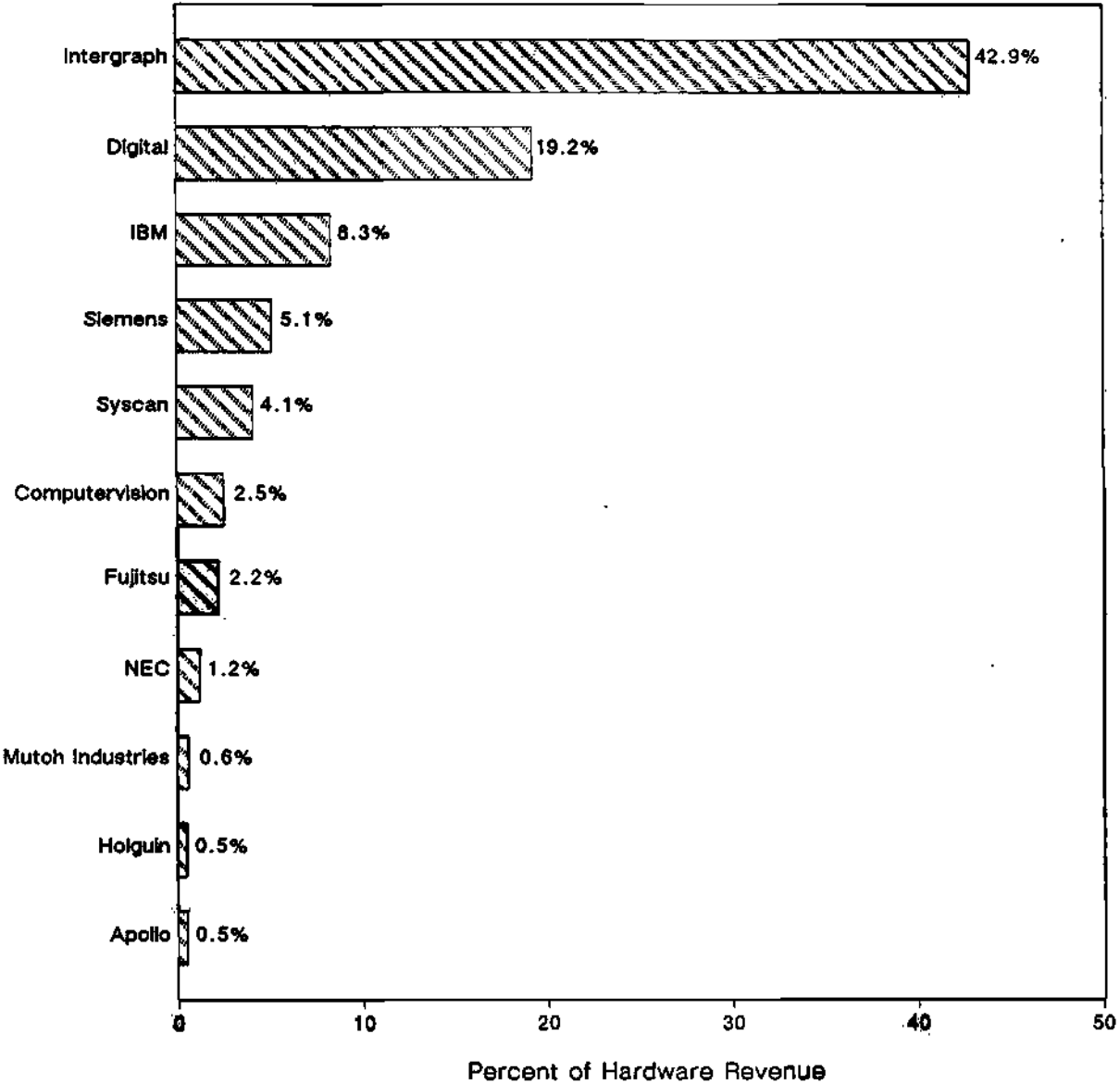
Figure 2.5-1

### Mapping 1986 Worldwide Market Share Total Revenue



Source: Dataquest  
June 1987

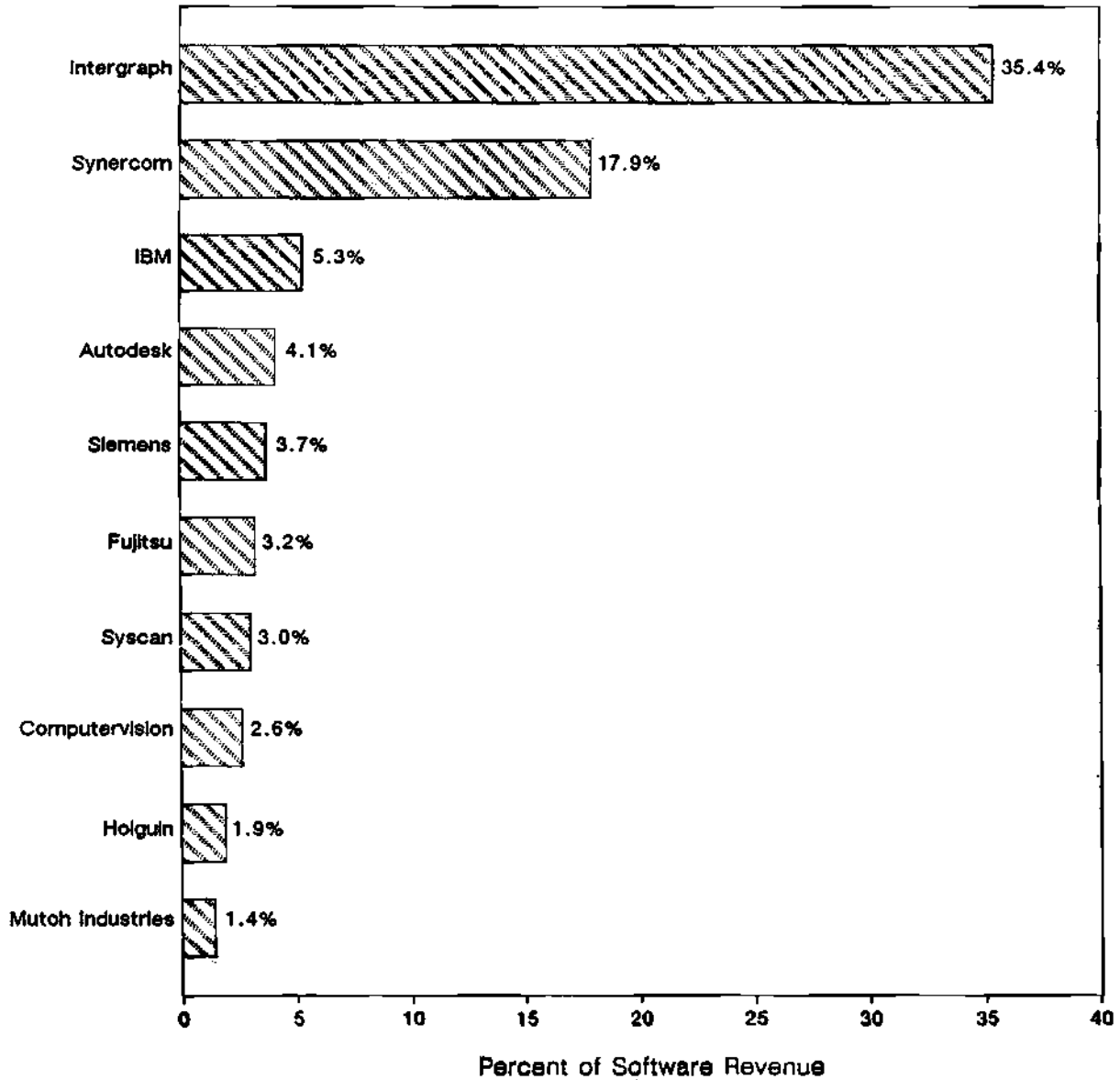
Figure 2.5-2  
Mapping 1986 Worldwide Market Share  
Hardware Revenue



Source: Dataquest  
June 1987

Figure 2.5-3

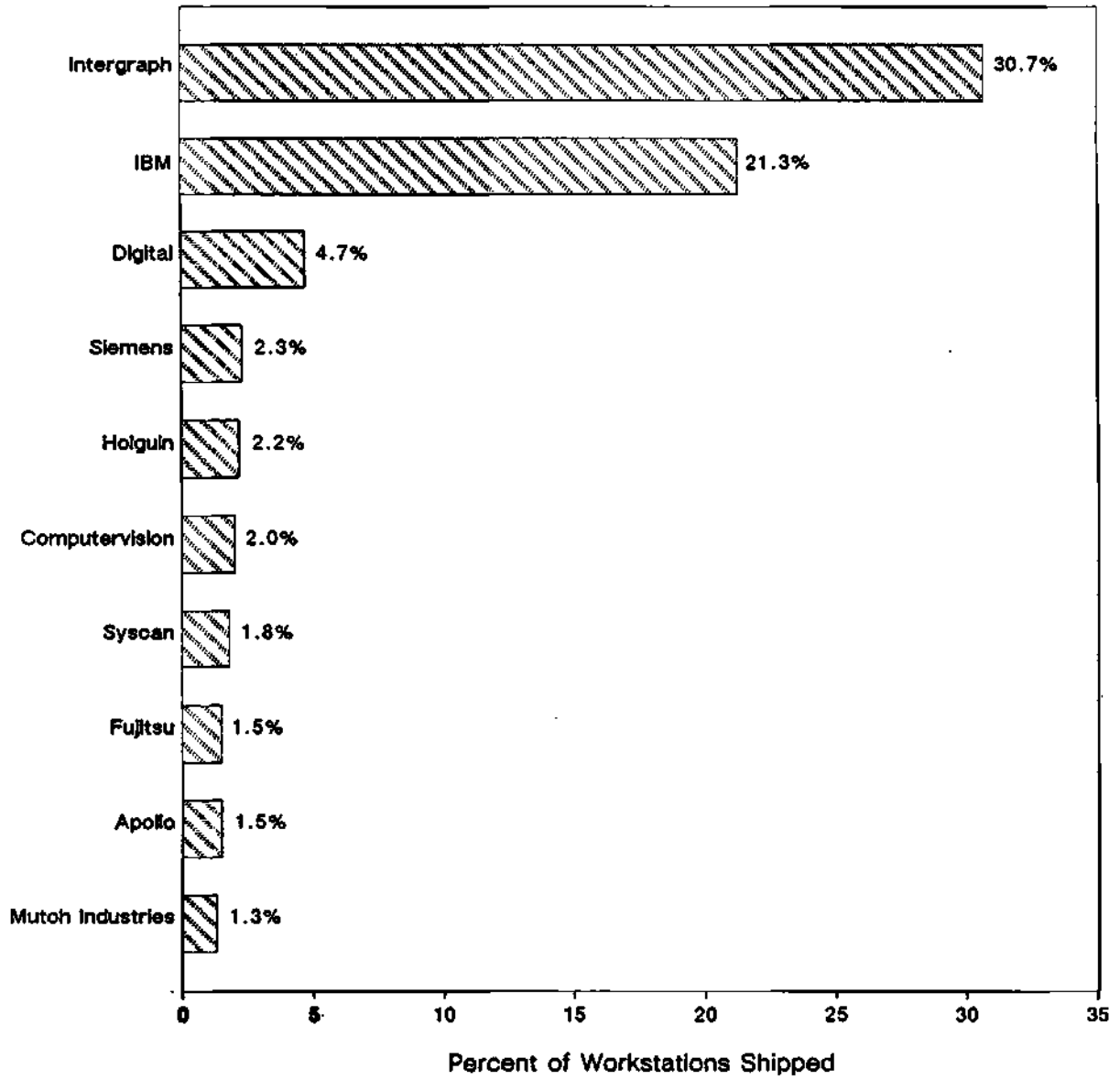
Mapping 1986 Worldwide Market Share  
Software Revenue



Source: Dataquest  
June 1987

Figure 2.5-4

Mapping 1986 Worldwide Market Share  
Workstation Shipments



Source: Dataquest  
June 1987

Table 2.5-1

Mapping 1986 Worldwide Market Share  
(Millions of Dollars/Actual Units)

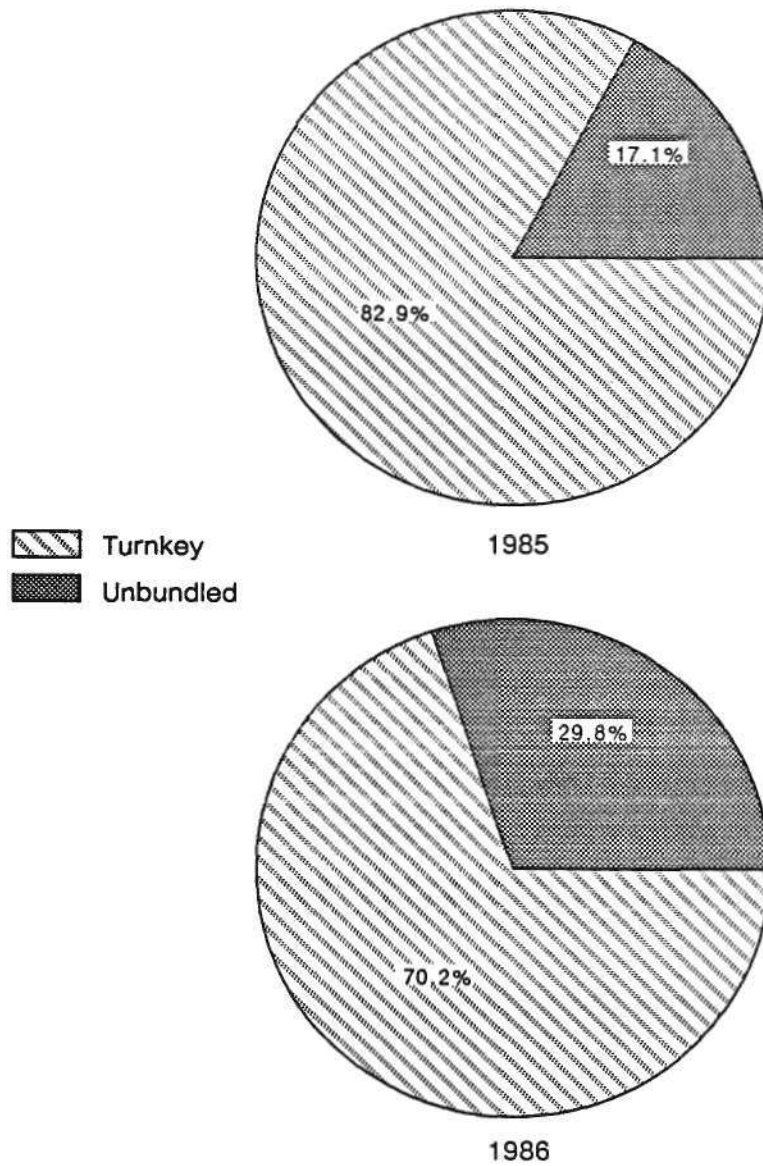
Company					----- Market Share -----			
	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Total Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Intergraph	151	100	25	961	42.3%	42.9%	35.4%	30.7%
Digital	51	45	0	149	14.2%	19.2%	.0%	4.7%
IBM	27	19	4	667	7.7%	8.3%	5.3%	21.3%
Synercom	17	0	12	0	4.8%	.0%	17.9%	.0%
Siemens	17	12	3	73	4.6%	5.1%	3.7%	2.3%
Syscan	14	10	2	57	3.8%	4.1%	3.0%	1.8%
Computervision	10	6	2	64	2.8%	2.5%	2.6%	2.0%
Fujitsu	8	5	2	48	2.2%	2.2%	3.2%	1.5%
NEC	4	3	1	20	1.1%	1.2%	1.0%	.6%
Autodesk	3	0	3	0	.8%	.0%	4.1%	.0%
Holguin	3	1	1	69	.8%	.5%	1.9%	2.2%
Mutoh Industries	2	1	1	41	.7%	.6%	1.4%	1.3%
Apollo	1	1	0	48	.3%	.5%	.0%	1.5%
Pafec	1	0	1	0	.2%	.0%	1.0%	.0%
Other Companies	49	30	14	939	13.8%	12.9%	19.5%	30.0%
All Far East-Based Companies	17	12	4	116	4.8%	5.1%	6.0%	3.7%
All European-Based Companies	31	21	5	130	8.6%	9.2%	7.7%	4.1%
All Hardware Companies	70	64	0	1,207	19.5%	27.4%	.0%	38.5%
All Turnkey & SW Companies	288	169	70	1,927	80.5%	72.6%	100.0%	61.5%
All Companies	358	232	70	3,134	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987

These bullets present the mapping market share by turnkey versus unbundled product deliveries. It contains Figure 2.5-5 and Table 2.5-2.

- Sales of unbundled mapping systems are growing rapidly, increasing 163 percent between 1985 and 1986, while bundled sales increased 28 percent. In absolute dollars, unbundled systems accounted for \$90 million, or 30 percent of the 1986 mapping market, versus \$212 million, or 70 percent, for bundled systems.
- Approximately 62 percent of mapping software revenue is derived from bundled sales, with the remaining 38 percent coming from unbundled sales.
- Approximately 72 percent of all 1986 mapping hardware revenue is derived from bundled sales. The remaining 28 percent is from unbundled sales. Bundled mapping hardware revenue increased by 25 percent between 1985 and 1986, whereas unbundled hardware revenue increased by 274 percent.
- Bundled workstation shipments continued to outnumber unbundled workstation shipments. Dataquest estimates that approximately 1,927 bundled workstations shipped in 1986, as opposed to 1,207 unbundled workstations. However, while unbundled shipments increased by 275 percent in 1986, bundled shipments increased by only 3 percent.

**Figure 2.5-5**  
**Mapping—Turnkey versus Unbundled**  
**(Percentage of Revenue)**



Source: Dataquest  
June 1987



Table 2.5-2

**Mapping—Turnkey versus Unbundled  
(Millions of Dollars/Actual Units)**

	1985	1986	CAGR	Market Share	
	====	====		====	====
<b>Total Hardware and Software Revenue</b>					
Turnkey	166	212	27.7%	82.9%	70.2%
Unbundled	34	90	163.9%	17.1%	29.8%
Total	200	302	50.9%	100.0%	100.0%
<b>Hardware Revenue</b>					
Turnkey	135	169	24.7%	88.8%	72.6%
Unbundled	17	64	274.0%	11.2%	27.4%
Total	152	232	52.6%	100.0%	100.0%
<b>Software Revenue</b>					
Turnkey	31	43	40.8%	64.3%	62.2%
Unbundled	17	26	54.1%	35.7%	37.8%
Total	48	70	45.6%	100.0%	100.0%
<b>Workstation Shipments</b>					
Turnkey	1,863	1,927	3.4%	85.3%	61.5%
Unbundled	322	1,207	275.3%	14.7%	38.5%
Total	2,184	3,134	43.5%	100.0%	100.0%

Source: Dataquest  
June 1987

GIS--GEOGRAPHIC INFORMATION SYSTEMS

THIS IS A TEMPORARY TAB WHICH WILL  
BE REPLACED WITH A PERMANENT TAB SHORTLY

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# **GIS—Geographic Information Systems**

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## **INTRODUCTION**

This chapter covers the Geographic Information System (GIS) market opportunity. It begins with a definition of GIS and follows with an in-depth discussion of competitive and market-related issues. The GIS strategies and products of four major vendors, ESRI, IBM, Intergraph, and Synercom, are examined in detail and are followed by an overview discussion of some of the smaller and/or newer vendors. The chapter concludes with Dataquest's GIS market sizing and forecast.

## **DEFINITION OF GIS**

A GIS is a computer system used to capture, edit, display, and most importantly, analyze geographic information. GISs were initially developed as a method to overlay and combine diverse kinds of data into a single map summarizing geographic, cultural, and scientific attributes. Since then, GISs have evolved and been optimized for a variety of uses including:

- Land-use analysis and planning
- Natural resource management
- Land-form interpretation
- Census maps and analysis
- Route or corridor selection
- Natural hazard assessment
- Scientific studies
- Military trafficability assessment

The two types of mapping that are important from the GIS standpoint are cartographic and thematic mapping.

### **Cartographic Mapping**

Cartography is the technology of drawing lines and cartographic symbols to depict selected geographic features (such as natural boundaries) of the spherical planet Earth onto a flat surface. These simple mathematical models are called projections and are the simplest type of maps. Cartographers also develop techniques to abstract the multidimensional attributes commonly overlaid onto planimetric base maps. A planimetric map is any map that correctly shows the horizontal or plane position of features. Bathymetric and topographic contours from a data base of surveying data or aerial photography, as well as political boundaries, are commonly included as a part of simple base maps to make topographic maps. Virtually all cartographic work today is based on photogrammetry, which is the technology of obtaining quantitative information from photographs.

Computer-aided cartography is most commonly done with vector-based CAD-type systems, and the output is provided by pen plotters. The kind of simple maps that are best represented by CAD systems are planimetric maps with linear features, such as contour lines (or other isolines), boundary lines, transportation networks, supply lines, and hydrographic networks.

**Thematic Mapping**

Thematic mapping is the task of placing summary attribute data such as categories or classes onto a base map using shaded isolines. This procedure assigns a hue or texture to a closed polygon that represents the region of study, such as a county or state. Thematic maps depict themes or classes, such as soil or tree types, range of hill-slope angle, or population density. These maps can be used to provide information to a wide spectrum of industries. Mapping is usually done by the researchers or agencies that gather the data or integrate this data into their research problem.

Computer-aided thematic mapping is being done more frequently with raster-based graphics or image processing systems. One of the most common initial tasks is digitizing a line-oriented planimetric base map into a raster-based system. This is usually achieved with a digitizing tablet or scanner interfaced with a GIS software package.

**CAD Mapping versus GIS**

During the 1960s and early 1970s, two basic methodologies for dealing with geographic data were developed:

- Computer-aided design (CAD) mapping systems
- Geographic information systems (GIS)

Both CAD mapping systems and GISs capture, edit, and display geographic information. However, as illustrated in Table 1, CAD mapping systems were primarily designed to produce very detailed, high-quality, cartographic maps, whereas GISs were developed to perform geographic analysis and create thematic maps.

**Table 1**  
**Functional Comparison of Geographic Systems Evolution**

Era	CAD	CAD + DBMS	GIS
Beginning	Mid 1960s	Early 1970s	Late 1970s
Primary Purpose	Cartographic map creation	Cartographic map creation	Analysis and thematic mapping
Data Structure	Graphic entities	Graphic entities plus attributes	Topological and relational

Source: Dataquest  
 August 1987

The most important difference between the two technologies is that a GIS employs a much more flexible and robust data structure based on topological relationships. This means an entity and its boundary form a logical unit and is addressable as such. A typical GIS has line strings, or chains, with each chain having information about what is on either side. This information is then cross-referenced to an attribute file. Because of this topological structure, various kinds of geographic data analysis can be accomplished. For example, consider the front yard of a house. In a CAD mapping system, the boundaries defining the driveway, sidewalk, and lawn are stored as lines. At a point within the boundaries, information about that entity such as "green" and "Bermuda grass" is stored. In a topological GIS structure, the entire area is described as "green" and "Bermuda grass," not just an identifying point. If the driveway is widened, thereby changing the lawn boundary, a topological data structure automatically adjusts to the change. In the CAD mapping system, however, each of the lines constituting the lawn boundary would have to be deleted or edited and redrawn to the correct size.

Because of the topological data structure, a GIS offers greater capabilities for the entry, management, manipulation, analysis, query, and display of large collections of spatial data. In particular, a GIS greatly facilitates "what if" types of analysis. For example, an urban planner may wish to query the GIS for the best locations to place ride-sharing transit locations based on population densities of the surrounding communities. The system could produce a thematic map displaying color-coded locations overlaid on a detailed street map. In a traditional CAD mapping system, this type of analysis is next to impossible to accomplish because it does not contain a topologically related data structure.

Although CAD mapping systems still outperform GISs when used solely for the creation of maps, Dataquest believes that many of the newer GISs have considerably narrowed the map creation gap. We also believe there is a strong trend in the marketplace to merge these two approaches into a single unified system yet retain the topological GIS data structure as the foundation technology.

## MARKET OVERVIEW

Dataquest believes that the GIS market is driven primarily by industries that have traditionally generated large volumes of maps. These industries listed in order of GIS market\*potential are as follows:

- Federal government
- State and local governments
- Oil and gas firms
- Utilities
- Design (A/E) firms

## Federal Government

The federal government, through various agencies such as the U.S. Geological Survey (USGS), the Defense Mapping Agency (DMA), the Central Intelligence Agency (CIA), and the Agency for International Development (AID), is the major producer and user of maps in this country. The cartographic division of the USGS has as its major responsibility the production of all the civilian topographic maps (planimetric base maps with elevation contours). It also produces limited quantities of specialty maps, such as shaded relief, orthophoto, and slope maps. Additionally, this division produces all of the USGS geologic maps. The DMA also produces large quantities of maps for the entire world—anywhere U.S. armed forces or those of its NATO allies might be expected to fight or anywhere smart weapons might be deployed. The DMA maintains, among other data bases, an elevation data base called a digital elevation (or terrain) model for virtually the entire world. Besides an unknown quantity of maps for its internal use, the CIA occasionally publishes maps of foreign countries that the public may purchase. Below is a list developed by the U.S. Department of the Interior of all the federal map publishing and distributing agencies.

U.S. Bureau of the Census  
Subscriber Service Section (Pubs)  
Administrative Service Division  
Washington, D.C. 20233

U.S. Bureau of Indian Affairs  
Office of Public Information  
1951 Constitution Avenue, NW  
Washington, D.C. 20245

U.S. Bureau of Land Management  
Office of Public Affairs  
Washington, D.C. 20240

U.S. Army Engineer District  
Corps of Engineers, Chicago  
219 South Dearborn Street  
Chicago, IL 60604

U.S. Army Engineer District  
Corps of Engineers, Louisville  
P.O. Box 59  
Louisville, KY 40201

U.S. Army Engineer District  
Corps of Engineers, Nashville  
P.O. Box 1070  
Nashville, TN 37202

U.S. Army Engineer District  
Corps of Engineers, Omaha  
6014 U.S. Post Office  
and Courthouse Bldg.  
Omaha, NE 68102

U.S. Geological Survey  
Branch of Distribution  
Box 25286, Federal Center  
Denver, CO 80225

International Boundary Commission  
United States and Canada  
425 Eye Street, NW, Rm. 150  
Washington, D.C. 20536

Interstate Commerce Commission  
Office of Public Information  
Constitution Avenue & 12th St. NW  
Washington, D.C. 20423

Library of Congress  
Geography and Map Division  
845 South Pickett Street  
Alexandria, VA 22304

U.S. National Archives & Records Serv.  
Cartographic Archives Division (NNS)  
Pennsylvania Avenue at 8th St. NW  
Washington, D.C. 20408

Federal Railroad Administration  
Office of Public Affairs, RPD-1  
400 Seventh Street NW  
Washington, D.C. 20590

U.S. Army Engineer District  
Corps of Engineers, Vicksburg  
P.O. Box 60  
Vicksburg, MS 39180

Defense Mapping Agency  
Topographic Center  
Attn: Code 55500  
Washington, D.C. 20315

Federal Communications Commission  
Office of Public Information  
1919 M Street, NW  
Washington, D.C. 20554

Federal Power Commission  
Office of Public Information  
825 North Capitol Street  
Washington, D.C. 20426

U.S. Forest Service  
Information Office, Rm. 3238  
P.O. Box 2417  
Washington, D.C. 20013

U.S. Geological Survey  
Branch of Distribution  
1200 South Eads Street  
Arlington, VA 22202

U.S. National Climatic Center  
Federal Bldg.  
Asheville, NC 28801

U.S. National Ocean Survey  
Distribution Division (C-44)  
Riverdale, MD 20840

U.S. National Park Service  
Office of Public Inquiries  
Room 1013  
Washington, D.C. 20240

U.S. National Weather Service  
Gramax Building  
8060 13th Street  
Silver Spring, MD 20910

Superintendent of Documents  
U.S. Gov't Printing Office  
North Capitol & H St. NW  
Washington, D.C. 20402

Tennessee Valley Authority  
Mapping Services Branch  
111 Haney Building  
Chattanooga, TN 37401

One of the most visible proponents of data management and GISs is the U.S. Census Bureau, which decided it needed to strive for greater efficiency and value in its role as an information provider. Prior to the 1980 census, information was put into digital form, but little or no association existed between information types. The bureau believed the information gathered could be more useful to decision makers if greater integration and association between data types was established. Immediately following the 1980 census, plans were implemented for the development of an integrated graphics and data base management system, code-named TIGER (topologically integrated geographic encoding and referencing). The target for completion of TIGER is 1989, just in time for the 1990 census, thus representing a 10-year development effort involving many persons and an untold investment in computing equipment.

## Other Users

Other major GIS users include state and local government planning groups whose uses include street maps, population density maps, road and canal maps, elevation maps, and maps that portray information on water, sanitary, and storm sewer systems. It is essential for some industries, such as utilities, to maintain accurate records for federal government regulation as well as to have information, such as locations of power transmission lines, instantly available. Natural resource agencies, regulatory agencies, and landscape architects use maps and geographic information systems for environmental or regional planning and agriculture, wildlife, forestry, and land management. Private industry uses GISs for site and corridor selection and many other applications. The petroleum and gas industry is the single largest civilian user and producer of proprietary maps.

Dataquest believes that GISs are gaining widespread use among the world's cartographers, surveyors, civil engineers, city planners, photogrammetrists, geophysicists, geographers, utilities engineers, and a wide range of other types of users. Computer-based systems also allow GIS functions to be rapidly and accurately carried out by personnel not necessarily skilled in cartography or mapping, which has greatly accelerated the use of GIS technology.

## COMPETITIVE ANALYSIS

Table 2 is a listing of GIS vendors and products sold in North America. As evidenced by this list, the GIS market from a vendor perspective is in its very early stages. Of the 16 vendors listed, 9 have revenue of \$1 million or less. Many of these smaller vendors, however, have only recently introduced GIS products.

The most popular hardware platforms for GIS applications are Digital Equipment's VAX and MicroVAX computers, followed by IBM's mainframe and personal computers. Dataquest believes that UNIX-based workstations such as those from Apollo and Sun will become popular GIS platforms. In all cases, the ability to connect and share data with IBM mainframes is a critical requirement due to the large installed base of IBM machines in geographic processing applications.

To date, four major GIS vendors have emerged in the marketplace:

- Environmental Systems Research Institute (Redlands, California)
- IBM Corp. (Armonk, New York)
- Intergraph Corp. (Huntsville, Alabama)
- Synercom Technology, Inc. (Sugarland, Texas)



Table 2

**Geographic Information Systems  
(Millions of Dollars)**

Vendor/Location	Estimated 1986 GIS Revenue	GIS Product Name	Hardware Platform
A.C.D.S. Quebec, Canada	\$ 2.0	MIME	Variety of UNIX systems
Criterion Systems San Diego, CA	\$ 0.3	Landtrak	PC AT/compatibles (MS-DOS)
Computervision Bedford, MA	\$ 1.0	AIMS	Sun Microsystem (UNIX)
Decision Images Princeton, NJ	0	Resource	PC AT/compatibles (MS-DOS)
Delta Systems Fort Collins, CO	\$ 0.2	DeltaMap	HP 9000 300/500 (UNIX)
ESRI Redlands, CA	\$22.0	ARC/INFO	Digital VAX (VMS) Prime Computer (PRIMOS) PC AT (MS-DOS) Sun Microsystems (UNIX)
GeoBased Systems Raleigh, NC	\$ 0.5	Strings	Digital VAX/MicroVAX (VMS) PC AT/compatibles (MS-DOS)
Geovision Ottawa, Canada	\$ 1.5	GIS	Digital VAX/MicroVAX (VMS)
IBM Armonk, NY	\$10.0	GFIS	IBM mainframes (MVS,VM)
Intergraph Corp. Huntsville, AL	\$15.0	GPPU	Digital VAX/MicroVAX (VMS)
Kern Instruments Brewster, NY	0	InfoCAM	Digital VAX/MicroVAX (VMS)
Kork Systems Bangor, Maine	0	Kork GIS	MicroVAX/VAXstation (VMS)
MPSI, Inc. Tulsa, OK	\$ 1.0	GIS	IBM mainframes (MVS,VM) PC AT (DOS)
Synercom Technology Sugarland, TX	\$ 7.0	EMIS	Digital VAX/MicroVAX (VMS)
Terra Mar Mountain View, CA	0	TerraPak	PC AT/compatibles (MS-DOS)
Wild Heerbrug Farmingdale, NY	0	System 9	Sun Microsystems (UNIX)

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Environmental Systems Research Institute (ESRI) was the first company to offer a GIS product commercially. ESRI announced its system in 1982, which it named ARC/INFO to reflect the focus on information management. The earliest users of ARC/INFO were forestry and other natural resource agencies, and several state and local government groups. Dataquest believes the commercial GIS market has been dominated by ESRI, which we attribute to the company's exclusive focus in this area and long-standing presence as a consultant on environmental concerns.

The second and fourth largest GIS vendors are Intergraph and Synercom which introduced GIS-related functionality in 1985 and 1984, respectively. Both Intergraph's and Synercom's products were developed to interface with the core interactive graphics capabilities of their mapping systems. This approach changed the GIS picture considerably, from that of a batch-oriented, number-crunching process characteristic of the earliest systems, to a more interactive visual process.

Intergraph's proprietary product offering, called GPPU (Graphics Polygon Processing Utility), represented only a start for Intergraph. It later announced plans to develop a major GIS offering, which will be unveiled later this month. Synercom's product resulted from an agreement to be the exclusive distributor of a Harvard-developed system known as Odyssey, which Synercom markets under the name of Environmental Management Information System (EMIS).

The third largest GIS vendor, IBM, has only recently made inroads into the GIS market. IBM's success is due in large part to the popularity of IBM mainframes in geographic processing.

## ESRI

ESRI is, in our view, the leading GIS company in terms of both revenue (\$22 million in 1986) and reputation. The company is widely recognized as being one of the early GIS pioneers and is the only company that is consistently singled out by its competitors as being the toughest vendor to beat in sales and benchmark situations.

Dataquest believes four factors are behind ESRI's success in the GIS market:

- ESRI was one of the first vendors to offer a commercial GIS product.
- The company has focused exclusively on the GIS segment.
- ESRI has a strong organization that is knowledgeable in GIS applications.
- ESRI has the most mature and stable GIS software offering.

ESRI's product, ARC/INFO, was introduced in 1982. It is one of the few GIS products that runs on multiple computer platforms (Data General, Digital, IBM, Prime, and Sun). Of particular significance is ESRI's Prime Computer offering. Prime has been making a large strategic thrust into mapping and geoprocessing applications over the past several years. Recently, Prime secured one of the largest geoprocessing orders ever

recorded with the U.S. Department of the Interior. The contract calls for 447 superminicomputers valued at more than \$64 million. We believe ESRI will be a major benefactor of this business, since it is Prime's leading software vendor of mapping and GIS systems.

The ARC/INFO software system is a vector-based GIS and is based on a dual approach. The ARC system, developed by ESRI, is used for storing cartographic data, while the INFO system is a fully relational data base that is provided by Henco, Inc., and used for storing attributes. Major strengths of the ARC/INFO system are its flexibility and its ability to be customized for a given user's requirements. This capability, along with ARC/INFO's data base structure, is often cited by users as one of the key differentiating features of the ESRI system versus those available from other GIS vendors.

With respect to ESRI's future, Dataquest feels that the company will be challenged significantly by both IBM and Intergraph as the market growth and acceptance of GIS continues to rise. We believe the company's future success will hinge on the following:

- ESRI's ability to stay focused in GIS from both an organizational and a product standpoint
- ESRI's ability to grow internationally
- ESRI's ability to coexist with other vendors (e.g., IBM and Intergraph)

## IBM

In 1981, IBM introduced its first mapping/GIS related software product called Distributed Facilities Information System (DFIS). DFIS was announced after nine years of joint development with the Public Service Company of Colorado and initially had strong ties with the utility market. In 1985, the company changed the name DFIS to Geographic Facilities Information System (GFIS).

Central to IBM's GFIS marketing strategy are three cooperative marketing partnerships (CMPs). The CMPs were set up to provide IBM GFIS users with tools and support to make GFIS a customized solution for their environment. These CMPs include:

- Integrated Information Systems (San Diego, California)—Solutions for electric utility companies and local government
- United Teleplex (Laguna Hills, California)—Solutions for transportation (rail and highway) concerns; systems integration for telecommunications firms and municipal governments
- WPS Development, Inc. (Green Bay, Wisconsin)—Solutions mostly for electric and gas utility companies and some telephone company applications; solutions also for oil exploration

GFIS is composed of three modules that when combined, form a graphics/ data base management system. These modules are as follows:

- GPG—Graphics Program Generator, for creation and display of information about geographically dispersed facilities. It is the interactive graphics system.
- GASP—is a prerequisite to GPG for supporting the workstation functions.
- GDBS—provides the interface to the standard IBM data base management system called Information Management System (IMS). This enables the capture, storage, and maintenance of geographically related data.

For the IBM GFIS portion of the system, a purchaser is looking at an initial software investment of approximately \$80,000. That provides just a shell. A purchaser looking to turn the system into a fully functional GIS would then have to spend an additional \$50,000 to \$100,000 for GIS application software. GIS-related application software (called Municipal Information System) can be purchased from Integrated Information Systems (IIS), one of IBM's GFIS CMPs.

Dataquest believes that current users of the GFIS shell and IIS application package perceive IBM's offering to be very competitive, although they are neither marketed specifically by IBM as a GIS, nor offer much of what GIS purists consider to be true GIS technology. In 1986, we believe IBM sold several GFIS systems with the IIS software. We estimate IBM's 1986 GIS-related revenue, including hardware and software, was \$10 million. We also believe IBM's installed base of GFIS users currently numbers 30 to 35.

Because of IBM's strong computing hardware presence in geographic processing applications, Dataquest believes that IBM will eventually become a major player in the GIS market at least from a hardware perspective. Much of IBM's future success, we believe, hinges on the how well its CMP strategy is received. Many purchasers are often uncomfortable about having to rely on multiple vendors to supply a computerized solution to any problem, let alone one as complex as GIS.

### **Intergraph**

Dataquest believes that next to ESRI, Intergraph is the most significant player in the GIS arena. Our reasoning behind this considers two factors:

- Intergraph's major presence in the overall mapping market
- Intergraph's corporate commitment to provide GIS products

In 1986, Intergraph's revenue worldwide in the mapping market was an estimated \$151 million, an increase of 10 percent over 1985 revenue. This revenue figure includes hardware and software. We estimate the software-only portion of the company's mapping revenue was \$25 million, while the remaining revenue was derived from hardware (\$100 million) and services (\$26 million).

Intergraph's current worldwide installed base of workstations used for mapping and related applications is estimated at approximately 6,000 as of the end of 1986. The North American installed base is estimated at approximately 4,500 at the end of 1986.

We believe one of Intergraph's major installed markets is civil engineering and other engineering/photogrammetry-related services, including state Departments of Transportation (DOT) that use Intergraph's COGO and DTM offerings for road/highway work. Intergraph currently has mapping systems installed in 35 to 40 state DOTs.

Intergraph's primary geographic software offering is a CAD-based map drafting system called Intergraph Graphic Design System and Data Management and Retrieval System (IGDS/DMRS). Although most of Intergraph's mapping revenue has been derived from the CAD-based IGDS/DMRS map drafting system and exploration-related mapping, we believe they also shipped several new systems in 1986 that incorporated GIS functionality. Topology was introduced about a year ago into an existing IGDS/DMRS application product called Graphics Polygon Processing Utility (GPPU). The introduction of topology into GPPU, combined with another more recently announced product called Land Resources Management (LRM), make up Intergraph's first step toward a GIS product platform. Both GPPU and LRM require Intergraph's core graphics offering, IGDS/DMRS, in order to run. They are also both VMS-based products.

Dataquest believes that Intergraph GIS revenue from sales of mapping systems with the new topology-based GPPU application package accounted for 10 percent of the company's mapping revenue in 1986, or approximately \$15 million. This includes both hardware and software. To date, we estimate that Intergraph has installed 200 to 250 copies of the GPPU product.

Because of the large number of installed Intergraph mapping users, one of Intergraph's strategies is to retrofit a large portion of its installed VMS-based IGDS customers with a new, upgraded version of the GPPU product, called EDITOR/ANALYST. EDITOR/ANALYST contains much more GIS functionality than Intergraph's current GPPU offering. Dataquest believes the city of Chicago and Great Northern Paper are currently two of the beta test sites for this product. The Chicago site has been referred to by many as one of the most advanced computerized mapping/information management installations in the country.

The second major component of Intergraph's GIS strategy relates to a completely new system being developed called TIGRIS. TIGRIS uses an object-oriented data structure (which lends itself nicely to GIS topological structures) and runs under the UNIX operating system. TIGRIS is referred to by Intergraph as its workstation product family for integrated GIS applications. It will be based on a new, proprietary, UNIX-based 32-bit workstation product that employs the 5-mips Fairchild Clipper microprocessor. At present, the availability of the three new products, TIGRIS MAPPER, SURVEYOR, and EDITOR/ANALYST, has been pushed further out, and from what we are able to gather, it could be as late as early 1988. However, the pending announcement of the VAX-based EDITOR/ANALYST products we view as equally significant, particularly in light of Intergraph's large installed base.

We view Intergraph's new proprietary workstation (referred to as the Clipper workstation) on which TIGRIS is based as a major gamble for the company. Although the Clipper workstation has powerful computing and graphics capabilities, we believe buyers in the mapping market would prefer a familiar hardware architecture, not a proprietary offering. Only time will tell whether this approach is acceptable to the purchasing world, but Intergraph is betting on this as a major winner in all environments.

Dataquest believes Intergraph is taking the approach that "GIS is whatever users deem it to be." To Intergraph, GIS is simply an analysis tool that extends the capability of its IGDS/DMRS systems, the basis of Intergraph's existence in the CAD/CAM world as well as the mapping world. In this case, perceptions seem to be what matters, and for Intergraph, we believe that this approach will be successful because of its large installed base of mapping users. Intergraph is claiming the role of being the first company to successfully combine a CAD and topology data structure, and the company believes this is what users ultimately will want.

### **Synercom**

Synercom, the fourth largest vendor in the GIS market, had an estimated \$7 million in 1986 software sales of its GIS product, Environmental Management Information System (EMIS). EMIS systems accounted for slightly less than half of Synercom's total 1986 mapping revenue of \$17 million. Dataquest believes that Synercom's installed base totals over 150 systems and is heavily weighted towards the public utility segment of the market.

Synercom's EMIS product resulted from an agreement to be the exclusive distributor of the Harvard-developed system known as Odyssey. Like Intergraph's GPPU program, EMIS is sold primarily as a layered application software product that works in conjunction with Synercom's INFOMAP core-interactive graphics and data base management software. Unlike Intergraph's GPPU, however, EMIS can run in standalone mode (without INFOMAP).

Synercom's view of GIS, in our opinion, is very similar to that of Intergraph's in that they both believe GIS is a layer that runs in conjunction with numerous other CAD mapping applications. Synercom has positioned its offering as more of a mapping/information management system (MIMS) than a GIS.

MIMS has become the GIS buzzword for the utility/infrastructure markets that place a heavy emphasis on discrete and accurate location of geographically dispersed facilities and that stress interactive CAD-type graphics. Like other mapping markets, greater emphasis on the data base management side of these systems has heightened significantly over recent years. Dataquest believes Synercom has one of the better offerings for the utility/infrastructure markets, but by no means does it have exclusive ownership of this segment. We believe IBM and Intergraph will become serious contenders in this area.

Synercom Technology has recently completed a major product transition with an overhaul of its core graphics/data management package. The new product, Informap III, is now positioned to take advantage of distributed computing environments, utilizing the Digital Equipment family of workstations and minicomputers. Synercom is the first vendor to introduce this strategy, which Dataquest believes has been met with less enthusiasm than anticipated by the company. During the last two quarters, Synercom has reported heavy losses and a dramatic falloff in sales. The company attributes this to the product transition from Digital VAX to MicroVAX workstations.

### Other Vendors

Table 3 lists the other vendors competing in or readying products in the GIS market. Included in Table 3 are the significant details related to product offerings and company status relative to 1986 GIS revenue.

Most of the companies derive revenue from software sales only, with the exception of Computervision and Geovision, both of which sell Digital and Sun Microsystem hardware, respectively, along with their GIS software. In addition, most vendors derive some revenue from consulting. We believe however, that consulting revenue represents only a small percentage of GIS revenue for the firms listed in Table 3. Dataquest believes that helping end users with data base definition at the time of installation is an important consulting component for ensuring success of the system. We predict that all GIS vendors will be performing more on-site consulting to help promote future software sales. Geovision and Wild have already shown a strong desire to move in this direction.

Table 3  
GIS Vendors

	A.C.D.S. Quebec, CAN	Computervision Bedford, MA	Criterion Sys. San Diego, CA	Decision Images Princeton, NJ	Delta Systems Ft. Collins, CO
GIS Product Name(s)	MIME	Area Info. Mgmt.	Landtrak	Resource	Deltamap
How Positioned	As a GIS	As a polygonal proc./analysis pkg.	As a GIS	Municipal GIS	As a GIS
First Available	Early 1986	Late 70s	Late 70s	August 1986	Nov. 1985
Markets Sold into with GIS	Local gov't.	Multiple markets have bought	Emergency services, police, school districts, local gov't.	Universities, consulting companies	Local gov't.
Products Sold	HW & SW	HW & SW	SW only	HW & SW	SW only
Estimated 1986 GIS Revenue	\$2 million	\$1 million	\$250,000	0	\$150,000
Language	C	FORTRAN		APL, C	C, FORTRAN
HW Platforms/Operating Systems	Calcomp, Sun, IBM RT, C. River (UNIX)	Sun Micro (UNIX)	PC AT/compat. (MS-DOS)	PC AT/compat, (MS-DOS)	HP 9000 (UNIX)
Cost of SW (Minimum-Maximum)	\$20K-\$45K	\$15K-\$25K	\$12K-\$15K	\$2K-\$17K	\$34K-\$50K
How Sold Currently	Direct-Can. Calcomp-U.S.	Direct	Direct	Direct	Direct-U.S. Distr.-Int'l.
Graphics or Attributes	Both	Graphics	Both	Both	Both
Vector or Raster	Vector	Vector	Vector	Both	Both
Interfaces to Other Graphics/Image Processing Systems	IGES	Many, they claim via IGES		USGS DLG, AutoCAD	Holquin, ARC/Info, Calma, CV, Moss, USGS DLG, DEM
Name of DBMS	NetBase	None		D-BASE II	Internal to Deltamap
Data Base Structure	Rel/Network	Rel		Rel	Rel
Services Included in Base SW Purchase Price		Installation, 2 weeks training for 2 people		Free updates on low-end systems	Installation, 2- to 4-day training, 1st yr. updates
Directions SW Will Take in the Future	80386, better graphics			UNIX O/S support	More CAD-like functionality, full SQL query language

(Continued)



Table 3 (Continued)  
GIS Vendors

Main Perceived Competition	A.C.D.S. Quebec, CAN	Computervision Bedford, MA	Criterion Sys. San Diego, CA	Decision Images Princeton, NJ	Delta Systems Ft. Collins, CO
Other Comments Related to Company & Products	ESRI, Intergraph Generating lots of interest in Canada	Intergraph, ESRI The CV GIS is described by many to have good GIS functionality	Intergraph, ESRI, GeoBased Sys. Firm originated from merger of an economic analysis group and a GIS consulting firm	ERDAS, Terra Mar First product was a PC-based image analysis remote sensing package	Intergraph, ESRI, Geovision Delta is a spinoff from Autometric, the originators of MOSS
Other Comments Related to Company & Products	GeoBased Sys. Raleigh, NC Looking for big growth in revenue this year	Geovision Ottawa, Can. Believe that state gov'ts. will be a large buying group for InfoCAM	Kern Instruments Brewster, NY Will leverage its photogrammetry user base	Kork Systems Bangor, ME Heavy emphasis on private sector for sales	Wild Heerbrug Denver, CO System appears to be very similar to Synercom system in interface and organization
GIS Product Name(s)	Strings	InfoCAM	KGIS	GIS	System 9
How Positioned	As a GIS	As a GIS	As a GIS	As a GIS	As a GIS
First Available	Late 1983	Soon	2nd qtr. 1987	Sep. 1985	Soon
Markets Sold into with GIS	Photogrammy, local gov't., forestry, utilities	Local gov't.		Retail sales, consumer goods, forestry, financial	
Products Sold	HW & SW	SW only	SW only	SW only	HW & SW
Estimated 1986 GIS Revenue	\$1 million	\$1 million	0	\$500,000	0
Language	FORTRAN	C	FORTRAN	FORTRAN	
HW Platforms/Operating Systems	VAX/MicroVAX (VMS) PC AT/compat. (MS-DOS)	VAX/MicroVAX (VMS)	MicroVAX/GPX (VMS)	MicroVAX/VAXstm (VMS)	Sun (UNIX)
Cost of SW (Minimum-Maximum)	\$17.5K-\$35K	\$80K and up	\$7K-\$49K	\$12K-\$32K	\$15K-\$50K

(Continued)

Table 3 (Continued)  
GIS Vendors

	GeoBased Sys. Raleigh, NC	Geovision Ottawa, Can.	Kern Instruments Brewster, NY	Kork Systems Bangor, ME	MPSI, Inc. Tulsa, OK	Wild Heerbrug Denver, CO
How Sold Currently	Direct & distr.	Direct-Can. Distr.-Int'l.	Via engr'g. firms	Direct	Direct	Direct
Graphics or Attributes	Both	Both	Both	Both	Both	Both
Vector or Raster	Vector	Vector	Raster	Vector	Vector	Both
Interfaces to Other Graphics/Image Processing Systems	PC-based image processing sys. called EBBA	INA	Intergraph	Oracle, any SQL DBMS	None	Both
Name of DBMS	INGRES	Oracle	InfoCAM	DBMS		
Data Base Structure	Rel	Rel	Rel	Rel/Network	Rel	Rel
Services Included in Base SW Purchase Price	SW maintenance \$150 to \$300 month	90-day warranty for SW & HW, 5-day training		Installation, training,	Installation, training updates	
Directions SW Will Take in the Future	Increased functionality of PC version, image processing	Raster/image, low-cost HW support	Other VAX systems, better graphics	Seamless data base, PCs (32-bit)	Business graphics, more modeling, AI links	
Main Perceived Competition	Intergraph, ESRI	ESRI, Easinet	ESRI		ESRI, Geographic Sys.	
Other Comments Related to Company & Products	GeoBased is well regarded for the PC-based sirings product version	Looking for big growth in revenue this year	Believe that state gov'is. will be a large buying group for InfoCAM	Will leverage its photogrammetry user base	Heavy emphasis on private sector for sales	System appears to be very similar to Synercom system in interface and organization

Source: Dataquest August 1987

## MARKET SIZING AND FORECAST

Although it is relatively easy to distinguish between GIS and CAD mapping systems today, we believe the merging of these two technologies will make it almost meaningless to treat these systems separately, particularly when forecasting. We strongly believe, however, that GIS will serve as the foundation data structure technology in all future GIS/mapping systems; therefore, it is important to acknowledge the market for systems that incorporate this combined approach.

As illustrated in Table 4, Dataquest estimates that the 1986 total mapping market worldwide was \$358 million. We forecast that the market will grow at nearly a 16 percent compounded annual growth rate (CAGR) through 1991, when the market is expected to reach \$740 million. We are forecasting a drop in revenue this year due to rapid price erosion in computing hardware and the changing product mixes that more heavily favor lower-cost systems based on personal computers and workstations. Software revenue, however, is expected to continue growing at a brisk rate, reaching \$346 million by 1991, a CAGR of 37.8 percent.

Table 4

### Worldwide Mapping Market Forecast (Millions of Dollars)

	1986*	1987	1988	1989	1990	1991	CAGR
Hardware	\$232	\$165	\$170	\$187	\$206	\$235	0.3%
Software	70	96	129	180	252	346	37.8%
Service	56	68	85	104	128	158	23.0%
Total	\$358	\$329	\$384	\$471	\$586	\$739	15.6%

\*1986 figures are estimates

Source: Dataquest  
August 1987

Table 5 is Dataquest's forecast for the GIS market. Built into this forecast is the belief that GIS systems will eventually replace traditional CAD mapping systems as the technology of choice for performing geographic mapping and analysis work. We expect this transition to occur rapidly over the next five years, during which the market is predicted to grow to \$464 million in revenue.

Table 6 is Dataquest's estimate of GIS market shares during 1986. ESRI was the leading vendor, capturing 19 percent of the total market with revenue of \$22 million. It is important to note, however, that ESRI's revenue does not include the sale of hardware. The if-sold value of hardware revenue is shown in the "Others & Computer Hardware Vendors" line in Table 6.

Table 5

GIS Worldwide Market Forecast  
(Millions of Dollars)

	1986*	1987	1988	1989	1990	1991	CAGR
Hardware	\$57	\$66	\$75	\$87	\$100	\$115	15.0%
Software	38	57	86	128	192	288	50.0%
Service	20	25	31	39	49	61	25.0%
<b>Total</b>	<b>\$115</b>	<b>\$148</b>	<b>\$192</b>	<b>\$254</b>	<b>\$341</b>	<b>\$464</b>	<b>32.2%</b>

\*1986 figures are estimates

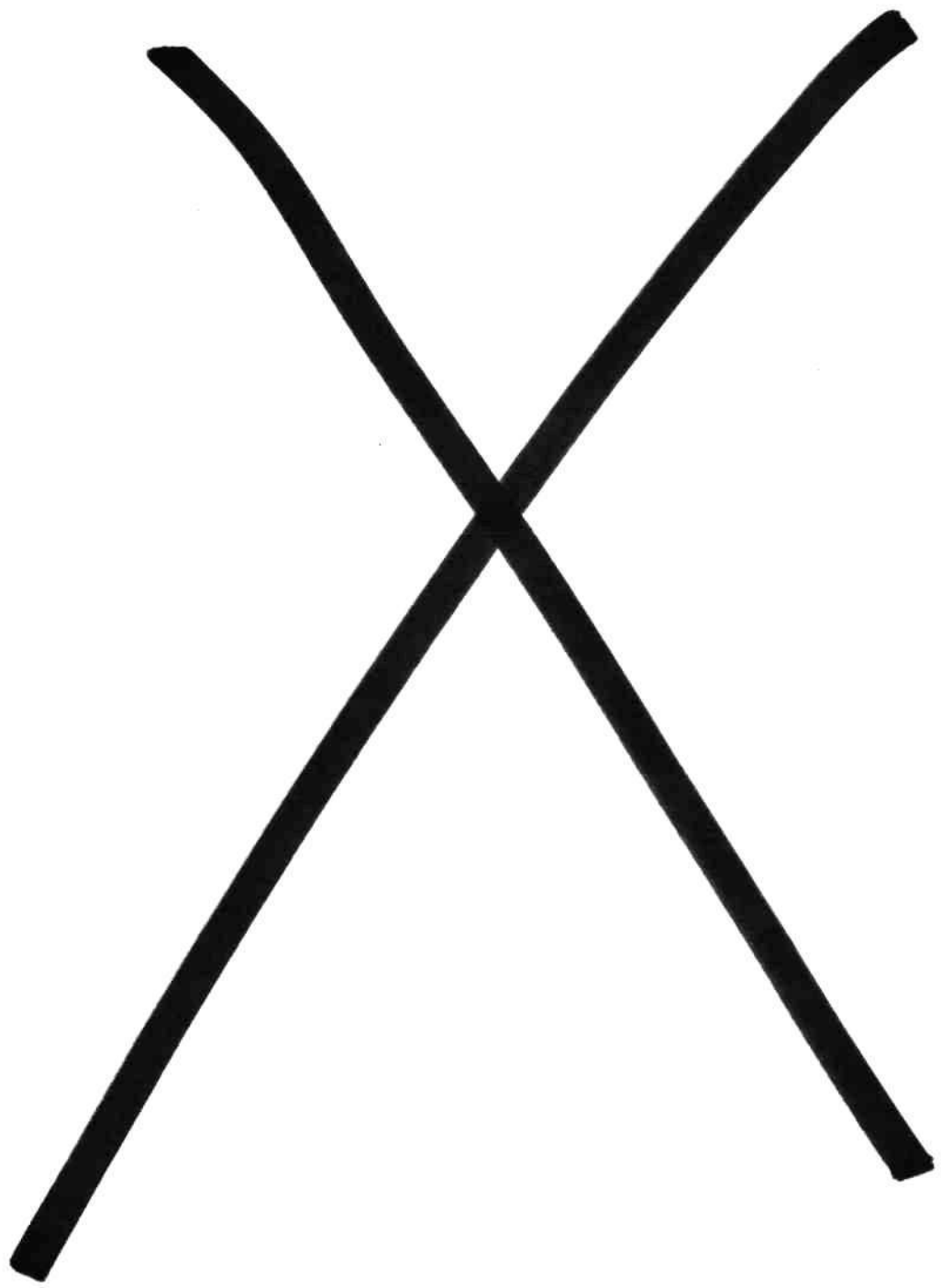
Source: Dataquest  
August 1987

Table 6

1986 Estimated GIS Market Share  
(Millions of Dollars)

	Revenue	Share
ESRI	\$ 22.0	19%
Intergraph Corp.	15.0	13
IBM	10.0	9
Synercom Technology	7.0	6
A.C.D.S.	2.0	2
Geovision	1.5	1
Computervision	1.0	1
MPSI, Inc.	1.0	1
Others & Computer Hardware Vendors	55.5	48
<b>Total</b>	<b>\$115.0</b>	<b>100%</b>

Source: Dataquest  
August 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

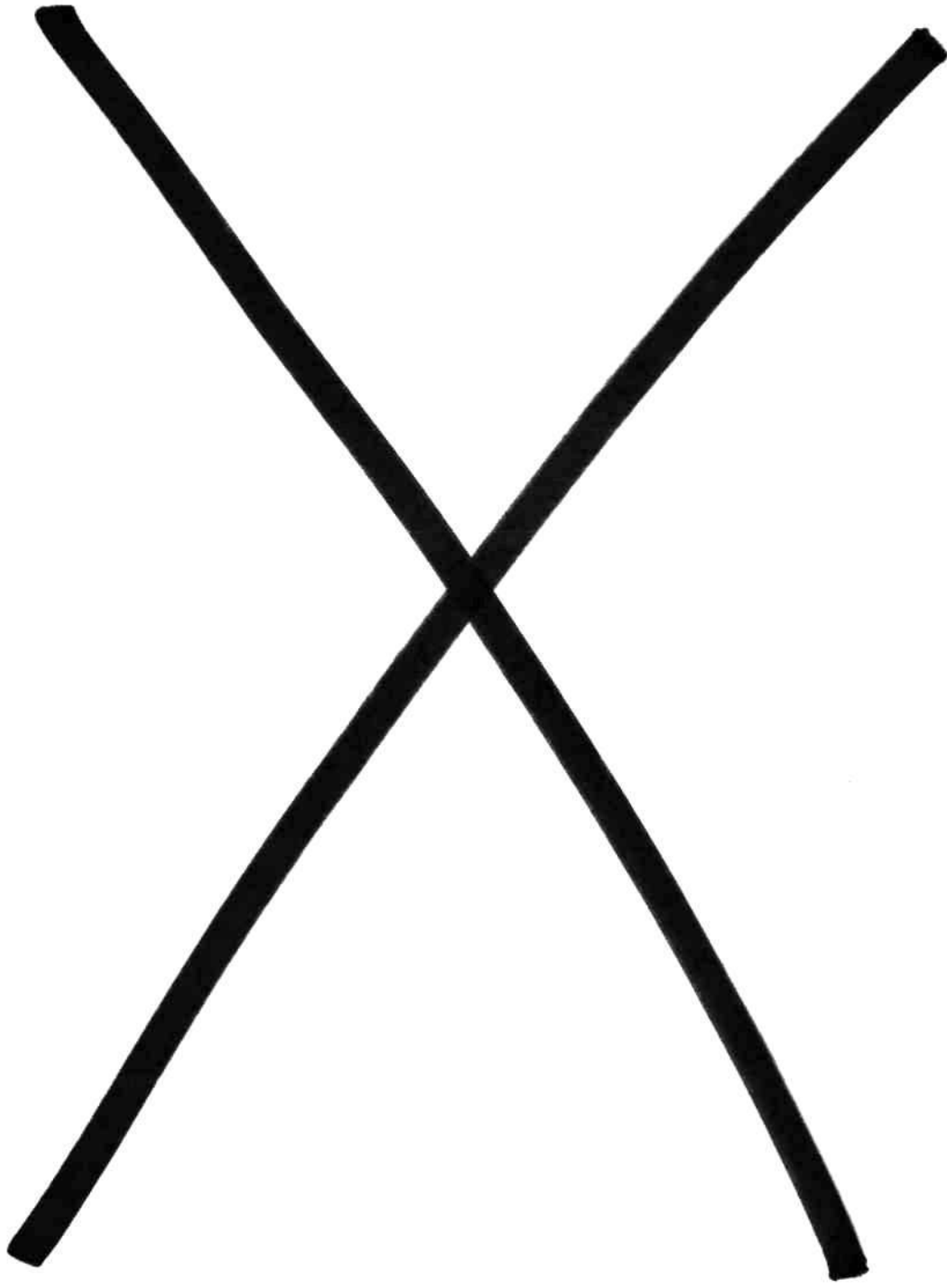
Average price per seat (APPS) data are now reported in Appendix A for each of the applications binders. In this way, clients can more easily view and understand Dataquest's trends and forecasts for the APPS for each of the applications, regions, and platforms. All pricing data is shown in the form of 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: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	635	990	11,797	16,144	23,231	30,850	41,100	51,150	60,900	68,900	146%	24%
Workstation Shipments	2,168	2,370	13,976	20,357	26,205	34,000	43,750	53,200	62,500	70,150	86%	22%
CPU Installed Base	1,939	2,929	14,726	30,870	54,100	84,850	125,850	176,850	237,200	303,600	130%	41%
Workstation Installed Base	6,345	8,715	22,691	43,048	69,253	102,650	145,650	198,100	259,150	325,850	82%	36%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	309.8	278.7	45.9	45.1	35.1	21.2	17.6	16.4	16.2	16.5	-42%	-14%
Average Price per Seat	90.8	116.4	38.7	35.8	31.1	19.2	16.5	15.8	15.8	16.2	-23%	-12%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	250	311	238	256	290	334	285	NA	-2%
Workstation Revenue	NA	NA	NA	261	285	226	248	285	331	283	NA	-0%
Software Revenue	NA	NA	NA	188	189	217	286	365	444	591	NA	26%
Peripheral Revenue	NA	NA	NA	84	82	64	70	83	99	237	NA	24%
Service Revenue	33	49	83	104	139	182	227	280	339	410	43%	24%
Total Revenue	230	325	624	858	1,005	928	1,088	1,302	1,546	1,806	45%	12%
Increase over Prior Year	NA	41%	92%	38%	17%	-8%	17%	20%	19%	17%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-2  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	530	1,078	2,177	3,761	5,750	8,350	11,700	15,850	20,750	NA	41%
Workstation Shipments	0	530	1,078	2,177	3,761	5,750	8,350	11,700	15,850	20,750	NA	41%
CPU Installed Base	0	530	1,608	3,785	7,546	13,300	21,600	33,350	48,850	69,100	NA	56%
Workstation Installed Base	0	530	1,608	3,785	7,546	13,300	21,600	33,350	48,850	69,100	NA	56%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	68.1	95.0	71.1	50.5	48.6	46.1	43.7	41.2	38.8	NA	-5%
Average Price per Seat	.0	68.1	95.0	71.1	50.5	48.6	46.1	43.7	41.2	38.8	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	40	57	83	115	153	195	153	NA	22%
Workstation Revenue	NA	NA	NA	40	57	83	114	152	194	153	NA	22%
Software Revenue	NA	NA	NA	62	60	92	129	176	231	351	NA	42%
Peripheral Revenue	NA	NA	NA	28	24	35	48	64	82	217	NA	56%
Service Revenue	0	7	20	21	42	57	89	133	188	255	NA	43%
Total Revenue	0	43	122	178	240	350	495	678	889	1,129	NA	36%
Increase over Prior Year	NA	NA	185%	46%	34%	46%	42%	37%	31%	27%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-3  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	====	====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	635	460	732	1,115	1,289	600	400	300	250	200	19%	-31%
Workstation Shipments	2,168	1,840	2,911	5,328	4,264	3,750	3,050	2,350	1,850	1,400	18%	-20%
CPU Installed Base	1,939	2,399	3,131	4,246	5,535	6,000	6,300	6,500	6,550	6,500	30%	3%
Workstation Installed Base	6,345	8,185	11,096	16,424	20,688	23,850	26,150	27,750	28,500	28,750	34%	7%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	309.8	521.4	460.2	433.6	394.0	371.5	327.3	283.0	242.9	207.2	6%	-12%
Average Price per Seat	90.8	130.3	115.7	90.7	119.1	58.5	45.1	36.1	30.6	25.7	7%	-26%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	170	205	89	55	34	23	15	NA	-41%
Workstation Revenue	NA	NA	NA	182	179	78	48	30	20	13	NA	-41%
Software Revenue	NA	NA	NA	98	75	38	31	29	32	36	NA	-14%
Peripheral Revenue	NA	NA	NA	53	53	23	14	9	6	4	NA	-41%
Service Revenue	33	42	63	82	91	119	128	132	133	132	29%	8%
Total Revenue	230	282	399	570	604	347	276	235	214	199	27%	-20%
Increase over Prior Year	NA	23%	42%	43%	6%	-43%	-20%	-15%	-9%	-7%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-4  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	*****	*****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	9,987	12,852	18,180	24,500	32,400	39,100	44,850	48,000	NA	21%
Workstation Shipments	0	0	9,987	12,852	18,180	24,500	32,400	39,100	44,850	48,000	NA	21%
CPU Installed Base	0	0	9,987	22,839	41,019	65,500	97,900	137,000	181,850	228,000	NA	41%
Workstation Installed Base	0	0	9,987	22,839	41,019	65,500	97,900	137,000	181,850	228,000	NA	41%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	10.2	7.0	6.4	6.3	6.3	6.2	6.1	6.1	NA	-1%
Average Price per Seat	.0	.0	10.2	7.0	6.4	6.3	6.3	6.2	6.1	6.1	NA	-1%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	39	49	66	86	102	116	117	NA	19%
Workstation Revenue	NA	NA	NA	39	49	66	86	102	116	117	NA	19%
Software Revenue	NA	NA	NA	28	53	87	127	160	181	204	NA	31%
Peripheral Revenue	NA	NA	NA	3	5	6	8	10	11	16	NA	28%
Service Revenue	0	0	1	2	5	7	10	14	19	23	NA	34%
Total Revenue	0	0	103	110	162	231	316	389	444	478	NA	24%
Increase over Prior Year	NA	NA	NA	7%	47%	43%	37%	23%	14%	8%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-5  
 TITLE: History and forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	*****	*****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	507	752	8,405	9,711	12,938	17,550	24,050	31,000	38,300	44,550	125%	28%
Workstation Shipments	1,708	1,678	9,962	12,478	14,609	19,100	25,150	31,700	38,750	44,800	71%	25%
CPU Installed Base	1,476	2,229	10,634	20,345	33,283	50,800	74,750	105,650	143,650	186,650	118%	41%
Workstation Installed Base	4,849	6,526	16,488	28,967	43,576	62,250	86,950	118,150	156,000	198,750	73%	35%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	274.0	248.5	42.3	46.8	35.2	20.8	17.0	15.7	15.1	15.2	-40%	-15%
Average Price per Seat	81.4	111.4	35.7	36.4	31.2	19.1	16.3	15.4	14.9	15.1	-21%	-13%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	147	175	130	141	164	194	166	NA	-1%
Workstation Revenue	NA	NA	NA	165	163	124	138	162	193	166	NA	0%
Software Revenue	NA	NA	NA	128	106	136	187	239	288	378	NA	29%
Peripheral Revenue	NA	NA	NA	54	45	37	41	49	59	146	NA	27%
Service Revenue	24	35	58	74	84	99	122	151	185	227	37%	22%
Total Revenue	163	222	413	545	573	527	629	766	919	1,083	37%	14%
Increase over Prior Year	NA	37%	86%	32%	5%	-8%	20%	22%	20%	18%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-6  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	451	799	1,557	2,533	3,750	5,500	7,750	10,400	13,650	NA	40%
Workstation Shipments	0	451	799	1,557	2,533	3,750	5,500	7,750	10,400	13,650	NA	40%
CPU Installed Base	0	451	1,250	2,807	5,340	9,100	14,600	22,400	32,600	45,900	NA	54%
Workstation Installed Base	0	451	1,250	2,807	5,340	9,100	14,600	22,400	32,600	45,900	NA	54%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	69.0	96.0	74.5	50.9	48.4	45.5	42.5	39.6	36.8	NA	-6%
Average Price per Seat	.0	69.0	96.0	74.5	50.9	48.4	45.5	42.5	39.6	36.8	NA	-6%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	30	38	54	75	99	123	95	NA	20%
Workstation Revenue	NA	NA	NA	30	38	54	75	98	123	95	NA	21%
Software Revenue	NA	NA	NA	47	43	61	85	114	146	219	NA	39%
Peripheral Revenue	NA	NA	NA	22	16	23	31	41	52	136	NA	53%
Service Revenue	0	7	16	15	31	40	61	90	126	169	NA	41%
Total Revenue	0	38	92	133	165	232	327	442	569	714	NA	34%
Increase over Prior Year	NA	NA	144%	44%	24%	41%	41%	35%	29%	25%		

Source: Dataquest  
 June 1987



TABLE NUMBER: A.1-7  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	507	301	484	635	678	300	150	100	50	50	8%	-41%
Workstation Shipments	1,708	1,227	2,041	3,402	2,349	1,800	1,250	800	500	300	8%	-34%
CPU Installed Base	1,476	1,778	2,262	2,897	3,575	3,800	3,900	3,900	3,850	3,750	25%	1%
Workstation Installed Base	4,849	6,075	8,117	11,519	13,868	15,250	16,050	16,350	16,200	15,850	30%	3%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	274.0	517.0	439.1	457.6	402.5	378.3	330.3	284.1	242.9	206.3	10%	-13%
Average Price per Seat	81.4	127.0	104.2	85.4	116.2	59.6	45.6	36.2	30.6	25.6	9%	-26%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	95	112	43	23	12	6	3	NA	-51%
Workstation Revenue	NA	NA	NA	113	100	38	20	10	5	3	NA	-51%
Software Revenue	NA	NA	NA	65	35	16	11	9	9	10	NA	-21%
Peripheral Revenue	NA	NA	NA	32	28	11	6	3	2	1	NA	-51%
Service Revenue	24	28	42	58	52	58	58	56	54	51	22%	-0%
Total Revenue	163	184	254	352	326	166	118	90	76	68	19%	-27%
Increase over Prior Year	NA	13%	38%	38%	-7%	-49%	-29%	-24%	-15%	-10%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-8  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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	7,122	7,519	9,727	13,500	18,400	23,100	27,850	30,850	NA	26%
Workstation Shipments	0	0	7,122	7,519	9,727	13,500	18,400	23,100	27,850	30,850	NA	26%
CPU Installed Base	0	0	7,122	14,641	24,368	37,900	56,250	79,350	107,200	137,000	NA	41%
Workstation Installed Base	0	0	7,122	14,641	24,368	37,900	56,250	79,350	107,200	137,000	NA	41%
PRICING DATA (Thousands of Dollars)												
Average System Price	.0	.0	9.3	6.3	5.6	5.6	5.5	5.5	5.5	5.5	NA	-0%
Average Price per Seat	.0	.0	9.3	6.3	5.6	5.6	5.5	5.5	5.5	5.5	NA	-0%
REVENUE DATA												
CPU Revenue	NA	NA	NA	22	26	32	43	54	65	67	NA	21%
Workstation Revenue	NA	NA	NA	22	26	32	43	54	65	67	NA	21%
Software Revenue	NA	NA	NA	15	28	59	91	116	133	149	NA	39%
Peripheral Revenue	NA	NA	NA	1	1	3	4	5	6	9	NA	79%
Service Revenue	0	0	0	1	1	2	3	4	6	8	NA	40%
Total Revenue	0	0	67	60	81	128	185	234	274	301	NA	30%
Increase over Prior Year	NA	NA	NA	-10%	35%	57%	44%	27%	17%	10%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-9  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	14	146	1,769	4,581	6,727	8,400	10,250	11,850	12,750	13,250	369%	15%
Workstation Shipments	24	446	2,176	5,358	7,382	9,350	11,300	12,850	13,700	14,050	318%	14%
CPU Installed Base	22	168	1,937	6,517	13,245	21,600	31,850	43,650	56,350	69,000	398%	39%
Workstation Installed Base	39	485	2,661	8,019	15,400	24,650	35,850	48,550	61,950	75,150	346%	37%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	520.1	385.2	56.1	31.0	25.8	19.0	17.2	16.6	17.5	18.9	-53%	-6%
Average Price per Seat	300.7	126.3	45.6	26.5	23.5	17.1	15.6	15.3	16.3	17.8	-47%	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	51	69	60	65	70	77	63	NA	-2%
Workstation Revenue	NA	NA	NA	51	65	56	62	68	75	62	NA	-1%
Software Revenue	NA	NA	NA	33	36	45	57	73	92	126	NA	28%
Peripheral Revenue	NA	NA	NA	15	15	15	17	19	23	53	NA	29%
Service Revenue	1	11	15	20	30	48	62	77	92	108	151%	29%
Total Revenue	8	67	114	167	215	224	263	307	358	413	128%	14%
Increase over Prior Year	NA	739%	70%	46%	29%	4%	17%	17%	17%	15%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-10  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	48	122	416	740	1,050	1,550	2,200	3,050	4,000	NA	40%
Workstation Shipments	0	48	122	416	740	1,050	1,550	2,200	3,050	4,000	NA	40%
CPU Installed Base	0	48	170	586	1,326	2,400	3,950	6,100	9,100	13,000	NA	58%
Workstation Installed Base	0	48	170	586	1,326	2,400	3,950	6,100	9,100	13,000	NA	58%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	61.9	85.8	64.5	48.6	47.6	46.7	45.7	44.8	43.9	NA	-2%
Average Price per Seat	.0	61.9	85.8	64.5	48.6	47.6	46.7	45.7	44.8	43.9	NA	-2%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	7	12	15	22	30	41	34	NA	24%
Workstation Revenue	NA	NA	NA	7	11	15	21	30	40	34	NA	24%
Software Revenue	NA	NA	NA	11	11	17	24	34	48	76	NA	48%
Peripheral Revenue	NA	NA	NA	4	4	6	9	12	17	48	NA	66%
Service Revenue	0	0	2	4	6	9	15	23	33	47	NA	49%
Total Revenue	0	3	13	31	44	63	91	129	179	238	NA	40%
Increase over Prior Year	NA	NA	321%	151%	40%	43%	45%	42%	39%	33%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-11  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	****	****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	14	98	143	203	257	200	150	150	150	100	107%	-17%
Workstation Shipments	24	398	550	981	911	1,100	1,200	1,200	1,100	900	148%	-0%
CPU Installed Base	22	120	263	466	723	900	1,050	1,150	1,250	1,350	141%	13%
Workstation Installed Base	39	437	987	1,967	2,878	3,900	5,000	6,050	6,900	7,500	193%	21%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	520.1	543.2	491.2	442.4	408.0	383.5	337.5	290.3	247.8	211.0	-6%	-12%
Average Price per Seat	300.7	134.0	127.7	91.7	115.0	60.4	46.6	37.0	31.2	26.2	-21%	-26%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	33	42	27	23	18	14	9	NA	-26%
Workstation Revenue	NA	NA	NA	33	38	24	20	15	12	8	NA	-26%
Software Revenue	NA	NA	NA	16	16	14	15	17	20	23	NA	8%
Peripheral Revenue	NA	NA	NA	10	11	7	6	5	4	2	NA	-25%
Service Revenue	1	11	13	15	22	38	45	51	54	56	133%	20%
Total Revenue	8	64	83	106	130	110	109	106	104	100	101%	-5%
Increase over Prior Year	NA	701%	29%	28%	23%	-15%	-1%	-3%	-2%	-4%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-12  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	1,504	3,962	5,731	7,150	8,550	9,500	9,600	9,100	NA	10%
Workstation Shipments	0	0	1,504	3,962	5,731	7,150	8,550	9,500	9,600	9,100	NA	10%
CPU Installed Base	0	0	1,504	5,466	11,197	18,350	26,900	36,400	46,000	54,650	NA	37%
Workstation Installed Base	0	0	1,504	5,466	11,197	18,350	26,900	36,400	46,000	54,650	NA	37%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	12.4	6.3	5.7	5.7	5.6	5.6	5.6	5.6	NA	-0%
Average Price per Seat	.0	.0	12.4	6.3	5.7	5.7	5.6	5.6	5.6	5.6	NA	-0%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	11	15	17	20	23	23	20	NA	6%
Workstation Revenue	NA	NA	NA	11	15	17	20	23	23	20	NA	6%
Software Revenue	NA	NA	NA	6	9	14	18	22	24	27	NA	23%
Peripheral Revenue	NA	NA	NA	1	1	2	2	2	2	3	NA	39%
Service Revenue	0	0	0	1	1	2	2	3	4	5	NA	30%
Total Revenue	0	0	19	30	41	52	63	72	75	75	NA	13%
Increase over Prior Year	NA	NA	NA	56%	39%	25%	22%	15%	4%	-1%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-13  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	*****	*****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	8	80	1,321	1,443	2,830	3,500	4,400	5,250	6,200	7,000	332%	20%
Workstation Shipments	14	198	1,517	1,976	3,340	4,000	4,700	5,450	6,350	7,150	292%	16%
CPU Installed Base	13	92	1,414	2,857	5,687	9,150	13,550	18,750	24,900	31,650	360%	41%
Workstation Installed Base	23	220	1,737	3,713	7,053	11,000	15,600	20,950	27,150	33,900	319%	37%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	521.5	326.2	55.0	76.4	53.1	28.8	23.4	22.2	21.9	21.9	-44%	-16%
Average Price per Seat	301.4	131.7	47.9	55.8	45.0	25.2	21.9	21.4	21.4	21.5	-38%	-14%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	44	52	38	37	41	48	42	NA	-4%
Workstation Revenue	NA	NA	NA	36	45	36	36	41	47	41	NA	-2%
Software Revenue	NA	NA	NA	21	41	27	31	39	47	63	NA	9%
Peripheral Revenue	NA	NA	NA	12	19	9	9	10	12	29	NA	9%
Service Revenue	0	3	8	6	18	27	33	40	48	57	154%	25%
Total Revenue	5	29	81	119	175	137	147	172	202	232	147%	6%
Increase over Prior Year	NA	510%	183%	46%	48%	-22%	8%	17%	17%	15%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-14  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	31	90	138	340	650	900	1,300	1,750	2,300	NA	47%
Workstation Shipments	0	31	90	138	340	650	900	1,300	1,750	2,300	NA	47%
CPU Installed Base	0	31	121	259	599	1,250	2,100	3,400	5,100	7,350	NA	65%
Workstation Installed Base	0	31	121	259	599	1,250	2,100	3,400	5,100	7,350	NA	65%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	64.2	92.7	51.3	55.0	53.9	51.2	48.1	44.8	41.4	NA	-6%
Average Price per Seat	.0	64.2	92.7	51.3	55.0	53.9	51.2	48.1	44.8	41.4	NA	-6%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	2	5	10	14	18	24	18	NA	27%
Workstation Revenue	NA	NA	NA	2	5	10	14	18	23	18	NA	27%
Software Revenue	NA	NA	NA	2	5	10	14	20	26	40	NA	50%
Peripheral Revenue	NA	NA	NA	1	3	4	6	8	10	26	NA	55%
Service Revenue	0	0	1	1	4	6	10	15	21	29	NA	50%
Total Revenue	0	2	9	8	23	41	57	79	105	131	NA	42%
Increase over Prior Year	NA	NA	369%	-13%	180%	79%	40%	39%	32%	25%		

Source: Dataquest  
 June 1987



TABLE NUMBER: A.1-15  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	****	****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	8	49	97	252	273	100	50	50	0	0	141%	-100%
Workstation Shipments	14	167	292	785	783	600	350	250	150	150	173%	-28%
CPU Installed Base	13	61	158	410	683	750	800	800	800	800	171%	3%
Workstation Installed Base	23	189	482	1,266	2,049	2,600	2,850	3,000	3,050	3,050	208%	8%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	521.5	492.9	521.1	347.5	383.1	360.1	316.8	272.4	232.5	197.9	-7%	-12%
Average Price per Seat	301.4	144.2	172.3	111.5	133.6	56.7	43.7	34.7	29.2	24.6	-18%	-29%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	37	39	13	6	3	2	1	NA	-49%
Workstation Revenue	NA	NA	NA	29	32	12	5	3	2	1	NA	-48%
Software Revenue	NA	NA	NA	13	22	6	4	3	2	2	NA	-41%
Peripheral Revenue	NA	NA	NA	10	13	4	2	1	0	0	NA	-51%
Service Revenue	0	3	7	5	12	19	20	20	19	19	129%	9%
Total Revenue	5	27	58	93	118	53	36	29	25	23	124%	-28%
Increase over Prior Year	NA	468%	116%	62%	26%	-55%	-31%	-20%	-13%	-8%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-16  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	****	****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	1,135	1,053	2,217	2,750	3,450	3,950	4,400	4,700	NA	16%
Workstation Shipments	0	0	1,135	1,053	2,217	2,750	3,450	3,950	4,400	4,700	NA	16%
CPU Installed Base	0	0	1,135	2,188	4,405	7,200	10,600	14,550	19,000	23,500	NA	40%
Workstation Installed Base	0	0	1,135	2,188	4,405	7,200	10,600	14,550	19,000	23,500	NA	40%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	12.3	14.9	12.1	12.0	12.0	11.9	11.9	11.8	NA	-1%
Average Price per Seat	.0	.0	12.3	14.9	12.1	12.0	12.0	11.9	11.9	11.8	NA	-1%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	5	7	14	17	20	22	22	NA	25%
Workstation Revenue	NA	NA	NA	5	7	14	17	20	22	22	NA	25%
Software Revenue	NA	NA	NA	5	14	11	13	16	18	22	NA	9%
Peripheral Revenue	NA	NA	NA	1	4	1	2	2	2	3	NA	-3%
Service Revenue	0	0	0	0	3	3	4	6	7	9	NA	28%
Total Revenue	0	0	14	17	35	43	54	64	72	78	NA	18%
Increase over Prior Year	NA	NA	NA	23%	102%	24%	26%	18%	13%	8%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-17  
 TITLE: History and forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	*****	*****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	106	12	301	409	735	1,400	2,400	3,050	3,650	4,100	62%	41%
Workstation Shipments	422	48	321	545	875	1,600	2,600	3,200	3,750	4,150	20%	37%
CPU Installed Base	429	440	742	1,151	1,885	3,250	5,700	8,750	12,350	16,300	45%	54%
Workstation Installed Base	1,435	1,483	1,805	2,349	3,224	4,800	7,300	10,450	14,100	18,050	22%	41%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	437.3	572.9	43.9	55.0	47.4	21.2	14.4	12.8	12.4	12.5	-43%	-23%
Average Price per Seat	110.0	136.6	41.2	41.3	39.8	18.4	13.4	12.3	12.1	12.3	-22%	-21%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	7	16	11	13	14	16	14	NA	-2%
Workstation Revenue	NA	NA	NA	9	12	10	12	14	16	14	NA	3%
Software Revenue	NA	NA	NA	6	6	8	11	14	17	23	NA	32%
Peripheral Revenue	NA	NA	NA	3	3	3	3	4	4	10	NA	25%
Service Revenue	8	0	2	4	6	8	10	12	15	18	-10%	26%
Total Revenue	55	7	15	27	42	40	49	57	67	78	-6%	13%
Increase over Prior Year	NA	-87%	119%	77%	56%	-6%	21%	18%	18%	16%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-18  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	====	====	====	====	====	====	====	====	====	====	====	====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	67	66	149	250	400	500	650	800	NA	40%
Workstation Shipments	0	0	67	66	149	250	400	500	650	800	NA	40%
CPU Installed Base	0	0	67	133	282	550	950	1,450	2,050	2,850	NA	59%
Workstation Installed Base	0	0	67	133	282	550	950	1,450	2,050	2,850	NA	59%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	103.4	75.0	43.7	42.8	42.0	41.1	40.3	39.5	NA	-2%
Average Price per Seat	.0	.0	103.4	75.0	43.7	42.8	42.0	41.1	40.3	39.5	NA	-2%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	1	2	3	5	6	8	6	NA	23%
Workstation Revenue	NA	NA	NA	1	2	3	5	6	8	6	NA	23%
Software Revenue	NA	NA	NA	2	2	4	6	8	10	16	NA	58%
Peripheral Revenue	NA	NA	NA	1	1	1	2	3	3	8	NA	63%
Service Revenue	0	0	1	1	1	2	3	5	7	10	NA	50%
Total Revenue	0	0	8	6	8	14	21	28	36	46	NA	42%
Increase over Prior Year	NA	NA	NA	-28%	39%	76%	46%	36%	30%	27%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.1-19  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	106	12	8	25	81	50	50	0	0	0	-7%	-100%
Workstation Shipments	422	48	28	161	221	250	200	150	100	100	-15%	-15%
CPU Installed Base	429	440	448	473	554	600	600	600	600	600	7%	2%
Workstation Installed Base	1,435	1,483	1,511	1,672	1,893	2,100	2,250	2,350	2,350	2,350	7%	4%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	437.3	572.9	447.6	619.1	315.5	296.5	267.1	238.9	211.4	186.3	-8%	-10%
Average Price per Seat	110.0	136.6	128.5	96.8	115.6	46.7	36.8	30.4	26.6	23.1	1%	-28%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	5	12	5	3	2	1	1	NA	-42%
Workstation Revenue	NA	NA	NA	7	9	4	3	2	1	1	NA	-39%
Software Revenue	NA	NA	NA	3	2	2	1	1	0	0	NA	-32%
Peripheral Revenue	NA	NA	NA	2	2	1	1	1	0	0	NA	-38%
Service Revenue	8	0	1	3	4	5	6	6	6	6	-16%	6%
Total Revenue	55	7	4	19	30	17	13	11	9	8	-14%	-24%
Increase over Prior Year	NA	-87%	-38%	327%	59%	-42%	-23%	-20%	-16%	-13%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.1-20  
 TITLE: History and Forecast  
 APPLICATION: Facilities Design  
 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
	****	****	****	****	****	****	****	****	****	****	****	****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	226	318	505	1,100	2,000	2,550	3,000	3,300	NA	46%
Workstation Shipments	0	0	226	318	505	1,100	2,000	2,550	3,000	3,300	NA	46%
CPU Installed Base	0	0	226	544	1,049	2,150	4,150	6,700	9,700	12,900	NA	65%
Workstation Installed Base	0	0	226	544	1,049	2,150	4,150	6,700	9,700	12,900	NA	65%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	11.9	6.5	5.6	5.6	5.5	5.5	5.5	5.5	NA	-0%
Average Price per Seat	.0	.0	11.9	6.5	5.6	5.6	5.5	5.5	5.5	5.5	NA	-0%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	1	1	3	5	6	7	7	NA	40%
Workstation Revenue	NA	NA	NA	1	1	3	5	6	7	7	NA	40%
Software Revenue	NA	NA	NA	1	2	3	4	5	6	7	NA	32%
Peripheral Revenue	NA	NA	NA	0	0	0	0	1	1	1	NA	118%
Service Revenue	0	0	0	0	0	0	1	1	1	2	NA	101%
Total Revenue	0	0	3	3	5	9	15	19	22	25	NA	40%
Increase over Prior Year	NA	NA	NA	-6%	64%	89%	69%	28%	17%	11%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-1  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	****	****	****	****	****	****	****	****	****	****	*****	*****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	345	227	264	531	1,752	2,500	3,700	5,300	7,350	9,850	50%	41%
Workstation Shipments	1,424	964	1,263	2,184	3,134	4,250	5,600	7,300	9,450	11,950	22%	31%
CPU Installed Base	825	1,052	1,316	1,847	3,599	6,100	9,750	14,950	22,250	32,000	45%	55%
Workstation Installed Base	3,366	4,330	5,593	7,778	10,912	15,150	20,450	27,350	36,200	47,500	34%	34%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	346.2	359.1	555.6	344.6	157.2	87.0	62.8	51.1	42.9	38.7	-18%	-24%
Average Price per Seat	83.8	84.6	116.2	83.8	87.9	51.7	41.6	37.0	33.4	31.8	1%	-18%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	57	106	62	63	69	75	86	NA	-4%
Workstation Revenue	NA	NA	NA	76	97	83	84	92	98	106	NA	2%
Software Revenue	NA	NA	NA	54	70	96	129	180	252	346	NA	38%
Peripheral Revenue	NA	NA	NA	19	29	20	22	27	33	44	NA	8%
Service Revenue	22	24	25	37	56	68	85	104	128	158	26%	23%
Total Revenue	142	105	172	237	358	329	384	472	586	740	26%	16%
Increase over Prior Year	NA	-26%	63%	38%	51%	-8%	17%	23%	24%	26%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-2  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	118	14	58	423	750	1,250	2,050	3,400	5,050	NA	64%
Workstation Shipments	0	113	14	58	423	750	1,250	2,050	3,400	5,050	NA	64%
CPU Installed Base	0	118	133	191	614	1,350	2,600	4,650	8,050	13,050	NA	84%
Workstation Installed Base	0	113	128	186	609	1,350	2,600	4,650	8,050	13,050	NA	85%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	73.2	29.1	42.1	58.8	56.0	53.2	50.6	48.1	45.8	NA	-5%
Average Price per Seat	.0	76.4	29.1	42.1	58.8	56.0	53.2	50.6	48.1	45.8	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	1	8	10	16	25	36	46	NA	43%
Workstation Revenue	NA	NA	NA	1	8	10	16	25	36	46	NA	43%
Software Revenue	NA	NA	NA	1	8	20	41	74	128	205	NA	93%
Peripheral Revenue	NA	NA	NA	0	3	5	8	12	19	30	NA	57%
Service Revenue	0	1	0	0	4	7	13	22	36	57	NA	69%
Total Revenue	0	10	0	3	30	53	93	157	255	384	NA	66%
Increase over Prior Year	NA	NA	-95%	576%	876%	74%	77%	68%	63%	50%		

Source: Dataquest  
 June 1987



TABLE NUMBER: A.2-3  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	====	====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	345	109	250	290	521	350	350	350	300	300	11%	-10%
Workstation Shipments	1,424	851	1,249	1,943	1,903	2,100	2,250	2,350	2,400	2,450	8%	5%
CPU Installed Base	825	933	1,183	1,473	1,994	2,350	2,600	2,900	3,100	3,300	25%	11%
Workstation Installed Base	3,366	4,217	5,466	7,409	9,312	11,400	13,300	15,250	17,050	18,800	29%	15%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	346.2	670.2	586.0	617.2	461.0	444.6	424.4	396.7	368.6	341.6	7%	-6%
Average Price per Seat	83.8	85.7	117.2	92.1	126.2	77.3	63.8	56.7	47.6	42.7	11%	-19%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	56	95	44	37	31	23	21	NA	-26%
Workstation Revenue	NA	NA	NA	74	86	65	58	54	46	42	NA	-14%
Software Revenue	NA	NA	NA	51	55	64	72	85	98	109	NA	15%
Peripheral Revenue	NA	NA	NA	18	25	15	14	13	12	11	NA	-15%
Service Revenue	22	23	25	36	51	60	70	79	87	94	23%	13%
Total Revenue	142	95	171	230	312	249	250	262	265	276	22%	-2%
Increase over Prior Year	NA	-33%	79%	35%	35%	-20%	1%	5%	1%	4%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-4  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	0	183	807	1,450	2,150	2,900	3,700	4,500	NA	41%
Workstation Shipments	0	0	0	183	807	1,450	2,150	2,900	3,700	4,500	NA	41%
CPU Installed Base	0	0	0	183	990	2,400	4,550	7,450	11,100	15,650	NA	74%
Workstation Installed Base	0	0	0	183	990	2,400	4,550	7,450	11,100	15,650	NA	74%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	.0	8.4	12.8	12.1	11.5	11.1	10.7	10.4	NA	-4%
Average Price per Seat	.0	.0	.0	8.4	12.8	12.1	11.5	11.1	10.7	10.4	NA	-4%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	1	3	7	10	13	16	19	NA	40%
Workstation Revenue	NA	NA	NA	1	3	7	10	13	16	19	NA	40%
Software Revenue	NA	NA	NA	2	7	11	16	22	26	32	NA	34%
Peripheral Revenue	NA	NA	NA	0	1	1	1	1	1	3	NA	21%
Service Revenue	0	0	0	0	1	1	2	4	5	7	NA	57%
Total Revenue	0	0	0	3	16	27	40	53	66	79	NA	38%
Increase over Prior Year	NA	NA	NA	NA	362%	73%	46%	32%	24%	21%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-5  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	211	155	189	242	980	1,550	2,350	3,300	4,500	5,750	47%	42%
Workstation Shipments	757	739	930	1,390	1,758	2,400	3,200	4,100	5,200	6,350	23%	29%
CPU Installed Base	542	696	885	1,128	2,108	3,650	5,950	9,200	13,700	19,400	40%	56%
Workstation Installed Base	2,019	2,758	3,688	5,078	6,837	9,250	12,250	16,100	20,950	26,950	36%	32%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	388.2	356.5	552.8	478.8	149.7	76.4	53.1	44.4	39.2	36.7	-21%	-25%
Average Price per Seat	108.1	74.6	112.3	83.5	83.4	49.2	39.1	35.8	33.9	33.3	-6%	-17%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	35	56	33	34	37	42	46	NA	-4%
Workstation Revenue	NA	NA	NA	49	52	44	43	46	49	52	NA	-0%
Software Revenue	NA	NA	NA	36	41	59	83	118	169	233	NA	42%
Peripheral Revenue	NA	NA	NA	12	15	11	12	15	19	25	NA	10%
Service Revenue	13	16	17	26	32	36	43	52	64	79	26%	20%
Total Revenue	95	71	121	154	197	184	215	269	343	435	20%	17%
Increase over Prior Year	NA	-25%	71%	27%	28%	-7%	17%	25%	27%	27%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.2-6  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	77	9	25	274	500	900	1,550	2,500	3,600	NA	67%
Workstation Shipments	0	72	9	25	274	500	900	1,550	2,500	3,600	NA	67%
CPU Installed Base	0	77	87	112	385	900	1,800	3,300	5,850	9,450	NA	90%
Workstation Installed Base	0	72	82	107	380	900	1,800	3,300	5,850	9,400	NA	90%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	74.9	31.7	40.7	59.0	56.0	53.2	50.6	48.1	45.7	NA	-5%
Average Price per Seat	.0	80.1	31.7	40.7	59.0	56.0	53.2	50.6	48.1	45.7	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	5	7	12	18	27	33	NA	46%
Workstation Revenue	NA	NA	NA	0	5	7	12	18	27	33	NA	46%
Software Revenue	NA	NA	NA	0	5	15	30	55	95	148	NA	95%
Peripheral Revenue	NA	NA	NA	0	2	3	6	9	14	21	NA	61%
Service Revenue	0	1	0	0	3	4	8	15	25	39	NA	69%
Total Revenue	0	7	0	1	20	37	68	116	188	274	NA	69%
Increase over Prior Year	NA	NA	-95%	371%	1261%	84%	85%	70%	63%	46%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-7  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	211	77	180	167	271	200	150	150	100	100	7%	-18%
Workstation Shipments	757	667	921	1,314	1,049	1,050	1,000	950	800	650	9%	-9%
CPU Installed Base	542	619	799	965	1,236	1,400	1,500	1,600	1,650	1,700	23%	7%
Workstation Installed Base	2,019	2,686	3,607	4,921	5,970	7,000	7,800	8,500	8,950	9,250	31%	9%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	388.2	638.4	579.3	688.0	462.4	443.9	421.7	392.2	364.7	339.2	4%	-6%
Average Price per Seat	108.1	74.0	113.1	87.2	119.5	77.2	63.4	56.0	47.1	42.4	3%	-19%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	34	49	22	16	12	8	6	NA	-35%
Workstation Revenue	NA	NA	NA	49	46	33	25	21	15	11	NA	-24%
Software Revenue	NA	NA	NA	34	31	37	41	48	55	63	NA	15%
Peripheral Revenue	NA	NA	NA	12	13	7	6	5	4	3	NA	-25%
Service Revenue	13	15	17	26	29	31	34	36	37	37	22%	5%
Total Revenue	95	64	121	150	168	130	122	122	118	120	15%	-6%
Increase over Prior Year	NA	-32%	88%	24%	11%	-22%	-6%	-0%	-3%	1%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-8  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	0	51	435	850	1,300	1,650	1,900	2,100	NA	37%
Workstation Shipments	0	0	0	51	435	850	1,300	1,650	1,900	2,100	NA	37%
CPU Installed Base	0	0	0	51	486	1,350	2,650	4,300	6,150	8,250	NA	76%
Workstation Installed Base	0	0	0	51	486	1,350	2,650	4,300	6,150	8,250	NA	76%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	.0	9.6	12.0	11.4	10.8	10.3	9.8	9.3	NA	-5%
Average Price per Seat	.0	.0	.0	9.6	12.0	11.4	10.8	10.3	9.8	9.3	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	2	4	6	7	8	8	NA	33%
Workstation Revenue	NA	NA	NA	0	2	4	6	7	8	8	NA	33%
Software Revenue	NA	NA	NA	2	5	8	12	15	18	21	NA	35%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	1	1	NA	22%
Service Revenue	0	0	0	0	1	1	1	2	3	3	NA	43%
Total Revenue	0	0	0	2	9	17	25	32	37	41	NA	35%
Increase over Prior Year	NA	NA	NA	NA	319%	84%	47%	25%	15%	12%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.2-9  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	95	34	41	189	423	550	800	1,150	1,600	2,250	45%	40%
Workstation Shipments	421	112	194	485	786	1,100	1,500	1,950	2,600	3,400	17%	34%
CPU Installed Base	138	172	212	401	824	1,400	2,150	3,250	4,850	7,100	56%	54%
Workstation Installed Base	609	721	915	1,400	2,186	3,300	4,700	6,550	9,000	12,200	38%	41%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	206.7	393.4	562.2	204.8	182.3	118.2	92.2	74.1	58.5	50.1	-3%	-23%
Average Price per Seat	46.5	118.3	118.2	79.7	98.2	60.4	49.2	42.5	36.1	33.4	21%	-19%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	12	28	18	19	20	21	24	NA	-3%
Workstation Revenue	NA	NA	NA	16	29	26	28	31	33	36	NA	5%
Software Revenue	NA	NA	NA	12	16	21	27	36	50	68	NA	34%
Peripheral Revenue	NA	NA	NA	3	8	6	7	8	10	13	NA	9%
Service Revenue	7	6	6	8	15	20	26	34	42	53	20%	29%
Total Revenue	27	19	28	51	95	91	107	130	156	194	37%	15%
Increase over Prior Year	NA	-27%	47%	79%	86%	-5%	18%	21%	20%	25%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-10  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	22	2	21	83	150	200	300	550	900	NA	61%
Workstation Shipments	0	22	2	21	83	150	200	300	550	900	NA	61%
CPU Installed Base	0	22	24	46	128	250	450	800	1,300	2,200	NA	76%
Workstation Installed Base	0	22	24	46	128	250	450	800	1,300	2,200	NA	76%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	70.0	30.4	47.6	64.6	61.4	58.3	55.4	52.6	50.0	NA	-5%
Average Price per Seat	.0	70.0	30.4	47.6	64.6	61.4	58.3	55.4	52.6	50.0	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	2	2	3	4	6	9	NA	41%
Workstation Revenue	NA	NA	NA	0	2	2	3	4	6	9	NA	41%
Software Revenue	NA	NA	NA	0	2	4	7	12	22	37	NA	87%
Peripheral Revenue	NA	NA	NA	0	1	1	1	2	3	6	NA	53%
Service Revenue	0	0	0	0	1	2	3	4	7	12	NA	69%
Total Revenue	0	2	0	1	6	10	17	27	45	73	NA	63%
Increase over Prior Year	NA	NA	-95%	1338%	457%	58%	63%	62%	66%	63%		

Source: Dataquest  
 June 1987



TABLE NUMBER: A.2-11  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	95	12	38	73	135	100	100	150	150	150	9%	2%
Workstation Shipments	421	90	192	369	497	650	800	1,000	1,150	1,300	4%	21%
CPU Installed Base	138	150	188	261	396	500	600	750	850	1,000	30%	20%
Workstation Installed Base	609	699	891	1,260	1,757	2,400	3,150	4,050	5,000	6,100	30%	28%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	206.7	1000.9	594.0	505.3	519.6	493.6	468.9	436.1	401.2	369.1	26%	-7%
Average Price per Seat	46.5	130.1	119.2	99.8	140.9	85.8	70.5	62.3	51.8	46.1	32%	-20%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	11	25	15	15	14	12	12	NA	-14%
Workstation Revenue	NA	NA	NA	16	27	23	23	25	24	24	NA	-2%
Software Revenue	NA	NA	NA	12	13	16	18	22	25	28	NA	17%
Peripheral Revenue	NA	NA	NA	3	8	5	6	6	6	6	NA	-3%
Service Revenue	7	6	6	8	14	18	23	28	33	39	18%	23%
Total Revenue	27	18	28	49	86	77	85	95	101	109	34%	5%
Increase over Prior Year	NA	-33%	59%	73%	75%	-11%	11%	12%	6%	8%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.2-12  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	0	94	206	300	450	650	950	1,200	NA	42%
Workstation Shipments	0	0	0	94	206	300	450	650	950	1,200	NA	42%
CPU Installed Base	0	0	0	94	300	600	1,100	1,750	2,700	3,900	NA	67%
Workstation Installed Base	0	0	0	94	300	600	1,100	1,750	2,700	3,900	NA	67%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	.0	8.1	8.8	8.4	7.9	7.6	7.2	6.8	NA	-5%
Average Price per Seat	.0	.0	.0	8.1	8.8	8.4	7.9	7.6	7.2	6.8	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	1	1	2	2	3	3	NA	35%
Workstation Revenue	NA	NA	NA	0	1	1	2	2	3	3	NA	35%
Software Revenue	NA	NA	NA	0	1	1	2	2	3	3	NA	24%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	41%
Service Revenue	0	0	0	0	0	0	1	1	2	3	NA	67%
Total Revenue	0	0	0	1	3	4	6	8	10	13	NA	35%
Increase over Prior Year	NA	NA	NA	NA	240%	47%	39%	36%	32%	24%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-13  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	****	****	****	****	****	****	****	****	****	****	****	****
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	1	35	30	85	275	300	450	600	900	1,250	298%	35%
Workstation Shipments	2	94	119	216	445	550	650	850	1,100	1,450	286%	27%
CPU Installed Base	2	36	66	151	426	750	1,150	1,800	2,650	3,900	297%	56%
Workstation Installed Base	3	97	216	432	878	1,400	2,050	2,850	3,850	5,250	310%	43%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	527.3	320.1	550.6	232.9	137.0	75.6	54.4	40.4	31.3	26.6	-29%	-28%
Average Price per Seat	288.6	117.7	138.3	91.6	84.6	45.5	36.1	30.2	25.4	22.9	-26%	-23%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	8	16	7	7	7	8	9	NA	-10%
Workstation Revenue	NA	NA	NA	6	11	9	9	9	10	11	NA	-1%
Software Revenue	NA	NA	NA	3	8	8	10	13	18	26	NA	26%
Peripheral Revenue	NA	NA	NA	2	4	2	2	2	2	3	NA	-6%
Service Revenue	0	1	2	1	6	8	10	12	13	16	213%	22%
Total Revenue	1	12	18	21	45	34	37	43	51	65	190%	7%
Increase over Prior Year	NA	1852%	47%	16%	112%	-24%	9%	16%	18%	26%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.2-14  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	19	3	9	42	50	100	100	150	250	NA	43%
Workstation Shipments	0	19	3	9	42	50	100	100	150	250	NA	43%
CPU Installed Base	0	19	22	31	72	150	200	350	500	750	NA	60%
Workstation Installed Base	0	19	22	31	72	150	200	350	500	750	NA	60%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	70.0	17.9	35.3	51.0	48.4	46.0	43.7	41.5	39.5	NA	-5%
Average Price per Seat	.0	70.0	17.9	35.3	51.0	48.4	46.0	43.7	41.5	39.5	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	1	1	1	1	2	2	NA	23%
Workstation Revenue	NA	NA	NA	0	1	1	1	1	2	2	NA	23%
Software Revenue	NA	NA	NA	0	1	1	2	5	8	14	NA	91%
Peripheral Revenue	NA	NA	NA	0	0	0	0	1	1	1	NA	37%
Service Revenue	0	0	0	0	0	1	1	1	2	3	NA	56%
Total Revenue	0	1	0	0	3	4	6	9	14	23	NA	55%
Increase over Prior Year	NA	NA	-95%	533%	571%	47%	49%	61%	54%	63%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.2-15  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	1	16	27	39	80	50	50	50	50	50	192%	-9%
Workstation Shipments	2	75	116	170	250	250	250	250	250	250	234%	0%
CPU Installed Base	2	17	44	84	163	200	250	250	300	300	213%	13%
Workstation Installed Base	3	78	195	365	615	850	1,100	1,300	1,500	1,650	275%	22%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	527.3	625.2	605.3	487.9	408.5	388.2	368.7	342.7	315.5	290.4	-6%	-7%
Average Price per Seat	288.6	129.8	141.2	112.6	130.2	67.5	55.4	49.0	40.7	36.3	-18%	-23%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	8	14	5	4	3	2	2	NA	-35%
Workstation Revenue	NA	NA	NA	6	10	7	6	5	4	3	NA	-20%
Software Revenue	NA	NA	NA	3	7	6	6	6	7	7	NA	1%
Peripheral Revenue	NA	NA	NA	2	3	2	1	1	1	1	NA	-23%
Service Revenue	0	1	2	1	5	7	8	10	11	11	208%	16%
Total Revenue	1	11	18	21	39	26	25	25	24	24	180%	-9%
Increase over Prior Year	NA	1644%	63%	13%	92%	-34%	-3%	-1%	-3%	1%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-16  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	====	====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	0	37	154	200	300	450	700	950	NA	44%
Workstation Shipments	0	0	0	37	154	200	300	450	700	950	NA	44%
CPU Installed Base	0	0	0	37	190	400	700	1,200	1,850	2,800	NA	71%
Workstation Installed Base	0	0	0	37	190	400	700	1,200	1,850	2,800	NA	71%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	.0	7.6	19.6	18.6	17.7	16.8	16.0	15.2	NA	-5%
Average Price per Seat	.0	.0	.0	7.6	19.6	18.6	17.7	16.8	16.0	15.2	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	1	2	2	3	4	6	NA	49%
Workstation Revenue	NA	NA	NA	0	1	2	2	3	4	6	NA	49%
Software Revenue	NA	NA	NA	0	1	1	1	2	3	4	NA	30%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	1	NA	11%
Service Revenue	0	0	0	0	0	0	0	1	1	1	NA	NA
Total Revenue	0	0	0	0	3	5	6	9	13	18	NA	41%
Increase over Prior Year	NA	NA	NA	NA	935%	42%	42%	45%	41%	36%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-17  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	38	4	5	15	74	100	150	250	350	600	18%	52%
Workstation Shipments	244	19	20	93	145	200	300	400	550	800	-12%	41%
CPU Installed Base	143	147	152	167	241	350	450	700	1,050	1,650	14%	47%
Workstation Installed Base	734	753	774	867	1,012	1,200	1,500	1,850	2,350	3,050	8%	25%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	455.6	501.2	643.5	568.9	188.5	115.4	83.2	62.0	47.5	39.6	-20%	-27%
Average Price per Seat	71.2	111.4	145.9	91.2	95.8	50.7	41.5	36.2	31.6	29.4	8%	-21%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	2	6	3	3	4	4	6	NA	-2%
Workstation Revenue	NA	NA	NA	4	5	4	4	5	6	7	NA	9%
Software Revenue	NA	NA	NA	2	5	7	9	12	16	20	NA	32%
Peripheral Revenue	NA	NA	NA	1	1	1	1	1	2	2	NA	13%
Service Revenue	2	0	0	2	4	5	6	7	8	10	13%	22%
Total Revenue	20	2	3	10	21	20	24	30	36	45	2%	17%
Increase over Prior Year	NA	-89%	55%	213%	103%	-5%	20%	24%	22%	25%		

Source: Dataquest  
June 1987

TABLE NUMBER: A.2-18  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	----	----	----	----	----	----	----	----	----	----	-----	-----
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	0	3	25	50	50	100	150	300	NA	64%
Workstation Shipments	0	0	0	3	25	50	50	100	150	300	NA	64%
CPU Installed Base	0	0	0	3	28	50	100	200	400	650	NA	87%
Workstation Installed Base	0	0	0	3	28	50	100	200	400	650	NA	87%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	52.6	34.2	51.1	48.6	46.2	43.8	41.6	39.5	NA	-5%
Average Price per Seat	.0	.0	52.6	34.2	51.1	48.6	46.2	43.8	41.6	39.5	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	0	0	1	1	2	2	NA	39%
Workstation Revenue	NA	NA	NA	0	0	0	1	1	2	2	NA	39%
Software Revenue	NA	NA	NA	0	0	1	1	2	3	5	NA	82%
Peripheral Revenue	NA	NA	NA	0	0	0	0	1	1	1	NA	57%
Service Revenue	0	0	0	0	0	0	1	1	2	3	NA	75%
Total Revenue	0	0	0	0	2	2	3	6	9	14	NA	57%
Increase over Prior Year	NA	NA	NA	1100%	1167%	45%	58%	59%	61%	61%		

Source: Dataquest  
 June 1987



TABLE NUMBER: A.2-19  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 REGION: Rest of World  
 PLATFORM: Host-Dependent  
 UNITS: Millions of Dollars/Actual Units

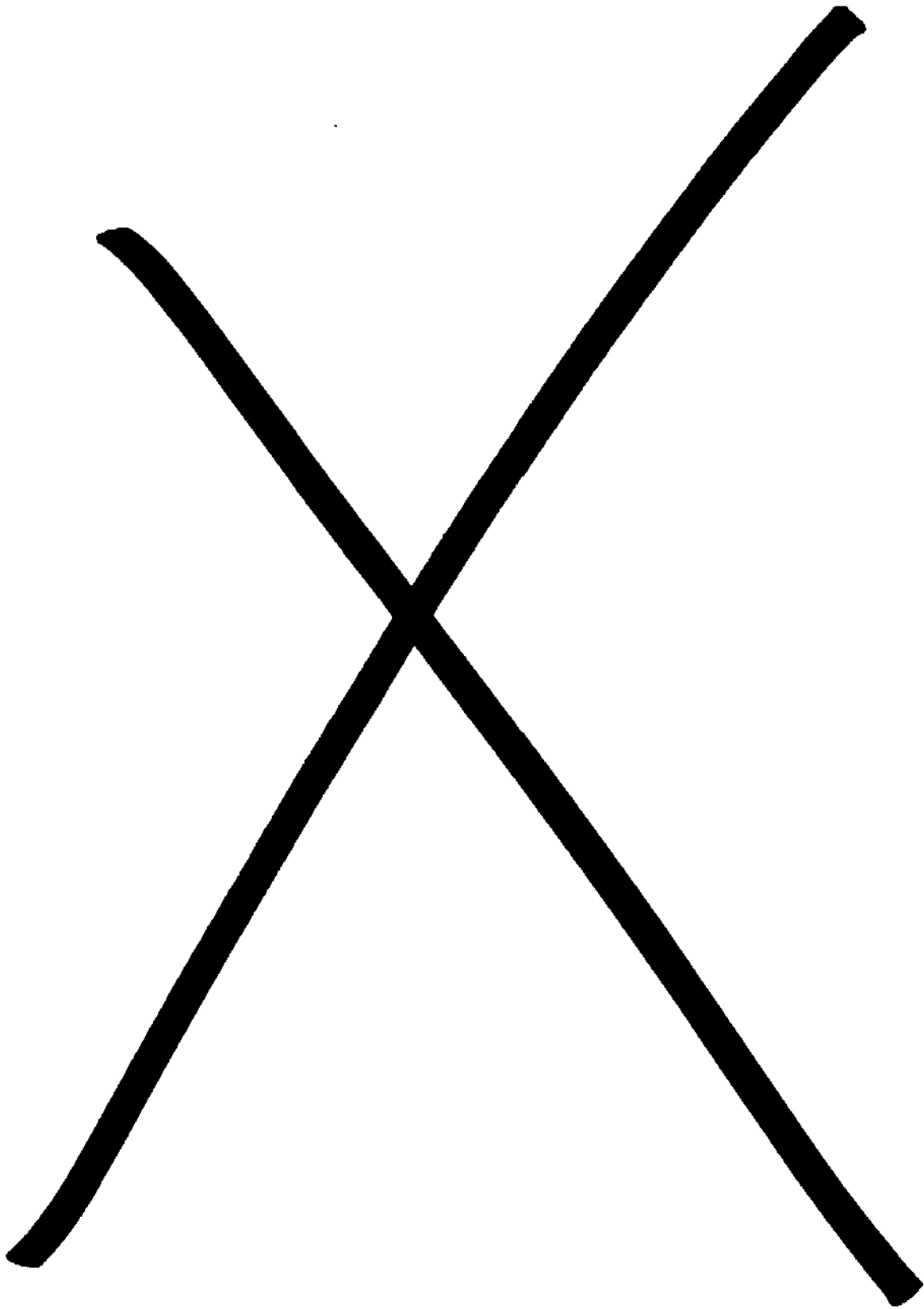
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	CAGR 82-86	CAGR 86-91
	====	====	====	====	====	====	====	====	====	====	=====	=====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	38	4	4	11	36	0	50	50	50	50	-2%	7%
Workstation Shipments	244	19	20	90	107	150	150	200	200	250	-19%	19%
CPU Installed Base	143	147	152	163	199	200	250	250	300	300	9%	9%
Workstation Installed Base	734	753	773	863	970	1,100	1,250	1,400	1,550	1,750	7%	13%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	455.6	501.2	668.9	746.7	345.4	328.2	311.8	289.9	266.7	245.6	-7%	-7%
Average Price per Seat	71.2	111.4	146.8	93.8	115.0	57.1	46.9	41.4	34.4	30.7	13%	-23%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	2	6	2	2	2	2	1	NA	-24%
Workstation Revenue	NA	NA	NA	4	4	3	3	3	3	3	NA	-7%
Software Revenue	NA	NA	NA	2	4	6	7	9	10	12	NA	21%
Peripheral Revenue	NA	NA	NA	1	1	1	1	1	1	1	NA	-9%
Service Revenue	2	0	0	2	4	4	5	5	6	7	12%	13%
Total Revenue	20	2	3	10	19	16	18	20	22	23	-1%	4%
Increase over Prior Year	NA	-89%	55%	208%	87%	-14%	10%	12%	8%	7%		

Source: Dataquest  
 June 1987

TABLE NUMBER: A.2-20  
 TITLE: History and Forecast  
 APPLICATION: Mapping  
 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
	====	====	====	====	====	====	====	====	====	====	====	====
<b>UNIT SHIPMENT DATA</b>												
CPU Shipments	0	0	0	1	13	50	50	100	200	300	NA	88%
Workstation Shipments	0	0	0	1	13	50	50	100	200	300	NA	88%
CPU Installed Base	0	0	0	1	14	50	100	200	400	650	NA	116%
Workstation Installed Base	0	0	0	1	14	50	100	200	400	650	NA	116%
<b>PRICING DATA (Thousands of Dollars)</b>												
Average System Price	.0	.0	.0	9.4	23.7	22.6	21.5	20.3	19.3	18.3	NA	-5%
Average Price per Seat	.0	.0	.0	9.4	23.7	22.6	21.5	20.3	19.3	18.3	NA	-5%
<b>REVENUE DATA</b>												
CPU Revenue	NA	NA	NA	0	0	0	1	1	1	2	NA	83%
Workstation Revenue	NA	NA	NA	0	0	0	1	1	1	2	NA	83%
Software Revenue	NA	NA	NA	0	0	1	1	2	3	3	NA	59%
Peripheral Revenue	NA	NA	NA	0	0	0	0	0	0	0	NA	71%
Service Revenue	0	0	0	0	0	0	0	0	0	0	NA	54%
Total Revenue	0	0	0	0	1	2	3	4	6	8	NA	70%
Increase over Prior Year	NA	NA	NA	NA	575%	189%	67%	57%	39%	34%		

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.

## Appendix B Market Shares

TABLE NUMBER: B.1-1  
 TITLE: 1986 Market Share  
 APPLICATION: Facilities Design  
 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
Intergraph	267	175	43	1,692	26.5%	25.9%	22.9%	6.5%
Digital	131	115	0	383	13.0%	17.0%	.0%	1.5%
IBM	67	53	6	5,748	6.6%	7.8%	3.3%	21.9%
Calma	65	35	14	676	6.4%	5.2%	7.6%	2.6%
Computervision	40	23	7	254	3.9%	3.4%	3.9%	1.0%
Fujitsu	38	25	11	228	3.8%	3.7%	5.7%	.9%
McDonnell Douglas	38	22	10	494	3.7%	3.3%	5.0%	1.9%
Auto-Trol	31	12	7	351	3.1%	1.8%	3.7%	1.3%
Calcomp	30	18	9	402	3.0%	2.7%	4.8%	1.5%
Autodesk	25	0	25	0	2.5%	.0%	13.3%	.0%
Prime	19	12	3	167	1.9%	1.7%	1.4%	.6%
Holguin	18	8	9	441	1.8%	1.1%	4.5%	1.7%
NEC	14	9	4	210	1.4%	1.4%	2.2%	.8%
Apollo	12	11	0	478	1.2%	1.6%	.0%	1.8%
Hewlett-Packard	12	8	2	270	1.2%	1.2%	1.2%	1.0%
Hitachi	8	5	3	189	.8%	.7%	1.6%	.7%
Otsukashokai	7	3	4	594	.7%	.4%	2.2%	2.3%
Toshiba	7	6	1	59	.7%	.9%	.3%	.2%
Robo Systems	7	5	1	788	.7%	.7%	.6%	3.0%
Control Data	6	3	2	85	.6%	.5%	.8%	.3%
Mitsubishi Electric	5	3	1	35	.5%	.5%	.5%	.1%
Pafec	3	0	3	0	.3%	.0%	1.4%	.0%
Siemens	3	2	0	16	.2%	.3%	.2%	.1%
Hitachi Zosen	2	1	1	63	.2%	.2%	.4%	.2%
Sun	2	2	0	95	.2%	.3%	.0%	.4%
Mutoh Industries	1	1	0	32	.1%	.1%	.2%	.1%
Seiko I&E	1	1	0	4	.1%	.1%	.1%	.0%
Matra Datavision	1	1	0	3	.1%	.1%	.1%	.0%
Other Companies	150	122	22	12,508	15.0%	18.0%	11.9%	47.7%
All Far East-Based Companies	99	61	31	1,619	9.8%	9.0%	16.2%	6.2%
All European-Based Companies	13	7	5	876	1.3%	1.0%	2.6%	3.3%
All Hardware Companies	268	250	0	17,804	26.7%	36.9%	.0%	67.9%
All Turnkey & SW Companies	737	428	189	8,401	73.3%	63.1%	100.0%	32.1%
All Companies	1,005	678	189	26,205	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: Facilities Design  
 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	39	19	11	445	16.3%	14.1%	17.6%	11.8%
Auto-Trol	31	12	7	351	13.0%	9.0%	11.5%	9.3%
Calcomp	29	18	8	402	12.0%	13.5%	13.2%	10.7%
Intergraph	26	14	8	187	10.8%	9.9%	12.7%	5.0%
McDonnell Douglas	25	13	8	381	10.2%	9.7%	12.5%	10.1%
Holguin	16	7	8	359	6.7%	5.0%	12.9%	9.5%
Digital	13	12	0	383	5.5%	8.4%	.0%	10.2%
Apollo	12	11	0	478	5.1%	7.9%	.0%	12.7%
Hewlett-Packard	12	8	2	270	4.9%	6.2%	3.7%	7.2%
Computervision	11	7	3	107	4.5%	5.2%	4.7%	2.9%
IBM	3	1	1	20	1.1%	.9%	1.2%	.5%
Sun	2	2	0	95	.9%	1.3%	.0%	2.5%
Pafec	1	0	1	0	.3%	.0%	1.3%	.0%
Seiko I&E	1	0	0	3	.3%	.3%	.4%	.1%
Control Data	0	0	0	4	.2%	.1%	.3%	.1%
Mutoh Industries	0	0	0	1	.1%	.1%	.2%	.0%
Autodesk	0	0	0	0	.1%	.0%	.4%	.0%
Prime	0	0	0	1	.1%	.1%	.1%	.0%
Other Companies	20	12	5	283	8.2%	8.6%	7.7%	7.5%
All Far East-Based Companies	2	1	1	9	.9%	1.0%	1.1%	.2%
All European-Based Companies	1	0	1	10	.5%	.2%	1.5%	.3%
All Hardware Companies	29	26	0	1,031	12.2%	18.8%	.0%	27.4%
All Turnkey & SW Companies	210	111	60	2,730	87.8%	81.2%	100.0%	72.6%
All Companies	240	137	60	3,761	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987

# Appendix B Market Shares

TABLE NUMBER: B.1-3  
 TITLE: 1986 Market Share  
 APPLICATION: Facilities Design  
 PLATFORM: Host-Dependent  
 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
Intergraph	235	158	35	1,378	39.0%	36.1%	46.4%	32.3%
Digital	118	104	0	0	19.5%	23.7%	.0%	.0%
Fujitsu	38	25	11	228	6.3%	5.7%	14.3%	5.3%
IBM	33	23	4	327	5.5%	5.4%	5.5%	7.7%
Computervision	28	16	4	135	4.6%	3.6%	4.9%	3.2%
Calma	25	15	4	212	4.2%	3.5%	4.8%	5.0%
Prime	19	11	3	166	3.1%	2.6%	3.6%	3.9%
McDonnell Douglas	13	9	2	113	2.2%	2.1%	2.7%	2.7%
NEC	9	7	2	60	1.5%	1.5%	2.3%	1.4%
Toshiba	6	5	1	29	1.0%	1.1%	.7%	.7%
Control Data	5	3	1	80	.9%	.7%	1.8%	1.9%
Mitsubishi Electric	4	3	1	25	.7%	.7%	1.1%	.6%
Hitachi	3	2	1	12	.5%	.3%	1.4%	.3%
Siemens	3	2	0	16	.4%	.4%	.5%	.4%
Pafec	2	0	2	0	.3%	.0%	2.6%	.0%
Hitachi Zosen	1	1	0	24	.2%	.1%	.5%	.6%
Holguin	1	0	0	15	.1%	.1%	.5%	.4%
Matra Datavision	1	1	0	3	.1%	.1%	.2%	.1%
Other Companies	62	55	5	1,489	10.3%	12.6%	6.3%	34.9%
All Far East-Based Companies	72	48	19	463	12.0%	11.0%	25.2%	10.9%
All European-Based Companies	5	2	3	16	.8%	.4%	3.7%	.4%
All Hardware Companies	162	147	0	1,327	26.8%	33.6%	.0%	31.1%
All Turnkey & SW Companies	442	291	75	2,937	73.2%	66.4%	100.0%	68.9%
All Companies	604	438	75	4,264	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987

# Appendix B Market Shares

TABLE NUMBER: B.1-4  
 TITLE: 1986 Market Share  
 APPLICATION: Facilities Design  
 PLATFORM: Personal Computer  
 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
IBM	31	28	1	5,400	19.3%	27.6%	2.6%	29.7%
Autodesk	25	0	25	0	15.4%	.0%	46.6%	.0%
Otsukashokai	7	3	4	594	4.4%	2.6%	7.8%	3.3%
Robo Systems	7	5	1	788	4.1%	4.5%	2.2%	4.3%
Hitachi	6	3	2	176	3.4%	3.0%	3.9%	1.0%
Intergraph	5	3	1	128	3.2%	3.3%	1.6%	.7%
NEC	5	2	2	150	3.2%	2.3%	4.5%	.8%
Calcomp	1	0	1	0	.8%	.0%	2.2%	.0%
Toshiba	1	1	0	30	.7%	1.0%	.2%	.2%
Hitachi Zosen	1	1	0	39	.7%	.6%	.8%	.2%
Computervision	1	0	1	12	.7%	.2%	1.7%	.1%
Holguin	1	0	0	67	.6%	.4%	.6%	.4%
Calma	1	0	0	19	.4%	.3%	.2%	.1%
Mutoh Industries	1	0	0	31	.4%	.3%	.4%	.2%
Mitsubishi Electric	0	0	0	10	.1%	.2%	.1%	.1%
Seiko I&E	0	0	0	1	.1%	.1%	.1%	.0%
Control Data	0	0	0	0	.1%	.0%	.2%	.0%
Other Companies	69	55	13	10,736	42.4%	53.6%	24.4%	59.1%
All Far East-Based Companies	24	12	11	1,147	15.0%	11.3%	20.7%	6.3%
All European-Based Companies	7	5	1	850	4.4%	4.8%	2.3%	4.7%
All Hardware Companies	77	77	0	15,446	47.6%	74.8%	.0%	85.0%
All Turnkey & SW Companies	85	26	53	2,734	52.4%	25.2%	100.0%	15.0%
All Companies	162	103	53	18,180	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: Facilities Design  
 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
Intergraph	187	123	30	1,207	32.6%	32.1%	28.7%	8.3%
Digital	73	64	0	214	12.8%	16.9%	.0%	1.5%
Calma	38	21	9	407	6.6%	5.5%	8.2%	2.8%
IBM	32	27	3	2,880	5.6%	7.0%	2.8%	19.7%
Auto-Trol	30	12	7	332	5.2%	3.1%	6.2%	2.3%
McDonnell Douglas	27	16	7	351	4.7%	4.2%	6.4%	2.4%
Calcomp	24	15	7	322	4.2%	3.9%	6.9%	2.2%
Computervision	17	10	3	111	2.9%	2.5%	2.9%	.8%
Autodesk	16	0	16	0	2.9%	.0%	15.5%	.0%
Holguin	16	7	7	388	2.8%	1.8%	7.1%	2.7%
Prime	13	8	2	112	2.2%	2.0%	1.6%	.8%
Apollo	6	5	0	239	1.1%	1.4%	.0%	1.6%
Hewlett-Packard	4	3	1	96	.7%	.7%	.6%	.7%
Control Data	4	2	1	51	.6%	.5%	.9%	.3%
Sun	1	1	0	57	.2%	.3%	.0%	.4%
Other Companies	87	70	13	7,842	15.1%	18.3%	12.2%	53.7%
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	152	142	0	10,566	26.6%	37.2%	.0%	72.3%
All Turnkey & SW Companies	420	240	106	4,043	73.4%	62.8%	100.0%	27.7%
All Companies	573	382	106	14,609	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987

## Appendix B Market Shares

TABLE NUMBER: B.1-6  
 TITLE: 1986 Market Share  
 APPLICATION: Facilities Design  
 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
Auto-Trol	30	12	7	332	17.9%	12.8%	15.4%	13.1%
Calma	23	12	7	277	14.1%	12.8%	15.5%	10.9%
Calcomp	23	15	6	322	13.9%	16.2%	14.8%	12.7%
Intergraph	19	10	6	135	11.3%	10.7%	12.9%	5.3%
McDonnell Douglas	17	9	5	271	10.6%	10.4%	12.5%	10.7%
Nolguin	14	6	7	316	8.6%	6.6%	16.0%	12.5%
Digital	7	6	0	214	4.4%	7.0%	.0%	8.5%
Apollo	6	5	0	239	3.7%	5.9%	.0%	9.4%
Computervision	4	3	1	46	2.4%	3.0%	2.4%	1.8%
Hewlett-Packard	4	3	1	96	2.3%	3.0%	1.6%	3.8%
Sun	1	1	0	57	.7%	1.2%	.0%	2.3%
IBM	1	1	0	8	.6%	.6%	.7%	.3%
Control Data	0	0	0	3	.2%	.1%	.3%	.1%
Autodesk	0	0	0	0	.1%	.0%	.4%	.0%
Other Companies	15	9	3	218	9.2%	9.8%	7.7%	8.6%
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	16	14	0	552	9.5%	15.1%	.0%	21.8%
All Turnkey & SW Companies	149	78	43	1,981	90.5%	84.9%	100.0%	78.2%
All Companies	165	92	43	2,533	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: Facilities Design  
 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
Intergraph	164	110	24	980	50.3%	46.2%	70.0%	41.7%
Digital	66	58	0	0	20.2%	24.3%	.0%	.0%
IBM	17	12	2	176	5.2%	5.2%	6.4%	7.5%
Calma	14	9	2	118	4.3%	3.8%	5.7%	5.0%
Prime	13	8	2	112	3.8%	3.2%	4.8%	4.8%
Computervision	12	7	2	60	3.7%	2.8%	4.6%	2.5%
McDonnell Douglas	9	6	1	80	2.8%	2.7%	4.1%	3.4%
Control Data	3	2	1	48	1.0%	.8%	2.3%	2.1%
Holguin	1	0	0	14	.2%	.2%	1.0%	.6%
Other Companies	27	26	0	760	8.3%	11.0%	1.1%	32.4%
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	91	82	0	743	27.8%	34.4%	.0%	31.6%
All Turnkey & SW Companies	236	157	35	1,606	72.2%	65.6%	100.0%	68.4%
All Companies	326	239	35	2,349	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: Facilities Design  
 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	16	0	16	0	19.9%	.0%	57.3%	.0%
IBM	14	14	0	2,696	17.6%	26.5%	1.7%	27.7%
Intergraph	4	2	1	92	4.6%	4.7%	2.2%	.9%
Calcomp	1	0	1	0	1.2%	.0%	3.3%	.0%
Holquin	1	0	0	59	1.0%	.8%	1.1%	.6%
Computervision	1	0	0	5	.6%	.1%	1.5%	.1%
Calma	0	0	0	13	.5%	.5%	.2%	.1%
Control Data	0	0	0	0	.1%	.0%	.2%	.0%
Other Companies	44	35	9	6,863	54.5%	67.4%	32.6%	70.6%
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	46	46	0	9,271	56.9%	89.5%	.0%	95.3%
All Turnkey & SW Companies	35	5	28	456	43.1%	10.5%	100.0%	4.7%
All Companies	81	52	28	9,727	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: Facilities Design  
 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
Intergraph	59	39	10	381	27.4%	26.1%	26.4%	5.2%
Digital	26	23	0	77	12.2%	15.5%	.0%	1.0%
IBM	20	16	2	1,711	9.3%	11.0%	5.2%	23.2%
Computervision	19	11	4	129	9.0%	7.6%	9.8%	1.7%
McDonnell Douglas	9	6	2	124	4.4%	3.8%	6.6%	1.7%
Calma	8	3	1	59	3.6%	2.1%	3.2%	.8%
Hewlett-Packard	7	5	1	168	3.1%	3.2%	3.3%	2.3%
Robo Systems	7	5	1	788	3.1%	3.1%	3.2%	10.7%
Calcomp	6	4	2	80	2.8%	2.5%	5.0%	1.1%
Autodesk	6	0	6	0	2.6%	.0%	15.5%	.0%
Prime	5	3	1	41	2.2%	1.9%	1.7%	.6%
Pafec	3	0	3	0	1.3%	.0%	7.5%	.0%
Siemens	3	2	0	16	1.2%	1.2%	1.1%	.2%
Apollo	2	2	0	96	1.1%	1.5%	.0%	1.3%
Control Data	2	1	0	25	.8%	.7%	1.3%	.3%
Holguin	2	1	1	42	.8%	.5%	2.3%	.6%
Auto-Trol	1	0	0	12	.5%	.3%	.6%	.2%
Matra Datavision	1	1	0	3	.3%	.4%	.4%	.0%
Sun	0	0	0	19	.2%	.2%	.0%	.3%
Other Companies	30	28	2	3,611	14.2%	18.5%	6.8%	48.9%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	13	7	5	876	6.2%	4.7%	13.7%	11.9%
All Hardware Companies	62	59	0	5,232	29.0%	39.4%	.0%	70.9%
All Turnkey & SW Companies	153	90	36	2,149	71.0%	60.6%	100.0%	29.1%
All Companies	215	149	36	7,382	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: Facilities Design  
 PLATFORM: Technical Workstation  
 REGION: Europe  
 UNITS: Millions of Dollars/Actual Units

Company	Total				Market Share			
	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped	Revenue	Hardware Revenue	Software Revenue	Wkstns Shipped
Hewlett-Packard	7	5	1	168	15.1%	17.8%	11.2%	22.7%
McDonnell Douglas	6	3	2	95	14.0%	12.4%	17.6%	12.9%
Intergraph	6	3	2	43	13.4%	11.5%	16.3%	5.7%
Calcomp	6	4	2	80	13.1%	13.8%	14.9%	10.9%
Computervision	5	3	1	53	10.5%	12.0%	11.2%	7.2%
Calma	4	2	1	25	8.5%	5.7%	5.2%	3.4%
Digital	3	2	0	77	6.0%	8.6%	.0%	10.4%
Apollo	2	2	0	96	5.6%	8.1%	.0%	12.9%
Holguin	2	1	1	34	3.5%	2.5%	7.0%	4.7%
Auto-Trol	1	0	0	12	2.3%	1.5%	2.2%	1.6%
Pafec	1	0	1	0	1.7%	.0%	7.1%	.0%
IBM	1	0	0	5	1.4%	1.2%	1.8%	.7%
Sun	0	0	0	19	.9%	1.3%	.0%	2.6%
Control Data	0	0	0	1	.3%	.2%	.5%	.2%
Autodesk	0	0	0	0	.1%	.0%	.6%	.0%
Other Companies	2	1	0	31	3.4%	3.3%	4.5%	4.2%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	1	0	1	10	2.9%	1.0%	8.6%	1.3%
All Hardware Companies	6	5	0	210	13.5%	19.5%	.0%	28.4%
All Turnkey & SW Companies	38	22	11	530	86.5%	80.5%	100.0%	71.6%
All Companies	44	27	11	740	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: Facilities Design  
 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
Intergraph	52	35	8	309	39.9%	38.1%	47.5%	34.0%
Digital	24	21	0	0	18.1%	22.7%	.0%	.0%
Computervision	14	8	2	70	10.9%	8.7%	11.6%	7.7%
IBM	11	8	1	113	8.4%	8.7%	8.7%	12.4%
Prime	5	3	1	41	3.6%	3.1%	3.9%	4.5%
Calma	4	2	1	34	3.1%	1.8%	3.8%	3.7%
McDonnell Douglas	3	2	1	28	2.5%	2.5%	3.1%	3.1%
Siemens	3	2	0	16	1.9%	1.9%	2.4%	1.8%
Pafec	2	0	2	0	1.5%	.0%	12.2%	.0%
Control Data	2	1	0	24	1.3%	1.0%	2.4%	2.6%
Matra Datavision	1	1	0	3	.6%	.6%	.9%	.3%
Holguin	0	0	0	1	.1%	.0%	.2%	.2%
Other Companies	11	10	1	272	8.1%	10.8%	3.2%	29.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	5	2	3	16	3.8%	1.9%	17.3%	1.8%
All Hardware Companies	33	30	0	267	25.1%	32.5%	.0%	29.3%
All Turnkey & SW Companies	97	62	16	644	74.9%	67.5%	100.0%	70.7%
All Companies	130	91	16	911	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:** Facilities Design  
**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	8	0	1,593	20.7%	26.6%	3.2%	27.8%
Robo Systems	7	5	1	788	16.0%	15.2%	12.2%	13.8%
Autodesk	6	0	6	0	13.5%	.0%	58.7%	.0%
Intergraph	1	1	0	29	2.9%	2.6%	2.0%	.5%
Computervision	1	0	0	6	1.4%	.3%	5.2%	.1%
Calcomp	0	0	0	0	.6%	.0%	2.4%	.0%
Holguin	0	0	0	6	.2%	.1%	.4%	.1%
Control Data	0	0	0	0	.1%	.0%	.3%	.0%
Other Companies	18	17	1	3,308	44.6%	55.2%	15.6%	57.7%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	7	5	1	850	17.3%	16.3%	13.2%	14.8%
All Hardware Companies	24	24	0	4,755	57.6%	78.0%	.0%	83.0%
All Turnkey & SW Companies	17	7	9	976	42.4%	22.0%	100.0%	17.0%
All Companies	41	30	9	5,731	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
 June 1987



## Appendix B Market Shares

TABLE NUMBER: B.1-13  
 TITLE: 1986 Market Share  
 APPLICATION: Facilities Design  
 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
Fujitsu	38	25	11	228	21.8%	21.5%	26.1%	6.8%
Digital	20	17	0	57	11.2%	14.9%	.0%	1.7%
Calma	15	8	3	161	8.5%	7.2%	8.4%	4.8%
NEC	14	9	4	210	8.2%	7.9%	10.0%	6.3%
IBM	14	10	1	1,099	7.8%	8.3%	3.3%	32.9%
Hitachi	8	5	3	189	4.7%	4.0%	7.6%	5.6%
Intergraph	7	5	1	15	4.1%	4.2%	2.6%	.5%
Otsukashokai	7	3	4	594	4.1%	2.3%	10.2%	17.8%
Toshiba	7	6	1	59	4.1%	5.1%	1.6%	1.8%
Mitsubishi Electric	5	3	1	35	2.6%	2.9%	2.1%	1.1%
Computervision	3	2	1	12	1.8%	1.5%	1.9%	.4%
Apollo	2	2	0	96	1.4%	1.9%	.0%	2.9%
Hitachi Zosen	2	1	1	63	1.3%	1.1%	2.0%	1.9%
Autodesk	2	0	2	0	1.0%	.0%	4.1%	.0%
McDonnell Douglas	2	1	0	20	.9%	.8%	.9%	.6%
Prime	1	1	0	9	.8%	.7%	.9%	.3%
Hewlett-Packard	1	1	0	0	.7%	.7%	.8%	.0%
Mutoh Industries	1	1	0	32	.5%	.4%	.9%	.9%
Seiko I&E	1	1	0	4	.5%	.5%	.6%	.1%
Auto-Trol	0	0	0	4	.2%	.1%	.2%	.1%
Sun	0	0	0	14	.2%	.2%	.0%	.4%
Control Data	0	0	0	4	.2%	.1%	.2%	.1%
Holguin	0	0	0	7	.2%	.1%	.3%	.2%
Other Companies	27	18	7	488	15.2%	15.7%	16.1%	14.6%
All Far East-Based Companies	99	61	31	1,619	56.4%	52.7%	74.8%	48.5%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	34	31	0	1,308	19.4%	26.9%	.0%	39.2%
All Turnkey & SW Companies	141	85	41	2,032	80.6%	73.1%	100.0%	60.8%
All Companies	175	116	41	3,340	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: Facilities Design  
 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
Calma	9	5	3	110	40.6%	34.0%	50.4%	32.2%
Apollo	2	2	0	96	10.8%	15.7%	.0%	28.1%
Computervision	2	1	1	8	9.3%	7.9%	11.7%	2.2%
Digital	2	2	0	57	8.6%	12.6%	.0%	16.9%
Hewlett-Packard	1	1	0	0	5.2%	5.7%	6.3%	.0%
McDonnell Douglas	1	1	0	15	4.3%	3.9%	5.7%	4.5%
IBM	1	0	0	6	4.0%	2.9%	4.4%	1.9%
Seiko I&E	1	0	0	3	2.9%	2.9%	4.4%	1.0%
Auto-Trol	0	0	0	4	1.4%	.9%	1.3%	1.0%
Mutoh Industries	0	0	0	1	1.4%	1.3%	2.3%	.3%
Sun	0	0	0	14	1.4%	2.0%	.0%	4.2%
Holguin	0	0	0	6	1.1%	.7%	2.5%	1.7%
Prime	0	0	0	1	1.0%	.9%	1.1%	.4%
Control Data	0	0	0	0	.1%	.1%	.2%	.1%
Other Companies	3	2	1	29	12.0%	12.8%	13.6%	8.5%
All Far East-Based Companies	2	1	1	9	9.6%	9.8%	12.8%	2.6%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	5	4	0	180	22.1%	32.4%	.0%	53.0%
All Turnkey & SW Companies	18	9	5	160	77.9%	67.6%	100.0%	47.0%
All Companies	23	14	5	340	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: Facilities Design  
 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
=====	=====	=====	=====	=====	=====	=====	=====	=====
Fujitsu	38	25	11	228	32.5%	29.7%	48.9%	29.1%
Digital	18	16	0	0	15.0%	18.5%	.0%	.0%
NEC	9	7	2	60	7.8%	8.1%	7.8%	7.7%
Intergraph	7	5	1	15	6.1%	5.8%	4.8%	1.9%
Toshiba	6	5	1	29	5.0%	5.9%	2.5%	3.7%
Calma	6	4	1	47	4.7%	4.2%	3.6%	6.0%
IBM	5	3	0	35	4.0%	3.3%	2.2%	4.4%
Mitsubishi Electric	4	3	1	25	3.7%	3.9%	3.7%	3.2%
Hitachi	3	2	1	12	2.3%	1.8%	4.7%	1.6%
Hitachi Zosen	1	1	0	24	1.0%	.7%	1.9%	3.1%
Prime	1	1	0	8	.9%	.8%	1.4%	1.0%
Computervision	1	1	0	5	.9%	.8%	.7%	.6%
McDonnell Douglas	1	0	0	5	.4%	.4%	.4%	.6%
Control Data	0	0	0	4	.2%	.2%	.3%	.5%
Holguin	0	0	0	0	.0%	.0%	.0%	.0%
Other Companies	20	15	4	337	17.3%	18.1%	17.4%	43.1%
All Far East-Based Companies	72	48	19	463	61.4%	57.2%	86.4%	59.2%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	24	22	0	200	20.7%	26.4%	.0%	25.5%
All Turnkey & SW Companies	94	62	22	584	79.3%	73.6%	100.0%	74.5%
All Companies	118	84	22	783	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: Facilities Design  
 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	8	6	1	1,058	23.2%	35.2%	4.6%	47.7%
Otsukashokai	7	3	4	594	20.8%	14.7%	30.1%	26.8%
Hitachi	6	3	2	176	16.0%	17.0%	15.0%	7.9%
NEC	5	2	2	150	14.9%	13.1%	17.2%	6.8%
Autodesk	2	0	2	0	4.8%	.0%	12.1%	.0%
Toshiba	1	1	0	30	3.5%	5.6%	.8%	1.4%
Hitachi Zosen	1	1	0	39	3.4%	3.4%	3.0%	1.8%
Mutoh Industries	1	0	0	31	1.6%	1.8%	1.7%	1.4%
Mitsubishi Electric	0	0	0	10	.7%	.9%	.3%	.5%
Seiko I&E	0	0	0	1	.5%	.7%	.2%	.0%
Calma	0	0	0	5	.4%	.5%	.1%	.2%
Control Data	0	0	0	0	.0%	.0%	.0%	.0%
Holguin	0	0	0	1	.0%	.0%	.0%	.0%
Other Companies	3	1	2	122	10.1%	7.1%	15.0%	5.5%
All Far East-Based Companies	24	12	11	1,147	69.9%	64.1%	79.8%	51.7%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	5	5	0	929	13.3%	25.4%	.0%	41.9%
All Turnkey & SW Companies	30	14	14	1,288	86.7%	74.6%	100.0%	58.1%
All Companies	35	18	14	2,217	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: Facilities Design  
 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
Intergraph	14	9	2	90	32.7%	29.3%	39.2%	10.2%
Digital	12	10	0	34	27.8%	33.4%	.0%	3.9%
Calma	5	3	1	49	10.7%	8.2%	18.2%	5.6%
Autodesk	1	0	1	0	3.5%	.0%	25.8%	.0%
Apollo	1	1	0	48	2.9%	3.5%	.0%	5.5%
IBM	1	1	0	57	1.6%	1.8%	1.2%	6.5%
Prime	1	0	0	5	1.3%	1.1%	1.4%	.6%
Computervision	0	0	0	3	.9%	.7%	1.2%	.3%
Auto-Trol	0	0	0	4	.7%	.4%	1.2%	.4%
Control Data	0	0	0	4	.7%	.5%	1.4%	.5%
Hewlett-Packard	0	0	0	6	.6%	.5%	.7%	.7%
Holguin	0	0	0	4	.4%	.2%	1.0%	.4%
Sun	0	0	0	5	.2%	.3%	.0%	.5%
Other Companies	7	6	1	567	15.9%	20.0%	8.7%	64.8%
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	19	18	0	698	45.4%	57.0%	.0%	79.8%
All Turnkey & SW Companies	23	13	6	176	54.6%	43.0%	100.0%	20.2%
All Companies	42	31	6	875	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: Facilities Design  
 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	1	1	33	35.3%	28.2%	49.7%	22.5%
Intergraph	1	1	0	10	17.4%	14.3%	25.5%	6.7%
Apollo	1	1	0	48	15.4%	21.5%	.0%	32.1%
Digital	1	1	0	34	14.8%	20.7%	.0%	23.2%
Auto-Trol	0	0	0	4	3.9%	2.6%	4.3%	2.4%
Hewlett-Packard	0	0	0	6	3.0%	3.4%	2.5%	4.0%
Holguin	0	0	0	3	1.6%	1.2%	3.7%	1.9%
Sun	0	0	0	5	1.3%	2.0%	.0%	3.2%
Computervision	0	0	0	1	1.1%	1.4%	1.2%	.7%
Control Data	0	0	0	0	.3%	.2%	.6%	.1%
IBM	0	0	0	0	.3%	.0%	.6%	.1%
Autodesk	0	0	0	0	.1%	.0%	.6%	.0%
Other Companies	0	0	0	4	5.5%	4.6%	11.2%	2.9%
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	3	2	0	89	32.1%	45.1%	.0%	60.1%
All Turnkey & SW Companies	5	3	2	59	67.9%	54.9%	100.0%	39.9%
All Companies	8	5	2	149	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: Facilities Design  
 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
=====	=====	=====	=====	=====	=====	=====	=====	=====
Intergraph	12	8	2	73	40.9%	35.2%	77.9%	33.0%
Digital	11	9	0	0	35.6%	40.0%	.0%	.0%
Calma	2	1	0	14	5.6%	4.7%	10.4%	6.4%
Prime	1	0	0	5	1.9%	1.5%	3.5%	2.3%
IBM	0	0	0	4	1.2%	1.2%	2.2%	1.7%
Computervision	0	0	0	1	1.0%	.7%	1.7%	.6%
Control Data	0	0	0	4	.9%	.7%	3.0%	1.8%
Holguin	0	0	0	0	.0%	.0%	.0%	.1%
Other Companies	4	4	0	120	12.8%	16.1%	1.3%	54.1%
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	14	13	0	118	47.8%	55.6%	.0%	53.3%
All Turnkey & SW Companies	16	10	2	103	52.2%	44.4%	100.0%	46.7%
All Companies	30	23	2	221	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: Facilities Design  
 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
Autodesk	1	0	1	0	32.0%	.0%	80.0%	.0%
IBM	0	0	0	53	6.3%	10.4%	.5%	10.5%
Intergraph	0	0	0	7	6.0%	6.3%	2.7%	1.4%
Calma	0	0	0	2	1.1%	.7%	.5%	.3%
Computervision	0	0	0	0	.2%	.0%	.5%	.0%
Control Data	0	0	0	0	.2%	.0%	.0%	.0%
Holguin	0	0	0	1	.2%	.0%	.0%	.1%
Other Companies	3	2	0	443	54.0%	82.5%	15.7%	87.7%
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	2	2	0	491	53.1%	91.8%	.0%	97.3%
All Turnkey & SW Companies	2	0	2	14	46.9%	8.2%	100.0%	2.7%
All Companies	5	3	2	505	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987



## Appendix B Market Shares

TABLE NUMBER: B.2-1  
 TITLE: 1986 Market Share  
 APPLICATION: Mapping  
 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
Intergraph	151	100	25	961	42.3%	42.9%	35.4%	30.7%
Digital	51	45	0	149	14.2%	19.2%	.0%	4.7%
IBM	27	19	4	667	7.7%	8.3%	5.3%	21.3%
Synercom	17	0	12	0	4.8%	.0%	17.9%	.0%
Siemens	17	12	3	73	4.6%	5.1%	3.7%	2.3%
Syscan	14	10	2	57	3.8%	4.1%	3.0%	1.8%
Computervision	10	6	2	64	2.8%	2.5%	2.6%	2.0%
Fujitsu	8	5	2	48	2.2%	2.2%	3.2%	1.5%
NEC	4	3	1	20	1.1%	1.2%	1.0%	.6%
Autodesk	3	0	3	0	.8%	.0%	4.1%	.0%
Holguin	3	1	1	69	.8%	.5%	1.9%	2.2%
Mutoh Industries	2	1	1	41	.7%	.6%	1.4%	1.3%
Apollo	1	1	0	48	.3%	.5%	.0%	1.5%
Pafec	1	0	1	0	.2%	.0%	1.0%	.0%
Other Companies	49	30	14	939	13.8%	12.9%	19.5%	30.0%
All Far East-Based Companies	17	12	4	116	4.8%	5.1%	6.0%	3.7%
All European-Based Companies	31	21	5	130	8.6%	9.2%	7.7%	4.1%
All Hardware Companies	70	64	0	1,207	19.5%	27.4%	.0%	38.5%
All Turnkey & SW Companies	288	169	70	1,927	80.5%	72.6%	100.0%	61.5%
All Companies	358	232	70	3,134	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987

## Appendix B Market Shares

TABLE NUMBER: B.2-2  
 TITLE: 1986 Market Share  
 APPLICATION: Mapping  
 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
Intergraph	15	8	4	106	48.6%	42.0%	56.8%	25.1%
Digital	5	4	0	149	16.7%	24.3%	.0%	35.1%
Holguin	3	1	1	56	8.3%	5.8%	15.9%	13.2%
Computervision	2	2	1	26	7.8%	8.8%	8.2%	6.1%
Apollo	1	1	0	48	4.1%	5.9%	.0%	11.3%
IBM	1	1	0	9	3.3%	2.9%	4.0%	2.1%
Pafec	0	0	0	0	.6%	.0%	2.5%	.0%
Autodesk	0	0	0	0	.1%	.0%	.4%	.0%
Other Companies	3	2	1	30	10.4%	10.4%	12.2%	7.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	.6%	.0%	2.5%	.0%
All Hardware Companies	7	6	0	207	21.6%	31.3%	.0%	48.9%
All Turnkey & SW Companies	24	13	8	216	78.4%	68.7%	100.0%	51.1%
All Companies	30	18	8	423	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: Mapping  
 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
=====	=====	=====	=====	=====	=====	=====	=====	=====
Intergraph	134	90	20	782	42.9%	43.7%	36.2%	41.1%
Digital	46	40	0	0	14.6%	19.5%	.0%	.0%
IBM	23	16	3	228	7.5%	7.9%	5.3%	12.0%
Synercom	17	0	12	0	5.5%	.0%	22.8%	.0%
Siemens	17	12	3	73	5.3%	5.7%	4.7%	3.9%
Syscan	14	10	2	57	4.4%	4.7%	3.8%	3.0%
Fujitsu	8	5	2	48	2.5%	2.5%	4.1%	2.5%
Computervision	7	4	1	34	2.3%	2.0%	1.7%	1.8%
NEC	4	3	1	20	1.2%	1.4%	1.3%	1.1%
Pafec	0	0	0	0	.2%	.0%	.9%	.0%
Holguin	0	0	0	2	.0%	.0%	.1%	.1%
Other Companies	42	26	10	658	13.5%	12.7%	19.1%	34.6%
All Far East-Based Companies	15	10	3	75	4.7%	5.1%	5.9%	3.9%
All European-Based Companies	31	21	5	130	9.9%	10.4%	9.4%	6.8%
All Hardware Companies	61	55	0	487	19.5%	26.9%	.0%	25.6%
All Turnkey & SW Companies	251	151	55	1,416	80.5%	73.1%	100.0%	74.4%
All Companies	312	206	55	1,903	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: Mapping  
 PLATFORM: Personal Computer  
 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
IBM	3	2	0	430	19.6%	31.3%	6.7%	53.2%
Intergraph	3	2	0	73	18.6%	24.6%	6.7%	9.0%
Autodesk	3	0	3	0	17.8%	.0%	38.7%	.0%
Mutoh Industries	2	1	1	41	15.5%	18.8%	13.4%	5.0%
Computervision	0	0	0	3	2.0%	.5%	3.6%	.4%
Holguin	0	0	0	10	.9%	1.0%	.7%	1.3%
Other Companies	4	2	2	251	25.6%	23.7%	30.2%	31.1%
All Far East-Based Companies	2	1	1	41	15.5%	18.8%	13.4%	5.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	3	3	0	513	16.1%	33.1%	.0%	63.5%
All Turnkey & SW Companies	13	5	7	294	83.9%	66.9%	100.0%	36.5%
All Companies	16	8	7	807	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: Mapping  
 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
	=====	=====	=====	=====	=====	=====	=====	=====
Intergraph	106	70	17	686	53.9%	56.2%	42.3%	39.0%
Digital	28	25	0	83	14.5%	20.2%	.0%	4.7%
Synercom	13	0	9	0	6.6%	.0%	22.9%	.0%
IBM	13	9	2	329	6.6%	7.5%	4.5%	18.7%
Computervision	4	2	1	28	2.1%	1.9%	1.9%	1.6%
Holguin	3	1	1	69	1.4%	1.0%	3.3%	3.9%
Autodesk	2	0	2	0	.9%	.0%	4.5%	.0%
Apollo	1	1	0	24	.3%	.4%	.0%	1.4%
Other Companies	27	16	8	540	13.7%	12.7%	20.5%	30.7%
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	39	35	0	627	19.8%	28.5%	.0%	35.7%
All Turnkey & SW Companies	158	89	41	1,131	80.2%	71.5%	100.0%	64.3%
All Companies	197	124	41	1,758	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: Mapping  
 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
Intergraph	11	6	3	77	53.3%	47.2%	59.8%	28.0%
Digital	3	3	0	83	14.3%	21.3%	.0%	30.4%
Holguin	3	1	1	56	12.7%	9.0%	23.3%	20.5%
Computervision	1	1	0	11	4.9%	5.8%	4.8%	4.1%
Apollo	1	1	0	24	3.1%	4.6%	.0%	8.7%
IBM	1	0	0	5	3.1%	2.8%	3.6%	1.9%
Autodesk	0	0	0	0	.1%	.0%	.4%	.0%
Other Companies	2	1	0	17	8.5%	9.3%	8.0%	6.3%
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	4	3	0	113	18.1%	26.9%	.0%	41.3%
All Turnkey & SW Companies	16	9	5	160	81.9%	73.1%	100.0%	58.7%
All Companies	20	12	5	274	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:** Mapping  
**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
Intergraph	93	63	14	557	55.7%	58.0%	44.7%	53.1%
Digital	26	23	0	0	15.3%	20.8%	.0%	.0%
Synercom	13	0	9	0	7.7%	.0%	30.3%	.0%
IBM	11	8	1	110	6.4%	7.2%	4.4%	10.5%
Computervision	3	2	0	15	1.8%	1.6%	1.3%	1.4%
Holguin	0	0	0	2	.1%	.1%	.2%	.2%
Other Companies	22	13	6	365	13.1%	12.3%	19.0%	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	34	31	0	273	20.3%	28.7%	.0%	26.0%
All Turnkey & SW Companies	133	77	31	777	79.7%	71.3%	100.0%	74.0%
All Companies	168	108	31	1,049	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: Mapping  
 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
Intergraph	2	1	0	52	22.8%	34.2%	7.4%	12.0%
Autodesk	2	0	2	0	19.7%	.0%	38.8%	.0%
IBM	2	1	0	214	17.7%	30.5%	6.1%	49.0%
Computervision	0	0	0	2	1.6%	.5%	2.5%	.4%
Holguin	0	0	0	10	1.5%	2.0%	1.1%	2.4%
Other Companies	3	1	2	158	36.7%	32.8%	44.1%	36.2%
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	241	12.9%	29.8%	.0%	55.4%
All Turnkey & SW Companies	8	3	5	194	87.1%	70.2%	100.0%	44.6%
All Companies	9	4	5	435	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: Mapping  
 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
Intergraph	33	22	5	216	35.2%	33.8%	35.2%	27.6%
Siemens	17	12	3	73	17.3%	18.1%	16.6%	9.3%
Syscan	14	10	2	57	14.5%	14.8%	13.5%	7.2%
Digital	10	9	0	30	10.7%	13.7%	.0%	3.8%
IBM	8	6	1	210	8.7%	9.2%	7.7%	26.7%
Computervision	5	3	1	32	5.1%	4.3%	5.8%	4.1%
Synercom	2	0	1	0	1.8%	.0%	8.1%	.0%
Pafec	1	0	1	0	.7%	.0%	4.3%	.0%
Autodesk	1	0	1	0	.7%	.0%	4.1%	.0%
Apollo	0	0	0	10	.3%	.3%	.0%	1.2%
Other Companies	5	4	1	158	5.1%	5.7%	4.7%	20.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	31	21	5	130	32.5%	32.9%	34.5%	16.5%
All Hardware Companies	14	13	0	293	15.0%	20.1%	.0%	37.4%
All Turnkey & SW Companies	81	52	16	492	85.0%	79.9%	100.0%	62.6%
All Companies	95	65	16	786	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
June 1987

## Appendix B Market Shares

TABLE NUMBER: 9.2-10  
 TITLE: 1986 Market Share  
 APPLICATION: Mapping  
 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
Intergraph	3	2	1	24	52.3%	44.8%	61.5%	29.2%
Computervision	1	1	0	13	17.8%	20.4%	18.6%	16.0%
Digital	1	1	0	30	15.9%	22.6%	.0%	35.9%
IBM	0	0	0	3	6.1%	5.3%	7.5%	4.1%
Apollo	0	0	0	10	3.9%	5.6%	.0%	11.5%
Pafec	0	0	0	0	3.0%	.0%	11.8%	.0%
Autodesk	0	0	0	0	.2%	.0%	.6%	.0%
Other Companies	0	0	0	3	.9%	1.3%	.0%	3.3%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	0	0	0	0	3.0%	.0%	11.8%	.0%
All Hardware Companies	1	1	0	42	20.7%	29.5%	.0%	50.7%
All Turnkey & SW Companies	5	3	2	41	79.3%	70.5%	100.0%	49.3%
All Companies	6	4	2	83	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:** Mapping  
**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
=====	=====	=====	=====	=====	=====	=====	=====	=====
Intergraph	29	20	4	176	34.3%	33.3%	34.0%	35.4%
Siemens	17	12	3	73	19.2%	19.7%	20.2%	14.7%
Syscan	14	10	2	57	16.0%	16.1%	16.3%	11.4%
Digital	9	8	0	0	10.6%	13.5%	.0%	.0%
IBM	7	5	1	70	7.9%	8.3%	6.9%	14.2%
Computervision	4	2	0	17	4.1%	3.3%	3.6%	3.5%
Synercom	2	0	1	0	2.0%	.0%	9.8%	.0%
Pafec	0	0	0	0	.6%	.0%	3.8%	.0%
Other Companies	5	3	1	104	5.3%	5.7%	5.5%	20.8%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All European-Based Companies	31	21	5	130	35.8%	35.9%	40.2%	26.1%
All Hardware Companies	12	11	0	98	14.2%	18.7%	.0%	19.6%
All Turnkey & SW Companies	74	48	13	399	85.8%	81.3%	100.0%	80.4%
All Companies	86	60	13	497	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: Mapping  
 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	0	136	37.6%	53.3%	17.4%	66.2%
Intergraph	1	0	0	16	24.0%	28.3%	10.1%	8.0%
Autodesk	1	0	1	0	22.6%	.0%	57.8%	.0%
Computervision	0	0	0	2	6.1%	1.3%	12.8%	.9%
Other Companies	0	0	0	51	9.7%	17.1%	1.8%	24.9%
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	1	1	0	154	27.2%	51.3%	.0%	74.8%
All Turnkey & SW Companies	2	1	1	52	72.8%	48.7%	100.0%	25.2%
All Companies	3	2	1	206	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: Mapping  
 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
=====	=====	=====	=====	=====	=====	=====	=====	=====
Fujitsu	8	5	2	48	17.5%	16.5%	26.8%	10.8%
Digital	8	7	0	22	16.8%	21.4%	.0%	5.0%
IBM	6	4	1	121	13.4%	12.0%	7.2%	27.1%
Intergraph	4	3	1	8	9.0%	8.8%	7.3%	1.7%
NEC	4	3	1	20	8.5%	9.0%	8.6%	4.5%
Mutoh Industries	2	1	1	41	5.4%	4.7%	11.9%	9.1%
Synercom	1	0	1	0	1.9%	.0%	7.5%	.0%
Computervision	1	1	0	3	1.7%	1.6%	1.8%	.7%
Apollo	0	0	0	10	.6%	.7%	.0%	2.1%
Autodesk	0	0	0	0	.4%	.0%	2.3%	.0%
Other Companies	11	8	2	173	24.7%	25.2%	26.7%	38.9%
All Far East-Based Companies	17	12	4	116	38.0%	38.2%	50.7%	26.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	11	10	0	220	23.8%	31.4%	.0%	49.3%
All Turnkey & SW Companies	34	21	8	225	76.2%	68.6%	100.0%	50.7%
All Companies	45	31	8	445	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:** Mapping  
**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
Digital	1	1	0	22	29.8%	39.2%	.0%	53.3%
Apollo	0	0	0	10	9.8%	12.9%	.0%	22.9%
Computervision	0	0	0	1	9.4%	7.6%	12.5%	2.7%
Other Companies	1	1	0	9	51.2%	40.5%	87.7%	21.1%
All Far East-Based Companies	0	0	0	0	.0%	.0%	.0%	.1%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	34	41.2%	55.0%	.0%	80.6%
All Turnkey & SW Companies	2	1	1	8	58.8%	45.0%	100.0%	19.4%
All Companies	3	2	1	42	100.0%	100.0%	100.0%	100.0%

Source: Dataquest  
 June 1987

## Appendix B Market Shares

**TABLE NUMBER:** B.2-15  
**TITLE:** 1986 Market Share  
**APPLICATION:** Mapping  
**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
=====	=====	=====	=====	=====	=====	=====	=====	=====
Fujitsu	8	5	2	48	20.1%	18.8%	33.9%	19.2%
Digital	7	6	0	0	17.4%	21.9%	.0%	.0%
IBM	6	3	1	45	14.4%	12.2%	9.1%	18.1%
Intergraph	4	3	1	8	10.4%	10.0%	9.2%	3.1%
NEC	4	3	1	20	9.7%	10.2%	10.9%	8.0%
Synercom	1	0	1	0	2.2%	.0%	9.5%	.0%
Computervision	1	0	0	2	1.4%	1.3%	1.2%	.8%
Other Companies	10	7	2	127	24.5%	25.5%	26.1%	50.7%
All Far East-Based Companies	15	10	3	75	37.3%	38.0%	49.2%	30.0%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	9	8	0	73	23.2%	30.2%	.0%	29.3%
All Turnkey & SW Companies	30	19	7	177	76.8%	69.8%	100.0%	70.7%
All Companies	39	28	7	250	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: Mapping  
 PLATFORM: Personal Computer  
 REGION: Far East  
 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
Mutoh Industries	2	1	1	41	76.3%	72.4%	83.1%	26.5%
IBM	0	0	0	75	11.5%	18.7%	.0%	49.0%
Autodesk	0	0	0	0	5.9%	.0%	16.1%	.0%
Other Companies	0	0	0	38	6.2%	8.9%	.8%	24.5%
All Far East-Based Companies	2	1	1	41	76.3%	72.4%	83.1%	26.5%
All European-Based Companies	0	0	0	0	.0%	.0%	.0%	.0%
All Hardware Companies	1	1	0	113	17.4%	27.6%	.0%	73.5%
All Turnkey & SW Companies	3	1	1	41	82.6%	72.4%	100.0%	26.5%
All Companies	3	2	1	154	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: Mapping  
 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
Intergraph	8	5	1	51	37.5%	42.8%	25.5%	35.1%
Digital	5	4	0	13	21.7%	33.3%	.0%	9.2%
Synercom	2	0	1	0	8.2%	.0%	24.9%	.0%
IBM	0	0	0	7	1.3%	1.6%	.8%	4.8%
Autodesk	0	0	0	0	.8%	.0%	3.4%	.0%
Apollo	0	0	0	5	.6%	.8%	.0%	3.3%
Computervision	0	0	0	1	.4%	.5%	.4%	.5%
Other Companies	6	3	2	68	29.5%	21.1%	45.0%	47.1%
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	6	5	0	67	28.8%	45.3%	.0%	46.4%
All Turnkey & SW Companies	15	7	5	78	71.2%	54.7%	100.0%	53.6%
All Companies	21	12	5	145	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:** Mapping  
**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
Intergraph	1	0	0	6	52.0%	40.4%	88.5%	22.3%
Digital	0	0	0	13	30.3%	40.4%	.0%	52.5%
Apollo	0	0	0	5	7.9%	10.1%	.0%	18.8%
Computervision	0	0	0	0	1.3%	2.0%	3.8%	1.1%
IBM	0	0	0	0	.7%	.0%	.0%	.4%
Other Companies	0	0	0	1	7.9%	7.1%	7.7%	4.9%
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	1	1	0	18	38.8%	50.5%	.0%	72.5%
All Turnkey & SW Companies	1	0	0	7	61.2%	49.5%	100.0%	27.5%
All Companies	2	1	0	25	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: Mapping  
 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
Intergraph	7	5	1	41	36.5%	42.8%	22.9%	38.7%
Digital	4	4	0	0	21.7%	33.3%	.0%	.0%
Synercom	2	0	1	0	9.1%	.0%	28.0%	.0%
IBM	0	0	0	2	1.2%	1.6%	.7%	2.2%
Computervision	0	0	0	0	.4%	.4%	.2%	.3%
Other Companies	6	2	2	63	31.1%	22.0%	48.2%	58.8%
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	5	5	0	44	28.7%	45.4%	.0%	40.8%
All Turnkey & SW Companies	14	6	4	63	71.3%	54.6%	100.0%	59.2%
All Companies	19	11	4	107	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: Mapping  
 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
Autodesk	0	0	0	0	31.5%	.0%	56.7%	.0%
Intergraph	0	0	0	4	29.6%	50.0%	10.0%	30.7%
IBM	0	0	0	5	7.4%	9.1%	3.3%	35.9%
Other Companies	0	0	0	4	31.5%	40.9%	30.0%	33.1%
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	0	0	0	5	5.6%	18.2%	.0%	40.6%
All Turnkey & SW Companies	1	0	0	8	94.4%	81.8%	100.0%	59.4%
All Companies	1	0	0	13	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.)