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Document Management

Copiers
- Copiers *North America*
- Copiers *Europe*

Facsimile
- Facsimile *North America*

Printers
- Printers *North America*
- Printers *Europe*
- Colour Products *Europe* (Module)
- Printer Quarterly Statistics *Europe*
- Printer Distribution Channels *Europe*
- Printers *Asia/Pacific*
- Printer Quarterly Statistics *Asia/Pacific*

Semiconductors

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- Semiconductors *Europe*
- Semiconductors *Japan*
- Semiconductors *Asia/Pacific*
  - China/Hong Kong
  - Taiwan
  - Korea
  - Singapore

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- ASIC Applications *Europe*
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- Memory IC Quarterly Statistics *Worldwide*
- Embedded Microcomponents *Worldwide*
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- DRAM Quarterly Supply/Demand Report

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- Semiconductor Supply and Pricing Worldwide

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- Semiconductor Application Markets *Europe*
- Semiconductor Application Markets *Asia/Pacific*
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- Consumer Multimedia Semiconductors & Applications *Worldwide*
- Semiconductor Directions in PCs & PC Multimedia *WW*
- PC Teardown Analysis
- PC Watch *Europe*
- Electronic Equipment Production Monitor *Europe*
- Electronic Application Markets *Europe* —Automotive
- Electronic Application Markets *Europe* —Communications
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- Electronic Application Markets *Europe* —EDP

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- LCD Industry *Worldwide*
- Semiconductor Contract Manufacturing *Worldwide*

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  - Wide Area Networks *North America*
  - Modems *North America*
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  - Asynchronous Transfer Mode *Europe*
  - ISDN *Europe*
  - Modems *Europe*
  - Local Area Networks *Europe*
  - WANs *Europe*
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  - Intelligent Hubs & Switches
  - Network Interface Cards
- Network Distribution Channels *Europe*

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  - Voice Processing *North America*
  - Computer-Integrated Telephony & Automatic Call Distributors *North America*
  - Premise Switching Systems *North America*
- Voice Communications *Europe*
  - Voice Processing *Europe*
  - Call Centres *Europe*
  - Telephones *Europe*
  - PBX/KTS Systems *Europe*

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- Public Network Equipment & Services *North America*
  - Public Network Equipment *North America*
  - Public Network Services *North America*
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  - Public Network Equipment *Europe*
  - Public Network Services *Europe*

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- Personal Communications *North America*
- Personal Communications *Europe*
  - Infrastructure and Services *Europe*
  - Terminals *Europe*
- Personal Communications Distribution Europe

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Technology Insights for:
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- Government Agencies
- Publishing, Media, and Consulting Firms
- IT Business Development for Financial Organizations
- IS and Purchasing Organizations
- IT Supporting Industries

Emerging IT Markets

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- Personal Computers
- Telecommunications

Latin America
- Personal Computers
- Printers

Asia/Pacific
- IT Market Insight *Asia/Pacific*
- Personal Computers *Asia/Pacific* & Quarterly Statistics
- Printers *Asia/Pacific* & Quarterly Statistics
- Professional Service Trends *Asia/Pacific*
  - Country-level reports on Asia/Pacific IT markets

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1996 RESEARCH PROGRAMS

From semiconductors to systems, software to services, telecommunications to document management, Dataquest's scope of expertise provides clients with a clear view of the relationships among information technology segments – relationships that can have a profound impact on making strategic business decisions.

Computer Systems and Peripherals

Computer Systems
- Client/Server Computing *Worldwide*
- Computer and Client/Server Systems *Europe*
- Servers *Europe*
- UNIX and Open Systems *Europe*

Workstations
- Advanced Desktop and Workstation Computing *Worldwide*
- Workstations *Europe*

Computer Storage
- Removable Storage *Worldwide*
- Optical Disk Drives *Worldwide*
- Optical Disk Drives *Europe*
- Rigid Disk Drives *Worldwide*
  - RAID Storage Systems *Worldwide*
- Rigid Disk Drives *Europe*
- Tape Drives *Worldwide*
- Tape Drives *Europe*

Graphics
- Graphics and Displays *Worldwide*

Personal Computing
- Personal Computers *Worldwide*
- Personal Computers Strategic Service *Europe*
- Personal Computers *Asia/Pacific*
- Mobile Computing *Worldwide*
- PC Distribution Channels *Worldwide*
- PC Distribution Channels *Europe*
- Desktop PC Technology Directions *Worldwide*
- Mobile PC Technology Directions *Worldwide*
- Personal Computers *Central and Eastern Europe*

Quarterly Statistics
- Advanced Desktop and Workstation Quarterly Statistics *Worldwide*
- Workstation Quarterly Statistics *Europe*
- Server Quarterly Statistics *North America*
- Server Quarterly Statistics *Europe*
- PC Quarterly Statistics *United States*
- PC Quarterly Statistics *Europe*
- PC Quarterly Statistics *Japan*
- PC Quarterly Statistics *Asia/Pacific*
- PC Quarterly Statistics *Worldwide by Region*

Online, Multimedia, and Software

Emerging Technologies
- Multimedia *Worldwide*
- Multimedia *Europe* (Module)
- Online Strategies *Worldwide*
- Online Strategies *Europe* (Module)

Productivity/Development Tools
- Client/Server Software *Worldwide*
- Workgroup Computing *Worldwide*
- Workgroup Computing *Europe* (Module)
- Personal Computing Software *Worldwide*
- Personal Computing Software *Europe* (Module)

Technical Applications
- AEC and GIS Applications *Worldwide*
- Electronic Design Automation (EDA) *Worldwide*
- Mechanical CAD/CAM/CAE *Worldwide*
- CAD/CAM/CAE/GIS *Europe* (Module)
- CAD/CAM/CAE *Asia/Pacific* (Module)

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Customer Services
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- Customer Services and Management Trends *Europe*

Professional Services
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  - Systems Integration and Applications Development
  - Consulting and Education
  - Systems Management
- Vertical Market Opportunities *North America*
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  - Systems Management
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- Professional Service Trends *Asia/Pacific*

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  - Notebook Services
  - Server Services
- User Computing Services *Europe*
- Network Integration and Support Services *North America*
- Network Integration and Support Services *Europe*
- Software Services *North America*
- Strategic Service Partnering *North America*

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DATAQUEST 1996 CONFERENCES

Dataquest Invitational Computer Conferences *(continued)*

January 17	Dataquest Storage Solutions Series-Europe	Paris, France
January 23	Dataquest Storage Solutions Series-Europe	Munich, Germany
January 30	Dataquest Storage Solutions Series-Europe	Milan, Italy
February 1	Dataquest Storage Solutions Series-Europe	Rome, Italy
June 10	Dataquest Storage Solutions Series-Europe	Budapest, Hungary
June 12	Dataquest Storage Solutions Series-Europe	Prague, Czech Republic
June 21	Dataquest Storage Solutions Series-Europe	St. Petersburg, Russia
June 25	Dataquest Storage Solutions Series-Europe	Moscow, Russia
July 1	Dataquest Storage Solutions Series-Europe	Warsaw, Poland
September 1	Dataquest Storage Solutions Series-Europe	Amsterdam, Holland
September 5	Dataquest Storage Solutions Series-Europe	Stockholm, Sweden
September 11	Dataquest Storage Solutions Series-Europe	London, England
September 19	Dataquest Storage Solutions Series-Europe	Frankfurt, Germany

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October 1 *	Latin America Series	Caracas, Venezuela
October 1 *	Latin America Series	Mexico City, Mexico
October 1 *	Latin America Series	São Paulo, Brazil
October 1 *	Latin America Series	Buenos Aires, Argentina
October 1 *	Latin America Series	Santiago, Chile
October 1 *	Latin America Series	Bogotà, Columbia
October 1 *	Latin America Series	Lima, Peru
February 19	South Africa Series	Capetown, South Africa
February 22	South Africa Series	Johannesburg, South Africa
April 11	LINK Series - North America	Orlando, Florida
April 30	LINK Series - North America	Austin, Texas
May 1	LINK Series - North America	Philadelphia, Pennsylvania
May 9	LINK Series - North America	Charlotte, North Carolina
May 14	LINK Series - North America	Denver, Colorado
May 21	LINK Series - North America	Portland, Oregon
November 1 *	LINK Series - North America	Montréal, Québec
November 1 *	LINK Series - North America	Ottawa, Ontario
November 1 *	LINK Series - North America	Calgary, Alberta
November 1 *	LINK Series - North America	Vancouver, BC
November 1 *	LINK Series - North America	Toronto, Ontario

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Program Code: DQGE-WW MKTG 1/96 (PSB)

DATAQUEST 1996 CONFERENCES

Dataquest sponsors an on-going series of conferences and invitational events focusing on trends and issues in information technology and IT services. These conferences are the preeminent source of insight and analysis of global IT market dynamics.

North America	January 24	Capitalizing on the Wireless Phenomenon	San Jose, California
	January 30	Dataquest Predicts	Boston, Massachusetts
	February 20	Dataquest Predicts	San Jose, California
	March 7	Channel Trends Conference	San Jose, California
	April 1-2	ServiceTrends Conference	Orlando, Florida
	April 1 *	Mining the Internet	Boston, Massachusetts
	May 6-7	Personal Computer Conference	San Jose, California
	May 13-14	Copier Conference	Boston, Massachusetts
	June 26-27	Storage Track Conference	Monterey, California
	July 1 *	SEMICON/West	San Francisco, California
	September 25-26 *	Multimedia	San Jose, California
	October 24-25	Semiconductors '96	Palm Desert, California
	December 1 *	Mining the Internet	San Jose, California
Europe	January 24	Computer Storage	Munich, Germany
	May 22-23	Semiconductors '96	Frankfurt, Germany
	September 10	Computer Storage	London, England
Japan	May 13-14	Semiconductors '96	Tokyo, Japan
	September 10-12	Computers and Peripherals	Tokyo, Japan
	December 6	Telecommunications	Tokyo, Japan
Dataquest Invitational Computer Conferences	December 1 *	Asia/Pacific Series	Tokyo, Japan
	December 1 *	Asia/Pacific Series	Seoul, Korea
	December 1 *	Asia/Pacific Series	Beijing, PRC
	December 1 *	Asia/Pacific Series	Shanghai, PRC
	December 1 *	Asia/Pacific Series	Xi'an, PRC
	December 1 *	Asia/Pacific Series	Guangzhou, PRC
	March 5	Dataquest Storage Solutions Series - USA	San Jose, California
	April 10	Dataquest Storage Solutions Series - USA	Irvine, California
	April 24	Dataquest Storage Solutions Series - USA	Nashua, New Hampshire
	September 24	Dataquest Storage Solutions Series - USA	Newton, Massachusetts
	April 1	Mediterranean Series	Dubai, UAE
	May 21	Mediterranean Series	Athens, Greece
	October 30	Mediterranean Series	Tel Aviv, Israel
	November 6	Mediterranean Series	Istanbul, Turkey

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MECHANICAL CAD/CAM/CAE WORLDWIDE

Dataquest's Mechanical CAD/CAM/CAE Worldwide program provides comprehensive and insightful analysis of the dynamics driving the growth of markets for mechanical CAD tools and applications. The service balances detailed worldwide quantitative statistics with qualitative assessments of leading MCAD players, products, channels, and market issues.

Partnering to Provide Solutions

As a client, you have direct access to experienced analysts who can provide insights and advice on market dynamics, industry events, and competitive issues.

Inquiry Support

Personalized inquiry support is a primary component of your Dataquest annual subscription program.

Through an interactive approach, Dataquest analysts work with you to tailor the program to meet the unique needs of your organization.

Electronic Delivery

Dataquest offers a variety of electronic tools, known collectively as *Dataquest on the Desktop*, that have the power to deliver Dataquest insights directly to you, whether you are on the road or in the office.

Please visit *Dataquest Interactive*, our Internet-based information system, at this URL: http://www.dataquest.com.

Information Resource Centers

Clients have unlimited access to Dataquest's extensive print and online resource libraries worldwide.

Optional Custom Research

Should your needs exceed the scope of this program, Dataquest offers comprehensive primary research and consulting services.

Market Coverage

Dataquest provides global MCAD software shipments, market share, revenue, and market forecasts, as follows:

Major Data Points

- Total factory, hardware, software, software service, and hardware service revenue
- Computer shipments and installed base
- Operating systems (27)
- Distribution channels
- Software revenue by application and industry

Applications

- Product data management
- Drafting/documentation
- Conceptual design
- Functional design
- Analysis
- Manufacturing engineering
- Manufacturing process simulation
- Numerical control

Industries

- Major discrete manufacturing industries

Modeling Technologies

- 2-D, 3-D, solid modeling

Operating Systems

- All major personal computer and UNIX operating systems

Geographies

- North America
- Europe *
- Japan *
- Asia/Pacific *
- Rest of world
- Worldwide

(* Country-level Europe and Japan/Asia/Pacific data is available in optional Market Statistics reports)

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WHAT YOU WILL RECEIVE AS A CLIENT

MECHANICAL CAD/CAM/CAE WORLDWIDE

Perspective

Dataquest Perspectives present analysis and commentary on key technologies, companies, market opportunities, trends, and issues in the mechanical CAD/CAM/CAE market. A minimum of six Perspective documents will be published on an event-driven basis throughout the year, as well as two Dataquest Predicts. Scheduled Perspectives for 1996 include:

Dataquest Predicts: Forward-looking analysis of MCAD software market dynamics that include Dataquest's predictions about future industry and technology directions.

Competitive Analysis: This year's competitive analyses will focus on technology-related issues that affect success in the MCAD market including STEP, CALS, analysis, NG, and PDM.

Market Analysis: Ongoing analysis of key MCAD market issues will be provided throughout the year.

Market Trends

Mechanical CAD/CAM/CAE Market Trends Report: This report includes detailed analysis from several perspectives on the forces driving the MCAD market. Trends and issues, changing end-user requirements, high-growth applications, analysis of leading vendors, regional differences, and computer industry technology changes are discussed in relation to their impact on MCAD market dynamics.

Available September 1996

Market Statistics

Mechanical CAD/CAM/CAE Market Statistics Reports: This report provides the most reliable and comprehensive set of market data on the MCAD market. It contains hardware, software, and service forecasts and market share for worldwide MCAD companies and applications. A total of four reports are published each year. Two reports presenting market share and forecasts are published during the first half of the year; these are updated during the second half of the year. A multidimensional database is used to capture and analyze all elements of Dataquest's CAD/CAM/CAE market coverage. Customized analysis of this database is available to our clients.

Reports

User Wants and Needs Report: Dataquest's annual mechanical CAD/CAM/CAE end-user study is the premier source of end-user buying and preference information in the industry. This year's survey will focus on mechanical design software usage and satisfaction, purchasing, and changes in the design process.

Available December 1996

Electronic NewsTakes

QuickTakes is a weekly electronic newsletter that provides summary/analysis of the top news in the software, multimedia, and online information industries.

Delivered via e-mail every Monday

Dataquest Alerts

News and commentary on late-breaking mechanical CAD/CAM/CAE industry events delivered by fax and/or e-mail.

Optional Europe & Asia MCAD Data

Market Statistics reports presenting detailed MCAD market shipments, revenue, and five-year forecasts for the seven major European countries and the six major Asia/Pacific countries are available as separate, optional products.

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Program Code: CMEC-WW MKTG 1/96 (PSB)

December 1995

Dear Dataquest Client:

In 1996, Dataquest will celebrate its 25th year as the leading global supplier of market intelligence to the IT vendor and financial communities. I would like to thank you, on behalf of all Dataquest associates worldwide, for your support. We are proud to be your information partner by providing the IT market insight and analysis you need to make crucial business and planning decisions.

The enclosed binder is for filing and storing the printed market research newsletters and reports that you will receive on an ongoing basis throughout 1996 as part of your subscription to Dataquest. You may notice that we've streamlined the binder tab and document filing structure this year. We hope that this 5-tab scheme increases your efficiency in filing and locating documents.

You probably know that in addition to paper-based delivery, Dataquest is also committed to delivering our market statistics and analysis electronically. We expect that our electronic products, known collectively as *Dataquest on the Desktop*, will play an increasing role in our ability to deliver information to you in a timely, efficient way. For your information, our electronic tools include:

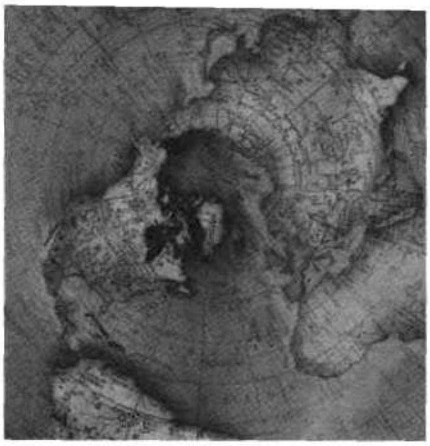
- ***Dataquest on Demand***—Our monthly CD-ROM containing a rolling 13 months of Dataquest's printed documents
- ***MarketView***—A data analysis tool containing many of Dataquest's market statistics databases
- ***Electronic NewsTakes and Dataquest Alerts***—Weekly/event-driven summary and analysis of top IT news, published via e-mail or fax by most Dataquest research groups
- ***Dataquest Interactive***—Our Internet-based electronic delivery system that you are invited to preview at this URL: http://www.dataquest.com

One last note: an optional binder called *Electronic News* is available on request for clients who wish to file their electronic newsletters and Dataquest Alerts. To order your copy, please fill out the FaxBack form found in the binder pocket and fax it back to us.

We look forward to working with you in our continuing process to improve the content, quality, and timeliness of our products and services. I encourage you to share with us your comments about our publications and electronic delivery tools.

Sincerely,

Jeffrey A. Byrne
Vice President, Worldwide Marketing



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CAD/CAM/CAE and GIS Market Definitions

Dataquest Guide

Program: CAD/CAM/CAE/GIS Asia/Pacific
Product Code: CCAM-AP-GU-9601
Publication Date: February 26, 1996
Filing: Guides

CAD/CAM/CAE and GIS Market Definitions

Dataquest Guide

Program: CAD/CAM/CAE/GIS Asia/Pacific
Product Code: CCAM-AP-GU-9601
Publication Date: February 26, 1996
Filing: Guides

Table of Contents

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Chapter 1
Market Share Survey Overview

Each year, Dataquest surveys CAD/CAM/CAE/GIS vendors in order to estimate their annual revenue. The survey for 1995 covers 300 vendors worldwide by six main applications segments, four operating systems groups, four world regions, European and Asian countries, hardware, software, services, and distribution channels. This exercise provides input for Dataquest's dynamic database of CAD/CAM/CAE/GIS shipments/revenue by world region/country, operating systems, and applications segment. The information gained is supplemented by, and cross-checked with, Dataquest's other information sources.

The CAD/CAM/CAE market share survey takes place twice each year. The first survey in the fourth quarter is to prepare early estimates for the calendar year. This is followed by a second survey in the spring in order to finalize estimates for the previous calendar year. The first survey takes place from October to December. Our preliminary estimates are completed by the end of the calendar year under review, and the results are summarized in a fax report that is released in January of the following year and published in a Source: Dataquest document by January 31.

The second survey takes place during April. Our final CAD/CAM/CAE/GIS market share estimates are again published in a Source: Dataquest document by May 31. There is usually minimal difference between early and final rankings, as Dataquest makes every effort to ensure preliminary estimates are as accurate as possible. However, there are usually some surprises at year-end, and our numbers do change. It should also be noted that when new information becomes available concerning a previous year's numbers, the database is updated to reflect the best information available.

The categories for which CAD/CAM/CAE/GIS revenue is reported are defined comprehensively for the purpose of clarity and guidance to survey participants. These definitions may occasionally be revised, altered, or expanded to reflect changes in the industry. To support these definitions, Dataquest will send an annual survey guide to all participants in its CAD/CAM/CAE/GIS market share survey program. This document comprises the 1995 survey guide.

Methodology

Dataquest utilizes both primary and secondary sources to produce market share data. In addition to the annual market share survey, Dataquest uses the following sources in order to accurately quantify market activity:

- Information published by major industry participants
- Estimates made by knowledgeable and reliable industry spokespersons
- Government data or trade association data
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users

- Relevant economic data
- Information and data from online or CD-ROM data banks
- Articles in both the general and trade press
- Reports from financial analysts
- Annual reports, Securities and Exchange Commission documents, credit reports
- Reseller and supplier reports and reports from a vendor's competitors
- User studies

Dataquest also sums vendor revenue across other industries covered by Dataquest to make sure revenue is not credited twice, and checks with multiple sources at one company to cross-check data on that company.

Dataquest analysts have many years of experience in how to apply the tools described to get the most accurate information possible on a particular company (such as what to use when, and what industry averages are). It is the CAD/CAM/CAE/GIS group's policy to continually update our market information for any year, based on any new data received, in order to arrive at the most accurate market representation possible.

We survey worldwide, which involves more vendors and therefore presents higher total market revenue, lower market share per vendor, and a more accurate overall market picture.

Despite the care taken in gathering, analyzing, and categorizing the data in a meaningful way, careful attention must be paid to the definitions and assumptions used herein when interpreting the estimates presented in this document. Various companies, government agencies, and trade associations may use slightly different definitions of product categories and regional groupings, or they may include different companies in their summaries. These differences should be kept in mind when making comparisons between data provided by Dataquest and data provided by other suppliers.

Chapter 2
CAD/CAM/CAE/GIS Companies to Be Surveyed Worldwide for 1995

Dataquest will survey the following CAD/CAM/CAE/GIS companies throughout the world for 1995 data.

The North American Companies

- 3Soft
- Accel Technologies
- Accugraph
- ACTEL
- Adina R&D
- ADRA Systems
- ael Advance Graphics Systems
- ALDEC
- Algor Interactive Systems
- Alias Research
- Altair Computing
- Altera
- Analogy
- Ansoft
- Ansys
- Applicon
- Aptix
- Ashlar
- Aspec Technology
- Aspect Development
- Aspen Technology
- AT&T Bell Laboratories
- Auto-Trol
- Autodesk
- Autometric
- Avant!
- B.A. Intelligence Networks
- Bentley Systems
- Boothroyd Dewhurst

- CAD WORKS
- Cadence
- Cadis Software
- CADKEY
- CADSI
- CAE Plus
- CAMAX
- Carrier Corporation
- Cascade Design Automation
- CGTech
- Chronology
- Chrysalis Symbolic Design
- Cimlinc
- Cimplex
- Claritas/NPDC
- CMstat
- CNC Software
- Compact Software
- COMPASS Design Automation
- Computer Aided Design Software
- Computervision
- Concentra
- Contec Microelectronics
- Cooper & Chyan Technology
- CrossCheck Technology
- CSAR Corporation
- Data I/O
- Database Applications Inc.
- Deneb Robotics
- Design Acceleration
- Digital Equipment Corporation
- DP Technology
- Dynamic Graphics
- EA Systems
- Eagle Design Automation
- Eagle Point

- Earth Resource Mapping
- EDS-Unigraphics
- Enghouse Systems Ltd. (Canada)
- Engineered Software
- Engineering Mechanics Research
- EOSTAT
- EPIC Design Technology
- Equifax/NDS
- ERDAS
- Escalade
- ESRI
- ETAK
- Evolution Computing
- Fintronic
- Formtek
- Frontline Design Automation
- Genasys II
- Geo/SQL
- Geographic Data Technology
- Geomax International
- Gibbs and Associates
- Graftek Inc.
- GRAPHSOFT
- Harris EDA
- Hewlett-Packard
- Hibbit, Karlsson & Sorensen
- High Level Design Systems
- i-Logix Inc.
- IBM
- Ikos Systems
- IMSI
- Information Handling Services
- Intergraph
- InterHDL
- International Software Systems
- Intusoft

- ISICAD
- Landmark Graphics
- Livermore Software Technologies
- LSI Logic
- LV Software
- MacNeal-Schwendler Corporation
- Macon
- MapInfo
- MARC
- MCS
- Mechanical Dynamics
- Mentor Graphics
- Meta-Software
- Micrografx
- Microsim
- Minc Software
- Motorola
- Nextwave Design Automation
- NovaSoft Systems
- OEA International
- Optem Engineering
- Orcad
- Pacific Numerics
- PacSoft
- PADS Software
- Parametric Technology
- PCI Remote Sensing Corporation
- PRC
- Protel Technology
- Quantic Laboratories
- Quickturn Systems
- Radian Corporation
- Rebis
- Research Engineers—Civilsoft
- Royal Digital Centers
- Scientific & Engineering SW

- SDRC
- Sherpa Corporation
- SHL Systemhouse
- Sigma Design
- Silicon Graphics
- Silicon Valley Research Inst.
- SIMUCAD
- Simulation Technology
- Softdesk
- Spatial Technology Inc.
- Speed
- SpeedSim
- Spot Image
- SRAC
- Strategic Mapping
- Summitt Design Inc.
- Sun Microsystems
- Surfware
- Sweet's Electronic Publishing
- Synopsys
- Synplicity
- Systems Science
- T D Technology
- Tactician Corporation
- Tanner Research
- Terr-Mar Resource Information Systems
- Terra Sciences
- TYDAC Technologies Inc.
- Unicad
- Unisys Corporation
- Variation System Analysis
- Veritools
- Viagrafix
- Viewlogic Systems
- VISTA Environmental Inf.
- VLSI Libraries

- VLSI Technologies
- Workgroup Technology
- Xilinx
- Zeelan Technology
- Zycad

The European Companies

- ABB Industria
- Abstract Hardware
- ACA Ltd.
- ALS Design
- Anilam Electronics
- APIC Systemes
- ARKTEC SA
- ASCAD/ASCAM
- Assigraph
- CAD Centre Ltd
- CAD Lab S.p.A.
- Cad-Distribution AG
- CAD-UL
- Cadtronic Computer Systeme
- CATALPA Groupe Missler
- Cimatron
- CIMTEK SA
- Cisigraph
- Clemessy Innovation SA
- Complansoft CAD GmbH
- Computational Mechanics
- Computer Services Consultants
- Dapco SA
- Dassault
- debis Systemhaus GmbH
- Delcam Systems International
- Eigner+Partner GmbH
- Elstree Computing Ltd
- Engineering Computer Services
- Exapt

- FHECOR
- Fides Industrielle Automation
- Framasoft
- Gable CAD Systems
- Geometria GIS Systems House
- Graphisoft Software Development
- Ground Modeling Systems Ltd.
- Han Dataport
- Hochtief
- ICEM Technologies
- ICL Finland OY
- IEZ CAD-Systeme GmbH
- Investronica SA
- ISD Software und Systeme GmbH
- ISDATA GmbH
- ISKA
- Kloeckner-Moeller GmbH
- Kockums Computer Systems AS
- Laser-Scan
- M.O.C.
- Marcus Computer Systeme
- Matra Datavision
- mb Programme
- Moss Systems Group
- Nemetschek Programmsystem GmbH
- Norlinvest Ltd Visionics
- Number One Systems
- PAFEC
- Pathtrace Engineering Systems
- Poppenhaeger Grips GmbH
- PROCAD GmbH und Co.KG
- Radan Computational Ltd.
- RIB/RZB
- RoboCAD Solutions Ltd.
- Sagantec Europe BV
- Sener Ingenieria y Sistemas SA

- Serbi SA
- Siemens Nixdorf Informationssysteme
- Sinus Software GmbH
- Smallworldwide
- Soft-Tech Software Technologies
- Softronics
- Speed
- Star Infromatic
- Straessle AG
- Superdraft
- Sysdeco Innovation AS
- Tebis
- Technische Computer Systeme GmbH
- Triplan
- ULTImate Technology
- VEDA—Design Automation
- Vero International Software
- Whessoe Computing Systems
- Wiechers Datentechnik
- Ziegler Informatics

The Japanese Companies

- Andor
- ARGO Graphics
- C. Itoh Techno-Science
- Cadix
- Century Research Center
- CPU
- Design Automation
- Fujitsu
- Graphtec Engineering
- Hakuto
- Hitachi
- Hitachi Zosen Information Systems
- Information Services International Dentsu
- Informatix
- INS Engineering

- Kubota Computer
- Marubeni Hytech
- Mitsubishi Electric
- Mitsui Engineering
- Mutoh Industries
- NEC
- Nihon Itek
- Nihon Unisys
- Omron
- Pasco
- Ricoh
- Seiko Instruments
- Sharp System Products
- Sony
- Sophia Systems
- Sumisho Electronics
- Sumitomo Denko Workstation
- Tokyo Electron
- Toshiba
- Toyo Information Systems
- Uchida Yoko
- Wacom
- Zuken-Redac

Of the 302 companies to be surveyed, 179 are North American, 85 are European, and 38 are Japanese.

Chapter 3
Research Metrics

Definitions for the research metrics used in this survey are as follows:

- Total revenue with the original equipment manufacturer (OEM): The total amount of money received by a company for all goods and services sold into the CAD/CAM/CAE/GIS market. This figure is typically only released when requested.
- Distribution channels: Distribution channels are defined as follows:
  - Direct channel—The channel through which product moves directly from the manufacturer or vendor to the end user, usually by means of a professionally trained salesforce
  - OEM—The channel through which vendors or manufacturers sell their finished product to other companies for resale through an agreement. Once sold, the product is usually modified slightly and then resold directly to the end user or through an indirect channel. Vendors that resell nonbranded product differ from VARs in that they often add their name to the product and back up its warranties.
  - Indirect channels—All other channels through which the finished product moves to the end user, including VARs, dealers, and mass merchandisers
- Turnkey: Bundling hardware and software for sale as a unit
- Total factory revenue: Money received by a company for its goods, excluding OEM revenue or consulting revenue
- Hardware revenue: Revenue derived from the sales of CPUs (including operating systems), terminals (for host-dependent systems), and peripherals
- Software revenue: Revenue derived from the sales of bundled (part of a turnkey system) and applications software. It does not include operating systems revenue, which is part of the hardware revenue.
- Service revenue: Revenue derived from the service and support of CAD/CAM/CAE/GIS systems. Service revenue can be calculated in the market share tables by subtracting hardware and software revenue from total factory revenue. Service revenue includes the following:
  - Applications development—Adding new functionality through design and development of new customized CAD/CAM/CAE/GIS software applications, or the modification, enhancement, or customization of existing software applications
  - Consulting—Including an assessment of a company's CAD/CAM/CAE/GIS business IT needs and formulation of a plan based on needs identification
  - Integration services—Planning, implementing, migrating, and integrating software products
  - Maintenance—Fees for hardware and software

- Management and operations services—Includes help desk, education and training, disaster recovery, vaulting, facilities management, configuration management, and relocation services
- Service bureau—Includes construction of database, data conversion, product design, analysis, or manufacturing

- Seats: The number of possible simultaneous users
- Unit shipments: The number of seats delivered, excluding those sold to another company for resale (OEM). CPU shipments are defined as the number of CPUs delivered, which is the same as unit shipments for all platforms but host-dependent platforms.
- Average selling price (ASP): The average amount of money received by the factory for the sale of a turnkey/hardware system. The database forces reconciliation of a company's revenue and unit shipments with the average selling prices of each application and platform.
- Installed base: The total number of seats/CPUs in use, calculated by forecasting the previous year's installed base plus the year's unit/CPU shipments, less retirements.
- Compound annual growth rate (CAGR): A computed, compounded growth rate used in forecasting

Chapter 4
Worldwide Geographic Region Definitions and Exchange Rates

Dataquest divides the different geographic regions as follows:

- North America: Includes Canada, Mexico, Puerto Rico, and the United States
- Europe
  - Western Europe: Includes Austria, Benelux (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)
  - Eastern Europe: Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)
- Japan
- Asia/Pacific: Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)
- Rest of World: Includes Africa, Central America, the Caribbean, the Middle East, Oceania, and South America

When converting a company's local currency sales into U.S. dollars, or vice versa, it is important to use the 1995 exchange rates provided below (see Table 4-1). These rates will prevent inconsistencies in the conversion of offshore sales between each company. These are the exchange rates that will be used in the final 1995 CAD/CAM/CAE and GIS market share survey. Exchange rates for historical years are available on request.

Table 4-1
Average 1994 and 1995 Exchange Rates against the U.S. Dollar

Country	1994 Rate	1995 Rate
Austria (Schilling)	11.33	10.06
Belgium (Franc)	33.36	29.42
China (Renminbi)	8.68	8.35
Denmark (Krone)	6.31	5.59
ECU	0.84	0.77
Finland (Markka)	5.21	4.37
France (Franc)	5.54	4.97
Germany (Mark)	1.62	1.43
Hong Kong (Dollar)	7.73	7.74
Italy (Lira)	1,609.19	1,628.21
Japan (Yen)	101.81	93.90
Netherlands (Gulden)	1.81	1.60
Norway (Krone)	7.04	6.33
Singapore (Dollar)	1.52	1.43
South Korea (Won)	802.40	770.57
Spain (Peseta)	133.48	124.40
Sweden (Krona)	7.7	7.14
Switzerland (Franc)	1.37	1.18
Taiwan (Dollar)	26.46	26.48
United Kingdom (Pound)	0.65	0.63

Note: The annual rate is estimated as the arithmetic mean of the 12 monthly rates.
Source: Dataquest (February 1996)

Chapter 5

CAD/CAM/CAE/GIS Operating Systems Group Definitions

Dataquest segments CAD/CAM/CAE/GIS data by four main operating system groups. These groups are as follows:

- UNIX—UNIX is a 32-bit, multitasking, multiuser operating system, originally developed at AT&T Bell Laboratories. It is portable and can be found on most CISC and RISC MPUs, including the Intel 80xxx, Motorola 68xxx, and Sun SPARC. UNIX includes all UNIX variants. A complete list of UNIX operating systems can be found in Chapter 8.
- Host-dependent systems—These systems include all minicomputer and mainframe operating systems in which the functions of external workstations are dependent on a host computer. The dominant operating systems in this group are IBM's VM and Digital Equipment's VMS operating systems.
- Windows NT—Windows NT is Microsoft's multiplatform, 32-bit operating system (either Windows NT or Windows NT Advanced Server) for high-end PCs, servers, and workstations.
- Personal computer (PC)—This group includes MS-DOS, PC-DOS, or DR-DOS operating systems. MS-DOS was designed by Microsoft for the original IBM PC. It is the dominant operating system on PC and PC-clone computing systems. PC-DOS is IBM's version of the disk operating system for PC and PC clones. DR-DOS is the Digital Research (Novell) version of this operating system. Other proprietary DOS variants such as NEC-DOS and J-DOS are included in this category.
- Also in the personal computer group are Mac OS, OS/2, Windows 3.1, and Windows 95. Mac OS is Apple's proprietary graphical user interface (GUI) operating system. OS/2 is IBM's GUI operating system for high-end PCs and PC servers. Windows 3.1 and Windows 95 are Microsoft's GUI operating systems for the PCs and PC clones. Windows 3.1 is a 16-bit operating system that runs on top of DOS. It is the dominant GUI operating system for PC and PC clones. Windows 95 is Microsoft's 32-bit version of Windows. Windows 95 is intended to replace Windows 3.1 and does not require a DOS foundation.

Chapter 6
CAD/CAM/CAE/GIS Software Applications Definitions

Dataquest segments data by application types. They are as follows:

- Mechanical—This segment refers to computer-aided tools used by engineers, designers, analysts, and drafters working predominantly in discrete manufacturing industries. Common design applications include conceptual design, industrial design, structural or thermal analysis, and detail design. Common manufacturing applications include tool and fixture design, numerical control part programming, and off-line robotics programming.
- Electronic design automation (EDA)—This segment covers computer-based tools that are used to automate the process of designing an electronic product, including printed circuit boards, ICs, and systems. EDA includes electronic CAE, IC layout, and PCB/hybrid/MCM, as follows:
  - Electronic computer-aided engineering (CAE)—These are computer-aided tools used in the engineering or design phase of electronic products (as opposed to the physical layout phase of the product). Examples of electronic CAE applications are schematic capture and simulation.
  - IC layout—This is a software applications tool that is used to create and validate the physical implementation of an integrated circuit (IC). The IC layout category comprises polygon editors, symbolic editors, placement and routing (gate array, cell, and block), design verification tools (DRC/ERC/logic-to-layout), compilers, and module development tools.
  - Printed circuit board (PCB)/hybrid/multichip module (MCM)—This segment covers products that are used to create the placement and routing of the traces and components laid out on a printed circuit board. Also included in this category are thermal analysis tools.
- Architecture, engineering, and construction (AEC)—This segment covers the use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and other people associated with these disciplines to aid in designing and managing buildings, industrial plants, ships, and other types of nondiscrete entities.
- Geographic information systems (GIS)/mapping—This is a computer-based technology, composed of hardware, software, and data used to capture, edit, display, and analyze spatial (tagged by location) information.

Chapter 7
CAD/CAM/CAE Subapplications Segmentation

Additional surveys are conducted to further segment the industry with software revenue sales by subapplication. The applications are divided as follows:

Mechanical

Modeling Technology

The modeling technology applications are as follows:

- Solid modeling—The representation of a part or assembly capturing all relevant data describing solid characteristics of a project. This can include shape, weight, color, surface texture, and mass properties. Boolean operations are commonly used to add and subtract volumes together to define the final shape of the object.
- 2-D modeling—The representation of a part in two dimensions (it has an x and y coordinate). This format requires three or more views (top, front, and side) to depict all aspects of the part. 2-D is the most common geometric modeling format and is used extensively with a drafting function.
- 3-D modeling—The representation of a part in three dimensions, usually in a wire-frame format (it has an x, y, and z coordinate). This format is commonly used in high-level CAD systems to determine the placement and fit of components in an assembly. It is generally not used for final drafting, although some systems have the capability to translate the 3-D image to a 2-D standard drafting format.
- Integrated—The integration of all 3 modeling technologies

Mechanical CAD/CAM/CAE Subapplication

The mechanical CAD/CAM/CAE subapplications are as follows:

- Conceptual design
  - Industrial design—A process that provides a common environment for the entire conceptual design process, including painting, modeling, rendering, and visualization
  - Design layout—An initial design process in which the major components and part interfaces are defined
  - Styling—A detailed design process in which aesthetic considerations are foremost in importance
- Functional design
  - Component design—Design of the individual components in an assembly
  - Assembly verification—Integration of components' designs into an assembly to test the size/shape and function characteristics

  - Linkage/mechanism—An assembly of components with two or more movable parts, usually providing some means of power, control, or fastening application
  - Analysis—The analysis of a physical system, part, or assembly; includes structural, thermal, vibrational, composite, fatigue, stack-up, mass property, and quality-control analysis
- Drafting and documentation
  - Detail drafting—Representation of a part in standard geometric drafting format, including all part geometry dimensions and notations describing mechanical/structural, functional, and material characteristics
  - Schematic/detailed diagrams—Schematics used to describe hydraulic and pneumatic systems
  - Technical illustration—Drawing of a component or assembly that is generally intended for publication
- Manufacturing engineering
  - Tool design—The design of custom-made tooling to facilitate a manufacturing process
  - Fixture design—The design of structural aids that hold the component or assembly during the manufacturing process
  - Part processing design—The design of a series of manufacturing processes
- Manufacturing process simulation
  - Numerical control part programming—The programming of a numerical control machine tool or automated processing system
  - Coordinating measuring machines—The programming of machines used to measure the physical dimensions of a part
  - Offline robotics—A process simulation that graphically represents the sequence of steps to program a robot for a particular operation and downloads data to a robot to update its control program
- System management and other tools
  - Product data management (PDM)—Software typically used in an engineering or manufacturing environment to manage product data. Characteristics of PDM systems include product/structure management, workflow, and vault/document management capabilities.
  - Engineering data management—Software with vault management capabilities and limited workflow capabilities designed for use within an engineering environment
  - Component information systems—Software used to navigate within and manage a repository of engineering parts and associated data
  - Knowledge-based engineering tools—Tools used to capture design intent and build standard practices for controlling, modifying, and automating design and manufacturing activities. Also known as rule-based engineering.

- Applications development environments—Programming tools to aid in the generation of user-defined programs that drive or interface with CAD/CAM/CAE.

EDA

For the past few years, Dataquest has subdivided the electronic CAE market in an entirely new way. The subdivisions are based on design methodologies such as gate-level design, register transfer (RT)-level design, and electronic system (ES)-level design.

Under the methodology, a design is first entered and simulated, usually at the RT level. It is then synthesized or compiled down to the level below it. This process continues (simulation and synthesis) until the design is placed and routed at the physical design level, at which point timing information is extracted from the physical design. At this point, the verification process begins.

For verification, the process flows in an upward direction. From the physical design level, timing information is extracted, and design rule checkers and logic rule checkers are used to ensure a correct design at the physical level. Verification continues in this upward fashion until the level at which the design process originally began is reached. The electronic design automation subapplications are as follows:

CAE

The CAE subapplications are as follows:

- ES level
  - ES-level design—Design at the conceptual level, including hardware/software co-design, design partitioning, and specification; it includes neither RT- nor logic-level descriptions.
  - Behavioral simulation—Nontiming-based simulation
  - Behavioral synthesis—Synthesis of an ES-level design description to the RT level
  - Formal verification—The process of mathematically proving that an RT-level description equates to an ES-level description (or less specifically, that any design representation equates to another)
- RT level
  - RT-level design—Tools designed to assist engineers in entering a design or analyzing the simulated results of that design. This includes the use of graphical symbols to represent RT-level VHDL or Verilog.
  - RT-level simulation—Simulation at the RT level
    - VHDL—Simulation using the VHSIC Hardware Description Language
    - Verilog—Simulation using the Verilog Hardware Description Language

- Logic synthesis—Synthesis or translation of an RT-level description to a gate-level description
- Target compiler—A translation of an RT-level description to the silicon implementation
- Timing analysis—Verification of the timing of a design; the process usually involves providing inputs to a physical circuit model or computer simulation to test the nondynamic functions of a design; static-timing verification does not require the use of test vectors to determine timing violations.
- Design for test tools—Tools used to determine, improve, or add to the testability of electronic circuits
- Silicon synthesis—Tools that estimate silicon-level performance at the RT-level by synthesizing the RT-level description to a virtual silicon implementation of that code and reflecting the estimated silicon performance back up to the RT level
- PCB synthesis—A process similar to silicon synthesis but without using synthesis technology. PCB synthesis uses a virtual representation of the PCB to estimate physical effects, bringing those effects back up to the CAE level of design.

- Gate level
  - Schematic capture—A design process that consists of graphical schematic entry and net-list extraction
  - Simulation—The use of representative or artificial data to reproduce conditions in a model that could occur in the performance of a system. Simulation is used to test the behavior of a system under different operating conditions.
    - Gate-level simulation—Simulation based upon a gate-level netlist (not VHDL or Verilog)
    - Analog simulation—Simulation in which both digital and analog inputs are used
    - Mixed-signal simulation—Simulation in which both digital and analog inputs are used
    - SPICE simulation—Simulation using a derivative of the Berkeley SPICE transistor-level simulator
  - Analysis tools—Tools used for the analysis of designs
    - Signal analysis (including transmission line and cross-talk analysis)—Analysis of high-speed coupling effects between signal line and reflection/degradation of the high-speed signal on PCBs, MCMs, or ICs
    - Power analysis—Analysis of the power consumption of PCBs, ICs, MCMs, and systems
    - Electromagnetic interference—Analysis of electromagnetic generation and interference for PCBs, ICs, and cables/connectors/packaging

    - Metal migration or electromigration—The unauthorized movement of metal in an IC because of excessive current density

- Miscellaneous
  - Accelerators—Dedicated hardware/software or optimized software used to speed up simulation, typically at the gate level
  - Emulators—Dedicated hardware/software that allows a designer to observe the function of a circuit or design prior to prototype
  - Fault simulation/grading—A process that determines which nodes in a design can be detected by a given set of test vectors
  - Interoperability tools—Software used for database, library, and tool management; they also include backplanes, file translators, and design environments (in general, all tools used specifically to integrate a set of EDA tools).
  - Libraries—Description of elements used in EDA designs (for example, components, simulation models, and symbols)
  - Field-programmable gate array (FPGA) toolset—Dedicated EDA software sold as a package for FPGA/complex-programmable logic device (CPLD) design
- IC CAD
  - DRC—The design rule and logic rule checkers used to perform final verification on an IC design prior to making masks
  - Floor planner—A tool that allows a designer to place elements of a design so that the designer can look at estimations of the effects of the final place and router.
  - FPGA place and route—Tools used to implement designs into the targeted FPGA or CPLD. These are also called "fitters" because they fit designs into the already existing logic structure of the targeted FPGA or CPLD.
  - IC place and route—Tools used to implement (lay out) designs into silicon
    - Gate array place and route—Tools used to lay out designs into a fixed-based array
    - Cell-based IC place and route—Tools used to lay out nonfixed, cell-based designs
    - Custom IC layout—Silicon design tools working at the transistor level. These tools can size transistors, accomplish analog design, and generally hand craft silicon implementation. Sometimes called "layout editors."
- PCB design
  - PCB design tools—Tools used to design, place, and route a PCB
  - MCM9 and hybrid design tools—Tools used to design, place, and route a multichip module or hybrid substrate

AEC/Architectural, Engineering, and Construction

The AEC, or architectural, engineering, and construction, subapplications are as follows:

- Architectural—Software used in the design and drafting of buildings and grounds
- Civil—Software for both site and structural engineering, typical for design and drafting of sites for buildings, roads, bridges, and airports and for the design of steel and concrete structures
- Facilities design/management—Software used to lay out, inventory, and manage assets such as personnel space, equipment, and utilities within a building or geographic service area
- Process plant design—Software used in design, analysis, drafting, and management of process, power, and manufacturing plants as well as ships

GIS/Mapping Software

GIS/Mapping Software is used to capture, edit, display, and analyze spatial (tagged by location) information. It can be categorized as follows:

- Base data—Software used to create baseline geographic data
  - Photogrammetry and surveying—Software used in developing original data for a GIS system based on ground surveying or on remotely sensed data. Examples include aerial photography or satellite imagery.
  - Data for resale—Includes both GIS software used to create data for resale to end users and revenue from the sale of geographic data
- Land information—Software used to gather and manage land data
  - Land records—GIS software used to manage land ownership or parcel information; the typical user is a tax assessor.
  - Planning and land use—GIS software used to manage land use; the typical user is a city planner.
- Biological—Software used to manage and analyze plant and animal life
  - Environmental public health and safety—GIS software used to manage natural resources and to monitor and analyze environmental factors that contribute to the welfare of the earth and its people
  - Forestry and agriculture—GIS software used for the management of forests and crops
- Geoscience (formerly energy exploration)—GIS software used to manage oil, gas, and mineral exploration projects. The emphasis of geoscience is typically on subsurface data.
- Infrastructure management—Management and analysis of man-made assets (not including utilities)
  - Transportation and logistics—GIS software used in transportation applications such as road or rail network modeling or route planning

- Emergency and dispatch services—GIS software used to manage emergency services such as "911" services and also for-profit dispatch management systems

- Automated mapping/facility management—GIS software used for managing utility industry networks, based on the following categories:
  - Telecommunications/telephone
  - Electric
  - Water and waste water
  - Other utilities (primarily gas)

- Business marketing and sales—GIS software used to promote and sell services and products, and to identify and evaluate opportunities in a competitive environment.
  - Demographic and location analysis—GIS software used to analyze problems in demographics or site characteristics. Examples include sales territory selection, site selection, or population analysis. Typical users are in advertising, marketing, insurance, banking, and real estate.
  - Sales and directional support—GIS software used to help salespeople locate targets of a sales effort (for example, to locate potential customers, specific properties for sale and driving routes to the properties). This also includes software used to help customers locate establishments, typically used as travelers' aids.

- Geopolitics—The sum of software used in defense/military and political districting applications
  - Defense/military—GIS software used to manage military or defense projects for the purpose of command and control
  - Political districting—GIS software used to manage the redistricting process based on census data

- Cartography—GIS software used in mapmaking applications

Chapter 8
CAD/CAM/CAE/GIS Operating System and Industry Segmentation

Additional surveys segment the software revenue by operating systems and by industry, providing yet another look at the CAD/CAM/CAE/GIS software market. These segments are as follows:

Operating Systems

- Apollo AEGIS
- Apple AUX
- Apple Macintosh/OS
- AT&T Systems V Derivatives
- CDC CYBER NOX/VE
- CONVEX UNIX
- CRAY UNIX
- Digital Equipment Corporation OSF
- Digital Equipment Corporation ULTRIX
- Digital Equipment Corporation VMS
- DOMAIN/Apollo UNIX
- DOS
- DOS with Windows
- Hewlett-Packard UX
- Hitachi HI-UX/G (UNIX)
- IBM AIX
- IBM VM/VMS
- Intergraph UNIX
- MIPS UNIX
- NEC EWS-UX (UNIX)
- OS2
- Prime PRIMOS
- Siemens-Host/Proprietary
- Siemens-UNIX
- Silicon Graphics Inc. UNIX
- Solaris
- Sony NEWS-OS (UNIX)
- Sun—UNIX/OS

- Windows
- Windows NT
- XENIX/SCO UNIX
- Others—UNIX
- Others
- All Operating Systems

Industry Sectors

- 1 Aerospace, guided missiles, and space vehicles
- 2 Agriculture, forestry, and fishing
- 3 Automotive, motorcycles, and bicycles
- 4 Chemical, allied, and petroleum products
- 5 Computers, office equipment, and computer peripherals
- ~~6~~ ~~Conserv~~ation management and waste management
- 6 Construction, contractors, and building
- 7 Consumer electronics (TV, VCR, and CD)
- 8 Education
- 9 Electrical/electronic equipment (power, appliances, test, and measurement)
- 10 Fabricated metal products, except machinery and transportation
- 11 Finance, insurance, and real estate
- 12 Government: environment and public health resource
- 13 Government: general, executive, public order, and taxation
- 14 Government: national security (defense)
- 15 Government: public works and engineering
- 16 Industrial and commercial machinery (engines and heavy equipment)
- 17 Industrial controls, robotics, and AGVs
- 18 Manufacturing not elsewhere classified (textiles, furniture, and foundries)
- 19 Medical manufacturing (instrument/x-ray)
- 20 Mining
- 21 Semiconductors
- 22 Service companies (including architecture firms, engineering consulting firms, and design services firms)
- 23 Shipbuilding, ship repairing, and developing offshore rigs
- 24 Telecommunications and data communications (telephone, radio, television, and cable)
- 25 Transportation (rail, public transit, and freight transport)

26 ■ Utilities and pipelines (electric, gas, sanitary services, and water)

27 ■ Others

28 ■ All industries

Results from these surveys and the subapplications' surveys are scheduled to be published in mid-1996.

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Perspective

Mechanical CAD/CAM/CAE Applications Worldwide

Market Analysis

Mechanical CAD/CAM/CAE: European Trends

Abstract: *Many European companies have come to the end of their CAD renewal cycle, which is why we are seeing large-scale orders, particularly in the automotive and aerospace industries. Product data management (PDM) in many cases is part of the new investment. All of the very large orders we have seen so far have been for UNIX-based systems, because at the time when product evaluation started, and even now, viable NT-based solutions were not available. As a result, the market grew 17 percent to $1.1 billion during 1995 and will increase a further 14 percent in 1996 (growth rates based on ECU).*
By Petra Gartzen

The European Mechanical CAD/CAM/CAE Market at a Glance

Highlights of the European CAD/CAM/CAE/GIS market in 1995 include the following:

- Overall, the European CAD/CAM/CAE/GIS market grew 17 percent to $6.3 billion in total factory revenue in 1995. Calculated in European Currency Units (ECU), the market grew 6.6 percent.
- CAD/CAM/CAE/GIS software revenue increased 22 percent to $2.1 billion. Based on ECU, software revenue grew 11 percent.
- The largest application sector in Europe is the mechanical segment, having some 51.6 percent of the total European CAD/CAM/CAE/GIS software market. It was also the fastest-growing sector with 17 percent growth in 1995, based on ECU.

Dataquest

Program: Mechanical CAD/CAM/CAE Applications Worldwide
Product Code: CMEC-WW-DP-9608
Publication Date: November 18, 1996
Filing: Perspective
(For Cross-Technology, file in the Online, Multimedia, and Software binder.)

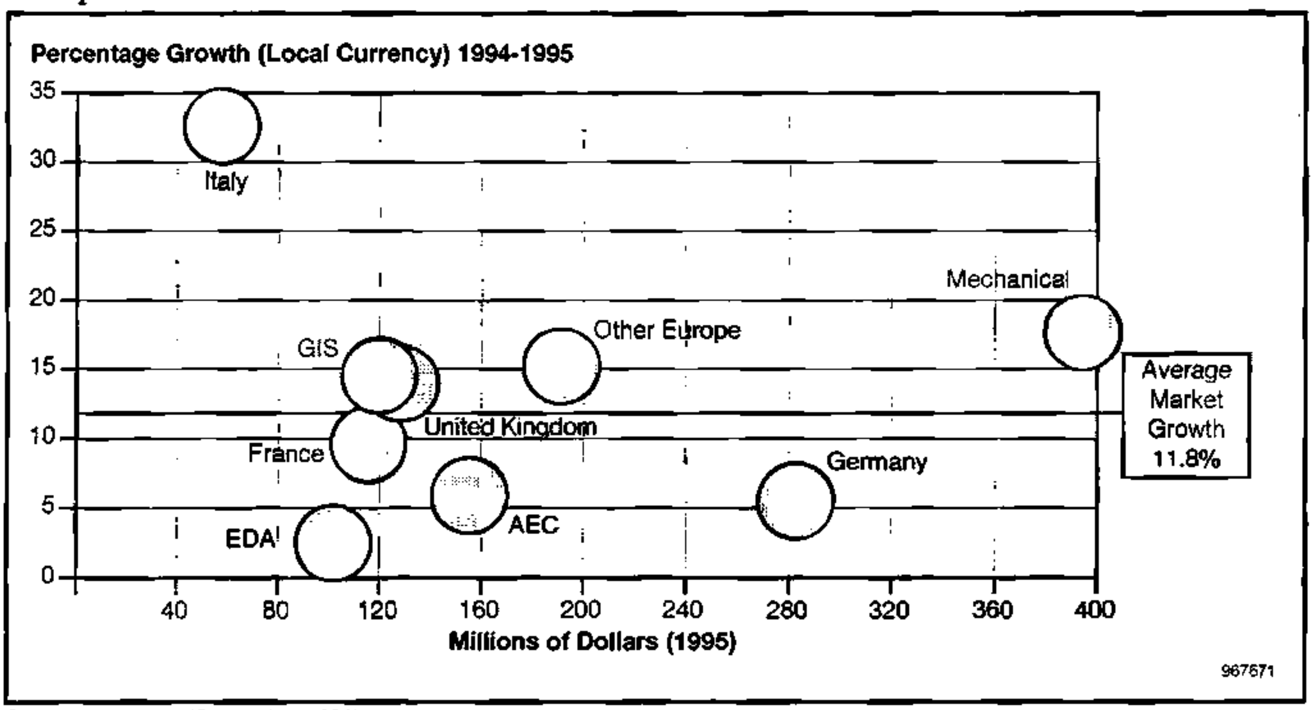
- European-based vendors generated only 25 percent of the mechanical CAD/CAM/CAE software revenue, compared with 75 percent generated by U.S.-based vendors.
- UNIX-based software dominates the market, accounting for 75 percent of mechanical CAD/CAM/CAE software sales in 1995.
- The largest regional market for mechanical CAD/CAM/CAE software in 1995 was Germany, with $391 million in software revenue, representing 36 percent of the European market.

Figures 1 and 2 provide a snapshot of the European CAD/CAM/CAE and GIS market as a whole, and the mechanical CAD/CAM/CAE market in particular.

Western European Economic Prospects

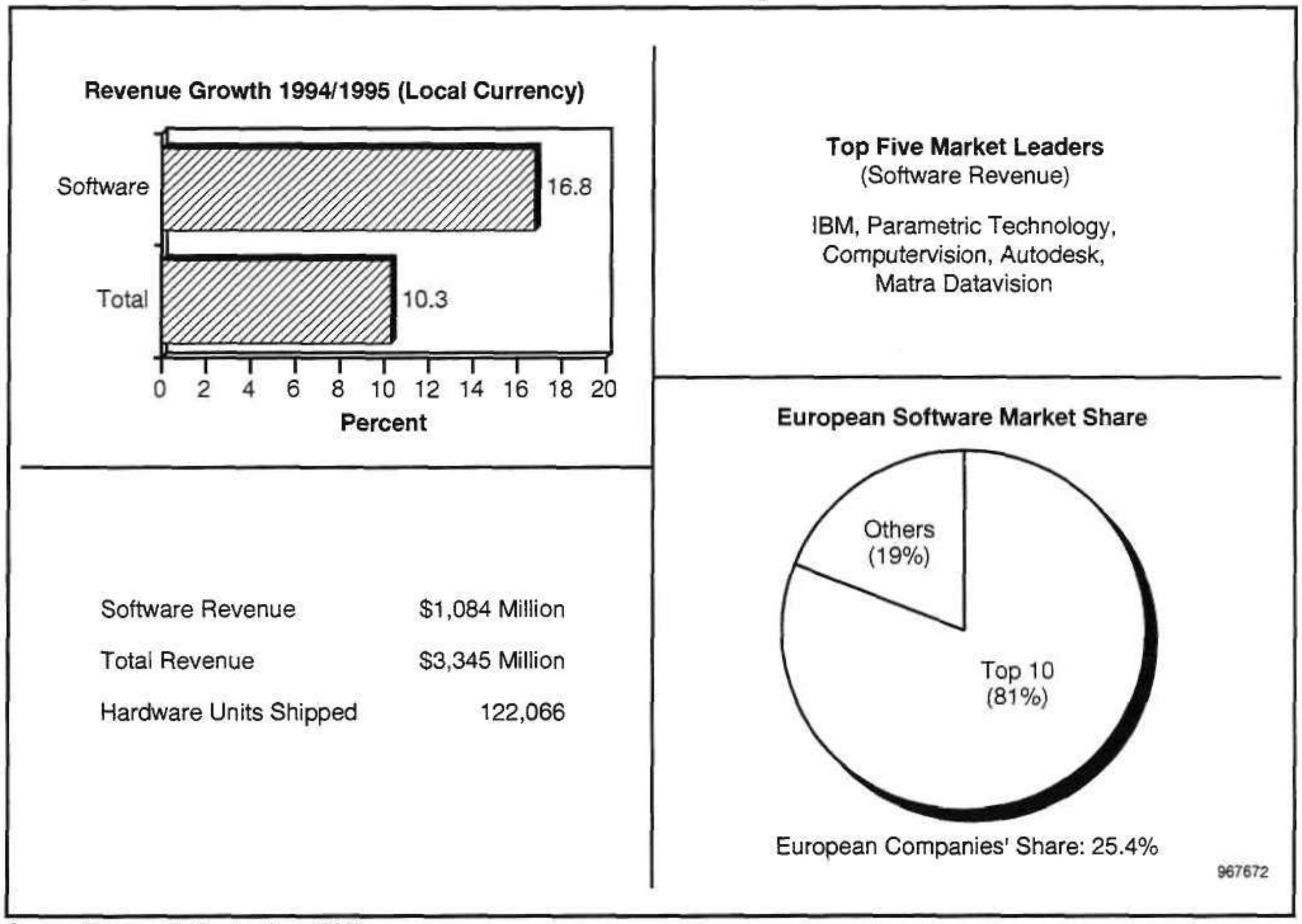
The economic downturn that began in the second half of 1995 continued in the first half of 1996 and has been much more severe than originally anticipated, particularly in Germany and France—two of the key economic engines of western Europe. While it is dangerous to consider western Europe as single economy as each country is structurally very different, there are two common factors that lie behind the fall in growth in the past 12 months. These factors will have a strong influence on the rate of growth in the years up to the millennium and beyond.

Figure 1
European CAD/CAM/CAE/GIS Software Market Portfolio



Source: Dataquest (September 1996)

Figure 2
European Mechanical CAD/CAM/CAE Market Snapshot



Source: Dataquest (September 1996)

The first is the European Monetary Union. Signatory countries of the Maastricht Treaty will struggle to meet the economic criteria laid down in this agreement. The agreement requires budget deficits to not exceed more than 3 percent of GDP, national debt to not exceed more than 60 percent, and inflation to not be more than 1.5 percent above the average of the three lowest inflation rates. Germany and France will find it particularly difficult to meet these criteria and will need to impose stricter spending controls if they are to meet the 1999 deadline. As two of the key economies in Europe, any decrease in investment will be felt in these countries. While it is highly likely that criteria will be interpreted less strictly than at first envisaged, (recently a prominent German minister stated that "all agreements are open to interpretation") the effect of the economic packages that will need to be put in place will depress investment for at least the next three years.

The second is the cost of reunification to the German economy. Forecasts of the cost of reunification now look very low. There is some evidence that GDP growth in former Eastern Germany is falling behind that of former Western Germany, which will prolong the process of reunification and escalate the cost yet further. For the German economy, this means higher taxes, which will drive down consumption.

The German economy is pivotal in the fortunes of the European prosperity as it is a major trading partner for many countries, particularly those geographically adjacent to it.

Looking more closely at individual countries, conditions in the German economy in particular are continuing to surprise many forecasters by their weakness: The German government recently suggested growth would be a mere 0.75 per cent this year, half the rate forecast three months ago. Private consumption remained disappointing in the second quarter and industrial investment was an especially weak point in the economic picture, with low capacity utilization and high costs and taxes combining with business uncertainty to hold back spending.

In France, GDP growth has gone from a 1.2 percent spurt in the first three months of 1996 back to almost zero growth in the second quarter. Most analysts expect consumer expenditure to remain subdued for the foreseeable future, owing to high taxes, concerns about job security, and the high rate of unemployment. The May monthly industrial survey conducted by INSEE, the French national statistics agency, suggests the outlook of professional equipment suppliers has taken a turn for the worse, with order books falling.

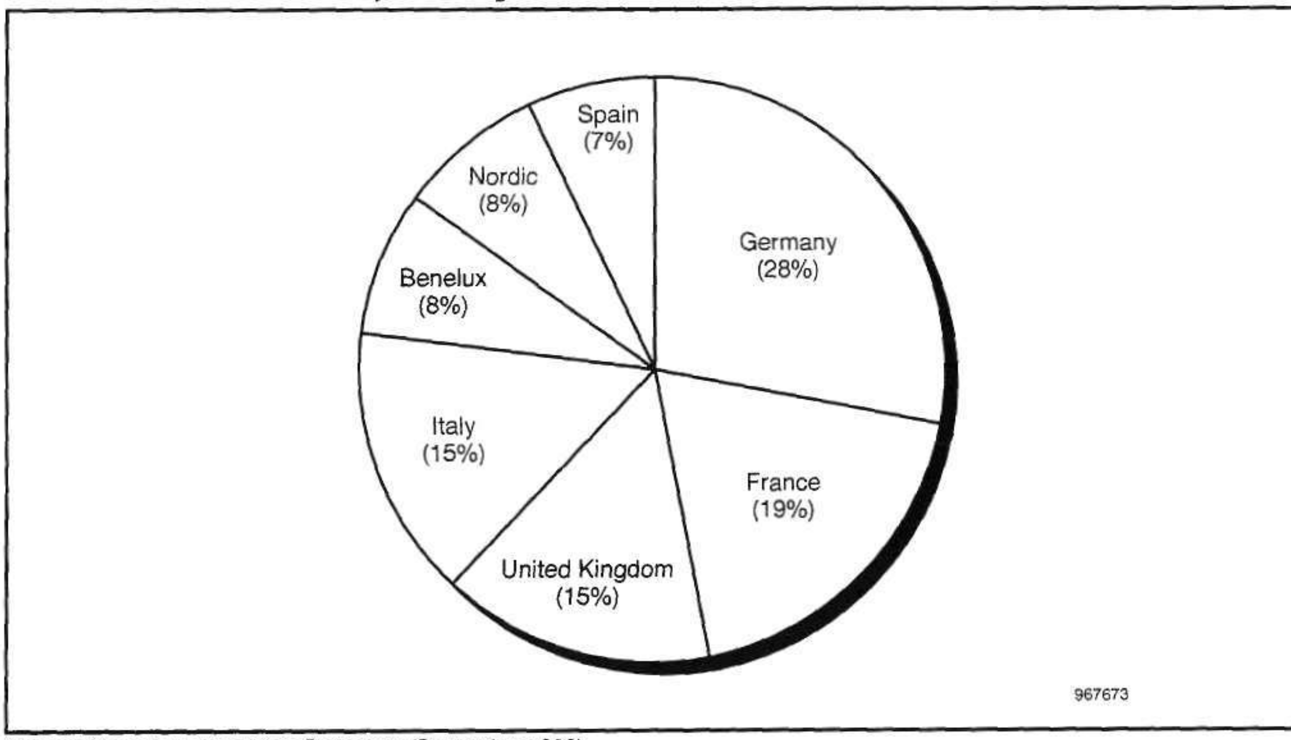
In the United Kingdom, the situation is more positive. A recent OECD report gave a largely favorable forecast for the U.K. economy, saying it believed the country would soon rebound from the recent slowdown amid a "favorable" inflation outlook. The OECD's broader optimism stems largely from the United Kingdom's recent labor market reforms and competition policy. It has also benefited from the devaluation of the pound two years ago, which has brought a competitive edge to the economy almost overnight. Growth is estimated to be in the region of 2 percent in 1996. Much of this growth can be attributed to domestic demand. Recent tax cuts, higher employment, and the maturation of a number of tax exemption saving schemes have increased disposable incomes.

Both the Spanish and Italian economies continue to underperform. A key economic burden for Spain is its high level of unemployment, which according to official statistics, accounted for 22.3 percent of the working population in second quarter 1996. In Italy, weak domestic demand output is expected to continue throughout 1996.

In the Nordic region, Sweden, the largest economy, has performed badly in the first six months of 1996 while its smaller neighbors, Finland, Denmark, and particularly Norway, have performed well. Once again this is related to Sweden's desire to join the EMU and the economic measures that have been implemented to achieve the requirements.

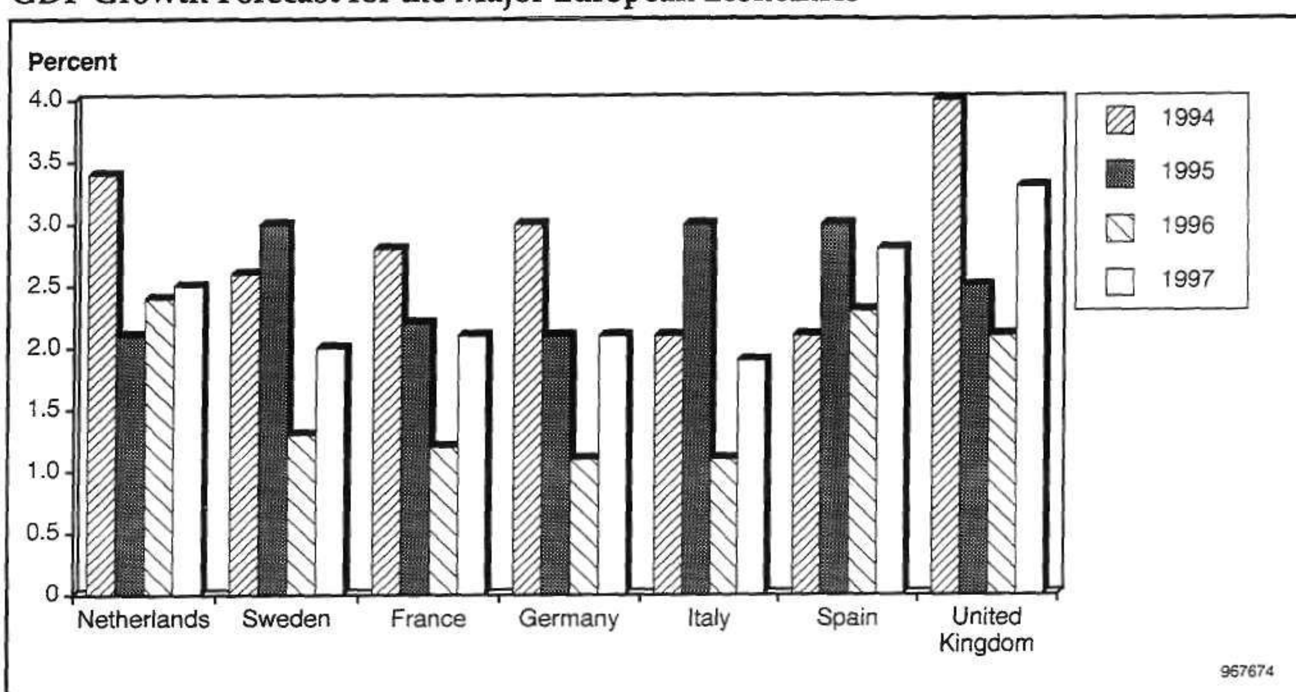
See Figures 3 through 6 for illustrations of these economic trends. These forecasts are based on the average of more than 20 forecasting bodies in each country. The trend is positive in almost all cases beginning in the second half of 1996. The year 1997 is forecast to be a better year economically than 1996. These forecasts should be treated with some caution as the numbers have been constantly revised downward in the last nine months. As previously discussed, the economic cost of achieving European Monetary Union may be high in the run up to 1999, and this will dampen growth. The precise degree as to how this will affect the European economy as a whole is unknown.

Figure 3
1996 Size of GDP for Major European Economies



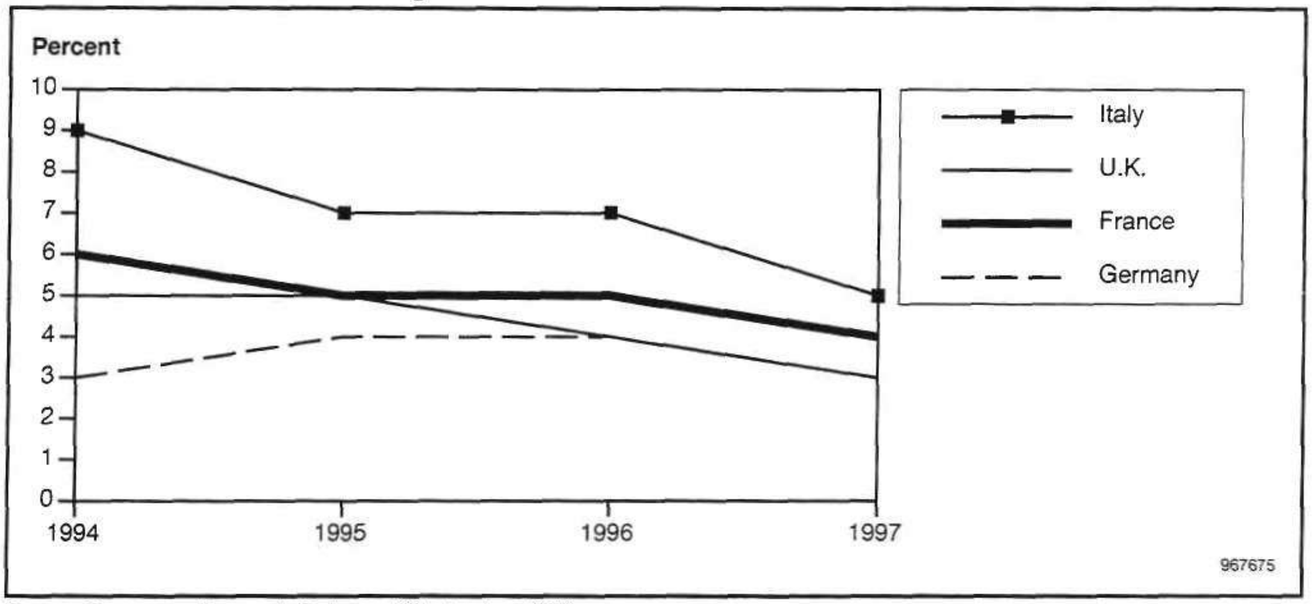
Source: Consensus Forecasts/Dataquest (September 1996)

Figure 4
GDP Growth Forecast for the Major European Economies



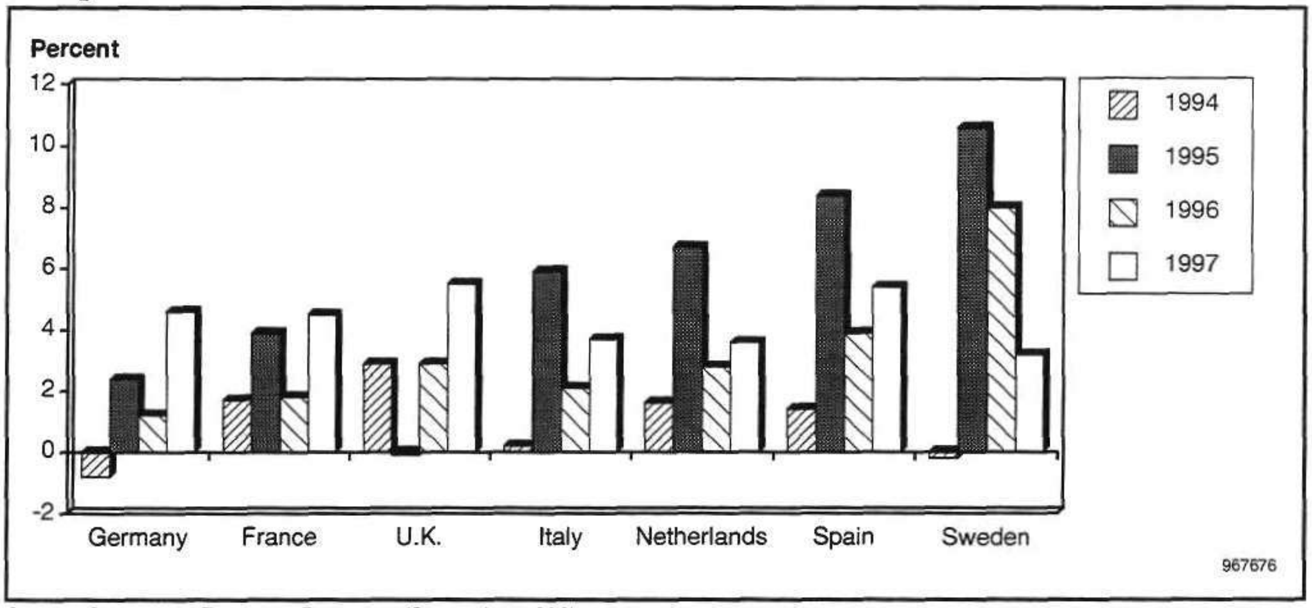
Source: Consensus Forecasts/Dataquest (September 1996)

Figure 5
Public Deficit as a Percentage of GDP



Source: Consensus Forecasts/Dataquest (September 1996)

Figure 6
European Business Investment Growth Forecast



Source: Consensus Forecasts/Dataquest (September 1996)

The Continuing Impact of Currency Shift

Fluctuating exchange rates once again masked the true market performance in the 1995 CAD/CAM/CAE and GIS market. European CAD/CAM/CAE and GIS software grew 22 percent from 1994 to 1995 when measured in U.S. dollars. The dollar depreciated more than 8 percent against the ECU, so European CAD/CAM/CAE and GIS software revenue grew 11.8 percent from 1994 to 1995 when measured in ECU. Table 1 shows the U.S. dollar's performance over the last three years against the individual European currencies. Table 2 highlights the effect that the fluctuations in the dollar exchange rate had on the results of the European CAD/CAM/CAE/GIS market performance.

Looking ahead, currency fluctuations will continue to be felt in all global markets. The dollar has appreciated slightly during the early months of this year, so if we were to assume a stable currency for the remainder of this year, 1996 will end with the dollar appreciating nearly 3 percent against the ECU. Although Dataquest does not forecast currency exchange rates, we do forecast with the best information available. The exchange rate is calculated as the simple arithmetic mean of the 12 monthly average rates for each country. For the purpose of this forecast, Dataquest assumes that the August exchange rate will remain stable in the future.

Mechanical CAD/CAM/CAE Market in Europe

The overall economic situation in Europe began to improve in 1995 but since then has started to slow down again. This, however, does not seem to stop the manufacturing companies from investing in IT tools. Especially in the automotive and aerospace industries, which made heavy investments in CAD/CAM/CAE tools. Many vendors targeting these two industry sectors reported growth rates above 20 percent for 1995 and similar growth is expected for 1996. Since 1995, we have seen mainly the large automotive and aerospace manufacturers invest in new tools, and we expect that during the end of 1996 and 1997 the suppliers' chain will invest. It seems that in many cases, the CAD installations were nearly 10 years old and that companies are currently making their decisions for the next 10 years. This trend can be seen in all major European automotive and aerospace industries such as Germany, the United Kingdom, Italy, Spain, and France.

When looking at some economic statistics, the role Germany plays in the manufacturing industry—and hence the mechanical CAD/CAM/CAE sector—becomes evident. Germany has a 36 percent share of the total European mechanical CAD/CAM/CAE software market—twice the size of France. So any major change in the German manufacturing industry will inevitably influence overall European market performance. On the other hand, the main consumer of mechanical CAD/CAM/CAE software in Europe is the automotive industry, and again, any major investment change in this industry will influence the MCAD market. And both in Germany and in the automotive industry across Europe, we are seeing an upturn in investment from recent years. See Figures 7 and 8 for workforce distribution by industry sector in the various European countries and Figure 9 for car production forecasts.

Table 1
U.S. Dollar Exchange Rates for European Currencies

Country	Currency	1993	1994	1995	Preliminary Average 1996	Projected Rate 1997	U.S. Dollar Appreciation (%) 1993-1994	1994-1995	1995-1996	1996-1997
Austria	Schilling	11.65	11.4	10.06	10.49	10.44	-2.1	-11.7	4.2	-0.5
Belgium	Franc	34.67	33.66	29.42	30.68	30.55	-2.9	-12.6	4.3	-0.4
Denmark	Krone	6.49	6.35	5.59	5.77	5.73	-2.2	-11.9	3.2	-0.7
Finland	Markka	5.73	5.21	4.37	4.56	4.48	-9.1	-16.1	4.4	-1.8
France	Franc	5.67	5.54	4.97	5.08	5.06	-2.3	-10.3	2.2	-0.4
Germany	D-Mark	1.66	1.62	1.43	1.49	1.48	-2.4	-11.7	4.2	-0.5
Italy	Lira	1,577.85	1,609.34	1,628.21	1,541.06	1,516.62	2.0	1.2	-5.4	-1.6
Netherlands	Guilder	1.86	1.82	1.60	1.67	1.66	-2.2	-11.9	4.2	-0.4
Norway	Krone	7.11	7.04	6.33	6.45	6.42	-1.0	-10.1	1.9	-0.5
Spain	Peseta	127.87	133.48	124.40	125.78	125.72	4.4	-6.8	1.1	0.0
Sweden	Krona	7.82	7.7	7.14	6.69	6.62	-1.5	-7.3	-6.2	-1.0
Switzerland	Franc	1.48	1.37	1.18	1.21	1.20	-7.4	-13.9	2.8	-0.8
United Kingdom	Pound	0.67	0.65	0.63	0.65	0.65	-3.0	-2.6	2.7	-0.7
Europe	ECU	0.8566	0.8436	0.77	0.80	0.79	-1.5	-8.3	2.9	-1.0

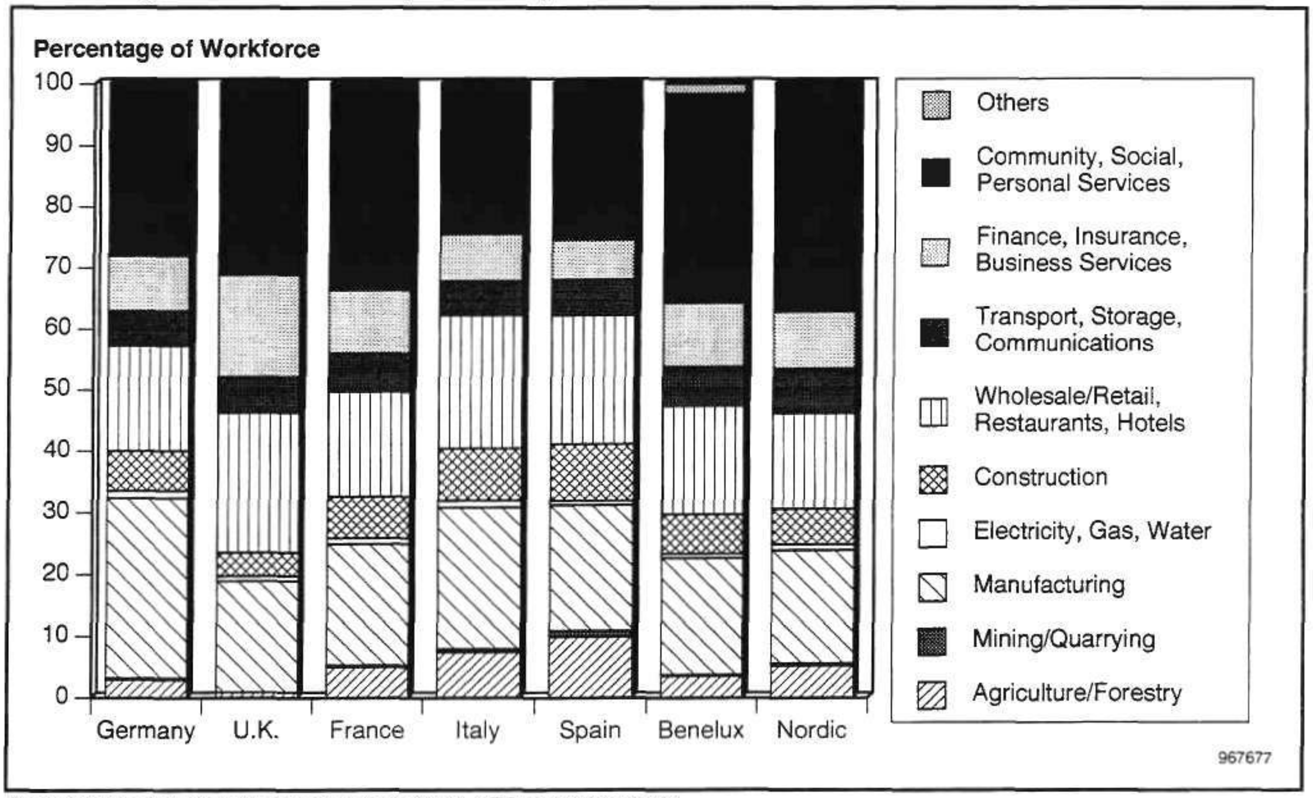
Source: Dataquest (September 1996)

Table 2
Software Revenue History and Forecast, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	Growth Rate (%) 1994-1995	Growth Rate (%) 1995-1996	CAGR (%) 1995-2000
European Revenue in U.S.$M											
Mechanical	785	851	1,084	1,204	1,294	1,376	1,493	1,642	27	11	8.7
AEC	319	362	417	403	416	455	502	543	15	-3	5.4
GIS/Mapping	229	259	321	350	394	447	497	550	24	9	11.3
EDA	236	250	277	304	335	366	391	428	11	10	9.1
All Applications	1,569	1,722	2,099	2,261	2,438	2,644	2,883	3,163	22	8	8.5
Exchange Rate, ECU/U.S.$	0.86	0.84	0.77	0.80	0.79	0.79	0.79	0.79			
European Revenue in ECU M											
Mechanical	672	718	838	959	1,020	1,085	1,177	1,294	17	14	9.1
AEC	274	305	322	321	328	359	395	428	6	-1	5.8
GIS/Mapping	196	219	248	279	311	352	392	433	14	12	11.8
EDA	202	211	214	242	264	289	308	338	1	13	9.5
All Applications	1,344	1,453	1,624	1,800	1,922	2,085	2,272	2,493	12	11	9.0

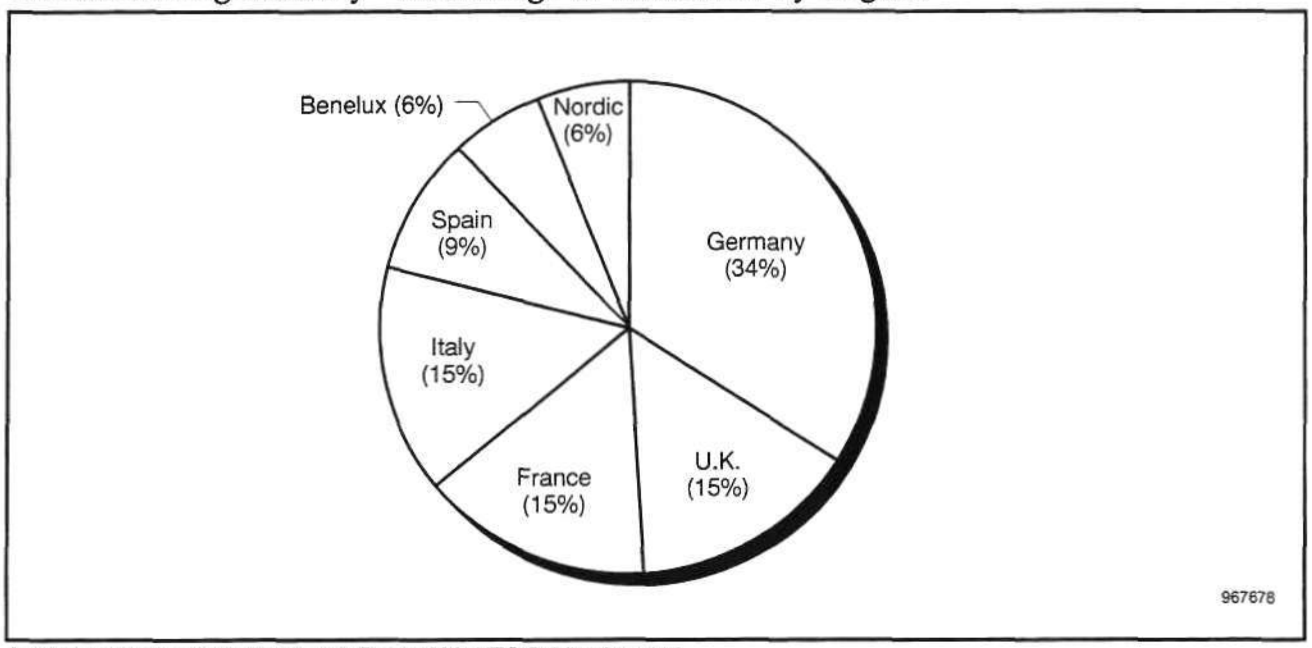
Source: Dataquest (September 1996)

Figure 7
Percentage of Workforce by Industry Sector



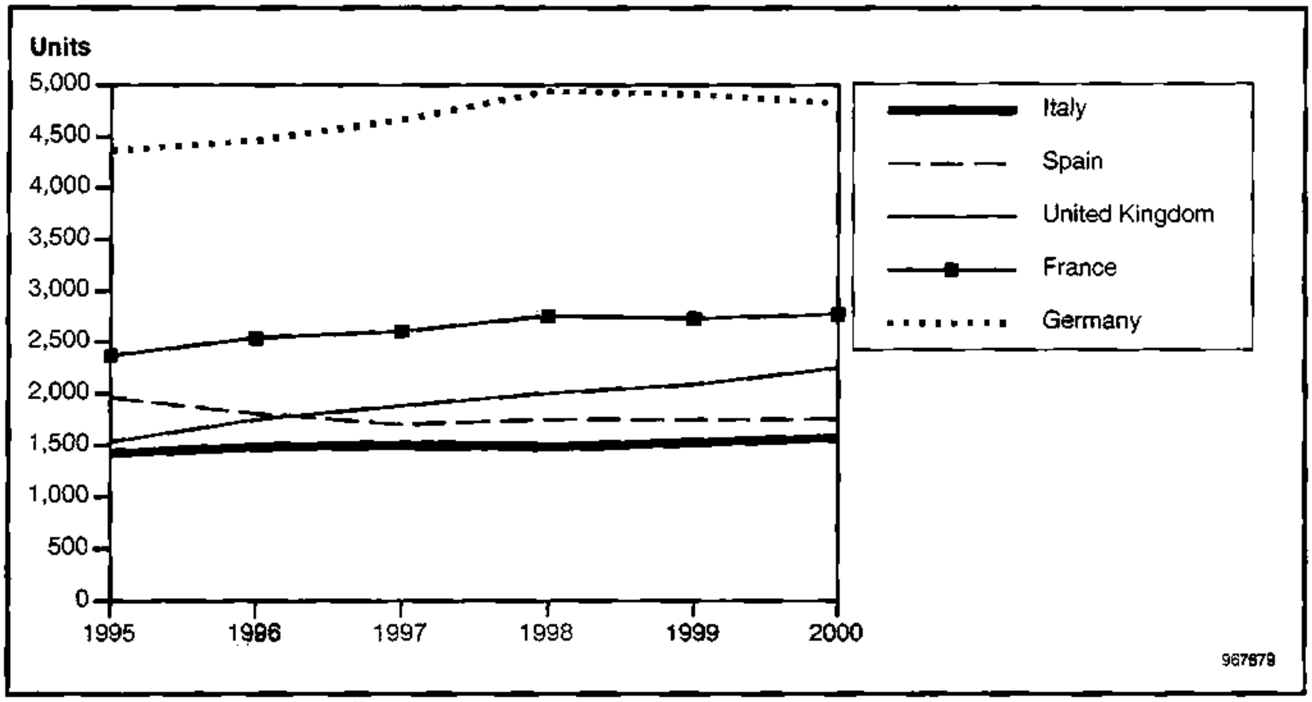
Source: European Marketing Pocket Book 1996, NTC Publications Ltd.

Figure 8
Manufacturing Industry—Percentage of Workforce by Region



Source: European Marketing Pocket Book 1996, NTC Publications Ltd.

Figure 9
European Car Production Forecast



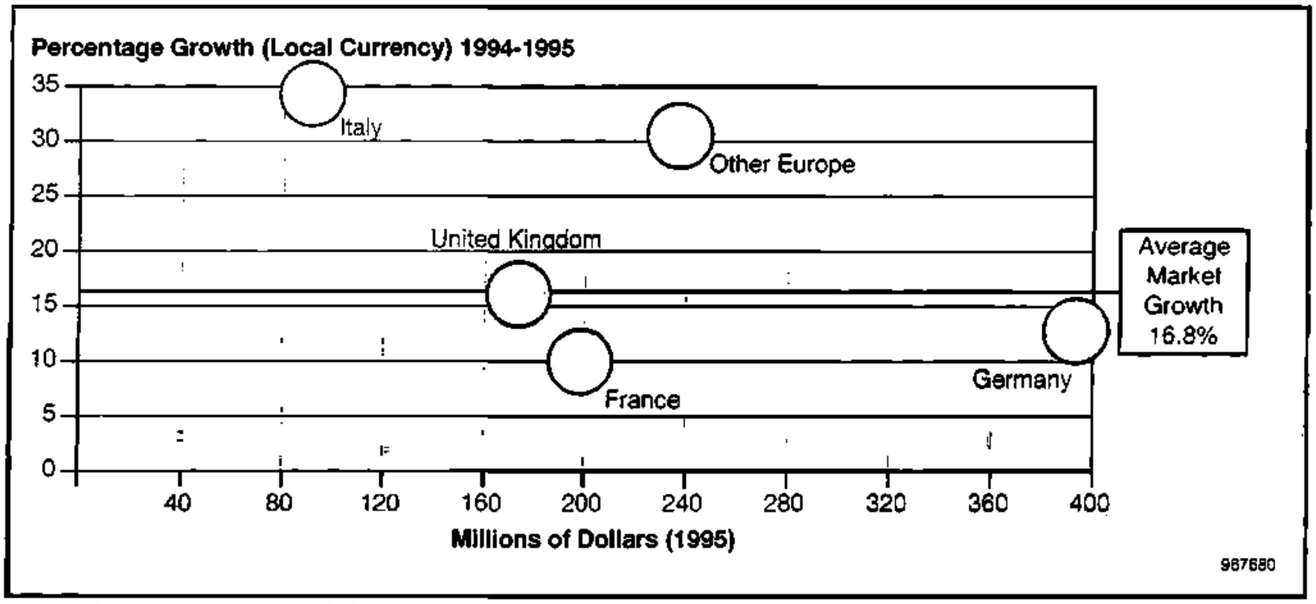
Source: Dataquest (September 1996)

Mechanical applications, which totaled $1.1 billion, had a 52 percent share of the total European CAD/CAM/CAE/GIS software market in 1995, compared with 49 percent in 1994. It increased by nearly 17 percent in software revenue in 1995. The top 10 vendors actually grew nearly 22 percent and now control 81 percent of this market, compared with 78 percent in 1994. The market is expected to increase by another 14 percent to $1.2 billion in 1996 (all growth rates are based on ECU). Overall, Dataquest expects the market for mechanical CAD/CAM/CAE to grow at a compound annual growth rate (CAGR) of 8.7 percent until the year 2000.

Figures 10 and 11 give a snapshot of the mechanical CAD/CAM/CAE software market in 1995 and Dataquest's predictions for the market by major European country.

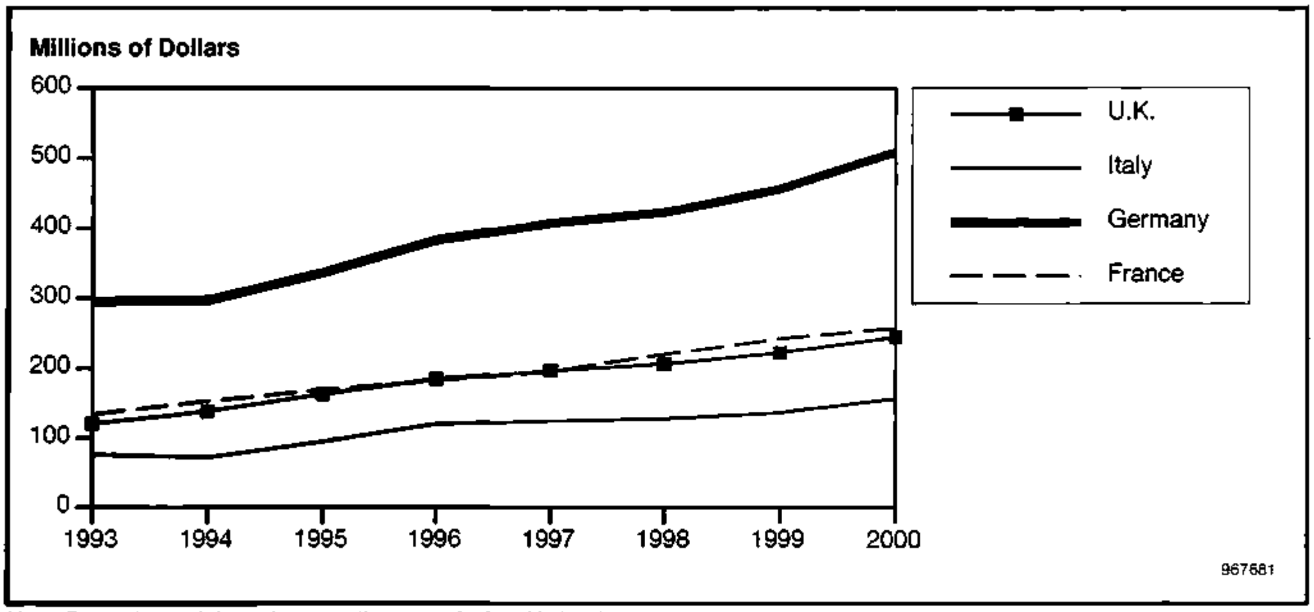
Among the top 10 European mechanical CAD/CAM/CAE software vendors, only one—namely, Matra Datavision—is a European company. Of the total European CAD/CAM/CAE/GIS software revenue, U.S.-based vendors had nearly 75 percent and European vendors had 25 percent in 1995. This indicates a gain of market share for U.S.-based vendors over 1994, when the distribution was 71 percent for U.S.-based vendors versus 29 percent for European vendors. The Asian vendors' share was negligible. However, when looking at this distribution, we have to remember that several of the products sold by U.S.-based vendors are actually developed in Europe. The leading example of this is CATIA, developed by Dassault Systémes, for which IBM has the sole distribution rights. Other examples include Computervision's Medusa product, Hewlett-Packard's Precision Engineering products, GDS, and the solid modelers Acis and Parasolids.

Figure 10
European Mechanical CAD/CAM/CAE Software Market Portfolio



Source: Dataquest (September 1996)

Figure 11
European Mechanical CAD/CAM/CAE Software Revenue Forecast by Country (Millions of Dollars)



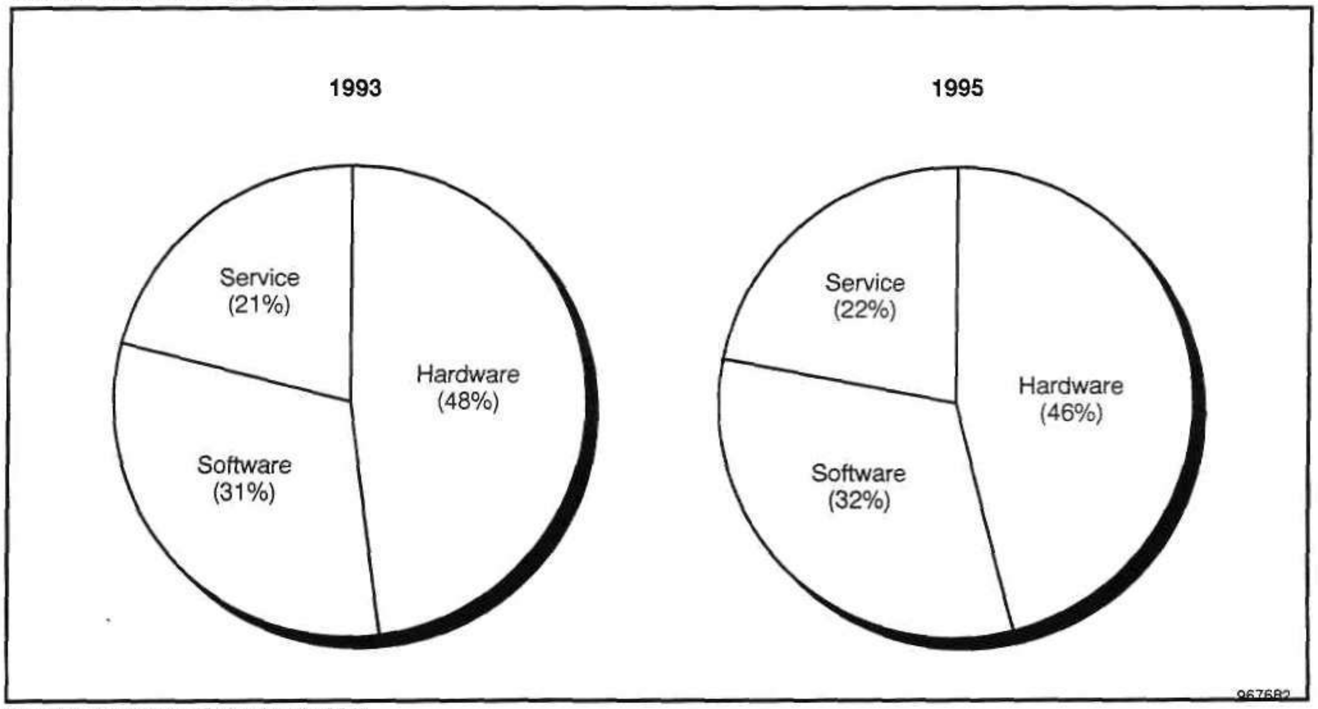
Note: Percent growth based on growth rates calculated in local currency.
Source: Dataquest (September 1996)

The share of European vendors is declining for many reasons. U.S. vendors over the years have acquired several of the European companies (Norsk Data, Isykon product line), local mergers and acquisitions took place (Strässle acquired Nestler, Fides and Siemens Nixdorf's product line; Matra Datavision acquired Cisigraph), and some companies have simply pulled out of this market. Also, it is much more difficult to find venture capital or other start-up funding for IT companies in many countries of Europe than it is in North America. Much of the U.S. CAD/CAM/CAE/GIS industry is driven by people leaving one company and starting a new company with new ideas. These start-ups often include veterans of the vendor and user companies. This happens to a greater extent in the United States because of the critical mass and partnership situation that exists there and the positive stance by the financial community toward investing in IT companies. Marketing is another issue, and many European companies are extremely reluctant to invest in the right kinds of marketing organizations. Marketing, market research, and press relations all cost money, and companies must be prepared to pay for these things. A third factor is that many European vendors operate only in their country of origin and one or two other countries, and it is these vendors that have suffered. Operating in a comparatively small region does not generate enough revenue to keep up the R&D investment necessary to continue to produce globally competitive products.

European Mechanical CAD/CAM/CAE Market by Component

The share of software revenue of the total revenue for mechanical CAD/CAM/CAE CAD applications has increased at the expense of hardware revenue. This trend is expected to continue in the future as the average selling prices (ASPs) of hardware decrease at a faster rate than those for software (see Figure 12).

Figure 12
European Mechanical CAD/CAM/CAE Revenue Comparison by Component (Millions of Dollars)



Source: Dataquest (September 1996)

Mechanical CAD/CAM/CAE Market by Platform

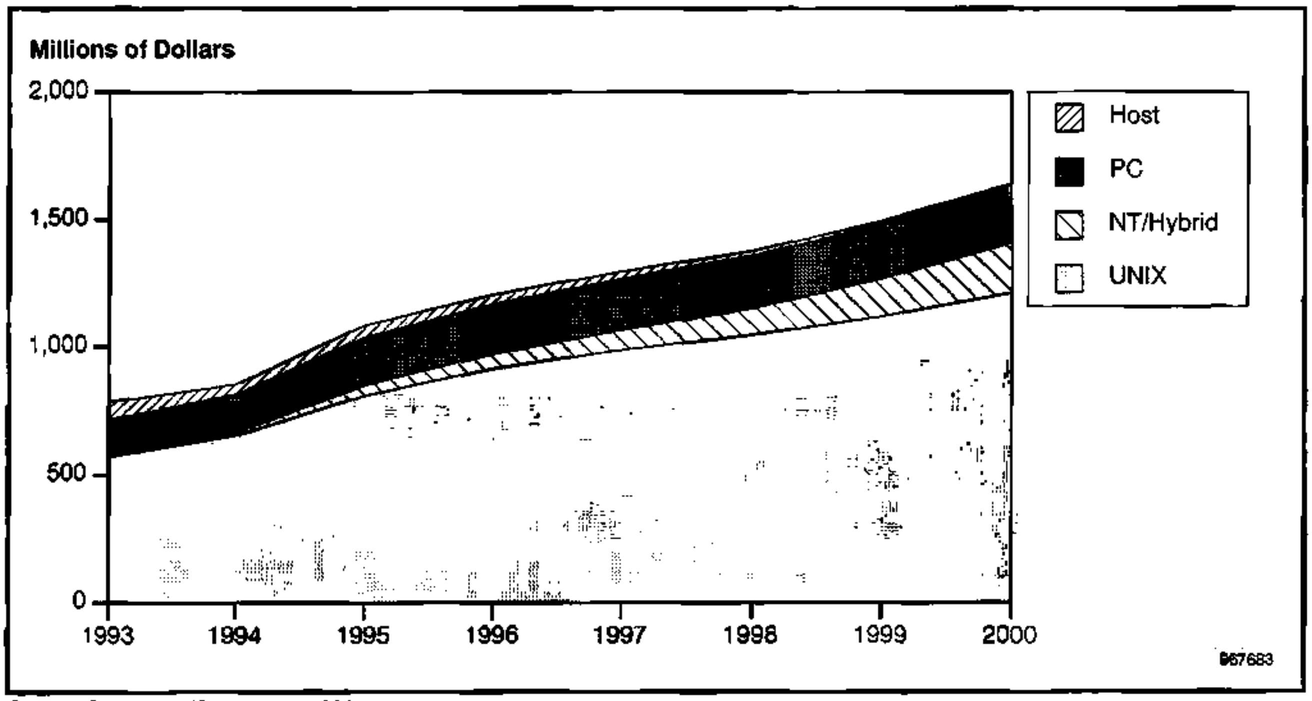
The mechanical CAD/CAM/CAE market segment is dominated by UNIX-based solutions, in terms of software revenue, which accounted for 75 percent of European MCAD software revenue. In terms of seats, UNIX-based seats made up 39 percent and PC-based seats 54 percent of the MCAD installed base in 1995 (see Figures 13 and 14). Of the 507,000 MCAD seats installed in Europe at the end of 1995, 274,000 of them were PCs, compared with more than the 200,000 UNIX seats.

Despite growth of 189 percent in 1995, NT-based applications have not encroached on revenue for applications on the other platforms. Investment in mechanical CAD/CAM/CAE tools in 1995 and 1996 is primarily driven by large UNIX-based orders from the automotive and aerospace industries. Also, not all of the leading products are available on NT today.

In Europe, we do not expect NT to play a significant role in the MCAD market until 1998. And even then, growth for NT-based solutions will not come from the traditional users in the automotive and aerospace industries, but from other industry sectors made up by small to medium-size companies.

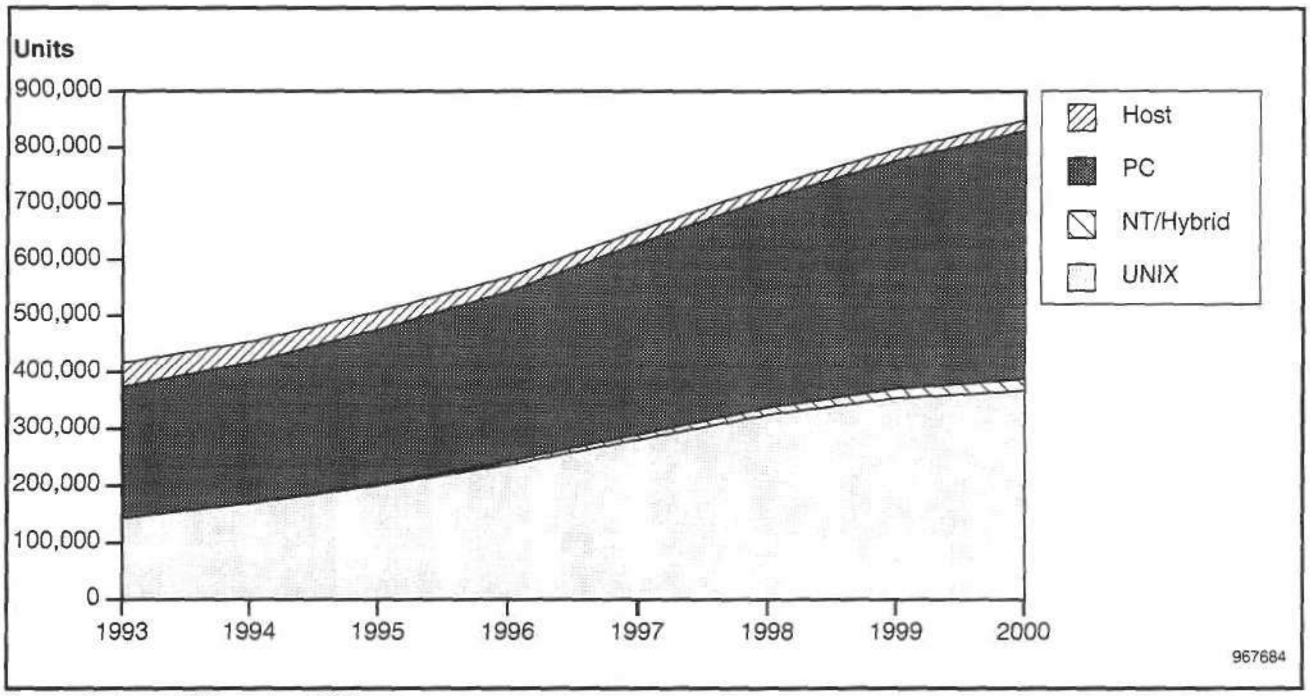
In the major industries such as automotive and aerospace, adoption of NT-based solutions will take longer as most of the large companies are currently investing in UNIX-based systems. Looking at the long IT investment cycles in these industries, it will take a number of years until these new installations will be replaced.

Figure 13
European Mechanical CAD/CAM/CAE Software Revenue Forecast by Platform (Millions of Dollars)



Source: Dataquest (September 1996)

Figure 14
European Mechanical CAD/CAM/CAE Hardware Seat Installed Base by Platform (Units)



Source: Dataquest (September 1996)

Dataquest Perspective

There is a clear indication that the European manufacturing industry is going through a major transformation to remain competitive in a more and more global economy. Also, Europe has to get ready for the threat from the emerging economies in Southeast Asia, which are expected to have more than half of the world's trade in 2020. High labor costs have forced industry to change radically and increase productivity despite high labor costs. This change in the structure of the European manufacturing industry is one of the factors behind the large IT investment we are currently witnessing.

CAD investment in Europe is part of global corporate strategy. This means that when orders are placed in Europe, generally they are of a much bigger magnitude than in the United States. The various large orders that came in from Europe over the last two years—such as Rolls Royce, Volkswagen, FIAT, Daimler Benz to name but a few—show this. But this also means that the IT investment cycles are longer in Europe. In some cases, these can be up to 10 years. We do not expect the mechanical CAD/CAM/CAE software market to continue to grow at the current pace. From 1998 onward, things will go back to normal and the market will again display all the signs of a mature replacement market.

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Perspective

Mechanical CAD/CAM/CAE Worldwide

Market Analysis

Channel Analysis of the Mechanical Design Market

Abstract: *Determining who the mechanical CAD/CAM/CAE market leader is, who grew the fastest, and what market share individual vendors hold all varies, depending on what metrics of measurement are used. This Perspective is intended to provide different views of the relative sizes of the mechanical CAD/CAM/CAE players using various revenue-based metrics.*

By Sharon Tan

Overview

The mechanical CAD/CAM/CAE market is diverse, with a host of players from around the world contributing to a $9.6 billion market. Assessing who the market leader is, who grew the fastest, and what market share individual vendors hold isn't as simple as just collapsing market statistics information to one single data point. Instead, the market players—and their relative positions—vary, depending on what metrics are used to form the basis of comparison. Here, we illustrate a number of different views of the mechanical CAD/CAM/CAE market. It is important for the reader to keep in mind what metrics are being used to measure the vendors.

Market Rankings by Total Distribution Revenue

Total distribution revenue is a metric that includes software, hardware, and service—or in a simplified nutshell, anything that gets sold to mechanical designers that is CAD and computing-related. About 47.7 percent of the worldwide mechanical market is derived from hardware sales (for example, sales of CPUs, printers, plotters), 31.5 percent from software sales, and the remainder is service-based revenue. As a result, many of the workstation

Dataquest

Program: Mechanical CAD/CAM/CAE Worldwide
Product Code: CMEC-WW-DP-9607
Publication Date: October 28, 1996
Filing: Perspective
(For Cross-Technology, file in the Online, Multimedia, and Software binder)

vendors—such as IBM Corporation, Hewlett-Packard Company, and Su Microsystems Inc.—hold the top spots in this market ranking. Table 1 sho the results for total distribution revenue for the major mechanical market players. An individual company's distribution revenue includes hardware, software, and service sales through all distribution channels—direct, indirect, OEM, and reseller. As a result, the sum of all companies' revenue or market share are greater than the total market size of $9.6 billion (total market size is determined by sales from the direct and indirect channels only).

The importance of looking at the market from this perspective—total distribution revenue—is to show the importance of hardware to the mechanical CAD/CAM/CAE market. Nearly one-half of the market, or $4.6 billion, was from hardware sales in 1995. Further, despite the continual speculation about NT-based solutions and their impact on the market, it is the UNIX-based hardware and software vendors that overwhelmingly dominate the list in Table 1.

Table 1
Worldwide Mechanical CAD/CAM/CAE Total Distribution Revenue (Millions of Dollars)

Ranking	Company	1994	1995	Growth (%)	Market Share (%)
1	IBM	1,443.8	1,658.4	14.9	17.3
2	Hewlett-Packard	851.5	1,088.4	27.8	11.4
3	Sun Microsystems	683.4	799.6	17.0	8.4
4	Digital Equipment	777.7	767.3	-1.3	8.0
5	Silicon Graphics	382.4	482.9	26.3	5.0
6	Parametric Technology	287.3	440.0	53.1	4.6
7	Fujitsu	307.0	355.8	15.9	3.7
8	Computervision	330.8	331.5	0.2	3.5
9	EDS Unigraphics	306.3	328.0	7.1	3.4
10	NEC	243.5	296.9	21.9	3.1
	All Companies	8,339.6	9,572.0	14.8	100.0

Note: Market statistics of each vendor includes direct, indirect, OEM, and reseller data where applicable, but OEM and reseller data is not counted in total market size of $9,572 million.
Source: Dataquest (October 1996)

Market Rankings by Company Software Revenue

The CAD world is complex, relying on a host of complex distribution channels to get products to the end user. A vendor's revenue is not just derived from sales of the company's own products, but also from sales of other company's products that it may OEM or resell through its VAR channel. The more commonly used metric for measuring the worldwide mechanical CAD/CAM/CAE market is one that includes company software revenue through all distribution channels—direct, indirect, OEM, and reseller. Table 2 shows vendor rankings based on company software revenue. Again, the total market size of $3.0 billion for 1995 is based on what gets sold through the direct and indirect channels only (to avoid double counting the market). An individual vendor's revenue and market share is based on what gets sold through all of its channels.

From this perspective, IBM clearly has bragging rights as being the No. 1 vendor in mechanical company software revenue for 1994 and 1995, followed by PTC and Autodesk. Dassault Systemes holds the No. 5 spot, even though Dassault does not sell any products of its own but instead generates revenue through its OEM arrangement with IBM. Similarly, under this methodology, Japanese-based vendor Fujitsu claims the No. 10 spot, boosted by its role as a reseller of other vendors' mechanical CAD products.

Table 2
Worldwide Mechanical CAD/CAM/CAE Company Software Revenue (Millions of Dollars)

Ranking	Company	1994	1995	Growth (%)	Market Share (%)
1	IBM	368.3	491.5	33.4	16.3
2	Parametric Technology	209.8	321.2	53.1	10.7
3	Autodesk	176.0	210.2	19.4	7.0
4	EDS Unigraphics	172.9	195.8	13.3	6.5
5	Dassault	154.2	190.6	23.6	6.3
6	Computervision	148.2	149.1	0.6	5.0
7	MicroCADAM	91.7	129.2	40.9	4.3
8	SDRC	103.3	117.6	13.8	3.9
9	MacNeal-Schwendler	90.8	114.0	25.5	3.8
10	Fujitsu	83.7	97.0	15.8	3.2
	All Companies	2,491.2	3,011.9	20.9	100.0

Note: Market statistics of each vendor includes direct, indirect, OEM, and reseller data where applicable, but OEM and reseller data is not counted in total market size of $3,012 million.
Source: Dataquest (October 1996)

Market Rankings by Software Product Revenue

Company software revenue, which we discussed earlier, encompasses software revenue from all the channels. Product revenue, which we discuss here, encompasses revenue from the direct and indirect channel *only*—thus, it represents what a company receives for selling its *own* products either directly or indirectly. In this scenario, the sum of market shares over all individual vendors will total 100 percent (see Table 3).

Compared to Table 2, most vendor market shares are about the same under either scenario, with the exception of IBM (which derives a portion of its revenue from reselling MicroCADAM). Dassault and Fujitsu (which generate revenue from largely OEM or reseller sales) disappear from the top 10 list, replaced by Matra Datavision and Hewlett-Packard in the No. 9 and No. 10 spots, respectively. The data in Table 3 is a good measure of those companies actually developing, marketing, and selling their own products under their own names. IBM is the exception here, acting more as a marketing and selling arm for Dassault.

Table 3
Worldwide Mechanical CAD/CAM/CAE Software Product Revenue (Millions of Dollars)

Ranking	Company	1994	1995	Growth (%)	Market Share (%)
1	IBM	319.7	435.5	36.2	14.5
2	Parametric Technology	206.5	321.2	55.5	10.7
3	Autodesk	175.9	208.1	18.3	6.9
4	EDS Unigraphics	169.8	192.5	13.4	6.4
5	Computervision	148.2	149.1	0.6	5.0
6	MicroCADAM	91.7	129.2	40.9	4.3
7	SDRC	103.3	117.6	13.8	3.9
8	MacNeal-Schwendler	90.8	114.0	25.6	3.8
9	Matra Datavision	75.6	87.4	15.6	2.9
10	Hewlett-Packard	74.5	81.5	9.4	2.7
	Other Companies	1,035.0	1,175.7	13.6	39.0
	All Companies	2,491.2	3,011.9	20.9	100.0

Source: Dataquest (October 1996)

Market Rankings by End-User Spending

Thus far, we have not looked at what the end user—the designer or mechanical engineer—is ultimately paying for the software he or she uses. By definition, software sold through the indirect channel is software that is sold to resellers or dealers, who in turn mark up the software and sell it to the end user. We have captured end-user spending for the top 10 vendors in Table 4. To calculate the statistics presented in Table 4, we introduce a new channel—dealer revenue. Dealer revenue is based on a multiplier of indirect revenue, which varies by vendor, by region, and by operating system. Dealer revenue always exists for every vendor with indirect sales, and it is always equal to or greater than indirect revenue. End-user spending for any named company in Table 4 is the sum of revenue from direct, dealer, OEM, and reseller channels.

By substituting dealer revenue in place of indirect revenue, the total software market increases substantially, from about $3.0 billion to $4.1 billion—meaning that users worldwide spent about $4.1 billion on mechanical CAD/CAM/CAE software in 1995. Table 2 and Table 4 are good comparison tables, showing the impact of the indirect channel and dealer revenue on market share rankings. The most notable change is with Autodesk, which claims the No. 2 spot in end-user spending, accompanied by a change in market share from 7.0 percent based on company software revenue to 10.8 percent based on end-user spending. Both IBM and Parametric Technology, which rely less heavily on the indirect channel, lose market share. IBM goes from 16.3 percent in market share based on company software revenue to 12.0 percent based on end-user spending, and PTC goes from 10.7 percent to 8.8 percent, respectively. Again, end-user spending measures what the user actually pays for the software. Under this scenario, Autodesk becomes a much more formidable player.

Table 4
1995 Worldwide Mechanical CAD/CAM/CAE End-User Software Spending (Millions of Dollars)

Ranking	Company	Indirect Revenue	Dealer Revenue	End-User Spending	Market Share (%)
1	IBM	-	-	491.5	12.0
2	Autodesk	185.8	416.6	440.9	10.8
3	Parametric Technology	32.1	71.5	360.6	8.8
4	EDS Unigraphics	25.5	53.0	223.4	5.5
5	Computervision	48.6	114.1	214.6	5.2
6	Dassault	-	-	190.6	4.7
7	SDRC	49.4	115.0	183.2	4.5
8	Hewlett-Packard	58.7	146.8	169.6	4.1
9	MicroCADAM	122.7	143.4	149.8	3.7
10	MacNeal-Schwendler	25.6	53.7	142.1	3.5
	All Companies	940.7	2,022.6	4,094.1	100.0

Note: End-user spending for each vendor includes direct, dealer, OEM, and reseller data where applicable, but OEM and reseller data is not counted in total market size of $4,094 million.
Source: Dataquest (October 1996)

Market Rankings Including Software and Software Service

Our final look at the market takes into consideration software service. Service is certainly not a small piece of the total mechanical CAD/CAM/CAE market—20.8 percent of the $9.6 billion, or about $2 billion in 1995, came from software and hardware service revenue. Of that amount, software service totaled about $1.1 billion in 1995—certainly not a small market. Taking into consideration software service along with company software revenue changes some vendor rankings, as illustrated in Table 5.

When including software service, Computervision jumps up in the rankings to the No. 4 spot worldwide, while Autodesk falls to the No. 6 spot. Again, vendor market share rankings are dependent on what metric is being used to compare the vendors. Clearly, Computervision earns a sizable revenue stream from its software services business, as do some of the other mechanical CAD players such as SDRC, Fujitsu, and IBM.

Table 5
Worldwide Mechanical CAD/CAM/CAE Software and Service Revenue (Millions of Dollars)

Ranking	Company	1994 Service	1994 Software and Service	1995 Service	1995 Software and Service	Software and Service Growth (%)	Software and Service Market Share (%)
1	IBM	180.9	549.2	202.0	693.5	26.3	16.7
2	Parametric	77.6	287.3	118.8	440.0	53.1	10.6
3	EDS Unigraphics	51.5	224.4	64.6	260.4	16.1	6.3
4	Computervision	107.6	255.8	109.1	258.2	0.9	6.2
5	Dassault	23.3	177.5	33.4	223.9	26.2	5.4
6	Autodesk	0.8	176.8	1.2	211.4	19.6	5.1
7	SDRC	64.2	167.5	86.5	204.1	21.8	4.9
8	Fujitsu	70.3	154.0	78.7	175.7	14.1	4.2
9	MicroCADAM	4.8	96.5	6.8	136.0	40.9	3.3
10	MacNeal-Schwendler	6.8	97.7	12.5	126.6	29.6	3.1
	All Companies	948.4	3,439.6	1,129.6	4,141.5	20.4	100.0

Note: Software and software services revenue for each vendor includes direct, dealer, OEM, and reseller data where applicable, but OEM and reseller data is not counted in total market size of $4,142 million.
Source: Dataquest (October 1996)

Dataquest Perspective

We have outlined a number of different reporting schemes in this perspective, each of which is a sound way of looking at mechanical CAD/CAM/CAE market. We have been careful not to double count the worldwide mechanical CAD/CAM/CAE market opportunity of $3.0 billion in 1995 software. While one may argue that overstating a given vendor's market share (in those cases where market share is based on revenue from all distribution channels, but market size is based on direct and indirect revenue) is not representative of the "truth," we feel that we have derived a system that allows all vendors to be represented. Without a reporting scheme such as the one we have outlined in this perspective, companies such as Dassault and Fujitsu would not appear as market leaders in our statistics, when clearly these companies are among the larger players in the mechanical market and are important to watch.

As the mechanical market evolves, the indirect channel and dealer sales will become more important, particularly with the emergence of what is being dubbed the "midrange" market and NT-based solutions. Indirect software sales grew 27.3 percent in 1995, well above the growth of the direct channel (18.2 percent); we expect similar results in the future as more vendors enter the market with solutions being sold through distributors. At the high end, software service will continue to represent a sizable revenue opportunity for vendors that should not be ignored.

Clearly, the market cannot be reduced to a single data point. Being able to capture money as it flows from the end users' pockets to the vendor's bank is important to understanding the complexities of the mechanical CAD/CAM/CAE market.

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Dataquest
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Perspective

Mechanical CAD/CAM/CAE Worldwide

Dataquest Predicts

Windows NT and Mechanical CAD—The Field Is Wide Open

Abstract: *Windows NT-based mechanical CAD/CAM/CAE applications became more widely available in 1995. In this newsletter, we revisit the continuing NT versus UNIX versus DOS/Windows debate. We examine the status of Windows NT in the mechanical CAD/CAM/CAE market and predict how market forces will affect the adoption of the Windows NT operating system in the mechanical design world.*

By Sharon Tan

Dataquest Predicts

In 1994, Windows NT barely scratched the surface of the mechanical CAD/CAM/CAE market. The year 1995 marked the beginning of a number of NT-based CAD software products targeted at mechanical design. NT-based CAD solutions are beginning to make inroads into the mechanical design arena, and the field is still wide open for all vendors. Dataquest predicts that Windows NT will continue to lay down a strong foundation at the low end and the midrange mechanical CAD markets. Its impact on the high end will be seen, but it will not be significant until 1998.

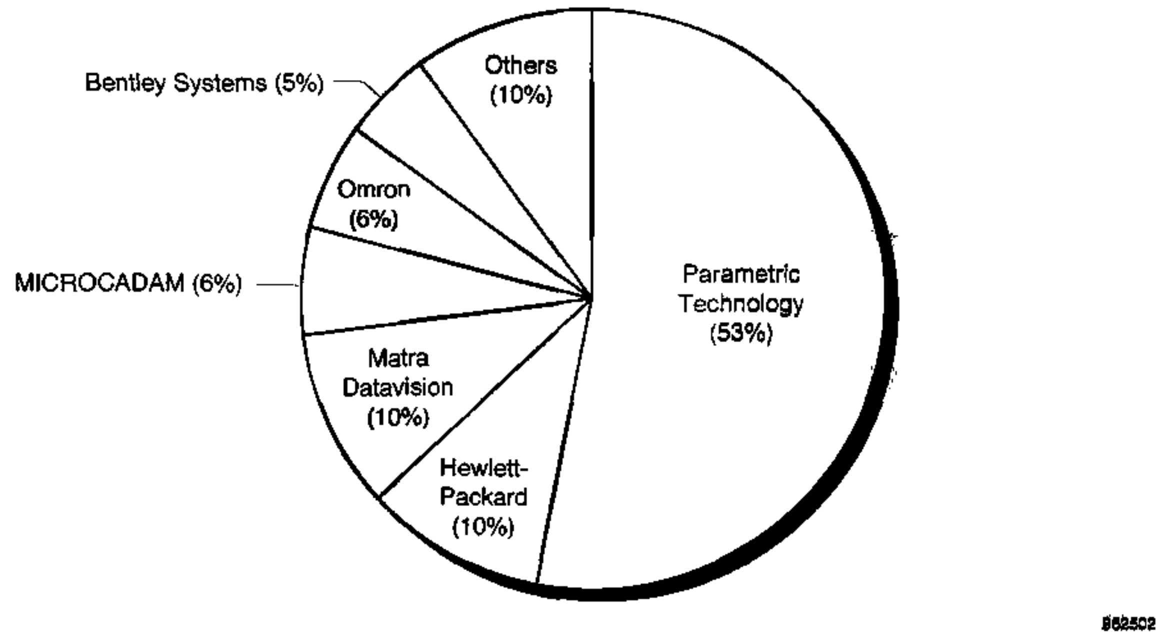
NT CAD Market Today

The market for Windows NT-based mechanical CAD software solutions reached about $100 million in 1995, representing 3.3 percent of the $2,989 million worldwide mechanical CAD/CAM/CAE software market. The NT platform showed substantial growth, up about 125 percent from 1994 mechanical CAD software sales. Leading the pack on the NT platform was Parametric Technology, with about $51 million of revenue attributed to sales on the NT platform, with Hewlett-Packard and Matra Datavision rounding out the top three (see Figure 1).

Dataquest

Program: Mechanical CAD/CAM/CAE Worldwide
Product Code: CMEC-WW-DP-9602
Publication Date: April 29, 1996
Filing: Perspective
(For Cross-Technology, file in the Online, Multimedia, and Software binder.)

Figure 1
1995 Windows NT Market Share



Source: Dataquest (April 1996)

Outside of the mechanical CAD/CAM/CAE market, adoption of Windows NT-based CAD software appears to be varying greatly by application. Overall, NT-based software sales made up 5.6 percent of the worldwide CAD/CAM/CAE/AEC and GIS markets in 1995. Both the architecture/engineering/construction and geographic information systems had greater NT sales than any other CAD application that Dataquest tracks (see Table 1).

Table 1
Windows NT Sales in CAD/CAM/CAE/AEC and GIS for 1995

Application	Percentage of Windows NT-Based Software Sales in 1994	Percentage of Windows NT-Based Software Sales in 1995
Mechanical CAD/CAM/CAE	1.7	3.3
Architecture/Engineering/Construction	4.2	12.3
Electronic Design Automation	0.4	1.6
Geographic Information Systems	3.5	13.3
All Applications	2.1	5.6

Source: Dataquest (April 1996)

Vendor Offerings

NT-based offerings became available from the vendor community beginning in 1994. NT-based solutions run the gamut of mechanical CAD/CAM/CAE systems, developed from high-end, UNIX-based systems (for example, Pro/ENGINEER) to low-end, PC-based packages (for example, CADKEY), and everything in between. A number of analysis, numerical control, and product data management vendors have now ported their products to the NT platform. To date, the leading mechanical CAD vendors have offered their full CAD suite, a subset of it, or a future architecture on the NT platform (see Table 2). It is important to note that the entries in Table 2 are not meant to represent all of the available NT-based mechanical CAD solutions.

With a few exceptions, vendors have not changed pricing for NT-based applications. For instance, Parametric Technology's Pro/ENGINEER has the same list price for both the UNIX version and the NT version. Similarly, Autodesk's AutoCAD has the same list price for both the DOS/Windows versions and the NT version.

Because CAD applications on Windows 95 did not hit the market until late 1995, we have not listed any of these vendors or products in Table 2.

Table 2
Windows NT Offerings by Select Mechanical CAD Vendors

Vendor	Product
IBM	CATIA/CADAM Drafting
Parametric Technology	Pro/ENGINEER
Autodesk	AutoCAD, Mechanical Desktop
EDS Unigraphics	Unigraphics
Computervision	Pelorus
MICROCADAM	MICRO CADAM
SDRC	I-DEAS Master Series
MacNeal-Schwendler	NASTRAN
Matra Datavision	Prelude, CAS.CADE
Hewlett-Packard	ME10
Intergraph	Solid Edge
ANSYS	ANSYS
Cimatron	Cimatron 90
Adra	Cadra
Bentley	MicroStation

Note: The products and vendors shown do not represent all available NT-based applications for mechanical CAD/CAM/CAE.
Source: Dataquest (April 1996)

Where Is the Growth Coming From?

Much of the debate about the impact of Windows NT in the CAD world has centered around whether the growth of NT will occur at the expense of UNIX-based CAD applications or at the expense of Windows/DOS-based applications. The jury is still out on this issue. One thought that has drawn much vendor interest is the emerging "midrange" market, which is oblivious to the UNIX/Windows/DOS/NT debate. Both traditional UNIX vendors and Windows/DOS vendors are attacking this market. Midrange CAD is addressing the needs of users that go beyond drafting but do not extend into the traditional, high-end, fully functional, and completely integrated CAD/CAM/CAE suite. Considering the vendors and applications ported to NT today, it is this midrange market that is probably the most viable one for the NT platform, at least in the near term.

Again, it is too early to tell exactly where the impact of NT will be felt. One perspective is to look at how CAD revenue generated by various operating systems has grown or shrunk over the past five years (see Table 3). In 1995, while NT-based mechanical CAD/CAM/CAE sales grew 125 percent, UNIX-based sales remained fairly stable, and Windows/DOS-based sales dropped, albeit slightly, from 1994 levels.

From an industry perspective, sales of NT-based solutions are coming from industries other than aerospace and automotive. Dataquest does not expect this trend to change drastically over the next year, as these two industries comprise large, UNIX-entrenched users whose CAD requirements continue to be addressed by some of the larger market players such as IBM and Computervision, both of whom do not have a full suite of CAD/CAM/CAE software available on the NT platform today.

Table 3
Mechanical CAD/CAM/CAE Software Revenue by Operating System (Percentage)

	1991	1992	1993	1994	1995
UNIX	63.3	67.2	70.0	73.6	74.5
Windows/DOS	19.7	20.9	19.8	19.2	18.3
Windows NT	NA	NA	0.1	1.7	3.3
Host	17.0	11.9	10.1	5.5	3.9
All Operating Systems	100.0	100.0	100.0	100.0	100.0

NA = Not available
Source: Dataquest (April 1996)

Growth of NT in the UNIX Installed Base

For the next few years, the road for NT traveling down the UNIX path will not be smooth, simply because the mechanical design market is dominated by a handful of traditional UNIX-based vendors with large installed bases. The No. 1 mechanical CAD software vendor today is IBM, with nearly 13 percent market share. The full CATIA mechanical CAD/CAM/CAE suite has not been ported to NT; only the CADAM drafting package has been. Similarly, the No. 4 and No. 5 vendors are traditional UNIX players EDS Unigraphics, which has only just released its NT solution, and Computervision, which derives much of its revenue from software that is not (and probably will not be) ported to NT. These three players represented 25 percent of mechanical CAD/CAM/CAE sales in 1995. We do not expect these users to transition quickly over to NT-based solutions for CAD.

Different Regions, Different Adoption Rates

Dataquest forecasts that by the year 2000, NT-based sales will make up about 18 percent of the mechanical CAD/CAM/CAE market. We expect adoption rates of NT-based mechanical CAD solutions to vary around the world, as different market forces affect each region. Of particular interest are Europe and Japan.

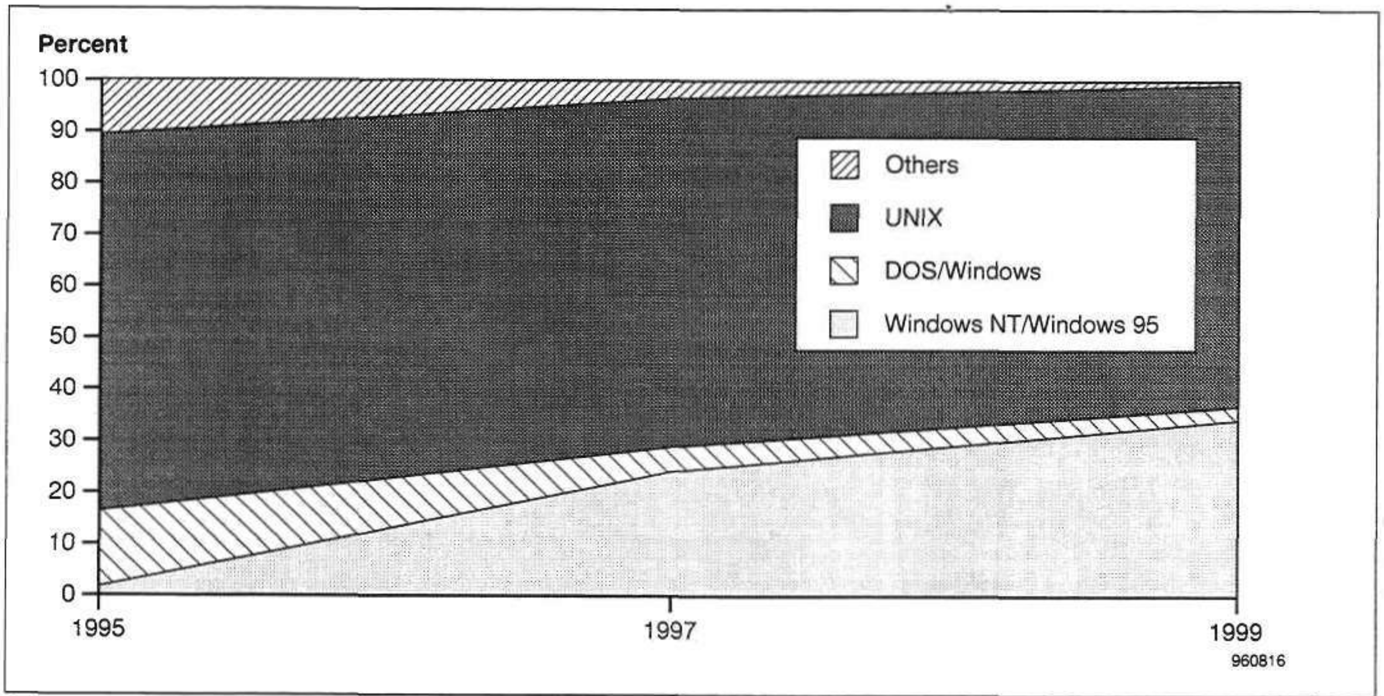
Europe

The prognosis for NT-based mechanical CAD solutions in Europe looks optimistic, particularly from the end-user viewpoint. In 1995, NT-based sales made up about 1.9 percent of the European mechanical CAD/CAM/CAE market. According to a recent Dataquest end-user survey, the European mechanical design community appears ready to embrace Windows NT, driven by the hope that CAD software running on NT will be cheaper, faster, and easier to use. In the study, we asked users which operating system they believe will be their dominant operating system in 1997 and in 1999. The results are shown in Figure 2. Full results of the survey are available in the Dataquest document, *CAD/CAM/CAE Technology Today and Tomorrow—A User's Perspective* (CMEC-WW-UW-9501, published February 5, 1996).

According to our survey results, end users are saying that DOS and Windows operating systems will shrink from 25 percent in 1995 to 3 percent by 1999. UNIX will lose some ground as well, going from 73 percent to 63 percent, and Windows NT/Windows 95 will gain a secure foothold in the mechanical CAD world, according to end users, growing from 2 percent to 34 percent by 1999.

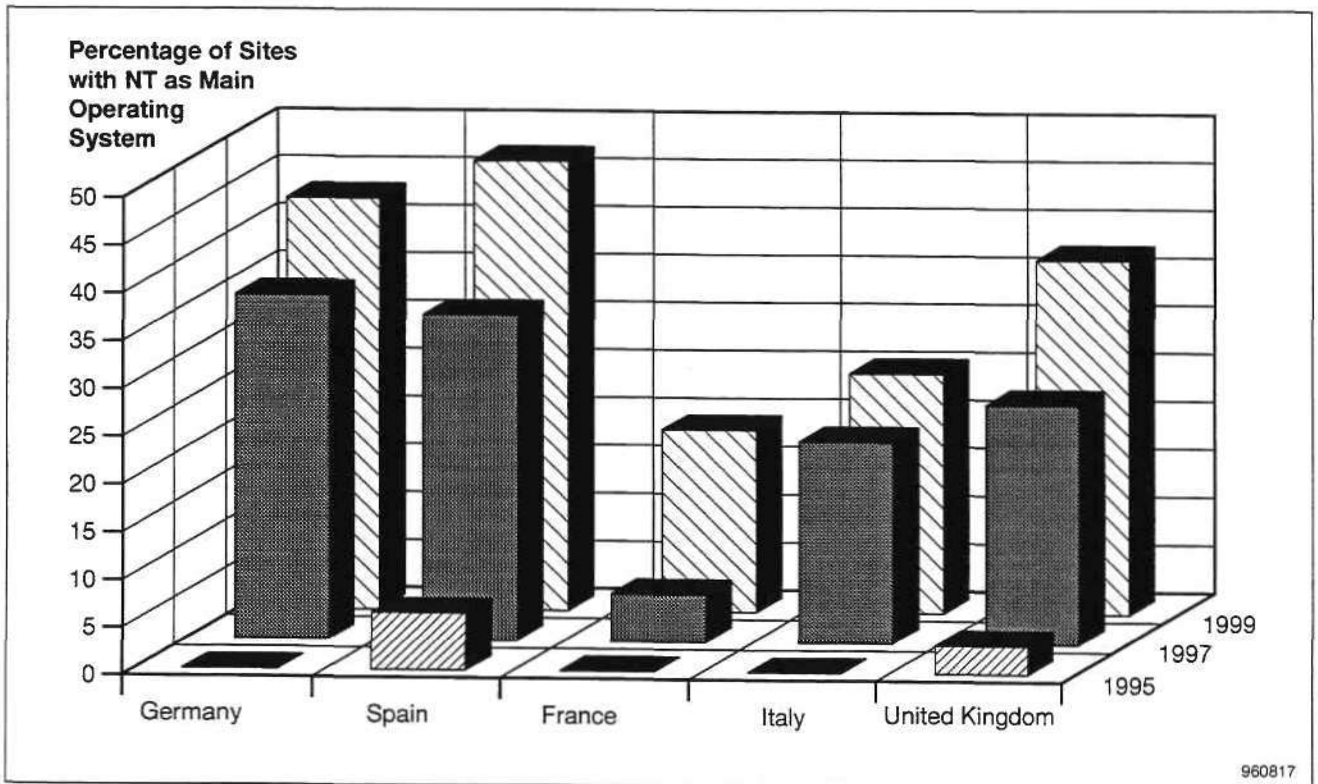
The overall numbers do not give the whole picture, however. From a country perspective, end users in France, Spain, and the United Kingdom all plan to move to NT at the expense of all current operating systems. However, in the cases of Germany and Italy, end users in these countries show that they will be holding onto their installed UNIX sites (see Figure 3).

Figure 2
Operating Systems of the Future, European End-User Viewpoint



Source: Dataquest (April 1996)

Figure 3
Adoption of Windows NT by Country, European End-User Viewpoint



Source: Dataquest (April 1996)

Japan

Particularly in Japan, the market for NT-based CAD sales is wide open. Of all mechanical CAD/CAM/CAE users, the Japanese market shows the most compelling reasons to move to NT the fastest:

- Economic concerns in Japan have forced some companies to reconsider the amount of money spent on CAD/CAM/CAE technology. End users at these companies are looking to turn away from the traditional proprietary CAD system to a commercially available one. Further compounding the situation is that many of their CAD systems are host-based. Over the next few years, Dataquest expects these users to be the main consumers of NT-based sales in Japan.
- The Japanese mechanical CAD/CAM/CAE market is heavily drafting-oriented. Many of the low-end or midrange NT packages are ideally suited to transition these 2-D users to solid modeling.
- There is no one single vendor with a significant lead in the NT market in Japan today. The top three contenders for NT-based mechanical CAD sales in Japan in 1995 were Parametric Technology, Omron, and MICROCADAM, with all companies reporting about the same amount of revenue.

The Prognosis for NT

The NT operating system has staked a claim in the mechanical CAD/CAM/CAE market, and we expect it to continue to grow at a rapid pace over the next five years as more applications become available that address the entire mechanical design process, from design to manufacturing. Its growth will be affected by a number of different variables, including application availability, CAD penetration in industries other than aerospace and automotive, cost-effective solutions (particularly for UNIX users who must switch both hardware and software), and development of a distribution channel to handle the midrange market.

Where Are the Opportunities for Vendors?

Many opportunities exist for software vendors looking to get a piece of the NT-based mechanical CAD/CAM/CAE market. Opportunities that vendors should consider include:

- Different regions of the world will adopt NT at different rates. Users in Japan are in a unique predicament of needing to move from proprietary systems to commercial ones, looking to reduce CAD costs, and ready to move from 2-D drafting to 3-D and solid modeling.
- Some industries will be easier to penetrate than others. The aerospace and automotive industries today consist of large UNIX-installed bases, and this is not expected to change in the near future.
- In order for NT solutions to be truly useful to the end user, they must cover the entire design and manufacturing processes, including analysis, design, drafting, and manufacturing. The end user today has a limited number of applications from which to choose.

The NT market is still in its infancy, and the field is wide open for any vendor who can address the needs of the end user with software that is inexpensive, bug-free, and easy to use.

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Dataquest
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Perspective

Mechanical CAD/CAM/CAE Worldwide

Market Analysis

Mechanical CAD: Opportunities in Asia/Pacific

Abstract: *While the mechanical CAD/CAM/CAE market has gone for many years without good growth, the Asia/Pacific region has been taking off. This market is still in its infancy, with room for more than just a few CAD competitors. In this Perspective, we examine some of the trends and opportunities in the Asia/Pacific mechanical CAD market.*
By Sharon Tan

Introduction

For the past five years, the Asia/Pacific mechanical CAD/CAM/CAE software market has grown faster than any other region worldwide. In 1995, the Asia/Pacific market for mechanical CAD/CAM/CAE software grew 46 percent in 1995, reaching $139 million. In this Perspective, we take a closer look at some of the current vendors and potential opportunities in the Asia/Pacific region, with portions focusing on Southeast Asia.

Definitions and Statistics

Dataquest's CAD/CAM/CAE group segments the world into five regions—Asia/Pacific, Europe, Japan, North America, and Rest of World. The Asia/Pacific region can be further subdivided into countries. These are China, Hong Kong, Korea, Singapore, Taiwan, and rest of Asia (Australia, India, Indonesia, Malaysia, New Zealand, Thailand, and the remaining Southeast Asian countries). Again, the focus of this Perspective is Asia/Pacific, which does not include Japan. Table 1 outlines economic factors for 1995 in some of the major Asia/Pacific countries.

Dataquest

Program: Mechanical CAD/CAM/CAE Worldwide
Product Code: CMEC-WW-DP-9606
Publication Date: August 26, 1996
Filing: Perspective
(For Cross-Technology, file in the Online, Multimedia, and Software binder.)

Table 1
National Economic Index for 1995

	Population	GDP Growth Rate (%)	GDP (U.S.$M)	GDP/Capital	Unemployment Rate (%)	Consumer Price Index (%)	Expected 1996 GDP Growth Rate (%)
Australia	18,054,000	4.8	414,636	22,966	8.4	5.1	NA
China	1,211,980,000	10.2	645,108	532	2.8	14.8	8 to 9
Hong Kong	6,300,000	5.3	137,414	21,812	3.1	8.7	5.0
Indonesia	195,460,000	7.2	157,231	804	4.4	9.1	7.1
Korea	44,851,000	9.0	300,453	6,699	1.8	5.1	7 to 7.5
Malaysia	19,250,000	9.6	111,964	5,816	2.8	3.4	8.5
Singapore	2,800,000	8.9	68,900	24,607	2.7	1.7	7 to 8
Taiwan	21,297,000	6.1	253,340	11,896	2.1	3.0	6 to 6.5
Thailand	60,297,000	8.6	160,130	2,656	2.6	5.8	8.3

NA = Not available
Source: International Financial Statistic, Economist Intelligence Unit, Dataquest (May 1996)

While the Asia/Pacific mechanical CAD software revenue market grew 46 percent in 1995, growth by country varied (see Figure 1). Some of the mechanical CAD vendors consider Hong Kong, Singapore, and Taiwan to have limited market potential, and are focusing efforts on China, Rest of Asia (in particular Malaysia, Indonesia, and India), and Korea.

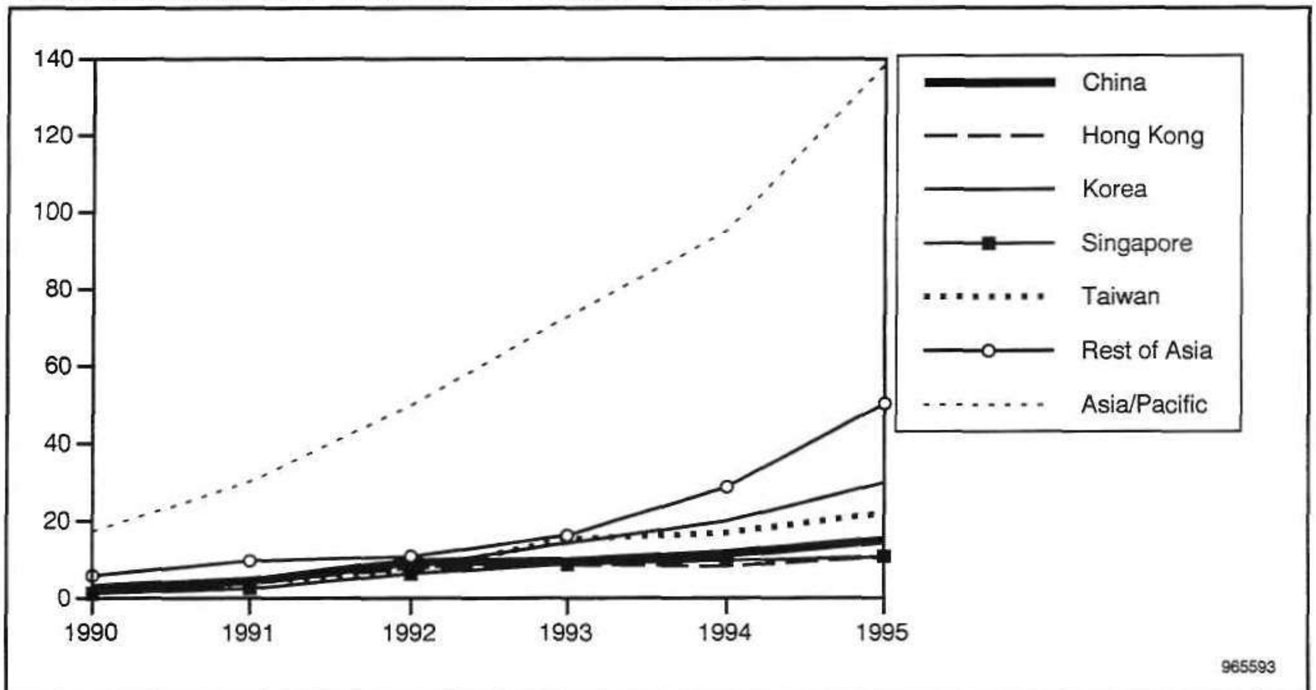
A Look by Vendor

Much of the information in this section is taken from the recent Autofact Asia show in Singapore held during the month of July. A summary of participating vendors at the trade show and their area of expertise is outlined in Table 2, and Table 3 looks at the leading Asia/Pacific CAD vendors. The following is a closer look at three of the leading vendors in this region.

IBM

IBM has led the Asia/Pacific region, with U.S.$37.5 million in software revenue in 1995. It is seeing business in its traditional strongholds (aerospace and automotive) as well as consumer electronics, shipbuilding, and other industries. IBM is different from other CAD vendors in the Asia/Pacific region in that it markets and implements an entire manufacturing solution, not just a CAD/CAM/CAE solution. IBM's solution includes both CAD/CAM/CAE software, plant maintenance, product data management, manufacturing execution systems (MES), production cells, and computing hardware. IBM has also partnered with a number of software vendors for enterprise resource planning (ERP) and MES, including Avalon, Baan, FASTech, SAP, SYMIX, and Wonderware.

Figure 1
1995 Asia/Pacific Mechanical CAD Market History



Source: Dataquest (September 1996)

Autodesk

Autodesk is the second-largest player in the Asia/Pacific region, with subsidiaries in each of the Asia/Pacific countries. Similar to other parts of the world, Autodesk relies on its extensive distributor network, which claims to be selling many of its sales on the Windows NT platform and not DOS or Windows 3.1. There are well over 60 third-party application providers for AutoCAD available in Southeast Asia. Interestingly, even in Asia, the company is still struggling to overcome its image as a strong 2-D CAD player. Nevertheless, the company is looking to grow its business by targeting those users who are currently 2-D designers. Autodesk has established a Mechatronics Design Center in Southeast Asia, that will focus on consulting, training, and application integration of both mechanical and electronic design.

Parametric Technology

At the Autofact Asia show in Singapore, Parametric Technology held a press conference outlining its aggressive expansion plans for the Asia/Pacific region. To a number of Malayan and Singaporean journalists, PTC said that it plans to double its Asia/Pacific workforce (primarily sales and support) to 900 over the next year. PTC also announced plans to set up direct offices in what it considers to be key growth countries, including Thailand, Philippines, and Indonesia.

It is no secret that PTC has been beefing up its salesforce for quite some time. The company has used its large and aggressive salesforce to successfully make inroads into the United States, Europe, and Japan. Now it is more than just eyeing the Asia/Pacific region—PTC wants to own it. While there is certainly strength in numbers, it remains to be seen whether or not this same approach will work in the Asia/Pacific region. Nevertheless, the window is narrow and the threat from PTC is credible. If the other mechanical CAD vendors do not move quickly with a plan to firmly establish themselves in this region (particularly Southeast Asia), PTC will yet again find itself far ahead of the competition in a short period of time.

Where Are the Opportunities for CAD Vendors?

Dataquest expects the Asia/Pacific region to grow faster than any other region of the world over the next five years. This market is still in its infancy, and there are many opportunities for vendors to pursue:

- Particularly in Southeast Asia, mechanical designers are not as advanced in their use of CAD as their counterparts worldwide. There exist a large number of 2-D users who are showing an interest in migrating to 3-D systems. Companies particularly focused on this area right now include Autodesk, Bentley, Intergraph, and SolidWorks—the same ones competing for that spot in the United States. To effectively target this segment, training and education need to become a vital part of a vendor's solution.
- For some companies that already have CAD systems in place, there exists a large gap between the acceptance of CAD/CAM/CAE technology within the company and the user-derived benefit from the system. Some companies may be quite far from using their CAD/CAM systems to their fullest potential. Simply selling a CAD package to a company is not enough. This strategy will only allow a vendor with a less expensive package to make a sale on the claim of "equivalent functionality for less

Table 2
Autofact Asia 1996 Exhibiting Vendors

Vendor	Office Represented	Primary Specialty
AccelGraphics Inc.	U.S.	3-D graphics
ARRK Creative Network Corp.	U.S.	Rapid prototyping services
Autodesk Asia Pte. Ltd.	Singapore	CAD. Partners include Ansys, Design Technologies International, ICEM Technologies, Genius, Moldflow, Open Mind, Striker
Beijing CoCim Science & Technology Group	China	Manufacturing service/consulting
Bentley Systems	Malaysia	CAD. Partners include SRAC, Mechanical Dynamics, Baystate Technologies, D.P. Technology
CAD-IT Consultants Pte. Ltd. & Matra Datavision	Singapore, Hong Kong	Service/consulting, CAD/CAM/CAE
Carl Zeiss Pte. Ltd.	Singapore	Rapid prototyping
CG Tech	U.S.	CAM
Champion Machine Tools Pte. Ltd.	Singapore	Systems integrator for SDRC, CAMAX, rapid prototyping, and other CAM software
Cimatron Ltd.	Israel	CAD/CAM
CNC Software	U.S.	CAM
Delcam International PLC	U.K.	CAD/CAM
DTM Corporation		Rapid prototyping
Engineering Computer Services	Singapore	CAD systems integrator
ESI Group	Japan	CAE
Flexi Interactive Systems Pte. Ltd.	Singapore	Systems integrator. Products include PTC, Electrogig, AccelGraphics, Icam
Flexmech Engineering Pte. Ltd.	Singapore	Rapid prototyping
Fuji Xerox Singapore Pte. Ltd.	Singapore	Printing/plotting
Hakko Electronics Co. Ltd.	Japan	Factory operations hardware
Hewlett-Packard Singapore	Singapore	CAD/CAM, manufacturing solutions. Partners include Oracle, QAD, Baan, EDS, SAP, TATA Technologies, PTC
IBM	Singapore	CAD/CAM/CAE, manufacturing solutions. Partners include Dassault, CSC, Avalon, Baan, Eutech, FASTech, ISP, Wonderware

(Continued)

Table 2 (Continued)
Autofact Asia 1996 Exhibiting Vendors

Vendor	Office Represented	Primary Specialty
Kinergy Pte. Ltd.	Singapore	Rapid prototyping
Mechanical Dynamics Inc.	U.S.	CAE
National Instruments Singapore Pte. Ltd.	Singapore	Manufacturing solutions
Newton CADesigns Pte. Ltd.	Singapore	CAD Service/consulting
Parametric Technology Ltd.	Hong Kong, Singapore	CAD/CAM/CAE
Photron Ltd.	Japan	CAD
SDRC	U.S.	CAD/CAM/CAE. Distributors include ISI-Dentsu/Singapore, Champion Machine Tools
SHONAN	Singapore	Rapid prototyping services
Silicon Graphics Pte. Ltd.	Singapore	Computing hardware
Smart Solutions Ltd.	Israel	Document management
SolidWorks Corporation	U.S.	CAD
Spring	France	CAM
Stratasys Inc.	U.S.	Rapid prototyping
Surfware Inc.	U.S.	CAD/CAM
Systems Design Pte. Ltd.	Singapore	Printers and plotters
TACTX Co.	Japan	Manufacturing hardware
Toyota Caelum	Japan	CAD/CAM/CAE
3-D Systems	U.S.	Rapid prototyping

Source: Society of Manufacturing Engineers and Dataquest (August 1996)

Table 3
1995 Asia/Pacific Market Share by Vendor

Rank	Vendor	1995 Market Share (%)	Strengths
1	IBM	24.0	Offers a complete manufacturing solution, of which one piece is CAD/CAM/CAE solution
2	Autodesk	16.4	Has established an extensive distribution network in Asia/Pacific
3	EDS Unigraphics	10.8	Traditional strength in CAM and manufacturing, and in implementation of high-end CAD/CAM/CAE systems
4	Parametric Technology	7.0	Plans to double Asia/Pacific staff over the next year, particularly in high-growth potential countries
5	SDRC	5.1	Previously stronger in Asia/Pacific; is refocusing on this area
	Other	63.3	
	All companies	100.0	

Source: Dataquest (August 1996)

money." Implementation and consulting services are needed to help the user get the most from their CAD system. While the above statements could be said of any region of the world, we found them to be true particularly in Asia/Pacific.

- Local and national governments play a heavy role in the development of information technology in many of the southeast Asian countries. Many of these countries have strong initiatives for jump-starting or growing the country's IT infrastructure, including CAD-related activities. CAD vendors have begun to partner with both education and government to help train users from the ground up.
- Cost of software, particularly in Southeast Asia where labor is inexpensive, will undoubtedly affect a buyer's final decision. Corporations in Southeast Asia do not always see the potential benefits of CAD. In a region where labor is cheap, corporations believe that to increase productivity, it is more cost-effective to hire more workers than to automate or computerize the design and manufacturing processes.
- CAD vendors are seeing various degrees of success in each Asia/Pacific country. A leading market position in one country does not necessarily translate to a leading market position in another country. While some of this difference is due to a vendor's ability to cater to local and/or national governments and agencies, some of it is also because multinational companies tend to use the same CAD package worldwide. Thus, a vendor with strong footing in some of the larger multinational discrete manufacturing firms may find an easier time pursuing a local market where that country may serve as an offshore production site.

- Future growth of mechanical CAD sales will be limited in Hong Kong, Singapore, and Taiwan, countries that have longer histories with CAD software. All vendors expect wild growth from China, Malaysia, and Indonesia, and looking even further into the future, from India, Thailand, and Australia.
- Opportunities are expected to open up in the automotive industry over the next two to five years, especially in Korea, Malaysia, Indonesia, and Thailand, as these countries come up to speed with their own automotive industries.

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Dataquest
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Perspective

Mechanical CAD/CAM/CAE Worldwide

Vendor Analysis

The European Mechanical CAD Designer

Abstract: *What is driving the demand for mechanical CAD/CAM/CAE applications in Europe? How much of an opportunity do vendors have to penetrate this market? Dataquest recently completed an in-depth survey of European mechanical end users. In this document, we report our findings on the shifting priorities, desires, and demands of these mechanical CAD users.*
By Sharon Tan

The European Mechanical CAD Designer

For mechanical CAD companies to be successful, they must have a thorough understanding of their target customer base. Each year, Dataquest's Mechanical CAD/CAM/CAE Worldwide program performs extensive surveys of mechanical designers and reports upon their shifting priorities, desires, and demands. The purpose behind these User Wants and Needs studies is to provide our clients with the most in-depth, up-to-date information on the mechanical design community. This document highlights some of the study's findings. For more detailed analysis and findings, see Dataquest's document titled *CAD/CAM/CAE Technology Today and Tomorrow—A User's Perspective* (CMEC-WW-UW-9501, published February 5, 1996).

Dataquest

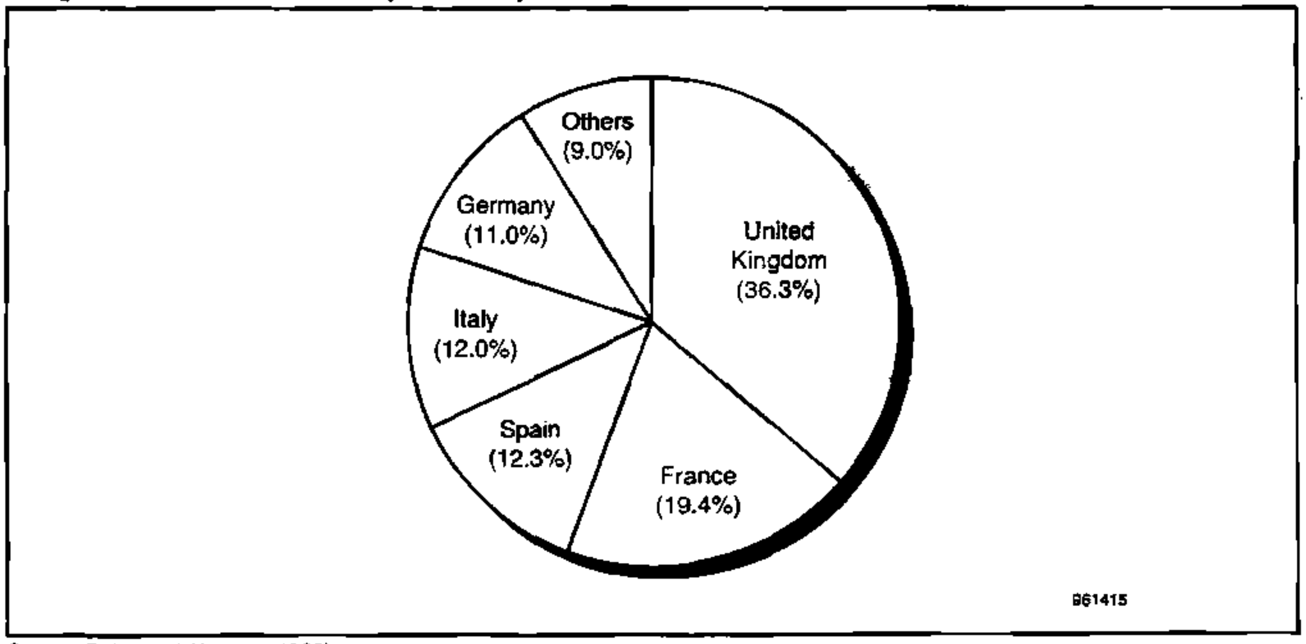
Program: Mechanical CAD/CAM/CAE Worldwide
Product Code: CMEC-WW-DP-9601
Publication Date: March 4, 1996
Filing: Perspective

Survey Methodology and Respondent Demographics

The survey questionnaire was sent out in October 1995 by the leading mechanical CAD/CAM/CAE vendors in Europe on behalf of Dataquest. All major European vendors were invited to participate, however, one leading vendor declined participation. All survey responses were sent directly to Dataquest and not to the mechanical CAD vendors. In total, 309 surveys were completed.

Figure 1 indicates the country in which the respondent's office is located. The United Kingdom was the most widely represented country, followed by France, Spain, Italy, and Germany. The "others" category consists primarily of respondents from Austria, Finland, and Switzerland.

Figure 1
Respondent Breakdown by Country

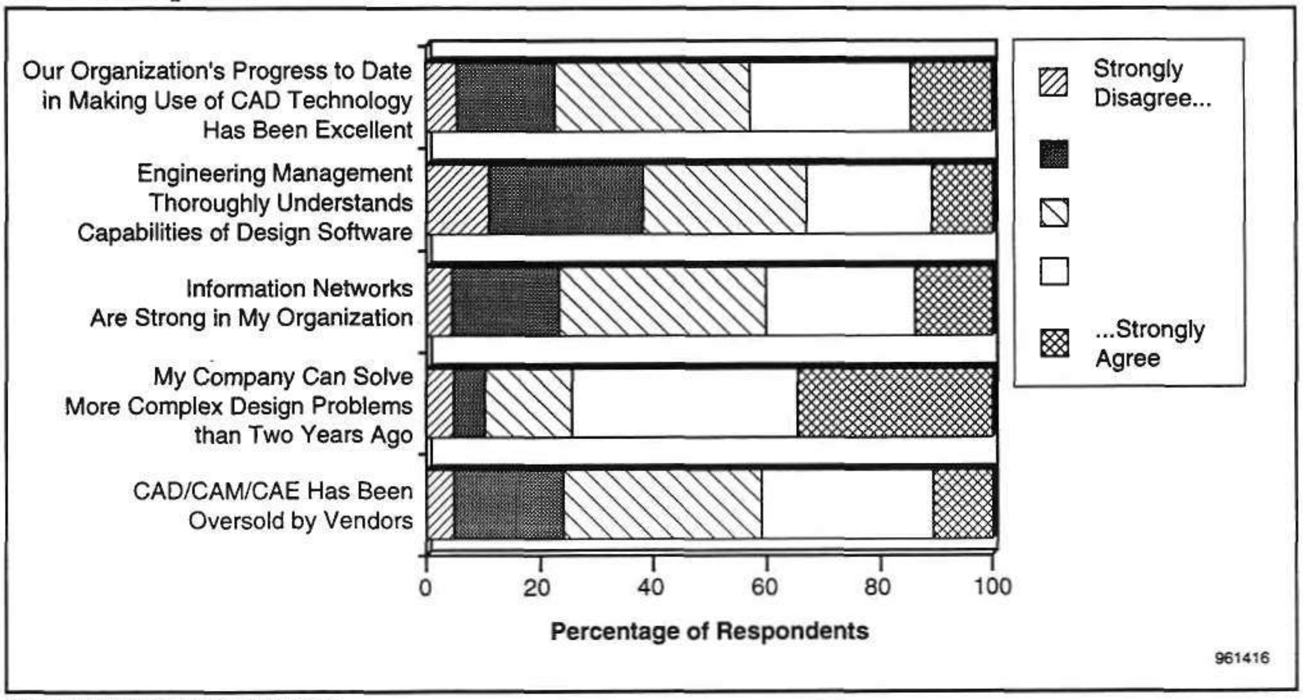


Source: Dataquest (January 1996)

User Expectations with CAD/CAM/CAE Technology

While CAD/CAM/CAE technology has promised many things to many users, we decided to investigate just what these benefits are and how well CAD/CAM/CAE is meeting user expectations. We asked respondents to what level they agree or disagree with a series of statements concerning CAD/CAM/CAE software, its role in the company, and its benefits (see Figure 2). Most respondents were neutral or tended to agree with the statements, "Information networks are strong in my organization," and "Our organization's progress to date in making use of CAD technology has been excellent." However, it is interesting to note that while respondents were neutral or tended to agree with the statement "CAD/CAM/CAE has been oversold by vendors," these same respondents strongly agreed that "My company can solve more complex design problems than two years ago." The statement, "Engineering management thoroughly understand capabilities of design software," incited the widest range of responses.

Figure 2
CAD Perceptions

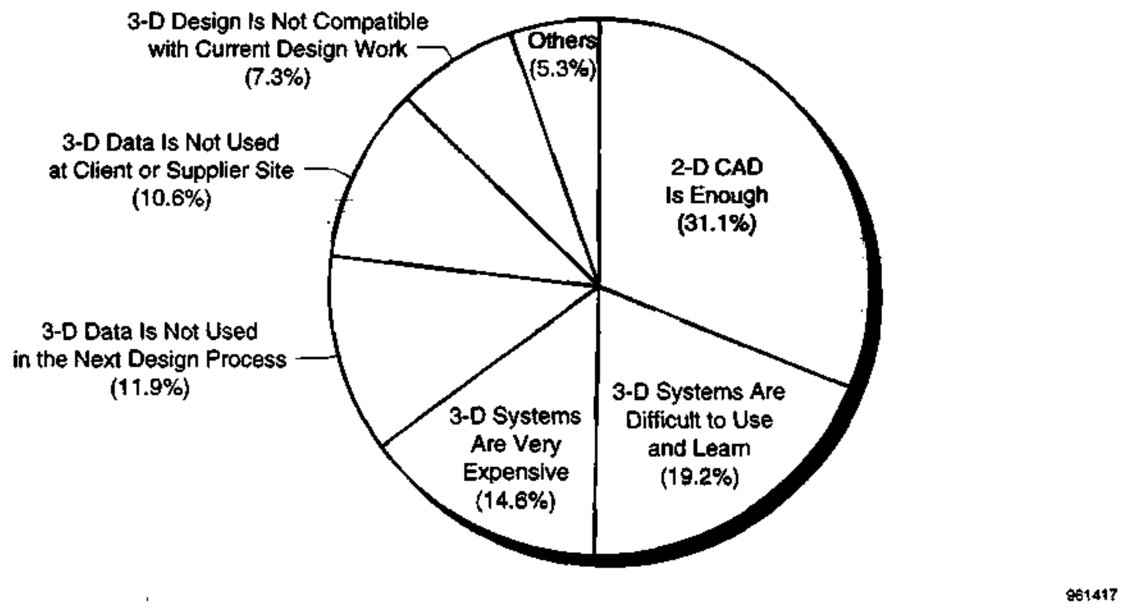


Source: Dataquest (January 1996)

European Designers—2-D or 3-D?

While the focus of vendors today has been on 3-D modeling, it appears there is still plenty of 2-D design being done among European end users. We asked respondents if they consider 3-D design to be their main form of design. A full 63 percent responded "yes" to that question. Both France and the United Kingdom report the highest usage of 3-D CAD, as do users in the electrical/electronic machinery and service/design/consulting. Of those users who do not consider 3-D to be their main form of design, we asked if it would become the main form by 1997. Surprisingly, only 41 percent of these respondents said "yes" and 59 percent said "no." Users cited many reasons for not planning to change to 3-D CAD by 1997 (see Figure 3).

Figure 3
Reasons Cited for Not Using 3-D by 1997



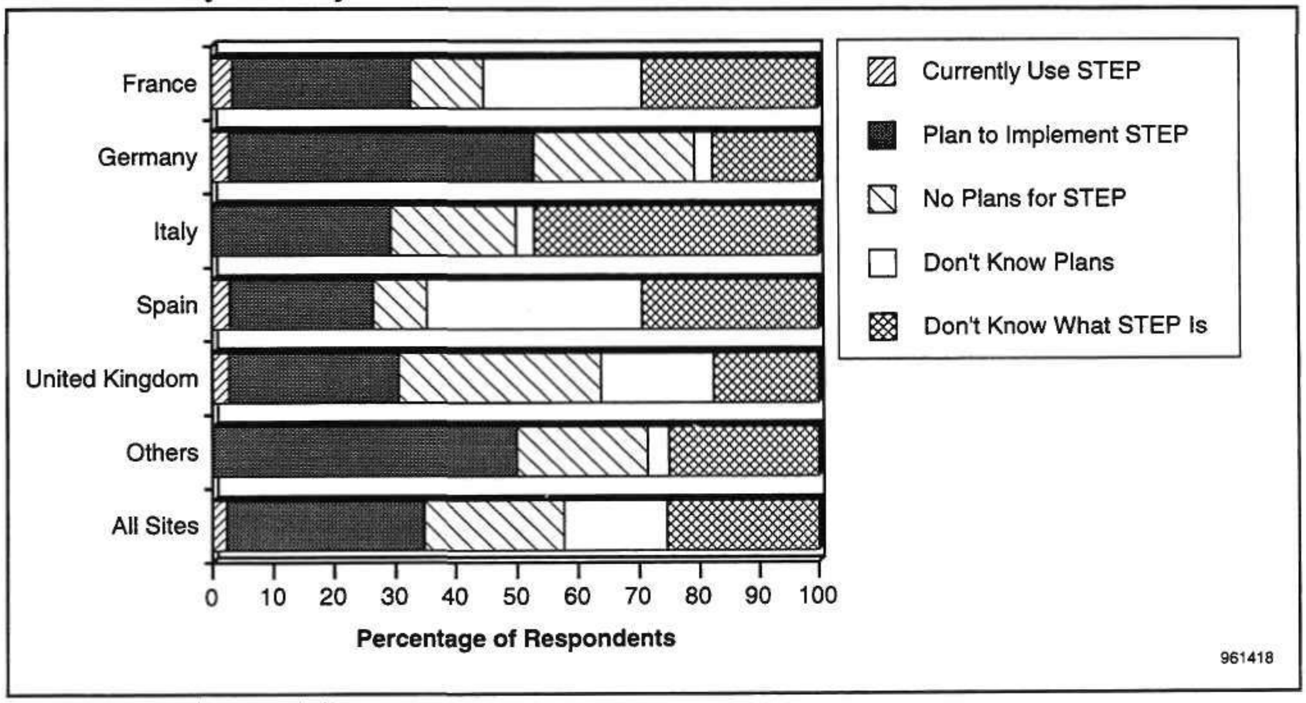
Source: Dataquest (January 1996)

The Future of STEP

It is clear from the comments of respondents in the survey that data translation is a hot issue. More than one user commented about the lack of standardization between CAD and CAM. Respondents blamed vendors for not being open enough with one another to facilitate data exchange, a general lack of robust translators, and difficulties in integrating different CAD/CAM/CAE packages. Users want the ability to transfer data between different CAD systems with a minimum of fuss and rework.

The STEP standard has been viewed as one solution to the data translation problem. The STEP standard has been drawing interest of the mechanical CAD/CAM/CAE community for quite some time, however, our survey results show it still has a long way to go until it is widely accepted and used (see Figure 4). The highest rates of STEP use or plans are among designers in Germany. This comes as no surprise, as much of the STEP development has been spearheaded by efforts in Germany (such as ProSTEP). Survey respondents in Italy and Spain showed the least awareness of the STEP standard.

Figure 4
STEP Plans by Country

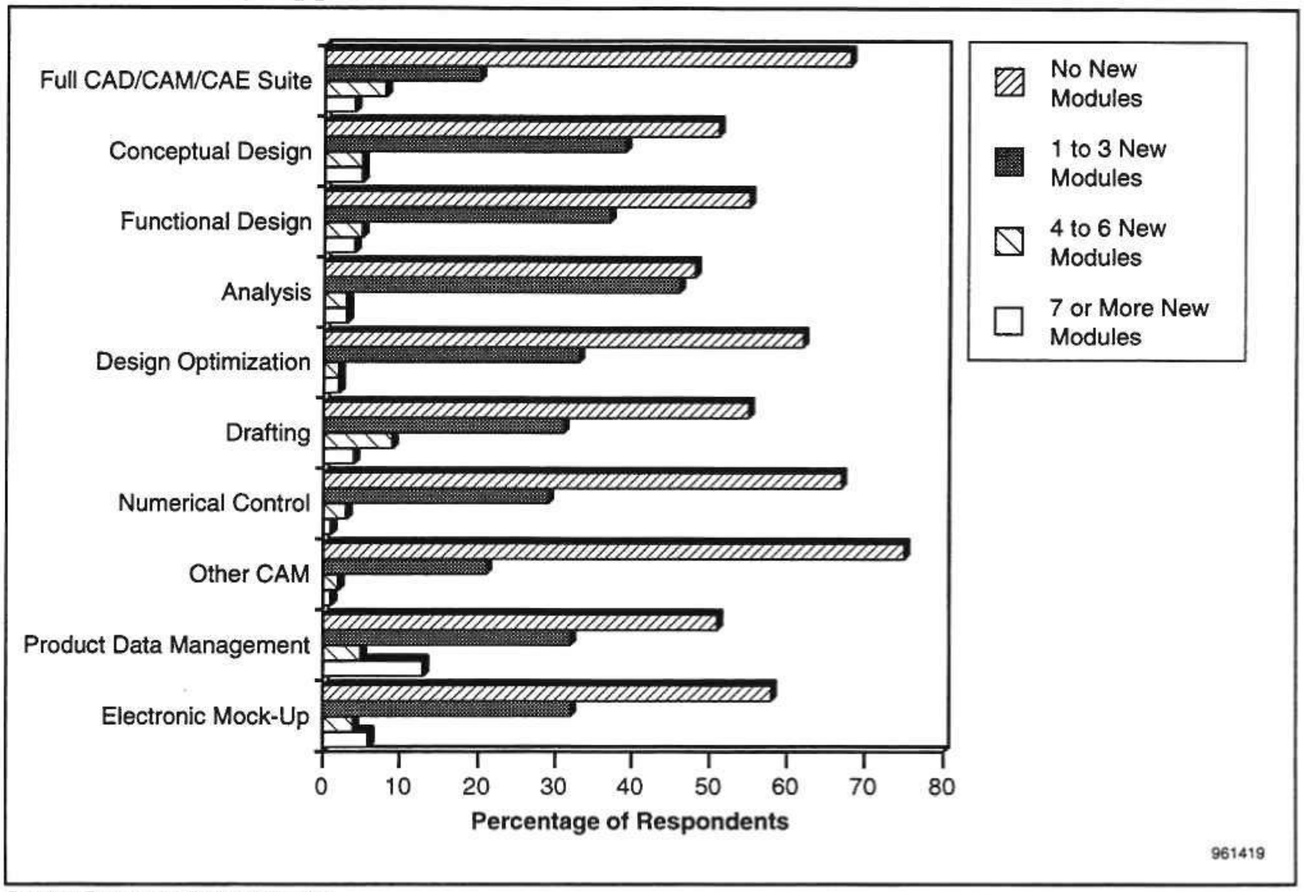


Source: Dataquest (January 1996)

Software Spending—Which Areas Will Grow?

We asked users to identify what CAD/CAM/CAE applications they are planning to purchase in the next two years. The results are given in Figure 5. It appears as if users are tending to shy away from the full CAD/CAM/CAE suite of software in favor of application-specific modules. Most new module purchases will come from conceptual design, analysis, and product data management (PDM). Of those users planning to purchase PDM software, nearly 13 percent indicate they intend to purchase seven or more modules, far greater than the average for all other CAD/CAM/CAE modules.

Figure 5
New Modules by Application



Source: Dataquest (January 1996)

Will It Be a Windows NT Future?

The Windows NT operating system entered the CAD world with a big splash in 1994, and vendors and users alike have been trying to ascertain exactly what effect Windows NT will have on the CAD/CAM/CAE market. It appears as if the European mechanical design community is ready to embrace Windows NT; these users are indicating that Windows NT will take market share away from all operating systems but in particular DOS and Windows.

We asked users what operating system they use today and what they believe will be their dominant operating system in 1997 and in 1999. According to our survey results, DOS, Windows, OS/2, and VMS operating systems will shrink from 25 percent to 3 percent by 1999. UNIX will lose some ground, going from 73 percent to 63 percent, and Windows NT/Windows 95 will gain a secure foothold in the mechanical CAD world, growing from 2 percent to 34 percent by 1999. User comments reveal that much of the movement to Windows NT will be driven by the hope that CAD software running on Windows NT will be cheaper, faster, and easier to use.

The overall numbers do not give the whole picture, however. It appears as though each country and each industry will adopt the Windows NT operating system at very different rates. From a country perspective, France, Spain, and the United Kingdom will all move to Windows NT at the expense of all of the operating systems. However, in the cases of Germany and Italy, these countries show that they will be holding onto their installed UNIX sites.

A Wish List of Software Characteristics

We asked a series of questions in order to understand how important and how satisfied designers are with the functionality of the CAD software that they use. We created a "wish list" of software characteristics and asked users to rate the importance and satisfaction of 11 characteristics relevant to all mechanical applications (see Table 1 and Figure 6).

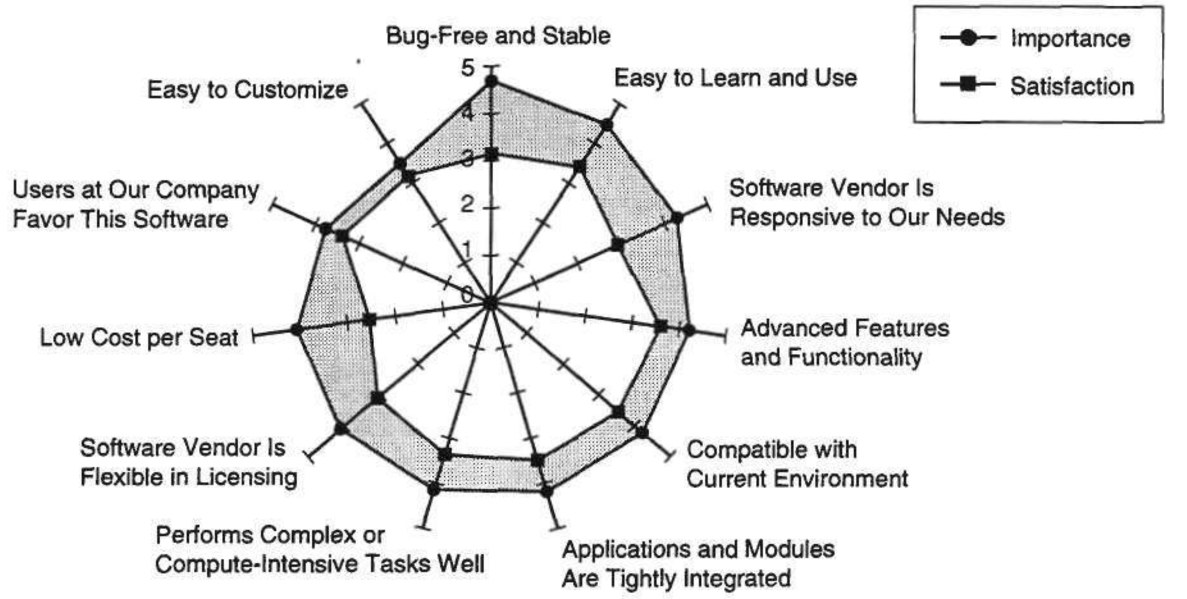
Nearly every item was ranked with an importance rating of 4.0 or higher. Topping the list in importance was the request for software that is bug free and stable. Software stability has always been an issue with the mechanical design community and can sometimes be an impediment to the adoption of new technologies and methodologies. Software that is easy to learn and use is also important to the design community. Engineers are always facing time-to-market pressures, and they have little time to spend learning new tools or applications. As we saw earlier, one impediment to the more widespread adoption of 3-D design methodologies is the user perception that 3-D systems are difficult to learn and use.

Table 1
Importance/Satisfaction Gap Analysis of Software Characteristics

	Importance	Satisfaction	Gap
Bug Free and Stable	4.69	3.15	-1.54
Easy to Learn and Use	4.47	3.42	-1.05
Software Vendor Is Responsive to Our Needs	4.29	2.93	-1.36
Advanced Features and Functionality	4.22	3.6	-0.62
Compatible with Current Environment	4.22	3.55	-0.67
Applications and Modules Are Tightly Integrated	4.19	3.49	-0.70
Performs Complex or Compute-Intensive Tasks Well	4.15	3.36	-0.79
Software Vendor Is Flexible in Licensing	4.10	3.10	-1.00
Low Cost per Seat	4.06	2.54	-1.52
Users at Our Company Favor This Software	3.77	3.39	-0.38
Easy to Customize	3.50	3.18	-0.32

Note: Ratings on a scale of 1 to 5, with 1 = not important/not satisfied, 5 = very important/very satisfied
Source: Dataquest (January 1996)

Figure 6
Importance/Satisfaction Gap Analysis of Software Characteristics



Note: Ratings on a scale of 1 to 5, with 1 = not important/not satisfied, 5 = very important/very satisfied
Source: Dataquest (January 1996)

Opportunities for the Vendor Community

Our survey reveals that there are many unmet needs within the European design community, thus paving the way for vendors to market a better solution based on newer technology or newer applications. Users are now seeing the benefits of CAD/CAM/CAE technology, enabling them to solve more complex problems than two years ago. These users are also facing the point where they must decide whether to significantly expand their CAD/CAM/CAE systems by adopting and integrating new applications, processes, or platforms. Issues for the vendor community to consider include:

- The mechanical design world is not all 3-D. There still exists, within the minds of some end users, the traditional impediments to adopting 3-D technology, including high cost and difficulty in learning and using 3-D systems.
- Data translation is one of the hot buttons on the minds of designers and engineers. STEP is still not in widespread use (nor widely understood) and users, on the whole, are unhappy with their current data-translation packages.
- Overall, users plan to increase CAD spending over 1995 levels. Product data management, conceptual design, and analysis software were frequently cited as the modules most likely to be purchased next.
- According to end users, Windows NT will make significant headway into the mechanical design community by 1999 at the expense of all other CAD operating systems. Adoption rates will vary significantly by country and industry.
- Bug-free, stable software continues to require vendor attention. Here, the gap between what users want and what they are satisfied with is large.

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Market Trends

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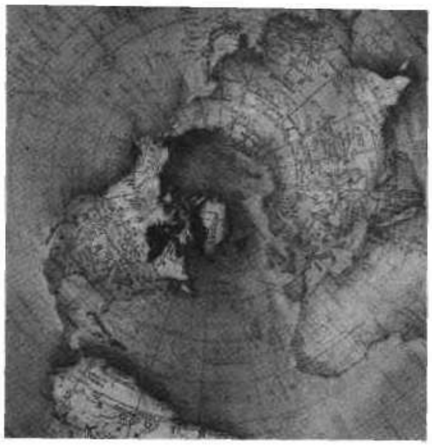

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CAD/CAM/CAE and GIS Market Definitions

Dataquest Guide

Program: CAD/CAM/CAE/GIS Asia/Pacific
Product Code: CCAM-AP-GU-9601
Publication Date: February 26, 1996
Filing: Guides

CAD/CAM/CAE and GIS Market Definitions

Dataquest Guide

Program: CAD/CAM/CAE/GIS Asia/Pacific
Product Code: CCAM-AP-GU-9601
Publication Date: February 26, 1996
Filing: Guides

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Chapter 1
Market Share Survey Overview

Each year, Dataquest surveys CAD/CAM/CAE/GIS vendors in order to estimate their annual revenue. The survey for 1995 covers 300 vendors worldwide by six main applications segments, four operating systems groups, four world regions, European and Asian countries, hardware, software, services, and distribution channels. This exercise provides input for Dataquest's dynamic database of CAD/CAM/CAE/GIS shipments/revenue by world region/country, operating systems, and applications segment. The information gained is supplemented by, and cross-checked with, Dataquest's other information sources.

The CAD/CAM/CAE market share survey takes place twice each year. The first survey in the fourth quarter is to prepare early estimates for the calendar year. This is followed by a second survey in the spring in order to finalize estimates for the previous calendar year. The first survey takes place from October to December. Our preliminary estimates are completed by the end of the calendar year under review, and the results are summarized in a fax report that is released in January of the following year and published in a Source: Dataquest document by January 31.

The second survey takes place during April. Our final CAD/CAM/CAE/GIS market share estimates are again published in a Source: Dataquest document by May 31. There is usually minimal difference between early and final rankings, as Dataquest makes every effort to ensure preliminary estimates are as accurate as possible. However, there are usually some surprises at year-end, and our numbers do change. It should also be noted that when new information becomes available concerning a previous year's numbers, the database is updated to reflect the best information available.

The categories for which CAD/CAM/CAE/GIS revenue is reported are defined comprehensively for the purpose of clarity and guidance to survey participants. These definitions may occasionally be revised, altered, or expanded to reflect changes in the industry. To support these definitions, Dataquest will send an annual survey guide to all participants in its CAD/CAM/CAE/GIS market share survey program. This document comprises the 1995 survey guide.

Methodology

Dataquest utilizes both primary and secondary sources to produce market share data. In addition to the annual market share survey, Dataquest uses the following sources in order to accurately quantify market activity:

- Information published by major industry participants
- Estimates made by knowledgeable and reliable industry spokespersons
- Government data or trade association data
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users

- Relevant economic data
- Information and data from online or CD-ROM data banks
- Articles in both the general and trade press
- Reports from financial analysts
- Annual reports, Securities and Exchange Commission documents, credit reports
- Reseller and supplier reports and reports from a vendor's competitors
- User studies

Dataquest also sums vendor revenue across other industries covered by Dataquest to make sure revenue is not credited twice, and checks with multiple sources at one company to cross-check data on that company.

Dataquest analysts have many years of experience in how to apply the tools described to get the most accurate information possible on a particular company (such as what to use when, and what industry averages are). It is the CAD/CAM/CAE/GIS group's policy to continually update our market information for any year, based on any new data received, in order to arrive at the most accurate market representation possible.

We survey worldwide, which involves more vendors and therefore presents higher total market revenue, lower market share per vendor, and a more accurate overall market picture.

Despite the care taken in gathering, analyzing, and categorizing the data in a meaningful way, careful attention must be paid to the definitions and assumptions used herein when interpreting the estimates presented in this document. Various companies, government agencies, and trade associations may use slightly different definitions of product categories and regional groupings, or they may include different companies in their summaries. These differences should be kept in mind when making comparisons between data provided by Dataquest and data provided by other suppliers.

Chapter 2
CAD/CAM/CAE/GIS Companies to Be Surveyed Worldwide for 1995

Dataquest will survey the following CAD/CAM/CAE/GIS companies throughout the world for 1995 data.

The North American Companies

- 3Soft
- Accel Technologies
- Accugraph
- ACTEL
- Adina R&D
- ADRA Systems
- ael Advance Graphics Systems
- ALDEC
- Algor Interactive Systems
- Alias Research
- Altair Computing
- Altera
- Analogy
- Ansoft
- Ansys
- Applicon
- Aptix
- Ashlar
- Aspec Technology
- Aspect Development
- Aspen Technology
- AT&T Bell Laboratories
- Auto-Trol
- Autodesk
- Autometric
- Avant!
- B.A. Intelligence Networks
- Bentley Systems
- Boothroyd Dewhurst

- CAD WORKS
- Cadence
- Cadis Software
- CADKEY
- CADSI
- CAE Plus
- CAMAX
- Carrier Corporation
- Cascade Design Automation
- CGTech
- Chronology
- Chrysalis Symbolic Design
- Cimlinc
- Cimplex
- Claritas/NPDC
- CMstat
- CNC Software
- Compact Software
- COMPASS Design Automation
- Computer Aided Design Software
- Computervision
- Concentra
- Contec Microelectronics
- Cooper & Chyan Technology
- CrossCheck Technology
- CSAR Corporation
- Data I/O
- Database Applications Inc.
- Deneb Robotics
- Design Acceleration
- Digital Equipment Corporation
- DP Technology
- Dynamic Graphics
- EA Systems
- Eagle Design Automation
- Eagle Point

- Earth Resource Mapping
- EDS-Unigraphics
- Enghouse Systems Ltd. (Canada)
- Engineered Software
- Engineering Mechanics Research
- EOSTAT
- EPIC Design Technology
- Equifax/NDS
- ERDAS
- Escalade
- ESRI
- ETAK
- Evolution Computing
- Fintronic
- Formtek
- Frontline Design Automation
- Genasys II
- Geo/SQL
- Geographic Data Technology
- Geomax International
- Gibbs and Associates
- Graftek Inc.
- GRAPHSOFT
- Harris EDA
- Hewlett-Packard
- Hibbit, Karlsson & Sorensen
- High Level Design Systems
- i-Logix Inc.
- IBM
- Ikos Systems
- IMSI
- Information Handling Services
- Intergraph
- InterHDL
- International Software Systems
- Intusoft

- ISICAD
- Landmark Graphics
- Livermore Software Technologies
- LSI Logic
- LV Software
- MacNeal-Schwendler Corporation
- Macon
- MapInfo
- MARC
- MCS
- Mechanical Dynamics
- Mentor Graphics
- Meta-Software
- Micrografx
- Microsim
- Minc Software
- Motorola
- Nextwave Design Automation
- NovaSoft Systems
- OEA International
- Optem Engineering
- Orcad
- Pacific Numerics
- PacSoft
- PADS Software
- Parametric Technology
- PCI Remote Sensing Corporation
- PRC
- Protel Technology
- Quantic Laboratories
- Quickturn Systems
- Radian Corporation
- Rebis
- Research Engineers—Civilsoft
- Royal Digital Centers
- Scientific & Engineering SW

- SDRC
- Sherpa Corporation
- SHL Systemhouse
- Sigma Design
- Silicon Graphics
- Silicon Valley Research Inst.
- SIMUCAD
- Simulation Technology
- Softdesk
- Spatial Technology Inc.
- Speed
- SpeedSim
- Spot Image
- SRAC
- Strategic Mapping
- Summitt Design Inc.
- Sun Microsystems
- Surfware
- Sweet's Electronic Publishing
- Synopsys
- Synplicity
- Systems Science
- T D Technology
- Tactician Corporation
- Tanner Research
- Terr-Mar Resource Information Systems
- Terra Sciences
- TYDAC Technologies Inc.
- Unicad
- Unisys Corporation
- Variation System Analysis
- Veritools
- Viagrafix
- Viewlogic Systems
- VISTA Environmental Inf.
- VLSI Libraries

- VLSI Technologies
- Workgroup Technology
- Xilinx
- Zeelan Technology
- Zycad

The European Companies

- ABB Industria
- Abstract Hardware
- ACA Ltd.
- ALS Design
- Anilam Electronics
- APIC Systemes
- ARKTEC SA
- ASCAD/ASCAM
- Assigraph
- CAD Centre Ltd
- CAD Lab S.p.A.
- Cad-Distribution AG
- CAD-UL
- Cadtronic Computer Systeme
- CATALPA Groupe Missler
- Cimatron
- CIMTEK SA
- Cisigraph
- Clemessy Innovation SA
- Complansoft CAD GmbH
- Computational Mechanics
- Computer Services Consultants
- Dapco SA
- Dassault
- debis Systemhaus GmbH
- Delcam Systems International
- Eigner+Partner GmbH
- Elstree Computing Ltd
- Engineering Computer Services
- Exapt

- FHECOR
- Fides Industrielle Automation
- Framasoft
- Gable CAD Systems
- Geometria GIS Systems House
- Graphisoft Software Development
- Ground Modeling Systems Ltd.
- Han Dataport
- Hochtief
- ICEM Technologies
- ICL Finland OY
- IEZ CAD-Systeme GmbH
- Investronica SA
- ISD Software und Systeme GmbH
- ISDATA GmbH
- ISKA
- Kloeckner-Moeller GmbH
- Kockums Computer Systems AS
- Laser-Scan
- M.O.C.
- Marcus Computer Systeme
- Matra Datavision
- mb Programme
- Moss Systems Group
- Nemetschek Programmsystem GmbH
- Norlinvest Ltd Visionics
- Number One Systems
- PAFEC
- Pathtrace Engineering Systems
- Poppenhaeger Grips GmbH
- PROCAD GmbH und Co.KG
- Radan Computational Ltd.
- RIB/RZB
- RoboCAD Solutions Ltd.
- Sagantec Europe BV
- Sener Ingenieria y Sistemas SA

- Serbi SA
- Siemens Nixdorf Informationssysteme
- Sinus Software GmbH
- Smallworldwide
- Soft-Tech Software Technologies
- Softronics
- Speed
- Star Infromatic
- Straessle AG
- Superdraft
- Sysdeco Innovation AS
- Tebis
- Technische Computer Systeme GmbH
- Triplan
- ULTImate Technology
- VEDA—Design Automation
- Vero International Software
- Whessoe Computing Systems
- Wiechers Datentechnik
- Ziegler Informatics

The Japanese Companies

- Andor
- ARGO Graphics
- C. Itoh Techno-Science
- Cadix
- Century Research Center
- CPU
- Design Automation
- Fujitsu
- Graphtec Engineering
- Hakuto
- Hitachi
- Hitachi Zosen Information Systems
- Information Services International Dentsu
- Informatix
- INS Engineering

- Kubota Computer
- Marubeni Hytech
- Mitsubishi Electric
- Mitsui Engineering
- Mutoh Industries
- NEC
- Nihon Itek
- Nihon Unisys
- Omron
- Pasco
- Ricoh
- Seiko Instruments
- Sharp System Products
- Sony
- Sophia Systems
- Sumisho Electronics
- Sumitomo Denko Workstation
- Tokyo Electron
- Toshiba
- Toyo Information Systems
- Uchida Yoko
- Wacom
- Zuken-Redac

Of the 302 companies to be surveyed, 179 are North American, 85 are European, and 38 are Japanese.

Chapter 3
Research Metrics

Definitions for the research metrics used in this survey are as follows:

- Total revenue with the original equipment manufacturer (OEM): The total amount of money received by a company for all goods and services sold into the CAD/CAM/CAE/GIS market. This figure is typically only released when requested.
- Distribution channels: Distribution channels are defined as follows:
  - Direct channel—The channel through which product moves directly from the manufacturer or vendor to the end user, usually by means of a professionally trained salesforce
  - OEM—The channel through which vendors or manufacturers sell their finished product to other companies for resale through an agreement. Once sold, the product is usually modified slightly and then resold directly to the end user or through an indirect channel. Vendors that resell nonbranded product differ from VARs in that they often add their name to the product and back up its warranties.
  - Indirect channels—All other channels through which the finished product moves to the end user, including VARs, dealers, and mass merchandisers
- Turnkey: Bundling hardware and software for sale as a unit
- Total factory revenue: Money received by a company for its goods, excluding OEM revenue or consulting revenue
- Hardware revenue: Revenue derived from the sales of CPUs (including operating systems), terminals (for host-dependent systems), and peripherals
- Software revenue: Revenue derived from the sales of bundled (part of a turnkey system) and applications software. It does not include operating systems revenue, which is part of the hardware revenue.
- Service revenue: Revenue derived from the service and support of CAD/CAM/CAE/GIS systems. Service revenue can be calculated in the market share tables by subtracting hardware and software revenue from total factory revenue. Service revenue includes the following:
  - Applications development—Adding new functionality through design and development of new customized CAD/CAM/CAE/GIS software applications, or the modification, enhancement, or customization of existing software applications
  - Consulting—Including an assessment of a company's CAD/CAM/CAE/GIS business IT needs and formulation of a plan based on needs identification
  - Integration services—Planning, implementing, migrating, and integrating software products
  - Maintenance—Fees for hardware and software

  - Management and operations services—Includes help desk, education and training, disaster recovery, vaulting, facilities management, configuration management, and relocation services
  - Service bureau—Includes construction of database, data conversion, product design, analysis, or manufacturing

- Seats: The number of possible simultaneous users
- Unit shipments: The number of seats delivered, excluding those sold to another company for resale (OEM). CPU shipments are defined as the number of CPUs delivered, which is the same as unit shipments for all platforms but host-dependent platforms.
- Average selling price (ASP): The average amount of money received by the factory for the sale of a turnkey/hardware system. The database forces reconciliation of a company's revenue and unit shipments with the average selling prices of each application and platform.
- Installed base: The total number of seats/CPUs in use, calculated by forecasting the previous year's installed base plus the year's unit/CPU shipments, less retirements.
- Compound annual growth rate (CAGR): A computed, compounded growth rate used in forecasting

Chapter 4

Worldwide Geographic Region Definitions and Exchange Rates

Dataquest divides the different geographic regions as follows:

- North America: Includes Canada, Mexico, Puerto Rico, and the United States
- Europe
  - Western Europe: Includes Austria, Benelux (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)
  - Eastern Europe: Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)
- Japan
- Asia/Pacific: Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)
- Rest of World: Includes Africa, Central America, the Caribbean, the Middle East, Oceania, and South America

When converting a company's local currency sales into U.S. dollars, or vice versa, it is important to use the 1995 exchange rates provided below (see Table 4-1). These rates will prevent inconsistencies in the conversion of offshore sales between each company. These are the exchange rates that will be used in the final 1995 CAD/CAM/CAE and GIS market share survey. Exchange rates for historical years are available on request.

Table 4-1
Average 1994 and 1995 Exchange Rates against the U.S. Dollar

Country	1994 Rate	1995 Rate
Austria (Schilling)	11.33	10.06
Belgium (Franc)	33.36	29.42
China (Renminbi)	8.68	8.35
Denmark (Krone)	6.31	5.59
ECU	0.84	0.77
Finland (Markka)	5.21	4.37
France (Franc)	5.54	4.97
Germany (Mark)	1.62	1.43
Hong Kong (Dollar)	7.73	7.74
Italy (Lira)	1,609.19	1,628.21
Japan (Yen)	101.81	93.90
Netherlands (Gulden)	1.81	1.60
Norway (Krone)	7.04	6.33
Singapore (Dollar)	1.52	1.43
South Korea (Won)	802.40	770.57
Spain (Peseta)	133.48	124.40
Sweden (Krona)	7.7	7.14
Switzerland (Franc)	1.37	1.18
Taiwan (Dollar)	26.46	26.48
United Kingdom (Pound)	0.65	0.63

Note: The annual rate is estimated as the arithmetic mean of the 12 monthly rates.
Source: Dataquest (February 1996)

Chapter 5

CAD/CAM/CAE/GIS Operating Systems Group Definitions

Dataquest segments CAD/CAM/CAE/GIS data by four main operating system groups. These groups are as follows:

- UNIX—UNIX is a 32-bit, multitasking, multiuser operating system, originally developed at AT&T Bell Laboratories. It is portable and can be found on most CISC and RISC MPUs, including the Intel 80xxx, Motorola 68xxx, and Sun SPARC. UNIX includes all UNIX variants. A complete list of UNIX operating systems can be found in Chapter 8.
- Host-dependent systems—These systems include all minicomputer and mainframe operating systems in which the functions of external workstations are dependent on a host computer. The dominant operating systems in this group are IBM's VM and Digital Equipment's VMS operating systems.
- Windows NT—Windows NT is Microsoft's multiplatform, 32-bit operating system (either Windows NT or Windows NT Advanced Server) for high-end PCs, servers, and workstations.
- Personal computer (PC)—This group includes MS-DOS, PC-DOS, or DR-DOS operating systems. MS-DOS was designed by Microsoft for the original IBM PC. It is the dominant operating system on PC and PC-clone computing systems. PC-DOS is IBM's version of the disk operating system for PC and PC clones. DR-DOS is the Digital Research (Novell) version of this operating system. Other proprietary DOS variants such as NEC-DOS and J-DOS are included in this category.
- Also in the personal computer group are Mac OS, OS/2, Windows 3.1, and Windows 95. Mac OS is Apple's proprietary graphical user interface (GUI) operating system. OS/2 is IBM's GUI operating system for high-end PCs and PC servers. Windows 3.1 and Windows 95 are Microsoft's GUI operating systems for the PCs and PC clones. Windows 3.1 is a 16-bit operating system that runs on top of DOS. It is the dominant GUI operating system for PC and PC clones. Windows 95 is Microsoft's 32-bit version of Windows. Windows 95 is intended to replace Windows 3.1 and does not require a DOS foundation.

Chapter 6
CAD/CAM/CAE/GIS Software Applications Definitions

Dataquest segments data by application types. They are as follows:

- Mechanical—This segment refers to computer-aided tools used by engineers, designers, analysts, and drafters working predominantly in discrete manufacturing industries. Common design applications include conceptual design, industrial design, structural or thermal analysis, and detail design. Common manufacturing applications include tool and fixture design, numerical control part programming, and off-line robotics programming.
- Electronic design automation (EDA)—This segment covers computer-based tools that are used to automate the process of designing an electronic product, including printed circuit boards, ICs, and systems. EDA includes electronic CAE, IC layout, and PCB/hybrid/MCM, as follows:
  - Electronic computer-aided engineering (CAE)—These are computer-aided tools used in the engineering or design phase of electronic products (as opposed to the physical layout phase of the product). Examples of electronic CAE applications are schematic capture and simulation.
  - IC layout—This is a software applications tool that is used to create and validate the physical implementation of an integrated circuit (IC). The IC layout category comprises polygon editors, symbolic editors, placement and routing (gate array, cell, and block), design verification tools (DRC/ERC/logic-to-layout), compilers, and module development tools.
  - Printed circuit board (PCB)/hybrid/multichip module (MCM)—This segment covers products that are used to create the placement and routing of the traces and components laid out on a printed circuit board. Also included in this category are thermal analysis tools.
- Architecture, engineering, and construction (AEC)—This segment covers the use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and other people associated with these disciplines to aid in designing and managing buildings, industrial plants, ships, and other types of nondiscrete entities.
- Geographic information systems (GIS)/mapping—This is a computer-based technology, composed of hardware, software, and data used to capture, edit, display, and analyze spatial (tagged by location) information.

Chapter 7
CAD/CAM/CAE Subapplications Segmentation

Additional surveys are conducted to further segment the industry with software revenue sales by subapplication. The applications are divided as follows:

Mechanical

Modeling Technology

The modeling technology applications are as follows:

- Solid modeling—The representation of a part or assembly capturing all relevant data describing solid characteristics of a project. This can include shape, weight, color, surface texture, and mass properties. Boolean operations are commonly used to add and subtract volumes together to define the final shape of the object.
- 2-D modeling—The representation of a part in two dimensions (it has an x and y coordinate). This format requires three or more views (top, front, and side) to depict all aspects of the part. 2-D is the most common geometric modeling format and is used extensively with a drafting function.
- 3-D modeling—The representation of a part in three dimensions, usually in a wire-frame format (it has an x, y, and z coordinate). This format is commonly used in high-level CAD systems to determine the placement and fit of components in an assembly. It is generally not used for final drafting, although some systems have the capability to translate the 3-D image to a 2-D standard drafting format.
- Integrated—The integration of all 3 modeling technologies

Mechanical CAD/CAM/CAE Subapplication

The mechanical CAD/CAM/CAE subapplications are as follows:

- Conceptual design
  - Industrial design—A process that provides a common environment for the entire conceptual design process, including painting, modeling, rendering, and visualization
  - Design layout—An initial design process in which the major components and part interfaces are defined
  - Styling—A detailed design process in which aesthetic considerations are foremost in importance
- Functional design
  - Component design—Design of the individual components in an assembly
  - Assembly verification—Integration of components' designs into an assembly to test the size/shape and function characteristics

  - Linkage/mechanism—An assembly of components with two or more movable parts, usually providing some means of power, control, or fastening application
  - Analysis—The analysis of a physical system, part, or assembly; includes structural, thermal, vibrational, composite, fatigue, stack-up, mass property, and quality-control analysis
- Drafting and documentation
  - Detail drafting—Representation of a part in standard geometric drafting format, including all part geometry dimensions and notations describing mechanical/structural, functional, and material characteristics
  - Schematic/detailed diagrams—Schematics used to describe hydraulic and pneumatic systems
  - Technical illustration—Drawing of a component or assembly that is generally intended for publication
- Manufacturing engineering
  - Tool design—The design of custom-made tooling to facilitate a manufacturing process
  - Fixture design—The design of structural aids that hold the component or assembly during the manufacturing process
  - Part processing design—The design of a series of manufacturing processes
- Manufacturing process simulation
  - Numerical control part programming—The programming of a numerical control machine tool or automated processing system
  - Coordinating measuring machines—The programming of machines used to measure the physical dimensions of a part
  - Offline robotics—A process simulation that graphically represents the sequence of steps to program a robot for a particular operation and downloads data to a robot to update its control program
- System management and other tools
  - Product data management (PDM)—Software typically used in an engineering or manufacturing environment to manage product data. Characteristics of PDM systems include product/structure management, workflow, and vault/document management capabilities.
  - Engineering data management—Software with vault management capabilities and limited workflow capabilities designed for use within an engineering environment
  - Component information systems—Software used to navigate within and manage a repository of engineering parts and associated data
  - Knowledge-based engineering tools—Tools used to capture design intent and build standard practices for controlling, modifying, and automating design and manufacturing activities. Also known as rule-based engineering.

- Applications development environments—Programming tools to aid in the generation of user-defined programs that drive or interface with CAD/CAM/CAE.

EDA

For the past few years, Dataquest has subdivided the electronic CAE market in an entirely new way. The subdivisions are based on design methodologies such as gate-level design, register transfer (RT)-level design, and electronic system (ES)-level design.

Under the methodology, a design is first entered and simulated, usually at the RT level. It is then synthesized or compiled down to the level below it. This process continues (simulation and synthesis) until the design is placed and routed at the physical design level, at which point timing information is extracted from the physical design. At this point, the verification process begins.

For verification, the process flows in an upward direction. From the physical design level, timing information is extracted, and design rule checkers and logic rule checkers are used to ensure a correct design at the physical level. Verification continues in this upward fashion until the level at which the design process originally began is reached. The electronic design automation subapplications are as follows:

CAE

The CAE subapplications are as follows:

- ES level
  - ES-level design—Design at the conceptual level, including hardware/software co-design, design partitioning, and specification; it includes neither RT- nor logic-level descriptions.
  - Behavioral simulation—Nontiming-based simulation
  - Behavioral synthesis—Synthesis of an ES-level design description to the RT level
  - Formal verification—The process of mathematically proving that an RT-level description equates to an ES-level description (or less specifically, that any design representation equates to another)
- RT level
  - RT-level design—Tools designed to assist engineers in entering a design or analyzing the simulated results of that design. This includes the use of graphical symbols to represent RT-level VHDL or Verilog.
  - RT-level simulation—Simulation at the RT level
    - VHDL—Simulation using the VHSIC Hardware Description Language
    - Verilog—Simulation using the Verilog Hardware Description Language

- Logic synthesis—Synthesis or translation of an RT-level description to a gate-level description
- Target compiler—A translation of an RT-level description to the silicon implementation
- Timing analysis—Verification of the timing of a design; the process usually involves providing inputs to a physical circuit model or computer simulation to test the nondynamic functions of a design; static-timing verification does not require the use of test vectors to determine timing violations.
- Design for test tools—Tools used to determine, improve, or add to the testability of electronic circuits
- Silicon synthesis—Tools that estimate silicon-level performance at the RT-level by synthesizing the RT-level description to a virtual silicon implementation of that code and reflecting the estimated silicon performance back up to the RT level
- PCB synthesis—A process similar to silicon synthesis but without using synthesis technology. PCB synthesis uses a virtual representation of the PCB to estimate physical effects, bringing those effects back up to the CAE level of design.

- Gate level
  - Schematic capture—A design process that consists of graphical schematic entry and net-list extraction
  - Simulation—The use of representative or artificial data to reproduce conditions in a model that could occur in the performance of a system. Simulation is used to test the behavior of a system under different operating conditions.
    - Gate-level simulation—Simulation based upon a gate-level netlist (not VHDL or Verilog)
    - Analog simulation—Simulation in which both digital and analog inputs are used
    - Mixed-signal simulation—Simulation in which both digital and analog inputs are used
    - SPICE simulation—Simulation using a derivative of the Berkeley SPICE transistor-level simulator
  - Analysis tools—Tools used for the analysis of designs
    - Signal analysis (including transmission line and cross-talk analysis)—Analysis of high-speed coupling effects between signal line and reflection/degradation of the high-speed signal on PCBs, MCMs, or ICs
    - Power analysis—Analysis of the power consumption of PCBs, ICs, MCMs, and systems
    - Electromagnetic interference—Analysis of electromagnetic generation and interference for PCBs, ICs, and cables/connectors/packaging

    - Metal migration or electromigration—The unauthorized movement of metal in an IC because of excessive current density

- Miscellaneous
  - Accelerators—Dedicated hardware/software or optimized software used to speed up simulation, typically at the gate level
  - Emulators—Dedicated hardware/software that allows a designer to observe the function of a circuit or design prior to prototype
  - Fault simulation/grading—A process that determines which nodes in a design can be detected by a given set of test vectors
  - Interoperability tools—Software used for database, library, and tool management; they also include backplanes, file translators, and design environments (in general, all tools used specifically to integrate a set of EDA tools).
  - Libraries—Description of elements used in EDA designs (for example, components, simulation models, and symbols)
  - Field-programmable gate array (FPGA) toolset—Dedicated EDA software sold as a package for FPGA/complex-programmable logic device (CPLD) design
- IC CAD
  - DRC—The design rule and logic rule checkers used to perform final verification on an IC design prior to making masks
  - Floor planner—A tool that allows a designer to place elements of a design so that the designer can look at estimations of the effects of the final place and router.
  - FPGA place and route—Tools used to implement designs into the targeted FPGA or CPLD. These are also called "fitters" because they fit designs into the already existing logic structure of the targeted FPGA or CPLD.
  - IC place and route—Tools used to implement (lay out) designs into silicon
    - Gate array place and route—Tools used to lay out designs into a fixed-based array
    - Cell-based IC place and route—Tools used to lay out nonfixed, cell-based designs
    - Custom IC layout—Silicon design tools working at the transistor level. These tools can size transistors, accomplish analog design, and generally hand craft silicon implementation. Sometimes called "layout editors."
- PCB design
  - PCB design tools—Tools used to design, place, and route a PCB
  - MCM9 and hybrid design tools—Tools used to design, place, and route a multichip module or hybrid substrate

AEC/Architectural, Engineering, and Construction

The AEC, or architectural, engineering, and construction, subapplications are as follows:

- Architectural—Software used in the design and drafting of buildings and grounds
- Civil—Software for both site and structural engineering, typical for design and drafting of sites for buildings, roads, bridges, and airports and for the design of steel and concrete structures
- Facilities design/management—Software used to lay out, inventory, and manage assets such as personnel space, equipment, and utilities within a building or geographic service area
- Process plant design—Software used in design, analysis, drafting, and management of process, power, and manufacturing plants as well as ships

GIS/Mapping Software

GIS/Mapping Software is used to capture, edit, display, and analyze spatial (tagged by location) information. It can be categorized as follows:

- Base data—Software used to create baseline geographic data
  - Photogrammetry and surveying—Software used in developing original data for a GIS system based on ground surveying or on remotely sensed data. Examples include aerial photography or satellite imagery.
  - Data for resale—Includes both GIS software used to create data for resale to end users and revenue from the sale of geographic data
- Land information—Software used to gather and manage land data
  - Land records—GIS software used to manage land ownership or parcel information; the typical user is a tax assessor.
  - Planning and land use—GIS software used to manage land use; the typical user is a city planner.
- Biological—Software used to manage and analyze plant and animal life
  - Environmental public health and safety—GIS software used to manage natural resources and to monitor and analyze environmental factors that contribute to the welfare of the earth and its people
  - Forestry and agriculture—GIS software used for the management of forests and crops
- Geoscience (formerly energy exploration)—GIS software used to manage oil, gas, and mineral exploration projects. The emphasis of geoscience is typically on subsurface data.
- Infrastructure management—Management and analysis of man-made assets (not including utilities)
  - Transportation and logistics—GIS software used in transportation applications such as road or rail network modeling or route planning

- Emergency and dispatch services—GIS software used to manage emergency services such as "911" services and also for-profit dispatch management systems

- Automated mapping/facility management—GIS software used for managing utility industry networks, based on the following categories:
  - Telecommunications/telephone
  - Electric
  - Water and waste water
  - Other utilities (primarily gas)

- Business marketing and sales—GIS software used to promote and sell services and products, and to identify and evaluate opportunities in a competitive environment.
  - Demographic and location analysis—GIS software used to analyze problems in demographics or site characteristics. Examples include sales territory selection, site selection, or population analysis. Typical users are in advertising, marketing, insurance, banking, and real estate.
  - Sales and directional support—GIS software used to help salespeople locate targets of a sales effort (for example, to locate potential customers, specific properties for sale and driving routes to the properties). This also includes software used to help customers locate establishments, typically used as travelers' aids.

- Geopolitics—The sum of software used in defense/military and political districting applications
  - Defense/military—GIS software used to manage military or defense projects for the purpose of command and control
  - Political districting—GIS software used to manage the redistricting process based on census data

- Cartography—GIS software used in mapmaking applications

Chapter 8

CAD/CAM/CAE/GIS Operating System and Industry Segmentation

Additional surveys segment the software revenue by operating systems and by industry, providing yet another look at the CAD/CAM/CAE/GIS software market. These segments are as follows:

Operating Systems

- Apollo AEGIS
- Apple AUX
- Apple Macintosh/OS
- AT&T Systems V Derivatives
- CDC CYBER NOX/VE
- CONVEX UNIX
- CRAY UNIX
- Digital Equipment Corporation OSF
- Digital Equipment Corporation ULTRIX
- Digital Equipment Corporation VMS
- DOMAIN/Apollo UNIX
- DOS
- DOS with Windows
- Hewlett-Packard UX
- Hitachi HI-UX/G (UNIX)
- IBM AIX
- IBM VM/VMS
- Intergraph UNIX
- MIPS UNIX
- NEC EWS-UX (UNIX)
- OS2
- Prime PRIMOS
- Siemens-Host/Proprietary
- Siemens-UNIX
- Silicon Graphics Inc. UNIX
- Solaris
- Sony NEWS-OS (UNIX)
- Sun—UNIX/OS

- Windows
- Windows NT
- XENIX/SCO UNIX
- Others—UNIX
- Others
- All Operating Systems

Industry Sectors

- Aerospace, guided missiles, and space vehicles
- Agriculture, forestry, and fishing
- Automotive, motorcycles, and bicycles
- Chemical, allied, and petroleum products
- Computers, office equipment, and computer peripherals
- Conservation management and waste management
- Construction, contractors, and building
- Consumer electronics (TV, VCR, and CD)
- Education
- Electrical/electronic equipment (power, appliances, test, and measurement)
- Fabricated metal products, except machinery and transportation
- Finance, insurance, and real estate
- Government: environment and public health resource
- Government: general, executive, public order, and taxation
- Government: national security (defense)
- Government: public works and engineering
- Industrial and commercial machinery (engines and heavy equipment)
- Industrial controls, robotics, and AGVs
- Manufacturing not elsewhere classified (textiles, furniture, and foundries)
- Medical manufacturing (instrument/x-ray)
- Mining
- Semiconductors
- Service companies (including architecture firms, engineering consulting firms, and design services firms)
- Shipbuilding, ship repairing, and developing offshore rigs
- Telecommunications and data communications (telephone, radio, television, and cable)
- Transportation (rail, public transit, and freight transport)

- Utilities and pipelines (electric, gas, sanitary services, and water)
- Others
- All industries

Results from these surveys and the subapplications' surveys are scheduled to be published in mid-1996.

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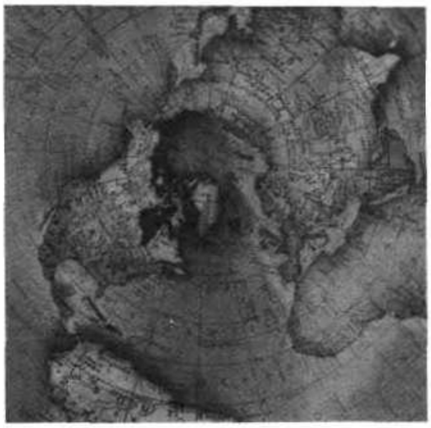

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Mechanical CAD/CAM/CAE Applications—A User's Perspective

User Wants and Needs

Program: Mechanical CAD/CAM/CAE Worldwide
Product Code: CMEC-WW-UW-9601
Publication Date: October 21, 1996
Filing: Reports

Mechanical CAD/CAM/CAE Applications—A User's Perspective

User Wants and Needs

Program: Mechanical CAD/CAM/CAE Worldwide
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Chapter 1
Executive Summary

Introduction

Each year, Dataquest's Mechanical CAD/CAM/CAE Worldwide program performs an extensive survey of mechanical designers and reports on their shifting priorities, needs, and demands. Our annual User Wants and Needs study provides our clients with the most in-depth, up-to-date information on the mechanical design community. For mechanical CAD companies to be successful, they must have a thorough understanding of their target customer base. Our research of mechanical CAD/CAM/CAE end users provides us with an insightful look into the tool preferences, software satisfaction, and spending plans of mechanical designers and engineers.

Survey Highlights

The information presented here is the result of a telephone survey of 214 designers, engineers, CAD administrators, and managers located throughout North America.

The objectives of this study were as follows:

- To understand what trends are taking place in the mechanical CAD/CAM/CAE industry
- To understand the design environment in which users work
- To examine end-user satisfaction with the current CAD/CAM/CAE tools
- To underscore some of the changes that will take place in mechanical design in the future

Structure of the Document

- The remainder of this document is organized as follows:
- Chapter 2, "Study Foundations and Methodology," explains the research process employed by Dataquest in gathering the information and demographics of the respondents of this survey.
- Chapter 3, "Use of CAD Technology Today," characterizes the mechanical designer today. We begin by examining the use of CAD/CAM/CAE within a company, including user experience with CAD systems, customization, and integration issues. We investigate 3-D design and hindrances to its more widespread use, and we delve further into the standards ACIS and STEP.
- Chapter 4, "The Designer's Work Environment," characterizes the environment in which the engineer works. We discuss hardware platforms, operating systems, and anticipated future spending for hardware, software, and service. We also investigate how quickly deployment of Microsoft's Windows NT operating system will take place in the mechanical design world, according to end users.

- Chapter 5, "Mechanical Applications Perceptions," reveals what designers think of the mechanical applications they use—what benefits have they seen, what CAD functionality and characteristics they seek, and what influences their purchasing decisions. Users rate the importance and satisfaction of a number of factors related to CAD/CAM/CAE and the engineering design process.
- Chapter 6, "A PDM Update" takes an exclusive look at this hot market. We characterize today's users of PDM tools, factors influencing PDM deployment, and potential for future growth.

Project Analyst: Sharon Tan

Chapter 2
Study Foundations and Methodology

Survey Methodology

The survey questionnaire was developed by analysts from Dataquest's Mechanical CAD/CAM/CAE Worldwide program and consisted of about 150 questions. The end-user data was gathered via a telephone survey conducted in May 1996. The results were entered into a statistical analysis package for analysis of the data. In total, 214 surveys were completed.

The specific respondent sample characteristics included the following:

- People involved in the decision-making process of new system purchases
- People who are currently or have been users of mechanical CAD/CAM/CAE tools
- People working in a major discrete manufacturing industry
- Employees in one of the major departments of potential CAD use

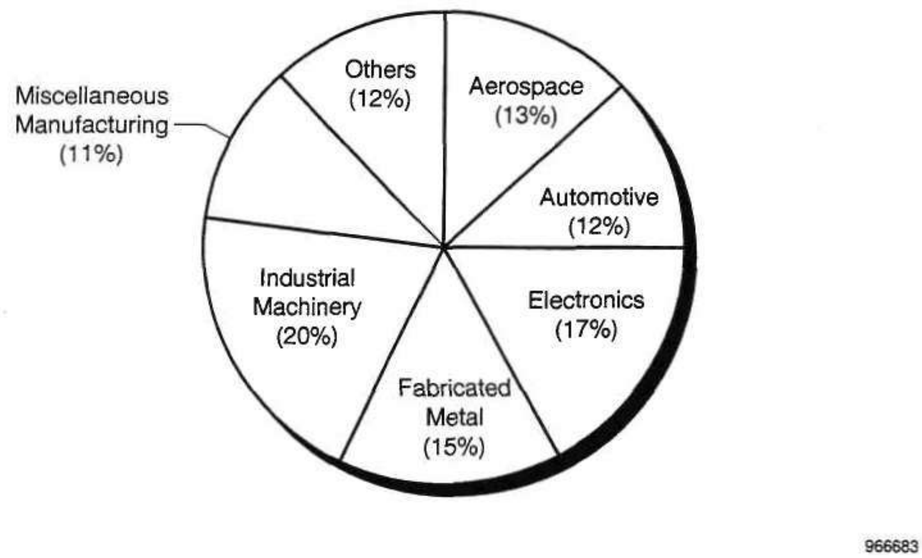
Any data point collected in the survey can form the basis of a cross-tabulation. Special cuts of the data (for example by computer platform used or software package) are available to Dataquest's Mechanical CAD/CAM/CAE Worldwide program clients by special request. However, the identities of the end users surveyed are strictly confidential.

Respondent Demographics

Figure 2-1 gives the respondent breakdown by industry. The data represents a wide cross section of prominent industries in North America. Miscellaneous manufacturing is dominated by medical manufacturing, but also includes other discrete manufacturing not classified elsewhere. The "other" category consists primarily of respondents in government, services, and process manufacturing. All respondents were placed into one of the categories shown in Figure 2-1, and further data analysis in this report will be based on those industry classifications.

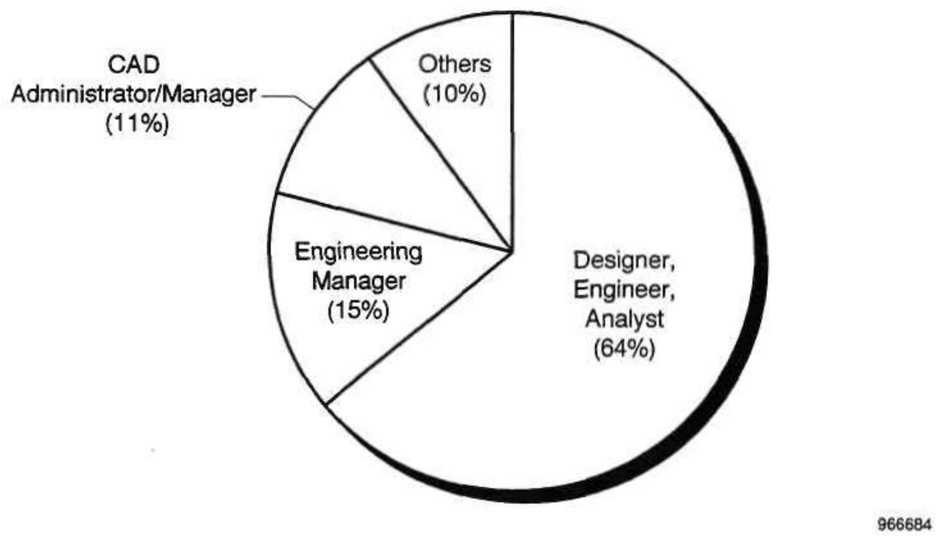
Respondent breakdown by job title is given in Figure 2-2. Our survey intentionally targeted those respondents in design, development, and engineering; we felt that workers in these departments would be most knowledgeable about CAD/CAM/CAE tools. We have also included a large proportion of managers and administrators, or those people in charge of budgets, spending, and future purchases. Our survey included a mixture of small, medium, and large sites, as shown in Figure 2-3.

Figure 2-1
Respondent Breakdown by Industry



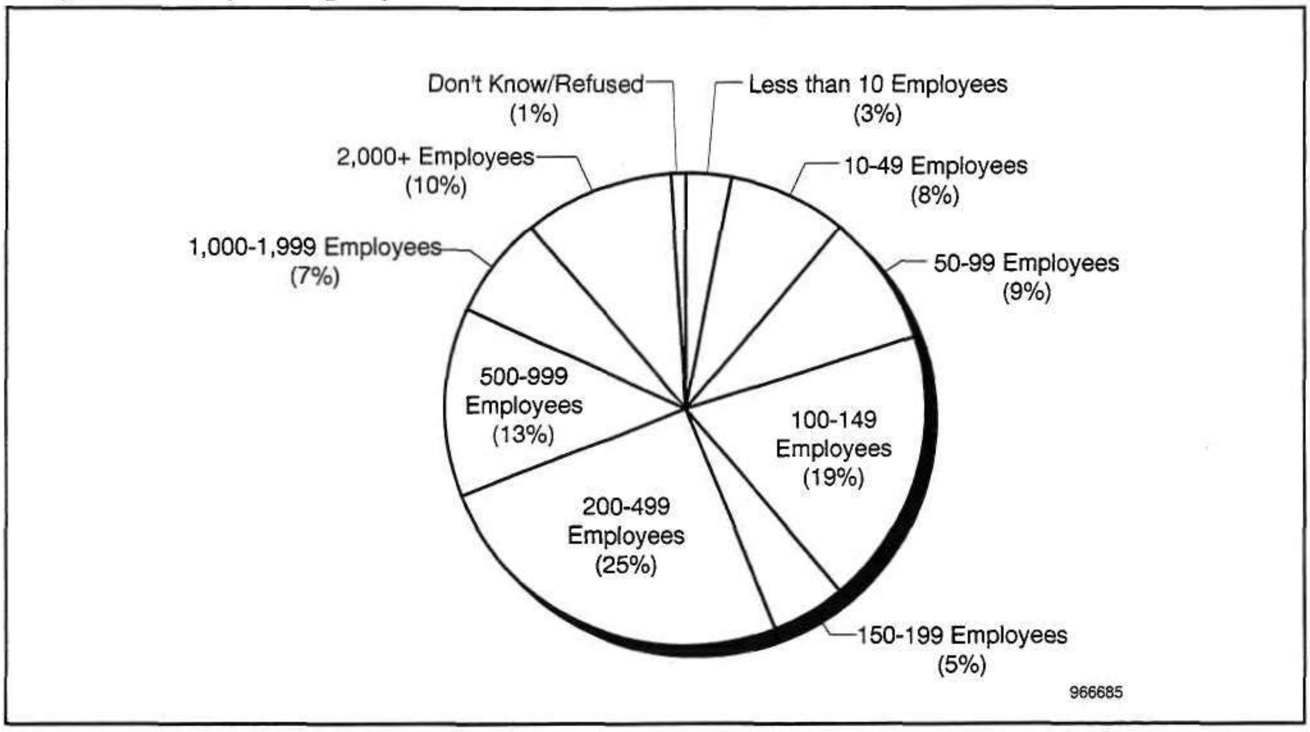
Source: Dataquest (September 1996)

Figure 2-2
Respondents by Job Title



Source: Dataquest (September 1996)

Figure 2-3
Respondents by Company Size



Source: Dataquest (September 1996)

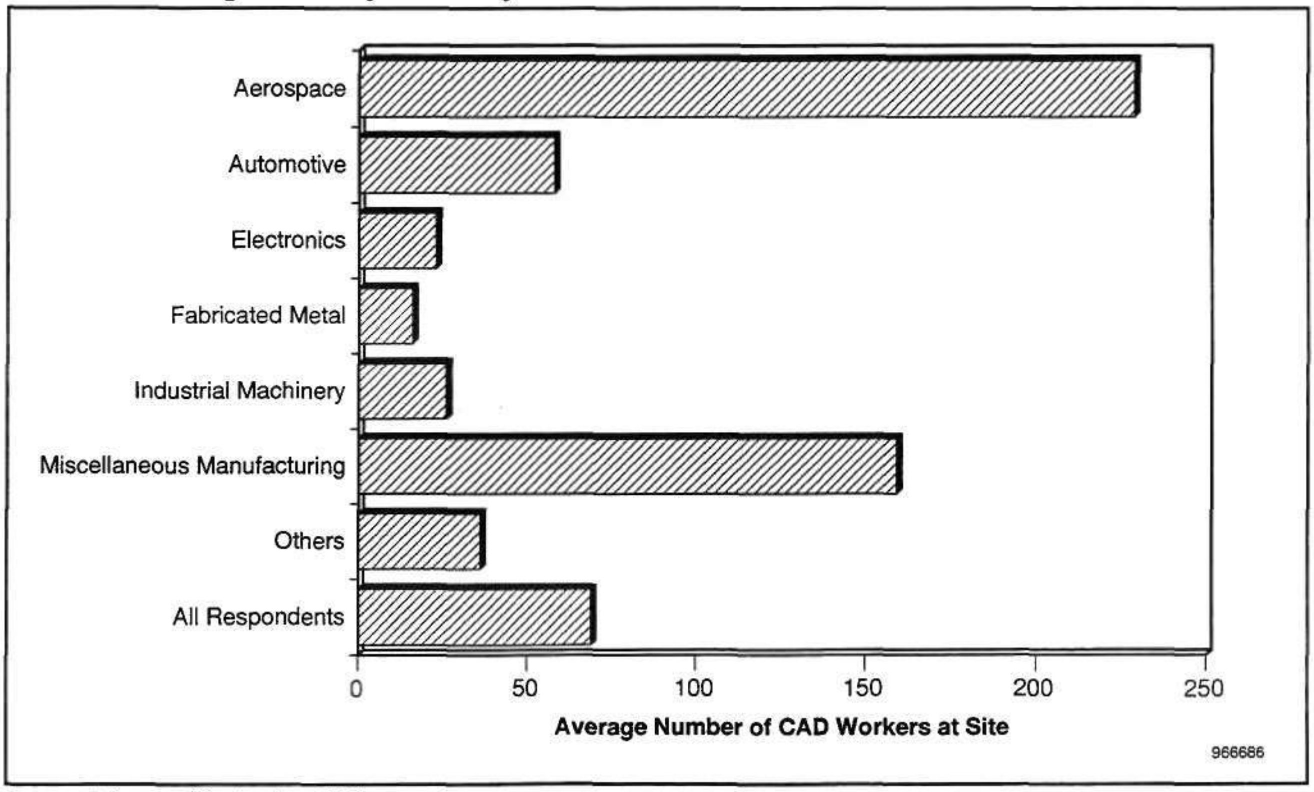
Chapter 3
Use of CAD Technology Today

Use of CAD within the Company

The number of engineers or designers working on a CAD system at a given company ranged from one to 4,000, with the average being 69 workers (see Figure 3-1). The data was weighted toward smaller sites; the median number of CAD workers at a given site for all survey responses was 12. The average number of hours worked per week on a CAD system was about 28 hours for all respondents, with little variation by industry. These figures are lower than what we have seen in other similar surveys—it is important to remember that this survey included a large number of managers and administrators (36 percent of the total number of respondents) as well as engineers and designers.

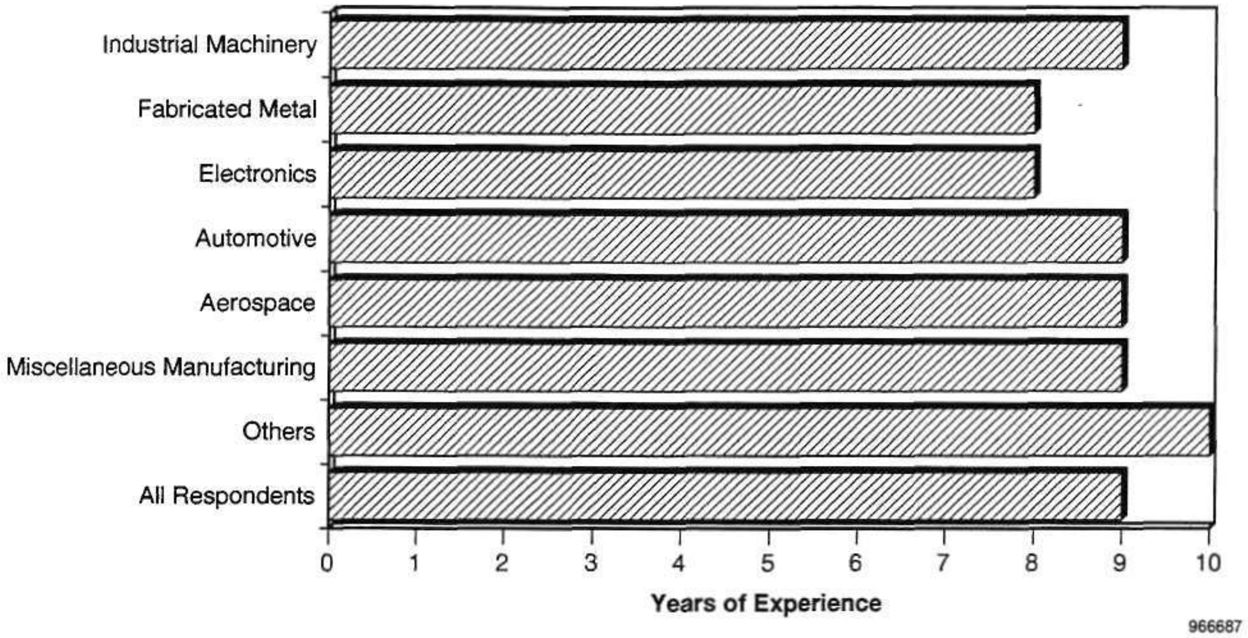
The respondent group as a whole is well-experienced with several years of hands-on use. The experience base of survey respondents was, on average, nine years. Only slight variation was seen by industry, as indicated in Figure 3-2. The median years of experience was eight years; the maximum was 30 years.

Figure 3-1
CAD Workers per Site by Industry



Source: Dataquest (September 1996)

Figure 3-2
Experience Base of CAD Users by Industry



Source: Dataquest (September 1996)

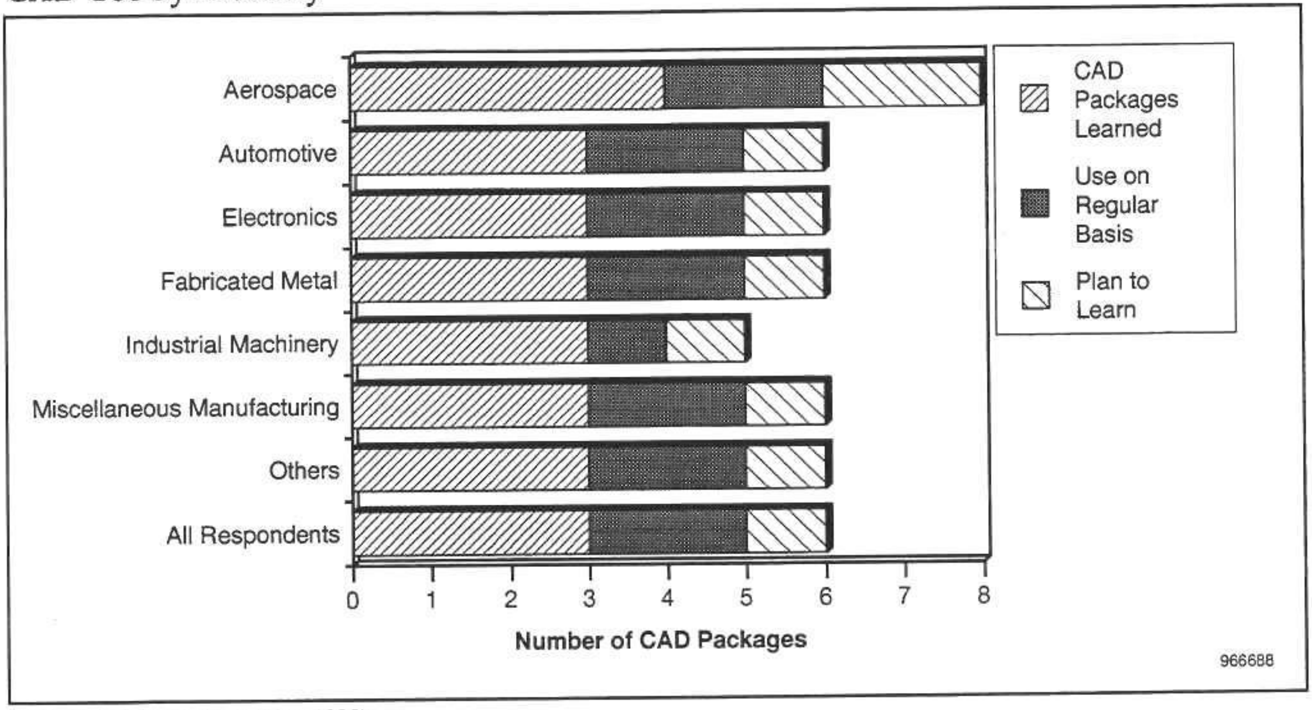
We asked respondents how many CAD packages they have learned, use on a regular basis, and plan to learn within the next two years. The results, by industry, are shown in Figure 3-3. On average, the aerospace users have learned and use regularly the greatest number of CAD packages. Those users in industrial machinery have learned the fewest packages, on average. Overall, respondents expect to learn only one or two CAD packages over the next two years.

Customization and Integration

The majority of CAD users continue to do some customization of their CAD/CAM/CAE systems. Those users doing the most customization came from aerospace and miscellaneous manufacturing (see Figure 3-4). The group reporting the largest "no customization" response was automotive. It is our belief that this group of users tends to purchase sophisticated CAD packages that are customized by the software vendor or systems integrator and not customized in-house.

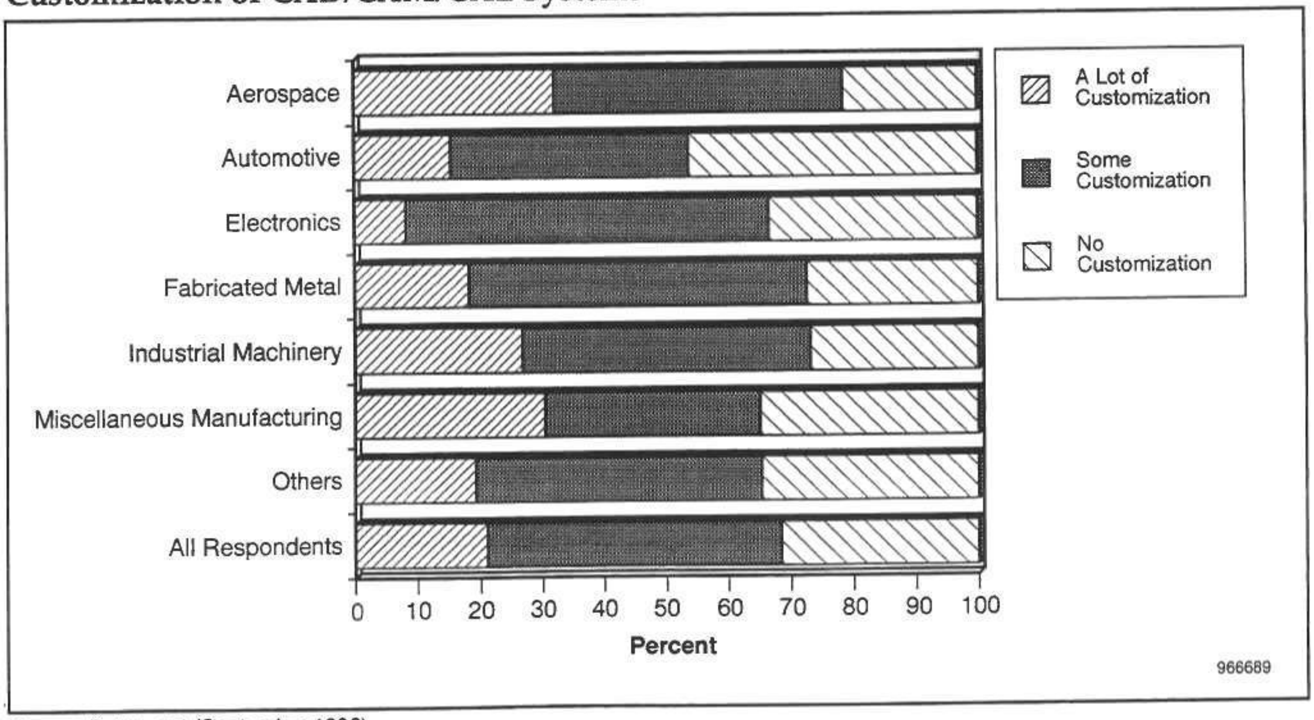
Some of this customization is because of the fact that users often must integrate one CAD package with another. Typically, these additional packages were used to either replace or supplement CAM and CAE functionality. About 45 percent of respondents use a CAM package and 37 percent use a CAE or analysis package in addition to their primary vendor's CAD package (see Table 3-1). As expected, the heaviest use of CAM was seen in the fabricated metal industry, and the heaviest use of CAE was seen in the aerospace industry.

Figure 3-3
CAD Use by Industry



Source: Dataquest (September 1996)

Figure 3-4
Customization of CAD/CAM/CAE Systems



Source: Dataquest (September 1996)

Table 3-1
Use of CAM and CAE Tools

Industry	Use CAM (% of Respondents)	Use CAE (% of Respondents)
Aerospace	50.0	63.0
Automotive	46.2	38.5
Electronics	36.1	30.6
Fabricated Metal	54.8	33.3
Industrial Machinery	50.0	33.3
Miscellaneous Manufacturing	30.4	30.4
Others	44.0	34.6
All Respondents	45.0	37.1

Source: Dataquest (September 1996)

Designing or Modifying

It is well known that mechanical CAD is not just designing, it is also modifying. Designers and engineers undoubtedly need to spend some of their time modifying existing parts and designs instead of always designing new parts. We asked respondents what is the proportion of new parts designed to existing parts that are modified. The results, by industry, are given in Table 3-2. On average, 54 percent of parts are completely new and 46 percent are modifications. The amount of modifications done points to a need to preserve legacy data in a form that will be accessible in the future.

Table 3-2
New Designs versus Modifications

	Design of Completely New Parts (%)	Modification of Existing Parts (%)
Aerospace	56	44
Automotive	49	51
Electronics	50	50
Fabricated Metal	57	43
Industrial Machinery	50	50
Miscellaneous Manufacturing	70	30
Others	49	51
All Respondents	54	46

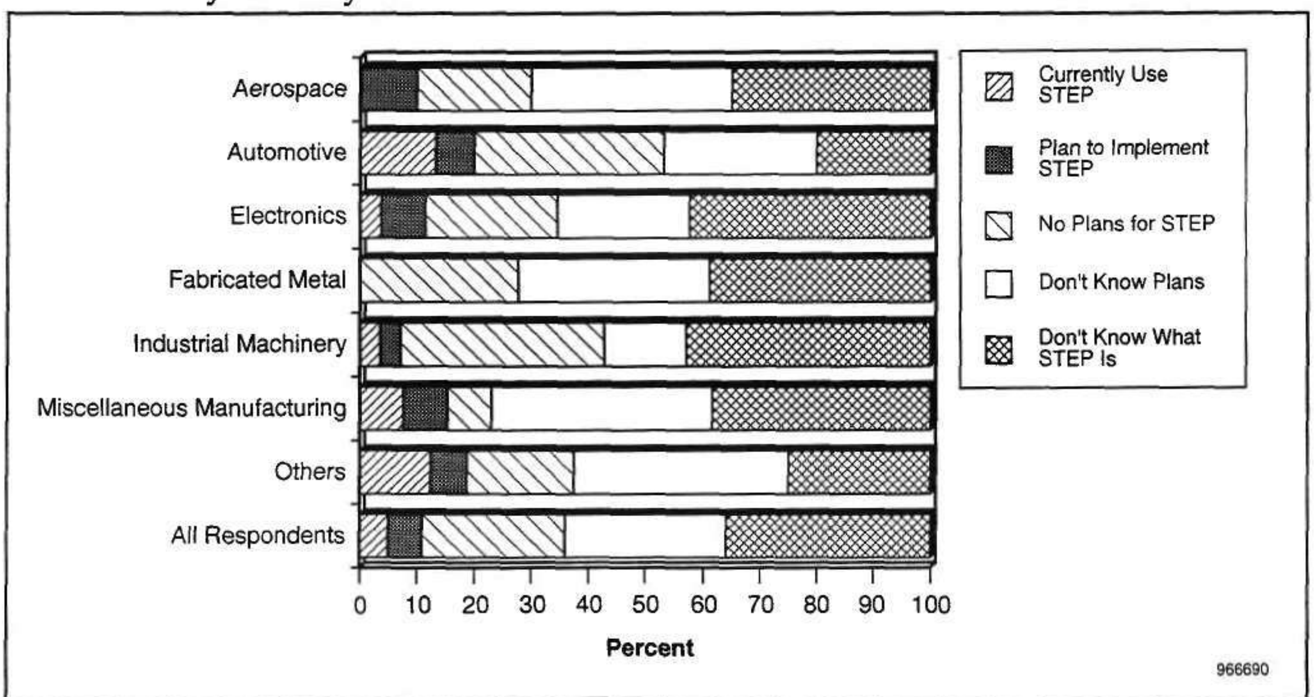
Source: Dataquest (September 1996)

Data Exchange—STEP and ACIS

It is clear from the comments of respondents in the survey that data translation is a hot issue. We have seen this issue surface in nearly all of the surveys that we do. Users want the ability to transfer data between different CAD systems with a minimum of fuss and rework. The STEP (Standard for the Exchange of Product Data) standard has been viewed as one solution to the data translation problem. STEP has been drawing the interest of the mechanical CAD/CAM/CAE community for quite some time, but our survey results show that it still has a long way to go until it is widely accepted and used. We saw similar results in our 1995 European end-user survey, where standards are generally given more consideration than they are in North America.

Specifically, we asked users if they were using STEP. The results are given in Figure 3-5. The highest rates of STEP use or plans are among designers in the automotive industry. This comes as no surprise, as much of the STEP development has been spearheaded by efforts in the automotive arena. These users also showed the greatest awareness of STEP; only 20 percent did not know what STEP is. Respondents in industrial machinery reported the highest "no plans for STEP" and also reported the least awareness of the STEP standard. In any case, the lack of awareness of STEP is still quite high for all industries, despite all of the STEP development and publicity that has centered around automotive, aerospace, and electronics design.

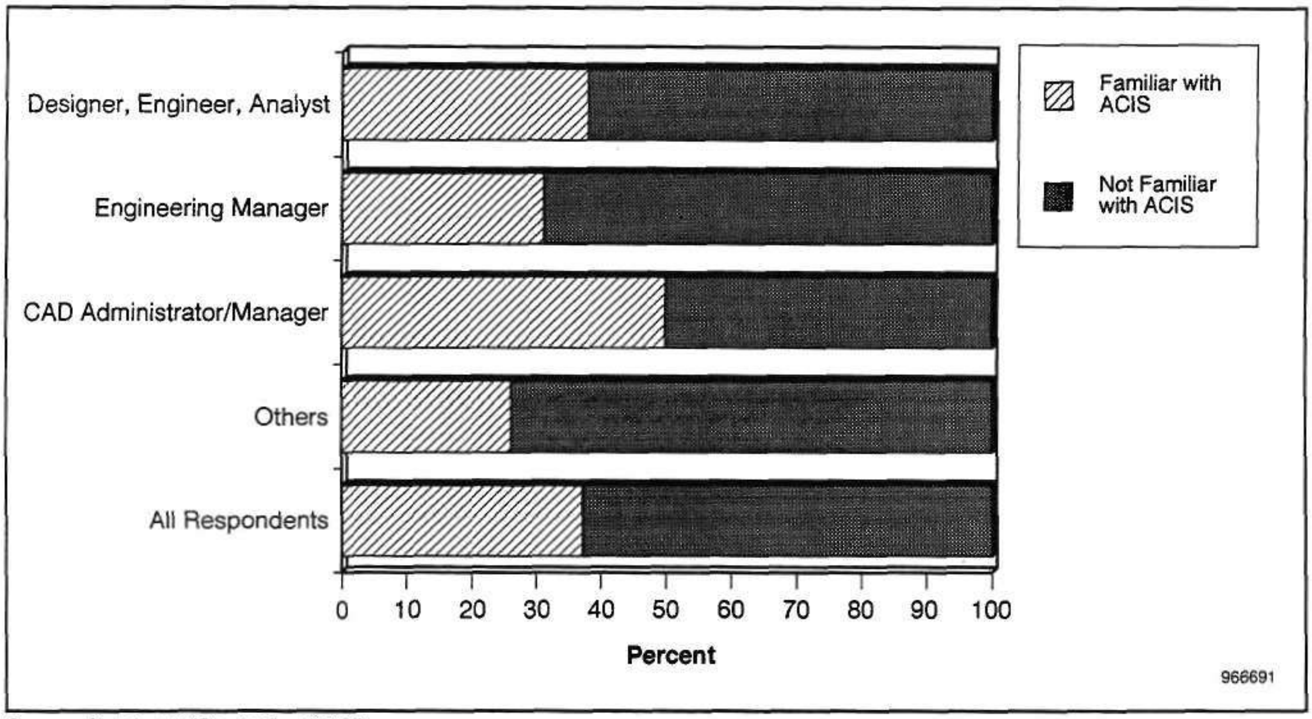
Figure 3-5
STEP Plans by Industry



Source: Dataquest (September 1996)

The ACIS modeling engine from Spatial Technology has been widely talked about as being the de facto "standard" for 3-D data—a standard that could eliminate the need for data exchange standards such as STEP or formats like IGES. Many of the leading mechanical CAD vendors use ACIS as the 3-D modeling engine, including Autodesk Inc., Bentley Systems Inc., Hewlett-Packard Company, and Intergraph Corporation. Surprisingly, ACIS is not that well known among the respondents in our survey. We asked respondents if they were familiar with the term "ACIS"—nearly 63 percent were not. Results varied little by industry, but more by job title (see Figure 3-6). It is true, however, that designers can certainly use 3-D data and use ACIS without having to be aware that they are using it.

Figure 3-6
"Are You Familiar with ACIS?"



Source: Dataquest (September 1996)

2-D versus 3-D Design

While the focus of vendors today has been on 3-D modeling, it appears there is still plenty of 2-D design being done among North American end users. We asked respondents if they consider 3-D design to be their main form of design. A full 55 percent responded yes to that question. Details by industry are given in Table 3-3. Both automotive and aerospace users report significantly higher percentages of 3-D design than other industries. There is still plenty of 2-D work being done in industrial machinery.

We further explored this issue of 3-D design by asking those users whose main form of design is 3-D, what percent of those 3-D functions are used. The average response was 67 percent. Answers varied from 0 percent to 100 percent of functions used. Little variation was seen by industry.

Table 3-3
"Is 3-D Design the Main Method of Design?"

Industry	Yes (%)	No (%)
Aerospace	61	39
Automotive	69	31
Electronics	42	58
Fabricated Metal	42	58
Industrial Machinery	21	79
Miscellaneous Manufacturing	43	57
Others	50	50
All Respondents	45	55

Source: Dataquest (September 1996)

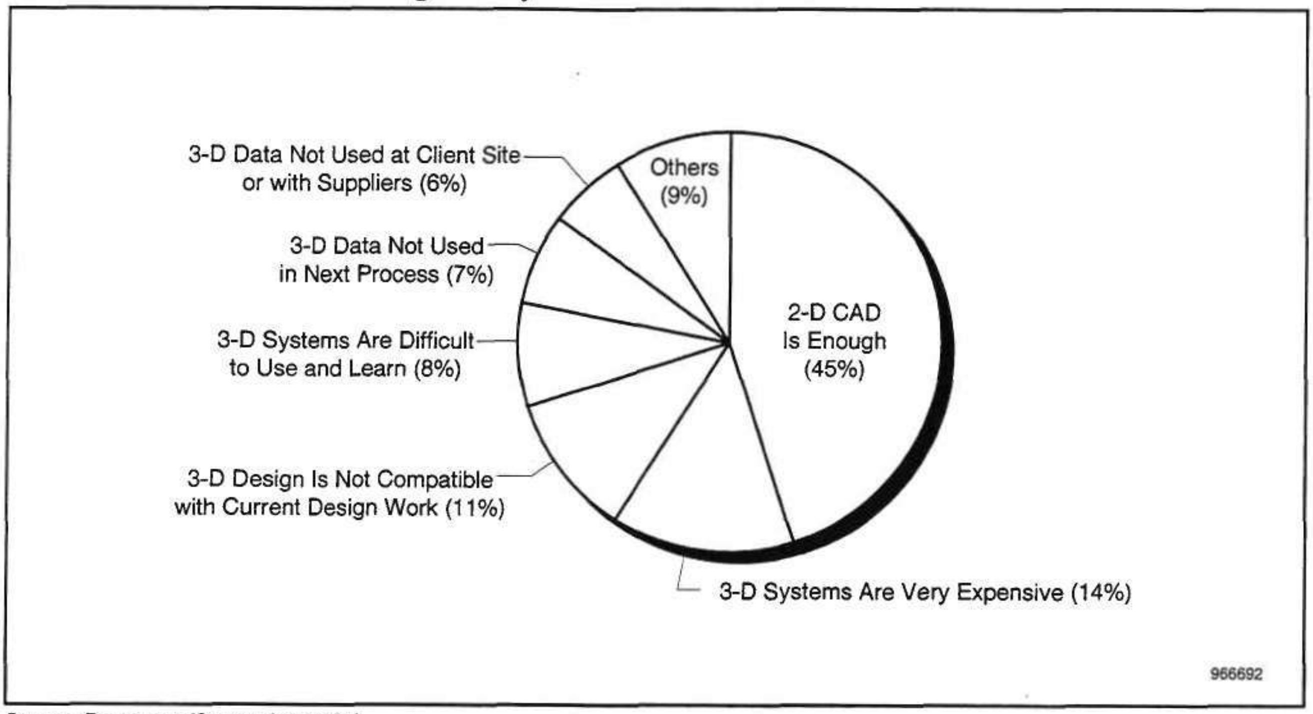
Of those users who do not consider 3-D to be their main form of design, we asked if it would become the main form by 1998. Surprisingly, only 41 percent of these respondents said yes and 52 percent said no, and the remainder did not specify. Users cited many reasons for not planning to change to 3-D CAD by 1998. By far, the most commonly cited reason was that 2-D CAD is enough to meet their needs. All reasons are summarized in Figure 3-7.

File Types

The mix of data file types is key to gaining an understanding of the level of use of various modeling technologies, and also points to the level of graphics performance necessary to view and edit design data as it is retrieved. Figure 3-8 shows the mix of files stored by modeling technology. All sites have a mix of 2-D or 3-D wire frame, surface, and solid model files. 2-D information dominates, with some sites having nearly all their files stored in 2-D.

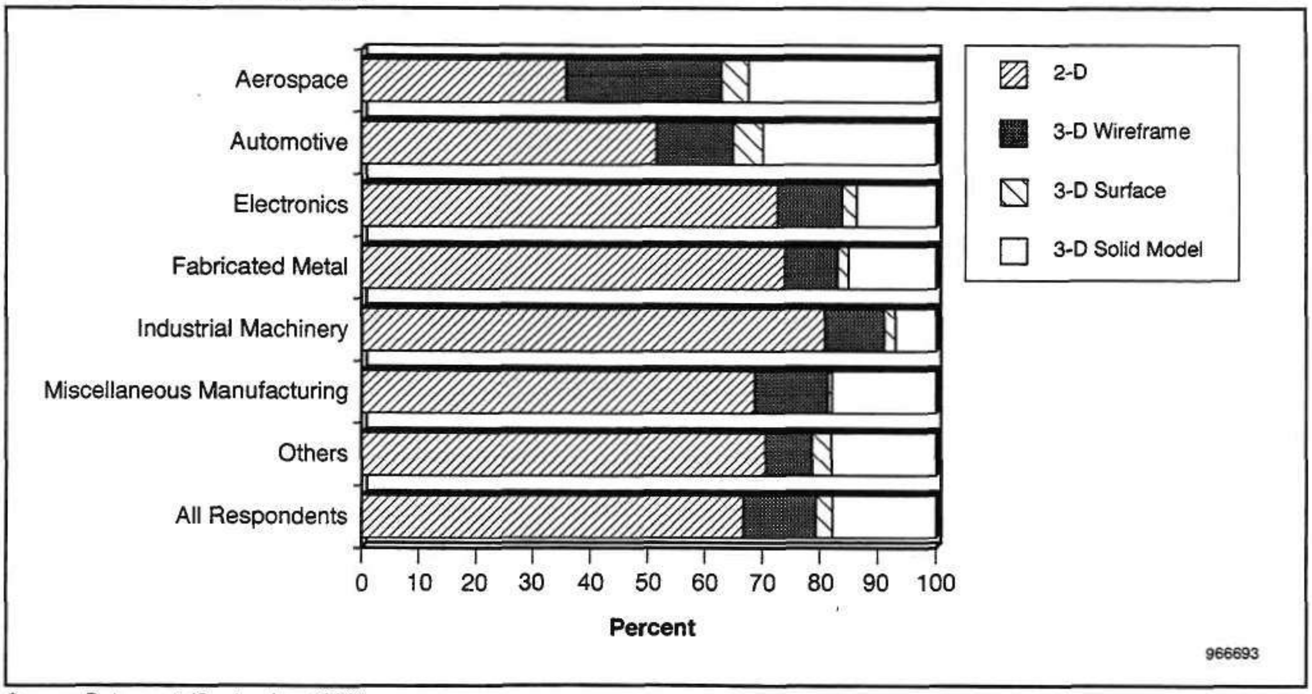
While our survey respondents are overwhelmingly storing files as 2-D files—67 percent of files—results vary greatly by industry. As expected, the automotive and aerospace industries show the highest percentage of files stored in 3-D solid models and also the highest percentage of 3-D surface files. Of course, not all industries have made the jump to 3-D data. As expected, respondents in industrial machinery and fabricated metal have the majority of their files stored as 2-D data. Clearly there is still plenty of opportunities for software vendors of 3-D CAD solutions to pursue.

Figure 3-7
Reasons Cited for Not Using 3-D by 1997



Source: Dataquest (September 1996)

Figure 3-8
Data Files Stored by Type



Source: Dataquest (September 1996)

Concurrent Engineering

Concurrent or simultaneous engineering is a concept that has been talked about for many years in engineering circles. We decided to investigate, from a user's perspective, if concurrent engineering was familiar. We asked respondents whether they were familiar with the concept of concurrent engineering; the results are displayed in Table 3-4. Forty-eight percent of respondents reported that their company uses concurrent engineering, and only 13 percent were not familiar with the concept (we left the term "uses" up to the interpretation of the survey respondent). The biggest "use" of concurrent engineering was in miscellaneous manufacturing, automotive, and aerospace. Automotive and aerospace users tend to be more advanced in their use of CAD and are often involved in large projects that encompass many groups of designers and lengthy design cycles—hence the need for concurrent engineering. At the other end of the spectrum, those users in fabricated metal tend to be designing discrete parts in smaller workgroups and the need for concurrent engineering principles here is undoubtedly less urgent. We expected to see a larger awareness of concurrent engineering in the electronics industry, as these users can also be involved in projects encompassing multiple disciplines (electronic and mechanical) and many groups of designers. Overall, however, awareness and/or use of concurrent engineering principles is high.

Table 3-4
Concurrent Engineering Use

	Yes, Our Company Uses Concurrent Engineering (%)	Familiar with Concurrent Engineering, But We Do Not Use It (%)	Not Familiar with Concurrent Engineering (%)
Aerospace	59	30	11
Automotive	63	33	4
Electronics	46	37	17
Fabricated Metal	31	44	25
Industrial Machinery	42	43	15
Miscellaneous Manufacturing	74	22	4
Others	34	58	8
All Respondents	48	39	13

Source: Dataquest (September 1996)

Chapter 4
The Designer's Work Environment

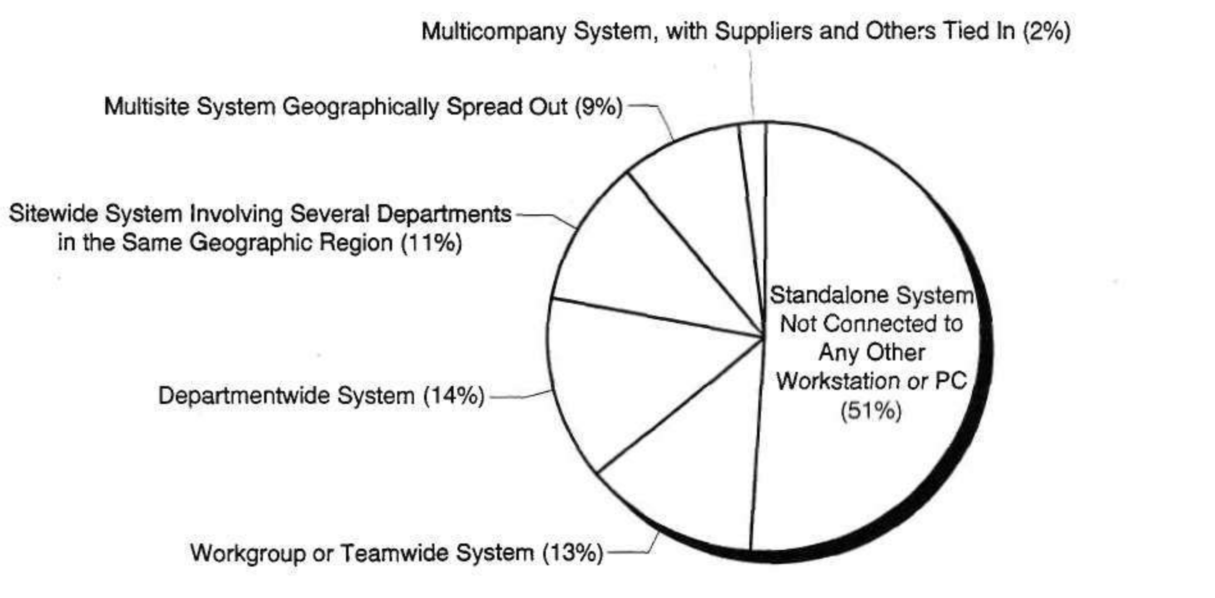
Level of System Operation

Respondents indicated a number of levels of CAD/CAM/CAE system operation. About one half of the survey respondents work on a standalone system not connected to any other PC or workstation; the other half work in a networked system (see Figure 4-1). Only 2 percent of respondents have employed a system that ties in the CAD system to suppliers and others outside of the organization or site. As expected, those respondents in sitewide, multisite, or multicompany system setups make up the majority of PDM system users. We will further discuss PDM systems in Chapter 6.

User Interest in Windows NT

Microsoft's NT operating system entered the CAD world with a big splash in 1994, and vendors and users alike have been trying to ascertain exactly what effect NT will have on the CAD/CAM/CAE market. It appears as if the North American mechanical design community is ready to embrace NT. Specifically, users are indicating that NT will take market share away from all operating systems, but in particular, DOS and Windows. We saw similar results in our European end-user survey of 1995, although less NT movement was expected in Europe, according to our survey sample at that time.

Figure 4-1
Level of System Operation



Source: Dataquest (September 1996)

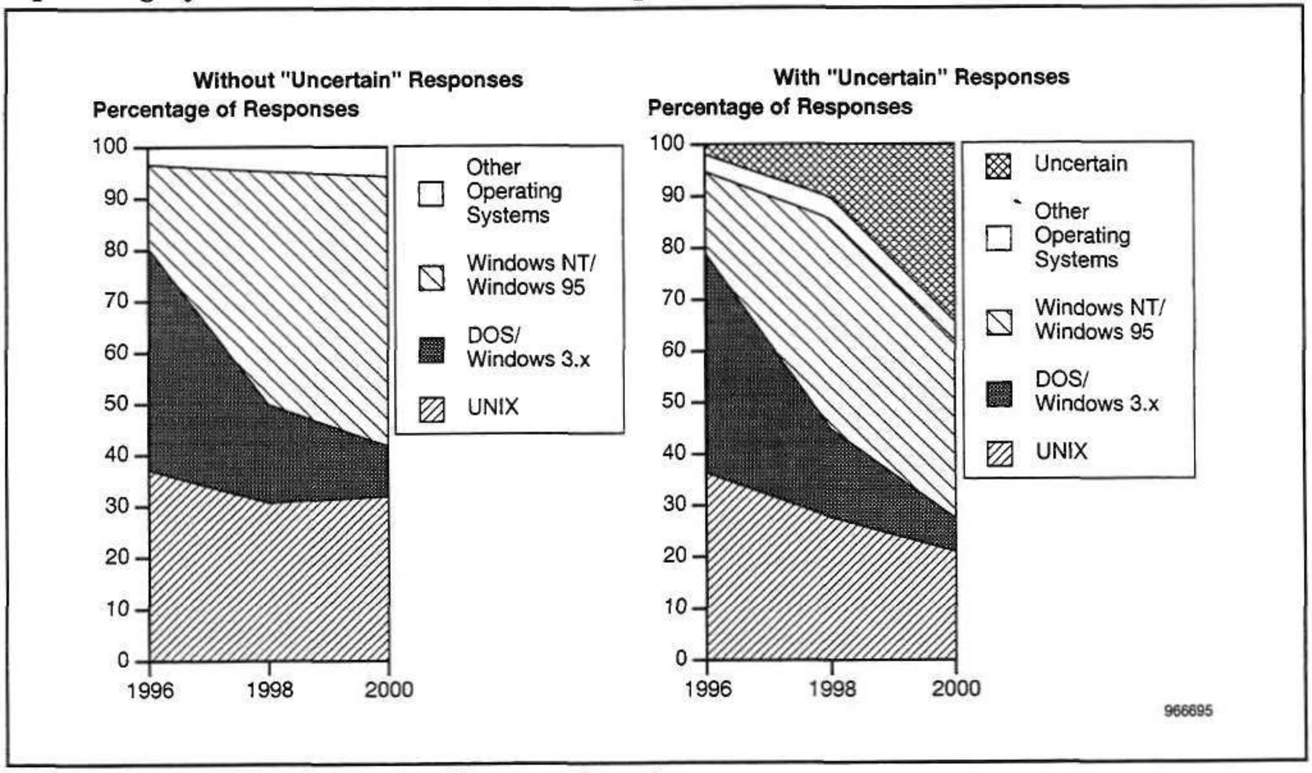
We asked North American users what operating system they use today and what they believe will be their dominant operating system in 1998 and in 2000. The results are shown in Figure 4-2, which compares the result when "do not know/uncertain" responses have been excluded, against when "uncertain" responses are included. Using the respondent sample without uncertain responses as our basis, DOS/Windows operating systems will shrink from 43 percent in 1996 to 10 percent by 2000. UNIX will lose some ground, going from 37 percent to 32 percent, and Windows NT/Windows 95 will gain a secure foothold in the mechanical CAD world, growing from 16 percent to 52 percent by 2000. However, when we include "do not know/uncertain" responses, we can see that there still is a large amount of uncertainty concerning the operating system of choice for many CAD users. This group of "uncertain" respondents, who are mostly UNIX users, could swing either way—they could migrate to Windows NT or stick with UNIX. It is exactly this group of users that will determine whether UNIX will ultimately survive—and prosper—in the mechanical CAD market. We will further explore user cited reasons for and against implementing the Windows NT operating system later in this chapter.

The overall numbers do not give the whole picture. It appears as though each industry will adopt the NT operating system at very different rates. We have illustrated some of these industry-level differences in Figure 4-3. The data in Figure 4-3 includes "uncertain" responses. The aerospace users will hold onto their UNIX installations. Movement to NT will be slower and at the expense of operating systems other than UNIX. This comes as no surprise, as aerospace sites tend to be larger sites that are well entrenched in UNIX and have the expertise and resources to maintain a UNIX-based system. Also, the aerospace industry relies heavily on applications for which vendors have not yet announced an NT solution. Automotive users are highly optimistic about their transition to NT, which comes as a bit of a surprise, as the automotive industry also relies heavily on applications for which vendors have not yet announced an NT solution. When looking at Figures 4-2 and 4-3, it is important to keep in mind these are responses from end users and are not a Dataquest forecast of mechanical CAD operating systems. Also, any drop from 1998 to 2000 in the percentage of users with NT as their main operating system in Figure 4-3 can be attributed to a change in the number of "uncertain" responses.

What Is Driving the NT Decision?

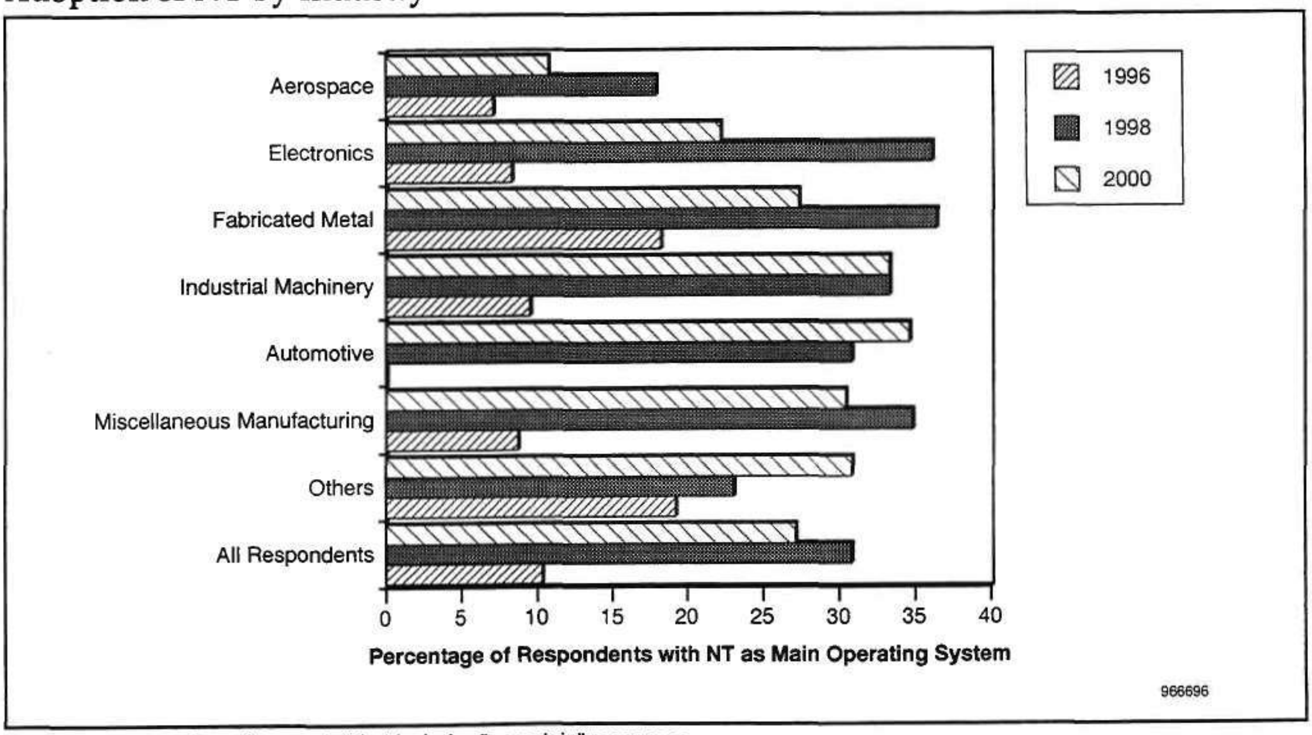
We asked respondents about their reasons, both for and against, moving to the NT operating system for their mechanical design work. The two top reasons to move to NT were NT-based CAD software functionality and the potential to combine business and engineering applications on the desktop (see Figure 4-4). However, the reasons to move to NT hinged greatly on whether or not the respondent was a current UNIX user or DOS/Windows user (see Figure 4-5). The two categories of users have widely differing viewpoints of the benefits of NT. Here, current UNIX users cited software costs as the top reason, closely followed by hardware costs and the potential to combine applications on one desktop.

Figure 4-2
Operating Systems of the Future, User Responses



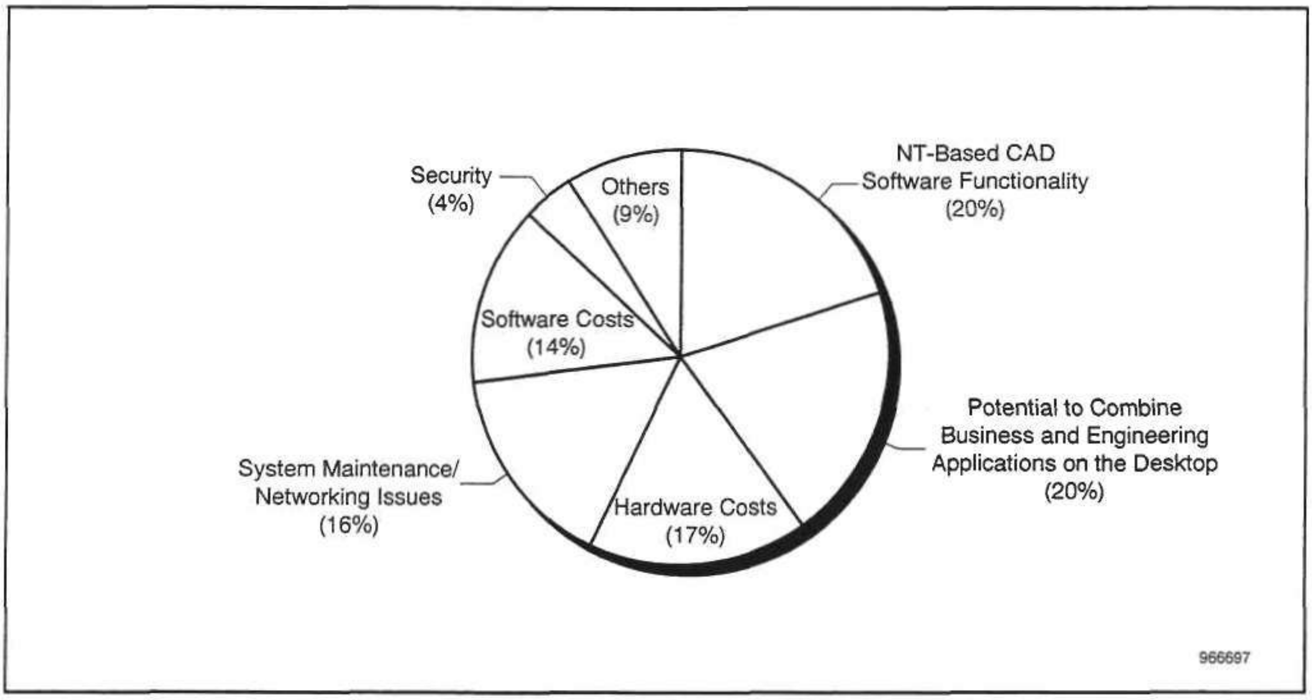
Note: "Others" category comprises mostly mainframe operating systems.
Source: Dataquest (September 1996)

Figure 4-3
Adoption of NT by Industry



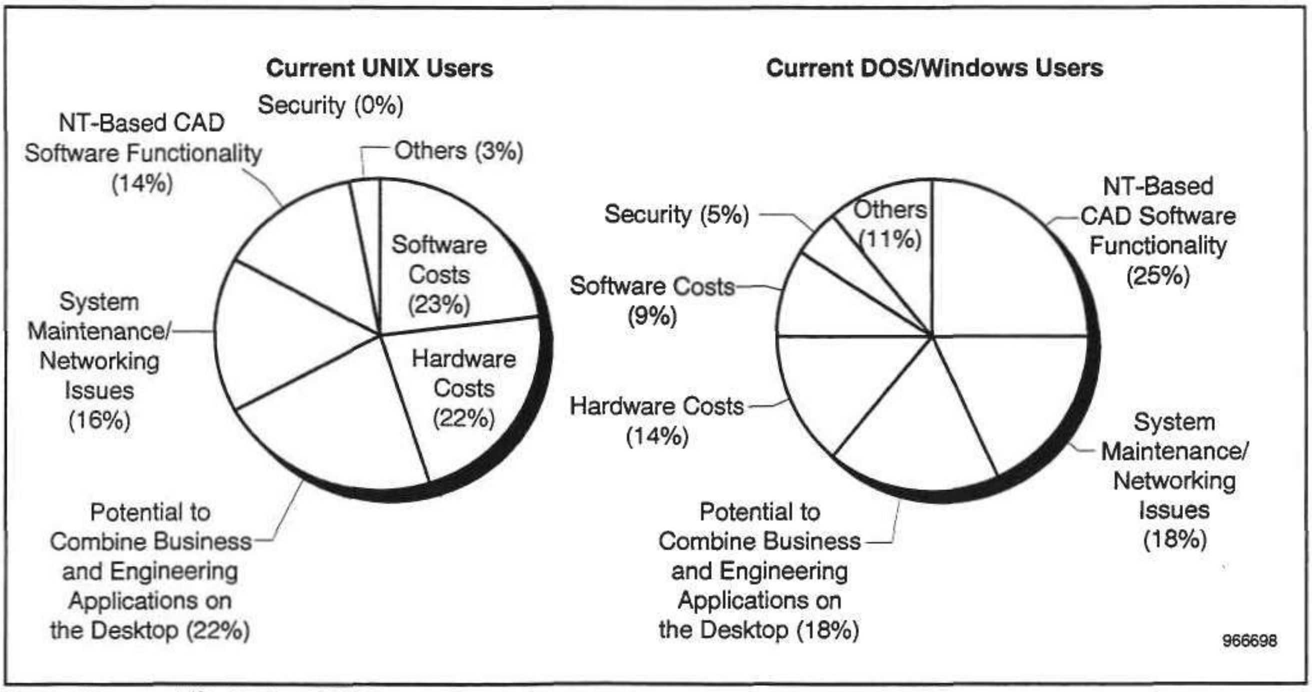
Note: Percentages based on a total that includes "uncertain" responses.
Source: Dataquest (September 1996)

Figure 4-4
Reasons to Move to NT



Source: Dataquest (September 1996)

Figure 4-5
Reasons to Move to NT, UNIX and Windows/DOS Users



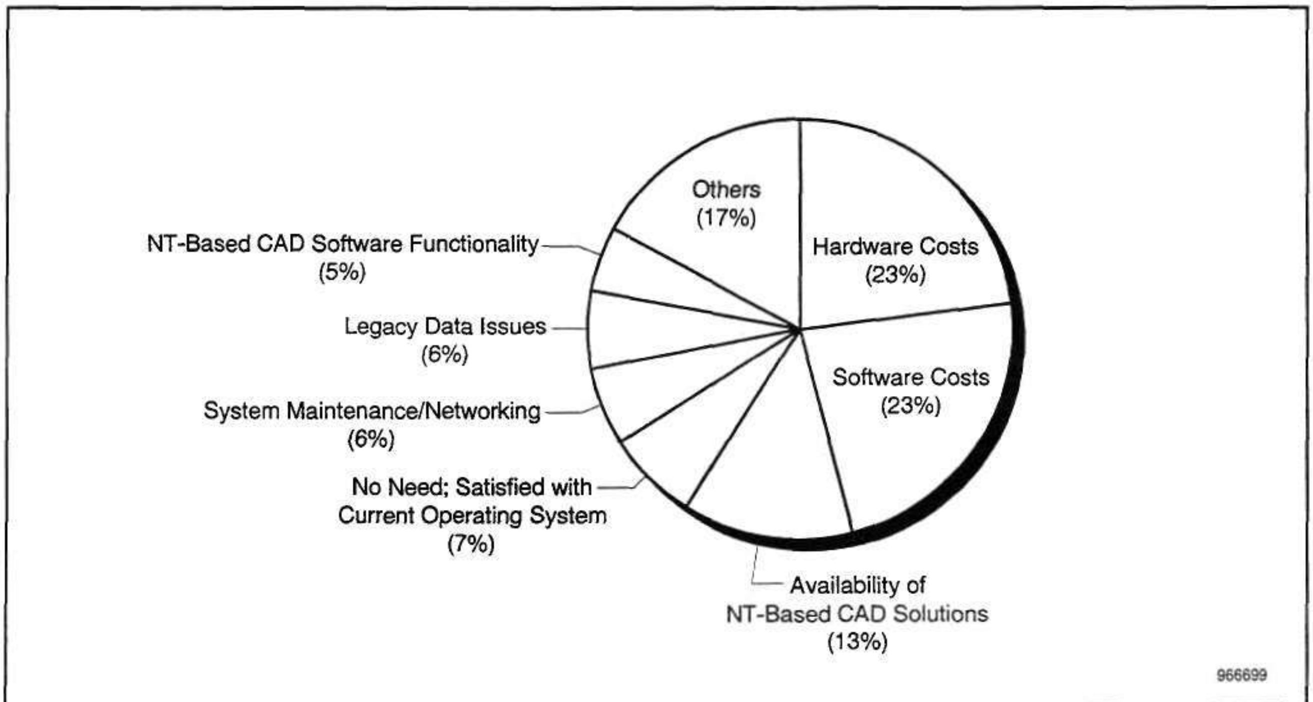
Source: Dataquest (September 1996)

We also investigated the reasons users did not expect to adopt NT as their primary operating system. Here, costs were an overriding issue, whether it was hardware or software costs (see Figure 4-6). Surprisingly, legacy data issues did not rank high among the reasons not to move to NT, even among current UNIX users (see Figure 4-7). Dataquest has always felt that legacy data would be one drawback for users to switch CAD systems and hardware—the data in this survey shows otherwise. The "others" responses in Figure 4-7 consisted of a wide range of responses, from the "power of UNIX" to corporate edicts to use another operating system.

CAD/CAM/CAE Seats Increasing

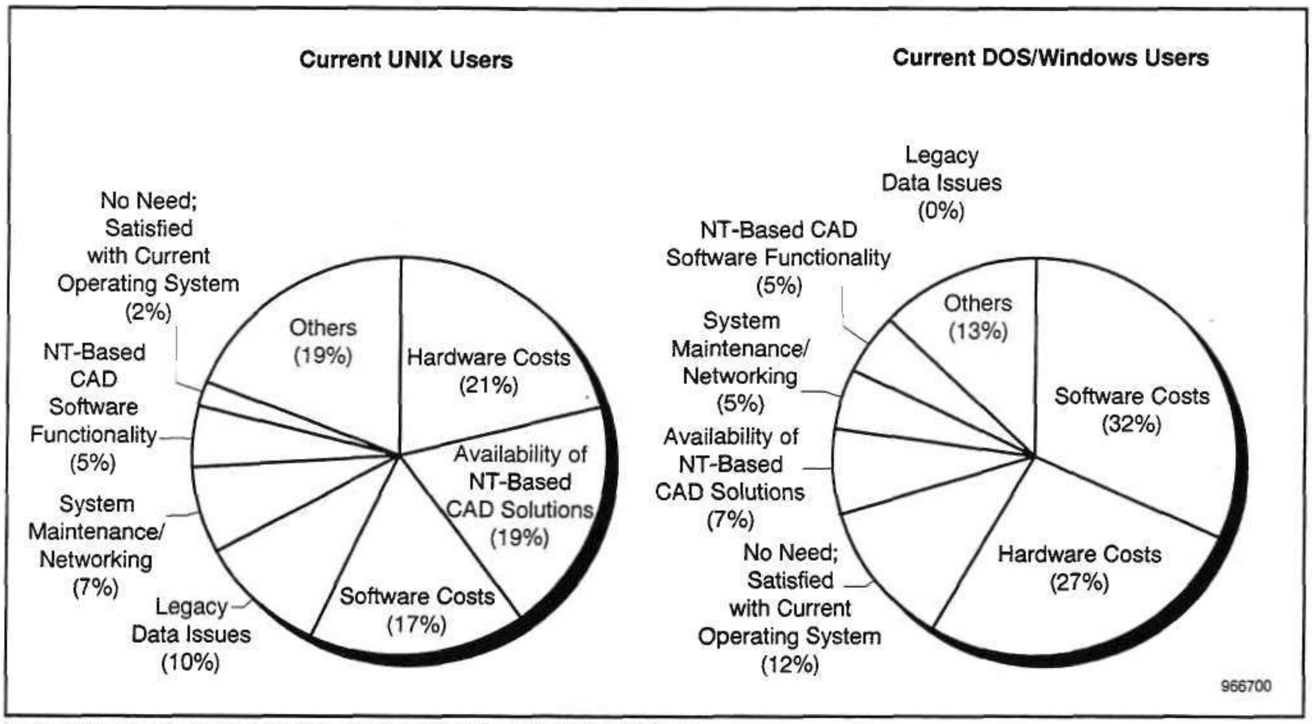
Users, on the whole, are expecting CAD/CAM/CAE seats to increase or remain the same from 1996 to 1998, with little variation by industry, as shown in Figure 4-8. The number of respondents expecting an increased seat count is high (as high as 75 percent of electronics respondents), indicating a pent-up demand for more CAD seats within an organization. The percentage change of anticipated seat count increases ranged from 26 percent in industrial machinery to 34 percent in aerospace, with the average overall responses being 27 percent increase. Responses for the amount of change in seat count decrease were too few to analyze.

Figure 4-6
Reasons to Not Move to NT



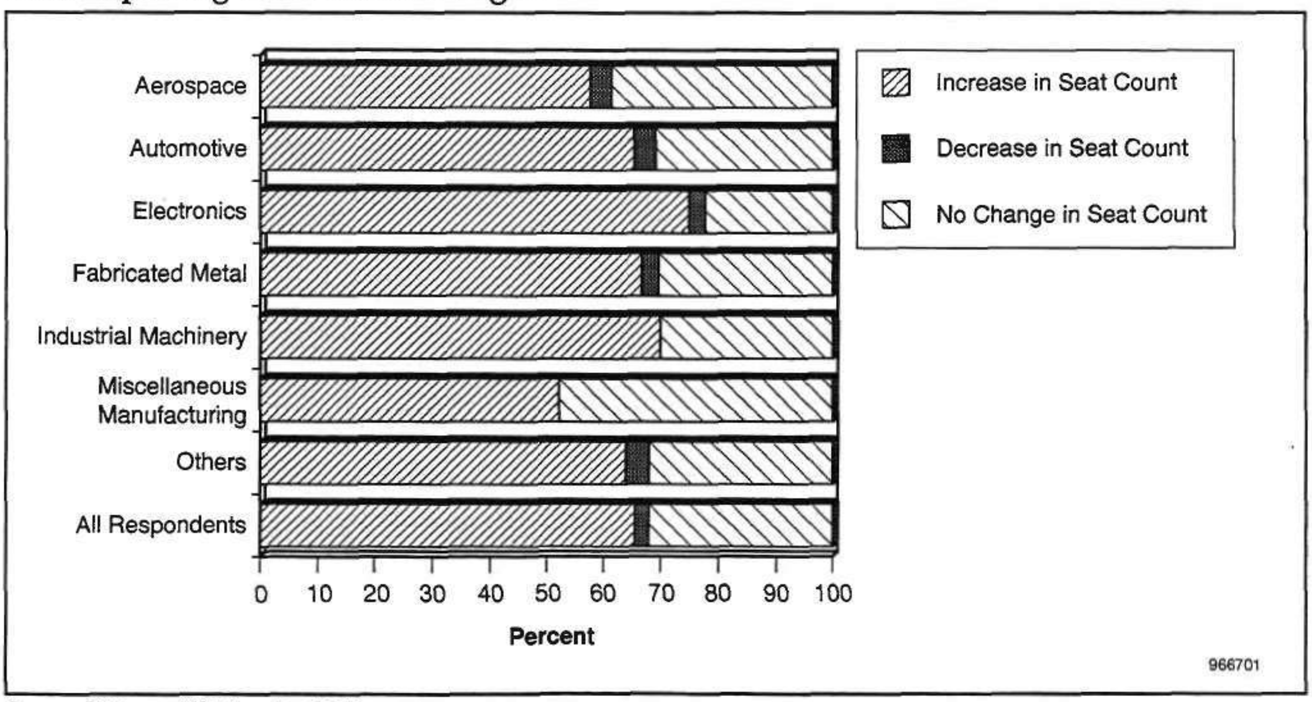
Note: "Others" category comprises mostly mainframe operating systems.
Source: Dataquest (September 1996)

Figure 4-7
Reasons to Not Move to NT, UNIX and Windows/DOS Users



Note: "Others" category comprises mostly mainframe operating systems.
Source: Dataquest (September 1996)

Figure 4-8
Sites Expecting Seat Count Changes

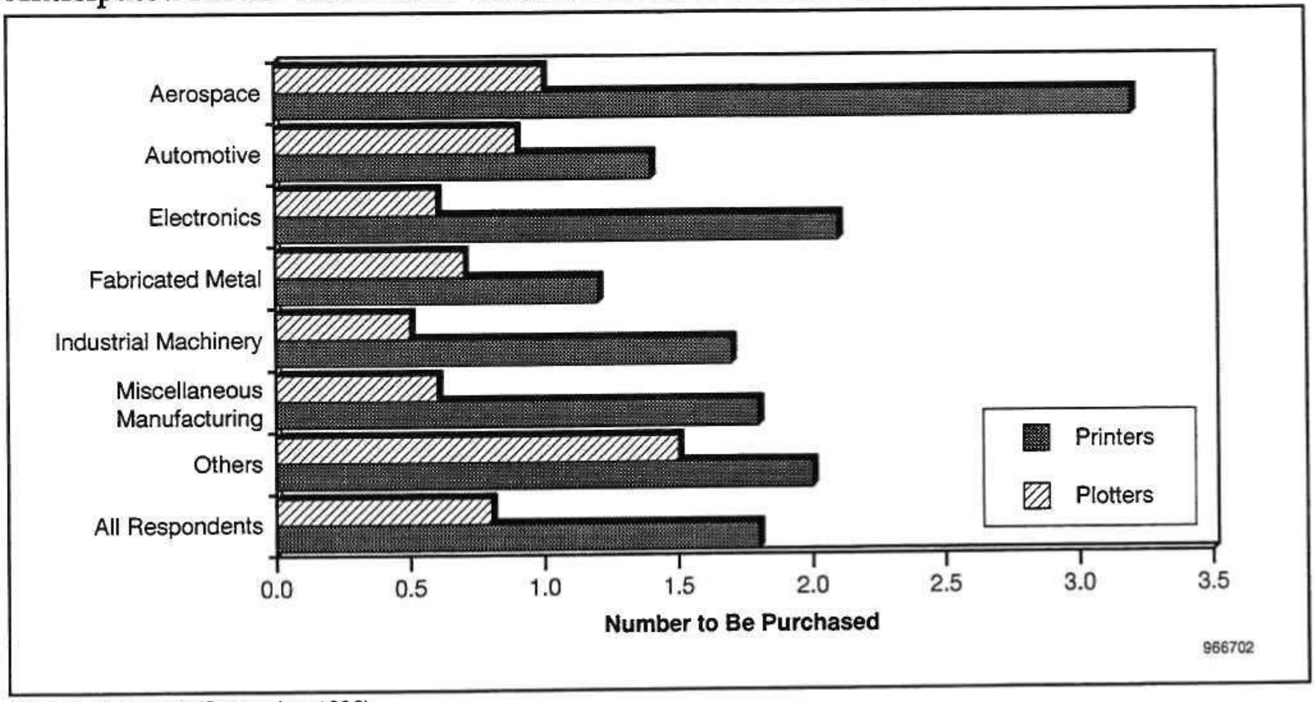


Source: Dataquest (September 1996)

Plotters and Printers

Any increase in the number of CAD/CAM/CAE seats leads to a corresponding increase of peripherals such as printers and plotters. Users in our survey plan to purchase, on average, one plotter and two printers over the next two years (see Figure 4-9). As a point of reference, we have included a summary of users' current plotter technology in Table 4-1. Laser plotters were the most frequently mentioned, followed by ink jet and pen plotters.

Figure 4-9
Anticipated Plotter and Printer Purchases over Next Two Years



Source: Dataquest (September 1996)

Table 4-1
Plotter Technology

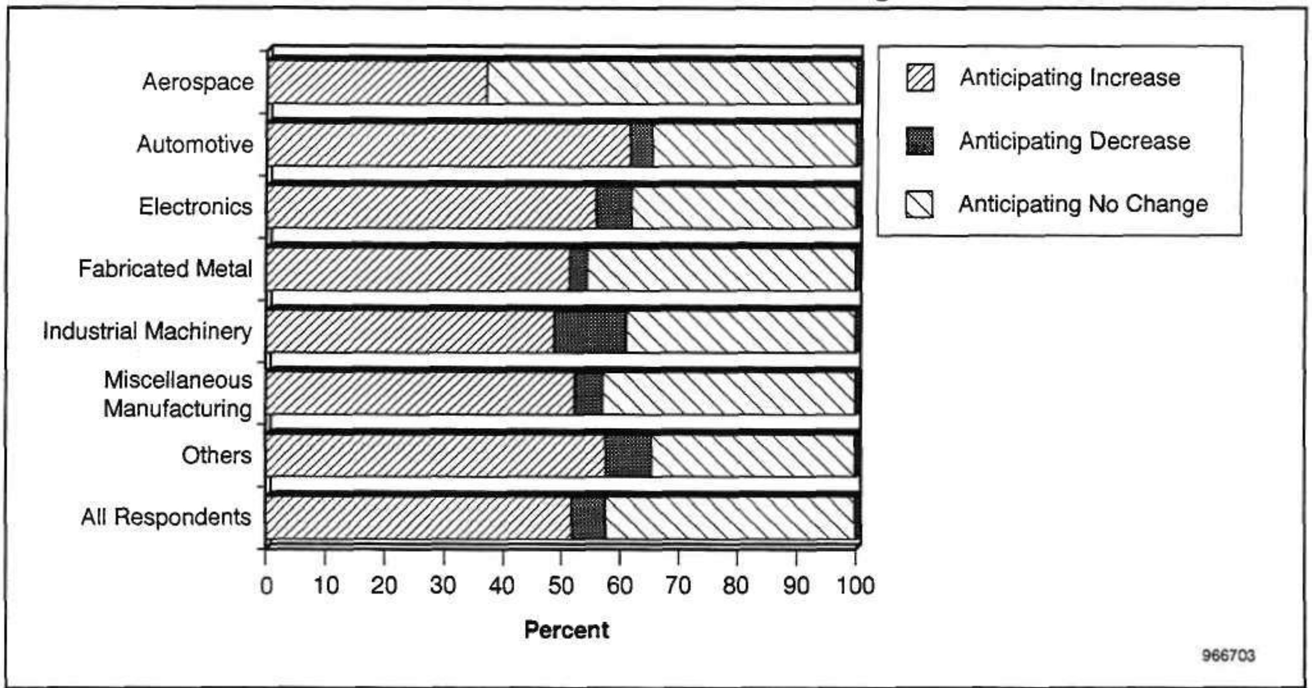
Plotter Type	Number of Responses (N = 363)
Laser	86
Ink Jet	83
Pen	83
Electrostatic	44
Color Ink Jet	26
Thermal	26
Others	15

Note: Multiple responses allowed
Source: Dataquest (September 1996)

Software Spending—Which Areas Will Grow?

Users are looking to buy new CAD software modules at a rate we haven't seen in the last two years. As seen in Figure 4-10, 52 percent of survey respondents indicate that software spending will increase from 1996 levels. More respondents in automotive than in any other industry are expecting an increase in software budgets for 1997. Some of this increased software spending is a reflection of the expected future transition toward NT-based CAD/CAM/CAE software in all of the industries.

Figure 4-10
Mechanical CAD/CAM/CAE Software Purchase Plan Changes for 1997



Source: Dataquest (September 1996)

A look at planned software retirements sheds further light on the software spending issue, because fewer retirements affect the capacity to absorb new software. Table 4-2 shows what percent of existing mechanical CAD/CAM/CAE software modules users expect to retire over the next two years. The automotive industry expects to retire 26 percent of its CAD software, well above the overall average of 10 percent.

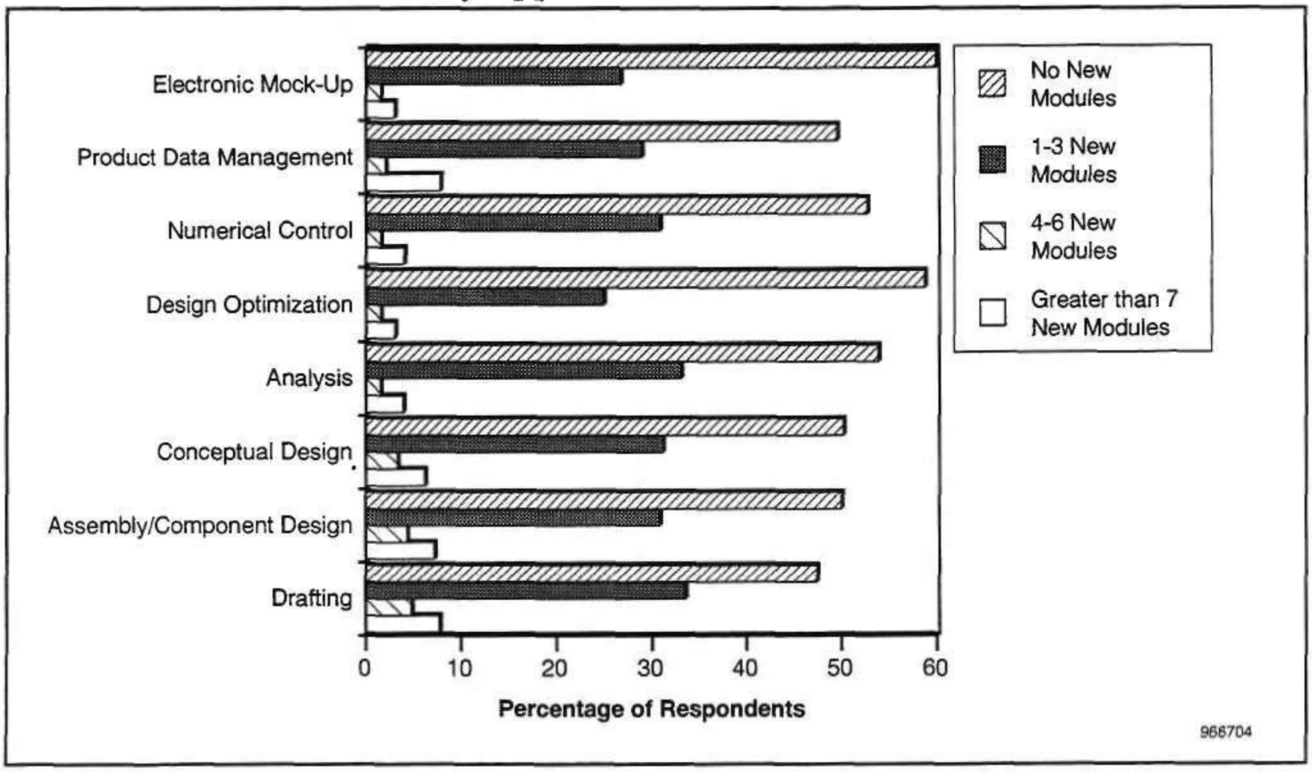
We asked users to identify what CAD/CAM/CAE applications they are planning to purchase in the next two years. The results are given in Figure 4-11. Most new module purchases will come from PDM and surprisingly, drafting. Of those users planning to purchase PDM software, nearly 8 percent indicate that they intend to purchase seven or more modules, greater than the average for all other CAD/CAM/CAE modules. Conceptual design and assembly/component design also look more promising than other areas. The planned purchase of drafting modules comes as a big surprise, as there have not been many new innovations or drastic technology changes in drafting. We believe these high numbers are, once again, partly a result of users looking to move to NT.

Table 4-2
Mechanical CAD/CAM/CAE Software Retirements

Industry	Software Retirements (%)
Aerospace	6
Automotive	26
Electronics	8
Fabricated Metal	13
Industrial Machinery	4
Miscellaneous Manufacturing	15
Others	2
All Respondents	10

Source: Dataquest (September 1996)

Figure 4-11
New Module Purchase Plans by Application over Next Two Years

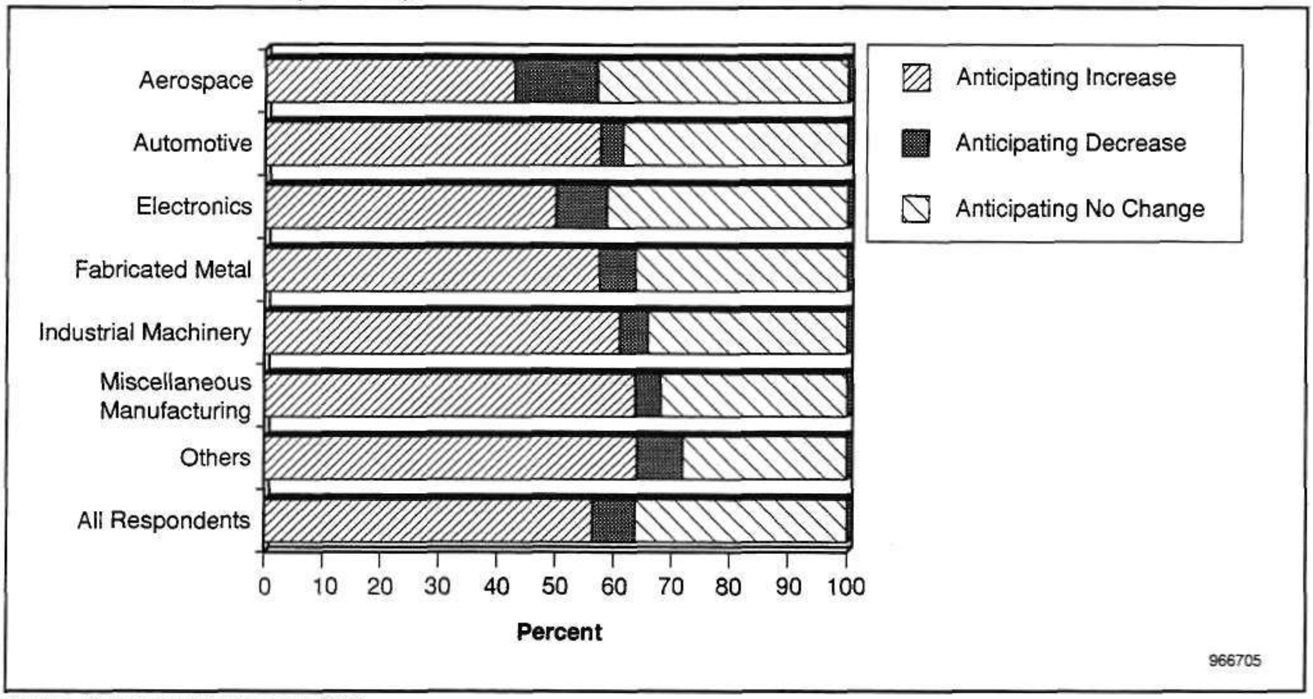


Source: Dataquest (September 1996)

Future Hardware Purchase Plans

Hardware spending plans for 1997 will be primarily a mix of increased spending or no change in spending from 1996 levels. Here, hardware implies computers (for example, PCs, workstations, and mainframes) as well as related peripherals (for example, plotters, printers, and terminals). Planned hardware spending changes for 1997 are illustrated in Figure 4-12. Only 7 percent of all respondents are expecting decreases in hardware spending, with aerospace expecting a 14 percent drop.

Figure 4-12
Hardware Spending Changes for 1997



Source: Dataquest (September 1996)

It is unusual for users to anticipate spending increases in both software and hardware. Typically, one takes precedence over the other. We expect that, over the next few years, CAD users in North America will be seriously re-evaluating their existing CAD/CAM/CAE systems, with careful consideration given to the new operating systems available and how much value/functionality they can get out of their software for the money they spend on it. Also, as we saw earlier in Chapter 3, there are many 2-D sites in this group of survey respondents—and 40 percent of those 2-D users are planning the move to 3-D design. Accompanying this move will be a greater demand for increased memory and graphics capabilities.

Maintenance, Consultants, and Software Development

As we have seen, more than one-half of all respondents are expecting increased hardware and software budgets next year. On the other hand, the sites expecting service spending increases are much less. We asked users about their plans for spending on several aspects of service, ranging from maintenance to software application development to consultants and systems integrators. The results are summarized in Table 4-3. If the results in this table are any indication, the future looks stable (but not growing wildly) for consultants/systems integrators. It looks even better for those involved in CAD/CAM/CAE system maintenance and better still for application developers.

The planned increases in spending for maintenance are expected. As users add more computers, networks, and software to their CAD/CAM/CAE systems, maintenance and related service costs will undoubtedly increase. Looking to the future, as the goal of object-oriented CAD software, objects, and new architectures become market realities, we expect application development budgets to rise accordingly.

Table 4-3
Service Spending Changes for 1997

	Maintenance			Consultants/Systems Integrators			Application Development		
Industry	Increase (%)	Decrease (%)	No Change (%)	Increase (%)	Decrease (%)	No Change (%)	Increase (%)	Decrease (%)	No Change (%)
Aerospace	29	7	64	14	7	79	34	7	59
Automotive	42	8	50	44	4	52	57	0	43
Electronics	26	3	71	43	0	57	39	0	61
Fabricated Metal	33	9	58	16	3	81	35	3	62
Industrial Machinery	32	5	63	23	5	72	47	0	53
Miscellaneous Manufacturing	30	5	65	20	0	80	30	0	70
Others	50	4	46	33	4	63	58	4	38
All Respondents	34	6	60	27	4	69	43	2	55

Source: Dataquest (September 1996)

Chapter 5
Mechanical Applications Perceptions

This chapter reveals what designers think of the mechanical applications they use—what benefits they have seen, what software functionality and characteristics they seek, and what influences their purchasing decisions. In delving into these issues, we asked users a series of questions based on their satisfaction with the mechanical applications themselves (for example, analysis and assembly design), with specific design-related tools and technologies (for example, photorealistic imaging and 3-D graphics), and with a "wish list" of items (for example, application stability and ease of use). The results are explored in the following sections.

Is CAD/CAM/CAE Technology Helping to Meet Business Goals?

Many factors can affect whether a company or business in discrete manufacturing succeeds or fails, and CAD/CAM/CAE technology is just one of them. While CAD technology has promised many things to many people, we decided to investigate just what users think about how well CAD technology is deployed in a company. Our thought is that those companies who have had more success in deploying CAD technology are better able to make the connection between CAD investment—dollars spent—and meeting business objectives—profits returned.

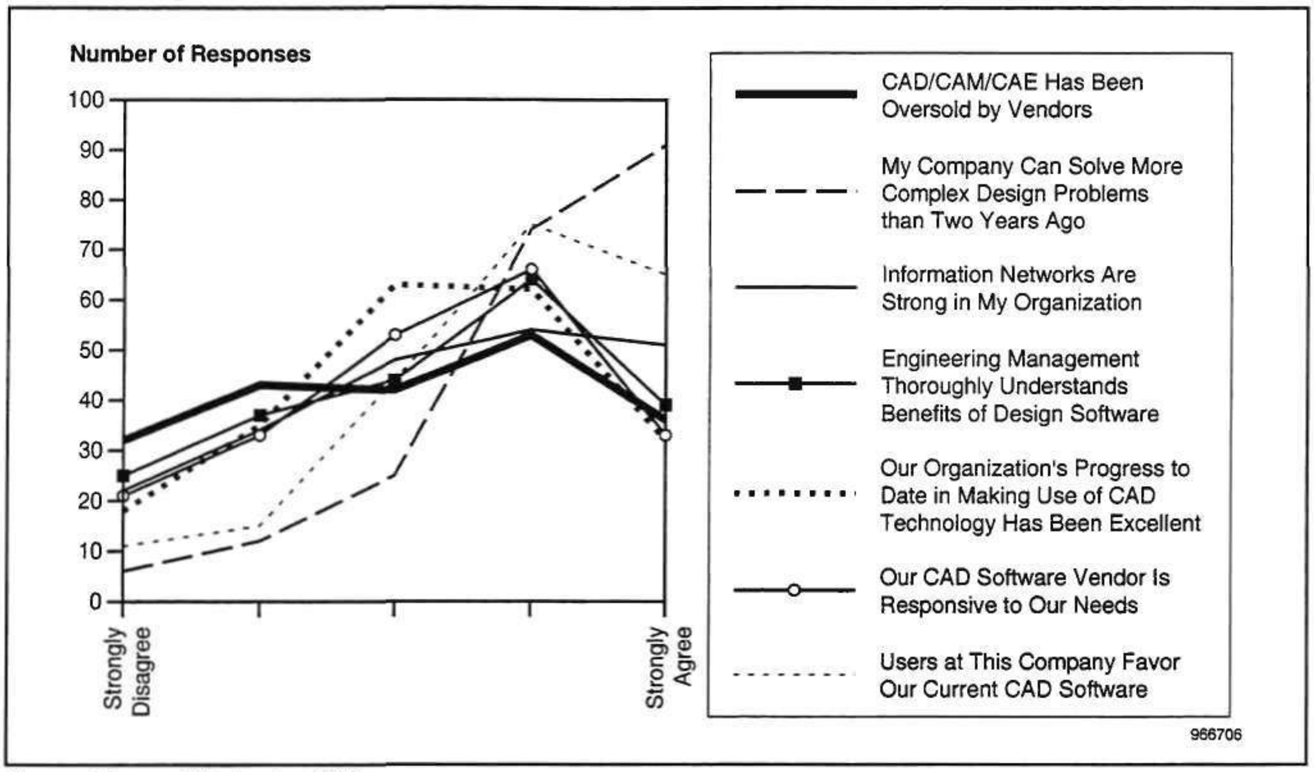
We asked respondents to what level they agree or disagree with a series of general statements concerning CAD/CAM/CAE, its role in the company, and its benefits—not just to engineering design but to the company's overall business processes. Overall, respondents in this survey appear to be fairly happy when they view their CAD/CAM/CAE systems with respect to their company's business goals—a change from previous surveys of other users around the world. The results are displayed in Figure 5-1 and Figure 5-2. Most respondents strongly agreed that CAD/CAM/CAE has helped their companies solve more complex design problems, and many users agreed with the statement that "users at this company favor our current CAD software." The widest range of responses was seen when users responded to the statement "CAD/CAM/CAE has been oversold by vendors."

Product Development Delays

Previous end-user surveys have indicated that development times are getting shorter and organizations are under continual pressure to bring products to market faster. Bringing products to market just doesn't concern engineering activities. Instead, it is a much broader issue that reflects greatly on the communication networks within a company, how well the company understands its processes, and how quickly it can react when interdepartmental "breakdowns" occur.

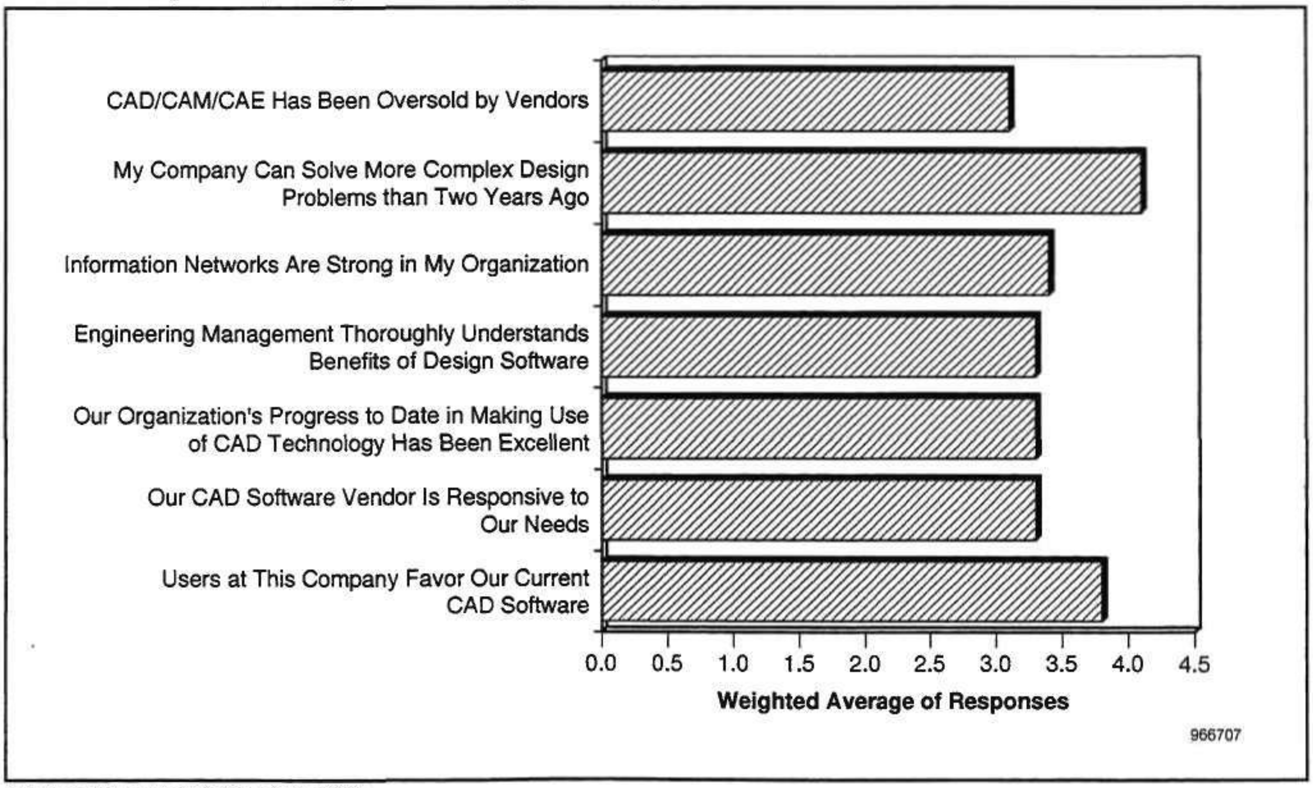
We investigated some of the typical causes cited for product delays, ranging from research and development issues to marketing/sales logistics. The results are summarized in Figure 5-3 and Figure 5-4. Respondents, on the whole, felt that research and development taking longer than expected, customers changing specifications, and supplier delays were the biggest reasons for products failing to meet time-to-market demands.

Figure 5-1
CAD Perceptions



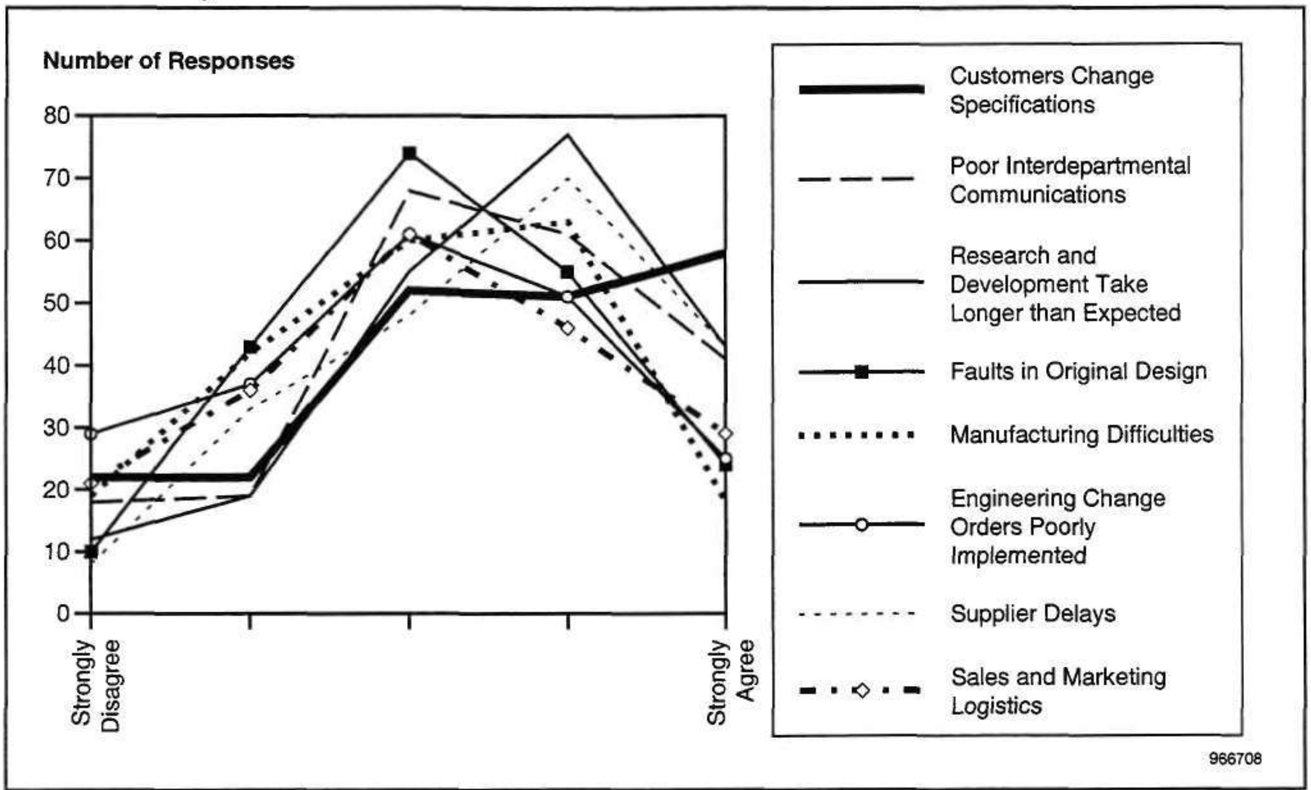
Source: Dataquest (September 1996)

Figure 5-2
CAD Perceptions, Weighted Average of Responses



Source: Dataquest (September 1996)

Figure 5-3
Product Delays



Source: Dataquest (September 1996)

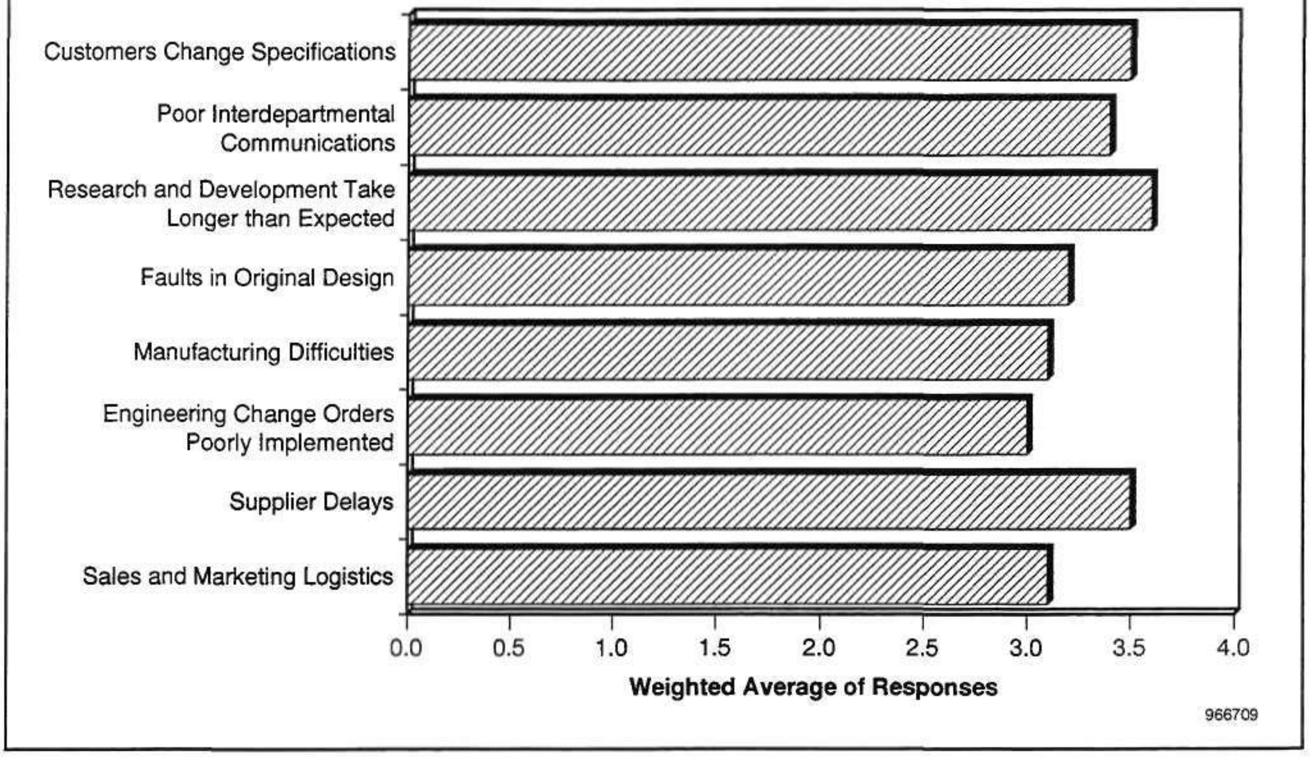
Respondents tended to be more neutral toward the statements that engineering change orders and manufacturing difficulties cause delays in bringing a product to market. It is interesting to note that the weighted average of responses for each of the product delay factors we investigated seemed to cluster around the "neutral" rating. Users are acknowledging that product delays can really stem from anywhere in the art-to-product-to-customer chain.

Mechanical CAD/CAM/CAE Applications—What Users Think

We asked designers to rate their CAD/CAM/CAE applications with respect to importance and satisfaction on a scale of 1 (not important or not satisfied) to 5 (very important or very satisfied). These applications were as follows:

- Detailing
- Component design
- Assembly design
- Conceptual design
- Analysis
- Manufacturing applications
- Product data management
- Data exchange and translation

Figure 5-4
Product Delays, Weighted Average of Responses

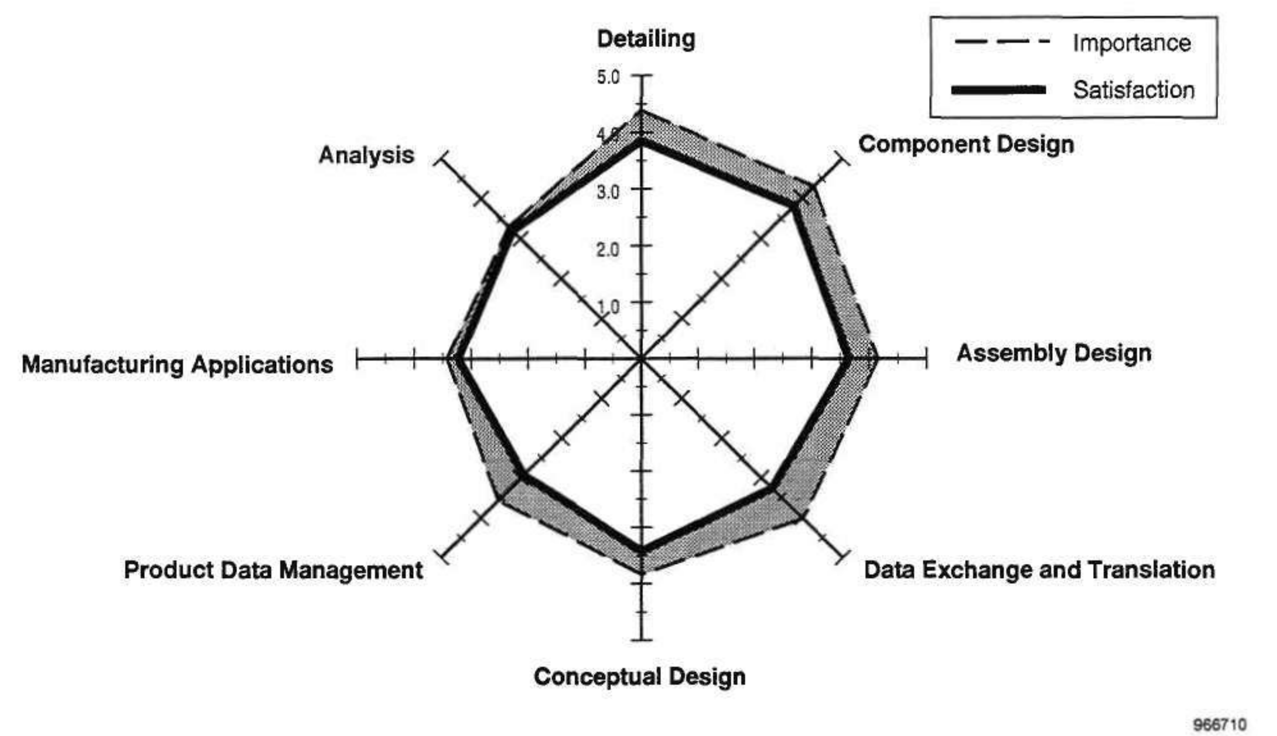


Source: Dataquest (September 1996)

Figure 5-5 provides a visual interpretation of these user importance and satisfaction ratings. The most important characteristic according to user rankings—detailing—is plotted on a 1-to-5 scale at the top of the chart, and the other applications (for example, component design, assembly design), are plotted in a counterclockwise manner about the axes in order of decreasing importance. The satisfaction rating for each application is mapped along the same axes as its corresponding importance rating. The gap, or difference, between the importance and satisfaction ratings for each application is indicated in Figure 5-5 by gray shading, exposing the areas that need vendor attention and improvements. In an ideal situation, importance and satisfaction ratings would be equal, and no gray area would appear in Figure 5-5 because the two circles would coincide. However, when the two circles do not coincide at every point, users are not as happy as they could be.

The numerical values of the gaps are given in Table 5-1. While most of the gaps in Table 5-1 are not large, there are clearly some unmet needs out there. Once again, we see the importance of data translation software to designers and engineers. This application was ranked high in importance by survey respondents, but this same group of people is very unsatisfied—a negative 0.76 gap—with the translation products they use. This is clearly one area that has always demanded vendor attention.

Figure 5-5
Importance/Satisfaction Gap Analysis of Mechanical Applications



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

Table 5-1
Importance/Satisfaction Gap Analysis of Mechanical Applications

	Importance	Satisfaction	Gap
Detailing	4.39	3.85	-0.54
Component Design	4.30	3.81	-0.50
Assembly Design	4.16	3.65	-0.51
Data Exchange and Translation	4.03	3.27	-0.76
Conceptual Design	3.84	3.43	-0.41
Product Data Management	3.57	2.93	-0.64
Manufacturing Applications	3.43	3.23	-0.19
Analysis	3.30	3.20	-0.10

Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

The high importance ranking given to detailing underscores the importance in mechanical design of this very basic application. In comparison to other applications, the gap here, negative 0.54, is not large. Software vendors could better spend their efforts focusing on other user-perceived problems, as we shall see later in this chapter.

Surprisingly, product data management did not rank high in importance among these North American survey respondents; we saw similar results in Europe last year. It is true that PDM did not really begin taking off until late 1994 or early 1995, and the PDM market is still in its infancy. But, just because PDM is not ranked high in importance does not mean that users are satisfied with what PDM solutions they have. On the contrary, the satisfaction rating for PDM was the lowest among all of the mechanical applications.

Design-Related Tools and Technologies—What Users Want

Getting a product to market isn't just about CAD software and design, but it is also about how CAD and related tools are used together. A host of tools and technologies are on the market today—such as videoconferencing and 3-D graphics cards—that are targeted at making the lives of designers easier.

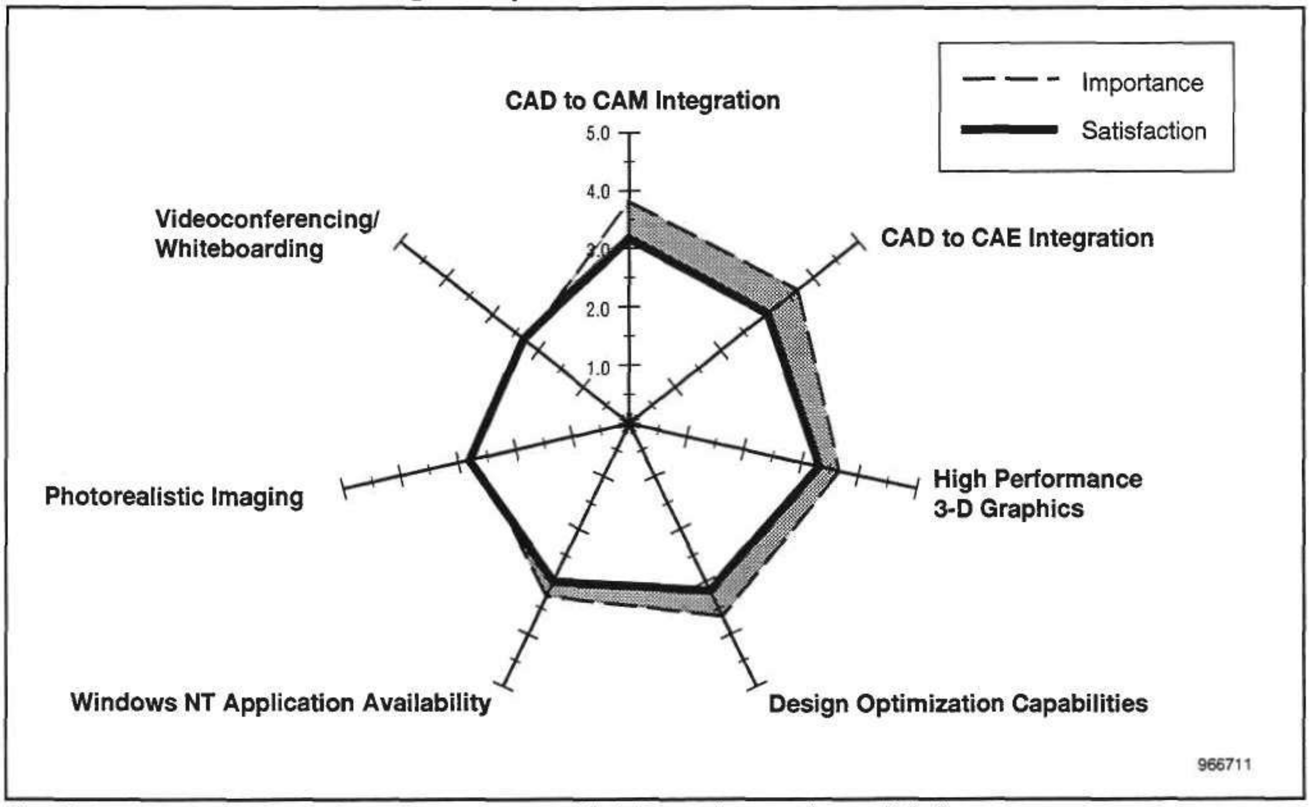
We asked users to rate the following CAD-related tools and technologies with respect to importance and satisfaction on a scale of 1 (not important/not satisfied) to 5 (very important/very satisfied):

- High-performance 3-D graphics
- Design optimization capabilities
- Photorealistic imaging
- NT platform availability
- Videoconferencing/whiteboarding
- CAD to CAM integration
- CAD to CAE integration

Figure 5-6 and Table 5-2 outline user ratings for the items listed above. To no surprise, integration of CAD with both CAM and CAE ranked high in importance and also showed the biggest importance-satisfaction gaps. The user-perceived dissatisfaction with CAD to CAM and CAD to CAE integration is consistent with what we saw earlier concerning data exchange and translation.

3-D graphics remains important to the end users, but their satisfaction with graphics is fairly high. As companies take on more complex design problems and become more entrenched in 3-D design, it is natural that graphics will become more of an important factor in influencing purchasing decisions. We can say the same for design optimization capabilities—as users begin to use more analysis and CAE tools in conjunction with CAD tools, the importance rating for optimization will rise.

Figure 5-6
Importance/Satisfaction Gap Analysis of CAD Features



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

Table 5-2
Importance/Satisfaction Gap Analysis of CAD Features

	Importance	Satisfaction	Gap
CAD to CAM Integration	3.81	3.17	-0.64
CAD to CAE Integration	3.67	3.02	-0.64
High-Performance 3-D Graphics	3.67	3.31	-0.36
Design Optimization Capabilities	3.66	3.17	-0.50
Windows NT Application Availability	3.28	3.00	-0.28
Photorealistic Imaging	2.68	2.81	0.13
Videoconferencing/Whiteboarding	2.25	2.32	0.07

Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

It is interesting to see that respondents in our survey do not rank highly the importance of having NT-based applications available. Yet, nearly one-third of our survey respondents plan to move to NT by 1998 or certainly by 2000. One possible explanation is that users are more concerned about the immediate issues facing them, rather than issues that are two or even four years out.

As we have seen in previous surveys, videoconferencing/whiteboarding solutions fall to the bottom of the list in importance. We have seen this happen both in Japan and in previous European/North American end-user surveys. While this technology could definitely be a catalyst for concurrent engineering, something—technology or marketing—is still missing. The interest we are seeing in the Internet, intranets, and product data management could be the right ingredient to propel forward the idea of videoconferencing/whiteboarding—although the ultimate solution may take on a very different form.

A Wish List of Software Characteristics

When we talk about CAD/CAM/CAE solutions, we can look at user rated importance and satisfaction from one of two angles. The first one is concerned with technical aspects of the design tools, software functionality, and CAD-related technologies. We explored these areas earlier in this chapter. The other piece is concerned with overall satisfaction with CAD/CAM/CAE solutions—such as software stability and vendor service.

We created a "wish list" of items and asked users to rate the importance and satisfaction of the following 10 characteristics relevant to any mechanical application:

- Software has advanced features and functionality.
- Software is easy to learn and use.
- Software is bug free and stable.
- Software is compatible with current environment.
- Software performs complex or compute-intensive tasks well.
- Software is easy to customize.
- Software has a low cost per seat.
- Applications and modules are tightly integrated.
- Vendor is flexible in its licensing policies.
- Vendor is responsive to our needs.

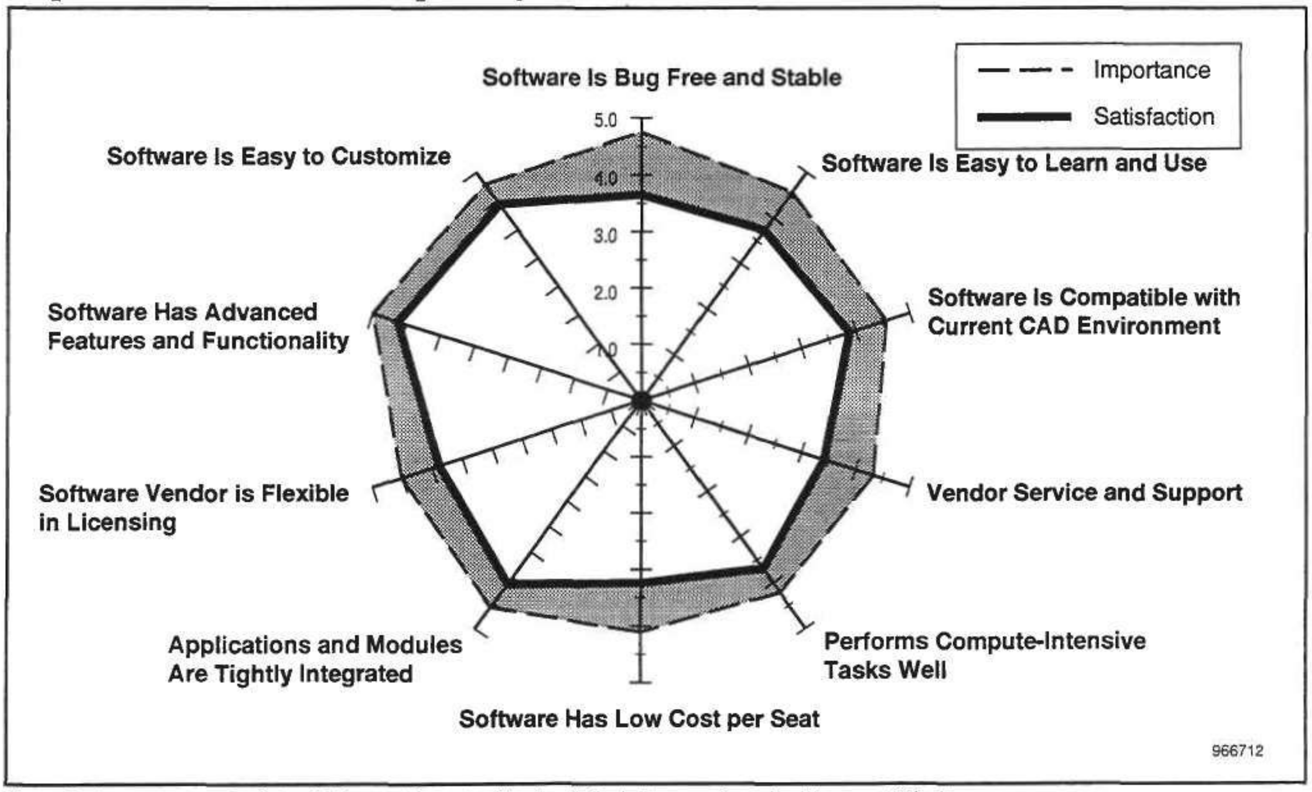
It is with this "wish list" that we see where the real dissatisfaction with CAD/CAM/CAE solutions lies among end users. Nearly every item on the list was ranked with an importance rating of 4.0 or higher (see Table 5-3). All of the issues on the "wish list" factor into a company's decision to purchase CAD/CAM/CAE tools, and vendors could choose to address any one of these issues, as all of the gaps are large (see Figure 5-7). We will discuss only some of these issues in the following section.

Table 5-3
Importance/Satisfaction Gap Analysis of Software Characteristics

	Importance	Satisfaction	Gap
Software Is Bug Free and Stable	4.75	3.65	-1.09
Software Is Easy to Learn and Use	4.57	3.73	-0.84
Software Is Compatible with Current CAD Environment	4.57	3.89	-0.68
Vendor Service and Support	4.33	3.42	-0.91
Software Performs Compute-Intensive Tasks Well	4.22	3.70	-0.51
Software Has Low Cost per Seat	4.11	3.24	-0.86
Applications and Modules Are Tightly Integrated	4.09	3.63	-0.46
Software Vendor Is Flexible in Licensing	4.01	3.38	-0.63
Software Has Advanced Features and Functionality	4.00	3.62	-0.38
Software Is Easy to Customize	3.79	3.44	-0.35

Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

Figure 5-7
Importance/Satisfaction Gap Analysis of Software Characteristics



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

Topping the list in importance was the request for software that is bug free and stable. The gap here is quite large—negative 1.1. Software stability has always been an issue with the mechanical design community and can sometimes be an impediment to the adoption of new technologies and methodologies. It also comes as no surprise that the importance-satisfaction gap for vendor service and support is similarly large.

Software that is easy to learn and use is also important to the design community. Engineers are always facing time-to-market pressures, and they have little time to spend learning new tools or applications or going to training. Some vendors, such as Intergraph with Solid Edge, have taken great steps in bringing down that learning barrier. Many design packages available today have a Windows-like look and feel, and we expect that as users move toward these new software tools, the importance-satisfaction gap for ease of learning/use will shrink.

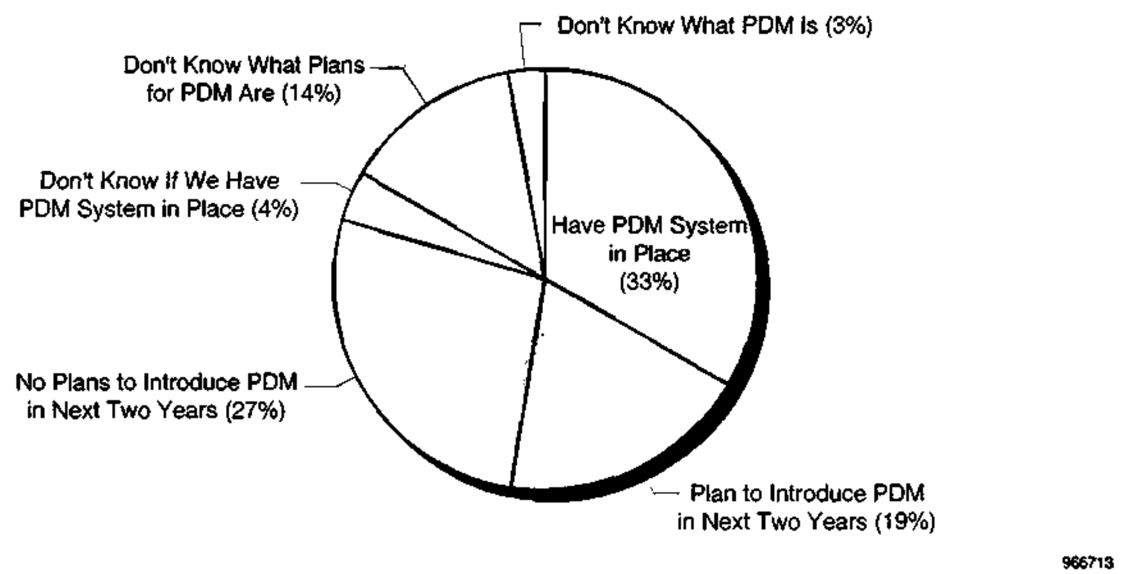
Of all the items on the "wish list," those falling to the bottom in importance were software having advanced features and functionality and software that is easy to customize. These two items are far more technology-related than the other items in the list. While advances in CAD/CAM/CAE technology are important, there are clearly other issues that a vendor can concentrate on in order to become a commanding player in the mechanical design market.

Chapter 6
A PDM Update

This year, we included a section in our survey on product data management. We asked a series of questions in order to better characterize PDM sites, the benefits users are seeing, and what impediments exist to further market penetration of PDM solutions.

About one-third of respondents said that they have a PDM system already in place and 19 percent plan to introduce PDM within the next two years (see Figure 6-1). Results varied by industry, as indicated in Table 6-1. Awareness or knowledge of PDM is high in North America—on average, less than 3 percent of respondents did not know what PDM is. But, nearly 8 percent of those respondents categorized as "others" did not know what PDM is. Again, our "others" respondents consisted largely of those users involved in process industries, government, and services. The aerospace and automotive respondents, while not heavily involved in PDM today, plan to do so over the next two years. Respondents in electronics, industrial machinery, and miscellaneous discrete manufacturing make up the majority of PDM users in our survey.

Figure 6-1
Planned Adoption of PDM in North America



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (September 1996)

Table 6-1
Planned Adoption of PDM Industry

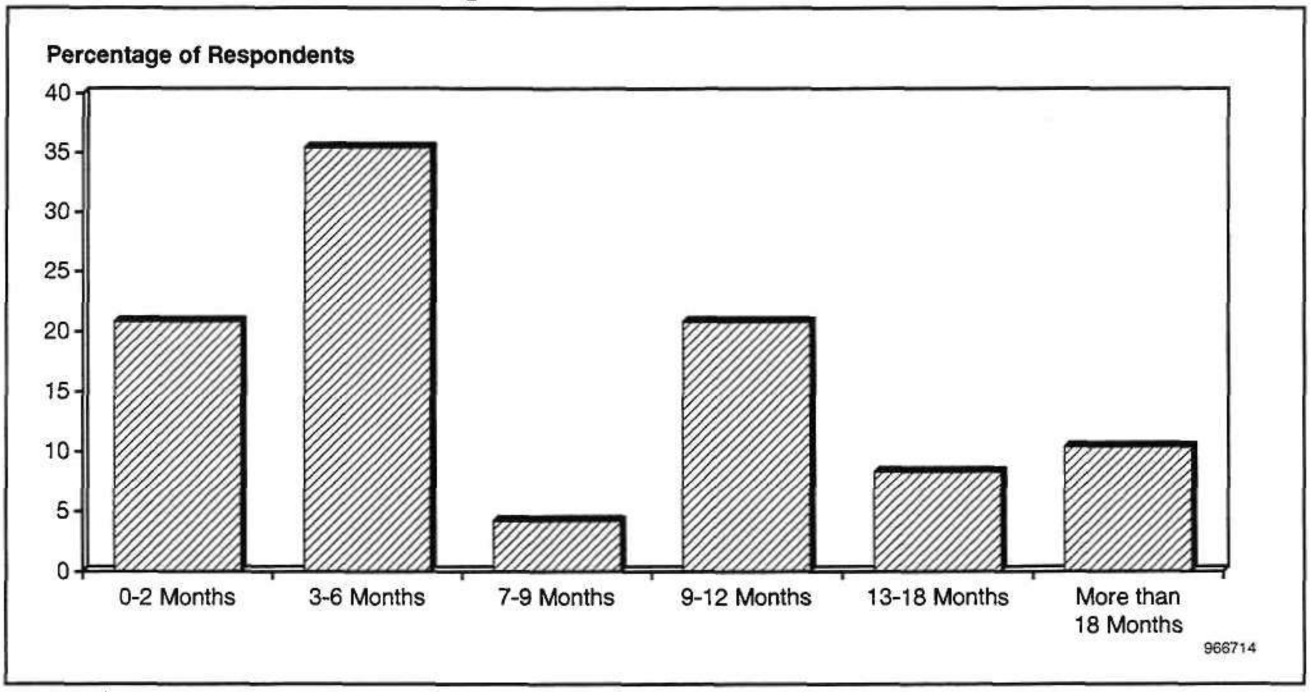
	Have PDM System in Place (%)	Plan to Introduce PDM in Next Two Years (%)	No Plans to Introduce PDM in Next Two Years (%)	Do Not Know If PDM System Is in Place (%)	Do Not Know Plans (%)	Do Not Know What PDM Is (%)
Aerospace	25.0	39.3	28.6	0	7.1	0
Automotive	24.0	32.0	24.0	4.0	12.0	4.0
Electronics	38.9	11.1	33.3	5.6	8.3	2.8
Fabricated Metal	24.2	18.2	45.5	6.1	6.1	0
Industrial Machinery	40.0	15.0	22.5	5.0	12.5	5.0
Miscellaneous Manufacturing	43.5	4.3	13.0	0	39.1	0
Others	34.6	15.4	19.2	3.8	19.2	7.7
All Respondents	33.2	19.0	27.5	3.8	13.7	2.8

Source: Dataquest (September 1996)

The following statements characterize the PDM sites of our survey:

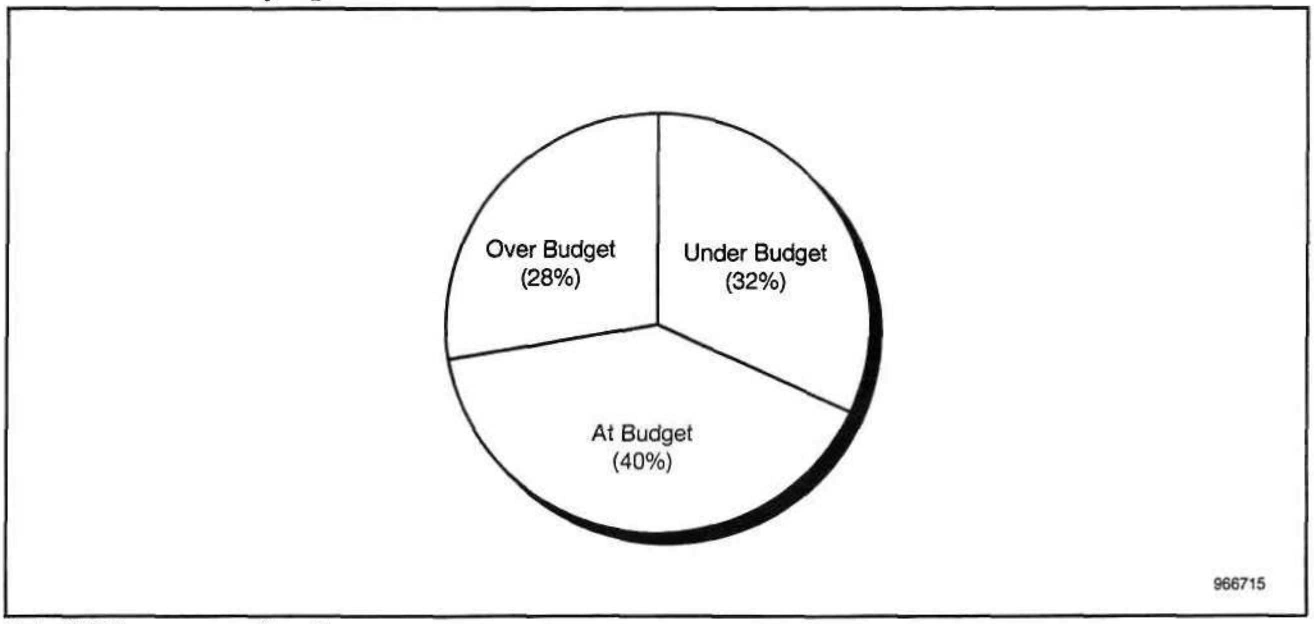
- PDM solutions have been around for many years, and not all systems being used today are commercial systems. Seventy-four percent of users said that their PDM systems are commercial systems, 26 percent said they were still using in-house developed systems.
- Of all respondents, 44 percent of users were in the pilot stages of implementation at the time of our survey. More than one-half of the aerospace, electronics, and industrial machinery sites were in the pilot phases.
- The time to have the PDM system up and running ranged from one to 30 months. Nine months was average among all PDM sites, with 56 percent of users having the system running in six months or less (see Figure 6-2). These percentages seem high—we expected implementation cycles to be longer. It could be that users are implementing portions of PDM systems, such as vault-only capabilities, or are taking implementation in stages.
- On average, 214 people have access to the PDM system at a given site. The number of people accessing a system ranged from three to 4,000. The wide range of responses points to the fact that there is room in the market for vendors focused on enterprisewide solutions as well as vendors focused on workgroup-oriented solutions. Both types of PDM systems are being purchased and implemented today. Consistent with what we expected, aerospace sites tend to implement the large, enterprisewide PDM systems; fabricated metal sites tend to implement PDM on a much smaller scale. Users access the PDM system 11 times per day, on average.
- We are not seeing large cost overruns for PDM acquisition and implementation, either in Europe or North America. The majority of the PDM systems in our survey were being acquired and set up at or under budget (see Figure 6-3). About 40 percent of respondents said that their systems were at budget and 32 percent were under budget.

Figure 6-2
Number of Months to PDM Implementation



Note: Multiple responses allowed
Source: Dataquest (September 1996)

Figure 6-3
Amount of Money Spent on PDM

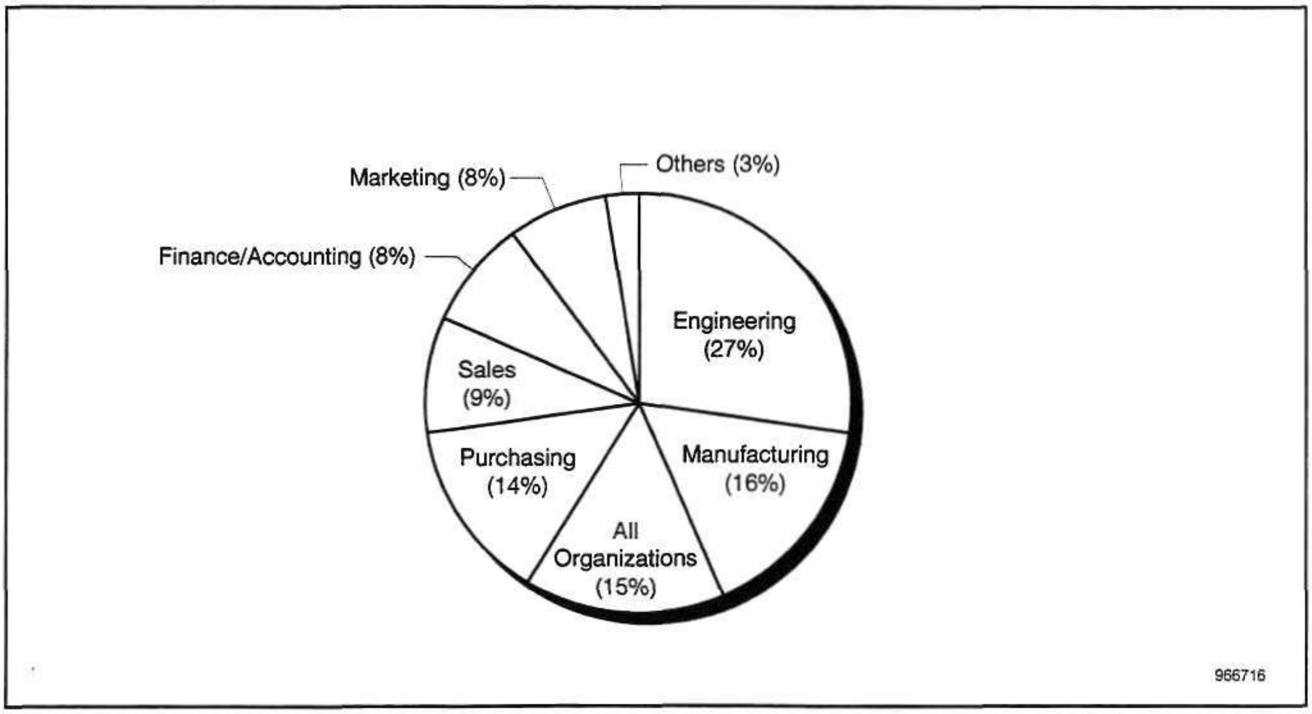


Note: Multiple responses allowed
Source: Dataquest (September 1996)

- Vendors need to know which group within an organization is most likely to buy PDM, and our results show that PDM systems clearly have their roots in engineering. Engineering was cited most often as the group using the PDM system on a regular basis (28 percent of responses), followed by manufacturing (see Figure 6-4). We expected to see a higher percentage of manufacturing groups using PDM, in light of all the integration between MRP systems and PDM systems that vendors have announced in the past year. Fifteen percent of PDM users said that all organizations use the system, up significantly from our European survey last year (6 percent of European respondents use the system regularly).

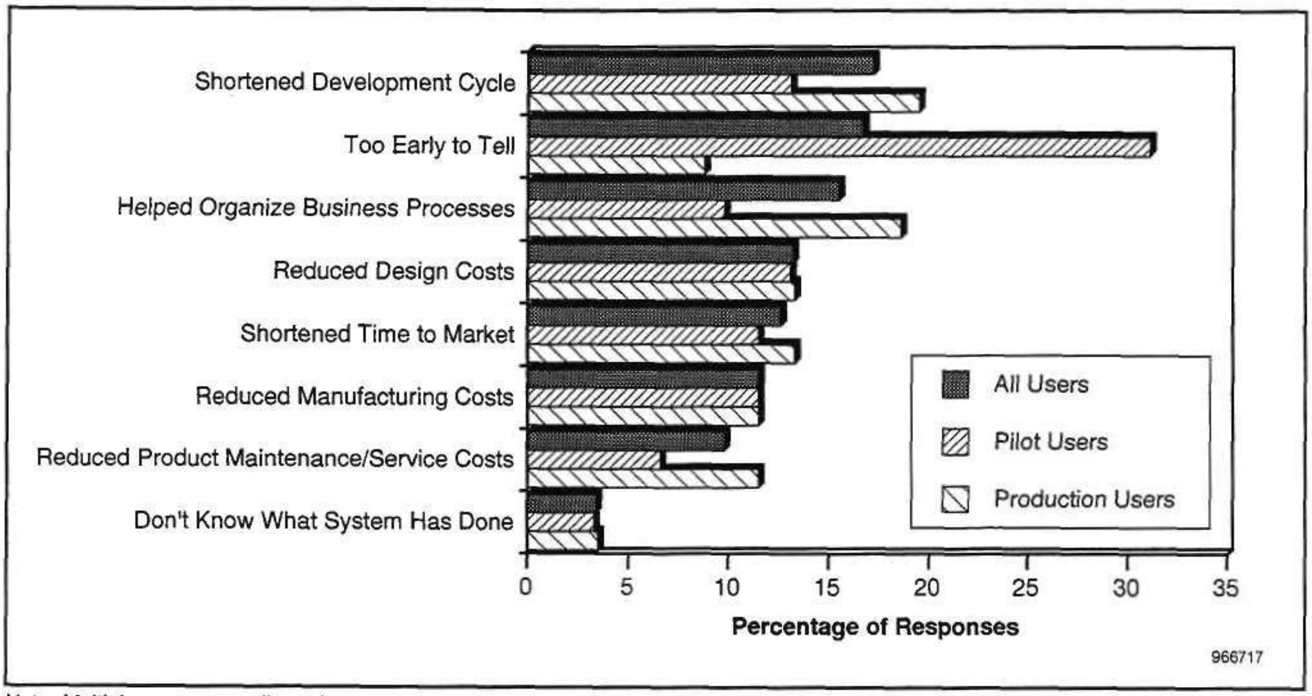
Figure 6-5 illustrates what PDM users think some of the benefits of their systems are. Here, we have split the data to show pilot users, production users, and all users. For those in the pilot phase, users say that it is too early to tell just what the benefits of PDM are. Putting that aside, these users are looking at reduced design costs and shorter development cycles as the major benefits. For production users, shorter development cycles are the main benefit, closely followed by a more intangible benefit—PDM systems help organize business processes. While we continually hear vendors touting the messages that PDM systems will help reduce product development times, lower costs, and help companies bring products to market faster, we rarely hear the message that PDM systems will help to organize a company's business processes. But from a user's perspective this is exactly one of the benefits they are seeing.

Figure 6-4
Groups Using PDM



Note: Multiple responses allowed
Source: Dataquest (September 1996)

Figure 6-5
User Perceived Benefits of PDM

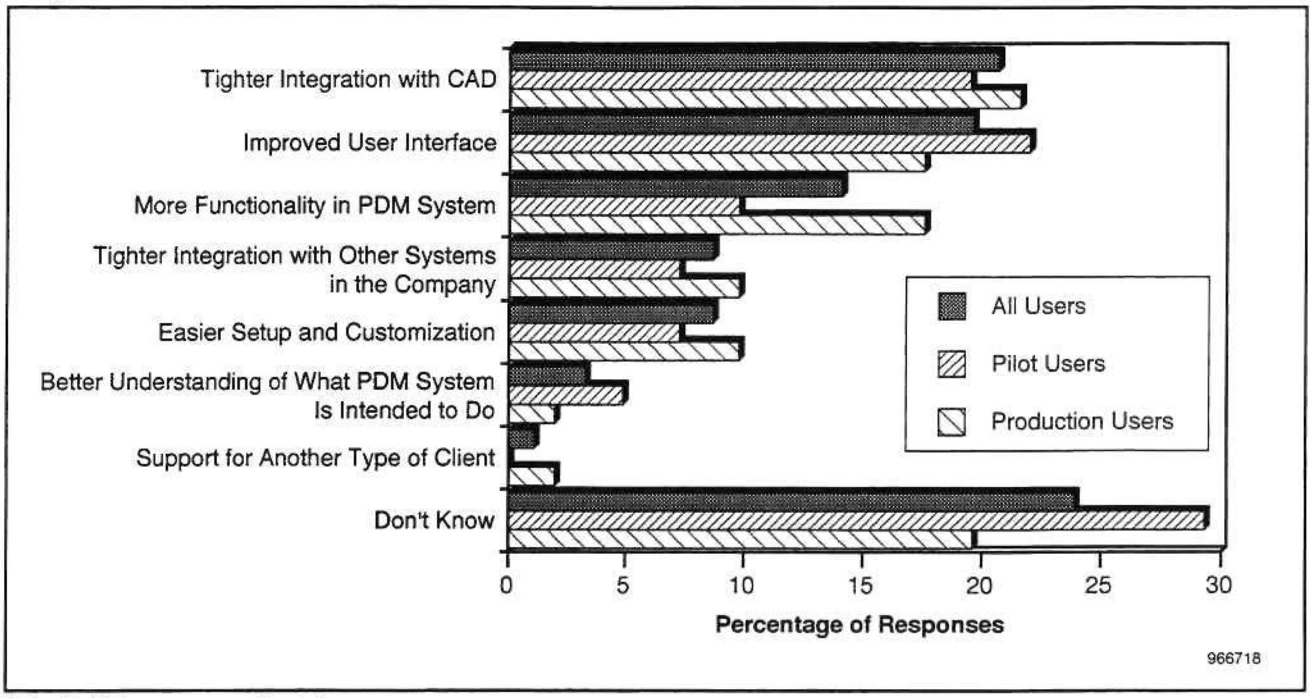


Note: Multiple responses allowed
Source: Dataquest (September 1996)

Finally, we asked users what two improvements could be made to their PDM systems. The results, split by pilot, production, and all users, are shown in Figure 6-6. Here, we included "do not know" as an option. For pilot users, the most frequently cited response was "do not know," followed by improved user interface. All users, pilot or production, are looking for tighter CAD integration.

We expected a high number of "do not know" responses among pilot users but not among production users. We believe that as users become more familiar with their PDM solutions, they will know what functionality and features they need most. Right now, the PDM market is still in its infancy, and users are still trying to see just what the benefits are before they can definitively say where improvements need to be made.

Figure 6-6
Improvements to PDM



Note: Multiple responses allowed
Source: Dataquest (September 1996)

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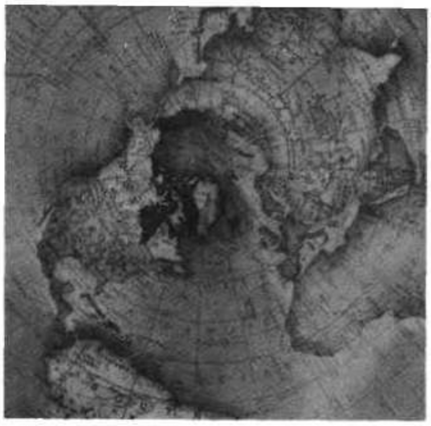

Dataquest

1995 Mechanical Europe Forecast Update

Market Statistics

Program: Mechanical Applications Europe
Product Code: CMEC-EU-MS-9602
Publication Date: September 30, 1996
Filing: Market Statistics

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Note: All tables show estimated data.

Chapter 1
1995 Mechanical CAD/CAM/CAE Europe Forecast Update

About This Document

This document contains Dataquest's detailed forecast information on the mechanical CAD/CAM/CAE markets at the country level. This report is meant to supplement your worldwide mechanical CAD/CAM/CAE forecast book by providing mechanical CAD/CAM/CAE forecast detail for European countries.

Although Dataquest does not forecast currency exchange rates, we do forecast with the best information available. The exchange rate is calculated as the simple arithmetic mean of the 12 average monthly rates for each country. For the purpose of this forecast, Dataquest assumes the July exchange rate will remain stable in the future (see Tables 1 and 2).

Additional market statistics publications for Dataquest's CAD/CAM/CAE and GIS services for 1996 are as follows:

Dataquest's 1995 Market Share document (published as CAEC-WW-MS-9601, CEDA-WW-MS-9601, and CMEC-WW-MS-9601) was sent to our clients in March.

Dataquest's 1995 forecast documents were released in May (published as CAEC-WW-MS-9602, CEDA-WW-MS-9602, and CMEC-WW-MS-9602).

Dataquest's 1995 market share data was verified, updated, and sent to our clients in August as a Market Share Update report (published as CAEC-WW-MS-9603, CEDA-WW-MS-9603, and CMEC-WW-MS-9603). Country-level data was made available at this time.

This document is an updated forecast that has been expanded to include country-level information and in-depth analysis.

Worldwide Forecast Assumptions

The following paragraphs describe the main forces driving the CAD/CAM/CAE and GIS worldwide software forecast. See Table 3 for worldwide forecast data.

All Applications

As CAD/CAM/CAE/GIS becomes more of a replacement market, market leaders would appear to have the upper hand; the cost of switching is high. However, software that lets users get a better product to market faster, software that helps eliminate business risks will always be in demand—regardless of market share. Thus there is always an opportunity for new vendors in technical markets.

The primary trend in design software function is toward operating at a higher level of abstraction. In all applications, we have seen an evolution of focus from "electronic paper" to component modeling, and now to

Table 1
CAD/CAM/CAE and GIS Revenue Growth Comparison
(U.S. Dollars versus Local Currency for Both Europe and Japan)

	1994	1995	Forecast 2000	Growth (%) 1994-1995	CAGR (%) 1995-2000
Europe (U.S.$ Million)					
Software Revenue	1,820.18	2,161.60	3,374.47	18.8	9.3
Hardware Revenue	2,591.56	2,807.99	5,017.48	8.4	12.3
Service Revenue	1,141.83	1,274.02	1,553.54	11.6	4.0
Total Factory Revenue	5,553.57	6,243.61	9,945.49	12.4	9.8
ECU/U.S.$ Exchange Rate*	0.84	0.77	0.80	-8.6	0.7
Europe (ECU Million)					
Software Revenue	1,535.50	1,666.38	2,691.40	8.5	10.1
Hardware Revenue	2,186.24	2,164.68	4,001.82	-1.0	13.1
Service Revenue	963.25	982.14	1,239.07	2.0	4.8
Total Factory Revenue	4,684.99	4,813.20	7,932.28	2.7	10.5
Japan (U.S.$ Million)					
Software Revenue	1,335.78	1,521.57	2,680.91	13.9	12.0
Hardware Revenue	2,143.29	2,286.92	4,063.64	6.7	12.2
Service Revenue	925.74	1,044.46	1,478.93	12.8	7.2
Total Factory Revenue	4,404.81	4,852.95	8,223.49	10.2	11.1
Japan/U.S.$ Exchange Rate*	110.85	93.90	105.94	-15.3	2.4
Japan (Yen Million)					
Software Revenue	148,071.13	142,875.66	284,015.37	-3.5	14.7
Hardware Revenue	237,583.90	214,741.36	430,502.52	-9.6	14.9
Service Revenue	102,618.14	98,074.81	156,678.33	-4.4	9.8
Total Factory Revenue	488,273.16	455,691.83	871,196.22	-6.7	13.8
North America (U.S.$ Million)					
Software Revenue	1,915.91	2,272.72	4,456.45	18.6	14.4
Hardware Revenue	2,482.33	2,776.43	6,289.30	11.8	17.8
Service Revenue	1,171.94	1,385.61	2,301.71	18.2	10.7
Total Factory Revenue	5,570.18	6,434.76	13,047.45	15.5	15.2
Worldwide (U.S.$ Million)					
Software Revenue	5,415.60	6,420.61	11,855.56	18.6	13.0
Hardware Revenue	7,667.54	8,418.59	17,092.16	9.8	15.2
Service Revenue	3,451.56	3,971.80	5,966.89	15.1	8.5
Total Factory Revenue	16,534.69	18,811.00	34,914.60	13.8	13.2

*Assuming a stable currency, the 2000 exchange rate is March 1996 exchange rate.
Source: Dataquest (March 1996)

Table 2
Foreign Currency per U.S. Dollar

		Actual				Current			Year-to-Year Change (%)					
Country	Currency	1991	1992	1993	1994	1995	1996	1997	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997
Austria	Schilling	11.67	10.95	11.65	11.40	10.06	10.55	10.58	-6.17	6.4	-2.1	-11.8	4.9	0.3
Belgium	Franc	34.13	32.02	34.67	33.66	29.42	30.84	30.95	-6.18	8.3	-2.9	-12.6	4.8	0.4
Denmark	Krone	6.39	6.02	6.49	6.35	5.59	5.80	5.80	-5.79	7.8	-2.2	-12.0	3.8	0
Finland	Markka	4.04	4.45	5.73	5.21	4.37	4.60	4.58	10.15	28.8	-9.1	-16.1	5.3	-0.4
France	Franc	5.64	5.27	5.67	5.54	4.97	5.09	5.09	-6.56	7.6	-2.3	-10.3	2.4	0
Germany	D-Mark	1.66	1.56	1.66	1.62	1.43	1.50	1.50	-6.02	6.4	-2.4	-11.7	4.9	0
Italy	Lira	1,238.93	1,227.75	1,577.85	1,609.34	1,628.21	1,545.31	1,526.82	-0.90	28.5	2.0	1.2	-5.1	-1.2
Netherlands	Guilder	1.87	1.75	1.86	1.82	1.60	1.68	1.69	-6.42	6.3	-2.2	-12.1	5.0	0.6
Norway	Krone	6.49	6.18	7.11	7.04	6.33	6.46	6.45	-4.78	15.0	-1.0	-10.1	2.1	-0.2
Spain	Peseta	103.81	101.90	127.87	133.48	124.40	126.29	126.96	-1.84	25.5	4.4	-6.8	1.5	0.5
Sweden	Krona	6.04	5.81	7.82	7.70	7.14	6.70	6.64	-3.81	34.6	-1.5	-7.3	-6.2	-0.9
Switzerland	Franc	1.43	1.40	1.48	1.37	1.18	1.22	1.23	-2.10	5.7	-7.4	-13.9	3.4	0.8
United Kingdom	Pound	0.57	0.57	0.67	0.65	0.63	0.65	0.64	0	17.5	-3.0	-3.1	3.9	-2.3
Europe Average	ECU	0.81	0.77	0.86	0.84	0.77	0.80	0.80	-4.86	11.4	-1.5	-8.7	3.6	0
China	Renminbi	5.33	5.51	5.76	8.54	8.35	8.34	8.34	3.38	4.5	48.3	-2.2	-0.1	0
Hong Kong	Dollar	7.77	7.74	7.74	7.73	7.74	7.74	7.74	-0.39	0	-0.1	0.1	0	0
Japan	Yen	134.59	126.34	110.85	101.56	93.90	107.93	109.19	-6.13	-12.3	-8.4	-7.5	14.9	1.2
Korea	Won	730.67	782.41	799.42	805.80	770.57	798.87	813.03	7.08	2.2	0.8	-4.4	3.7	1.8
Singapore	Dollar	1.73	1.63	1.62	1.53	1.43	1.41	1.42	-5.78	-0.9	-5.3	-6.5	-1.4	0.7
Taiwan	Dollar	26.49	24.93	26.15	26.45	26.48	27.50	27.57	-5.89	4.9	1.1	0.1	3.9	0.3

Source: Dataquest (March 1996)

system modeling. The eventual goal is the ability to fully simulate, evaluate, redesign, and test the design inside the computer prior to manufacture. At the same time, increased computing power is allowing the nature of design to evolve to include constituencies in manufacturing, product support, and from users themselves. Thus, the engineering process is being expanded to include input from a broader base.

At the same time, the nature of design data itself is expanding from a focus on geometry to include multiple data types—making the challenge of system modeling even more complex. Also, the World Wide Web holds the potential to expand the nature of collaborative design, by harnessing the joint power of anticipated increases in both computing power and communications bandwidth. Thus, there is little limit to the problems that design or GIS software can tackle. The primary challenge will continue to be developing robust, leading-edge software ahead of competitors. During the forecast period we anticipate significant, but not revolutionary, advances in the ability of the existing programmer pool to produce new software.

Mechanical Forecast Assumptions

New Interest in Mechanical CAD Technology

In 1995, we saw a mix of replacement business and new purchases for mechanical CAD technology, particularly in Europe and North America. Growth is picking up in nontraditional industries (those industries outside of aerospace, automotive, and industrial machinery). We expect this trend to continue, as mechanical modeling, analysis, design, and simulation software become more user-friendly. Closely linked to the use of mechanical CAD in new arenas is the availability of software on lower-cost platforms and the potential use of object technology to create customized industry- or application-specific solutions.

The product data management market has clearly found a worldwide interest. Within the past year, we have seen pilot programs move to full-scale production, support for new client platforms (Windows NT, Windows), integration with manufacturing resource planning (MRP) systems, and an emergence of parts/component management software. Product data management will be one of the significant drivers of the mechanical CAD market through 2000.

Growth in Asia/Pacific

The Asia/Pacific region is being fueled by CAD investments from local governments, multinational companies, and local initiatives (such as Indonesia's IPTN). Most of the sales to date are UNIX-based, but some of the future growth is expected to shift to NT.

Ground Shifts in Japan

Mechanical CAD/CAM/CAE growth in Japan is expected to undergo a significant shift in platform usage over our forecast period. The UNIX platform dominates the mechanical sector in Japan, despite the fact that the Japanese mechanical market still places a heavy emphasis on 2-D drafting instead of 3-D/solid modeling. We expect this drafting orientation to persist, and over next five years we anticipate a significant shift to more Windows NT-based systems at the expense of UNIX. This shift will not begin in earnest until 1997, when more NT-based applications are more widely available in Japan.

Windows NT

As of today, not all of the major mechanical CAD vendors have ported their products to the Windows NT platform. The lack of availability of Windows NT versions of some of the market-share-leading mechanical CAD packages, coupled with the fact that Europe has just completed its five-year investment cycle in mechanical CAD software, will mean that Windows NT will not begin to impact UNIX-based sales for at least a few more years.

AEC Forecast Assumptions

The Impact of Windows NT

Intergraph's shift to Windows NT has initiated the collapse of UNIX sales in North America, a trend expected to increase broadly in this cost-conscious application. At the same time, we expect growth in Windows NT from DOS-based users who find Windows 95 and successors less than reliable. The primary factor holding up growth in the large installed base of DOS users is their reluctance to buy the new hardware required for either Windows 95 or Windows NT.

The factors that should contribute to the long-term expansion of the AEC CAD industry are noted in the following sections.

CAD Is Becoming a Business Requirement

Large design firms are growing at the expense of smaller firms. These large end users increasingly require their employees and suppliers to adopt automation tools in the design and construction process. Smaller design firms must increasingly buy CAD systems or risk being dropped from consideration as a partner.

CAD purchases are increasingly justified as a competitive advantage in both sales and design reviews. Electronic design data is also required downstream by the designer's client—from the federal government down to the small commercial developer. Also, a significant pool of untapped users still exists. The relatively low market penetration of AEC CAD systems should allow steady worldwide growth during the next five years despite constant volatility in demand for the buildings and infrastructure to be designed.

New Features in AEC CAD Products Are Achievable

Better, lower-cost visualization tools will be in increasing demand as sales and communication tools. Data and database functions (versus graphics functions) are increasing in importance in AEC design systems, creating opportunities to sell users significant new functionality. Some vendors will create products that foster communications in the entire design, construction, and maintenance process—products that will increase the payoff in CAD investments.

The three trends that will inhibit growth in the AEC CAD industry are noted in the following sections.

Design Is Only Part of the Problem

AEC's one-design-one-build structure means CAD provides fewer economic benefits to these users than does the one-design-build-many structure of manufacturing. Construction, which is essentially a prototype build, is fraught with uncertainties and delays that are not well-addressed by AEC systems as they exist today. Design tools can only thrive in the AEC structure when they support more of the entire business problem. Based on Autodesk's increased commitment to progress in this arena, we have increased our forecast modestly; commitment to and cooperation on the problem from multiple vendors will allow us to increase the forecast growth rate further.

Poor Cooperation among Users

Users are poorly organized to take advantage of improved products, partly because of competition between engineering constructors and partly because designs are often split among several different companies representing different and competing aspects of the design process. New approaches to the design and construction process are appearing, allowing users to take full advantage of CAD tools. Still, many users in AEC will need to be shown leadership in working together, both from the very large, most competitive users, and from CAD vendors themselves.

Downturn in Germany

The German construction industry, which has been the driving force behind the high growth of the recent years, has come to an abrupt halt. Although other regions such as Italy are investing, Germany plays such a dominant role that it will drag down the overall European growth for AEC. The applications that are still growing even in Germany are facilities design/management as these are not dependent on the construction industry.

GIS/Mapping Forecast Assumptions

The Impact of Windows NT

Intergraph's move to Windows NT at the expense of UNIX will quickly make PC-based operating systems the dominant revenue stream in North America. In the long term, the GIS UNIX market is highly subject to erosion by Windows NT because of the appeal of better integration of GIS and Windows-based productivity tools, an appealing prospect to many GIS users.

The factors that should contribute to the long-term expansion of the GIS market are noted in the following sections.

"Open GIS"

The thrust of the Open GIS Foundation has been to allow some fresh air into a market that was getting a bit inbred. The nature of GIS data is under greater scrutiny, and several vendors are embarking on different, creative directions. Ultimately, much of "spatial analysis" will be embedded into other applications, rather than known as a GIS. Nonetheless, a fresh approach to spatial analysis is creating new opportunities for more useful solutions in traditional GIS environments.

Abundant Supply of Prospective Buyers

Penetration is still moderately low among core users. Bread-and-butter prospects in government and utilities are charged with maintaining information on land and assets in perpetuity. Many of these prospective buyers are still using paper maps, which will degrade over time, or have only entry-level systems in terms of value delivered. This creates a certain inevitability to moving from paper maps computer-based models.

New Technologies Will Drive Growth

Faster, cheaper computers will be continually leveraged to support new software products. Widespread computer industry developments in open, distributed systems supporting high-speed networking will make it possible for GIS technology to broadly expand the user base. Lower cost, higher resolution satellite imagery holds the potential to drive another explosion in GIS market growth among users who cannot afford aerial photography. Advances in aerial photography, global positioning systems (GPSs), and laser range finders are making it possible to create GISs that are significantly cheaper, more accurate, and more complete than existing paper maps, giving experienced users some compelling reasons to reinvest. Portable and pen-based computers are bringing GIS to new users in field operations. Finally, database companies themselves are gaining a better understanding of spatial analysis, a key factor in spreading use of GIS systems more broadly.

Data Will Drive Growth

The GIS business market is driving high growth on PCs. However, we see a wide band of uncertainty surrounding the clearly growing revenue opportunity from new applications. Several new applications in GIS are destined to become a relatively low revenue-producing feature in another software program (and market), rather than a standalone product in the GIS market. At the same time, data is increasing in value relative to software in this low-end market.

GIS has attained a certain indispensability, particularly among federal users and in utilities. As a result, users are beginning to expect to share the data that lies in their various GIS systems. Within three years, we expect data to be readily exchangeable across different systems. At that point, shareable data will help drive market growth.

Several factors seriously constraining the long-term expansion of the GIS market are noted in the following sections.

High Cost of Entry Remains a Barrier

There will remain an uncertain, but certainly high, cost of creating a working GIS system in traditional environments. No magic will emerge to create a low-cost, meaningful data set for mainstream customers in government and utilities. Data conversion will remain costly because the significant cost of correcting prior errors and omissions on paper maps is inevitably bundled into the cost of "conversion."

Price Pressures Inhibit Growth

Price pressure will hold down total revenue. Innovation is the only way to maintain prices in any software industry, and GIS vendors will struggle in their attempt to create compelling new applications and improved investment payoff for customers.

Electronic Design Automation Forecast Assumptions

The EDA software market grew 17.5 percent in 1995. Over the next five years, growth will continue to be fueled by continuing increasing design complexity and ever-higher speeds. The semiconductor downturn is a fact of life. Although many people expect a similar downturn in EDA sales, this is not the case. Semiconductor downturns, an indication of an electronic hardware downturn, actually increase EDA sales as companies design their way out of the recession. The EDA market typically sees its downturn three years later. Dataquest therefore predicts growth to drop off—to about 10 percent in 1999.

Electronic CAE

Design complexity is forcing a large-scale swap: Gate-level users are swapping up to register-transfer level (RTL) while RTL users are swapping up to electronic-system level (ESL) tools. RTL tools are beginning to appear on Windows NT, competing with UNIX-based tools, while the ESL tools will remain UNIX-based. The second wave, those FPGA/CPLD designers moving up to the RTL, are starting to make an impact on the numbers.

IC Layout

Final results show the IC layout market growing at 29.6 percent—a little lower that the preliminary data, but strong nonetheless. Design complexity and high speed are forcing replacement of obsolete tools, driving this high growth. This is primarily a replacement market of very high-cost tools and very few players. The ensuing frenzy for market share is the result. The few PC-based tools in this market are being replaced by UNIX-class tools in North America, and Windows NT will not be a factor in this market. In fact, this is the market that is demanding a "standard" 64-bit operating system. If UNIX repeats its 32-bit performance, these guys could wait for a 64-bit Windows NT.

PCB/MCM/Hybrid

The printed circuit board (PCB) market grew 4.7 percent in 1995. The swap out of old tools continues for the second year. The most significant shift has been the acceptance of Windows NT as the operating system of choice in the PCB design world. It will not happen overnight, as swap out in this segment is slower than in CAE and IC layout, but it will happen.

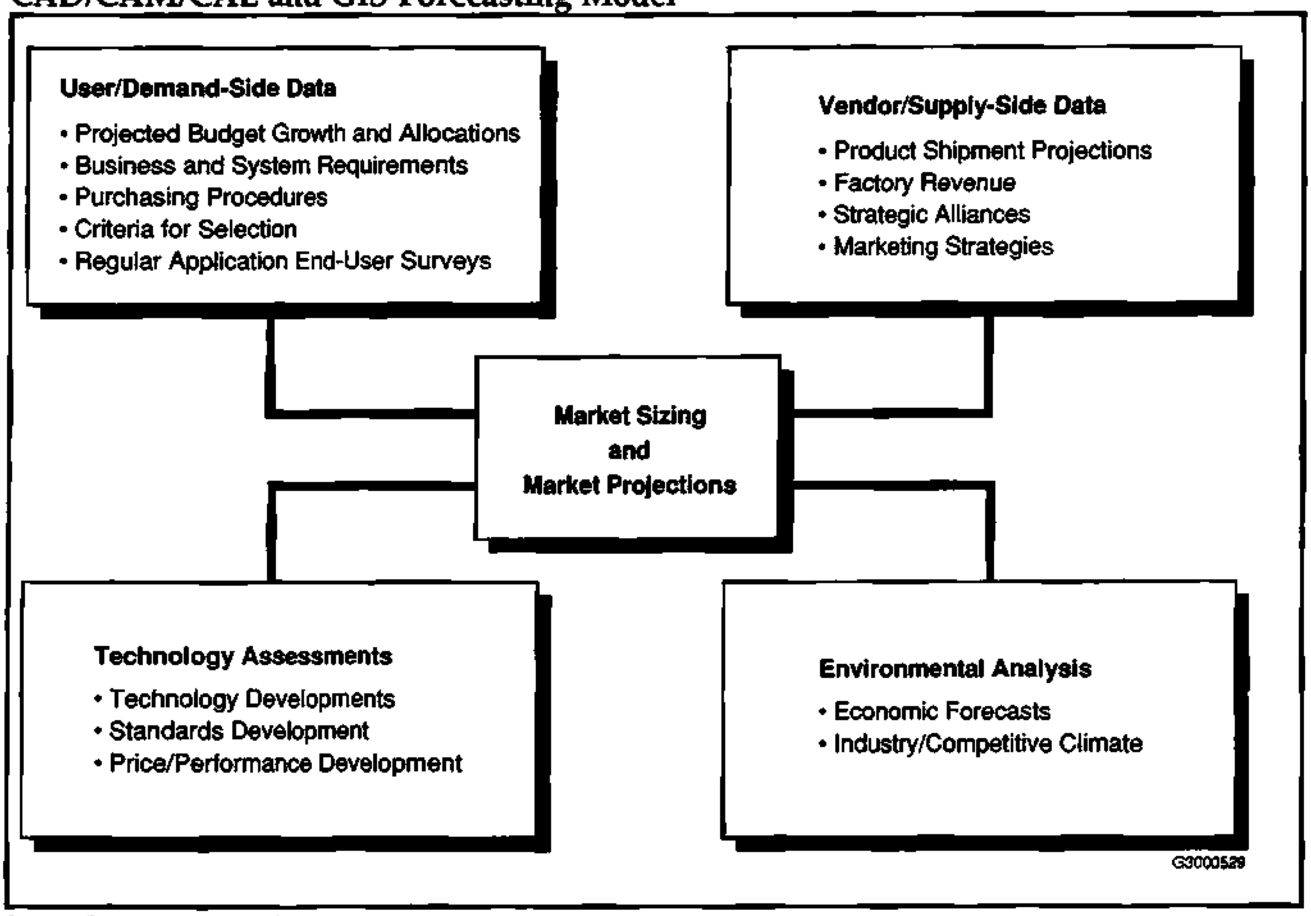
Forecast Methodology

Fundamental to the way Dataquest conducts its research is the underlying philosophy that the best data and analyses come from a well-balanced program. This program includes the following: balance between primary and secondary collection techniques; balance between supply-side and demand-side analysis; balance between focused, industry-specific research and coordinated, "big-picture" analysis aided by integration of data from the more than 25 separate high-technology industries Dataquest covers; and balance between the perspectives of experienced industry professionals and rigorous, disciplined techniques of seasoned market researchers.

Dataquest also analyzes trends in the macro environment, which can have major influences on both supply-side and demand-side forecasting. In addition to demographics, analysts look at gross national product (GNP) growth, interest rate fluctuation, business expectations, and capital spending plans. In the geopolitical arena, the group looks at trade issues, political stability or lack thereof, tariffs, nontariff barriers, and such factors as the effect on Europe of the events of 1995.

Figure 1 shows the CAD/CAM/CAE and GIS forecasting model. The overall forecasting process uses a combination of techniques such as

Figure 1
CAD/CAM/CAE and GIS Forecasting Model



Source: Dataquest (May 1996)

time series and technological modeling. Market estimates and forecasts are derived using the following research techniques:

- Segment forecasting—Individual forecasts are derived for each application segment tracked by the CAD/CAM/CAE and GIS group. Specifically, each application, segmented by region and platform, is forecast and rolled up. In this way, each application segment incorporates its own set of unique assumptions.
- Demand-based analysis—Market growth is tracked and forecast in terms of the present and anticipated demand of current and future users. This requires the development of a total available market model and a satisfied available market figure to assess the levels of penetration accurately. Dataquest analysts also factor in the acceptance or ability for users to consume new technology.
- 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, capacity limitations are capable of keeping shipments below the demand level.

Segmentation Definitions

Operating Systems

The following defines the operating systems:

- UNIX—UNIX includes all UNIX variants and older workstation operating systems.
- Host—Host includes minicomputer and mainframe operating systems in which external workstations' functions are dependent on a host computer.
- Windows NT—Windows NT is the Microsoft operating system.
- PC—PC includes DOS, Windows, Windows 95, OS/2, and Apple operating systems.

Line Items

Line item definitions are as follows:

- Average selling price (ASP) is defined as the average price of a product, inclusive of any discounts.
- CPU revenue is the portion of revenue derived from a system sale that is related to the value of the CPU.
- CPU shipment is defined as the number of CPUs delivered.
- CPU installed base is defined as the total number of CPUs in active, day-to-day use.
- Unit shipment is defined as the number of products delivered (that is, seats).

- Seats are defined as the number of possible simultaneous users.
- Installed seats are defined as the total number of seats in active, day-to-day use.
- Hardware revenue is defined as the sum of the revenue from the hardware system components: CPU revenue, terminal revenue, and peripherals revenue.
- Peripherals revenue is defined as the value of all the peripherals from turnkey sale. (Peripherals in this category typically are input and output devices.)
- Terminal revenue is defined as revenue derived from the sale of terminals used to graphically create, analyze, or manipulate designs. The term is applicable only to the host systems.
- Software revenue is revenue derived from the sale of application so-
ftware.
- Service revenue is defined as revenue derived from the service and support of CAD/CAM/CAE or GIS systems. Service is followed as software service and hardware service.
- Total factory revenue is defined as the amount of money received for goods measured in U.S. dollars and is the sum of hardware, software, and service revenue.

Table 3
CAD/CAM/CAE/GIS Software History and Forecast
Top-Level Worldwide Forecast, All Applications, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue (U.S.$ Million)									
Worldwide, All Operating Systems	4,881	5,416	6,421	7,446	8,419	9,500	10,664	11,856	13.0
Worldwide									
UNIX	3,371	3,815	4,377	4,901	5,351	5,751	6,181	6,607	8.6
Windows NT	5	115	381	724	1,087	1,595	2,160	2,762	48.6
Personal Computer	1,188	1,307	1,511	1,710	1,908	2,107	2,292	2,464	10.3
Host/Proprietary	317	178	152	111	73	47	32	22	-31.9
All Operating Systems									
North America	1,749	1,916	2,273	2,684	3,096	3,548	4,006	4,456	14.4
Europe	1,598	1,820	2,162	2,385	2,605	2,855	3,105	3,374	9.3
Japan	1,234	1,336	1,522	1,773	1,948	2,164	2,429	2,681	12.0
Asia/Pacific	208	253	362	484	631	770	930	1,095	24.8
Rest of World	93	90	103	120	139	162	195	249	19.3
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.9	18.6	16.0	13.1	12.8	12.3	11.2	
Worldwide									
UNIX		13.2	14.7	12.0	9.2	7.5	7.5	6.9	
Windows NT		2116.0	231.4	90.1	50.1	46.7	35.4	27.9	
Personal Computer		10.0	15.6	13.2	11.6	10.4	8.8	7.5	
Host/Proprietary		-43.7	-15.0	-26.8	-34.1	-35.7	-32.6	-29.8	
All Operating Systems									
North America		9.5	18.6	18.1	15.3	14.6	12.9	11.2	
Europe		13.9	18.8	10.3	9.2	9.6	8.7	8.7	
Japan		8.3	13.9	16.5	9.9	11.1	12.2	10.4	
Asia/Pacific		22.1	42.7	33.9	30.4	22.0	20.7	17.8	
Rest of World		-3.0	14.2	16.8	15.4	16.4	20.8	27.5	

Source: Dataquest (April 1996)

Table A-1
CAD/CAM/CAE/GIS Software History and Forecast
Top-Level Mechanical Forecast, Worldwide, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue (U.S.$ Million)									
Worldwide, All Operating Systems	2,253	2,490	3,011	3,430	3,798	4,143	4,513	4,903	10.2
Worldwide									
UNIX	1,566	1,849	2,212	2,528	2,759	2,930	3,113	3,298	8.3
Windows NT	1	41	117	213	339	499	666	844	48.4
Personal Computer	449	469	563	602	640	675	707	741	5.7
Host/Proprietary	237	131	118	86	60	39	27	20	-30.2
All Operating Systems									
North America	700	764	850	963	1,099	1,238	1,368	1,501	12.0
Europe	785	851	1,084	1,204	1,294	1,376	1,493	1,642	8.7
Japan	669	749	897	1,039	1,129	1,202	1,271	1,331	8.2
Asia/Pacific	72	94	137	175	223	269	316	358	21.1
Rest of World	27	32	42	49	53	59	65	72	11.2
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.5	20.9	13.9	10.7	9.1	8.9	8.6	
Worldwide									
UNIX		18.1	19.7	14.3	9.2	6.2	6.2	6.0	
Windows NT		2715.2	183.1	81.7	58.9	47.2	33.6	26.8	
Personal Computer		4.6	19.9	7.0	6.2	5.5	4.8	4.8	
Host/Proprietary		-44.9	-9.6	-27.0	-30.4	-34.3	-31.1	-27.9	
All Operating Systems									
North America		9.2	11.3	13.2	14.2	12.6	10.5	9.8	
Europe		8.4	27.3	11.1	7.4	6.4	8.5	10.0	
Japan		12.0	19.8	15.9	8.7	6.4	5.8	4.7	
Asia/Pacific		30.7	45.5	27.2	27.7	20.3	17.7	13.0	
Rest of World		15.5	32.8	15.4	9.3	10.6	10.7	10.0	

Source: Dataquest (September 1996)

Table B-1
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Europe, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	91,208	96,394	118,603	137,400	157,400	175,200	198,000	225,800	14
Seats	95,417	100,455	122,066	140,100	159,200	176,300	198,600	226,100	13
Year-to-Year Increase (%)	-5	5	22	15	14	11	13	14	
Installed Base									
CPUs	383,551	425,347	483,179	549,200	635,000	715,300	782,400	835,400	12
Seats	415,978	453,900	507,486	569,200	651,800	730,100	796,400	848,800	11
Year-to-Year Increase (%)	13	9	12	12	15	12	9	7	
Revenue Data (U.S.$ Million)									
CPU Revenue	1,069	1,189	1,386	1,600	1,805	1,946	2,170	2,459	12
Terminal Revenue	88	84	58	44	29	18	12	8	-33
Peripheral Revenue	84	62	93	118	144	175	228	318	28
Hardware Revenue	1,241	1,335	1,537	1,762	1,978	2,138	2,410	2,785	13
Year-to-Year Increase (%)	-21	8	15	15	12	8	13	16	
Software Revenue	785	851	1,084	1,204	1,294	1,376	1,493	1,642	9
Year-to-Year Increase (%)	-7	8	27	11	7	6	8	10	
Software Service	279	345	421	452	471	476	492	515	4
Hardware Service	252	250	303	328	355	364	388	420	7
Service Revenue	531	595	724	781	826	840	880	935	5
Year-to-Year Increase (%)	-8	12	22	8	6	2	5	6	
Total Factory Revenue	2,557	2,781	3,345	3,747	4,098	4,355	4,783	5,362	10
Year-to-Year Increase (%)	-14	9	20	12	9	6	10	12	

Source: Dataquest (September 1996)

Table B-2
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Benelux, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	3,849	4,429	5,132	5,400	6,200	7,400	8,200	8,800	11
Seats	3,973	4,541	5,244	5,400	6,200	7,400	8,200	8,800	11
Year-to-Year Increase (%)	-4	14	15	4	14	19	11	8	
Installed Base									
CPUs	17,075	18,956	21,391	23,600	26,700	30,000	33,000	34,700	10
Seats	18,961	20,336	22,394	24,300	27,200	30,500	33,400	35,100	9
Year-to-Year Increase (%)	7	7	10	9	12	12	10	5	
Revenue Data (U.S.$ Million)									
CPU Revenue	46	58	68	69	77	89	97	103	9
Terminal Revenue	4	4	3	2	1	1	1	0	-34
Peripheral Revenue	2	2	3	3	4	5	7	10	27
Hardware Revenue	52	64	73	74	83	95	104	113	9
Year-to-Year Increase (%)	-27	22	15	2	11	15	10	9	
Software Revenue	30	38	50	51	55	63	68	71	7
Year-to-Year Increase (%)	-8	26	30	1	9	15	7	5	
Software Service	8	13	17	17	18	19	20	20	4
Hardware Service	11	13	16	15	16	17	18	18	3
Service Revenue	19	26	32	31	33	37	38	39	4
Year-to-Year Increase (%)	-16	37	26	-3	6	10	4	2	
Total Factory Revenue	101	128	155	156	171	195	210	223	8
Year-to-Year Increase (%)	-20	26	22	1	10	14	8	6	

Source: Dataquest (September 1996)

Table B-3
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, France, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	13,768	15,500	18,179	19,800	22,600	26,400	30,000	32,600	12
Seats	14,380	16,237	18,829	20,300	23,000	26,600	30,100	32,700	12
Year-to-Year Increase (%)	1	13	16	8	13	16	13	9	
Installed Base									
CPUs	53,065	61,630	71,984	82,200	95,200	108,200	119,300	126,500	12
Seats	58,494	66,443	76,156	85,700	98,200	110,900	121,900	129,000	11
Year-to-Year Increase (%)	15	14	15	13	15	13	10	6	
Revenue Data (U.S.$ Million)									
CPU Revenue	184	219	246	269	303	344	387	420	11
Terminal Revenue	12	15	11	8	5	3	2	1	-34
Peripheral Revenue	14	8	15	18	22	29	38	51	27
Hardware Revenue	210	242	272	295	331	376	427	472	12
Year-to-Year Increase (%)	-16	15	13	8	12	14	14	11	
Software Revenue	134	157	192	203	219	246	271	288	8
Year-to-Year Increase (%)	0	17	23	5	8	13	10	6	
Software Service	51	66	77	77	81	86	90	91	3
Hardware Service	45	46	55	56	61	66	70	73	6
Service Revenue	96	113	132	134	142	152	160	163	4
Year-to-Year Increase (%)	-6	18	17	2	6	7	6	2	
Total Factory Revenue	440	511	597	631	691	773	859	923	9
Year-to-Year Increase (%)	-10	16	17	6	10	12	11	8	

Source: Dataquest (September 1996)

Table B-4
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Germany, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	32,670	33,428	42,886	48,700	55,800	61,100	68,900	80,100	13
Seats	34,358	35,238	44,583	50,100	56,700	61,600	69,200	80,300	13
Year-to-Year Increase (%)	-3	3	27	12	13	9	12	16	
Installed Base									
CPUs	134,651	149,277	171,435	195,500	226,500	254,400	276,700	295,900	12
Seats	145,914	159,811	181,072	204,000	234,100	261,300	283,400	302,400	11
Year-to-Year Increase (%)	14	10	13	13	15	12	8	7	
Revenue Data (U.S.$ Million)									
CPU Revenue	400	426	502	571	644	681	759	878	12
Terminal Revenue	32	35	27	21	13	8	5	4	-33
Peripheral Revenue	36	27	42	52	64	76	99	140	27
Hardware Revenue	468	488	572	644	722	766	863	1,021	12
Year-to-Year Increase (%)	-17	4	17	13	12	6	13	18	
Software Revenue	295	304	391	426	456	474	510	570	8
Year-to-Year Increase (%)	-3	3	29	9	7	4	8	12	
Software Service	102	120	150	158	163	160	164	174	3
Hardware Service	95	89	109	117	126	127	136	150	7
Service Revenue	197	209	259	275	289	288	300	324	5
Year-to-Year Increase (%)	-6	6	24	6	5	-1	4	8	
Total Factory Revenue	959	1,001	1,221	1,345	1,467	1,527	1,673	1,915	9
Year-to-Year Increase (%)	-11	4	22	10	9	4	10	14	

Source: Dataquest (September 1996)

Table B-5
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Italy, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	8,847	8,471	11,725	16,300	18,300	19,900	22,100	26,300	18
Seats	9,217	8,717	11,799	16,400	18,400	19,900	22,100	26,300	17
Year-to-Year Increase (%)	-19	-5	35	39	12	9	11	19	
Installed Base									
CPUs	39,287	42,441	47,941	57,000	68,000	78,100	85,400	92,700	14
Seats	42,855	45,374	50,068	58,400	69,000	78,700	85,900	93,100	13
Year-to-Year Increase (%)	11	6	10	17	18	14	9	8	
Revenue Data (U.S.$ Million)									
CPU Revenue	104	100	119	166	183	192	210	250	16
Terminal Revenue	8	5	1	1	1	0	0	0	-31
Peripheral Revenue	7	7	9	13	16	18	23	32	29
Hardware Revenue	119	112	129	181	200	211	233	282	17
Year-to-Year Increase (%)	-35	-6	15	40	11	6	11	21	
Software Revenue	76	70	92	123	129	133	141	163	12
Year-to-Year Increase (%)	-23	-7	31	34	5	3	6	15	
Software Service	28	31	36	47	48	48	49	54	8
Hardware Service	24	20	24	31	33	33	34	39	10
Service Revenue	52	51	60	79	81	80	83	92	9
Year-to-Year Increase (%)	-23	-1	18	30	3	-1	3	12	
Total Factory Revenue	247	234	281	383	410	425	457	537	14
Year-to-Year Increase (%)	-29	-5	20	36	7	3	8	17	

Source: Dataquest (September 1996)

Table B-6
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Scandinavia, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	5,014	5,823	8,889	11,400	12,500	13,700	16,800	19,000	16
Seats	5,282	6,090	9,187	11,700	12,700	13,800	16,900	19,100	16
Year-to-Year Increase (%)	-8	15	51	27	8	9	22	13	
Installed Base									
CPUs	23,983	25,678	30,496	37,500	45,600	53,100	60,200	66,200	17
Seats	26,582	27,824	32,287	39,000	46,900	54,300	61,400	67,400	16
Year-to-Year Increase (%)	5	5	16	21	20	16	13	10	
Revenue Data (U.S.$ Million)									
CPU Revenue	55	71	97	124	132	138	166	187	14
Terminal Revenue	6	5	5	4	2	2	1	1	-31
Peripheral Revenue	5	4	7	10	12	15	22	32	36
Hardware Revenue	66	80	109	138	146	155	190	219	15
Year-to-Year Increase (%)	-29	22	36	26	6	6	22	16	
Software Revenue	37	48	76	93	95	99	116	126	11
Year-to-Year Increase (%)	-15	29	57	23	2	4	17	9	
Software Service	12	20	27	32	32	32	35	37	6
Hardware Service	13	15	21	25	25	25	29	31	8
Service Revenue	25	36	48	57	57	57	65	68	7
Year-to-Year Increase (%)	-21	43	35	19	0	-1	13	6	
Total Factory Revenue	128	164	233	288	299	311	370	414	12
Year-to-Year Increase (%)	-24	28	42	24	4	4	19	12	

Source: Dataquest (September 1996)

Table B-7
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Spain, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	2,898	3,186	3,356	3,800	5,100	5,800	6,200	6,800	15
Seats	3,051	3,306	3,453	3,900	5,100	5,800	6,300	6,800	15
Year-to-Year Increase (%)	-28	8	4	12	32	14	7	9	
Installed Base									
CPUs	13,686	15,114	15,880	16,600	18,800	21,000	23,300	24,800	9
Seats	14,532	15,955	16,629	17,200	19,300	21,500	23,800	25,200	9
Year-to-Year Increase (%)	18	10	4	3	12	11	11	6	
Revenue Data (U.S.$ Million)									
CPU Revenue	24	33	34	38	51	57	60	66	14
Terminal Revenue	3	2	2	1	1	1	0	0	-32
Peripheral Revenue	2	2	2	3	4	5	6	7	25
Hardware Revenue	29	37	38	42	56	62	66	73	14
Year-to-Year Increase (%)	-43	26	1	13	31	11	7	10	
Software Revenue	19	25	28	30	38	41	42	44	10
Year-to-Year Increase (%)	-24	30	9	9	25	9	3	5	
Software Service	8	10	12	13	16	16	16	16	6
Hardware Service	6	7	7	8	10	11	11	11	10
Service Revenue	13	17	20	21	26	27	27	28	7
Year-to-Year Increase (%)	-13	26	16	7	24	5	0	2	
Total Factory Revenue	62	79	85	93	119	130	135	145	11
Year-to-Year Increase (%)	-33	27	7	10	28	9	4	7	

Source: Dataquest (September 1996)

Table B-8
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, United Kingdom, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	14,611	16,298	18,233	20,800	23,800	26,100	29,300	33,400	13
Seats	15,131	16,763	18,729	21,200	24,100	26,300	29,400	33,400	12
Year-to-Year Increase (%)	1	11	12	13	14	9	12	14	
Installed Base									
CPUs	62,376	69,192	77,383	86,800	99,100	110,300	119,800	126,600	10
Seats	66,798	72,773	80,366	89,300	101,200	112,200	121,700	128,400	10
Year-to-Year Increase (%)	10	9	10	11	13	11	8	6	
Revenue Data (U.S.$ Million)									
CPU Revenue	165	195	219	251	283	300	332	376	11
Terminal Revenue	13	11	10	7	5	3	2	1	-33
Peripheral Revenue	11	7	10	13	16	19	25	35	28
Hardware Revenue	189	214	239	271	303	321	359	412	11
Year-to-Year Increase (%)	-11	13	12	13	12	6	12	15	
Software Revenue	121	142	172	189	204	214	230	253	8
Year-to-Year Increase (%)	0	17	21	10	7	5	8	10	
Software Service	48	62	75	80	83	83	86	90	4
Hardware Service	39	43	51	55	59	60	64	70	7
Service Revenue	88	104	126	134	143	144	150	160	5
Year-to-Year Increase (%)	10	19	20	7	6	1	5	6	
Total Factory Revenue	398	461	537	594	649	679	739	825	9
Year-to-Year Increase (%)	-4	16	16	11	9	5	9	12	

Source: Dataquest (September 1996)

Table B-9
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Austria/Switzerland, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	1,053	2,348	5,099	5,300	6,100	6,900	7,700	8,500	11
Seats	1,082	2,368	5,124	5,300	6,200	6,900	7,700	8,500	11
Year-to-Year Increase (%)	43	119	116	4	15	13	11	10	
Installed Base									
CPUs	1,877	4,159	9,085	14,000	19,500	23,900	26,500	28,800	26
Seats	2,097	4,400	9,312	14,200	19,700	24,000	26,600	28,900	25
Year-to-Year Increase (%)	100	110	112	53	38	22	11	9	
Revenue Data (U.S.$ Million)									
CPU Revenue	17	23	41	43	49	53	58	64	9
Terminal Revenue	0	0	0	0	0	0	0	0	-36
Peripheral Revenue	2	1	2	2	3	4	4	6	21
Hardware Revenue	20	25	43	46	52	57	63	70	10
Year-to-Year Increase (%)	27	24	77	5	14	9	10	11	
Software Revenue	12	16	35	35	39	42	46	50	8
Year-to-Year Increase (%)	63	35	112	2	10	9	9	9	
Software Service	5	7	10	10	10	10	11	11	2
Hardware Service	5	5	7	7	8	8	8	8	2
Service Revenue	10	11	17	17	18	18	19	19	2
Year-to-Year Increase (%)	56	14	52	-2	6	2	2	3	
Total Factory Revenue	42	52	95	98	109	117	127	139	8
Year-to-Year Increase (%)	42	25	83	3	11	8	8	9	

Source: Dataquest (September 1996)

Table B-10
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Russia, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	24	117	589	700	900	1,100	1,300	1,500	21
Seats	24	117	589	700	900	1,100	1,300	1,500	21
Year-to-Year Increase (%)	NA	388	403	27	25	22	18	15	
Installed Base									
CPUs	24	141	731	1,500	2,400	3,300	4,100	4,800	46
Seats	24	141	731	1,500	2,400	3,300	4,100	4,800	46
Year-to-Year Increase (%)	NA	488	417	102	63	39	22	18	
Revenue Data (U.S.$ Million)									
CPU Revenue	1	2	4	6	7	9	10	12	21
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	0	0	0	0	1	1	1	1	15
Hardware Revenue	1	2	5	6	8	9	11	13	21
Year-to-Year Increase (%)	NA	199	124	31	26	18	17	14	
Software Revenue	0	1	4	5	5	6	7	8	15
Year-to-Year Increase (%)	NA	1,295	160	22	17	15	12	10	
Software Service	1	1	2	2	3	3	3	3	10
Hardware Service	0	0	1	1	1	1	1	2	16
Service Revenue	1	1	3	3	4	4	4	5	12
Year-to-Year Increase (%)	NA	53	95	22	16	9	7	5	
Total Factory Revenue	2	5	11	14	17	20	22	25	17
Year-to-Year Increase (%)	NA	191	127	26	20	15	13	11	

NA = Not applicable
Source: Dataquest (September 1996)

Table B-11
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Central Europe, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	999	1,263	2,256	2,700	3,400	3,900	4,400	5,400	19
Seats	1,030	1,249	2,276	2,700	3,400	3,900	4,400	5,400	19
Year-to-Year Increase (%)	10	21	82	19	25	15	13	23	
Installed Base									
CPUs	1,967	3,197	5,268	7,600	10,500	13,300	15,400	17,700	27
Seats	2,094	3,310	5,382	7,700	10,600	13,300	15,500	17,700	27
Year-to-Year Increase (%)	94	58	63	43	37	26	16	14	
Revenue Data (U.S.$ Million)									
CPU Revenue	18	20	28	34	43	48	54	66	19
Terminal Revenue	0	-	0	0	0	0	0	0	-30
Peripheral Revenue	1	1	1	2	2	3	4	6	35
Hardware Revenue	19	21	30	36	45	51	57	71	19
Year-to-Year Increase (%)	26	6	43	21	25	13	13	24	
Software Revenue	14	14	22	25	30	33	35	41	13
Year-to-Year Increase (%)	50	2	55	15	18	10	7	17	
Software Service	5	6	8	9	10	11	11	12	8
Hardware Service	5	4	6	7	9	9	10	12	13
Service Revenue	10	10	14	16	19	20	21	24	10
Year-to-Year Increase (%)	76	1	42	13	17	5	4	14	
Total Factory Revenue	43	45	66	77	94	103	113	136	16
Year-to-Year Increase (%)	43	4	47	17	21	10	9	20	

Source: Dataquest (September 1996)

Table B-12
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Rest of Europe, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	7,476	5,530	2,259	2,400	2,600	2,800	3,000	3,200	7
Seats	7,890	5,827	2,254	2,400	2,600	2,800	3,000	3,200	7
Year-to-Year Increase (%)	-11	-26	-61	5	10	8	7	6	
Installed Base									
CPUs	35,561	35,562	31,586	26,800	22,700	19,500	18,600	16,700	-12
Seats	37,627	37,533	33,089	27,900	23,400	19,900	19,000	17,000	-12
Year-to-Year Increase (%)	11	0	-12	-16	-16	-15	-5	-10	
Revenue Data (U.S.$ Million)									
CPU Revenue	55	43	27	29	32	34	36	38	7
Terminal Revenue	9	6	-	-	-	-	-	-	NA
Peripheral Revenue	3	3	0	0	0	0	0	0	2
Hardware Revenue	68	52	28	29	33	35	37	39	7
Year-to-Year Increase (%)	-38	-24	-47	7	11	6	6	5	
Software Revenue	46	34	23	23	24	25	26	27	3
Year-to-Year Increase (%)	-30	-25	-33	2	4	4	3	3	
Software Service	11	9	7	7	8	8	8	8	1
Hardware Service	10	7	6	6	6	6	6	6	2
Service Revenue	21	17	13	13	14	14	14	14	2
Year-to-Year Increase (%)	-42	-22	-21	0	5	1	1	1	
Total Factory Revenue	134	103	64	66	71	74	77	80	5
Year-to-Year Increase (%)	-36	-24	-38	4	7	4	4	4	

NA = Not applicable
Source: Dataquest (September 1996)

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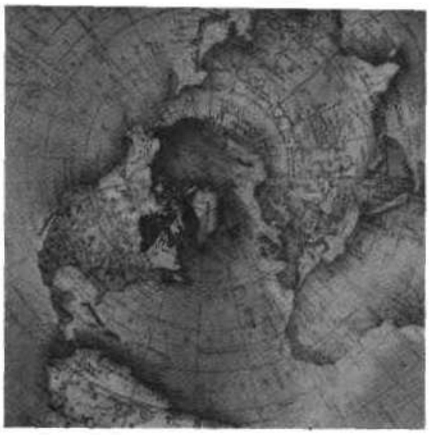

Dataquest

1995 Mechanical Asia/Pacific Forecast Update

Market Statistics

Program: Mechanical Applications Asia/Pacific
Product Code: CMEC-AP-MS-9602
Publication Date: September 30, 1996
Filing: Market Statistics

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Note: All tables show estimated data.

Chapter 1
1995 Mechanical CAD/CAM/CAE Asia/Pacific Forecast Update

About This Document

This document contains Dataquest's detailed forecast information on the mechanical CAD/CAM/CAE markets at the country level. This report is meant to supplement your worldwide mechanical CAD/CAM/CAE forecast book by providing mechanical CAD/CAM/CAE forecast detail for Asia/Pacific countries.

Although Dataquest does not forecast currency exchange rates, we do forecast with the best information available. The exchange rate is calculated as the simple arithmetic mean of the 12 average monthly rates for each country. For the purpose of this forecast, Dataquest assumes the July exchange rate will remain stable in the future (see Tables 1 and 2).

Additional market statistics publications for Dataquest's CAD/CAM/CAE and GIS services for 1996 are as follows:

Dataquest's 1995 Market Share document (published as CAEC-WW-MS-9601, CEDA-WW-MS-9601, and CMEC-WW-MS-9601) was sent to our clients in March.

Dataquest's 1995 forecast documents were released in May (published as CAEC-WW-MS-9602, CEDA-WW-MS-9602, and CMEC-WW-MS-9602).

Dataquest's 1995 market share data was verified, updated, and sent to our clients in August as a Market Share Update report (published as CAEC-WW-MS-9603, CEDA-WW-MS-9603, and CMEC-WW-MS-9603). Country-level data was made available at this time.

This document is an updated forecast that has been expanded to include country-level information and in-depth analysis.

Worldwide Forecast Assumptions

The following paragraphs describe the main forces driving the CAD/CAM/CAE and GIS worldwide software forecast. See Table 3 for worldwide forecast data.

All Applications

As CAD/CAM/CAE/GIS becomes more of a replacement market, market leaders would appear to have the upper hand; the cost of switching is high. However, software that lets users get a better product to market faster, software that helps eliminate business risks will always be in demand—regardless of market share. Thus there is always an opportunity for new vendors in technical markets.

The primary trend in design software function is toward operating at a higher level of abstraction. In all applications, we have seen an evolution of focus from "electronic paper" to component modeling, and now to

Table 1
CAD/CAM/CAE and GIS Revenue Growth Comparison
(U.S. Dollars versus Local Currency for Both Europe and Japan)

	1994	1995	Forecast 2000	Growth (%) 1994-1995	CAGR (%) 1995-2000
Europe (U.S.$ Million)					
Software Revenue	1,820.18	2,161.60	3,374.47	18.8	9.3
Hardware Revenue	2,591.56	2,807.99	5,017.48	8.4	12.3
Service Revenue	1,141.83	1,274.02	1,553.54	11.6	4.0
Total Factory Revenue	5,553.57	6,243.61	9,945.49	12.4	9.8
ECU/U.S.$ Exchange Rate*	0.84	0.77	0.80	-8.6	0.7
Europe (ECU Million)					
Software Revenue	1,535.50	1,666.38	2,691.40	8.5	10.1
Hardware Revenue	2,186.24	2,164.68	4,001.82	-1.0	13.1
Service Revenue	963.25	982.14	1,239.07	2.0	4.8
Total Factory Revenue	4,684.99	4,813.20	7,932.28	2.7	10.5
Japan (U.S.$ Million)					
Software Revenue	1,335.78	1,521.57	2,680.91	13.9	12.0
Hardware Revenue	2,143.29	2,286.92	4,063.64	6.7	12.2
Service Revenue	925.74	1,044.46	1,478.93	12.8	7.2
Total Factory Revenue	4,404.81	4,852.95	8,223.49	10.2	11.1
Japan/U.S.$ Exchange Rate*	110.85	93.90	105.94	-15.3	2.4
Japan (Yen Million)					
Software Revenue	148,071.13	142,875.66	284,015.37	-3.5	14.7
Hardware Revenue	237,583.90	214,741.36	430,502.52	-9.6	14.9
Service Revenue	102,618.14	98,074.81	156,678.33	-4.4	9.8
Total Factory Revenue	488,273.16	455,691.83	871,196.22	-6.7	13.8
North America (U.S.$ Million)					
Software Revenue	1,915.91	2,272.72	4,456.45	18.6	14.4
Hardware Revenue	2,482.33	2,776.43	6,289.30	11.8	17.8
Service Revenue	1,171.94	1,385.61	2,301.71	18.2	10.7
Total Factory Revenue	5,570.18	6,434.76	13,047.45	15.5	15.2
Worldwide (U.S.$ Million)					
Software Revenue	5,415.60	6,420.61	11,855.56	18.6	13.0
Hardware Revenue	7,667.54	8,418.59	17,092.16	9.8	15.2
Service Revenue	3,451.56	3,971.80	5,966.89	15.1	8.5
Total Factory Revenue	16,534.69	18,811.00	34,914.60	13.8	13.2

*Assuming a stable currency, the 2000 exchange rate is March 1996 exchange rate.
Source: Dataquest (March 1996)

Table 2
Foreign Currency per U.S. Dollar

		Actual			Current				Year-to-Year Change (%)					
Country	Currency	1991	1992	1993	1994	1995	1996	1997	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997
Austria	Schilling	11.67	10.95	11.65	11.40	10.06	10.55	10.58	-6.17	6.4	-2.1	-11.8	4.9	0.3
Belgium	Franc	34.13	32.02	34.67	33.66	29.42	30.84	30.95	-6.18	8.3	-2.9	-12.6	4.8	0.4
Denmark	Krone	6.39	6.02	6.49	6.35	5.59	5.80	5.80	-5.79	7.8	-2.2	-12.0	3.8	0
Finland	Markka	4.04	4.45	5.73	5.21	4.37	4.60	4.58	10.15	28.8	-9.1	-16.1	5.3	-0.4
France	Franc	5.64	5.27	5.67	5.54	4.97	5.09	5.09	-6.56	7.6	-2.3	-10.3	2.4	0
Germany	D-Mark	1.66	1.56	1.66	1.62	1.43	1.50	1.50	-6.02	6.4	-2.4	-11.7	4.9	0
Italy	Lira	1,238.93	1,227.75	1,577.85	1,609.34	1,628.21	1,545.31	1,526.82	-0.90	28.5	2.0	1.2	-5.1	-1.2
Netherlands	Guilder	1.87	1.75	1.86	1.82	1.60	1.68	1.69	-6.42	6.3	-2.2	-12.1	5.0	0.6
Norway	Krone	6.49	6.18	7.11	7.04	6.33	6.46	6.45	-4.78	15.0	-1.0	-10.1	2.1	-0.2
Spain	Peseta	103.81	101.90	127.87	133.48	124.40	126.29	126.96	-1.84	25.5	4.4	-6.8	1.5	0.5
Sweden	Krona	6.04	5.81	7.82	7.70	7.14	6.70	6.64	-3.81	34.6	-1.5	-7.3	-6.2	-0.9
Switzerland	Franc	1.43	1.40	1.48	1.37	1.18	1.22	1.23	-2.10	5.7	-7.4	-13.9	3.4	0.8
United Kingdom	Pound	0.57	0.57	0.67	0.65	0.63	0.65	0.64	0	17.5	-3.0	-3.1	3.9	-2.3
Europe Average	ECU	0.81	0.77	0.86	0.84	0.77	0.80	0.80	-4.86	11.4	-1.5	-8.7	3.6	0
China	Renminbi	5.33	5.51	5.76	8.54	8.35	8.34	8.34	3.38	4.5	48.3	-2.2	-0.1	0
Hong Kong	Dollar	7.77	7.74	7.74	7.73	7.74	7.74	7.74	-0.39	0	-0.1	0.1	0	0
Japan	Yen	134.59	126.34	110.85	101.56	93.90	107.93	109.19	-6.13	-12.3	-8.4	-7.5	14.9	1.2
Korea	Won	730.67	782.41	799.42	805.80	770.57	798.87	813.03	7.08	2.2	0.8	-4.4	3.7	1.8
Singapore	Dollar	1.73	1.63	1.62	1.53	1.43	1.41	1.42	-5.78	-0.9	-5.3	-6.5	-1.4	0.7
Taiwan	Dollar	26.49	24.93	26.15	26.45	26.48	27.50	27.57	-5.89	4.9	1.1	0.1	3.9	0.3

Source: Dataquest (March 1996)

system modeling. The eventual goal is the ability to fully simulate, evaluate, redesign, and test the design inside the computer prior to manufacture. At the same time, increased computing power is allowing the nature of design to evolve to include constituencies in manufacturing, product support, and from users themselves. Thus, the engineering process is being expanded to include input from a broader base.

At the same time, the nature of design data itself is expanding from a focus on geometry to include multiple data types—making the challenge of system modeling even more complex. Also, the World Wide Web holds the potential to expand the nature of collaborative design, by harnessing the joint power of anticipated increases in both computing power and communications bandwidth. Thus, there is little limit to the problems that design or GIS software can tackle. The primary challenge will continue to be developing robust, leading-edge software ahead of competitors. During the forecast period we anticipate significant, but not revolutionary, advances in the ability of the existing programmer pool to produce new software.

Mechanical Forecast Assumptions

New Interest in Mechanical CAD Technology

In 1995, we saw a mix of replacement business and new purchases for mechanical CAD technology, particularly in Europe and North America. Growth is picking up in nontraditional industries (those industries outside of aerospace, automotive, and industrial machinery). We expect this trend to continue, as mechanical modeling, analysis, design, and simulation software become more user-friendly. Closely linked to the use of mechanical CAD in new arenas is the availability of software on lower-cost platforms and the potential use of object technology to create customized industry- or application-specific solutions.

The product data management market has clearly found a worldwide interest. Within the past year, we have seen pilot programs move to full-scale production, support for new client platforms (Windows NT, Windows), integration with manufacturing resource planning (MRP) systems, and an emergence of parts/component management software. Product data management will be one of the significant drivers of the mechanical CAD market through 2000.

Growth in Asia/Pacific

The Asia/Pacific region is being fueled by CAD investments from local governments, multinational companies, and local initiatives (such as Indonesia's IPTN). Most of the sales to date are UNIX-based, but some of the future growth is expected to shift to NT.

Ground Shifts in Japan

Mechanical CAD/CAM/CAE growth in Japan is expected to undergo a significant shift in platform usage over our forecast period. The UNIX platform dominates the mechanical sector in Japan, despite the fact that the Japanese mechanical market still places a heavy emphasis on 2-D drafting instead of 3-D/solid modeling. We expect this drafting orientation to persist, and over next five years we anticipate a significant shift to more Windows NT-based systems at the expense of UNIX. This shift will not begin in earnest until 1997, when more NT-based applications are more widely available in Japan.

Windows NT

As of today, not all of the major mechanical CAD vendors have ported their products to the Windows NT platform. The lack of availability of Windows NT versions of some of the market-share-leading mechanical CAD packages, coupled with the fact that Europe has just completed its five-year investment cycle in mechanical CAD software, will mean that Windows NT will not begin to impact UNIX-based sales for at least a few more years.

AEC Forecast Assumptions

The Impact of Windows NT

Intergraph's shift to Windows NT has initiated the collapse of UNIX sales in North America, a trend expected to increase broadly in this cost-conscious application. At the same time, we expect growth in Windows NT from DOS-based users who find Windows 95 and successors less than reliable. The primary factor holding up growth in the large installed base of DOS users is their reluctance to buy the new hardware required for either Windows 95 or Windows NT.

The factors that should contribute to the long-term expansion of the AEC CAD industry are noted in the following sections.

CAD Is Becoming a Business Requirement

Large design firms are growing at the expense of smaller firms. These large end users increasingly require their employees and suppliers to adopt automation tools in the design and construction process. Smaller design firms must increasingly buy CAD systems or risk being dropped from consideration as a partner.

CAD purchases are increasingly justified as a competitive advantage in both sales and design reviews. Electronic design data is also required downstream by the designer's client—from the federal government down to the small commercial developer. Also, a significant pool of untapped users still exists. The relatively low market penetration of AEC CAD systems should allow steady worldwide growth during the next five years despite constant volatility in demand for the buildings and infrastructure to be designed.

New Features in AEC CAD Products Are Achievable

Better, lower-cost visualization tools will be in increasing demand as sales and communication tools. Data and database functions (versus graphics functions) are increasing in importance in AEC design systems, creating opportunities to sell users significant new functionality. Some vendors will create products that foster communications in the entire design, construction, and maintenance process—products that will increase the payoff in CAD investments.

The three trends that will inhibit growth in the AEC CAD industry are noted in the following sections.

Design Is Only Part of the Problem

AEC's one-design-one-build structure means CAD provides fewer economic benefits to these users than does the one-design-build-many structure of manufacturing. Construction, which is essentially a prototype build, is fraught with uncertainties and delays that are not well-addressed by AEC systems as they exist today. Design tools can only thrive in the AEC structure when they support more of the entire business problem. Based on Autodesk's increased commitment to progress in this arena, we have increased our forecast modestly; commitment to and cooperation on the problem from multiple vendors will allow us to increase the forecast growth rate further.

Poor Cooperation among Users

Users are poorly organized to take advantage of improved products, partly because of competition between engineering constructors and partly because designs are often split among several different companies representing different and competing aspects of the design process. New approaches to the design and construction process are appearing, allowing users to take full advantage of CAD tools. Still, many users in AEC will need to be shown leadership in working together, both from the very large, most competitive users, and from CAD vendors themselves.

Downturn in Germany

The German construction industry, which has been the driving force behind the high growth of the recent years, has come to an abrupt halt. Although other regions such as Italy are investing, Germany plays such a dominant role that it will drag down the overall European growth for AEC. The applications that are still growing even in Germany are facilities design/management as these are not dependent on the construction industry.

GIS/Mapping Forecast Assumptions

The Impact of Windows NT

Intergraph's move to Windows NT at the expense of UNIX will quickly make PC-based operating systems the dominant revenue stream in North America. In the long term, the GIS UNIX market is highly subject to erosion by Windows NT because of the appeal of better integration of GIS and Windows-based productivity tools, an appealing prospect to many GIS users.

The factors that should contribute to the long-term expansion of the GIS market are noted in the following sections.

"Open GIS"

The thrust of the Open GIS Foundation has been to allow some fresh air into a market that was getting a bit inbred. The nature of GIS data is under greater scrutiny, and several vendors are embarking on different, creative directions. Ultimately, much of "spatial analysis" will be embedded into other applications, rather than known as a GIS. Nonetheless, a fresh approach to spatial analysis is creating new opportunities for more useful solutions in traditional GIS environments.

Abundant Supply of Prospective Buyers

Penetration is still moderately low among core users. Bread-and-butter prospects in government and utilities are charged with maintaining information on land and assets in perpetuity. Many of these prospective buyers are still using paper maps, which will degrade over time, or have only entry-level systems in terms of value delivered. This creates a certain inevitability to moving from paper maps computer-based models.

New Technologies Will Drive Growth

Faster, cheaper computers will be continually leveraged to support new software products. Widespread computer industry developments in open, distributed systems supporting high-speed networking will make it possible for GIS technology to broadly expand the user base. Lower cost, higher resolution satellite imagery holds the potential to drive another explosion in GIS market growth among users who cannot afford aerial photography. Advances in aerial photography, global positioning systems (GPSs), and laser range finders are making it possible to create GISs that are significantly cheaper, more accurate, and more complete than existing paper maps, giving experienced users some compelling reasons to reinvest. Portable and pen-based computers are bringing GIS to new users in field operations. Finally, database companies themselves are gaining a better understanding of spatial analysis, a key factor in spreading use of GIS systems more broadly.

Data Will Drive Growth

The GIS business market is driving high growth on PCs. However, we see a wide band of uncertainty surrounding the clearly growing revenue opportunity from new applications. Several new applications in GIS are destined to become a relatively low revenue-producing feature in another software program (and market), rather than a standalone product in the GIS market. At the same time, data is increasing in value relative to software in this low-end market.

GIS has attained a certain indispensability, particularly among federal users and in utilities. As a result, users are beginning to expect to share the data that lies in their various GIS systems. Within three years, we expect data to be readily exchangeable across different systems. At that point, shareable data will help drive market growth.

Several factors seriously constraining the long-term expansion of the GIS market are noted in the following sections.

High Cost of Entry Remains a Barrier

There will remain an uncertain, but certainly high, cost of creating a working GIS system in traditional environments. No magic will emerge to create a low-cost, meaningful data set for mainstream customers in government and utilities. Data conversion will remain costly because the significant cost of correcting prior errors and omissions on paper maps is inevitably bundled into the cost of "conversion."

Price Pressures Inhibit Growth

Price pressure will hold down total revenue. Innovation is the only way to maintain prices in any software industry, and GIS vendors will struggle in their attempt to create compelling new applications and improved investment payoff for customers.

Electronic Design Automation Forecast Assumptions

The EDA software market grew 17.5 percent in 1995. Over the next five years, growth will continue to be fueled by continuing increasing design complexity and ever-higher speeds. The semiconductor downturn is a fact of life. Although many people expect a similar downturn in EDA sales, this is not the case. Semiconductor downturns, an indication of an electronic hardware downturn, actually increase EDA sales as companies design their way out of the recession. The EDA market typically sees its downturn three years later. Dataquest therefore predicts growth to drop off—to about 10 percent in 1999.

Electronic CAE

Design complexity is forcing a large-scale swap: Gate-level users are swapping up to register-transfer level (RTL) while RTL users are swapping up to electronic-system level (ESL) tools. RTL tools are beginning to appear on Windows NT, competing with UNIX-based tools, while the ESL tools will remain UNIX-based. The second wave, those FPGA/CPLD designers moving up to the RTL, are starting to make an impact on the numbers.

IC Layout

Final results show the IC layout market growing at 29.6 percent—a little lower that the preliminary data, but strong nonetheless. Design complexity and high speed are forcing replacement of obsolete tools, driving this high growth. This is primarily a replacement market of very high-cost tools and very few players. The ensuing frenzy for market share is the result. The few PC-based tools in this market are being replaced by UNIX-class tools in North America, and Windows NT will not be a factor in this market. In fact, this is the market that is demanding a "standard" 64-bit operating system. If UNIX repeats its 32-bit performance, these guys could wait for a 64-bit Windows NT.

PCB/MCM/Hybrid

The printed circuit board (PCB) market grew 4.7 percent in 1995. The swap out of old tools continues for the second year. The most significant shift has been the acceptance of Windows NT as the operating system of choice in the PCB design world. It will not happen overnight, as swap out in this segment is slower than in CAE and IC layout, but it will happen.

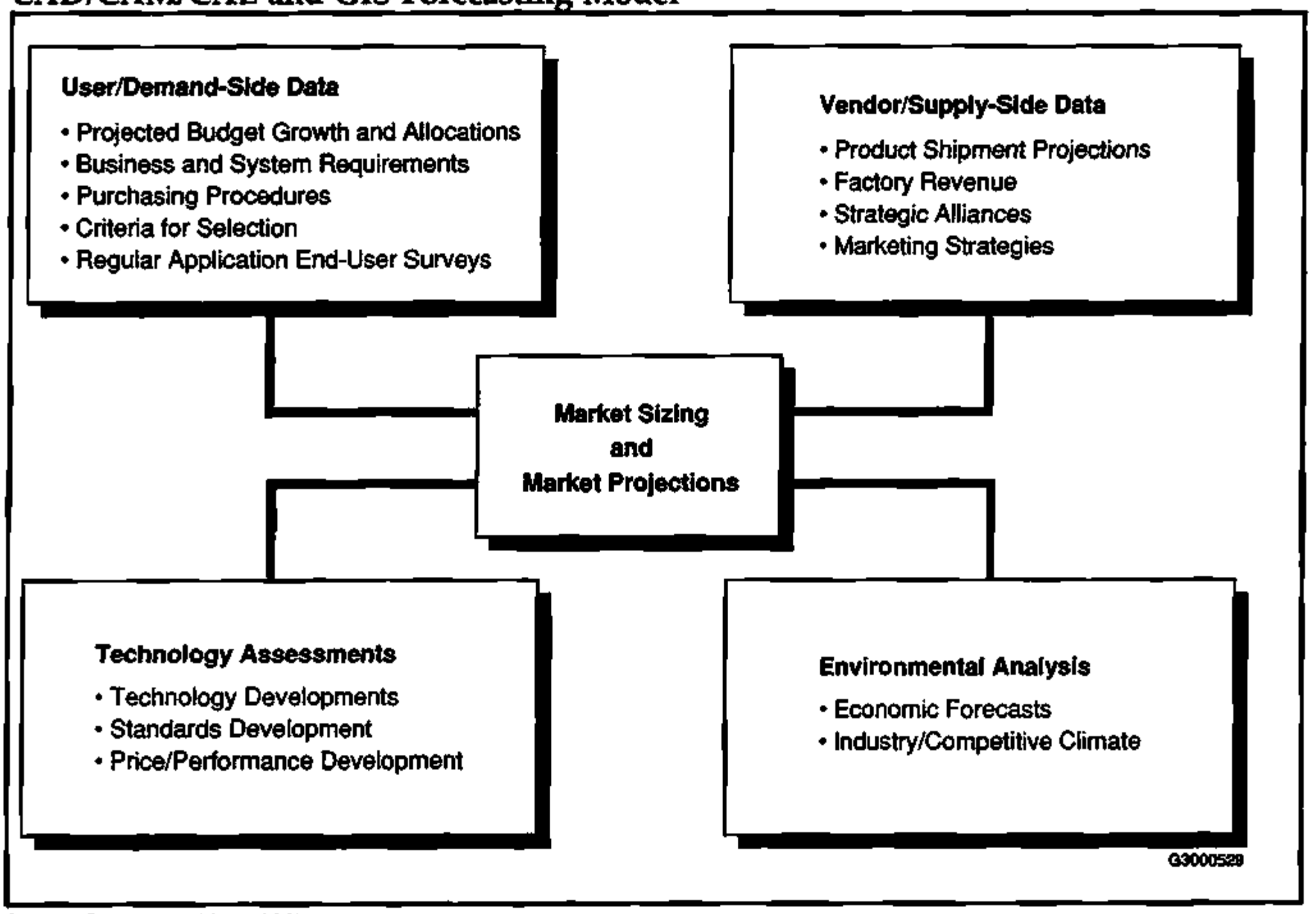
Forecast Methodology

Fundamental to the way Dataquest conducts its research is the underlying philosophy that the best data and analyses come from a well-balanced program. This program includes the following: balance between primary and secondary collection techniques; balance between supply-side and demand-side analysis; balance between focused, industry-specific research and coordinated, "big-picture" analysis aided by integration of data from the more than 25 separate high-technology industries Dataquest covers; and balance between the perspectives of experienced industry professionals and rigorous, disciplined techniques of seasoned market researchers.

Dataquest also analyzes trends in the macro environment, which can have major influences on both supply-side and demand-side forecasting. In addition to demographics, analysts look at gross national product (GNP) growth, interest rate fluctuation, business expectations, and capital spending plans. In the geopolitical arena, the group looks at trade issues, political stability or lack thereof, tariffs, nontariff barriers, and such factors as the effect on Europe of the events of 1995.

Figure 1 shows the CAD/CAM/CAE and GIS forecasting model. The overall forecasting process uses a combination of techniques such as

Figure 1
CAD/CAM/CAE and GIS Forecasting Model



Source: Dataquest (May 1996)

time series and technological modeling. Market estimates and forecasts are derived using the following research techniques:

- Segment forecasting—Individual forecasts are derived for each application segment tracked by the CAD/CAM/CAE and GIS group. Specifically, each application, segmented by region and platform, is forecast and rolled up. In this way, each application segment incorporates its own set of unique assumptions.
- Demand-based analysis—Market growth is tracked and forecast in terms of the present and anticipated demand of current and future users. This requires the development of a total available market model and a satisfied available market figure to assess the levels of penetration accurately. Dataquest analysts also factor in the acceptance or ability for users to consume new technology.
- 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, capacity limitations are capable of keeping shipments below the demand level.

Segmentation Definitions

Operating Systems

The following defines the operating systems:

- UNIX—UNIX includes all UNIX variants and older workstation operating systems.
- Host—Host includes minicomputer and mainframe operating systems in which external workstations' functions are dependent on a host computer.
- Windows NT—Windows NT is the Microsoft operating system.
- PC—PC includes DOS, Windows, Windows 95, OS/2, and Apple operating systems.

Line Items

Line item definitions are as follows:

- Average selling price (ASP) is defined as the average price of a product, inclusive of any discounts.
- CPU revenue is the portion of revenue derived from a system sale that is related to the value of the CPU.
- CPU shipment is defined as the number of CPUs delivered.
- CPU installed base is defined as the total number of CPUs in active, day-to-day use.
- Unit shipment is defined as the number of products delivered (that is, seats).

- Seats are defined as the number of possible simultaneous users.
- Installed seats are defined as the total number of seats in active, day-to-day use.
- Hardware revenue is defined as the sum of the revenue from the hardware system components: CPU revenue, terminal revenue, and peripherals revenue.
- Peripherals revenue is defined as the value of all the peripherals from turnkey sale. (Peripherals in this category typically are input and output devices.)
- Terminal revenue is defined as revenue derived from the sale of terminals used to graphically create, analyze, or manipulate designs. The term is applicable only to the host systems.
- Software revenue is revenue derived from the sale of application software.
- Service revenue is defined as revenue derived from the service and support of CAD/CAM/CAE or GIS systems. Service is followed as software service and hardware service.
- Total factory revenue is defined as the amount of money received for goods measured in U.S. dollars and is the sum of hardware, software, and service revenue.

Table 3
CAD/CAM/CAE/GIS Software History and Forecast
Top-Level Worldwide Forecast, All Applications, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue (U.S.$ Million)									
Worldwide, All Operating Systems	4,881	5,416	6,421	7,446	8,419	9,500	10,664	11,856	13.0
Worldwide									
UNIX	3,371	3,815	4,377	4,901	5,351	5,751	6,181	6,607	8.6
Windows NT	5	115	381	724	1,087	1,595	2,160	2,762	48.6
Personal Computer	1,188	1,307	1,511	1,710	1,908	2,107	2,292	2,464	10.3
Host/Proprietary	317	178	152	111	73	47	32	22	-31.9
All Operating Systems									
North America	1,749	1,916	2,273	2,684	3,096	3,548	4,006	4,456	14.4
Europe	1,598	1,820	2,162	2,385	2,605	2,855	3,105	3,374	9.3
Japan	1,234	1,336	1,522	1,773	1,948	2,164	2,429	2,681	12.0
Asia/Pacific	208	253	362	484	631	770	930	1,095	24.8
Rest of World	93	90	103	120	139	162	195	249	19.3
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.9	18.6	16.0	13.1	12.8	12.3	11.2	
Worldwide									
UNIX		13.2	14.7	12.0	9.2	7.5	7.5	6.9	
Windows NT		2116.0	231.4	90.1	50.1	46.7	35.4	27.9	
Personal Computer		10.0	15.6	13.2	11.6	10.4	8.8	7.5	
Host/Proprietary		-43.7	-15.0	-26.8	-34.1	-35.7	-32.6	-29.8	
All Operating Systems									
North America		9.5	18.6	18.1	15.3	14.6	12.9	11.2	
Europe		13.9	18.8	10.3	9.2	9.6	8.7	8.7	
Japan		8.3	13.9	16.5	9.9	11.1	12.2	10.4	
Asia/Pacific		22.1	42.7	33.9	30.4	22.0	20.7	17.8	
Rest of World		-3.0	14.2	16.8	15.4	16.4	20.8	27.5	

Source: Dataquest (April 1996)

Table A-1
CAD/CAM/CAE/GIS Software History and Forecast
Top-Level Mechanical Forecast, Worldwide, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue (U.S.$ Million)									
Worldwide, All Operating Systems	2,253	2,490	3,011	3,430	3,798	4,143	4,513	4,903	10.2
Worldwide									
UNIX	1,566	1,849	2,212	2,528	2,759	2,930	3,113	3,298	8.3
Windows NT	1	41	117	213	339	499	666	844	48.4
Personal Computer	449	469	563	602	640	675	707	741	5.7
Host/Proprietary	237	131	118	86	60	39	27	20	-30.2
All Operating Systems									
North America	700	764	850	963	1,099	1,238	1,368	1,501	12.0
Europe	785	851	1,084	1,204	1,294	1,376	1,493	1,642	8.7
Japan	669	749	897	1,039	1,129	1,202	1,271	1,331	8.2
Asia/Pacific	72	94	137	175	223	269	316	358	21.1
Rest of World	27	32	42	49	53	59	65	72	11.2
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.5	20.9	13.9	10.7	9.1	8.9	8.6	
Worldwide									
UNIX		18.1	19.7	14.3	9.2	6.2	6.2	6.0	
Windows NT		2,715.2	183.1	81.7	58.9	47.2	33.6	26.8	
Personal Computer		4.6	19.9	7.0	6.2	5.5	4.8	4.8	
Host/Proprietary		-44.9	-9.6	-27.0	-30.4	-34.3	-31.1	-27.9	
All Operating Systems									
North America		9.2	11.3	13.2	14.2	12.6	10.5	9.8	
Europe		8.4	27.3	11.1	7.4	6.4	8.5	10.0	
Japan		12.0	19.8	15.9	8.7	6.4	5.8	4.7	
Asia/Pacific		30.7	45.5	27.2	27.7	20.3	17.7	13.0	
Rest of World		15.5	32.8	15.4	9.3	10.6	10.7	10.0	

Source: Dataquest (September 1996)

Table B-1
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Asia/Pacific, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	13,884	17,508	22,846	30,600	39,900	50,100	61,400	73,200	26
Seats	14,187	18,183	23,730	31,400	40,500	50,600	61,800	73,500	25
Year-to-Year Increase (%)	71	28	31	32	29	25	22	19	
Installed Base									
CPUs	30,824	45,800	64,942	88,200	119,500	153,700	187,700	221,300	28
Seats	33,583	48,436	67,754	91,300	122,800	157,200	191,500	225,200	27
Year-to-Year Increase (%)	55	44	40	35	35	28	22	18	
Revenue Data (U.S.$ Million)									
CPU Revenue	99	135	183	241	315	379	448	518	23
Terminal Revenue	6	12	14	12	8	7	5	5	-20
Peripheral Revenue	9	11	15	22	31	45	70	121	51
Hardware Revenue	113	157	212	274	354	430	524	643	25
Year-to-Year Increase (%)	17	39	35	29	29	21	22	23	
Software Revenue	72	94	137	175	223	269	316	358	21
Year-to-Year Increase (%)	45	31	46	27	28	20	18	13	
Software Service	27	36	49	59	73	83	94	102	16
Hardware Service	20	25	36	44	54	61	67	72	15
Service Revenue	47	61	86	103	127	144	161	175	15
Year-to-Year Increase (%)	42	31	40	21	23	13	12	9	
Total Factory Revenue	232	313	435	552	704	843	1,001	1,176	22
Year-to-Year Increase (%)	29	35	39	27	28	20	19	17	

Source: Dataquest (September 1996)

Table B-2
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, China, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	1,127	1,432	1,786	2,700	3,800	5,100	6,400	7,600	34
Seats	1,183	1,468	1,835	2,700	3,900	5,100	6,400	7,700	33
Year-to-Year Increase (%)	-11	24	25	49	42	32	26	19	
Installed Base									
CPUs	3,469	4,615	5,908	7,900	10,900	14,700	18,800	22,900	31
Seats	3,922	4,968	6,192	8,100	11,100	14,900	19,000	23,100	30
Year-to-Year Increase (%)	29	27	25	31	37	34	28	22	
Revenue Data (U.S.$ Million)									
CPU Revenue	14	16	21	30	42	53	64	74	29
Terminal Revenue	1	0	0	0	0	0	0	0	-12
Peripheral Revenue	1	1	1	2	4	6	10	18	66
Hardware Revenue	16	18	22	33	46	59	74	93	33
Year-to-Year Increase (%)	-10	12	27	46	41	28	26	24	
Software Revenue	10	11	15	22	31	39	48	56	29
Year-to-Year Increase (%)	9	12	34	43	40	29	23	15	
Software Service	4	5	6	8	11	13	15	17	22
Hardware Service	3	3	5	6	8	10	11	12	21
Service Revenue	7	8	11	15	19	23	26	29	22
Year-to-Year Increase (%)	10	13	34	35	32	20	15	9	
Total Factory Revenue	33	37	49	69	96	122	149	177	30
Year-to-Year Increase (%)	-1	12	31	42	39	27	23	19	

Source: Dataquest (September 1996)

Table B-3
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Hong Kong, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	1,503	1,467	1,688	2,000	2,400	2,800	3,300	3,800	18
Seats	1,525	1,491	1,716	2,100	2,400	2,800	3,300	3,800	17
Year-to-Year Increase (%)	24	-2	15	20	16	18	18	17	
Installed Base									
CPUs	3,838	4,999	6,187	7,300	8,700	10,100	11,400	12,500	15
Seats	4,156	5,228	6,359	7,500	8,900	10,200	11,500	12,700	15
Year-to-Year Increase (%)	42	26	22	18	18	15	13	10	
Revenue Data (U.S.$ Million)									
CPU Revenue	12	13	15	18	20	23	26	30	14
Terminal Revenue	1	0	0	0	0	0	0	0	-22
Peripheral Revenue	1	1	2	2	3	4	5	8	36
Hardware Revenue	15	14	17	20	23	27	31	38	17
Year-to-Year Increase (%)	2	-2	22	17	15	15	17	20	
Software Revenue	9	9	11	12	14	15	17	19	12
Year-to-Year Increase (%)	19	-8	28	13	12	12	12	10	
Software Service	3	3	4	4	5	5	5	5	6
Hardware Service	3	2	3	3	4	4	4	4	7
Service Revenue	6	6	7	8	8	9	9	10	6
Year-to-Year Increase (%)	55	-1	29	7	8	5	6	5	
Total Factory Revenue	29	28	35	40	45	51	58	67	13
Year-to-Year Increase (%)	14	-4	25	14	13	12	14	15	

Source: Dataquest (September 1996)

Table B-4
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Korea, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	3,114	4,024	5,208	6,600	8,600	10,800	13,500	16,200	25
Seats	3,163	4,236	5,431	6,800	8,700	10,900	13,600	16,200	25
Year-to-Year Increase (%)	102	34	28	26	28	25	25	19	
Installed Base									
CPUs	6,017	9,629	14,220	19,400	26,100	33,300	40,600	48,000	28
Seats	6,634	10,269	14,920	20,100	27,000	34,200	41,600	49,100	27
Year-to-Year Increase (%)	68	55	45	35	34	27	22	18	
Revenue Data (U.S.$ Million)									
CPU Revenue	20	29	39	48	62	74	89	103	22
Terminal Revenue	1	4	4	3	2	2	2	1	-18
Peripheral Revenue	2	4	4	5	7	10	15	25	46
Hardware Revenue	23	37	46	56	71	85	106	130	23
Year-to-Year Increase (%)	28	59	24	21	27	20	24	23	
Software Revenue	13	20	29	35	45	54	66	75	21
Year-to-Year Increase (%)	60	45	49	21	28	21	22	14	
Software Service	7	9	12	14	17	20	23	26	17
Hardware Service	4	5	7	8	10	11	12	13	12
Service Revenue	11	14	19	22	27	31	36	39	15
Year-to-Year Increase (%)	72	26	42	14	23	14	16	10	
Total Factory Revenue	48	70	95	113	143	170	207	244	21
Year-to-Year Increase (%)	45	48	35	20	26	19	22	18	

Source: Dataquest (September 1996)

Table B-5
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Singapore, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	1,205	1,273	1,490	1,800	2,100	2,500	2,900	3,400	18
Seats	1,269	1,386	1,705	2,000	2,200	2,600	3,000	3,500	15
Year-to-Year Increase (%)	23	9	23	16	13	15	17	16	
Installed Base									
CPUs	2,806	3,913	5,071	6,300	7,700	9,000	10,200	11,300	17
Seats	3,097	4,250	5,558	6,900	8,300	9,800	11,000	12,100	17
Year-to-Year Increase (%)	56	37	31	24	22	17	13	10	
Revenue Data (U.S.$ Million)									
CPU Revenue	13	14	16	19	21	24	27	31	14
Terminal Revenue	1	2	4	3	2	2	1	1	-22
Peripheral Revenue	1	1	1	1	2	2	4	6	39
Hardware Revenue	14	17	21	23	26	28	32	38	12
Year-to-Year Increase (%)	21	24	23	10	9	10	14	17	
Software Revenue	9	10	11	13	15	17	19	22	14
Year-to-Year Increase (%)	40	8	18	15	15	14	14	12	
Software Service	3	4	5	5	6	6	7	8	11
Hardware Service	3	3	3	4	4	4	4	5	6
Service Revenue	6	7	8	9	10	11	12	12	9
Year-to-Year Increase (%)	4	10	18	9	11	8	10	8	
Total Factory Revenue	29	34	41	45	50	56	63	72	12
Year-to-Year Increase (%)	22	16	21	11	11	11	13	14	

Source: Dataquest (September 1996)

Table B-6
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Taiwan, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	3,358	3,880	4,902	6,000	7,200	8,800	10,700	12,700	21
Seats	3,395	4,007	5,122	6,200	7,300	8,900	10,700	12,700	20
Year-to-Year Increase (%)	174	18	28	21	18	21	21	18	
Installed Base									
CPUs	5,562	9,154	13,592	18,200	23,600	28,700	33,400	38,200	23
Seats	5,978	9,572	14,121	18,800	24,300	29,500	34,200	39,100	23
Year-to-Year Increase (%)	106	60	48	33	29	21	16	14	
Revenue Data (U.S.$ Million)									
CPU Revenue	19	22	28	34	40	47	55	63	17
Terminal Revenue	1	3	4	3	2	2	1	1	-22
Peripheral Revenue	2	1	2	2	3	4	6	10	42
Hardware Revenue	22	26	34	39	45	52	62	74	17
Year-to-Year Increase (%)	47	16	31	15	15	16	19	20	
Software Revenue	15	17	22	26	31	37	44	50	18
Year-to-Year Increase (%)	106	14	33	17	20	18	19	14	
Software Service	5	6	8	9	10	12	14	16	14
Hardware Service	3	4	5	5	6	6	6	7	7
Service Revenue	8	10	13	14	16	18	20	22	12
Year-to-Year Increase (%)	58	18	35	10	13	11	13	10	
Total Factory Revenue	45	52	69	79	92	107	127	147	16
Year-to-Year Increase (%)	65	16	33	15	16	16	18	16	

Source: Dataquest (September 1996)

Table B-7
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Rest of Asia, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	3,577	5,432	7,772	11,400	15,800	20,200	24,600	29,500	31
Seats	3,652	5,595	7,921	11,600	15,900	20,300	24,700	29,500	30
Year-to-Year Increase (%)	90	53	42	46	38	27	21	20	
Installed Base									
CPUs	9,132	13,489	19,965	29,200	42,500	57,900	73,300	88,300	35
Seats	9,795	14,150	20,603	29,800	43,200	58,700	74,100	89,100	34
Year-to-Year Increase (%)	43	44	46	45	45	36	26	20	
Revenue Data (U.S.$ Million)									
CPU Revenue	21	40	64	93	129	158	186	217	27
Terminal Revenue	1	2	1	1	1	1	1	1	-14
Peripheral Revenue	1	3	5	8	13	19	31	54	59
Hardware Revenue	23	45	71	103	143	179	218	271	31
Year-to-Year Increase (%)	17	93	58	44	40	25	22	24	
Software Revenue	16	29	49	67	88	106	121	136	23
Year-to-Year Increase (%)	45	81	69	37	32	20	15	12	
Software Service	5	10	14	19	24	27	29	31	16
Hardware Service	4	8	13	17	23	26	29	31	20
Service Revenue	9	18	27	36	46	53	58	62	18
Year-to-Year Increase (%)	62	102	56	32	29	14	9	8	
Total Factory Revenue	48	91	147	205	278	337	397	469	26
Year-to-Year Increase (%)	32	91	61	40	35	21	18	18	

Source: Dataquest (September 1996)

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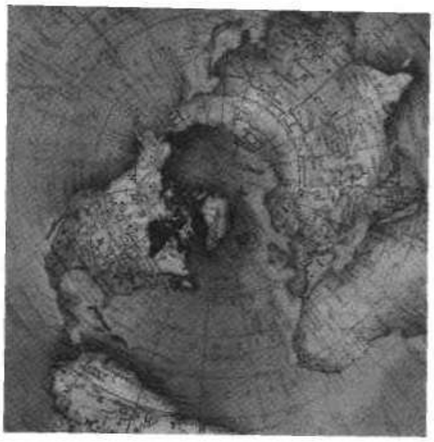

Dataquest

Mechanical CAD/CAM/CAE Forecast Update

Market Statistics

Program: Mechanical CAD/CAM/CAE Worldwide
Product Code: CMEC-WW-MS-9604
Publication Date: September 23, 1996
Filing: Market Statistics

Mechanical CAD/CAM/CAE Forecast Update

Market Statistics

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Mechanical CAD/CAM/CAE Forecast Update

Introduction

Dataquest's CAD/CAM/CAE and GIS forecast is based on market share software revenue gathered primarily during the first quarter of 1996. Dataquest's software forecast for all CAD/CAM/CAE and GIS applications includes:

- Three-year historical software and hardware revenue by region and operating system
- Five-year forecast of software, hardware, and service revenue by region and operating system
- Three-year history and five-year forecast of hardware shipments and installed base data

Although Dataquest does not forecast currency exchange rates, we do forecast with the best information available. The exchange rate is calculated as the simple arithmetic mean of the 12 average monthly rates for each country. For the purpose of this forecast, Dataquest assumes the July exchange rate will remain stable in the future (see Tables 1 and 2).

Additional market statistics publications for Dataquest's CAD/CAM/CAE and GIS services for 1996 are as follows:

- Dataquest's 1995 Market Share document (published as CAEC-WW-MS-9601, CEDA-WW-MS-9601, and CMEC-WW-MS-9601) was sent to our clients in March.
- Dataquest's 1995 forecast documents were released in May (published as CAEC-WW-MS-9602, CEDA-WW-MS-9602, and CMEC-WW-MS-9602).
- Dataquest's 1995 market share data was verified, updated, and sent to our clients in August as a Market Share Update report (published as CAEC-WW-MS-9603, CEDA-WW-MS-9603, and CMEC-WW-MS-9603). Country-level data was made available at this time.

This document is an updated forecast that has been expanded to include country-level information and in-depth analysis.

Worldwide Forecast Assumptions

The following section describes the main forces driving the CAD/CAM/CAE and GIS worldwide software forecast. See Table 3 for worldwide forecast data.

Table 1
CAD/CAM/CAE and GIS Revenue Growth Comparison
(U.S. Dollars versus Local Currency for Both Europe and Japan)

	1994	1995	Forecast 2000	Growth (%) 1994-1995	CAGR (%) 1995-2000
Europe (U.S.$ Million)					
Software Revenue	1,722.19	2,098.63	3,162.67	21.9	8.5
Hardware Revenue	2,564.26	2,875.36	5,198.78	12.1	12.6
Service Revenue	1,105.03	1,322.33	1,732.88	19.7	5.6
Total Factory Revenue	5,391.48	6,296.32	10,094.33	16.8	9.9
ECU/U.S$ Exchange Rate*	0.84	0.77	0.80	-8.7	0.7
Europe (ECU Million)					
Software Revenue	1,452.84	1,615.95	2,522.47	11.2	9.3
Hardware Revenue	2,163.21	2,214.03	4,146.42	2.3	13.4
Service Revenue	932.20	1,018.20	1,382.10	9.2	6.3
Total Factory Revenue	4,548.25	4,848.17	8,050.99	6.6	10.7
Japan (U.S.$ Million)					
Software Revenue	1,390.78	1,619.06	2,734.07	16.4	11.0
Hardware Revenue	2,473.61	2,708.99	5,059.97	9.5	13.3
Service Revenue	1,015.66	1,205.87	1,862.75	18.7	9.1
Total Factory Revenue	4,880.05	5,533.92	9,656.80	13.4	11.8
Japan/U.S.$ Exchange Rate*	101.56	93.90	107.93	-7.5	2.8
Japan (Yen Million)					
Software Revenue	141,247.93	152,029.54	295,088.20	7.6	14.2
Hardware Revenue	251,219.54	254,374.60	546,123.10	1.3	16.5
Service Revenue	103,150.46	113,230.97	201,046.82	9.8	12.2
Total Factory Revenue	495,617.94	519,635.11	1,042,258.12	4.8	14.9

(Continued)

Table 1 (Continued)
CAD/CAM/CAE and GIS Revenue Growth Comparison
(U.S. Dollars versus Local Currency for Both Europe and Japan)

	1994	1995	Forecast 2000	Growth (%) 1994-1995	CAGR (%) 1995-2000
North America (U.S.$ Million)					
Software Revenue	1,874.61	2,153.26	4,163.06	14.9	14.1
Hardware Revenue	2,533.51	2,750.34	6,025.62	8.6	17.0
Service Revenue	1,184.42	1,430.03	2,458.27	20.7	11.4
Total Factory Revenue	5,592.53	6,333.63	12,646.95	13.3	14.8
Worldwide (U.S.$ Million)					
Software Revenue	5,340.51	6,342.95	11,434.70	18.8	12.5
Hardware Revenue	8,099.47	8,986.02	18,392.56	10.9	15.4
Service Revenue	3,528.29	4,254.57	6,826.12	20.6	9.9
Total Factory Revenue	16,968.27	19,583.55	36,653.38	15.4	13.4

*Assuming a stable currency, the 2000 exchange rate is July 1996 monthly rate.

Source: Dataquest (August 1996)

Table 2
Foreign Currency/U.S. Dollar

		Actual					Current		Year-to-Year Change (%)					
Country	Currency	1991	1992	1993	1994	1995	1996	1997	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997
Austria	Schilling	11.67	10.95	11.65	11.40	10.06	10.55	10.58	-6.17	6.4	-2.1	-11.8	4.9	0.3
Belgium	Franc	34.13	32.02	34.67	33.66	29.42	30.84	30.95	-6.18	8.3	-2.9	-12.6	4.8	0.4
Denmark	Krone	6.39	6.02	6.49	6.35	5.59	5.80	5.80	-5.79	7.8	-2.2	-12.0	3.8	0
Finland	Markka	4.04	4.45	5.73	5.21	4.37	4.60	4.58	10.15	28.8	-9.1	-16.1	5.3	-0.4
France	Franc	5.64	5.27	5.67	5.54	4.97	5.09	5.09	-6.56	7.6	-2.3	-10.3	2.4	0
Germany	D-Mark	1.66	1.56	1.66	1.62	1.43	1.50	1.50	-6.02	6.4	-2.4	-11.7	4.9	0
Italy	Lira	1,238.93	1,227.75	1,577.85	1,609.34	1,628.21	1,545.31	1,526.82	-0.90	28.5	2.0	1.2	-5.1	-1.2
Netherlands	Guilder	1.87	1.75	1.86	1.82	1.60	1.68	1.69	-6.42	6.3	-2.2	-12.1	5.0	0.6
Norway	Krone	6.49	6.18	7.11	7.04	6.33	6.46	6.45	-4.78	15.0	-1.0	-10.1	2.1	-0.2
Spain	Peseta	103.81	101.90	127.87	133.48	124.40	126.29	126.96	-1.84	25.5	4.4	-6.8	1.5	0.5
Sweden	Krona	6.04	5.81	7.82	7.70	7.14	6.70	6.64	-3.81	34.6	-1.5	-7.3	-6.2	-0.9
Switzerland	Franc	1.43	1.40	1.48	1.37	1.18	1.22	1.23	-2.10	5.7	-7.4	-13.9	3.4	0.8
United Kingdom	Pound	0.57	0.57	0.67	0.65	0.63	0.65	0.64	0	17.5	-3.0	-3.1	3.9	-2.3
Europe Average	ECU	0.81	0.77	0.86	0.84	0.77	0.80	0.80	-4.86	11.4	-1.5	-8.7	3.6	0
China	Renminbi	5.33	5.51	5.76	8.54	8.35	8.34	8.34	3.38	4.5	48.3	-2.2	-0.1	0
Hong Kong	Dollar	7.77	7.74	7.74	7.73	7.74	7.74	7.74	-0.39	0	-0.1	0.1	0	0
Japan	Yen	134.59	126.34	110.85	101.56	93.90	107.93	109.19	-6.13	-12.3	-8.4	-7.5	14.9	1.2
Korea	Won	730.67	782.41	799.42	805.80	770.57	798.87	813.03	7.08	2.2	0.8	-4.4	3.7	1.8
Singapore	Dollar	1.73	1.63	1.62	1.53	1.43	1.41	1.42	-5.78	-0.9	-5.3	-6.5	-1.4	0.7
Taiwan	Dollar	26.49	24.93	26.15	26.45	26.48	27.50	27.57	-5.89	4.9	1.1	0.1	3.9	0.3

Source: Dataquest (August 1996)

Table 3
CAD/CAM/CAE/GIS Software History and Forecast
Top Level Worldwide Forecast, All Applications, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	1995-2000 CAGR (%)
Software Revenue (M$)									
Worldwide, All Operating Systems	4,814	5,341	6,343	7,221	8,148	9,193	10,142	11,435	12.5
Worldwide									
UNIX	3,311	3,749	+4,298	4,807	5,244	5,619	5,944	6,377	8.2
Windows NT	5	119	359	654	1,031	1,560	2,033	2,746	50.2
Personal Computer	1,174	1,277	1,502	1,637	1,793	1,964	2,131	2,289	8.8
Host/Proprietary	323	194	184	122	80	51	33	23	-34.1
All Operating Systems									
North America	1,720	1,875	2,153	2,499	2,878	3,295	3,672	4,163	14.1
Europe	1,569	1,722	2,099	2,261	2,438	2,644	2,883	3,163	8.5
Japan	1,235	1,391	1,619	1,860	2,056	2,298	2,469	2,734	11.0
Asia/Pacific	200	264	358	463	606	740	859	1,013	23.2
Rest of World	91	89	114	137	170	215	259	362	25.9
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.9	18.8	13.8	12.8	12.8	10.3	12.8	
Worldwide									
UNIX		13.2	14.6	11.8	9.1	7.2	5.8	7.3	
Windows NT		2221.0	200.3	82.3	57.7	51.3	30.4	35.0	
Personal Computer		8.8	17.6	9.0	9.5	9.5	8.5	7.4	
Host/Proprietary		-39.9	-5.4	-33.4	-34.8	-36.7	-34.3	-31.1	
All Operating Systems									
North America		9.0	14.9	16.1	15.1	14.5	11.4	13.4	
Europe		9.8	21.9	7.8	7.8	8.4	9.0	9.7	
Japan		12.6	16.4	14.9	10.5	11.8	7.4	10.7	
Asia/Pacific		32.0	35.5	29.6	30.8	22.1	16.0	18.0	
Rest of World		-1.8	28.4	19.6	24.0	27.0	20.4	39.4	

Source: Dataquest (April 1996)

All Applications

As CAD/CAM/CAE/GIS becomes more of a replacement market, market leaders would appear to have the upper hand; the cost of switching is high. However, software that lets users get a better product to market faster, software that helps eliminate business risks will always be in demand—regardless of market share. Thus, there is always an opportunity for new vendors in technical markets.

The primary trend in design software function is toward operating at a higher level of abstraction. In all applications, we have seen an evolution of focus from "electronic paper" to component modeling, and now to system modeling. The eventual goal is the ability to fully simulate, evaluate, redesign, and test the design inside the computer prior to manufacture. At the same time, increased computing power is allowing the nature of design to evolve to include constituencies in manufacturing, product support, and from users themselves. Thus the engineering process is being expanded to include input from a broader base.

At the same time, the nature of design data itself is expanding from a focus on geometry to include multiple data types—making the challenge of system modeling even more complex. Also, the World Wide Web holds the potential to expand the nature of collaborative design, by harnessing the joint power of anticipated increases in both computing power and communications bandwidth. Thus there is little limit to the problems that design or GIS software can tackle. The primary challenge will continue to be developing robust, leading-edge software ahead of competitors. During the forecast period we anticipate significant, but not revolutionary, advances in the ability of the existing programmer pool to produce new software.

Mechanical Forecast Assumptions

New Interest in Mechanical CAD Technology

In 1995, we saw a mix of replacement business and new purchases for mechanical CAD technology, particularly in Europe and North America. Growth is picking up in nontraditional industries (those industries outside of aerospace, automotive, and industrial machinery). We expect this trend to continue, as mechanical modeling, analysis, design, and simulation software become more user-friendly. Closely linked to the use of mechanical CAD in new arenas is the availability of software on lower-cost platforms and the potential use of object technology to create customized industry- or application-specific solutions.

The product data management market has clearly found a worldwide interest. Within the past year, we have seen pilot programs move to full-scale production, support for new client platforms (Windows NT, Windows), integration with manufacturing resource planning (MRP) systems, and an emergence of parts/component management software. Product data management will be one of the significant drivers of the mechanical CAD market through 2000.

Growth in Asia/Pacific

The Asia/Pacific region is being fueled by CAD investments from local governments, multinational companies, and local initiatives (such as Indonesia's IPTN). Most of the sales to date are UNIX-based, but some of the future growth is expected to shift to NT.

Ground Shifts in Japan

Mechanical CAD/CAM/CAE growth in Japan is expected to undergo a significant shift in platform usage over our forecast period. The UNIX platform dominates the mechanical sector in Japan, despite the fact that the Japanese mechanical market still places a heavy emphasis on 2-D drafting instead of 3-D/solid modeling. We expect this drafting orientation to persist, and over next five years we anticipate a significant shift to more Windows NT-based systems at the expense of UNIX. This shift will not begin in earnest until 1997, when more NT-based applications are more widely available in Japan.

Windows NT

As of today, not all of the major mechanical CAD vendors have ported their products to the Windows NT platform. The lack of availability of Windows NT versions of some of the market-share-leading mechanical CAD packages, coupled with the fact that Europe has just completed its five-year investment cycle in mechanical CAD software, will mean that Windows NT will not begin to impact UNIX-based sales for at least a few more years.

AEC Forecast Assumptions

The Impact of Windows NT

Intergraph's shift to Windows NT has initiated the collapse of UNIX sales in North America, a trend expected to increase broadly in this cost-conscious application. At the same time, we expect growth in Windows NT from DOS-based users who find Windows 95 and successors less than reliable. The primary factor holding up growth in the large installed base of DOS users is their reluctance to buy the new hardware required for either Windows 95 or Windows NT.

The factors that should contribute to the long-term expansion of the AEC CAD industry are noted in the following sections.

CAD Is Becoming a Business Requirement

Large design firms are growing at the expense of smaller firms. These large end users increasingly require their employees and suppliers to adopt automation tools in the design and construction process. Smaller design firms must increasingly buy CAD systems or risk being dropped from consideration as a partner.

CAD purchases are increasingly justified as a competitive advantage in both sales and design reviews. Electronic design data is also required downstream by the designer's client—from the federal government down to the small commercial developer. Also, a significant pool of untapped users still exists. The relatively low market penetration of AEC CAD systems should allow steady worldwide growth during the next five years despite constant volatility in demand for the buildings and infrastructure to be designed.

New Features in AEC CAD Products Are Achievable

Better, lower-cost visualization tools will be in increasing demand as sales and communication tools. Data and database functions (versus graphics functions) are increasing in importance in AEC design systems, creating opportunities to sell users significant new functionality. Some vendors will create products that foster communications in the entire design, construction, and maintenance process—products that will increase the payoff in CAD investments.

The three trends that will inhibit growth in the AEC CAD industry are noted in the following sections.

Design Is Only Part of the Problem

AEC's one-design-one-build structure means CAD provides fewer economic benefits to these users than does the one-design-build-many structure of manufacturing. Construction, which is essentially a prototype build, is fraught with uncertainties and delays that are not well-addressed by AEC systems as they exist today. Design tools can only thrive in the AEC structure when they support more of the entire business problem. Based on Autodesk's increased commitment to progress in this arena, we have increased our forecast modestly; commitment to and cooperation on the problem from multiple vendors will allow us to increase the forecast growth rate further.

Poor Cooperation among Users

Users are poorly organized to take advantage of improved products, partly because of competition between engineering constructors and partly because designs are often split among several different companies representing different and competing aspects of the design process. New approaches to the design and construction process are appearing, allowing users to take full advantage of CAD tools. Still, many users in AEC will need to be shown leadership in working together, both from the very large, most competitive users, and from CAD vendors themselves.

Downturn in Germany

The German construction industry, which has been the driving force behind the high growth of the recent years, has come to an abrupt halt. Although other regions such as Italy are investing, Germany plays such a dominant role that it will drag down the overall European growth for AEC. The applications that are still growing even in Germany are facilities design/management as these are not dependent on the construction industry.

GIS/Mapping Forecast Assumptions

The Impact of Windows NT

Intergraph's move to Windows NT at the expense of UNIX will quickly make PC-based operating systems the dominant revenue stream in North America. In the long term, the GIS UNIX market is highly subject to erosion by Windows NT because of the appeal of better integration of GIS and Windows-based productivity tools, an appealing prospect to many GIS users. The factors that should contribute to the long-term expansion of the GIS market are noted in the following sections.

"Open GIS"

The thrust of the Open GIS Foundation has been to allow some fresh air into a market that was getting a bit inbred. The nature of GIS data is under greater scrutiny, and several vendors are embarking on different, creative directions. Ultimately, much of "spatial analysis" will be embedded into other applications, rather than known as a GIS. Nonetheless, a fresh approach to spatial analysis is creating new opportunities for more useful solutions in traditional GIS environments.

Abundant Supply of Prospective Buyers

Penetration is still moderately low among core users. Bread-and-butter prospects in government and utilities are charged with maintaining information on land and assets in perpetuity. Many of these prospective buyers are still using paper maps, which will degrade over time, or have only entry-level systems in terms of value delivered. This creates a certain inevitability to moving from paper maps computer-based models.

New Technologies Will Drive Growth

Faster, cheaper computers will be continually leveraged to support new software products. Widespread computer industry developments in open, distributed systems supporting high-speed networking will make it possible for GIS technology to broadly expand the user base. Lower cost, higher resolution satellite imagery holds the potential to drive another explosion in GIS market growth among users who cannot afford aerial photography. Advances in aerial photography, global positioning systems (GPSs), and laser range finders are making it possible to create GISs that are significantly cheaper, more accurate, and more complete than existing paper maps, giving experienced users some compelling reasons to reinvest. Portable and pen-based computers are bringing GIS to new users in field operations. Finally, database companies themselves are gaining a better understanding of spatial analysis, a key factor in spreading use of GIS systems more broadly.

Data Will Drive Growth

The GIS business market is driving high growth on PCs. However, we see a wide band of uncertainty surrounding the clearly growing revenue opportunity from new applications. Several new applications in GIS are destined to become a relatively low revenue-producing feature in another software program (and market), rather than a standalone product in the GIS market. At the same time, data is increasing in value relative to software in this low-end market.

GIS has attained a certain indispensability, particularly among federal users and in utilities. As a result, users are beginning to expect to share the data that lies in their various GIS systems. Within three years, we expect data to be readily exchangeable across different systems. At that point, shareable data will help drive market growth.

Several factors seriously constraining the long-term expansion of the GIS market are noted in the following sections.

High Cost of Entry Remains a Barrier

There will remain an uncertain, but certainly high, cost of creating a working GIS system in traditional environments. No magic will emerge to create a low-cost, meaningful data set for mainstream customers in government and utilities. Data conversion will remain costly because the significant cost of correcting prior errors and omissions on paper maps is inevitably bundled into the cost of "conversion."

Price Pressures Inhibit Growth

Price pressure will hold down total revenue. Innovation is the only way to maintain prices in any software industry, and GIS vendors will struggle in their attempt to create compelling new applications and improved investment payoff for customers.

Electronic Design Automation Forecast Assumptions

The EDA software market grew 17.5 percent in 1995. Over the next five years, growth will continue to be fueled by continuing increasing design complexity and ever-higher speeds. The semiconductor downturn is a fact of life. Although many people expect a similar downturn in EDA sales, this is not the case. Semiconductor downturns, an indication of an electronic hardware downturn, actually increase EDA sales as companies design their way out of the recession. The EDA market typically sees its downturn three years later. Dataquest therefore predicts growth to drop off—to about 10 percent in 1999.

Electronic CAE

Design complexity is forcing a large-scale swap: Gate-level users are swapping up to register-transfer level (RTL) while RTL users are swapping up to electronic-system level (ESL) tools. RTL tools are beginning to appear on Windows NT, competing with UNIX-based tools, while the ESL tools will remain UNIX-based. The second wave, those FPGA/CPLD designers moving up to the RTL, are starting to make an impact on the numbers.

IC Layout

Final results show the IC layout market growing at 29.6 percent—a little lower than the preliminary data, but strong nonetheless. Design complexity and high speed are forcing replacement of obsolete tools, driving this high growth. This is primarily a replacement market of very high-cost tools and very few players. The ensuing frenzy for market share is the result. The few PC-based tools in this market are being replaced by

UNIX-class tools in North America, and Windows NT will not be a factor in this market. In fact, this is the market that is demanding a "standard" 64-bit operating system. If UNIX repeats its 32-bit performance, these guys could wait for a 64-bit Windows NT.

PCB/MCM/Hybrid

The printed circuit board (PCB) market grew 4.7 percent in 1995. The swap out of old tools continues for the second year. The most significant shift has been the acceptance of Windows NT as the operating system of choice in the PCB design world. It will not happen overnight, as swap out in this segment is slower than in CAE and IC layout, but it will happen.

Forecast Methodology

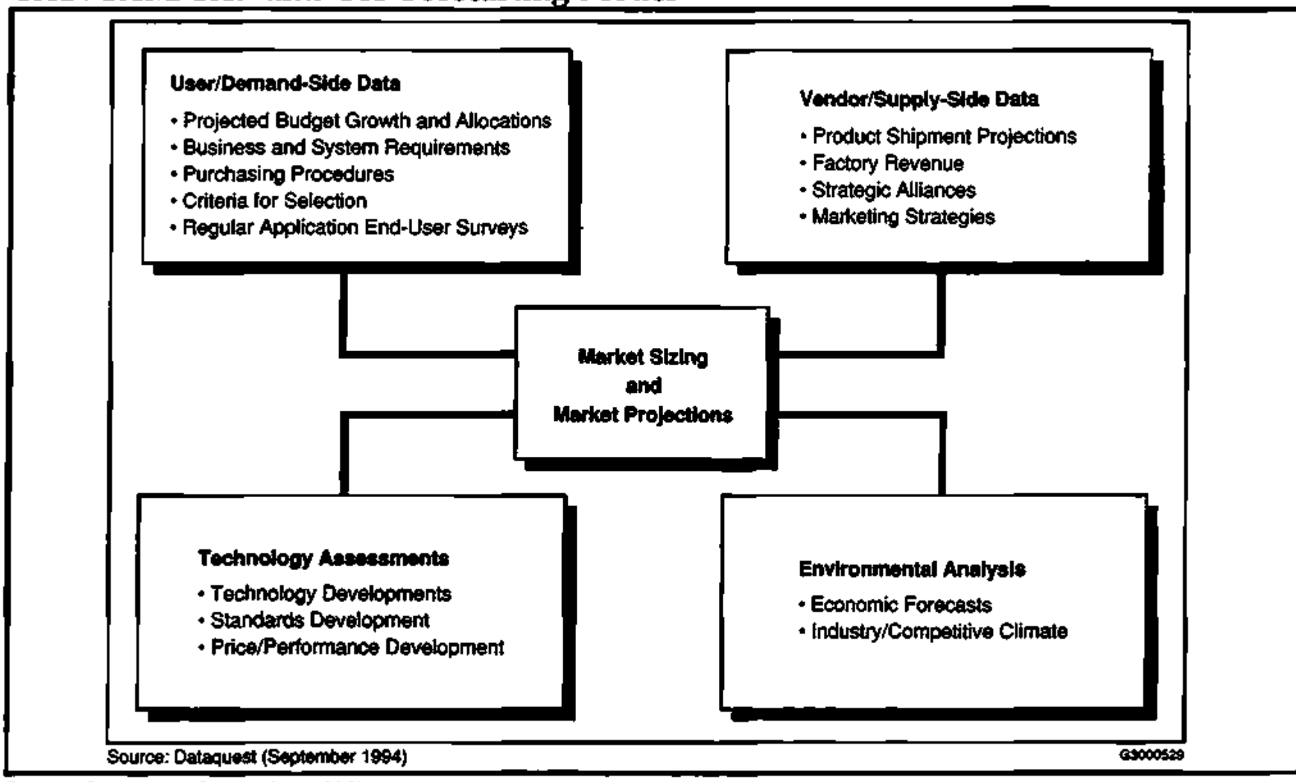
Fundamental to the way Dataquest conducts its research is the underlying philosophy that the best data and analysis come from a well-balanced program. This program includes the following: balance between primary and secondary collection techniques; balance between supply-side and demand-side analysis; balance between focused, industry-specific research and coordinated, "big picture" analysis aided by integration of data from the more than 25 separate high-technology industries Dataquest covers; and balance between the perspectives of experienced industry professionals and rigorous, disciplined techniques of seasoned market researchers.

Dataquest also analyzes trends in the macro environment, which can have major influences on both supply-side and demand-side forecasting. In addition to demographics, analysts look at gross national product (GNP) growth, interest rate fluctuation, business expectations, and capital spending plans. In the geopolitical arena, the group looks at trade issues, political stability or lack thereof, tariffs, nontariff barriers, and such factors as the effect on Europe of the events of 1995.

Figure 1 shows the CAD/CAM/CAE and GIS forecasting model. The overall forecasting process uses a combination of techniques such as time series and technological modeling. Market estimates and forecasts are derived using the following research techniques:

- Segment forecasting—Individual forecasts are derived for each application segment tracked by the CAD/CAM/CAE and GIS group. Specifically, each application, segmented by region and platform, is forecast and rolled up. In this way, each application segment incorporates its own set of unique assumptions.
- Demand-based analysis—Market growth is tracked and forecast in terms of the present and anticipated demand of current and future users. This requires the development of a total available market model and a satisfied available market figure to assess the levels of penetration accurately. Dataquest analysts also factor in the acceptance or ability for users to consume new technology.

Figure 1
CAD/CAM/CAE and GIS Forecasting Model



Source: Dataquest (September 1996)

- 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, capacity limitations are capable of keeping shipnents below the demand level.

Segmentation Definitions

- UNIX—Includes all UNIX variants and older workstation operating systems
- Host—Host includes minicomputer and mainframe operating systems in which external workstations' functions are dependent on a host computer.
- Windows NT—Windows NT is the Microsoft operating system.
- PC—PC includes DOS, WIndows, Windows 95, OS/2, and Apple Operating Systems.

Line Items

Line item definitions are as follows:

- Average selling price (ASP) is defined as the average price of a product, inclusive of any discounts.

- CPU revenue is the portion of revenue derived from a system sale that is related to the value of the CPU.
- CPU shipment is defined as the number of CPUs delivered.
- CPU installed base is defined as the total number of CPUs in active, day-to-day use.
- Unit shipment is defined as the number of products delivered (that is, seats).
- Seats are defined as the number of possible simultaneous users.
- Installed seats are defined as the total number of seats in active, day-to-day use.
- Hardware revenue is defined as the sum of the revenue from the hardware system components: CPU revenue, terminal revenue, and peripherals revenue.
- Peripherals revenue is defined as the value of all the peripherals from turnkey sale. (Peripherals in this category typically are input and output devices.)
- Terminal revenue is defined as revenue derived from the sale of terminals used to graphically create, analyze, or manipulate designs. The term is applicable only to the host systems.
- Software revenue is revenue derived from the sale of application software.
- Service revenue is defined as revenue derived from the service and support of CAD/CAM/CAE or GIS systems. Serevice is followed as software service and hardware service.
- Total factory revenue is defined as the amount of money received for goods measured in U.S. dollars and is the sum of hardware, software, and service revenue.

Table A-1
CAD/CAM/CAE/GIS Software History and Forecast
Top Level Mechanical Forecast, Worldwide, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue (U.S.$ Million)									
Worldwide, All Operating Systems	2,253	2,490	3,011	3,430	3,798	4,143	4,513	4,903	10.2
Worldwide									
UNIX	1,566	1,849	2,212	2,528	2,759	2,930	3,113	3,298	8.3
Windows NT	1	41	117	213	339	499	666	844	48.4
Personal Computer	449	469	563	602	640	675	707	741	5.7
Host/Proprietary	237	131	118	86	60	39	27	20	-30.2
All Operating Systems									
North America	700	764	850	963	1,099	1,238	1,368	1,501	12.0
Europe	785	851	1,084	1,204	1,294	1,376	1,493	1,642	8.7
Japan	669	749	897	1,039	1,129	1,202	1,271	1,331	8.2
Asia/Pacific	72	94	137	175	223	269	316	358	21.1
Rest of World	27	32	42	49	53	59	65	72	11.2
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.5	20.9	13.9	10.7	9.1	8.9	8.6	
Worldwide									
UNIX		18.1	19.7	14.3	9.2	6.2	6.2	6.0	
Windows NT		2,715.2	183.1	81.7	58.9	47.2	33.6	26.8	
Personal Computer		4.6	19.9	7.0	6.2	5.5	4.8	4.8	
Host/Proprietary		-44.9	-9.6	-27.0	-30.4	-34.3	-31.1	-27.9	
All Operating Systems									
North America		9.2	11.3	13.2	14.2	12.6	10.5	9.8	
Europe		8.4	27.3	11.1	7.4	6.4	8.5	10.0	
Japan		12.0	19.8	15.9	8.7	6.4	5.8	4.7	
Asia/Pacific		30.7	45.5	27.2	27.7	20.3	17.7	13.0	
Rest of World		15.5	32.8	15.4	9.3	10.6	10.7	10.0	

Source: Dataquest (September 1996)

Table B-1
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	274,863	297,123	345,101	412,400	484,700	552,600	632,200	721,000	16
Seats	287,369	308,138	354,394	418,600	488,800	555,100	633,800	722,000	15
Year-to-Year Increase (%)	9	7	15	18	17	14	14	14	
Installed Base									
CPUs	1,022,239	1,177,042	1,362,603	1,578,300	1,860,300	2,133,100	2,371,500	2,561,300	13
Seats	1,110,142	1,254,413	1,428,243	1,631,400	1,903,700	2,170,800	2,406,700	2,594,900	13
Year-to-Year Increase (%)	17	13	14	14	17	14	11	8	
Revenue Data (U.S.$ Million)									
CPU Revenue	3,085	3,518	3,934	4,661	5,410	5,931	6,624	7,399	13
Terminal Revenue	225	203	154	102	66	42	28	21	-33
Peripheral Revenue	263	289	344	422	497	567	691	913	22
Hardware Revenue	3,573	4,010	4,432	5,185	5,973	6,541	7,343	8,333	13
Year-to-Year Increase (%)	-12	12	11	17	15	10	12	13	
Software Revenue	2,253	2,490	3,011	3,430	3,798	4,143	4,513	4,903	10
Year-to-Year Increase (%)	6	11	21	14	11	9	9	9	
Software Service	754	948	1,130	1,231	1,318	1,366	1,425	1,480	6
Hardware Service	712	715	850	938	1,039	1,079	1,149	1,223	8
Service Revenue	1,465	1,663	1,979	2,169	2,357	2,446	2,574	2,704	6
Year-to-Year Increase (%)	12	13	19	10	9	4	5	5	
Total Factory Revenue	7,291	8,163	9,421	10,783	12,128	13,130	14,430	15,940	11
Year-to-Year Increase (%)	-3	12	15	14	12	8	10	10	

Source: Dataquest (September 1996)

Table B-2
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, UNIX

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	94,657	111,475	125,761	149,200	170,200	178,800	191,900	205,400	10
Seats	94,657	111,475	125,761	149,200	170,200	178,800	191,900	205,400	10
Year-to-Year Increase (%)	19	18	13	19	14	5	7	7	
Installed Base									
CPUs	338,204	423,071	517,861	629,300	762,500	895,100	984,800	1,020,100	15
Seats	338,204	423,071	517,861	629,300	762,500	895,100	984,800	1,020,100	15
Year-to-Year Increase (%)	29	25	22	22	21	17	10	4	
Revenue Data (U.S.$ Million)									
CPU Revenue	2,095	2,487	2,884	3,526	4,126	4,439	4,882	5,352	13
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	199	220	262	302	328	326	332	335	5
Hardware Revenue	2,295	2,707	3,146	3,829	4,454	4,765	5,214	5,688	13
Year-to-Year Increase (%)	0	18	16	22	16	7	9	9	
Software Revenue	1,566	1,849	2,212	2,528	2,759	2,930	3,113	3,298	8
Year-to-Year Increase (%)	9	18	20	14	9	6	6	6	
Software Service	611	780	934	1,025	1,085	1,094	1,105	1,101	3
Hardware Service	558	568	712	829	937	972	1,029	1,085	9
Service Revenue	1,169	1,348	1,646	1,854	2,022	2,066	2,134	2,186	6
Year-to-Year Increase (%)	27	15	22	13	9	2	3	2	
Total Factory Revenue	5,029	5,903	7,004	8,210	9,234	9,761	10,461	11,172	10
Year-to-Year Increase (%)	8	17	19	17	12	6	7	7	

NA = Not applicable
Source: Dataquest (September 1996)

Table B-3
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, NT/Hybrid

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	72	2,263	5,984	11,500	19,200	28,900	39,300	49,800	53
Seats	72	2,263	5,984	11,500	19,200	28,900	39,300	49,800	53
Year-to-Year Increase (%)	NA	3,053	164	92	67	51	36	26	
Installed Base									
CPUs	72	2,334	8,318	19,800	38,900	60,600	81,300	107,000	67
Seats	72	2,334	8,318	19,800	38,900	60,600	81,300	107,000	67
Year-to-Year Increase (%)	NA	3,153	256	138	97	56	34	32	
Revenue Data (U.S.$ Million)									
CPU Revenue	1	28	69	116	182	260	338	430	44
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	-	4	6	9	13	18	22	26	36
Hardware Revenue	1	33	74	125	196	278	360	456	44
Year-to-Year Increase (%)	NA	3,884	128	68	56	42	30	27	
Software Revenue	1	41	117	213	339	499	666	844	48
Year-to-Year Increase (%)	NA	2,715	183	82	59	47	34	27	
Software Service	0	15	31	57	95	145	201	265	53
Hardware Service	-	11	9	13	19	26	32	40	36
Service Revenue	0	26	40	69	113	171	233	304	50
Year-to-Year Increase (%)	NA	15,505	52	75	64	51	37	30	
Total Factory Revenue	2	100	231	408	648	947	1,259	1,605	47
Year-to-Year Increase (%)	NA	3,974	131	76	59	46	33	27	

NA = Not applicable
Source: Dataquest (September 1996)

Table B-4
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, Personal Computer

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	176,017	179,749	210,667	249,700	293,800	343,900	400,200	465,200	17
Seats	176,017	179,751	211,030	249,700	293,800	343,900	400,200	465,200	17
Year-to-Year Increase (%)	11	2	17	18	18	17	16	16	
Installed Base									
CPUs	657,489	727,612	815,883	912,400	1,044,700	1,164,700	1,293,300	1,422,300	12
Seats	657,489	727,612	815,883	912,400	1,044,700	1,164,700	1,293,300	1,422,300	12
Year-to-Year Increase (%)	17	11	12	12	15	11	11	10	
Revenue Data (U.S.$ Million)									
CPU Revenue	529	609	704	842	996	1,169	1,363	1,589	18
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	31	46	47	58	70	83	98	116	20
Hardware Revenue	559	656	752	900	1,066	1,252	1,461	1,705	18
Year-to-Year Increase (%)	-9	17	15	20	18	17	17	17	
Software Revenue	449	469	563	602	640	675	707	741	6
Year-to-Year Increase (%)	1	5	20	7	6	5	5	5	
Software Service	74	69	81	85	88	90	91	93	3
Hardware Service	24	30	33	42	52	63	75	91	22
Service Revenue	99	98	114	127	140	153	167	184	10
Year-to-Year Increase (%)	74	0	16	12	10	9	9	10	
Total Factory Revenue	1,107	1,224	1,429	1,630	1,846	2,080	2,335	2,630	13
Year-to-Year Increase (%)	-1	11	17	14	13	13	12	13	

NA = Not applicable
Source: Dataquest (September 1996)

Table B-5
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, Host/Proprietary

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	4,117	3,637	2,690	2,100	1,500	1,100	800	600	-26
Seats	16,623	14,649	11,619	8,200	5,600	3,500	2,400	1,700	-32
Year-to-Year Increase (%)	-34	-12	-21	-29	-33	-36	-33	-30	
Installed Base									
CPUs	26,474	24,024	20,542	16,800	14,100	12,600	12,100	11,900	-10
Seats	114,377	101,396	86,181	69,900	57,500	50,300	47,300	45,500	-12
Year-to-Year Increase (%)	-9	-11	-15	-19	-18	-13	-6	-4	
Revenue Data (U.S.$ Million)									
CPU Revenue	460	393	277	177	106	64	41	27	-37
Terminal Revenue	225	203	154	102	66	42	28	21	-33
Peripheral Revenue	33	18	30	52	85	140	239	436	71
Hardware Revenue	718	615	460	331	258	246	308	484	1
Year-to-Year Increase (%)	-37	-14	-25	-28	-22	-4	25	57	
Software Revenue	237	131	118	86	60	39	27	20	-30
Year-to-Year Increase (%)	-6	-45	-10	-27	-30	-34	-31	-28	
Software Service	68	84	83	64	51	37	28	22	-24
Hardware Service	130	106	96	54	32	19	12	8	-39
Service Revenue	198	191	179	118	83	56	40	30	-30
Year-to-Year Increase (%)	-40	-4	-6	-34	-30	-32	-29	-25	
Total Factory Revenue	1,153	936	758	535	400	342	375	533	-7
Year-to-Year Increase (%)	-33	-19	-19	-29	-25	-15	10	42	

Source: Dataquest (September 1996)

Table B-6
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, North America, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	105,236	112,395	117,789	138,100	161,700	183,700	208,500	235,300	15
Seats	109,013	115,384	119,605	138,900	162,100	183,900	208,700	235,400	15
Year-to-Year Increase (%)	8	6	4	16	17	13	13	13	
Installed Base									
CPUs	398,381	451,643	504,718	565,200	646,200	723,900	794,700	845,600	11
Seats	430,463	478,425	525,486	580,100	656,700	731,800	801,500	851,800	10
Year-to-Year Increase (%)	15	11	10	10	13	11	10	6	
Revenue Data (U.S.$ Million)									
CPU Revenue	860	981	1,023	1,189	1,415	1,590	1,800	2,031	15
Terminal Revenue	58	49	33	15	8	5	4	3	-38
Peripheral Revenue	37	29	33	38	44	51	66	95	24
Hardware Revenue	956	1,058	1,089	1,241	1,468	1,646	1,870	2,130	14
Year-to-Year Increase (%)	-6	11	3	14	18	12	14	14	
Software Revenue	700	764	850	963	1,099	1,238	1,368	1,501	12
Year-to-Year Increase (%)	16	9	11	13	14	13	11	10	
Software Service	210	274	306	334	376	410	442	472	9
Hardware Service	197	201	219	237	271	290	315	341	9
Service Revenue	407	475	526	571	646	700	757	812	9
Year-to-Year Increase (%)	18	17	11	9	13	8	8	7	
Total Factory Revenue	2,063	2,297	2,465	2,775	3,213	3,584	3,994	4,443	13
Year-to-Year Increase (%)	5	11	7	13	16	12	11	11	

Source: Dataquest (September 1996)

Table B-7
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Europe, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	91,208	96,394	118,603	137,400	157,400	175,200	198,000	225,800	14
Seats	95,417	100,455	122,066	140,100	159,200	176,300	198,600	226,100	13
Year-to-Year Increase (%)	-5	5	22	15	14	11	13	14	
Installed Base									
CPUs	383,551	425,347	483,179	549,200	635,000	715,300	782,400	835,400	12
Seats	415,978	453,900	507,486	569,200	651,800	730,100	796,400	848,800	11
Year-to-Year Increase (%)	13	9	12	12	15	12	9	7	
Revenue Data (U.S.$ Million)									
CPU Revenue	1,069	1,189	1,386	1,600	1,805	1,946	2,170	2,459	12
Terminal Revenue	88	84	58	44	29	18	12	8	-33
Peripheral Revenue	84	62	93	118	144	175	228	318	28
Hardware Revenue	1,241	1,335	1,537	1,762	1,978	2,138	2,410	2,785	13
Year-to-Year Increase (%)	-21	8	15	15	12	8	13	16	
Software Revenue	785	851	1,084	1,204	1,294	1,376	1,493	1,642	9
Year-to-Year Increase (%)	-7	8	27	11	7	6	8	10	
Software Service	279	345	421	452	471	476	492	515	4
Hardware Service	252	250	303	328	355	364	388	420	7
Service Revenue	531	595	724	781	826	840	880	935	5
Year-to-Year Increase (%)	-8	12	22	8	6	2	5	6	
Total Factory Revenue	2,557	2,781	3,345	3,747	4,098	4,355	4,783	5,362	10
Year-to-Year Increase (%)	-14	9	20	12	9	6	10	12	

Source: Dataquest (September 1996)

Table B-8
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Japan, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	58,658	64,133	78,203	97,200	114,800	130,500	148,500	168,200	17
Seats	62,675	67,216	81,155	98,900	115,800	131,100	148,800	168,400	16
Year-to-Year Increase (%)	27	7	21	22	17	13	14	13	
Installed Base									
CPUs	193,470	233,330	283,391	343,700	420,500	494,400	553,600	599,300	16
Seats	211,977	250,907	299,676	357,800	432,500	504,900	563,300	608,400	15
Year-to-Year Increase (%)	24	18	19	19	21	17	12	8	
Revenue Data (U.S.$ Million)									
CPU Revenue	1,022	1,170	1,286	1,564	1,797	1,930	2,105	2,276	12
Terminal Revenue	70	57	47	30	19	11	7	5	-37
Peripheral Revenue	130	184	199	239	270	286	310	351	12
Hardware Revenue	1,222	1,411	1,533	1,833	2,086	2,227	2,422	2,632	11
Year-to-Year Increase (%)	-8	15	9	20	14	7	9	9	
Software Revenue	669	749	897	1,039	1,129	1,202	1,271	1,331	8
Year-to-Year Increase (%)	10	12	20	16	9	6	6	5	
Software Service	229	282	340	370	383	380	379	373	2
Hardware Service	236	231	280	316	346	350	363	373	6
Service Revenue	465	514	620	686	729	730	742	746	4
Year-to-Year Increase (%)	39	10	21	11	6	0	2	0	
Total Factory Revenue	2,356	2,673	3,049	3,558	3,944	4,159	4,435	4,708	9
Year-to-Year Increase (%)	4	13	14	17	11	5	7	6	

Source: Dataquest (September 1996)

Table B-9
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Asia/Pacific, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	13,884	17,508	22,846	30,600	39,900	50,100	61,400	73,200	26
Seats	14,187	18,183	23,730	31,400	40,500	50,600	61,800	73,500	25
Year-to-Year Increase (%)	71	28	31	32	29	25	22	19	
Installed Base									
CPUs	30,824	45,800	64,942	88,200	119,500	153,700	187,700	221,300	28
Seats	33,583	48,436	67,754	91,300	122,800	157,200	191,500	225,200	27
Year-to-Year Increase (%)	55	44	40	35	35	28	22	18	
Revenue Data (U.S.$ Million)									
CPU Revenue	99	135	183	241	315	379	448	518	23
Terminal Revenue	6	12	14	12	8	7	5	5	-20
Peripheral Revenue	9	11	15	22	31	45	70	121	51
Hardware Revenue	113	157	212	274	354	430	524	643	25
Year-to-Year Increase (%)	17	39	35	29	29	21	22	23	
Software Revenue	72	94	137	175	223	269	316	358	21
Year-to-Year Increase (%)	45	31	46	27	28	20	18	13	
Software Service	27	36	49	59	73	83	94	102	16
Hardware Service	20	25	36	44	54	61	67	72	15
Service Revenue	47	61	86	103	127	144	161	175	15
Year-to-Year Increase (%)	42	31	40	21	23	13	12	9	
Total Factory Revenue	232	313	435	552	704	843	1,001	1,176	22
Year-to-Year Increase (%)	29	35	39	27	28	20	19	17	

Source: Dataquest (September 1996)

Table B-10
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Rest of World, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Hardware Shipment Data									
Shipments									
CPUs	5,878	6,692	7,660	9,200	11,000	13,200	15,900	18,600	19
Seats	6,076	6,900	7,838	9,300	11,100	13,300	15,900	18,700	19
Year-to-Year Increase (%)	44	14	14	19	19	19	20	17	
Installed Base									
CPUs	16,012	20,922	26,374	32,000	39,000	46,000	53,200	59,700	18
Seats	18,141	22,746	27,840	33,100	40,000	46,800	54,000	60,600	17
Year-to-Year Increase (%)	32	25	22	19	21	17	15	12	
Revenue Data (U.S.$ Million)									
CPU Revenue	35	43	55	67	78	88	101	116	16
Terminal Revenue	2	2	2	1	1	1	1	1	-19
Peripheral Revenue	3	3	4	6	7	10	16	27	46
Hardware Revenue	40	48	61	74	86	99	118	144	19
Year-to-Year Increase (%)	-19	19	27	22	17	15	19	22	
Software Revenue	27	32	42	49	53	59	65	72	11
Year-to-Year Increase (%)	9	15	33	15	9	11	11	10	
Software Service	8	11	13	15	16	17	18	18	7
Hardware Service	7	8	11	13	14	15	16	17	10
Service Revenue	16	18	24	27	30	31	33	36	8
Year-to-Year Increase (%)	-12	18	31	14	8	5	7	7	
Total Factory Revenue	83	98	127	150	169	189	216	251	15
Year-to-Year Increase (%)	-10	18	30	18	13	12	14	16	

Source: Dataquest (September 1996)

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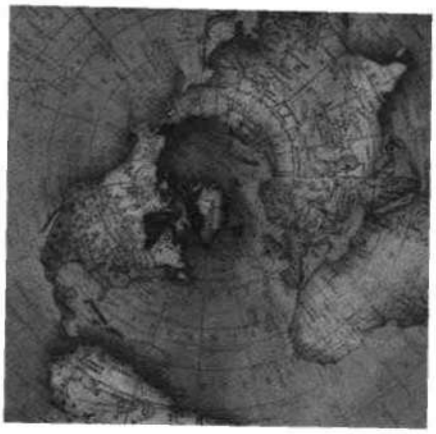

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1995 Mechanical CAD/CAM/CAE Market Share Update

Market Statistics

Program: Mechanical Applications Europe
Product Code: CMEC-EU-MS-9601
Publication Date: August 26, 1996
Filing: Market Statistics

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Note: All tables show estimated data.

1995 Mechanical CAD/CAM/CAE Market Share Update

About This Document

This document contains Dataquest's detailed market share information on the mechanical CAD/CAM/CAE industry at the country level. This report is meant to supplement your worldwide mechanical CAD/CAM/CAE market share book by providing mechanical CAD/CAM/CAE market share detail for European and/or Asia/Pacific countries.

Definitions

This section lists the definitions specific to this document. For other definitions, we ask that you reference your worldwide market statistics book.

Europe

Western Europe

Includes Austria, Benelux, (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)

Eastern Europe

Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)

Asia/Pacific

Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)

Publishing Schedule

We publish market share and forecasting at the country level once each year. Our delivery schedule is as follows:

- Updated market share tables for 1995, based on data collection and analysis beginning in January 1996, are presented in this report. This information is presented at the country level for either Asia/Pacific and/or Europe, according to the services you have purchased from Dataquest. At this point, the market share database is frozen and will not be changed until the end of 1996.

- Forecast tables will be available electronically by September 2, and books will be shipped by September 30. These forecast tables will contain country-level information for Asia/Pacific and/or Europe.

A Final Note

Dataquest's policy is to continually update its market information, for current and past years, with any new data received in order to arrive at the most accurate market representation possible. Our ongoing commitment is to maintain an accurate and complete model of the entire CAD/CAM/CAE/GIS market, worldwide, and we welcome your input. Please feel free to contact any member of the CAD/CAM/CAE team if you have any questions or concerns.

Table A-1
1995 Top 30 Mechanical Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	361.1	368.3	491.5	33.4	16.3
2	Parametric Technology	165.7	209.8	321.2	53.1	10.7
3	Autodesk	159.4	176.0	210.2	19.4	7.0
4	EDS Unigraphics	152.8	172.9	195.8	13.3	6.5
5	Dassault	133.4	154.2	190.6	23.6	6.3
6	Computervision	149.2	148.2	149.1	0.6	5.0
7	MicroCADAM	-	91.7	129.2	40.9	4.3
8	SDRC	93.9	103.3	117.6	13.8	3.9
9	MacNeal-Schwendler	76.6	90.8	114.0	25.5	3.8
10	Fujitsu	74.3	83.7	97.0	15.8	3.2
11	Matra Datavision	63.6	75.6	87.4	15.6	2.9
12	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	2.8
13	Hewlett-Packard	70.9	74.5	81.5	9.4	2.7
14	NEC	54.3	61.7	72.9	18.1	2.4
15	Hitachi	63.9	66.7	70.9	6.4	2.4
16	Toshiba*	95.7	54.5	58.7	7.8	2.0
17	Intergraph	71.0	61.1	54.0	-11.6	1.8
18	Nihon Unisys	103.0	48.1	52.8	9.8	1.8
19	Hitachi Zosen Info Systems	77.3	34.5	38.7	12.1	1.3
20	Ansys	30.3	32.5	37.4	15.0	1.2
21	Applicon	29.6	29.6	31.1	5.2	1.0
22	C. Itoh Techno-Science*	30.4	34.6	30.8	-10.8	1.0
23	Hakuto*	21.2	23.6	29.8	26.5	1.0
24	Siemens Nixdorf Info systeme	26.2	24.7	25.2	2.2	0.8
25	Sherpa Corp.	12.0	18.8	20.6	10.0	0.7
26	Tecnomatix Technology	-	13.0	20.1	54.3	0.7
27	Marubeni Hytech*	15.1	18.3	19.9	8.9	0.7
28	Seiko*	17.4	18.0	19.7	9.3	0.7
29	ADRA Systems	17.5	18.0	19.0	5.7	0.6
30	Formtek	9.7	17.4	18.9	9.1	0.6
	All N.A. Companies	1,569.2	1,771.2	2,201.0	24.3	73.1
	All European Companies	282.9	293.3	336.5	14.7	11.2
	All Asian Companies	402.4	426.7	474.4	11.2	15.7
	All Companies	2,254.5	2,491.2	3,011.9	20.9	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-2
1995 Top 30 Mechanical Software Companies, Europe, All Operating Systems
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	138.8	165.9	249.5	50.4	23.0
2	Dassault	73.4	86.3	110.5	28.0	10.2
3	Parametric Technology	42.6	68.3	109.2	59.9	10.1
4	Computervision	93.0	90.9	100.1	10.1	9.2
5	Autodesk	52.6	59.9	81.3	35.8	7.5
6	Matra Datavision	53.1	63.5	70.0	10.1	6.5
7	EDS Unigraphics	39.4	44.9	52.1	15.9	4.8
8	Hewlett-Packard	38.3	37.3	44.8	20.3	4.1
9	SDRC	27.1	28.4	33.1	16.6	3.1
10	MacNeal-Schwendler	22.5	18.4	32.0	73.4	3.0
11	Siemens Nixdorf Info systeme	25.7	24.2	24.7	2.2	2.3
12	Intergraph	21.4	21.2	19.7	-7.0	1.8
13	Applicon	16.2	14.2	17.3	22.2	1.6
14	ASCAD	8.7	12.1	14.9	22.5	1.4
15	ISD Software	15.3	10.5	14.5	37.7	1.3
16	CAD Lab	13.8	11.4	13.6	19.2	1.3
17	Tebis	8.7	5.2	12.5	138.8	1.2
18	Straessle Informationssysteme	15.2	15.6	12.0	-23.3	1.1
19	Ansys	9.1	8.5	11.9	41.2	1.1
20	Tecnomatix Technology	-	5.7	11.6	103.4	1.1
21	Wiechers Datentechnik	9.5	8.9	11.4	27.6	1.1
22	MicroCADAM	-	7.3	10.3	40.9	1.0
23	ICEM Technologies	6.2	6.2	9.8	56.8	0.9
24	Engineering Computer Services*	5.5	6.9	7.9	14.9	0.7
25	Han Dataport	6.2	7.1	7.8	10.7	0.7
26	Delcam International	5.2	5.6	7.7	38.2	0.7
27	Radan Computational	8.2	8.2	7.6	-6.8	0.7
28	Sherpa Corp.	4.8	8.4	7.2	-14.7	0.7
29	ADRA Systems	4.8	4.4	6.8	54.8	0.6
30	Eigner + Partner	*	5.4	6.3	15.9	0.6
	All N.A. Companies	538.3	600.7	808.6	34.6	74.6
	All European Companies	247.0	250.5	275.3	9.9	25.4
	All Asian Companies	-	-	-	NA	-
	All Companies	785.3	851.2	1,083.9	27.3	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-3
1995 Top 30 Mechanical Software Companies, France, All Operating Systems
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	26.1	33.0	45.6	38.0	23.6
2	Matra Datavision	29.9	34.8	38.5	10.6	20.0
3	Dassault	33.0	30.8	34.3	11.2	17.8
4	Parametric Technology	9.2	14.8	24.9	68.4	12.9
5	Computervision	20.0	23.3	23.6	1.5	12.3
6	Autodesk	7.9	9.0	9.9	10.6	5.2
7	SDRC	4.9	5.4	6.2	16.6	3.2
8	Serbi	4.5	5.0	5.9	16.4	3.0
9	EDS Unigraphics	4.6	4.8	5.6	15.9	2.9
10	Hewlett-Packard	4.2	4.1	4.1	-0.5	2.1
11	Framasoft	3.5	3.8	3.7	-2.8	1.9
12	MacNeal-Schwendler	2.5	2.0	3.5	73.4	1.8
13	MicroCADAM	-	1.8	2.6	40.9	1.3
14	Sherpa Corp.	-	-	2.3	NA	1.2
15	Applicon	1.9	1.7	2.0	18.6	1.0
16	Ansys	1.5	1.6	1.9	13.5	1.0
17	ADRA Systems	1.0	1.1	1.8	54.8	0.9
18	Intergraph	1.8	1.8	1.7	-7.0	0.9
19	Catalpa groupe Missler	1.1	-	1.4	NA	0.7
20	Exapt	1.9	1.4	1.2	-12.8	0.6
21	CAD Lab	0.5	0.5	1.0	73.8	0.5
22	ICL	0.6	0.5	0.7	26.1	0.3
23	ICEM Technologies	0.1	0.7	0.6	-6.4	0.3
24	Adina R&D	-	0.5	0.6	12.5	0.3
25	Mechanical Dynamics	0.4	0.7	0.4	-47.9	0.2
26	Spatial Technology	-	0.2	0.3	52.2	0.2
27	Camax Manufacturing	0.1	0.1	0.3	99.8	0.1
28	B.A. Intelligence Networks	0.2	0.2	0.3	3.9	0.1
29	Ashlar	0.1	0.2	0.2	-15.5	0.1
30	Superdraft	0.1	0.2	0.2	-1.2	0.1
	Other Companies	4.8	8.1	7.9	-2.8	4.1
	All N.A. Companies	86.6	102.2	132.5	29.6	68.7
	All European Companies	43.1	46.5	52.4	12.6	27.2
	All Asian Companies	-	-	-	NA	-
	All Companies	134.5	156.9	192.8	22.9	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table A-4
1995 Top 30 Mechanical Software Companies, Germany, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	60.5	68.0	106.9	57.1	27.3
2	Dassault	22.7	29.3	40.0	36.6	10.2
3	Hewlett-Packard	25.6	25.0	24.5	-2.0	6.3
4	Siemens Nixdorf Info systeme	23.6	22.3	22.7	2.2	5.8
5	Autodesk	14.7	16.8	21.7	29.5	5.6
6	Parametric Technology	7.9	12.7	21.4	68.4	5.5
7	Computervision	23.6	17.3	20.6	19.5	5.3
8	EDS Unigraphics	10.4	12.4	14.4	15.9	3.7
9	ASCAD	8.0	11.3	14.1	25.2	3.6
10	Matra Datavision	13.1	15.9	14.0	-11.9	3.6
11	Applicon	7.8	6.8	11.8	73.0	3.0
12	ISD Software	11.6	8.2	11.3	37.7	2.9
13	Tebis	3.4	2.8	11.0	298.1	2.8
14	Straessle Informationssysteme	9.4	13.9	10.5	-24.9	2.7
15	Wiechers Datentechnik	7.0	7.4	9.4	27.6	2.4
16	MacNeal-Schwendler	4.8	4.7	8.2	73.4	2.1
17	SDRC	6.8	6.4	7.4	16.6	1.9
18	Intergraph	7.7	7.6	7.1	-7.0	1.8
19	ICEM Technologies	3.1	4.1	6.3	51.5	1.6
20	Eigner + Partner	-	4.2	4.9	15.9	1.2
21	PROCAD GmbH	3.4	2.8	4.6	66.6	1.2
22	ADRA Systems	2.2	2.5	3.8	54.8	1.0
23	Ansys	2.1	2.3	3.0	31.1	0.8
24	debis Systemhaus	2.3	2.7	3.0	9.8	0.8
25	Han Dataport	2.1	2.5	2.8	10.7	0.7
26	Ziegler Informatics	4.3	4.0	2.6	-34.3	0.7
27	MicroCADAM	-	1.8	2.6	40.9	0.7
28	Technische Computer Systeme	1.8	1.9	2.4	22.1	0.6
29	Exapt	2.7	2.1	2.2	1.5	0.6
30	Just In Time Systems	1.4	1.6	2.1	32.6	0.5
	Other Companies	10.4	15.2	15.6	2.2	4.0
	All N.A. Companies	181.2	180.2	250.4	38.9	64.1
	All European Companies	103.2	108.7	124.9	14.9	32.0
	All Asian Companies	-	-	-	NA	
	All Companies	294.8	304.2	390.9	28.5	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-5
1995 Top 30 Mechanical Software Companies, Benelux, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	4.2	6.7	11.4	68.4	22.8
2	EDS Unigraphics	5.8	9.0	10.4	15.9	20.9
3	IBM	5.2	6.1	9.2	51.0	18.5
4	Autodesk	4.2	4.8	5.8	22.0	11.7
5	Dassault	2.2	3.1	3.8	23.6	7.6
6	Matra Datavision	1.0	0.8	1.7	131.3	3.5
7	Computervision	0.5	1.2	1.4	16.4	2.8
8	MacNeal-Schwendler	1.1	0.8	1.4	73.4	2.7
9	Intergraph	1.4	1.4	1.3	-7.0	2.6
10	SDRC	0.8	0.9	1.0	16.6	2.1
11	Ansys	0.5	0.5	0.7	36.1	1.5
12	ISD Software	0.5	0.4	0.6	37.7	1.2
13	Siemens Nixdorf Info systeme	0.5	0.5	0.5	2.2	1.0
14	Han Dataport	0.3	0.3	0.4	10.7	0.8
15	Applicon	0.3	0.3	0.3	18.6	0.7
16	Delcam International	0.2	0.1	0.3	188.4	0.7
17	Wiechers Datentechnik	0.2	0.3	0.3	27.6	0.6
18	ASCAD	0.4	0.6	0.3	-51.0	0.6
19	RoboCAD Solutions	0.3	0.3	0.3	-17.4	0.6
20	Camax Manufacturing	0.1	0.2	0.3	49.8	0.5
21	MCS	0	0.2	0.2	5.0	0.4
22	Gerber Systems	0.3	0.2	0.2	10.2	0.3
23	Radan Computational	0.2	0.2	0.2	-3.0	0.3
24	ICEM Technologies	0.1	0.1	0.2	180.7	0.3
25	Technische Computer Systeme	0.1	0.1	0.1	20.0	0.3
26	Sherpa Corp.	-	-	0.1	NA	0.3
27	Cimatron	0.3	0.1	0.1	80.3	0.2
28	Exapt	0.1	0.1	0.1	1.6	0.2
29	Ashlar	0	0.1	0.1	-15.5	0.2
30	debis Systemhaus	0.1	0.1	0.1	9.8	0.2
	Other Companies	1.2	2.2	2.2	2.1	4.5
	All N.A. Companies	24.9	32.3	42.5	31.7	85.3
	All European Companies	4.4	3.9	5.1	31.9	10.2
	All Asian Companies	-	-	-	NA	
	All Companies	30.5	38.3	49.9	30.1	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-6
1995 Top 30 Mechanical Software Companies, United Kingdom, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Computervision	24.9	27.8	33.5	20.5	19.5
2	IBM	12.4	17.3	28.7	66.2	16.7
3	Parametric Technology	8.2	13.2	22.3	68.4	13.0
4	Dassault	2.2	6.2	11.4	85.4	6.7
5	Autodesk	7.9	9.0	11.4	27.3	6.7
6	EDS Unigraphics	7.5	9.5	11.0	15.9	6.4
7	Engineering Computer Services*	5.5	6.9	7.9	14.9	4.6
8	MacNeal-Schwendler	3.6	4.0	7.0	73.4	4.1
9	Radan Computational	7.6	7.5	6.8	-10.2	3.9
10	SDRC	4.6	5.6	6.5	16.6	3.8
11	Whessoe Computing Systems	3.6	4.0	4.5	12.3	2.6
12	Hewlett-Packard	5.5	5.6	4.1	-27.1	2.4
13	Intergraph	3.8	3.7	3.5	-7.0	2.0
14	ICL	2.6	2.5	3.1	24.1	1.8
15	Matra Datavision	2.0	3.0	2.6	-13.3	1.5
16	MicroCADAM	-	1.8	2.6	40.9	1.5
17	Anilam Electronics	1.7	2.0	2.2	12.7	1.3
18	Applicon	2.1	1.8	2.2	18.6	1.3
19	Delcam International	2.4	2.4	2.2	-10.7	1.3
20	Ansys	1.3	1.4	1.5	4.1	0.9
21	Sherpa Corp.	-	-	1.3	NA	0.8
22	Pathtrace Engineering Systems	0.9	1.2	1.3	11.7	0.8
23	MCS	1.0	1.0	1.0	5.0	0.6
24	CIMLINC	1.5	0.7	1.0	35.5	0.6
25	Cimtel	1.0	0.8	1.0	16.4	0.6
26	RoboCAD Solutions	1.5	1.1	0.9	-17.4	0.5
27	CGTech	-	-	0.9	NA	0.5
28	Superdraft	0.7	0.7	0.7	-1.2	0.4
29	Formtek	1.4	2.5	0.7	-72.0	0.4
30	Mechanical Dynamics	0.4	0.7	0.6	-21.9	0.3
	Other Companies	4.5	7.7	7.5	-2.4	4.4
	All N.A. Companies	86.3	105.0	138.5	31.9	80.7
	All European Companies	30.4	29.3	25.7	-12.1	15.0
	All Asian Companies	-	-	-	NA	
	All Companies	121.2	142.0	171.8	21.0	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-7
1995 Top 30 Mechanical Software Companies, Austria/Switzerland, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	-	-	5.6	NA	16.1
2	IBM	4.4	4.3	5.5	28.4	15.9
3	CAD Distribution	2.9	3.3	5.1	52.7	14.6
4	Hewlett-Packard	-	-	4.1	NA	11.7
5	SDRC	1.9	2.0	2.4	16.6	6.8
6	Matra Datavision	0.3	-	2.2	NA	6.3
7	Dassault	2.2	1.5	1.9	23.6	5.5
8	Han Dataport	0.1	1.7	1.8	10.7	5.3
9	Straessle Informationssysteme	-	0.9	1.2	30.4	3.4
10	PROCAD GmbH	1.2	0.7	1.2	66.6	3.3
11	Computervision	2.0	0.7	0.8	12.2	2.3
12	Ansys	0.1	-	0.7	NA	2.2
13	ICEM Technologies	0.3	0.4	0.6	60.4	1.8
14	ISD Software	0.5	0.4	0.6	37.7	1.7
15	Eigner + Partner	-	0.5	0.6	15.9	1.6
16	Intergraph	0.6	0.6	0.6	-7.0	1.6
17	ASCAD	0	-	0.4	NA	1.3
18	Tebis	0.8	0.2	0.4	90.5	1.1
19	Just In Time Systems	0.2	0.3	0.4	32.6	1.1
20	B.A. Intelligence Networks	0.1	0.1	0.1	3.9	0.4
21	Ziegler Informatics	0.8	-	0.1	NA	0.3
22	Spatial Technology	-	0.1	0.1	52.2	0.3
23	Ashlar	0	0.1	0.1	-15.5	0.3
24	Framasoft	-	0.1	0.1	7.0	0.3
25	Delcam International	0.1	0.1	0.1	44.2	0.2
26	Vero International Software	0	0	0	23.4	0.1
27	CAD Centre	0	0	0	212.2	0.1
28	GRAPHSOFT	-	-	0	NA	0
29	Technische Computer Systeme	0.3	0.3	-	-100.0	
30	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	0.5	0.7	1.3	75.7	3.8
	All N.A. Companies	9.0	7.3	19.2	161.8	55.3
	All European Companies	2.7	8.1	14.2	76.2	41.0
	All Asian Companies	-	-	-	NA	
	All Companies	12.1	16.2	34.8	115.0	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-8
1995 Top 30 Mechanical Software Companies, Spain, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	CIMTEK*	3.5	4.1	4.7	14.8	17.0
2	IBM	2.8	3.7	4.6	26.2	16.7
3	Dassault	0.7	3.1	3.8	23.6	13.8
4	Computervision	3.7	3.7	3.7	-0.3	13.4
5	Parametric Technology	1.3	2.1	3.5	68.4	12.7
6	Autodesk	2.1	2.4	3.4	42.9	12.4
7	EDS Unigraphics	1.2	1.7	2.0	15.9	7.3
8	ABB Industria*	2.4	1.3	1.4	6.7	5.1
9	MacNeal-Schwendler	0.9	0.7	1.3	73.4	4.6
10	Intergraph	1.2	1.2	1.1	-7.0	4.0
11	ICEM Technologies	0.3	0.3	1.1	217.0	3.9
12	SDRC	0.8	0.9	1.0	16.6	3.7
13	Softronics	1.3	0.9	1.0	8.4	3.7
14	Matra Datavision	0.4	-	0.9	NA	3.2
15	Delcam International	0.3	0.3	0.8	140.3	3.0
16	FHECOR*	0.6	0.5	0.6	9.1	2.0
17	Tebis	0.6	0.6	0.4	-34.7	1.4
18	Ansys	0.3	0.4	0.4	-1.7	1.4
19	Cimatron	0.3	0.2	0.3	80.3	1.1
20	ISD Software	0.2	0.2	0.3	37.7	1.0
21	Camax Manufacturing	0	0	0.3	499.3	1.0
22	ADRA Systems	0.1	0.2	0.3	54.8	0.9
23	Exapt	0.2	0.2	0.2	-15.1	0.7
24	Applicon	0.2	0.1	0.2	18.6	0.6
25	Han Dataport	0.1	0.1	0.2	10.7	0.6
26	Straessle Informationssysteme	0.1	0.2	0.1	-18.5	0.5
27	CAD Lab	0.1	0.1	0.1	138.4	0.5
28	Gerber Systems	-	0.1	0.1	10.0	0.3
29	Ziegler Informatics	0.2	0.1	0.1	-34.3	0.2
30	Anilam Electronics	0.1	0	0	8.0	0.2
	Other Companies	0.7	1.3	1.2	-10.2	4.3
	All N.A. Companies	14.6	16.7	21.2	26.7	76.6
	All European Companies	4.0	7.3	5.3	-27.5	19.1
	All Asian Companies	-	-	-	NA	
	All Companies	19.3	25.3	27.6	9.2	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-9
1995 Top 30 Mechanical Software Companies, Italy, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	12.6	13.8	18.5	34.4	20.2
2	CAD Lab	10.7	10.5	12.2	16.6	13.4
3	Computervision	12.6	10.4	9.7	-6.7	10.6
4	Autodesk	4.7	5.4	9.2	70.4	10.0
5	Parametric Technology	3.4	5.4	9.2	68.4	10.0
6	Matra Datavision	5.2	5.3	6.1	15.6	6.7
7	Dassault	4.4	4.6	5.7	23.6	6.2
8	Hewlett-Packard	2.7	2.6	4.1	56.3	4.5
9	MacNeal-Schwendler	3.8	2.2	3.8	73.4	4.1
10	SDRC	3.0	2.2	2.5	16.6	2.8
11	Cimatron	2.2	1.0	1.9	80.3	2.0
12	Intergraph	1.4	1.4	1.3	-7.0	1.4
13	Formtek	-	-	1.2	NA	1.3
14	Delcam International	0.5	0.6	1.2	101.9	1.3
15	Ansys	0.7	0.8	1.1	47.5	1.2
16	Vero International Software	0.5	0.7	1.1	65.6	1.2
17	Sherpa Corp.	-	-	0.9	NA	0.9
18	Han Dataport	0.5	0.6	0.7	10.7	0.8
19	Tebis	0.6	0.5	0.6	15.6	0.7
20	Adina R&D	-	0.5	0.6	12.5	0.6
21	ADRA Systems	0.3	0.3	0.5	54.8	0.6
22	Applicon	0.5	0.4	0.5	18.6	0.6
23	CGTech	-	-	0.5	NA	0.5
24	Siemens Nixdorf Info systeme	0.5	0.5	0.5	2.2	0.5
25	Camax Manufacturing	0.2	0.4	0.4	12.4	0.4
26	Mechanical Dynamics	0.3	0.6	0.4	-37.5	0.4
27	ICEM Technologies	0.2	0.2	0.3	47.8	0.3
28	ISD Software	0.2	0.2	0.3	37.7	0.3
29	MCS	0.3	0.2	0.2	5.0	0.3
30	Spatial Technology	-	0.1	0.2	52.2	0.2
	Other Companies	2.7	3.6	3.7	3.5	4.1
	All N.A. Companies	46.7	45.1	62.6	38.9	68.4
	All European Companies	26.3	21.4	25.2	17.7	27.5
	All Asian Companies	-	-	-	NA	
	All Companies	75.7	70.1	91.6	30.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-10
1995 Top 30 Mechanical Software Companies, Scnadinavia, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	11.8	16.9	26.8	58.1	35.4
2	Autodesk	4.7	5.4	10.0	85.9	13.2
3	Parametric Technology	3.6	5.7	9.6	68.4	12.7
4	Dassault	1.5	4.6	5.7	23.6	7.6
5	Computervision	3.1	5.2	5.5	5.3	7.3
6	Hewlett-Packard	-	-	4.1	NA	5.4
7	SDRC	2.2	2.4	2.8	16.6	3.7
8	MacNeal-Schwendler	1.3	1.6	2.7	73.4	3.6
9	MicroCADAM	-	1.8	2.6	40.9	3.4
10	Intergraph	2.6	2.6	2.4	-7.0	3.2
11	Matra Datavision	0.4	-	2.2	NA	2.9
12	Ansys	0.9	1.0	1.5	53.9	2.0
13	Formtek	0.5	0.8	0.9	4.9	1.2
14	Sherpa Corp.	-	-	0.5	NA	0.7
15	Camax Manufacturing	0	0.1	0.4	349.5	0.5
16	Applicon	0.3	0.3	0.3	18.6	0.4
17	Cimatron	0.2	0.2	0.3	80.3	0.4
18	ISD Software	0.2	0.2	0.3	37.7	0.4
19	Whessoe Computing Systems	0.3	0.3	0.3	6.8	0.4
20	Delcam International	0.2	0.2	0.3	8.2	0.3
21	Anilam Electronics	0.2	0.2	0.2	9.0	0.3
22	Mechanical Dynamics	0.1	0.2	0.2	-21.9	0.2
23	Exapt	0.3	0.2	0.2	0.2	0.2
24	CNC Software	0.1	0.2	0.2	10.0	0.2
25	Livermore Software Tech.	0.1	0.1	0.2	87.1	0.2
26	Superdraft	0.1	0.2	0.2	-1.2	0.2
27	ICEM Technologies	0.2	0.1	0.2	180.7	0.2
28	Wiechers Datentechnik	0.1	0.1	0.1	27.6	0.2
29	Ziegler Informatics	0.3	0.2	0.1	-34.3	0.2
30	Computational Mechanics	0.1	0.1	0.1	-	0.2
	Other Companies	1.4	2.8	3.5	23.5	4.6
	All N.A. Companies	31.6	42.4	67.4	59.1	89.0
	All European Companies	4.2	3.0	4.8	62.9	6.4
	All Asian Companies	-	-	-	NA	
	All Companies	37.3	48.1	75.7	57.3	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-11
1995 Top 11 Mechanical Software Companies, Russia, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Dassault	2.2	1.5	1.9	23.6	49.5
2	Delcam International	0.4	0.6	1.7	188.4	43.3
3	Autodesk	-	-	0.9	NA	23.8
4	Matra Datavision	0	0.8	0.9	15.6	22.7
5	Ansys	0.9	-	0.1	NA	2.9
6	Cimatron	-	0	0.1	80.3	2.3
7	Computervision	0.4	0.1	0.1	-8.4	2.2
8	Ziegler Informatics	-	-	0.1	NA	1.7
9	GRAPHSOFT	-	-	0	NA	0.3
10	CAD Centre	-	-	0	NA	0.2
11	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	0	0.1	0.1	131.8	3.2
	All N.A. Companies	0	0.1	1.1	1102.8	29.0
	All European Companies	0.1	1.3	2.6	94.4	67.8
	All Asian Companies	-	-	-	NA	-
	All Companies	0.1	1.5	3.9	158.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-12
1995 Top 23 Mechanical Software Companies, Central Europe, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	EDS Unigraphics	5.0	7.1	8.2	15.9	37.1
2	IBM	2.8	-	3.7	NA	16.9
3	Autodesk	-	-	2.4	NA	10.9
4	SDRC	1.5	1.9	2.2	16.6	10.0
5	Dassault	2.2	1.5	1.9	23.6	8.6
6	Han Dataport	0.1	0.8	0.9	10.7	4.1
7	Matra Datavision	0.3	0.8	0.9	15.6	3.9
8	Computervision	1.1	0.7	0.6	-19.2	2.7
9	CNC Software	0.4	0.5	0.6	10.0	2.6
10	ISD Software	0.5	0.4	0.6	37.7	2.6
11	Delcam International	0.4	0.6	0.5	-13.5	2.3
12	Intergraph	0.4	0.4	0.4	-7.0	1.7
13	Ansys	0.3	-	0.4	NA	1.7
14	Gerber Systems	0.2	0.2	0.3	21.0	1.3
15	ADRA Systems	0.1	0.2	0.3	54.8	1.1
16	ICEM Technologies	1.1	0.1	0.2	40.4	0.7
17	Spatial Technology	-	0.1	0.1	52.2	0.5
18	Vero International Software	0	0	0.1	97.3	0.3
19	CAD Centre	-	-	0	NA	0.2
20	GRAPHSOFT	-	-	0	NA	0
21	Exapt	0.4	0.3	-	-100.0	-
22	Tebis	0.2	0.2	-	-100.0	-
23	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	0.5	0.8	1.0	25.6	4.4
	All N.A. Companies	11.1	10.9	18.4	69.2	83.1
	All European Companies	2.4	2.6	2.8	8.4	12.5
	All Asian Companies	-	-	-	NA	-
	All Companies	14.0	14.2	22.1	55.8	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-13
1995 Top 30 Mechanical Software Companies, Rest of Europe, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	2.6	4.2	7.0	68.4	30.4
2	MacNeal-Schwendler	4.4	2.4	4.1	73.4	17.9
3	Wiechers Datentechnik	0.9	1.0	1.3	27.6	5.6
4	SDRC	0.7	0.9	1.0	16.6	4.5
5	Siemens Nixdorf Info systeme	1.0	1.0	1.0	2.2	4.3
6	Mechanical Dynamics	-	-	0.9	NA	4.1
7	Han Dataport	2.7	0.8	0.9	10.7	3.9
8	Autodesk	6.3	7.2	0.8	-88.4	3.6
9	Eigner + Partner	-	0.7	0.8	15.9	3.5
10	Ansys	0.4	0.4	0.6	41.6	2.6
11	Intergraph	0.6	0.6	0.5	-7.0	2.3
12	Computervision	1.0	0.5	0.5	13.1	2.2
13	Radan Computational	0.1	0.1	0.5	276.4	2.1
14	EDS Unigraphics	4.0	0.3	0.4	15.9	1.7
15	Sherpa Corp.	-	-	0.4	NA	1.6
16	debis Systemhaus	0.3	0.3	0.4	9.8	1.6
17	RoboCAD Solutions	0.3	0.3	0.3	-17.4	1.2
18	CNC Software	0.1	0.2	0.2	10.0	0.7
19	MCS	0.2	0.1	0.1	5.0	0.7
20	Straessle Informationssysteme	5.5	0.4	0.1	-59.2	0.7
21	ISD Software	1.1	0.1	0.1	37.7	0.6
22	Framasoft	0.2	0.1	0.1	105.1	0.6
23	Camax Manufacturing	0	0.1	0.1	149.7	0.6
24	CAD Lab	0.1	0.2	0.1	-43.2	0.6
25	Spatial Technology	-	0.1	0.1	52.2	0.5
26	Ziegler Informatics	0.8	0.4	0.1	-79.6	0.4
27	B.A. Intelligence Networks	0	0.1	0.1	3.9	0.3
28	CIMLINC	-	-	0.1	NA	0.3
29	Superdraft	0	0	0	-1.2	0.2
30	Research Engineers—Civilsoft	-	0	0	91.9	0.1
	Other Companies	1.6	1.8	1.0	-46.4	4.2
	All N.A. Companies	24.6	22.5	16.5	-26.7	71.9
	All European Companies	19.5	10.2	5.5	-46.0	24.0
	All Asian Companies	-	-	-	NA	
	All Companies	45.7	34.5	23.0	-33.4	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

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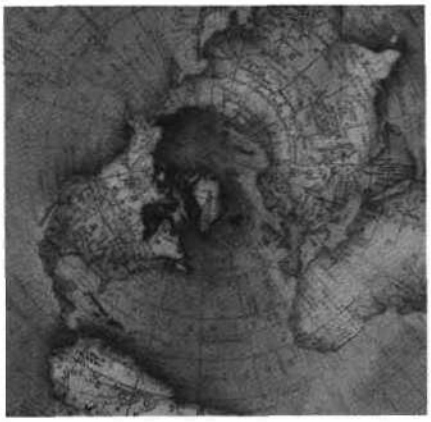

Dataquest

CAD/CAM/CAE/GIS Mechanical Market Share Update

Market Statistics

Program: Mechanical Applications Worldwide
Product Code: CMEC-WW-MS-9603
Publication Date: August 12, 1996
Filing: Market Statistics

CAD/CAM/CAE/GIS Mechanical Market Share Update

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Note: All tables show estimated data.

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Note: All tables show estimated data.

Chapter 1
CAD/CAM/CAE/GIS Mechanical Market Share Update

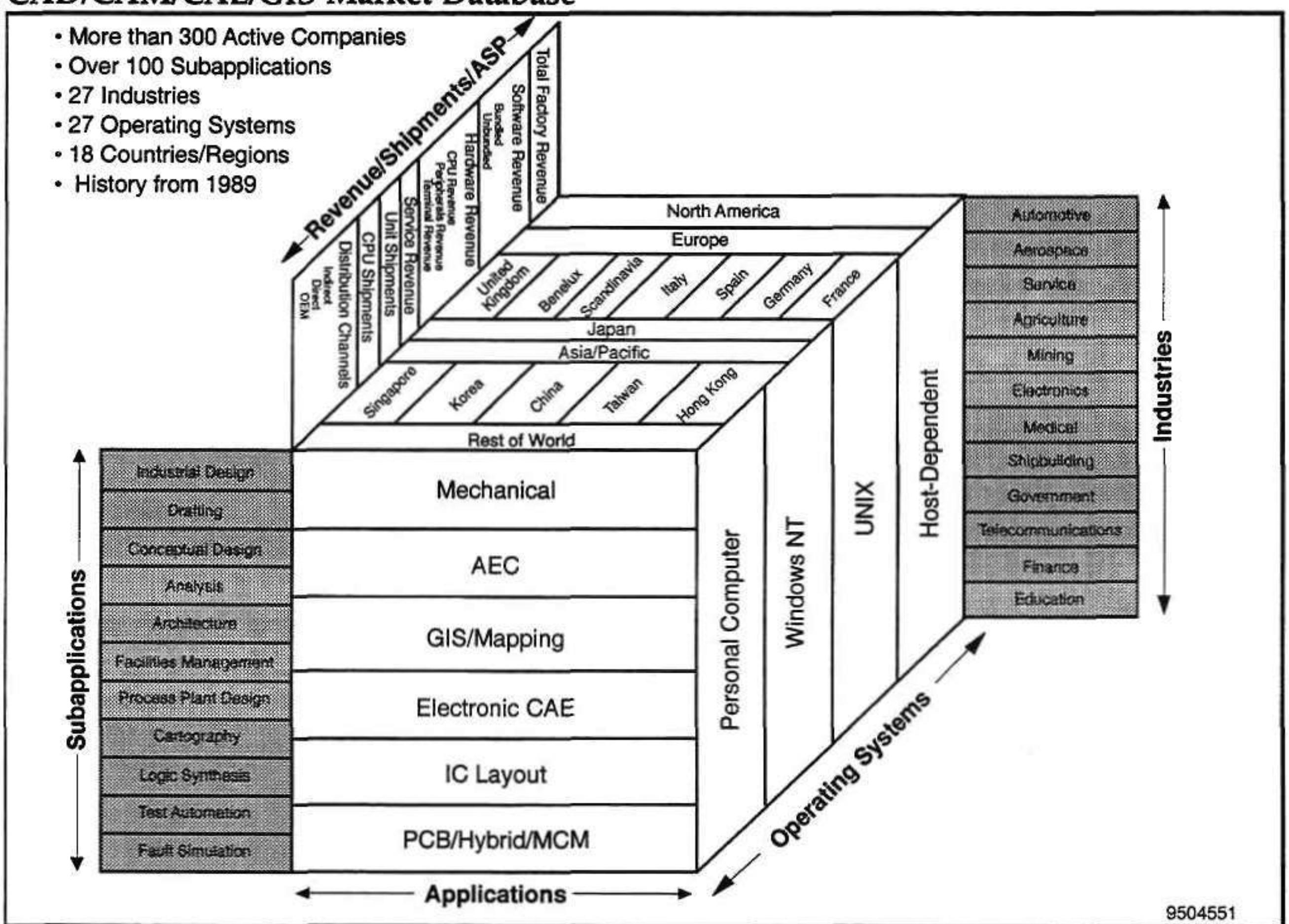
Introduction

CAD/CAM/CAE/GIS systems have dramatically changed the methods by which designers and production managers originate and implement products. CAD and CAE systems allow designers to create, draft, analyze, test, and manipulate products on a screen in two and three dimensions. As CAD/CAM/CAE/GIS systems continue to decrease in cost, they become more available and cost-justifiable to new users.

In order to provide a comprehensive view of the CAD/CAM/CAE/GIS industry, Dataquest's CAD/CAM/CAE/GIS group maintains a large database of industry information. The type of information contained in the database is depicted in Figure 1.

Table 1 summarizes the performance in various segments of the CAD/CAM/CAE/GIS markets in 1995 versus 1994.

Figure 1
CAD/CAM/CAE/GIS Market Database



Source: Dataquest (July 1995)

Table 1
CAD/CAM/CAE/GIS Market Summary, 1994 to 1995

	Software Revenue		Growth (%)	Total Factory Revenue		Growth (%)	Seat Shipments		Growth (%)
	1994	1995	1994-1995	1994	1995	1994-1995	1994	1995	1994-1995
Applications									
Mechanical	2,491.15	3,011.91	20.90	8,339.60	9,571.96	14.78	306,513.18	353,406.86	15.30
AEC	840.13	958.22	14.06	2,444.13	2,768.62	13.28	208,900.88	247,104.23	18.29
GIS/Mapping	692.92	826.29	19.25	2,230.49	2,613.11	17.15	106,411.06	131,365.76	23.45
Electronic CAE	861.06	1,020.03	18.46	2,460.41	2,938.66	19.44	96,349.49	101,773.77	5.63
IC Layout	203.35	263.50	29.58	712.51	885.53	24.28	12,340.43	14,251.15	15.48
PCB/MCM/Hybrid	253.90	265.84	4.70	799.12	827.01	3.49	27,012.53	27,546.43	1.98
Electronic Design Automation	1,318.31	1,549.36	17.53	3,972.03	4,651.20	17.10	135,702.45	143,571.36	5.80
All Applications	5,342.51	6,345.79	18.78	16,986.24	19,604.89	15.42	757,527.57	875,448.20	15.57
Regions									
North America	1,874.61	2,153.26	14.86	5,942.32	6,599.13	11.05	335,044.51	354,952.40	5.94
Europe	1,722.46	2,098.63	21.84	5,472.44	6,489.91	18.59	246,367.12	299,541.87	21.58
Japan	1,390.78	1,619.06	16.41	4,610.52	5,276.78	14.45	114,609.09	143,641.20	25.33
Asia-Pacific	265.60	360.50	35.73	720.99	916.86	27.17	43,760.89	56,326.06	28.71
Rest of World	89.06	114.34	28.38	239.98	322.22	34.27	17,745.96	20,986.67	18.26
Worldwide	5,342.51	6,345.79	18.78	16,986.24	19,604.89	15.42	757,527.57	875,448.20	15.57
Operating Systems									
UNIX	3,749.35	4,298.63	14.65	12,206.29	13,880.11	13.71	232,067.13	249,634.54	7.57
Host/Proprietary	194.47	183.91	-5.43	1,309.64	1,130.22	-13.70	17,325.44	13,673.37	-21.08
NT/Hybrid	119.41	358.64	200.33	311.72	929.48	198.17	7,942.47	26,088.00	228.46
Personal Computer	1,279.28	1,504.60	17.61	3,158.59	3,665.09	16.04	500,192.53	586,052.30	17.17
All Operating Systems	5,342.51	6,345.79	18.78	16,986.24	19,604.89	15.42	757,527.57	875,448.20	15.57

Source: Dataquest (July 1996)

About This Document

This document contains Dataquest's detailed market share information on the CAD/CAM/CAE/GIS industry. The following list contains descriptions of the companies included in the Market Share books. See Tables 2, 3, 4, and 5 for changes in the companies tracked from our 1994 report.

- Mechanical applications—All companies in database with mechanical revenue
- GIS and AEC applications—All companies in database with GIS revenue and all companies in database with AEC revenue. We also have added GIS data companies.
- Electronic design automation applications—All companies in database with EDA (electronic CAE, IC layout, PCB/hybrid/MCM) revenue
- Europe—All companies with European revenue
- Asia—All companies with Asian revenue

We no longer publish top-level market statistics for the entire CAD/CAM/CAE/GIS industry. This data is available by calling Suzanne Snygg at (408) 468-8124. More detailed data on these markets may be requested through our client inquiry service.

This document represents our final market share of 1995 shipments and revenue.

Table 2
Companies Renamed Since 1994

Original Company Name	New Company Name
American Small Business Company	Viagrafix
SHL Systemhouse	SHL VISION Solutions
IEZ	IEZ-Speedikon

Source: Dataquest (July 1996)

Table 3
Companies (or CAD Portions of Companies) Sold/Merged in 1994

Original Company Name	Acquired by/Merged with
3Soft	Mentor Graphics
Exemplar Logic	Mentor Graphics
Facilities Mapping Systems	Eagle Point
Geographix	Landmark Graphics
Integrated Silicon Systems & Arcsys	Avant!
Integrity Engineering	Mentor Graphics
Marcus Computer Systems	ISD Software
Neocad	Xilinx
Rasna	Parametric Technology

Source: Dataquest (February 1996)

Table 4
Companies Deleted from Database Since 1994

Company
Aucotec
INS Engineering
Micrografx

Source: Dataquest (July 1996)

Table 5
Companies Added to Database Since 1994

Company
Altair Computing Inc.
Ansoft
Bentley Systems
Bionic Knight
CAE Plus Inc.
Eagle Design Automation
Escalade
Frontline Design Automation
Just in Time Systems
Logic Vision
Macon
MicroCADAM Inc.
Number One Systems
Protel Technologies
Speedsim

Source: Dataquest (July 1996)

Dataquest's policy is to continually update its market information, for current and past years, with any new data received in order to arrive at the most accurate market representation possible.

Segmentation Definitions

This section lists the definitions specific to this document. The following paragraphs define the segments.

Applications

Mechanical

The mechanical segment refers to computer-aided tools used by engineers, designers, analysts, technicians, and draftspeople working predominantly in the discrete manufacturing industries, but includes government and education. Users of mechanical CAD/CAM/CAE tools work in all departments across the typical organization, with a majority found in product design, advanced engineering, and manufacturing engineering. Common design applications include conceptual design, industrial design, structural or thermal analysis, detail design, and electromechanical design (the mechanical part of design with electrical or electronic components and mechanisms). Common manufacturing applications include tool and fixture design, numerical control part programming, offline robotics programming, and interface to quality control systems. Management tools for database control and distribution are included in this segment, as well as user-defined application programming.

Architecture, Engineering, and Construction (AEC)

The AEC segment covers the use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and other people associated with these disciplines to aid in designing and managing buildings, industrial plants, ships, and other types of nondiscrete entities.

Geographic Information Systems (GIS)/Mapping

GIS is computer-based technology, and the segment comprises hardware, software, and data used to capture, edit, display, and analyze spatial (tagged by location) information.

Electronic Design Automation (EDA)

The EDA segment covers computer-based tools used to automate the design of an electronic product, including printed circuit boards, ICs, and systems. EDA includes ECAE, IC layout, and PCB/hybrid/MCM, as follows:

- Electronic computer-aided engineering (ECAE)—These are computer-aided tools used in the engineering or design phase of electronic products (as opposed to the physical layout phase of the product). Examples of electronic CAE applications are schematic capture and simulation.
- IC layout—This is a software application tool used to create and validate the physical implementation of an IC. The IC layout category comprises polygon editors, symbolic editors, placement and routing (gate array, cell, and block), and design verification tools (DRC/ERC/logic-to-layout).
- PCB/hybrid/MCM—This segment covers products used to create the placement and routing of the traces and components laid out on a printed circuit board. Also included in this category are thermal analysis tools.

Regions

The following paragraphs define the regions.

North America

Includes Canada, Mexico, Puerto Rico, and the United States

Europe

Western Europe. Includes Austria, Benelux (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)

Eastern Europe. Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)

Japan

Asia/Pacific
Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)

Rest of World
Includes Africa, Central America, the Caribbean, the Middle East, Oceania, and South America

Operating Systems

Dataquest defines the operating systems as follows:

- UNIX: UNIX includes all UNIX variants and older workstation operating systems.
- Host: Host includes minicomputer and mainframe operating systems in which the functions of external workstations are dependent on a host computer.
- Windows NT: Windows NT is the Microsoft operating system. We understand that code for Windows NT and Windows will be merged within the next three years. The probability is high that Microsoft will develop a client environment and a server environment. In our forecast, the future client environment is included in PC operating systems, and the future server environment is referenced as NT. Also included in NT is potential for an additional, new, high-end operating environment that could be developed by any vendor.
- PC: PC includes DOS, Windows, Windows 95, and Apple operating systems.

Metrics

The following paragraphs define measurements:

- Total factory revenue is defined as the amount of money received by a manufacturer for its goods and services measured in U.S. dollars. Total factory revenue does not include revenue that a company may receive from products that are sold to another company for resale (OEM revenue). Total factory revenue is the sum of software revenue, hardware revenue, and service revenue.
- Unit shipment is defined as the number of seats delivered (number of possible simultaneous users of product delivered) excluding OEM shipments.

- Hardware revenue is revenue derived from sales of CPUs (including operating systems), terminals (for host-dependent systems), and peripherals.
- Software revenue is revenue derived from the sale of application software that exists on a company's standard price list.
- End-user revenue
- Service revenue is defined as all revenue derived from the service and support of CAD/CAM/CAE/GIS systems. Service revenue can be calculated in the tables by subtracting hardware and software revenue from total revenue. A split by hardware service and software service is available through inquiry.
  - Maintenance fees for hardware and software
  - Management and operations services—Help desk, education and training, disaster recovery, vaulting, and configuration management
  - Service bureau—Project work, including construction of database, data conversion, product design, analysis, or manufacturing
  - Application development—Design and development of customized software applications or the modification, enhancement of customization of existing software applications, adding new functionality
  - Consulting revenue—Assessment of CAD/CAM/CAE/GIS business and information technology needs and the formulation of a plan based on needs identification
  - Implementation and integration services—Planning, implementation, migration, and integration of software products (software network support and integration, account integration management, data center design, and construction)

Market Share Methodology

Dataquest uses both primary and secondary sources to produce our market share data. In the fourth quarter of each year and second quarter of the subsequent year, we survey all participants in each industry. Each vendor is offered the opportunity to self-report the information required. Although there is a primary contact for each company, large companies are surveyed across product lines and across geographic regions. Thus there is a corresponding increase in the number of contacts at large companies. (Dataquest maintains a large contact database on all sources of information.) Examples of the job titles of people contacted for information are the following:

- President and CEO
- Vice president and general manager
- Vice president of marketing
- Vice president, strategic product planning

- Director of strategic planning
- Director of marketing
- Director of market development
- Manager, CAD/CAM/CAE/GIS marketing programs
- Market research analyst

The Audit Process

Data supplied by vendors is evaluated against information drawn from many sources, including the following:

- Revenue published by major industry participants
- Estimates made by knowledgeable and reliable industry spokespersons
- Government data or trade association data
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users
- Relevant economic data
- Information and data from online data banks
- Articles in both the general and trade press
- Annual reports, SEC documents, credit reports
- Company publications and press releases
- Reports from financial analysts
- User studies
- Reseller and supplier reports and reports from a vendor's competitors

Dataquest also sums vendor revenue across other industries covered by Dataquest to make sure that revenue is not credited twice, and checks with multiple sources at one company to cross-check data on that company.

Dataquest analysts have many years of experience in how to apply the tools described to get the most accurate information possible on a particular company (such as what to use when and what industry averages are). We believe that the estimates presented here are the most accurate and meaningful generally available today. It is the CAD/CAM/CAE/GIS group's policy to continually update our market information for any year, based on any new data received, in order to arrive at the most accurate market representation possible.

Dataquest's CAD/CAM/CAE/GIS market numbers are often higher than those reported by other sources. We survey worldwide, which involves more vendors, higher total market revenue, lower market share per vendor, and a more accurate market picture—which is particularly useful when comparing regions or applications.

Reporting Changes

Beginning with our March 4 publication, we published market share data that reports OEM revenue for all regions. Also, for the first time in the United States our market share tables included companies that resell products from other vendors as well as their own products (these are primarily Japanese companies), and companies that sell products primarily to other vendors (such as Dassault). In the past, this reporting was standard only in our products for Japan, Europe, and Asia/Pacific. We believe that this reporting accurately reflects the activity of all the vendors in the CAD/CAM/CAE and GIS market. To prevent double counting of the market, we will continue to count the total market size by excluding OEM and reseller revenue. As a result, the sum of the individual software vendors will be greater than the total market size in all market share tables. On an inquiry basis, we can produce market share tables that exclude OEM revenue, or report only OEM revenue.

We have also altered IBM's revenue to exclude revenue derived from MicroCADAM sales. We have restated history so that MicroCADAM now appears as its own company for 1994 and 1995, in much the same way that we now separately report Bentley and Intergraph. We believe this will correctly reflect both the change in IBM's ownership of MicroCADAM and a reduction of IBM's role as a reseller of this product. Also, after close examination of Fujitsu, we have restated this company's revenue split to more accurately reflect its OEM sales.

These reporting changes primarily reflect our efforts to both accurately depict markets while accounting for revenue by distribution channel. Dataquest's CAD/CAM/CAE/GIS database was first developed in the turnkey era of CAD/CAM, when channel reporting was relatively unimportant. Today, of course, worldwide distribution and PC-based products require us to better report revenue by channel. While our existing database does account for much of this information, we believe improvements are necessary.

Changes in Software Distribution Channel Accounting

The CAD/CAM/CAE/GIS software industries make extensive use of complex distribution channels throughout the world, which has resulted in considerable confusion. At last, we believe we have developed a data architecture that accurately reflects the revenue flow. This Market Statistics is our first effort to present this new reporting.

For many years, our market database could report the following categories for distribution channels: direct, indirect, OEM, and "*" companies. The "*" *generally* was used to indicate data *included* (but not limited to) revenue received by a vendor acting as a reseller, typically a Japanese vendor reselling U.S. originated products. This "*" revenue was typically reported in tables delivered to clients in Europe and Asia, where very large resellers exist, and not reported in tables delivered to clients in North America.

From now on, we are tracking this reseller revenue as a separate channel, in addition to new tracking of software based on user spending. Definitions and examples of this new reporting follow.

Channel Definitions

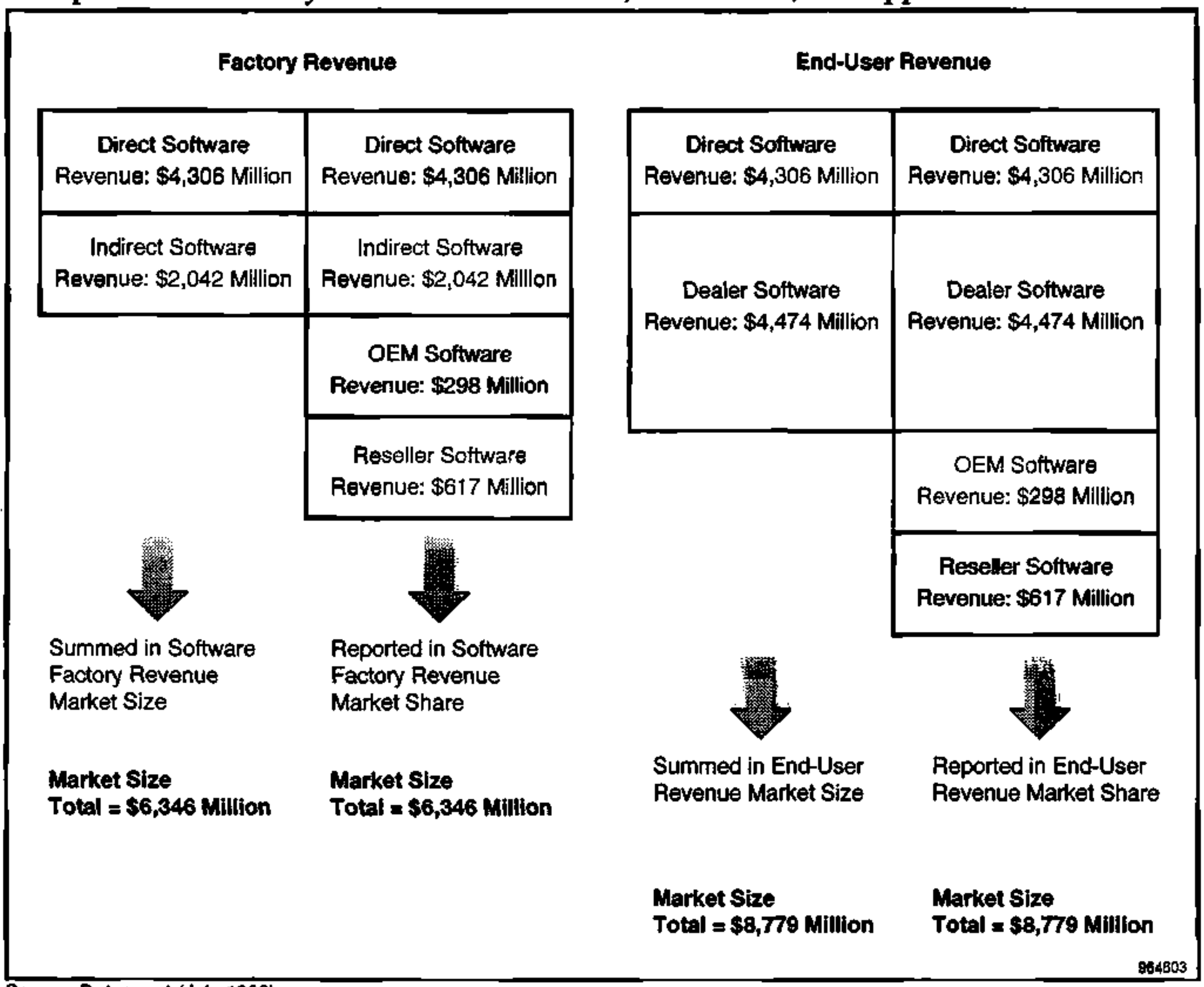
- Direct—Direct to end user
- Indirect—Sales to resellers, from which dealer revenue is calculated
- Dealer Revenue—The calculation of total end-user revenue earned by resellers. Dealer revenue is based on a multiplier of indirect revenue. Thus, dealer revenue always exists for every vendor with indirect sales and it is always at least equal to indirect revenue. Calculation of these multipliers will vary by vendor, by region, and by platform.
- OEM—A channel through which vendors sell their finished product to other companies for resale through an agreement. This revenue is included in reporting by vendor in typical market share tables, but is not added to our market totals, to avoid double counting. Once sold, the product is usually modified slightly, relabeled and rebranded by the new original equipment manufacturer, and then resold directly to the end user or through an indirect channel. Revenue as sold by that final vendor (who, from the perspective of the original component supplier, is also popularly known as the OEM) is then credited as factory revenue to the final supplier, and as revenue contributing to the market.
- Reseller—The revenue a named company in the CAD/CAM/CAE/GIS database receives for selling another company's product, such as Intergraph's revenue from Bentley Microstation products, IBM's revenue for reselling MicroCADAM, or Fujitsu's revenue for reselling software from several U.S. vendors. Essentially, this is "dealers" revenue for the cases where we actively track individual dealers, or resellers.
- Software product—Direct and indirect software revenue combined, excluding OEM and reseller sales. Here the individual vendor's revenue will exactly equal the total market. These tables will be published occasionally and are always available on request. Although we can produce tables from a wide variety of conceptually consistent perspectives, the following are typical tables that we will publish:
    - Company software tables that include OEM and reseller revenue at the vendor level but do not add revenue from these two channels to the total market
    - End-user revenue tables (new)

Standard components (direct and indirect revenue) are used to calculate company software revenue and two additional components (reseller revenue and OEM revenue) are reported on the table—and market shares are calculated on the total number listed on the table. This means that the sum of market shares will be somewhat more than 100 percent.

The same plan is used to calculate end-user revenue—the additional component included is dealer revenue. This reporting is outlined in the summary in Figure 2.

To understand this concept for the vendors with complex business models, imagine separating the part of a company that writes a software product from the company that owns the copyright (that is, HP's mechanical software or IBM's architectural design software) from the part of the company that packages software into complete offerings. So Fujitsu, the packaging company, sells its own sofware and software from outside vendors. In a special case, IBM receives direct revenue credit for selling Dassault's Catia (rather than reseller revenue) because, as the sole reseller, IBM essentially obscures the Dassault identity and effectively puts its own label on the product as the original equipment manufacturer (if Dassault ever sold CAD software through multiple resellers, we would alter our reporting appropriately). Dassault's revenue will be

Figure 2
Comparison of Factory and End-User Market, Worldwide, All Applications



Source: Dataquest (July 1996)

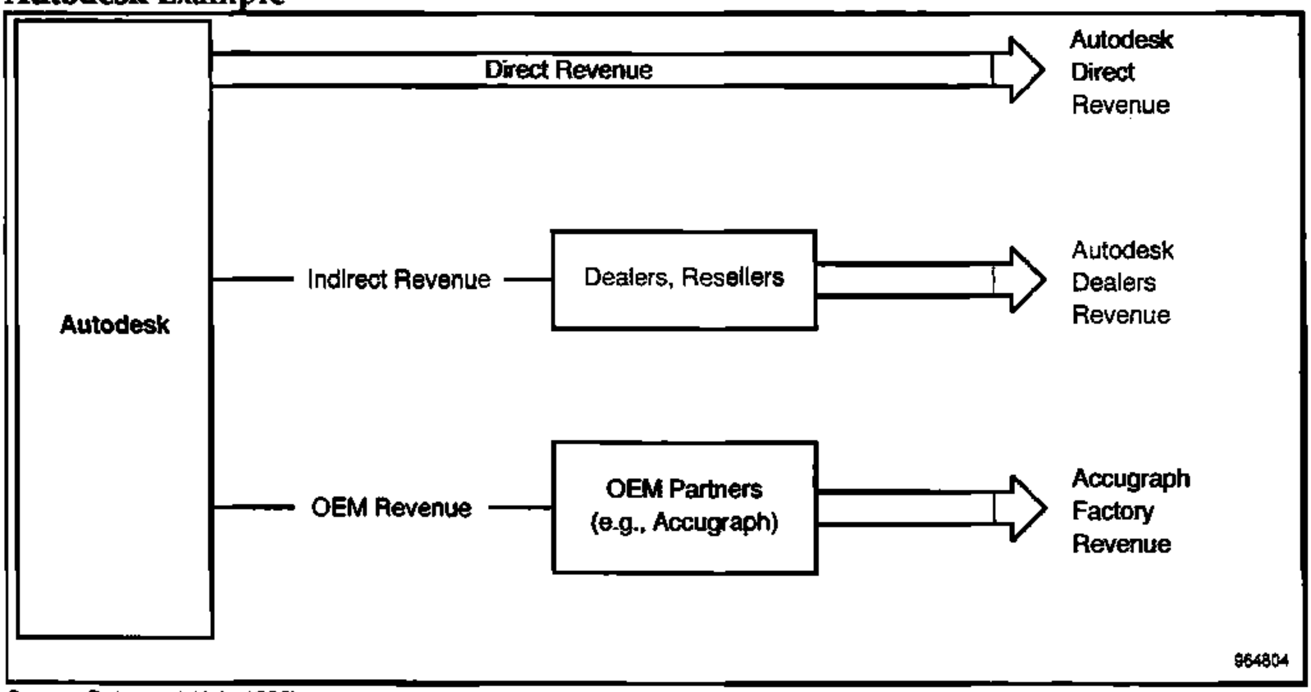
reported on market share tables, but OEM revenue will not be added to the market total (avoiding double counting). Also, in the case where IBM itself sells MicroCADAM software (a company 50 percent owned by IBM), it will receive reseller revenue—but IBM gets no revenue credit for the Microcadam revenue sold by others. At the same time, MicroCADAM Inc.'s revenue is calculated both for its indirect and dealers revenue, in the same way that Bentley Systems (also owned 50 percent by Intergraph) receives its own revenue credit, regardless of who sells its products.

The best way to think about this is to picture the revenue counted for key companies. A few examples follow; see Figures 3, 4, and 5. The labels refer to the specific vendor and type of revenue as it would be reported.

This reporting scheme means that the sum of vendor revenue (and market shares) will total to more than the sum of the market. We have used similar reporting for European and Asian clients for years, in response to the realities of market requirements. We believe the best way to accurately report market opportunities and positioning worldwide is through this method. Advantages to this approach include:

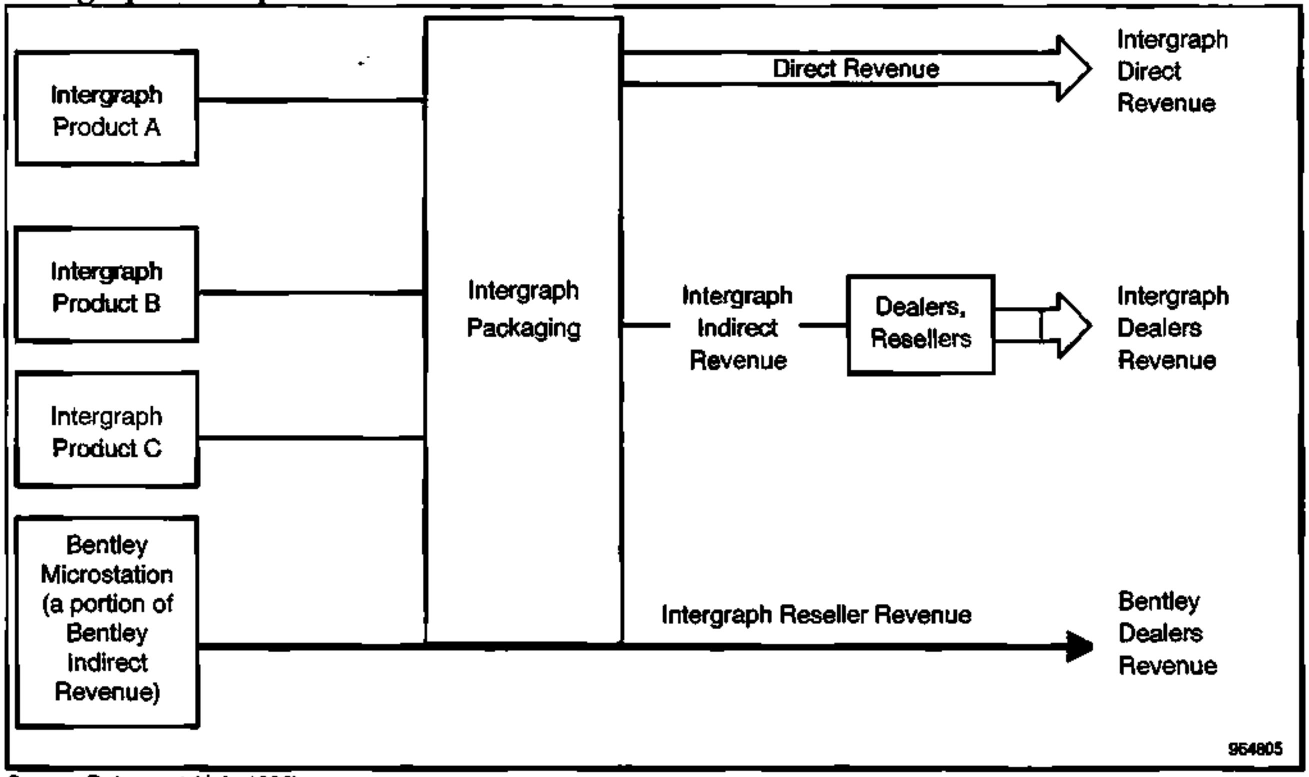
- We do not double count any total market opportunity, and we will continue to avoid overstating the actual revenue available, which will help our clients make the most reasonable investments.

Figure 3
Autodesk Example



Source: Dataquest (July 1996)

Figure 4
Intergraph Example

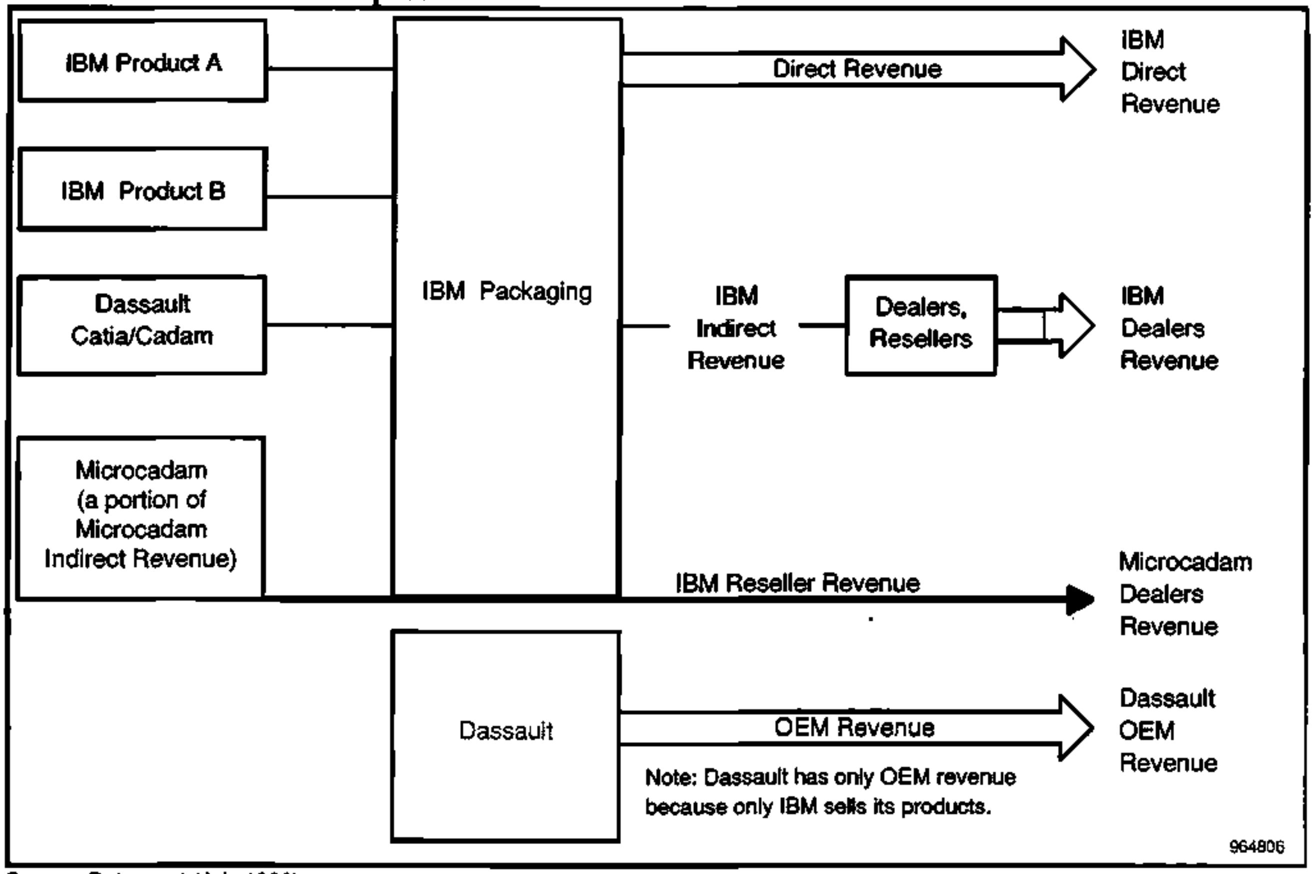


Source: Dataquest (July 1996)

- The high level of activity of vendors who are active in multiple channels will show up in market share tables, again without double counting revenue. For example, it will be possible to understand the status of Bentley Systems vis-a-vis Intergraph. We can report Bentley's factory software revenue, Bentley's total end-user revenue (some of which will be sold by Intergraph), Intergraph's sales from Intergraph products, Intergraph resesser sales from Bentley products, and sales made by Intergraph's own dealers. In general, this model will allow us to better detail market contributions by companies with complex business models, such as Fujitsu, IBM, and NEC.
- In our ongoing tests of alternate reporting schemes, tables that report only vendor revenue (that is, tables where individual vendor revenue always sums to the total market) produce significantly misleading results in a number of important cases. On the other hand, tables that add all revenue reported into the market total produce results that mislead vendors about the actual revenue opportunity. We have found that tables that include all vendor activity while not double counting the market actually produce the closest to what we believe is a true depiction of the market.

Tables 6, 7, and 8, which follow, provide three successive views of the market, beginning with product software revenue in Table 6, in which Autodesk has a slim lead. In Table 7, which shows company software revenue (or revenue in the bank for any CAD software sales), IBM takes

Figure 5
IBM and Dassault Examples



Source: Dataquest (July 1996)

the lead, because of the company's significant resales of MicroCADAM. Finally, in Table 8, we see the calculation of end-user revenue (or revenue from the user's wallet), where Autodesk's dominant market position, only suggested by Table 6, becomes clear. Calculated on the basis of what Autodesk's extensive dealer network receives from users, Autodesk is almost twice the size of its nearest competitor. For those receiving GIS tables, we highlight the significant differences between factory revenue, where Intergraph, through its direct sales, puts more money in the bank than ESRI, which relies on an extensive international network of dealers (that, it is important to note, are often partially owned by CEO, Jack Dangermond, independent of ESRI Inc.). ESRI's market dominance is only clear in Table 8, where the software revenue from these resellers is calculated in the equation.

A Final Note

The tables we choose to publish in statistics books are those we believe useful for the greatest number of clients. However, given the rich dynamics in distribution channels, it is not possible to understand the full opportunity from a single viewpoint. On request, we are happy to deliver alternative views of the market, as detailed tables—we do prefer to deliver these as Excel workbooks via e-mail. For example, we will continue to be able to produce tables that show only product software revenue, direct revenue, indirect revenue, or OEM revenue. Our ongoing committment is to maintain an accurate and complete model of the entire CAD/CAM/CAE/GIS market, worldwide, and we welcome your input.

Publishing Schedule

We publish market share and forecasting twice each year for each, allowing for both timely distribution of data and thorough analysis and forecasting. Our annual delivery schedule is as follows:

- Market share was published and distributed to clients by March 4.
- A five-year forecast for CAD/CAM/CAE/GIS was shipped to clients on May 13.
- Final updated market share tables, based on additional data collection and analysis, are presented in this report. At this point, the market share database is frozen and will not be changed until the end of the year. For the next six months, supplementary market data will be based on this final market data. Other cuts of data not presented in these books (such as subapplication information) are available through our Client Inquiry service.

  We provide complete final forecast tables by September 2. These tables take into consideration changes in the market share during the previous six months. Books will be shipped by September 31.

Table 6
Top 30 Product Software Revenue, Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	398.6	438.6	511.3	16.6	8.1
2	IBM	426.6	358.4	467.6	30.5	7.4
3	Parametric Technology	163.7	206.5	321.2	55.5	5.1
4	Intergraph	322.2	318.4	295.6	-7.2	4.7
5	Cadence	179.5	197.8	253.6	28.2	4.0
6	Synopsys	112.9	142.7	193.5	35.6	3.0
7	EDS Unigraphics	148.9	169.8	192.5	13.4	3.0
8	Mentor Graphics	167.3	175.6	182.2	3.8	2.9
9	Computervision	172.6	163.1	163.7	0.3	2.6
10	Fujitsu	125.2	135.1	151.4	12.1	2.4
11	MicroCADAM	-	91.7	129.2	40.9	2.0
12	Hewlett-Packard	104.0	108.9	117.8	8.2	1.9
13	SDRC	85.6	103.3	117.6	13.8	1.9
14	MacNeal-Schwendler	77.4	93.6	117.6	25.5	1.9
15	NEC	96.4	103.4	109.9	6.3	1.7
16	ESRI	76.1	95.0	109.2	15.0	1.7
17	Hitachi	85.1	88.9	94.5	6.4	1.5
18	Siemens Nixdorf Info systeme	86.8	91.4	93.2	2.0	1.5
19	Landmark Graphics	64.1	72.5	89.9	24.0	1.4
20	Bentley Systems	-	4.2	89.9	2032.9	1.4
21	Matra Datavision	64.1	75.6	87.4	15.6	1.4
22	Toshiba*	64.8	78.1	86.0	10.1	1.4
23	Nihon Unisys	62.9	69.9	77.1	10.3	1.2
24	Zuken-Redac	71.5	67.7	72.4	7.0	1.1
25	Quickturn Design Systems	49.5	59.0	70.7	19.9	1.1
26	Nemetschek	44.7	58.1	65.8	13.1	1.0
27	Viewlogic Systems	63.4	70.0	65.5	-6.5	1.0
28	GDS	38.4	45.2	52.2	15.6	0.8
29	Compass Design Automation	43.0	43.1	50.4	16.8	0.8
30	IEZ-Speedikon	29.6	40.3	46.9	16.6	0.7
	All N.A. Companies	3,444.1	3,865.0	4,691.3	21.4	73.9
	All European Companies	632.4	698.7	796.1	13.9	12.5
	All Asian Companies	739.6	778.8	858.4	10.2	13.5
	All Companies	4,816.1	5,342.5	6,345.8	18.8	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table 7
Top 30 Company Software Revenue, Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	426.6	411.5	527.6	28.2	8.3
2	Autodesk	398.6	438.9	516.4	17.6	8.1
3	Intergraph	322.2	318.3	345.8	8.6	5.4
4	Parametric Technology	165.7	209.8	321.2	53.1	5.1
5	Cadence	189.5	200.8	257.7	28.3	4.1
6	Fujitsu	161.6	182.1	210.8	15.8	3.3
7	EDS Unigraphics	152.8	172.9	195.8	13.3	3.1
8	*Dassault	136.0	157.1	194.5	23.8	3.1
9	Synopsys	113.7	142.7	193.5	35.6	3.0
10	Mentor Graphics	167.3	175.6	184.0	4.7	2.9
11	Computervision	173.3	163.1	163.7	0.3	2.6
12	MicroCADAM	-	91.7	129.2	40.9	2.0
13	Hewlett-Packard	104.0	108.9	117.8	8.2	1.9
14	SDRC	93.9	103.3	117.6	13.8	1.9
15	MacNeal-Schwendler	77.4	93.6	117.6	25.5	1.9
16	NEC	96.4	103.4	109.9	6.3	1.7
17	ESRI	76.1	95.0	109.2	15.0	1.7
18	Hitachi	85.1	88.9	94.5	6.4	1.5
19	Siemens Nixdorf Info systeme	86.8	91.4	93.2	2.0	1.5
20	Landmark Graphics	65.1	72.5	89.9	24.0	1.4
21	Bentley Systems	-	26.0	89.9	245.4	1.4
22	Matra Datavision	64.1	75.6	87.4	15.6	1.4
23	Toshiba*	136.7	78.1	86.0	10.1	1.4
24	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	1.3
25	Viewlogic Systems	76.9	83.3	77.3	-7.3	1.2
26	Nihon Unisys	125.9	69.9	77.1	10.3	1.2
27	Zuken-Redac	73.6	67.7	72.4	7.0	1.1
28	Quickturn Design Systems	51.5	59.0	70.7	19.9	1.1
29	Nemetschek	47.9	58.1	65.8	13.1	1.0
30	C. Itoh Techno-Science*	52.5	59.0	52.9	-10.4	0.8
	All N.A. Companies	3,444.1	3,865.0	4,691.3	21.4	73.9
	All European Companies	632.4	698.7	796.1	13.9	12.5
	All Asian Companies	739.6	778.8	858.4	10.2	13.5
	All Companies	4,816.1	5,342.5	6,345.8	18.8	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table 8
Top 30 End User Software Revenue, Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	692.7	763.3	1,086.9	42.4	12.4
2	IBM	856.5	425.1	531.3	25.0	6.1
3	Intergraph	370.4	381.6	370.9	-2.8	4.2
4	Parametric Technology	206.8	212.2	360.6	69.9	4.1
5	Cadence	194.1	244.2	314.1	28.6	3.6
6	Fujitsu	189.4	213.7	246.3	15.2	2.8
7	Hewlett-Packard	199.7	215.3	241.9	12.4	2.8
8	Computervision	206.0	224.1	235.2	4.9	2.7
9	ESRI	159.8	199.4	229.5	15.1	2.6
10	EDS Unigraphics	163.2	193.8	223.4	15.3	2.5
11	Mentor Graphics	187.1	199.7	200.0	0.1	2.3
12	Synopsys	117.4	146.4	198.6	35.7	2.3
13	Dassault	136.0	157.1	194.5	23.8	2.2
14	SDRC	142.4	161.9	183.2	13.1	2.1
15	Bentley Systems	-	27.8	170.4	512.1	1.9
16	MicroCADAM	-	106.3	149.8	40.9	1.7
17	MacNeal-Schwendler	87.1	111.5	146.4	31.3	1.7
18	NEC	112.3	134.2	137.9	2.7	1.6
19	Landmark Graphics	68.0	107.4	126.8	18.0	1.4
20	Toshiba*	195.0	111.7	123.2	10.3	1.4
21	Matra Datavision	80.8	90.8	117.5	29.4	1.3
22	Siemens Nixdorf Info systeme	98.3	104.4	115.7	10.9	1.3
23	Hitachi	102.8	107.3	114.1	6.4	1.3
24	Viewlogic Systems	88.5	96.1	97.8	1.7	1.1
25	Nihon Unisys	125.9	88.6	94.1	6.3	1.1
26	IEZ-Speedikon	44.7	57.3	90.1	57.1	1.0
27	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	1.0
28	Zuken-Redac	92.4	77.1	84.3	9.3	1.0
29	Nemetschek	47.8	68.8	77.8	13.1	0.9
30	Quickturn Design Systems	60.0	70.2	77.8	10.8	0.9
	All N.A. Companies	4,862.7	5,138.1	6,478.0	26.1	73.8
	All European Companies	871.4	940.3	1,119.3	19.0	12.7
	All Asian Companies	988.5	1,044.9	1,182.1	13.1	13.5
	All Companies	6,722.6	7,123.4	8,779.4	23.2	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-1
1995 Top 30 Mechanical Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	361.1	368.3	491.5	33.4	16.3
2	Parametric Technology	165.7	209.8	321.2	53.1	10.7
3	Autodesk	159.4	176.0	210.2	19.4	7.0
4	EDS Unigraphics	152.8	172.9	195.8	13.3	6.5
5	Dassault	133.4	154.2	190.6	23.6	6.3
6	Computervision	149.2	148.2	149.1	0.6	5.0
7	MicroCADAM	-	91.7	129.2	40.9	4.3
8	SDRC	93.9	103.3	117.6	13.8	3.9
9	MacNeal-Schwendler	76.6	90.8	114.0	25.5	3.8
10	Fujitsu	74.3	83.7	97.0	15.8	3.2
11	Matra Datavision	63.6	75.6	87.4	15.6	2.9
12	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	2.8
13	Hewlett-Packard	70.9	74.5	81.5	9.4	2.7
14	NEC	54.3	61.7	72.9	18.1	2.4
15	Hitachi	63.9	66.7	70.9	6.4	2.4
16	Toshiba*	95.7	54.5	58.7	7.8	2.0
17	Intergraph	71.0	61.1	54.0	-11.6	1.8
18	Nihon Unisys	103.0	48.1	52.8	9.8	1.8
19	Hitachi Zosen Info Systems	77.3	34.5	38.7	12.1	1.3
20	Ansys	30.3	32.5	37.4	15.0	1.2
21	Applicon	29.6	29.6	31.1	5.2	1.0
22	C. Itoh Techno-Science*	30.4	34.6	30.8	-10.8	1.0
23	Hakuto*	21.2	23.6	29.8	26.5	1.0
24	Siemens Nixdorf Info systeme	26.2	24.7	25.2	2.2	0.8
25	Sherpa Corp.	12.0	18.8	20.6	10.0	0.7
26	Tecnomatix Technology	-	13.0	20.1	54.3	0.7
27	Marubeni Hytech*	15.1	18.3	19.9	8.9	0.7
28	Seiko*	17.4	18.0	19.7	9.3	0.7
29	ADRA Systems	17.5	18.0	19.0	5.7	0.6
30	Formtek	9.7	17.4	18.9	9.1	0.6
	All N.A. Companies	1,569.2	1,771.2	2,201.0	24.3	73.1
	All European Companies	282.9	293.3	336.5	14.7	11.2
	All Asian Companies	402.4	426.7	474.4	11.2	15.7
	All Companies	2,254.5	2,491.2	3,011.9	20.9	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-2
1995 Top 30 Mechanical Software Companies, Worldwide, UNIX
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	193.7	278.3	402.7	44.7	18.2
2	Parametric Technology	156.8	188.9	269.8	42.9	12.2
3	EDS Unigraphics	125.8	172.9	195.8	13.3	8.9
4	Dassault	94.2	115.5	146.4	26.7	6.6
5	Computervision	139.7	141.3	142.5	0.9	6.4
6	SDRC	92.9	103.3	117.6	13.8	5.3
7	MacNeal-Schwendler	28.9	59.9	86.6	44.4	3.9
8	Info. Services Int'l. Dentsu*	50.5	62.7	80.9	29.1	3.7
9	Matra Datavision	62.6	74.0	75.5	2.1	3.4
10	Fujitsu	34.9	56.1	65.0	15.8	2.9
11	Hewlett-Packard	70.9	69.7	59.3	-14.9	2.7
12	Hitachi	51.7	53.9	57.3	6.4	2.6
13	Intergraph	58.7	37.9	52.2	38.0	2.4
14	Nihon Unisys	81.3	43.8	51.8	18.0	2.3
15	MicroCADAM	-	36.7	51.7	40.9	2.3
16	NEC	36.3	42.0	43.7	4.0	2.0
17	Toshiba*	67.0	39.6	43.0	8.5	1.9
18	Hitachi Zosen Info Systems	77.3	34.5	38.7	12.1	1.8
19	C. Itoh Techno-Science*	25.9	30.9	28.4	-8.2	1.3
20	Ansys	17.7	22.1	28.1	26.9	1.3
21	Applicon	29.6	28.6	24.6	-14.2	1.1
22	Siemens Nixdorf Info systeme	22.5	21.2	22.1	4.1	1.0
23	Sherpa Corp.	12.0	18.8	20.4	8.9	0.9
24	Tecnomatix Technology	-	13.0	20.1	54.3	0.9
25	Marubeni Hytech*	15.1	18.3	19.9	8.9	0.9
26	Seiko*	17.4	18.0	19.7	9.3	0.9
27	MARC	11.4	15.5	18.2	17.1	0.8
28	Hakuto*	12.7	14.1	17.9	26.5	0.8
29	Tokyo Electron*	26.6	16.0	17.4	8.6	0.8
30	Alias Research	24.4	13.1	17.3	31.6	0.8
	All N.A. Companies	1,064.2	1,296.8	1,614.2	24.5	73.0
	All European Companies	197.8	211.8	230.3	8.8	10.4
	All Asian Companies	303.8	340.0	367.6	8.1	16.6
	All Companies	1,565.9	1,848.6	2,212.2	19.7	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-3
1995 Top 29 Mechanical Software Companies, Worldwide, NT/Hybrid
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	2.0	20.6	51.4	148.9	43.8
2	Matra Datavision	-	-	9.6	NA	8.2
3	MicroCADAM	-	4.6	6.4	40.7	5.5
4	Omron	-	-	5.8	NA	5.0
5	NEC	-	-	5.2	NA	4.4
6	Bentley Systems	-	1.5	5.1	246.8	4.4
7	Wacom	-	-	4.9	NA	4.2
8	Camax Manufacturing	-	-	4.8	NA	4.1
9	Ansys	-	-	4.5	NA	3.8
10	Spatial Technology	-	2.5	3.9	52.2	3.3
11	CAD Distribution	-	0.1	3.5	4,978.2	3.0
12	Hewlett-Packard	-	-	3.3	NA	2.8
13	Mutoh Industries*	-	2.5	2.3	-7.3	2.0
14	Cimatron	-	1.1	1.9	73.9	1.6
15	Intergraph	-	13.6	1.8	-87.1	1.5
16	MCS	-	-	1.4	NA	1.2
17	MacNeal-Schwendler	-	-	1.1	NA	1.0
18	CGTech	-	0.6	1.0	64.9	0.8
19	DP Technology	-	-	1.0	NA	0.8
20	ASCAD	-	-	0.9	NA	0.8
21	SRAC	-	-	0.7	NA	0.6
22	CAD Lab	-	-	0.7	NA	0.6
23	B.A. Intelligence Networks	-	-	0.7	NA	0.6
24	PROCAD GmbH	-	0.3	0.6	66.6	0.5
25	NOVASOFT Systems	-	-	0.5	NA	0.4
26	Cadtronic*	-	0.1	0.2	102.7	0.2
27	CIMLINC	-	-	0.1	NA	0.1
28	Research Engineers—Civilsoft	-	0	0.1	137.4	0.1
29	Radan Computational	-	0.1	-	-100.0	-
	All N.A. Companies	1.8	39.9	84.3	111.1	71.8
	All European Companies	-	1.5	17.1	1,032.7	14.6
	All Asian Companies	-	-	15.9	NA	13.6
	All Companies	1.8	41.4	117.3	183.1	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

*Company statistics contain VAR/distributor revenue not counted in total.

Source: Dataquest (June 1996)

Table A-4
1995 Top 30 Mechanical Software Companies, Worldwide, Personal Computer (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	149.9	165.6	199.6	20.5	35.4
2	MicroCADAM	-	50.4	71.1	40.9	12.6
3	Fujitsu	33.4	20.9	24.2	15.8	4.3
4	NEC	11.8	19.7	24.0	21.9	4.3
5	Hewlett-Packard	-	4.9	19.0	290.8	3.4
6	Andor*	17.1	17.6	15.9	-9.6	2.8
7	Toshiba*	28.7	14.9	15.8	6.0	2.8
8	Hakuto*	8.5	9.4	11.9	26.5	2.1
9	Design Automation	5.7	7.0	11.6	64.4	2.1
10	Investronica SA	9.9	10.6	11.1	4.8	2.0
11	Wiechers Datentechnik	8.8	8.2	10.4	27.6	1.8
12	Hitachi	9.2	9.6	10.2	6.4	1.8
13	CNC Software	6.9	7.6	8.4	10.0	1.5
14	Tebis	9.1	5.1	8.0	56.6	1.4
15	MCS	7.6	9.0	7.5	-17.6	1.3
16	CADKEY	7.3	6.8	7.5	9.9	1.3
17	Cimatron	5.2	5.1	7.5	46.8	1.3
18	Bentley Systems	-	2.1	7.3	245.0	1.3
19	Computervision	9.6	6.9	6.6	-5.5	1.2
20	Applicon	-	0.9	6.6	601.2	1.2
21	Algor Interactive Systems	4.1	4.1	6.0	47.6	1.1
22	Serbi	9.0	5.0	5.9	16.4	1.0
23	Ashlar	4.4	5.8	5.7	-2.3	1.0
24	Formtek	2.9	5.2	5.7	9.1	1.0
25	Viagrafix	4.8	5.5	5.6	2.0	1.0
26	CAD Lab	5.0	3.4	5.4	58.9	1.0
27	ADRA Systems	5.4	5.1	5.1	1.3	0.9
28	Surfware	1.5	2.7	5.0	85.0	0.9
29	Engineering Computer Services*	3.0	4.5	4.9	10.0	0.9
30	Sumisho Electronics*	5.1	5.2	4.6	-12.4	0.8
	All N.A. Companies	300.7	322.0	399.2	23.9	70.8
	All European Companies	77.5	76.2	86.0	12.9	15.2
	All Asian Companies	71.3	72.1	79.0	9.5	14.0
	All Companies	449.5	470.3	564.2	19.9	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-5
1995 Top 26 Mechanical Software Companies, Worldwide, Host/Proprietary
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	117.6	90.0	88.8	-1.4	75.1
2	Dassault	39.3	38.7	44.2	14.3	37.4
3	MacNeal-Schwendler	46.7	30.9	25.1	-18.9	21.2
4	Fujitsu	5.9	6.7	7.8	15.8	6.6
5	Exapt	8.0	6.1	4.5	-25.8	3.8
6	Hitachi	3.0	3.1	3.3	6.4	2.8
7	C. Itoh Techno-Science*	4.6	3.6	2.4	-33.2	2.0
8	Mechanical Dynamics	1.0	2.1	2.2	5.6	1.9
9	Ansys	5.0	3.3	1.5	-54.3	1.3
10	Mitsubishi Electric*	1.8	1.5	1.2	-16.2	1.0
11	Nihon Unisys	21.6	4.3	1.1	-75.1	0.9
12	Toyo Information Systems*	2.4	0.9	0.8	-12.0	0.7
13	Kubota Computer	2.0	0.9	0.8	-13.2	0.6
14	Computational Mechanics	0.9	0.5	0.5	-	0.5
15	Whessoe Computing Systems	1.7	0.6	0.5	-27.5	0.4
16	Framasoft	1.3	0.4	0.4	6.1	0.4
17	Access Corp.	0.5	0.5	0.4	-13.3	0.3
18	GRAFTEK	0.5	0.4	0.3	-17.6	0.3
19	Century Research Center	0.9	0.4	0.3	-13.0	0.3
20	Debis Systemhaus	0.2	0.2	0.2	9.8	0.2
21	Sherpa Corp.	-	-	0.2	NA	0.2
22	CIMTEK*	0.1	0.2	0.2	-19.7	0.1
23	Cimtel	-	0	0	16.4	0
24	Technodia*	0	0	0	-10.8	0
25	NOVASOFT Systems	0.3	0.7	-	-100.0	-
26	Parametric Technology	-	0.1	-	-100.0	-
	All N.A. Companies	202.6	112.4	103.4	-8.0	87.4
	All European Companies	7.5	3.9	3.1	-20.7	2.6
	All Asian Companies	27.3	14.5	11.9	-18.5	10.0
	All Companies	237.4	130.8	118.3	-9.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-6
1995 Top 30 Mechanical Software Companies, North America, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	107.5	114.7	160.6	40.0	18.9
2	EDS Unigraphics	99.1	112.4	113.6	1.1	13.4
3	IBM	94.6	86.4	93.4	8.2	11.0
4	Autodesk	76.5	83.6	81.5	-2.5	9.6
5	SDRC	29.0	44.3	51.8	16.9	6.1
6	MacNeal-Schwendler	36.0	48.3	50.0	3.6	5.9
7	Dassault	40.0	43.2	47.6	10.4	5.6
8	Computervision	23.2	30.8	28.6	-7.2	3.4
9	Intergraph	41.3	33.1	24.8	-25.2	2.9
10	Ansys	14.7	17.2	17.3	0.1	2.0
11	Sherpa Corp.	7.2	10.3	13.4	30.2	1.6
12	Applicon	12.1	14.2	12.5	-11.6	1.5
13	Hewlett-Packard	11.3	11.2	12.2	9.4	1.4
14	Formtek	5.1	9.2	10.0	9.2	1.2
15	Algor Interactive Systems	4.8	6.5	9.7	47.4	1.1
16	Concentra	6.0	8.1	9.5	17.2	1.1
17	MicroCADAM	-	5.0	9.0	79.4	1.1
18	Alias Research	15.9	7.9	8.6	9.6	1.0
19	MCS	7.9	8.3	8.6	3.3	1.0
20	Camax Manufacturing	8.1	7.7	8.5	9.7	1.0
21	Gerber Systems	6.8	7.1	8.3	16.6	1.0
22	ADRA Systems	8.5	9.4	8.1	-14.4	0.9
23	Tecnomatix Technology	-	6.8	7.4	9.8	0.9
24	Spatial Technology	-	4.3	6.6	52.2	0.8
25	Deneb Robotics	5.0	5.6	6.5	16.0	0.8
26	Bentley Systems	-	1.8	6.1	244.4	0.7
27	Altair Computing	-	4.3	6.0	40.9	0.7
28	CADKEY	6.1	5.4	5.8	8.0	0.7
29	CNC Software	4.6	5.1	5.6	10.0	0.7
30	CGTech	2.0	3.0	5.5	83.2	0.6
	All N.A. Companies	684.9	747.7	831.3	11.2	97.7
	All European Companies	14.1	15.3	17.6	14.9	2.1
	All Asian Companies	1.1	1.2	1.6	29.6	0.2
	All Companies	700.1	764.3	850.5	11.3	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-7
1995 Top 30 Mechanical Software Companies, North America, UNIX
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	101.5	103.3	134.9	30.6	21.5
2	EDS Unigraphics	82.2	112.4	113.6	1.1	18.1
3	IBM	42.6	56.0	75.7	35.2	12.1
4	SDRC	28.7	44.3	51.8	16.9	8.3
5	MacNeal-Schwendler	13.5	31.9	38.0	19.2	6.1
6	Dassault	28.2	32.3	36.6	13.1	5.8
7	Computervision	20.1	29.2	27.3	-6.6	4.4
8	Intergraph	34.6	20.6	24.0	16.5	3.8
9	Sherpa Corp.	7.2	10.3	13.3	28.9	2.1
10	Ansys	8.9	11.7	12.9	10.4	2.1
11	Applicon	12.1	13.7	9.9	-27.9	1.6
12	Concentra	6.0	8.1	9.5	17.2	1.5
13	Hewlett-Packard	11.3	10.4	8.9	-14.9	1.4
14	Alias Research	15.9	7.9	8.6	9.6	1.4
15	Gerber Systems	6.8	7.1	8.3	16.6	1.3
16	Tecnomatix Technology	-	6.8	7.4	9.8	1.2
17	Formtek	3.6	6.4	7.0	9.2	1.1
18	Deneb Robotics	5.0	5.6	6.5	16.0	1.0
19	ADRA Systems	6.1	6.8	5.9	-13.0	0.9
20	Altair Computing	-	4.2	5.9	40.9	0.9
21	Autodesk	4.6	5.0	4.9	-2.4	0.8
22	ICEM Technologies	2.5	3.8	4.5	17.5	0.7
23	Mechanical Dynamics	2.0	5.1	4.4	-14.0	0.7
24	Spatial Technology	-	2.8	4.3	52.2	0.7
25	Algor Interactive Systems	0.9	2.6	3.9	47.4	0.6
26	CGTech	1.0	2.1	3.9	83.2	0.6
27	Matra Datavision	4.8	5.2	3.8	-27.1	0.6
28	MicroCADAM	-	2.0	3.6	79.4	0.6
29	CIMLINC	5.5	2.6	3.4	31.7	0.5
30	Camax Manufacturing	4.4	3.9	3.3	-13.2	0.5
	All N.A. Companies	445.7	535.2	612.6	14.5	97.6
	All European Companies	10.3	12.2	13.5	10.9	2.1
	All Asian Companies	0.9	1.0	1.4	38.0	0.2
	All Companies	456.8	548.4	627.5	14.4	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-8
1995 Top 19 Mechanical Software Companies, North America, NT/Hybrid (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	1.5	11.2	25.7	128.7	65.1
2	Camax Manufacturing	-	-	3.0	NA	7.5
3	Spatial Technology	-	1.5	2.3	52.2	5.9
4	Bentley Systems	-	0.7	2.3	244.4	5.8
5	Ansys	-	-	2.1	NA	5.2
6	MCS	-	-	0.9	NA	2.2
7	Intergraph	-	7.3	0.8	-89.0	2.0
8	DP Technology	-	-	0.8	NA	1.9
9	CGTech	-	0.3	0.6	83.2	1.4
10	MacNeal-Schwendler	-	-	0.5	NA	1.3
11	Hewlett-Packard	-	-	0.5	NA	1.2
12	Matra Datavision	-	-	0.5	NA	1.2
13	MicroCADAM	-	0.3	0.5	79.4	1.1
14	SRAC	-	-	0.4	NA	1.1
15	NOVASOFT Systems	-	-	0.2	NA	0.6
16	B.A. Intelligence Networks	-	-	0.2	NA	0.6
17	Cimatron	-	0.1	0.2	73.9	0.5
18	CIMLINC	-	-	0.1	NA	0.2
19	Research Engineers—Civilsoft	-	0	0.1	68.9	0.2
	All N.A. Companies	1.3	19.4	38.8	100.4	98.3
	All European Companies	-	0.1	0.7	516.7	1.7
	All Asian Companies	-	-	-	NA	-
	All Companies	1.3	19.5	39.5	102.8	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table A-9
1995 Top 30 Mechanical Software Companies, North America, Personal Computer (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	71.9	78.6	76.6	-2.5	49.3
2	Algor Interactive Systems	3.9	3.9	5.8	47.4	3.7
3	CADKEY	5.8	5.4	5.8	8.0	3.7
4	CNC Software	4.6	5.1	5.6	10.0	3.6
5	MicroCADAM	-	2.8	5.0	79.4	3.2
6	Viagrafix	4.4	4.9	5.0	2.0	3.2
7	MCS	3.9	5.8	4.7	-18.9	3.0
8	Surfware	1.5	1.9	3.6	85.2	2.3
9	Bentley Systems	-	1.0	3.3	244.4	2.1
10	Formtek	1.5	2.8	3.0	9.2	1.9
11	Ashlar	3.6	3.5	3.0	-13.7	1.9
12	Hewlett-Packard	-	0.7	2.8	290.8	1.8
13	Applicon	-	0.4	2.6	489.2	1.7
14	Gibbs and Assoc.	1.7	1.9	2.2	17.6	1.4
15	ADRA Systems	2.4	2.7	2.2	-17.8	1.4
16	Camax Manufacturing	3.7	3.9	2.1	-44.4	1.4
17	Bionic Knight Software	1.0	1.5	2.0	33.3	1.3
18	DP Technology	1.4	1.6	1.9	17.8	1.2
19	Workgroup Tech.	-	-	1.8	NA	1.2
20	Ansys	3.2	3.8	1.6	-59.1	1.0
21	SRAC	0.4	1.5	1.5	1.5	1.0
22	Pathtrace Engineering Systems	1.3	1.4	1.5	5.9	1.0
23	Computervision	3.1	1.5	1.3	-17.8	0.8
24	Variation Systems Analysis	0.7	1.1	1.3	10.0	0.8
25	CGTech	1.0	0.6	1.1	83.2	0.7
26	Engineering Mechanics	2.7	3.0	1.0	-65.5	0.7
27	Boothroyd Dewhurst	0.9	0.9	1.0	12.0	0.7
28	GRAPHSOFT	1.2	0.7	1.0	51.3	0.7
29	NOVASOFT Systems	0	0.1	1.0	634.3	0.6
30	Softdesk	3.2	1.0	0.9	-14.7	0.5
	All N.A. Companies	144.1	147.7	152.0	2.9	97.9
	All European Companies	2.7	2.9	3.2	12.6	2.1
	All Asian Companies	0.1	0.1	0.1	-12.2	0
	All Companies	146.8	150.7	155.3	3.1	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-10
1995 Top 13 Mechanical Software Companies, North America, Host/Proprietary (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	49.2	30.4	17.8	-41.7	63.0
2	Dassault	11.8	10.8	11.1	2.1	39.2
3	MacNeal-Schwendler	21.9	16.4	11.0	-33.0	39.0
4	Exapt	2.7	2.0	1.5	-25.7	5.4
5	Mechanical Dynamics	0.4	0.9	0.8	-13.4	2.9
6	Ansys	2.5	1.7	0.7	-60.0	2.4
7	Access Corp.	0.5	0.4	0.4	-12.4	1.3
8	GRAFTEK	0.4	0.3	0.3	-23.6	0.9
9	Computational Mechanics	0.2	0.2	0.2	15.6	0.7
10	Sherpa Corp.	-	-	0.1	NA	0.5
11	Kubota Computer	0.2	0.1	0.1	-15.9	0.4
12	NOVASOFT Systems	0.1	0.4	-	-100.0	-
13	Parametric Technology	-	0.1	-	-100.0	-
	All N.A. Companies	93.8	45.4	27.9	-38.7	98.9
	All European Companies	1.2	0.2	0.2	15.8	0.7
	All Asian Companies	0.2	0.1	0.1	-15.9	0.4
	All Companies	95.1	45.7	28.2	-38.4	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-11
1995 Top 30 Mechanical Software Companies, Europe, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	138.8	165.9	249.5	50.4	23.0
2	Dassault	73.4	86.3	110.5	28.0	10.2
3	Parametric Technology	42.6	68.3	109.2	59.9	10.1
4	Computervision	93.0	90.9	100.1	10.1	9.2
5	Autodesk	52.6	59.9	81.3	35.8	7.5
6	Matra Datavision	53.1	63.5	70.0	10.1	6.5
7	EDS Unigraphics	39.4	44.9	52.1	15.9	4.8
8	Hewlett-Packard	38.3	37.3	44.8	20.3	4.1
9	SDRC	27.1	28.4	33.1	16.6	3.1
10	MacNeal-Schwendler	22.5	18.4	32.0	73.4	3.0
11	Siemens Nixdorf Info systeme	25.7	24.2	24.7	2.2	2.3
12	Intergraph	21.4	21.2	19.7	-7.0	1.8
13	Applicon	16.2	14.2	17.3	22.2	1.6
14	ASCAD	8.7	12.1	14.9	22.5	1.4
15	ISD Software	15.3	10.5	14.5	37.7	1.3
16	CAD Lab	13.8	11.4	13.6	19.2	1.3
17	Tebis	8.7	5.2	12.5	138.8	1.2
18	Straessle Informationssysteme	15.2	15.6	12.0	-23.3	1.1
19	Ansys	9.1	8.5	11.9	41.2	1.1
20	Tecnomatix Technology	-	5.7	11.6	103.4	1.1
21	Wiechers Datentechnik	9.5	8.9	11.4	27.6	1.1
22	MicroCADAM	-	7.3	10.3	40.9	1.0
23	ICEM Technologies	6.2	6.2	9.8	56.8	0.9
24	Engineering Computer Services*	5.5	6.9	7.9	14.9	0.7
25	Han Dataport	6.2	7.1	7.8	10.7	0.7
26	Delcam International	5.2	5.6	7.7	38.2	0.7
27	Radan Computational	8.2	8.2	7.6	-6.8	0.7
28	Sherpa Corp.	4.8	8.4	7.2	-14.7	0.7
29	ADRA Systems	4.8	4.4	6.8	54.8	0.6
30	Eigner + Partner	-	5.4	6.3	15.9	0.6
	All N.A. Companies	538.3	600.7	808.6	34.6	74.6
	All European Companies	247.0	250.5	275.3	9.9	25.4
	All Asian Companies	-	-	-	NA	-
	All Companies	785.3	851.2	1,083.9	27.3	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-12
1995 Top 30 Mechanical Software Companies, Europe, UNIX
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	89.9	132.5	206.0	55.5	25.5
2	Computervision	87.3	86.4	95.7	10.7	11.8
3	Parametric Technology	40.5	61.5	91.7	49.2	11.4
4	Dassault	51.8	64.7	84.9	31.2	10.5
5	Matra Datavision	52.2	62.1	60.4	-2.7	7.5
6	EDS Unigraphics	31.8	44.9	52.1	15.9	6.4
7	SDRC	26.9	28.4	33.1	16.6	4.1
8	Hewlett-Packard	38.3	34.8	32.6	-6.4	4.0
9	MacNeal-Schwendler	8.5	12.2	24.3	99.4	3.0
10	Siemens Nixdorf Info systeme	22.0	20.8	21.6	4.1	2.7
11	Intergraph	17.1	13.0	19.1	46.2	2.4
12	Applicon	16.2	13.7	13.7	-0.4	1.7
13	ASCAD	8.5	11.5	12.8	10.9	1.6
14	Straessle Informationssysteme	15.2	15.6	12.0	-23.3	1.5
15	Tecnomatix Technology	-	5.7	11.6	103.4	1.4
16	ISD Software	13.6	7.5	10.4	38.4	1.3
17	ICEM Technologies	4.0	6.2	9.8	56.8	1.2
18	Ansys	4.7	5.8	9.0	55.7	1.1
19	Han Dataport	5.3	7.1	7.8	10.7	1.0
20	Radan Computational	8.0	7.9	7.5	-5.0	0.9
21	CAD Lab	8.9	8.0	7.5	-6.3	0.9
22	Delcam International	5.0	5.3	7.4	39.9	0.9
23	Sherpa Corp.	4.8	8.4	7.1	-15.5	0.9
24	Eigner + Partner	-	5.4	6.3	15.9	0.8
25	PROCAD GmbH	4.6	3.1	5.2	66.6	0.6
26	ADRA Systems	2.8	3.2	5.0	57.3	0.6
27	Tebis	-	0.5	4.6	752.9	0.6
28	MARC	2.6	3.8	4.5	19.2	0.6
29	Alias Research	3.7	3.3	4.3	31.6	0.5
30	MicroCADAM	-	2.9	4.1	40.9	0.5
	All N.A. Companies	396.5	469.3	618.2	31.7	76.5
	All European Companies	174.0	183.4	189.5	3.4	23.5
	All Asian Companies	-	-	-	NA	-
	All Companies	570.6	652.6	807.8	23.8	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-13
1995 Top 24 Mechanical Software Companies, Europe, NT/Hybrid
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	0.3	6.8	17.5	158.2	42.9
2	Matra Datavision	-	-	7.7	NA	18.9
3	CAD Distribution	-	0.1	3.5	4,978.2	8.6
4	Bentley Systems	-	0.7	2.4	244.4	5.8
5	Hewlett-Packard	-	-	1.8	NA	4.4
6	Ansys	-	-	1.4	NA	3.5
7	Camax Manufacturing	-	-	1.0	NA	2.4
8	ASCAD	-	-	0.9	NA	2.2
9	Spatial Technology	-	0.5	0.8	52.2	1.9
10	Cimatron	-	0.3	0.7	101.9	1.7
11	CAD Lab	-	-	0.7	NA	1.7
12	Intergraph	-	4.8	0.6	-86.6	1.6
13	PROCAD GmbH	-	0.3	0.6	66.6	1.4
14	MicroCADAM	-	0.4	0.5	40.9	1.3
15	MacNeal-Schwendler	-	-	0.3	NA	0.8
16	B.A. Intelligence Networks	-	-	0.3	NA	0.8
17	MCS	-	-	0.3	NA	0.7
18	Cadtronic*	-	0.1	0.2	102.7	0.5
19	CGTech	-	0.2	0.2	11.1	0.5
20	SRAC	-	-	0.2	NA	0.4
21	NOVASOFT Systems	-	-	0.1	NA	0.4
22	DP Technology	-	-	0.1	NA	0.2
23	CIMLINC	-	-	0	NA	0
24	Research Engineers—Civilsoft	-	-	0	NA	0
	All N.A. Companies	0.2	12.2	26.8	118.7	65.6
	All European Companies	-	0.8	14.0	1,735.8	34.4
	All Asian Companies	-	-	-	NA	-
	All Companies	0.2	13.0	40.8	213.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-14
1995 Top 30 Mechanical Software Companies, Europe, Personal Computer (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	49.5	56.3	78.2	39.0	41.6
2	Hewlett-Packard	-	2.4	10.4	329.9	5.5
3	Wiechers Datentechnik	8.7	8.1	10.3	27.6	5.5
4	Tebis	8.7	4.7	7.9	68.5	4.2
5	Investronica SA	5.4	5.7	6.0	4.8	3.2
6	Serbi	4.5	5.0	5.9	16.4	3.1
7	MicroCADAM	-	4.0	5.7	40.9	3.0
8	CAD Lab	4.9	3.4	5.4	58.9	2.9
9	Engineering Computer Services*	3.0	4.5	4.9	10.0	2.6
10	Computervision	5.7	4.5	4.4	-2.4	2.3
11	ISD Software	1.7	3.0	4.0	36.0	2.1
12	Whessoe Computing Systems	3.5	3.5	3.8	10.0	2.0
13	Applicon	-	0.4	3.7	714.1	1.9
14	Bentley Systems	-	1.0	3.3	244.4	1.8
15	Ziegler Informatics	6.9	4.9	3.3	-34.3	1.7
16	Siemens Nixdorf Info systeme	3.6	3.4	3.1	-9.3	1.6
17	Cimatron	3.0	1.6	2.7	70.5	1.4
18	Anilam Electronics	4.3	2.8	2.6	-5.1	1.4
19	Just In Time Systems	1.6	1.9	2.5	32.6	1.3
20	CAD Distribution	6.4	3.6	2.3	-35.2	1.2
21	Softronics	2.6	1.9	2.0	8.4	1.1
22	RoboCAD Solutions	3.3	2.2	1.9	-17.4	1.0
23	ADRA Systems	2.0	1.2	1.8	48.5	1.0
24	Matra Datavision	0.9	1.4	1.8	30.3	1.0
25	Vero International Software	1.0	1.4	1.7	21.4	0.9
26	Kloeckner-Moeller	2.4	1.9	1.7	-10.0	0.9
27	Pathtrace Engineering Systems	1.3	1.5	1.6	7.8	0.9
28	MCS	2.3	1.8	1.5	-17.6	0.8
29	ABB Industria*	2.4	1.3	1.4	6.7	0.8
30	Formtek	0.7	1.2	1.4	8.9	0.7
	All N.A. Companies	76.2	83.6	119.0	42.4	63.3
	All European Companies	67.1	63.0	69.1	9.7	36.7
	All Asian Companies	-	-	-	NA	-
	All Companies	143.4	146.6	188.2	28.4	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-15
1995 Top 17 Mechanical Software Companies, Europe, Host/Proprietary
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	41.8	33.5	43.6	30.2	92.3
2	Dassault	21.6	21.7	25.6	18.4	54.4
3	MacNeal-Schwendler	13.7	6.3	7.0	12.0	14.9
4	Exapt	5.3	4.0	3.0	-25.9	6.3
5	Mechanical Dynamics	0.3	0.6	0.7	16.2	1.4
6	Ansys	1.4	0.8	0.5	-43.5	1.0
7	Framasoft	0.9	0.4	0.4	4.8	0.9
8	Whessoe Computing Systems	1.0	0.4	0.3	-18.8	0.7
9	Computational Mechanics	0.6	0.2	0.2	-	0.5
10	Debis Systemhaus	0.2	0.2	0.2	9.8	0.5
11	CIMTEK*	0.1	0.2	0.2	-19.7	0.3
12	Sherpa Corp.	-	-	0.1	NA	0.2
13	Cimtel	-	0	0	16.4	0.1
14	GRAFTEK	0	0	0	81.1	0
15	Access Corp.	-	0	0	-13.3	0
16	NOVASOFT Systems	0	0.1	-	-100.0	-
17	Parametric Technology	-	0	-	-100.0	-
	All N.A. Companies	65.3	35.6	44.6	25.0	94.4
	All European Companies	5.8	3.4	2.6	-21.9	5.6
	All Asian Companies	-	-	-	NA	-
	All Companies	71.1	39.0	47.2	21.0	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-16
1995 Top 30 Mechanical Software Companies, Japan, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	MicroCADAM	-	75.2	104.7	39.2	11.7
2	IBM	109.7	76.4	101.3	32.6	11.3
3	Fujitsu	74.3	83.7	97.0	15.8	10.8
4	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	9.5
5	NEC	54.3	61.7	72.9	18.1	8.1
6	Hitachi	63.9	66.7	70.9	6.4	7.9
7	Toshiba*	50.4	54.5	58.7	7.8	6.5
8	Nihon Unisys	51.5	48.1	52.8	9.8	5.9
9	Parametric Technology	15.0	26.3	41.8	58.7	4.7
10	Hitachi Zosen Info Systems	38.3	34.2	38.3	12.1	4.3
11	C. Itoh Techno-Science*	30.4	34.6	30.8	-10.8	3.4
12	Hakuto*	21.2	23.6	29.8	26.5	3.3
13	MacNeal-Schwendler	14.5	22.3	29.6	32.9	3.3
14	SDRC	29.2	24.5	25.7	4.9	2.9
15	Hewlett-Packard	19.8	22.4	23.6	5.8	2.6
16	Autodesk	12.4	10.7	20.2	87.9	2.3
17	Marubeni Hytech*	15.1	18.3	19.9	8.9	2.2
18	Seiko*	17.4	18.0	19.7	9.3	2.2
19	Dassault	12.0	13.9	19.1	37.3	2.1
20	Sumisho Electronics*	16.8	18.4	18.8	2.5	2.1
21	Tokyo Electron*	14.0	16.0	17.4	8.6	1.9
22	Andor*	17.1	17.6	15.9	-9.6	1.8
23	Mitsui Engineering	16.7	12.9	14.0	8.7	1.6
24	Computervision	23.5	22.3	13.9	-37.9	1.5
25	Mutoh Industries*	26.8	14.2	13.1	-7.3	1.5
26	Toshiba Engineering*	9.9	10.9	11.6	6.4	1.3
27	MARC	8.2	9.6	11.1	15.1	1.2
28	EDS Unigraphics	3.8	3.6	10.8	196.7	1.2
29	Design Automation	4.9	6.1	10.0	64.4	1.1
30	Graphtec Engineering	7.0	7.9	8.6	8.5	1.0
	All N.A. Companies	261.3	316.0	410.0	29.7	45.7
	All European Companies	8.6	9.7	17.3	77.9	1.9
	All Asian Companies	398.8	422.9	469.5	11.0	52.3
	All Companies	668.7	748.7	896.8	19.8	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-17
1995 Top 30 Mechanical Software Companies, Japan, UNIX
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	52.2	56.8	82.1	44.6	12.5
2	Info. Services Int'l. Dentsu*	50.5	62.7	80.9	29.1	12.3
3	Fujitsu	34.9	56.1	65.0	15.8	9.9
4	Hitachi	51.7	53.9	57.3	6.4	8.7
5	Nihon Unisys	40.7	43.8	51.8	18.0	7.9
6	NEC	36.3	42.0	43.7	4.0	6.6
7	Toshiba*	35.3	39.6	43.0	8.5	6.5
8	MicroCADAM	-	30.1	41.9	39.2	6.4
9	Hitachi Zosen Info Systems	38.3	34.2	38.3	12.1	5.8
10	Parametric Technology	14.3	23.7	35.1	48.0	5.3
11	C. Itoh Techno-Science*	25.9	30.9	28.4	-8.2	4.3
12	SDRC	28.9	24.5	25.7	4.9	3.9
13	MacNeal-Schwendler	5.5	14.7	22.5	52.9	3.4
14	Marubeni Hytech*	15.1	18.3	19.9	8.9	3.0
15	Seiko*	17.4	18.0	19.7	9.3	3.0
16	Hakuto*	12.7	14.1	17.9	26.5	2.7
17	Tokyo Electron*	14.0	16.0	17.4	8.6	2.6
18	Hewlett-Packard	19.8	20.9	17.2	-17.7	2.6
19	Dassault	8.5	10.4	14.6	40.8	2.2
20	Sumisho Electronics*	11.7	13.1	14.2	8.5	2.2
21	Mitsui Engineering	16.3	12.4	13.5	8.8	2.0
22	Computervision	23.1	21.6	13.3	-38.7	2.0
23	Toshiba Engineering*	9.9	10.9	11.6	6.4	1.8
24	MARC	6.9	9.6	11.1	15.1	1.7
25	EDS Unigraphics	3.1	3.6	10.8	196.7	1.6
26	Graphtec Engineering	7.0	7.9	8.6	8.5	1.3
27	Mutoh Industries*	13.1	7.8	7.3	-7.3	1.1
28	Toyo Information Systems*	5.8	6.7	7.3	8.7	1.1
29	Adam Net	3.6	6.7	7.2	8.2	1.1
30	Kubota Computer	4.9	6.0	6.6	9.2	1.0
	All N.A. Companies	173.1	223.0	281.3	26.1	42.8
	All European Companies	6.9	8.0	12.2	52.2	1.9
	All Asian Companies	301.1	337.3	364.1	8.0	55.4
	All Companies	481.1	568.3	657.6	15.7	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-18
1995 Top 18 Mechanical Software Companies, Japan, NT/Hybrid
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	0.1	2.6	6.7	156.4	21.3
2	Omron	-	-	5.8	NA	18.5
3	MicroCADAM	-	3.8	5.2	39.2	16.7
4	NEC	-	-	5.2	NA	16.6
5	Wacom	-	-	4.9	NA	15.6
6	Mutoh Industries*	-	2.5	2.3	-7.3	7.5
7	Hewlett-Packard	-	-	0.9	NA	3.0
8	Ansys	-	-	0.6	NA	2.0
9	Matra Datavision	-	-	0.6	NA	1.8
10	Spatial Technology	-	0.3	0.5	52.2	1.6
11	Camax Manufacturing	-	-	0.4	NA	1.2
12	MacNeal-Schwendler	-	-	0.3	NA	0.9
13	CGTech	-	0.1	0.2	122.1	0.6
14	Cimatron	-	0.1	0.2	131.8	0.5
15	SRAC	-	-	0.1	NA	0.3
16	Intergraph	-	0.6	0.1	-87.1	0.3
17	Bentley Systems	-	0	0.1	273.5	0.2
18	MCS	-	-	0	NA	0.1
	All N.A. Companies	0.1	7.1	14.7	106.3	47.0
	All European Companies	-	0.1	0.7	1,017.5	2.3
	All Asian Companies	-	-	15.9	NA	50.7
	All Companies	0.1	7.2	31.4	335.0	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-19
1995 Top 30 Mechanical Software Companies, Japan, Personal Computer
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	MicroCADAM	-	41.3	57.6	39.2	33.3
2	Fujitsu	33.4	20.9	24.2	15.8	14.0
3	NEC	11.8	19.7	24.0	21.9	13.9
4	Autodesk	11.7	10.2	19.2	87.9	11.1
5	Andor*	17.1	17.6	15.9	-9.6	9.2
6	Toshiba*	15.1	14.9	15.8	6.0	9.1
7	Hakuto*	8.5	9.4	11.9	26.5	6.9
8	Hitachi	9.2	9.6	10.2	6.4	5.9
9	Design Automation	4.9	6.1	10.0	64.4	5.8
10	Hewlett-Packard	-	1.5	5.5	277.8	3.2
11	Sumisho Electronics*	5.1	5.2	4.6	-12.4	2.7
12	Info. Services Int'l. Dentsu*	-	3.3	4.3	29.1	2.5
13	Mutoh Industries*	13.8	3.8	3.5	-7.3	2.0
14	Kozo Keikaku Engineering*	3.4	3.7	3.3	-10.8	1.9
15	PAFEC	-	-	2.4	NA	1.4
16	Argo Graphics*	1.9	1.9	2.0	6.0	1.2
17	Mitsubishi Electric*	1.7	1.8	1.7	-5.4	1.0
18	Ashlar	0.4	1.2	1.6	36.8	0.9
19	Anilam Electronics	1.0	1.1	1.2	11.2	0.7
20	Wacom	4.7	4.7	1.1	-76.1	0.7
21	Formtek	0.4	0.8	0.9	8.9	0.5
22	ADRA Systems	0.8	0.9	0.8	-13.5	0.4
23	Workgroup Tech.	-	-	0.7	NA	0.4
24	CADKEY	0.7	0.6	0.7	9.9	0.4
25	Computervision	0.4	0.7	0.6	-12.2	0.4
26	Cimatron	0.4	0.3	0.6	95.7	0.3
27	Mitsui Engineering	0.4	0.5	0.5	6.0	0.3
28	Ansys	0.9	1.0	0.5	-52.9	0.3
29	CNC Software	0.5	0.4	0.4	10.0	0.2
30	CGTech	-	0.2	0.4	122.1	0.2
	All N.A. Companies	55.0	61.1	90.7	48.5	52.5
	All European Companies	1.4	1.5	4.3	186.9	2.5
	All Asian Companies	70.5	71.2	77.7	9.1	45.0
	All Companies	126.9	133.8	172.7	29.1	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-20
1995 Top 19 Mechanical Software Companies, Japan, Host/Proprietary
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	20.9	19.6	19.3	-1.9	54.8
2	Fujitsu	5.9	6.7	7.8	15.8	22.1
3	MacNeal-Schwendler	8.8	7.6	6.5	-14.1	18.5
4	Dassault	3.5	3.5	4.4	27.0	12.6
5	Hitachi	3.0	3.1	3.3	6.4	9.5
6	C. Itoh Techno-Science*	4.6	3.6	2.4	-33.2	6.9
7	Mitsubishi Electric*	1.8	1.5	1.2	-16.2	3.5
8	Nihon Unisys	10.8	4.3	1.1	-75.1	3.0
9	Toyo Information Systems*	1.2	0.9	0.8	-12.0	2.4
10	Kubota Computer	0.9	0.7	0.6	-12.7	1.8
11	Mechanical Dynamics	0.2	0.4	0.5	31.7	1.5
12	Century Research Center	0.5	0.4	0.3	-13.0	0.9
13	Ansys	0.7	0.5	0.2	-54.0	0.6
14	Whessoe Computing Systems	0.1	0.1	0.1	-21.6	0.2
15	GRAFTEK	0.1	0.1	0.1	-11.4	0.2
16	Technodia*	0	0	0	-10.8	0.1
17	Computational Mechanics	0.1	0.1	0	-45.5	0.1
18	Framasoft	0	0	0	23.6	0.1
19	Parametric Technology	-	0	-	-100.0	-
	All N.A. Companies	33.0	24.8	23.3	-6.1	66.2
	All European Companies	0.4	0.2	0.1	-22.9	0.4
	All Asian Companies	27.1	14.4	11.7	-18.5	33.4
	All Companies	60.5	39.4	35.1	-10.7	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-21
1995 Top 30 Mechanical Software Companies, Asia/Pacific, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	13.1	29.0	37.5	29.2	27.0
2	Autodesk	11.5	16.0	23.0	43.3	16.5
3	EDS Unigraphics	7.9	9.0	15.3	69.9	11.0
4	Dassault	8.0	10.8	13.3	23.6	9.6
5	Parametric Technology	0.3	0.1	9.6	14,828.4	6.9
6	SDRC	8.2	6.2	7.1	13.8	5.1
7	Matra Datavision	1.9	2.6	7.0	164.3	5.0
8	Computervision	6.1	2.8	4.6	65.8	3.3
9	Investronica SA	3.5	3.8	3.9	4.8	2.8
10	MicroCADAM	-	3.0	3.9	29.8	2.8
11	Delcam International	2.1	2.3	2.8	21.4	2.0
12	MacNeal-Schwendler	2.8	1.8	2.4	31.5	1.7
13	Ansys	1.4	1.3	2.2	72.0	1.6
14	Intergraph	2.9	2.4	2.1	-12.6	1.5
15	MCS	2.3	1.3	1.8	36.5	1.3
16	Alias Research	0.6	-	1.7	NA	1.2
17	Cimatron	0.7	1.1	1.7	55.2	1.2
18	Straessle Informationssysteme	0.1	1.1	1.6	44.4	1.1
19	Design Automation	0.8	0.9	1.6	64.4	1.1
20	Sharp*	1.3	1.2	1.3	8.4	0.9
21	Gerber Systems	1.0	1.1	1.2	16.1	0.9
22	Camax Manufacturing	0.8	1.4	1.2	-13.4	0.9
23	Mechanical Dynamics	0.6	1.0	1.2	12.4	0.8
24	ADRA Systems	1.2	0.7	1.1	54.8	0.8
25	Bentley Systems	-	0.3	0.9	257.2	0.7
26	Hewlett-Packard	1.4	3.7	0.8	-78.1	0.6
27	Formtek	0.4	0.7	0.8	8.9	0.5
28	CNC Software	0.5	0.5	0.6	10.0	0.4
29	Spatial Technology	-	0.4	0.6	52.2	0.4
30	Surfware	-	0.3	0.5	85.2	0.4
	All N.A. Companies	61.4	80.5	117.7	46.2	84.8
	All European Companies	9.1	12.3	17.8	43.8	12.8
	All Asian Companies	2.5	2.5	3.3	30.5	2.4
	All Companies	73.0	95.3	138.7	45.5	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

*Company statistics contain VAR/distributor revenue not counted in total.

Source: Dataquest (June 1996)

Table A-22
1995 Top 30 Mechanical Software Companies, Asia/Pacific, UNIX
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	6.3	24.3	31.0	27.6	33.6
2	EDS Unigraphics	6.5	9.0	15.3	69.9	16.6
3	Dassault	5.6	8.1	10.2	26.7	11.1
4	Parametric Technology	0.3	0.1	8.1	13,880.8	8.8
5	SDRC	8.2	6.2	7.1	13.8	7.7
6	Matra Datavision	1.9	2.6	6.0	133.4	6.6
7	Computervision	5.9	2.7	4.4	66.7	4.8
8	Delcam International	2.0	2.2	2.7	22.8	3.0
9	Intergraph	2.4	1.5	2.0	35.6	2.2
10	MacNeal-Schwendler	1.1	1.2	1.8	51.6	2.0
11	Alias Research	0.6	-	1.7	NA	1.9
12	Ansys	0.9	0.9	1.7	90.3	1.8
13	Straessle Informationssysteme	0.1	1.1	1.6	44.4	1.7
14	MicroCADAM	-	1.2	1.6	30.1	1.7
15	Autodesk	0.7	1.0	1.4	43.4	1.5
16	Sharp*	1.3	1.2	1.3	8.4	1.4
17	Gerber Systems	1.0	1.1	1.2	16.1	1.3
18	Mechanical Dynamics	0.5	0.8	0.9	11.9	1.0
19	ADRA Systems	0.9	0.5	0.8	57.3	0.9
20	MCS	1.2	0.4	0.6	58.9	0.7
21	Hewlett-Packard	1.4	3.5	0.6	-83.0	0.6
22	Formtek	0.3	0.5	0.5	8.9	0.6
23	Camax Manufacturing	0.6	0.7	0.5	-34.4	0.5
24	Altair Computing	-	0.3	0.4	40.9	0.4
25	Hitachi Zosen Info Systems	0.8	0.3	0.4	12.1	0.4
26	Spatial Technology	-	0.2	0.4	52.2	0.4
27	Concentra	0.1	0.1	0.3	137.9	0.3
28	Cimatron	0.3	0.2	0.3	75.9	0.3
29	CGTech	-	0.2	0.3	66.6	0.3
30	Applicon	0.5	0.3	0.3	-15.6	0.3
	All N.A. Companies	36.9	53.4	79.2	48.4	86.0
	All European Companies	4.5	6.3	10.8	72.4	11.7
	All Asian Companies	1.8	1.6	2.0	24.1	2.2
	All Companies	43.3	61.3	92.1	50.2	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-23
1995 Top 17 Mechanical Software Companies, Asia/Pacific, NT/Hybrid
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Parametric Technology	0	0	1.5	24,857.3	35.0
2	Matra Datavision	-	-	0.8	NA	17.5
3	Camax Manufacturing	-	-	0.4	NA	9.6
4	Bentley Systems	-	0.1	0.4	273.5	8.1
5	Cimatron	-	0.2	0.3	73.9	6.4
6	Ansys	-	-	0.3	NA	6.1
7	Spatial Technology	-	0.1	0.2	52.2	4.4
8	MicroCADAM	-	0.1	0.2	23.6	4.2
9	MCS	-	-	0.2	NA	4.0
10	B.A. Intelligence Networks	-	-	0.1	NA	2.3
11	Intergraph	-	0.5	0.1	-87.1	1.5
12	DP Technology	-	-	0.1	NA	1.5
13	CGTech	-	0	0	66.6	0.9
14	Hewlett-Packard	-	-	0	NA	0.7
15	MacNeal-Schwendler	-	-	0	NA	0.4
16	Research Engineers—Civilsoft	-	-	0	NA	0.3
17	Radan Computational	-	0.1	-	-100.0	-
	All N.A. Companies	0	0.7	3.4	349.4	76.1
	All European Companies	-	0.2	1.1	546.2	23.9
	All Asian Companies	-	-	-	NA	-
	All Companies	0	0.9	4.4	384.8	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-24
1995 Top 30 Mechanical Software Companies, Asia/Pacific, Personal Computer
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	10.8	15.1	21.6	43.3	60.0
2	Investronica SA	3.5	3.8	3.9	4.8	11.0
3	MicroCADAM	-	1.6	2.1	30.1	5.9
4	Design Automation	0.8	0.9	1.6	64.4	4.3
5	Cimatron	0.4	0.8	1.1	46.8	3.1
6	MCS	1.0	0.9	1.0	7.1	2.7
7	CNC Software	0.5	0.5	0.6	10.0	1.6
8	Bentley Systems	-	0.1	0.5	244.4	1.4
9	Surfware	-	0.3	0.5	85.2	1.4
10	CADKEY	0.4	0.3	0.4	9.9	1.0
11	Vero International Software	0.2	0.2	0.3	56.7	0.9
12	Camax Manufacturing	0.2	0.7	0.3	-53.4	0.9
13	ADRA Systems	0.2	0.2	0.3	48.5	0.9
14	B.A. Intelligence Networks	0.1	0.2	0.2	55.9	0.7
15	Formtek	0.1	0.2	0.2	8.9	0.6
16	Computervision	0.3	0.1	0.2	46.9	0.6
17	Ansys	0.3	0.3	0.2	-29.4	0.6
18	Hewlett-Packard	-	0.2	0.2	-21.8	0.5
19	Matra Datavision	0	0.1	0.2	212.7	0.5
20	DP Technology	0.2	0.1	0.2	49.4	0.5
21	Delcam International	0.1	0.1	0.1	-5.8	0.3
22	CADWORKS	0	0.1	0.1	-5.8	0.3
23	Ashlar	-	-	0.1	NA	0.3
24	Research Engineers—Civilsoft	-	0.1	0.1	68.9	0.3
25	Superdraft	0.1	0.1	0.1	-1.2	0.2
26	CGTech	-	0	0.1	66.6	0.2
27	Applicon	-	0	0.1	589.8	0.2
28	Engineered Software	0	0	0.1	2,816.0	0.2
29	Mechanical Dynamics	0	0	0	20.8	0.1
30	Algor Interactive Systems	0.1	0	0	43.6	0.1
	All N.A. Companies	17.4	21.5	28.9	34.4	80.3
	All European Companies	4.5	5.8	5.8	0.2	16.3
	All Asian Companies	0.7	0.9	1.2	42.4	3.5
	All Companies	22.7	28.2	36.0	27.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-25
1995 Top Eight Mechanical Software Companies, Asia/Pacific, Host/Proprietary
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	3.5	4.8	6.5	37.1	104.6
2	Dassault	2.4	2.7	3.1	14.3	49.6
3	MacNeal-Schwendler	1.7	0.6	0.5	-14.8	8.4
4	Mechanical Dynamics	0.1	0.2	0.2	12.7	2.8
5	Ansys	0.2	0.1	0.1	-36.5	1.3
6	Computational Mechanics	0	0	0	-	0.5
7	Framasoft	0	-	0	NA	0
8	Whessoe Computing Systems	0.1	0.1	-	-100.0	-
	All N.A. Companies	7.0	4.8	6.2	28.1	99.4
	All European Companies	0.1	0.1	0	-52.8	0.6
	All Asian Companies	-	-	-	NA	-
	All Companies	7.1	4.9	6.2	26.8	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-26
1995 Top 30 Mechanical Software Companies, Rest of World, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	4.8	10.6	9.7	-8.3	23.1
2	Intergraph	2.0	1.5	4.9	227.8	11.6
3	Engineering Mechanics	-	-	4.5	NA	10.8
4	Autodesk	6.4	5.8	4.3	-26.5	10.1
5	EDS Unigraphics	2.6	2.9	4.1	39.9	9.8
6	Cimatron	1.8	2.8	3.5	26.6	8.3
7	Delcam International	0.6	1.1	2.2	95.5	5.1
8	Computervision	3.4	1.4	2.0	39.6	4.6
9	MicroCADAM	-	1.1	1.3	12.5	3.1
10	NOVASOFT Systems	0.2	0.4	1.0	120.3	2.3
11	Matra Datavision	0.2	-	0.9	NA	2.1
12	Formtek	0.4	0.7	0.8	8.9	1.8
13	Ansys	0.9	1.0	0.7	-24.8	1.7
14	Investronica SA	0.5	0.5	0.5	4.8	1.3
15	Siemens Nixdorf Info systeme	0.5	0.5	0.5	2.2	1.2
16	CNC Software	0.4	0.5	0.5	10.0	1.2
17	Whessoe Computing Systems	0.4	0.4	0.5	3.7	1.1
18	CADKEY	0.3	0.3	0.4	48.4	1.0
19	Straessle Informationssysteme	-	-	0.3	NA	0.8
20	Spatial Technology	-	0.1	0.2	52.2	0.5
21	Viagrafix	0.1	0.2	0.2	2.0	0.4
22	Mechanical Dynamics	0.1	0.1	0.1	40.5	0.3
23	DP Technology	-	-	0.1	NA	0.3
24	SRAC	0.1	0.1	0.1	102.3	0.3
25	B.A. Intelligence Networks	0	0.1	0.1	3.9	0.3
26	Bentley Systems	-	0	0.1	305.9	0.3
27	Camax Manufacturing	0.4	0.3	0.1	-56.3	0.3
28	Computational Mechanics	0.1	0.1	0.1	-	0.3
29	Tebis	-	-	0.1	NA	0.3
30	MCS	-	-	0.1	NA	0.3
	All N.A. Companies	23.4	26.3	33.6	27.7	79.8
	All European Companies	4.1	5.4	8.5	58.0	20.2
	All Asian Companies	-	-	-	NA	-
	All Companies	27.4	31.7	42.1	32.8	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table A-27
1995 Top 30 Mechanical Software Companies, Rest of World, UNIX
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	2.7	8.9	8.0	-9.5	29.4
2	Intergraph	1.7	0.9	4.7	408.6	17.3
3	EDS Unigraphics	2.1	2.9	4.1	39.9	15.1
4	Engineering Mechanics	-	-	3.0	NA	11.0
5	Delcam International	0.6	1.1	2.1	97.7	7.6
6	Computervision	3.3	1.3	1.9	40.5	6.9
7	Matra Datavision	0.2	-	0.8	NA	2.8
8	Cimatron	0.9	0.4	0.6	43.5	2.2
9	Ansys	0.5	0.7	0.6	-15.4	2.1
10	Formtek	0.3	0.5	0.5	8.9	1.9
11	MicroCADAM	-	0.5	0.5	12.7	1.9
12	NOVASOFT Systems	0.1	0.3	0.5	83.6	1.8
13	Siemens Nixdorf Info systeme	0.4	0.4	0.4	4.1	1.6
14	Straessle Informationssysteme	-	-	0.3	NA	1.2
15	Autodesk	0.4	0.3	0.3	-27.2	0.9
16	Spatial Technology	-	0.1	0.1	52.2	0.5
17	Mechanical Dynamics	0.1	0.1	0.1	39.9	0.4
18	Computational Mechanics	0.1	0.1	0.1	-	0.3
19	CGTech	-	0	0.1	66.6	0.3
20	ADRA Systems	0.1	0.2	0.1	-55.2	0.3
21	Whessoe Computing Systems	0	0	0	8.4	0.2
22	Camax Manufacturing	0	0.1	0	-67.6	0.2
23	MCS	-	-	0	NA	0.2
24	SRAC	0.1	0	0	99.7	0.2
25	Tebis	-	-	0	NA	0.2
26	DP Technology	-	-	0	NA	0.2
27	GRAFTEK	0	0	0	6.4	0.1
28	Algor Interactive Systems	0	0	0	47.4	0.1
29	CAD Centre	0	0	0	22.4	0.1
30	B.A. Intelligence Networks	0	0.1	0	-74.0	0.1
	All N.A. Companies	12.0	16.0	23.0	43.5	84.3
	All European Companies	2.1	2.0	4.3	119.5	15.7
	All Asian Companies	-	-	-	NA	-
	All Companies	14.1	18.0	27.3	51.8	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table A-28
1995 Top 14 Mechanical Software Companies, Rest of World, NT/Hybrid
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Cimatron	-	0.4	0.6	41.8	45.5
2	Intergraph	-	0.3	0.2	-51.7	12.2
3	Matra Datavision	-	-	0.1	NA	7.5
4	NOVASOFT Systems	-	-	0.1	NA	7.5
5	Ansys	-	-	0.1	NA	6.4
6	Spatial Technology	-	0.1	0.1	52.2	6.0
7	MicroCADAM	-	0.1	0.1	7.1	4.8
8	Bentley Systems	-	0	0.1	273.5	4.0
9	Camax Manufacturing	-	-	0	NA	3.6
10	B.A. Intelligence Networks	-	-	0	NA	2.6
11	DP Technology	-	-	0	NA	2.2
12	SRAC	-	-	0	NA	1.2
13	Parametric Technology	0	0	-	-100.0	-
14	CGTech	-	0	-	-100.0	-
	All N.A. Companies	0	0.4	0.6	40.9	47.0
	All European Companies	-	0.4	0.7	65.1	53.0
	All Asian Companies	-	-	-	NA	-
	All Companies	0	0.8	1.3	52.8	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table A-29
1995 Top 30 Mechanical Software Companies, Rest of World, Personal Computer (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	6.0	5.5	4.0	-26.5	33.5
2	Cimatron	0.9	1.9	2.3	19.8	19.3
3	Engineering Mechanics	-	-	1.5	NA	12.9
4	MicroCADAM	-	0.6	0.7	12.7	5.9
5	Investronica SA	0.5	0.5	0.5	4.8	4.5
6	CNC Software	0.4	0.5	0.5	10.0	4.2
7	CADKEY	0.3	0.3	0.4	48.4	3.4
8	NOVASOFT Systems	0	0	0.4	781.2	3.2
9	Whessoe Computing Systems	0.3	0.3	0.3	9.7	2.9
10	Formtek	0.1	0.2	0.2	8.9	1.9
11	Viagrafix	0.1	0.2	0.2	2.0	1.4
12	Surfware	-	0.1	0.1	75.9	0.8
13	Computervision	0.2	0.1	0.1	23.7	0.7
14	B.A. Intelligence Networks	0	0.1	0.1	55.9	0.7
15	Tebis	-	-	0.1	NA	0.7
16	Delcam International	0	0.1	0.1	51.5	0.7
17	SRAC	0	0	0.1	69.7	0.6
18	MCS	-	-	0.1	NA	0.6
19	Bentley Systems	-	0	0.1	273.5	0.6
20	DP Technology	-	-	0.1	NA	0.6
21	Siemens Nixdorf Info systeme	0.1	0.1	0.1	-9.3	0.5
22	Ansys	0.2	0.2	0.1	-71.1	0.5
23	Superdraft	0.1	0	0	-1.2	0.3
24	Algor Interactive Systems	0	0	0	47.4	0.3
25	Camax Manufacturing	0.3	0.1	0	-76.7	0.3
26	Ziegler Informatics	0	0	0	-34.3	0.3
27	GRAPHSOFT	-	0	0	48.2	0.2
28	Pathtrace Engineering Systems	0	0	0	7.7	0.2
29	Matra Datavision	0	-	0	NA	0.2
30	Computational Mechanics	0	0	0	-	0.2
	All N.A. Companies	8.0	8.1	8.5	4.4	70.9
	All European Companies	1.8	3.0	3.5	18.2	29.1
	All Asian Companies	-	-	-	NA	-
	All Companies	9.8	11.1	12.0	8.1	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-30
1995 Top Nine Mechanical Software Companies, Rest of World, Host/Proprietary (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	2.1	1.7	1.7	-2.2	110.7
2	Whessoe Computing Systems	0.1	0.1	0.1	-26.1	3.5
3	Computational Mechanics	0	0	0	-	2.1
4	Ansys	0.1	0.1	0	-71.8	1.8
5	Mechanical Dynamics	0	0	0	40.9	1.4
6	GRAFTEK	0	-	0	NA	0.2
7	NOVASOFT Systems	0	0.1	-	-100.0	-
8	Access Corp.	-	0	-	-100.0	-
9	Parametric Technology	-	0	-	-100.0	-
	All N.A. Companies	3.4	1.7	1.5	-13.4	95.9
	All European Companies	0.1	0.1	0.1	-15.2	4.1
	All Asian Companies	-	-	-	NA	-
	All Companies	3.5	1.8	1.5	-13.5	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table B-1
All Mechanical Software Companies, Worldwide, All Operating Systems
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	ABB Industria*	2.4	1.3	1.4	6.7	0
2	Access Corp.	1.2	0.8	0.6	-14.4	0
3	Accugraph	0.3	0.4	-	-100.0	-
4	Adam Net	7.3	6.9	7.5	7.7	0.2
5	Adina R&D	-	8.0	9.0	12.5	0.3
6	ADRA Systems	17.5	18.0	19.0	5.7	0.6
7	Algor Interactive Systems	5.0	6.8	10.0	47.5	0.3
8	Alias Research	24.4	13.1	17.3	31.6	0.6
9	Altair Computing	-	5.7	8.0	40.8	0.3
10	Andor*	17.1	17.6	15.9	-9.6	0.5
11	Anilam Electronics	5.6	4.1	3.8	-6.2	0.1
12	Ansys	30.3	32.5	37.4	15.0	1.2
13	Applicon	29.6	29.6	31.1	5.2	1.0
14	Argo Graphics*	3.4	3.6	3.8	7.2	0.1
15	ASCAD	8.7	12.1	14.9	22.5	0.5
16	Ashlar	4.4	5.8	5.7	-2.3	0.2
17	Auto-Trol	3.5	4.4	2.8	-35.3	0.1
18	Autodesk	159.4	176.0	210.2	19.4	7.0
19	B.A. Intelligence Networks	2.3	2.6	2.7	3.9	0.1
20	Bentley Systems	-	3.9	13.5	246.3	0.4
21	Bionic Knight Software	1.0	1.5	2.0	33.3	0.1
22	Boothroyd Dewhurst	1.3	1.4	1.6	10.9	0.1
23	C. Itoh Techno-Science*	30.4	34.6	30.8	-10.8	1.0
24	CAD Centre	0.8	0.7	0.9	23.2	0
25	CAD Distribution	6.5	3.8	5.8	52.7	0.2
26	CAD Lab	13.9	11.4	13.6	19.2	0.5
27	Cadis Software	0.3	0.4	1.2	200.0	0
28	CADIX	7.2	4.2	4.7	11.1	0.2
29	CADKEY	7.7	6.8	7.5	9.9	0.2
30	CADSI	2.8	2.1	2.2	5.3	0.1
31	Cadtronic*	0.4	0.2	0.3	56.7	0
32	CADWORKS	0.2	0.2	0.2	-1.0	0
33	Camax Manufacturing	12.4	12.1	13.6	12.9	0.5
34	Catalpa groupe Missler	1.6	1.1	1.5	37.7	0
35	Century Research Center	2.2	1.1	1.1	1.4	0
36	CGTech	2.0	6.0	10.0	66.4	0.3
37	Cimatron	10.0	7.3	11.3	55.2	0.4
38	CIMLINC	10.0	4.8	5.8	23.1	0.2
39	Cimplex	1.5	1.1	1.0	-5.8	0

(Continued)

Table B-1 (Continued)
All Mechanical Software Companies, Worldwide, All Operating Systems
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
40	CIMTEK*	4.4	4.1	4.7	14.8	0.2
41	Cimtel	2.0	0.8	1.0	16.4	0
42	CMstat	1.0	0.7	0.7	15.0	0
43	CNC Software	6.9	7.6	8.4	10.0	0.3
44	Computational Mechanics	2.4	2.1	2.1	-	0.1
45	Computervision	149.2	148.2	149.1	0.6	5.0
46	Concentra	8.9	12.1	14.4	19.0	0.5
47	CSAR Corp.	1.1	1.2	3.4	185.7	0.1
48	Dassault	133.4	154.2	190.6	23.6	6.3
49	Database Applications	0.4	0.5	0.5	1.1	0
50	Debis Systemhaus	2.8	3.2	3.5	9.8	0.1
51	Delcam International	10.0	11.6	16.7	44.3	0.6
52	Deneb Robotics	5.5	8.0	9.3	16.0	0.3
53	Design Automation	5.7	7.0	11.6	64.4	0.4
54	DP Technology	3.6	3.7	4.8	28.1	0.2
55	EDS Unigraphics	152.8	172.9	195.8	13.3	6.5
56	Eigner + Partner	-	5.4	6.3	15.9	0.2
57	Engineered Software	0.3	0.6	0.6	1.8	0
58	Engineering Computer Services*	5.5	6.9	7.9	14.9	0.3
59	Engineering Mechanics	6.8	8.1	7.6	-6.1	0.3
60	Evolution Computing	1.5	0.6	0.6	1.0	0
61	Exapt	9.1	7.2	5.7	-20.8	0.2
62	FHECOR*	0.6	0.5	0.6	5.0	0
63	Formtek	9.7	17.4	18.9	9.1	0.6
64	Framasoft	5.3	4.7	4.7	-1.1	0.2
65	Fujitsu	74.3	83.7	97.0	15.8	3.2
66	Gerber Systems	11.9	12.1	13.1	8.5	0.4
67	Gibbs and Assoc.	1.7	1.9	2.2	17.6	0.1
68	GRAFTEK	3.1	3.3	3.7	11.1	0.1
69	Graphisoft Group	0.1	0.2	-	-100.0	-
70	GRAPHSOFT	1.2	1.0	1.5	50.3	0
71	Graphtec Engineering	14.1	7.9	8.6	8.5	0.3
72	Hakuto*	21.2	23.6	29.8	26.5	1.0
73	Han Dataport	6.5	7.1	7.8	10.7	0.3
74	Hewlett-Packard	70.9	74.5	81.5	9.4	2.7
75	Hitachi	63.9	66.7	70.9	6.4	2.4
76	Hitachi Zosen Info Systems	77.3	34.5	38.7	12.1	1.3
77	HoSoft CAD	1.0	1.3	0.9	-30.1	0
78	IBM	361.1	368.3	491.5	33.4	16.3

(Continued)

Table B-1 (Continued)
All Mechanical Software Companies, Worldwide, All Operating Systems
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
79	ICEM Technologies	10.8	10.9	15.3	40.4	0.5
80	ICL	3.4	3.2	4.0	24.6	0.1
81	IMSI	0.6	0.5	0.4	-23.0	0
82	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	2.8
83	Intergraph	71.0	61.1	54.0	-11.6	1.8
84	Investronica SA	9.9	10.6	11.1	4.8	0.4
85	ISD Software	15.3	10.5	14.5	37.7	0.5
86	ISKA	0.9	0.9	1.1	27.6	0
87	Just In Time Systems	1.6	1.9	2.5	32.6	0.1
88	Kloeckner-Moeller	2.4	1.9	1.7	-10.0	0.1
89	Kozo Keikaku Engineering*	6.8	7.4	7.3	-0.9	0.2
90	Kubota Computer	13.5	8.3	8.9	6.7	0.3
91	Livermore Software Tech.	0.9	1.1	1.6	43.7	0.1
92	MacNeal-Schwendler	76.6	90.8	114.0	25.5	3.8
93	MARC	14.2	15.5	18.2	17.1	0.6
94	Marubeni Hytech*	15.1	18.3	19.9	8.9	0.7
95	Matra Datavision	63.6	75.6	87.4	15.6	2.9
96	MCS	14.6	13.0	13.6	4.9	0.5
97	Mechanical Dynamics	6.7	13.9	14.6	5.3	0.5
98	MicroCADAM	-	91.7	129.2	40.9	4.3
99	Mitsubishi Electric*	6.3	6.3	6.3	1.4	0.2
100	Mitsui Engineering	33.4	12.9	14.0	8.7	0.5
101	Mutoh Industries*	26.8	14.2	13.1	-7.3	0.4
102	NEC	54.3	61.7	72.9	18.1	2.4
103	Nihon Itek*	4.0	5.1	5.5	8.5	0.2
104	Nihon Unisys	103.0	48.1	52.8	9.8	1.8
105	NOVASOFT Systems	0.9	2.2	4.8	120.3	0.2
106	Omron	9.2	5.2	7.8	50.2	0.3
107	PAFEC	5.4	5.2	6.0	14.5	0.2
108	Parametric Technology	165.7	209.8	321.2	53.1	10.7
109	Pathtrace Engineering Systems	2.7	3.0	3.2	7.0	0.1
110	PROCAD GmbH	4.7	3.5	5.8	66.6	0.2
111	Radan Computational	8.8	9.0	8.2	-9.5	0.3
112	Research Engineers—Civilsoft	-	0.5	0.8	63.3	0
113	Ricoh	3.9	3.9	4.8	21.4	0.2
114	RoboCAD Solutions	3.5	2.3	1.9	-17.4	0.1
115	SDRC	93.9	103.3	117.6	13.8	3.9
116	Seiko*	17.4	18.0	19.7	9.3	0.7
117	Serbi	9.0	5.0	5.9	16.4	0.2

(Continued)

Table B-1 (Continued)
All Mechanical Software Companies, Worldwide, All Operating Systems
(Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
118	Sharp*	6.6	5.9	6.4	8.4	0.2
119	Sherpa Corp.	12.0	18.8	20.6	10.0	0.7
120	Siemens Nixdorf Info systeme	26.2	24.7	25.2	2.2	0.8
121	Softdesk	3.3	1.2	0.9	-24.9	0
122	Softronics	2.6	1.9	2.0	8.4	0.1
123	Spatial Technology	-	7.2	11.0	52.2	0.4
124	SRAC	5.9	3.4	4.8	41.0	0.2
125	Straessle Informationssysteme	16.3	18.3	16.4	-10.7	0.5
126	Sumisho Electronics*	16.8	18.4	18.8	2.5	0.6
127	Superdraft	2.4	1.4	1.4	-1.2	0
128	Surfware	1.5	2.7	5.0	85.0	0.2
129	Tebis	9.1	5.7	12.6	122.0	0.4
130	Technische Computer Systeme	3.6	3.9	3.2	-18.8	0.1
131	Technodia*	2.6	3.6	3.9	8.3	0.1
132	Tecnomatix Technology	-	13.0	20.1	54.3	0.7
133	Tokyo Electron*	26.6	16.0	17.4	8.6	0.6
134	Toshiba Engineering*	19.0	11.1	11.8	6.6	0.4
135	Toshiba*	95.7	54.5	58.7	7.8	2.0
136	Toyo Information Systems*	13.9	7.6	8.1	6.1	0.3
137	Uchida Yoko	1.4	0.3	0.3	12.5	0
138	Variation Systems Analysis	1.5	2.4	2.6	10.0	0.1
139	Vero International Software	1.2	1.6	2.1	27.0	0.1
140	Viagrafix	4.8	5.5	5.6	2.0	0.2
141	Wacom	11.4	5.9	6.0	1.8	0.2
142	Whessoe Computing Systems	6.4	5.3	5.4	1.8	0.2
143	Wiechers Datentechnik	9.6	9.0	11.5	27.6	0.4
144	WiN Technology	0.3	0.4	-	-100.0	-
145	Workgroup Tech.	2.0	3.0	6.3	108.9	0.2
146	Yokogawa Digital Computer	-	0.2	0.2	12.9	0
147	Ziegler Informatics	7.1	5.0	3.3	-34.3	0.1
148	Zuken-Redac	1.0	0.7	0.5	-28.6	0
	All N.A. Companies	1,569.2	1,771.2	2,201.0	24.3	73.1
	All European Companies	282.9	293.3	336.5	14.7	11.2
	All Asian Companies	402.4	426.7	474.4	11.2	15.7
	All Companies	2,254.5	2,491.2	3,011.9	20.9	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table C-1
1995 Top 30 Mechanical Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars, Actual Units)

Rank	Company Name	CPU Shipments	Software Revenue	CPU Revenue	Service Revenue	Total Distribution Revenue	1995 Share of Market (%)
1	IBM	52,561	491.5	753.5	316.7	1,658.4	17.3
2	Hewlett-Packard	42,775	81.5	810.0	196.9	1,088.4	11.4
3	Sun Microsystems	41,063	-	678.5	121.1	799.6	8.4
4	Digital Equipment	54,228	-	667.1	100.2	767.3	8.0
5	Silicon Graphics	15,886	-	412.0	70.9	482.9	5.0
6	Parametric Technology	-	321.2	-	118.8	440.0	4.6
7	Fujitsu	11,551	97.0	168.6	90.3	355.8	3.7
8	Computervision	-	149.1	-	182.4	331.5	3.5
9	EDS Unigraphics	4,437	195.8	54.4	77.7	328.0	3.4
10	NEC	18,859	72.9	130.8	30.8	296.9	3.1
11	Dassault	-	190.6	-	33.4	224.0	2.3
12	Nihon Unisys	1,624	52.8	77.3	65.2	213.0	2.2
13	Autodesk	-	210.2	-	1.2	211.4	2.2
14	SDRC	-	117.6	-	86.5	204.1	2.1
15	Matra Datavision	2,544	87.4	44.8	17.4	159.2	1.7
16	Hitachi	4,237	70.9	68.9	16.7	156.5	1.6
17	Intergraph	1,613	54.0	42.2	49.0	153.4	1.6
18	Toshiba*	3,920	58.7	52.6	13.1	136.1	1.4
19	MicroCADAM	-	129.2	-	6.8	136.0	1.4
20	MacNeal-Schwendler	-	114.0	-	12.5	126.6	1.3
21	Argo Graphics*	1,375	3.8	53.4	-	115.4	1.2
22	Sumisho Electronics*	1,050	18.8	32.6	-	112.0	1.2
23	Hitachi Zosen Info Systems	882	38.7	38.7	19.4	107.6	1.1
24	Info. Services Int'l. Dentsu*	591	85.2	21.3	-	106.5	1.1
25	Mitsubishi Electric*	911	6.3	34.8	-	96.5	1.0
26	Seiko*	251	19.7	12.3	17.1	83.7	0.9
27	Applicon	735	31.1	13.1	21.7	72.8	0.8
28	Hakuto*	1,340	29.8	31.0	2.7	63.5	0.7
29	Technodia*	280	3.9	19.4	9.5	61.5	0.6
30	C. Itoh Techno-Science*	-	30.8	14.8	10.7	59.3	0.6
	Other Companies	115,411	-	320.9	8.9	455.6	4.8
	All N.A. Companies	164,802	2,201.0	2,690.1	1,486.2	6,530.3	68.2
	All European Companies	10,995	336.5	175.3	160.9	725.9	7.6
	All Asian Companies	52,906	474.4	875.0	334.6	1,860.2	19.4
	All Companies	344,114	3,011.9	4,061.3	1,990.6	9,572.0	100.0

Note: Vendor data includes OEM revenue and shipments, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table C-2
1995 Top 30 Mechanical Software Companies, Worldwide, UNIX (Revenue in Millions of Dollars, Actual Units)

Rank	Company Name	CPU Shipments	Software Revenue	CPU Revenue	Service Revenue	Total Distribution Revenue	1995 Share of Market (%)
1	IBM	22,091	402.7	549.0	236.5	1,237.5	17.3
2	Hewlett-Packard	28,605	59.3	765.5	188.1	1,012.9	14.2
3	Sun Microsystems	41,063	-	678.5	121.1	799.6	11.2
4	Silicon Graphics	15,886	-	412.0	70.9	482.9	6.8
5	Parametric Technology	-	269.8	-	99.8	369.6	5.2
6	EDS Unigraphics	4,437	195.8	54.4	77.7	328.0	4.6
7	Digital Equipment	15,736	-	275.1	46.4	321.5	4.5
8	Computervision	-	142.5	-	174.4	316.9	4.4
9	Fujitsu	5,090	65.0	129.8	61.6	256.4	3.6
10	SDRC	-	117.6	-	86.5	204.1	2.9
11	Nihon Unisys	1,619	51.8	76.7	46.0	191.7	2.7
12	Dassault	-	146.4	-	25.6	172.0	2.4
13	NEC	4,364	43.7	58.2	17.8	161.8	2.3
14	Intergraph	1,499	52.2	41.0	44.6	145.9	2.0
15	Matra Datavision	2,193	75.5	38.6	15.5	137.8	1.9
16	Hitachi	2,599	57.3	55.7	13.5	126.6	1.8
17	Hitachi Zosen Info Systems	882	38.7	38.7	19.4	107.6	1.5
18	Toshiba*	1,212	43.0	40.2	9.9	101.7	1.4
19	Info. Services Int'l. Dentsu*	422	80.9	20.2	-	101.2	1.4
20	MacNeal-Schwendler	-	86.6	-	9.6	96.2	1.3
21	Sumisho Electronics*	186	14.2	25.5	-	88.0	1.2
22	Seiko*	251	19.7	12.3	17.1	83.7	1.2
23	Mitsubishi Electric*	483	3.5	30.7	-	82.9	1.2
24	Applicon	735	24.6	13.1	21.0	65.5	0.9
25	Technodia*	280	3.9	19.4	9.5	61.5	0.9
26	Argo Graphics*	284	1.8	27.1	-	58.2	0.8
27	C. Itoh Techno-Science*	-	28.4	13.7	9.8	54.6	0.8
28	MicroCADAM	-	51.7	-	2.7	54.4	0.8
29	Siemens Nixdorf Info systeme	647	22.1	13.9	13.0	49.9	0.7
30	Wacom	27	-	-	-	-	-
	All N.A. Companies	95,291	1,614.2	2,210.1	1,276.0	5,197.1	72.7
	All European Companies	6,930	230.3	137.4	121.3	515.0	7.2
	All Asian Companies	22,554	367.6	663.6	260.2	1,433.2	20.1
	All Companies	124,775	2,212.2	3,011.1	1,657.5	7,145.3	100.0

Note: Vendor data includes OEM revenue and shipments, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table C-3
1995 Top 29 Mechanical Software Companies, Worldwide, NT/Hybrid
(Revenue in Millions of Dollars, Actual Units)

Rank	Company Name	CPU Shipments	Software Revenue	CPU Revenue	Service Revenue	Total Distribution Revenue	1995 Share of Market (%)
1	Parametric Technology	-	51.4	-	19.0	70.4	30.4
2	Digital Equipment	2,019	-	23.6	4.0	27.6	11.9
3	Matra Datavision	-	9.6	4.9	1.9	17.5	7.6
4	NEC	987	5.2	5.2	2.2	14.8	6.4
5	Hewlett-Packard	380	3.3	4.2	1.7	9.1	3.9
6	Mutoh Industries*	221	2.3	3.6	1.3	9.0	3.9
7	Omron	139	5.8	3.0	0.1	8.9	3.8
8	Camax Manufacturing	-	4.8	-	2.2	7.0	3.0
9	MicroCADAM	-	6.4	-	0.3	6.8	2.9
10	Wacom	-	4.9	0.5	1.0	6.4	2.7
11	Bentley Systems	-	5.1	-	0.3	5.4	2.3
12	Intergraph	114	1.8	1.2	2.1	5.2	2.2
13	Ansys	-	4.5	-	0.2	4.7	2.0
14	CAD Distribution	-	3.5	-	0.4	3.9	1.7
15	Spatial Technology	-	3.9	-	-	3.9	1.7
16	Cimatron	-	1.9	-	0.4	2.3	1.0
17	MCS	-	1.4	0.1	0.2	1.7	0.7
18	CAD Lab	-	0.7	0.4	0.3	1.6	0.7
19	DP Technology	-	1.0	0.1	0.3	1.4	0.6
20	CGTech	-	1.0	-	0.3	1.3	0.6
21	SRAC	-	0.7	-	0.6	1.3	0.5
22	MacNeal-Schwendler	-	1.1	-	0.1	1.3	0.5
23	B.A. Intelligence Networks	-	0.7	-	0.4	1.0	0.4
24	ASCAD	-	0.9	-	-	0.9	0.4
25	PROCAD GmbH	7	0.6	0.1	0.1	0.8	0.3
26	NOVASOFT Systems	-	0.5	-	0.1	0.6	0.3
27	CIMLINC	-	0.1	-	0.1	0.2	0.1
28	Cadtronic*	-	0.2	-	-	0.2	0.1
29	Research Engineers—Civilsoft	-	0.1	-	-	0.1	0
	Other Companies	2,117	-	22.1	-	22.1	9.6
	All N.A. Companies	2,513	84.3	29.1	32.0	145.7	63.0
	All European Companies	7	17.1	5.4	3.2	26.9	11.6
	All Asian Companies	1,347	15.9	12.3	4.5	36.7	15.9
	All Companies	5,984	117.3	68.9	39.7	231.4	100.0

Note: Vendor data includes OEM revenue and shipments, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table C-4
1995 Top 30 Mechanical Software Companies, Worldwide, Personal Computer (Revenue in Millions of Dollars, Actual Units)

Rank	Company Name	CPU Shipments	Software Revenue	CPU Revenue	Service Revenue	Total Distribution Revenue	1995 Share of Market (%)
1	Autodesk	-	199.6	-	1.1	200.7	14.0
2	NEC	13,508	24.0	67.3	10.8	120.2	8.4
3	IBM	30,015	-	117.0	-	117.0	8.1
4	Digital Equipment	33,468	-	92.6	3.4	95.9	6.7
5	Fujitsu	6,461	24.2	38.8	22.3	85.3	5.9
6	MicroCADAM	-	71.1	-	3.7	74.8	5.2
7	Hewlett-Packard	13,790	19.0	40.3	7.1	66.3	4.6
8	Argo Graphics*	1,091	2.0	26.3	-	57.1	4.0
9	Investronica SA	-	11.1	11.0	8.1	44.1	3.1
10	Toshiba*	2,708	15.8	12.4	3.1	34.4	2.4
11	Hakuto*	938	11.9	12.4	1.1	25.4	1.8
12	Andor*	394	15.9	4.2	-	24.2	1.7
13	Sumisho Electronics*	864	4.6	7.1	-	24.0	1.7
14	Hitachi	1,145	10.2	9.9	2.4	22.6	1.6
15	Engineering Computer Services*	571	4.9	-	2.5	18.5	1.3
16	Tebis	176	8.0	2.3	4.9	16.8	1.2
17	Wiechers Datentechnik	312	10.4	3.2	2.4	16.0	1.1
18	Design Automation	-	11.6	3.3	0.2	15.1	1.0
19	Computervision	-	6.6	-	8.0	14.6	1.0
20	Altium*	4,733	-	13.6	-	13.6	0.9
21	CAD Lab	429	5.4	3.6	2.8	12.7	0.9
22	Mutoh Industries*	424	3.5	4.7	1.2	11.8	0.8
23	MCS	37	7.5	0.2	1.3	9.1	0.6
24	Cimatron	-	7.5	-	1.6	9.0	0.6
25	Formtek	95	5.7	0	3.3	9.0	0.6
26	CNC Software	-	8.4	-	-	8.4	0.6
27	Bentley Systems	-	7.3	-	0.4	7.7	0.5
28	Mitsubishi Electric*	412	1.7	2.2	-	7.6	0.5
29	ADRA Systems	-	5.1	-	2.4	7.5	0.5
30	Serbi	549	5.9	1.6	-	7.5	0.5
	Other Companies	113,105	-	263.3	-	263.3	18.3
	All N.A. Companies	65,090	399.2	219.5	44.8	663.7	46.2
	All European Companies	3,998	86.0	31.0	27.3	169.8	11.8
	All Asian Companies	28,474	79.0	190.9	42.0	340.8	23.7
	All Companies	210,667	564.2	704.7	114.1	1,437.6	100.0

Note: Vendor data includes OEM revenue and shipments, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table C-5
1995 Top 26 Mechanical Software Companies, Worldwide, Host/Proprietary (Revenue in Millions of Dollars, Actual Units)

Rank	Company Name	CPU Shipments	Software Revenue	CPU Revenue	Service Revenue	Total Distribution Revenue	1995 Share of Market (%)
1	Digital Equipment	3,005	-	275.8	46.5	322.3	42.5
2	IBM	455	88.8	87.4	80.2	303.9	40.1
3	Dassault	-	44.2	-	7.7	52.0	6.9
4	MacNeal-Schwendler	-	25.1	-	2.8	27.8	3.7
5	Nihon Unisys	5	1.1	0.6	19.2	21.3	2.8
6	Fujitsu	-	7.8	-	6.3	14.1	1.9
7	Hitachi	493	3.3	3.2	0.8	7.3	1.0
8	Mitsubishi Electric*	16	1.2	1.9	-	6.0	0.8
9	C. Itoh Techno-Science*	-	2.4	1.1	0.8	4.7	0.6
10	Exapt	55	4.5	1.2	0.7	4.0	0.5
11	Mechanical Dynamics	-	2.2	-	1.0	3.2	0.4
12	Toyo Information Systems*	16	0.8	1.2	0.3	2.5	0.3
13	Intergraph	-	-	-	2.3	2.3	0.3
14	Ansys	-	1.5	-	0.1	1.6	0.2
15	Kubota Computer	-	0.8	-	0.3	1.1	0.1
16	GRAFTEK	10	0.3	0.3	0.1	0.9	0.1
17	Framasoft	-	0.4	-	0.4	0.8	0.1
18	Access Corp.	-	0.4	-	0.4	0.8	0.1
19	Century Research Center	2	0.3	0.2	0.1	0.7	0.1
20	Computational Mechanics	-	0.5	-	-	0.5	0.1
21	Whessoe Computing Systems	-	0.5	-	-	0.5	0.1
22	Cimtel	1	0	0.1	0.2	0.3	0
23	Debis Systemhaus	-	0.2	0	0	0.3	0
24	Sherpa Corp.	-	0.2	-	0.1	0.3	0
25	CIMTEK*	4	0.2	0.1	0.1	0.2	0
26	Technodia*	-	0	-	-	0	0
	Other Companies	189	-	35.5	8.9	170.1	22.5
	All N.A. Companies	1,908	103.4	231.4	133.4	523.9	69.1
	All European Companies	60	3.1	1.5	9.1	14.2	1.9
	All Asian Companies	532	11.9	8.3	27.8	49.4	6.5
	All Companies	2,690	118.3	276.7	179.3	757.6	100.0

Note: Vendor data includes OEM revenue and shipments, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

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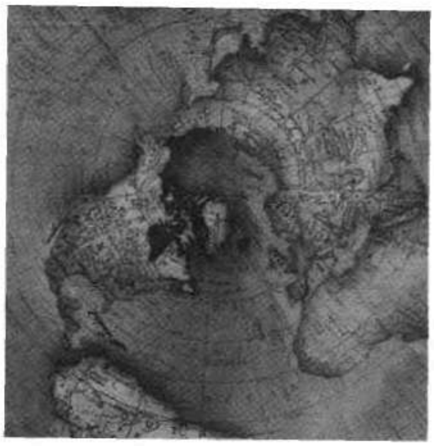

Dataquest

CAD/CAM/CAE/GIS Mechanical Forecast

Market Statistics

Program: Mechanical Applications Worldwide
Product Code: CMEC-WW-MS-9602
Publication Date: May 13, 1996
Filing: Market Statistics

CAD/CAM/CAE/GIS Mechanical Forecast

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CAD/CAM/CAE/GIS Mechanical Forecast

Introduction

Dataquest's CAD/CAM/CAE and GIS forecast is based upon market share software revenue gathered primarily during the first quarter of 1996. Dataquest's software forecast for all CAD/CAM/CAE and GIS applications includes:

- Three-year historical software and hardware revenue by region and operating system
- Five-year forecast of software, hardware, and service revenue by region and operating system
- Three-year history and five-year forecast of hardware shipments and installed base data

Although Dataquest does not forecast currency exchange rates, we do forecast with the best information available. The exchange rate is calculated as the simple arithmetic mean of the 12 average monthly rates for each country. For the purpose of this forecast, Dataquest assumes the March 1996 exchange rate will remain stable in the future (see Tables 1 and 2).

In 1995, we restructured our database in order to better serve our clients. We reiterate these changes here:

- Japan is now tracked as a region separate from Asia/Pacific.
- Asia/Pacific now includes China, Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, New Zealand, India, and Southeast Asia).
- Service is divided into Hardware Service and Software Service.
- Platforms have been replaced by Operating Systems, to include UNIX, Host, Windows NT, and PC.

Additional market statistics publications for Dataquest's CAD/CAM/CAE and GIS services for 1996 are as follows:

- Dataquest's 1995 Market Share document (published as CAEC-WW-MS-9601, CEDA-WW-MS-9601, and CMEC-WW-MS-9601) was published and sent to our clients in March.
- The market share data for 1995 is being verified and updated, and it will be available in July as a Market Share Update document. Country-level, industry, and subapplication data will be available at that time.
- Dataquest will also perform an updated forecast that will be expanded to include country-level information, additional metrics, and in-depth analysis. This Forecast Update will be available in September.

Table 1
CAD/CAM/CAE and GIS Revenue Growth Comparison
(U.S. Dollars versus Local Currency for Both Europe and Japan)

	1994	1995	Forecast 2000	Growth (%) 1994-1995	CAGR (%) 1995-2000
Europe (U.S.$ Million)					
Software Revenue	1,820.18	2,161.60	3,374.47	18.8	9.3
Hardware Revenue	2,591.56	2,807.99	5,017.48	8.4	12.3
Service Revenue	1,141.83	1,274.02	1,553.54	11.6	4.0
Total Factory Revenue	5,553.57	6,243.61	9,945.49	12.4	9.8
ECU/U.S.$ Exchange Rate*	0.84	0.77	0.80	-8.6	0.7
Europe (ECU Million)					
Software Revenue	1,535.50	1,666.38	2,691.40	8.5	10.1
Hardware Revenue	2,186.24	2,164.68	4,001.82	-1.0	13.1
Service Revenue	963.25	982.14	1,239.07	2.0	4.8
Total Factory Revenue	4,684.99	4,813.20	7,932.28	2.7	10.5
Japan (U.S.$ Million)					
Software Revenue	1,335.78	1,521.57	2,680.91	13.9	12.0
Hardware Revenue	2,143.29	2,286.92	4,063.64	6.7	12.2
Service Revenue	925.74	1,044.46	1,478.93	12.8	7.2
Total Factory Revenue	4,404.81	4,852.95	8,223.49	10.2	11.1
Japan/U.S.$ Exchange Rate*	110.85	93.90	105.94	-15.3	2.4
Japan (Yen Million)					
Software Revenue	148,071.13	142,875.66	284,015.37	-3.5	14.7
Hardware Revenue	237,583.90	214,741.36	430,502.52	-9.6	14.9
Service Revenue	102,618.14	98,074.81	156,678.33	-4.4	9.8
Total Factory Revenue	488,273.16	455,691.83	871,196.22	-6.7	13.8
North America (U.S.$ Million)					
Software Revenue	1,915.91	2,272.72	4,456.45	18.6	14.4
Hardware Revenue	2,482.33	2,776.43	6,289.30	11.8	17.8
Service Revenue	1,171.94	1,385.61	2,301.71	18.2	10.7
Total Factory Revenue	5,570.18	6,434.76	13,047.45	15.5	15.2
Worldwide (U.S.$ Million)					
Software Revenue	5,415.60	6,420.61	11,855.56	18.6	13.0
Hardware Revenue	7,667.54	8,418.59	17,092.16	9.8	15.2
Service Revenue	3,451.56	3,971.80	5,966.89	15.1	8.5
Total Factory Revenue	16,534.69	18,811.00	34,914.60	13.8	13.2

*Assuming a stable currency, the 2000 exchange rate is March 1996 exchange rate.
Source: Dataquest (March 1996)

Table 2
Foreign Currency per U.S. Dollar

		Actual				Current			Year-to-Year Change (%)					
Country	Currency	1991	1992	1993	1994	1995	1996	1997	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997
Austria	Schilling	11.67	10.95	11.65	11.40	10.06	10.38	10.39	-6.17	6.4	-2.1	-11.8	3.2	0.1
Belgium	Franc	34.13	32.02	34.67	33.66	29.42	30.33	30.37	-6.18	8.3	-2.9	-12.6	3.1	0.1
Denmark	Krone	6.39	6.02	6.49	6.35	5.59	5.70	5.71	-5.79	7.8	-2.2	-12.0	2.0	0.2
Finland	Markka	4.04	4.45	5.73	5.21	4.37	4.59	4.61	10.15	28.8	-9.1	-16.1	5.0	0.4
France	Franc	5.64	5.27	5.67	5.54	4.97	5.05	5.06	-6.56	7.6	-2.3	-10.3	1.6	0.2
Germany	D-Mark	1.66	1.56	1.66	1.62	1.43	1.48	1.48	-6.02	6.4	-2.4	-11.7	3.5	-0.2
Italy	Lira	1,238.93	1,227.75	1,577.85	1,609.34	1,628.21	1,564.93	1,562.43	-0.90	28.5	2.0	1.2	-3.9	-0.2
Netherlands	Guilder	1.87	1.75	1.86	1.82	1.60	1.65	1.65	-6.42	6.3	-2.2	-12.1	3.1	0.2
Norway	Krone	6.49	6.18	7.11	7.04	6.33	6.43	6.43	-4.78	15.0	-1.0	-10.1	1.6	0.0
Spain	Peseta	103.81	101.90	127.87	133.48	124.40	124.24	124.39	-1.84	25.5	4.4	-6.8	-0.1	0.1
Sweden	Krona	6.04	5.81	7.82	7.70	7.14	6.74	6.73	-3.81	34.6	-1.5	-7.3	-5.6	-0.1
Switzerland	Franc	1.43	1.40	1.48	1.37	1.18	1.19	1.20	-2.10	5.7	-7.4	-13.9	0.8	0.5
United Kingdom	Pound	0.57	0.57	0.67	0.65	0.63	0.65	0.65	0.00	17.5	-3.0	-3.1	3.9	0.0
Europe Average	ECU	0.81	0.77	0.86	0.84	0.77	0.80	0.80	-4.86	11.4	-1.5	-8.7	3.6	0.0
China	Renminbi	5.33	5.51	5.76	8.54	8.35	8.35	8.35	3.38	4.5	48.3	-2.2	0.0	0.0
Hong Kong	Dollar	7.77	7.74	7.74	7.73	7.74	7.73	7.73	-0.39	0.0	-0.1	0.1	-0.1	0.0
Japan	Yen	134.59	126.34	110.85	101.56	93.90	105.91	105.94	-6.13	-12.3	-8.4	-7.5	12.8	0.0
Korea	Won	730.67	782.41	799.42	805.80	770.57	781.70	781.31	7.08	2.2	0.8	-4.4	1.4	0.0
Singapore	Dollar	1.73	1.63	1.62	1.53	1.43	1.41	1.41	-5.78	-0.9	-5.3	-6.5	-1.4	0.0
Taiwan	Dollar	26.49	24.93	26.15	26.45	26.48	27.41	27.40	-5.89	4.9	1.1	0.1	3.5	0.0

Source: Dataquest (March 1996)

Worldwide Forecast Assumptions

The following sections describe the main forces driving the CAD/CAM/CAE and GIS worldwide software forecast.

All Applications

As CAD/CAM/CAE/GIS becomes more of a replacement market, market leaders would appear to have the upper hand; the cost of switching is high. However, software that lets users get a better product to market faster and software that helps eliminate business risks will always be in demand—regardless of market share. Thus there is always an opportunity for new vendors in technical markets.

The primary trend in design software function is toward operating at a higher level of abstraction. In all applications, we have seen an evolution of focus from "electronic paper" to component modeling and now to system modeling with the eventual goal being to fully simulate, evaluate, redesign, and test the design inside the computer prior to manufacture. At the same time, increased computing power is allowing the nature of design to evolve to include constituencies in manufacturing, product support, and from users themselves. Thus the engineering process is being expanded to include input from a broader base.

At the same time, the nature of design data itself is expanding from a focus on geometry to include multiple data types—making the challenge of system modeling even more complex. Also, the World Wide Web holds the potential to expand the nature of collaborative design by harnessing the joint power of anticipated increases in both computing power and communications bandwidth. Thus there is little limit to the problems that design or GIS software can tackle. The primary challenge will continue to be developing robust, leading-edge software ahead of competitors. During the forecast period we anticipate significant, but not revolutionary, advances in the ability of the existing programmer pool to produce new software.

Mechanical Forecast Assumptions

New Interest in Mechanical CAD Technology

In 1995 we saw a mix of replacement business and new purchases for mechanical CAD technology, particularly in Europe and North America. Growth is picking up in nontraditional industries (those industries outside of aerospace, automotive, and industrial machinery). We expect this trend to continue, as mechanical modeling, analysis, design, and simulation software become more user friendly. Closely linked to the use of mechanical CAD in new arenas is the availability of software on lower-cost platforms and the potential use of object technology to create customized industry- or applications-specific solutions.

The product data management market has clearly found a worldwide interest. Within the past year, we have seen pilot programs move to full-scale production, support for new client platforms (Windows NT, Windows), integration with manufacturing resource planning systems, and an emergence of a parts/component management software. Product data management will be one of the significant drivers of the mechanical CAD market through 2000.

Ground Shifts in Japan

Mechanical CAD/CAM/CAE growth in Japan is expected to undergo a significant shift in platform usage over our forecast period. The UNIX platform dominates the mechanical sector in Japan despite the fact that the Japanese mechanical market still places a heavy emphasis on 2-D drafting instead of 3-D/solid modeling. We expect this drafting orientation to persist, and in the next five years we anticipate a significant shift to more Windows NT and PC-based operating systems at the expense of UNIX. This shift will not begin in earnest until late 1996, when Japan-specific versions of mechanical software on Windows NT are more widely available.

Windows NT

As of today not all of the major mechanical CAD vendors have ported their products to the Windows NT platform. The lack of availability of Windows NT versions of some of the market-share-leading mechanical CAD packages will mean that Windows NT will not begin to impact UNIX-based sales for at least a few more years.

AEC Forecast Assumptions

The Impact of Windows NT

Intergraph's shift to Windows NT has initiated the collapse of UNIX sales in North America, a trend expected to increase broadly in this cost-conscious application. At the same time, we expect growth in Windows NT from DOS-based users who find Windows 95 and successors less than reliable. The primary factor holding up growth in the large installed base of DOS users is their reluctance to buy the new hardware required for either Windows 95 or Windows NT.

The factors that should contribute to the long-term expansion of the AEC CAD are noted in the following sections.

CAD Is Becoming a Business Requirement

Large design firms are growing at the expense of smaller firms. These large end users increasingly require their employees and suppliers to adopt automation tools in the design and construction process. Smaller design firms must increasingly buy CAD systems or risk being dropped from consideration as a partner.

CAD purchases are increasingly justified as a competitive advantage in both sales and design reviews. Electronic design data is also required downstream by the designer's client, from the federal government down to the small commercial developer. Also, a significant pool of untapped users still exists. The relatively low market penetration of AEC CAD systems should allow steady worldwide growth during the next five years despite constant volatility in demand for the buildings and infrastructure to be designed.

New Features in AEC CAD Products Are Achievable

Better, lower-cost visualization tools will be in increasing demand as sales and communications tools. Data and database functions (versus graphics functions) are increasing in importance in AEC design systems, creating opportunities to sell users significant new functionality. Some vendors will create products that foster communications in the entire design, construction, and maintenance process, products that will increase the payoff in CAD investments.

The three trends that will inhibit growth in the AEC CAD industry are noted in the following sections.

Design Is Only Part of the Problem

AEC's one-design-one-build structure means CAD provides fewer economic benefits to these users than does the one-design-build-many structure of manufacturing. Construction, which is essentially a prototype build, is fraught with uncertainties and delays that are not well-addressed by AEC systems as they exist today. Design tools can only thrive in the AEC structure when they support more of the entire business problem. Based on Autodesk's increased commitment to progress in this arena, we have increased our forecast modestly; commitment to and cooperation on the problem from multiple vendors will allow us to increase the forecast growth rate further.

Poor Cooperation among Users

Users are poorly organized to take advantage of improved products, partly because of competition between engineering constructors and partly because designs are often split among several different companies representing different and competing aspects of the design process. New approaches to the design and construction process are appearing that allow users to take full advantage of CAD tools. Still, many users in AEC will need to be shown leadership in working together, both from the very large, most-competitive users and from CAD vendors themselves.

Downturn in Germany

The German construction industry, which has been the driving force behind the high growth of the recent years, has come to an abrupt halt. Although other regions such as Italy are investing, Germany plays such a dominant role that it will drag down the overall European growth for AEC. The applications that are still growing even in Germany are facilities design/management because these are not dependent on the construction industry.

GIS/Mapping Forecast Assumptions

The Impact of Windows NT

Intergraph's move to Windows NT at the expense of UNIX will quickly make PC-based operating systems the dominant revenue stream in North America. In the long term, the GIS UNIX market is highly subject to erosion by Windows NT because of the appeal of better integration of GIS and Windows-based productivity tools, an appealing prospect to many GIS users.

The factors that should contribute to the long-term expansion of the GIS market are noted in the following sections.

"Open GIS"

The thrust of the Open GIS Foundation has been to allow some fresh air into a market that was getting a bit inbred. The nature of GIS data is under greater scrutiny, and several vendors are embarking in different, creative directions. Ultimately, much of "spatial analysis" will be embedded into other applications rather than known as a GIS. Nonetheless, a fresh approach to spatial analysis is creating new opportunities for more useful solutions in traditional GIS environments.

There Exists an Abundant Supply of Prospective Buyers

Penetration is still moderately low among core users. Bread-and-butter prospects in government and utilities are charged with maintaining information on land and assets in perpetuity. Many of these prospective buyers are still using paper maps, which will degrade over time, or have only entry-level systems in terms of value delivered. This creates a certain inevitability to moving from paper maps computer-based models.

New Technologies Will Drive Growth

Faster, cheaper computers will be continually leveraged to support new software products. Widespread computer industry developments in open, distributed systems supporting high-speed networking will make it possible for GIS technology to broadly expand the user base. Lower-cost, higher resolution satellite imagery holds the potential to drive another explosion in GIS market growth among users who cannot afford aerial photography. Advances in aerial photography, global positioning systems (GPSs), and laser range finders are making it possible to create GISs significantly cheaper, more accurate, and more complete than existing paper maps, giving experienced users some compelling reasons to reinvest. Portable and pen-based computers are bringing GIS to new users in field operations. Finally, database companies themselves are gaining a better understanding of spatial analysis, a key factor in spreading use of GIS systems more broadly.

Data Will Drive Growth

The GIS business market is driving high growth on PCs. However, we see a wide band of uncertainty surrounding the clearly growing revenue opportunity from new applications. Several new applications in GIS are destined to become a relatively low revenue-producing feature in another software program (and market) rather than a standalone product in the GIS market. At the same time, data is increasing in value relative to software in this low-end market.

GIS has attained a certain indispensability, particularly among federal users and in utilities. As a result, users are beginning to expect to share the data that lies in their various GIS systems. Within three years, we expect data to be readily exchangeable across different systems. At that point, shareable data will help drive market growth.

The several factors seriously constraining the long-term expansion of the GIS market are noted in the following sections.

High Cost of Entry Remains a Barrier

There will remain an uncertain, but certainly high, cost of creating a working GIS system in traditional environments. No magic will emerge to create a low-cost, meaningful data set for mainstream customers in government and utilities. Data conversion will remain costly because the significant cost of correcting prior errors and omissions on paper maps is inevitably bundled into the cost of "conversion."

Price Pressures Inhibit Growth

Price pressure will hold down total revenue. Innovation is the only way to maintain prices in any software industry, and GIS vendors will struggle in their attempt to create compelling new applications and improved investment payoff for customers.

Electronic Design Automation Forecast Assumptions

The EDA software market grew 17.2 percent in 1995. Over the next five years, growth will continue to be fueled by continuing increasing design complexity and ever-higher speeds.

Electronic CAE

Design complexity is forcing a large-scale swap: Gate-level users are swapping up to register-transfer level RTL while RTL users are swapping up to electronic-system level (ESL) tools. RTL tools are beginning to appear on Windows NT, competing with UNIX-based tools, while the ESL tools will remain UNIX-based. The second wave, those FPGA/CPLD designers moving up to the RTL, are starting to make an impact on the numbers. The full impact of Windows NT in the CAE market will not be felt until Synopsys ports the design compiler onto that operating system.

IC Layout

The IC layout market grew an astonishing 34.8 percent in 1995. Design complexity and high speed is forcing replacement of obsolete tools, driving this high growth. This is primarily a replacement market of very high-cost tools and very few players. The ensuing frenzy for market share is the result. The few PC-based tools in this market are being replaced by UNIX-class tools in North America, and Windows NT will not be a factor in this market. In fact, this is the market that is demanding a "standard" 64-bit operating system. If UNIX repeats its 32-bit performance, these users could wait for a 64-bit Windows NT.

PCB/MCM/Hybrid

The printed circuit board (PCB) market grew 4 percent in 1995. The swap out of old tools continues for the second year. The most significant shift has been the acceptance of Windows NT as the operating system of choice in the PCB design world. It will not happen overnight, as swap out in this segment is slower than in CAE and IC layout, but it will happen.

Table 3 shows the history and forecast of all applications.

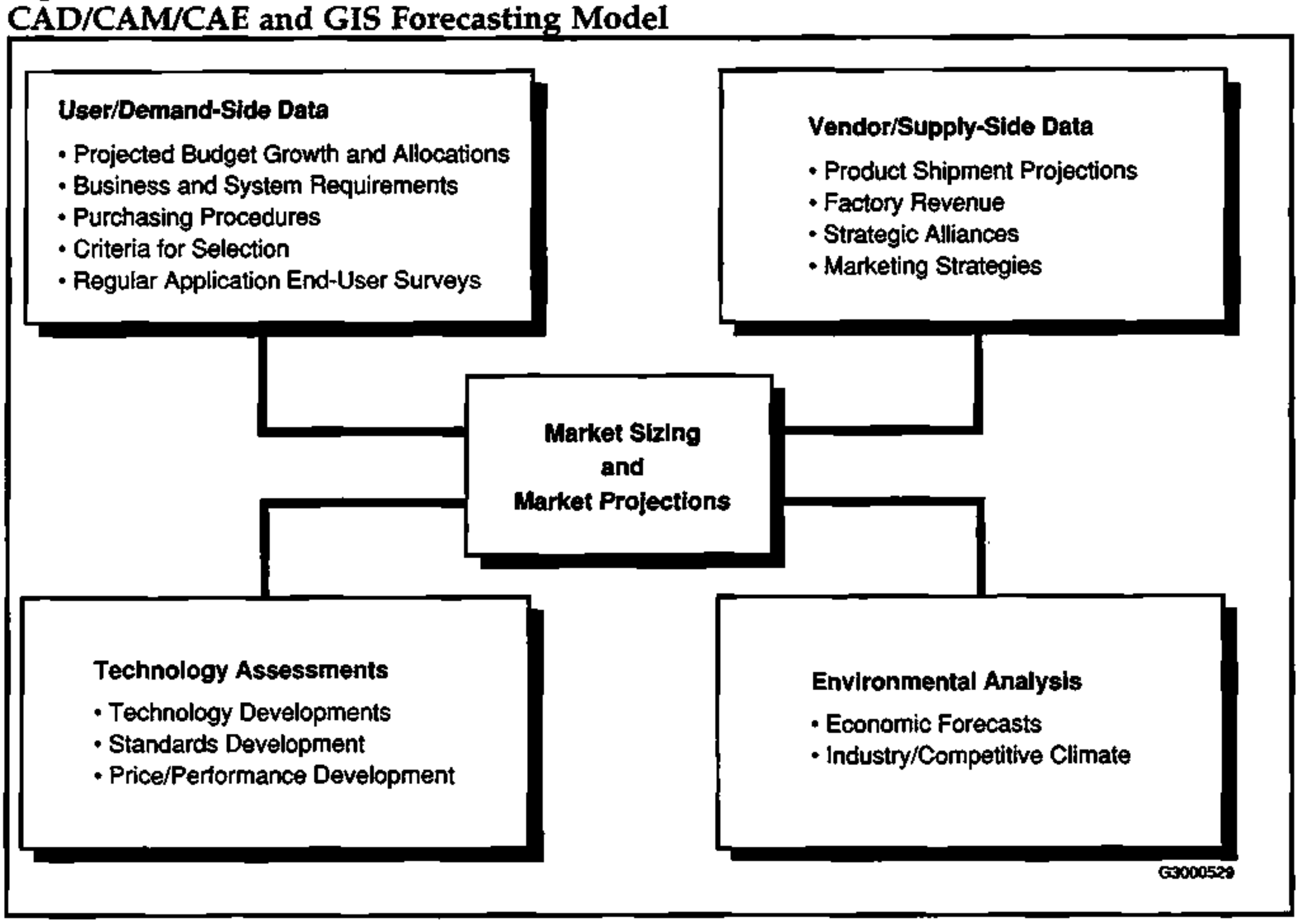
Forecast Methodology

Fundamental to the way Dataquest conducts its research is the underlying philosophy that the best data and analyses come from a well-balanced program. This program includes the following: balance between primary and secondary collection techniques; balance between supply-side and demand-side analysis; balance between focused, industry-specific research and coordinated, "big-picture" analysis aided by integration of data from the more than 25 separate high-technology industries Dataquest covers; and balance between the perspectives of experienced industry professionals and rigorous, disciplined techniques of seasoned market researchers.

Dataquest also analyzes trends in the macro environment, which can have major influences on both supply-side and demand-side forecasting. In addition to demographics, analysts look at gross national product (GNP) growth, interest rate fluctuation, business expectations, and capital spending plans. In the geopolitical arena, the group looks at trade issues, political stability or lack thereof, tariffs, nontariff barriers, and such factors as the effect on Europe of the events of 1995.

Figure 1 shows the CAD/CAM/CAE and GIS forecasting model. The overall forecasting process uses a combination of techniques such as

Figure 1
CAD/CAM/CAE and GIS Forecasting Model



Source: Dataquest (May 1996)

time series and technological modeling. Market estimates and forecasts are derived using the following research techniques:

- Segment forecasting—Individual forecasts are derived for each application segment tracked by the CAD/CAM/CAE and GIS group. Specifically, each application, segmented by region and platform, is forecast and rolled up. In this way, each application segment incorporates its own set of unique assumptions.
- Demand-based analysis—Market growth is tracked and forecast in terms of the present and anticipated demand of current and future users. This requires the development of a total available market model and a satisfied available market figure to assess the levels of penetration accurately. Dataquest analysts also factor in the acceptance or ability for users to consume new technology.
- 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, capacity limitations are capable of keeping shipments below the demand level.

Segmentation Definitions

Operating Systems

The following defines the operating systems:

- UNIX—UNIX includes all UNIX variants and older workstation operating systems.
- Host—Host includes minicomputer and mainframe operating systems in which external workstations' functions are dependent on a host computer.
- Windows NT—Windows NT is the Microsoft operating system. PCPC includes DOS, Windows, Windows 95, OS/2, and Apple operating systems.

Line Items

Line item definitions are as follows:

- Average selling price (ASP) is defined as the average price of a product, inclusive of any discounts.
- CPU revenue is the portion of revenue derived from a system sale that is related to the value of the CPU.
- CPU shipment is defined as the number of CPUs delivered.
- CPU installed base is defined as the total number of CPUs in active, day-to-day use.
- Unit shipment is defined as the number of products delivered (that is, seats).
- Seats are defined as the number of possible simultaneous users.

- Installed seats are defined as the total number of seats in active, day-to-day use.
- Hardware revenue is defined as the sum of the revenue from the hardware system components: CPU revenue, terminal revenue, and peripherals revenue.
- Peripherals revenue is defined as the value of all the peripherals from turnkey sale. (Peripherals in this category typically are input and output devices.)
- Terminal revenue is defined as revenue derived from the sale of terminals used to graphically create, analyze, or manipulate designs. The term is applicable only to the host systems.
- Software revenue is revenue derived from the sale of application software.
- Service revenue is defined as revenue derived from the service and support of CAD/CAM/CAE or GIS systems. Service is followed as software service and hardware service.
- Total factory revenue is defined as the amount of money received for goods measured in U.S. dollars and is the sum of hardware, software, and service revenue.

Table 3
CAD/CAM/CAE/GIS Software History and Forecast
Top-Level Worldwide Forecast, All Applications, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue ($M)									
Worldwide, All Operating Systems	4,881	5,416	6,421	7,446	8,419	9,500	10,664	11,856	13.0
Worldwide									
UNIX	3,371	3,815	4,377	4,901	5,351	5,751	6,181	6,607	8.6
Windows NT	5	115	381	724	1,087	1,595	2,160	2,762	48.6
Personal Computer	1,188	1,307	1,511	1,710	1,908	2,107	2,292	2,464	10.3
Host/Proprietary	317	178	152	111	73	47	32	22	-31.9
All Operating Systems									
North America	1,749	1,916	2,273	2,684	3,096	3,548	4,006	4,456	14.4
Europe	1,598	1,820	2,162	2,385	2,605	2,855	3,105	3,374	9.3
Japan	1,234	1,336	1,522	1,773	1,948	2,164	2,429	2,681	12.0
Asia/Pacific	208	253	362	484	631	770	930	1,095	24.8
Rest of World	93	90	103	120	139	162	195	249	19.3
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.9	18.6	16.0	13.1	12.8	12.3	11.2	
Worldwide									
UNIX		13.2	14.7	12.0	9.2	7.5	7.5	6.9	
Windows NT		2116.0	231.4	90.1	50.1	46.7	35.4	27.9	
Personal Computer		10.0	15.6	13.2	11.6	10.4	8.8	7.5	
Host/Proprietary		-43.7	-15.0	-26.8	-34.1	-35.7	-32.6	-29.8	
All Operating Systems									
North America		9.5	18.6	18.1	15.3	14.6	12.9	11.2	
Europe		13.9	18.8	10.3	9.2	9.6	8.7	8.7	
Japan		8.3	13.9	16.5	9.9	11.1	12.2	10.4	
Asia/Pacific		22.1	42.7	33.9	30.4	22.0	20.7	17.8	
Rest of World		-3.0	14.2	16.8	15.4	16.4	20.8	27.5	

NA = Not applicable
Source: Dataquest (April 1996)

Table A-1
CAD/CAM/CAE/GIS Software History and Forecast
Top-Level Mechanical Forecast, Worldwide, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
Software Revenue ($M)									
Worldwide, All Operating Systems	2,272	2,511	2,989	3,437	3,790	4,135	4,474	4,829	10.1
Worldwide									
UNIX	1,589	1,848	2,231	2,539	2,755	2,911	3,071	3,230	7.7
Windows NT	1	43	95	201	324	494	650	818	53.9
Personal Computer	451	480	546	605	649	689	725	760	6.9
Host/Proprietary	230	139	118	92	62	41	28	20	-29.7
All Operating Systems									
North America	701	781	911	1,044	1,178	1,313	1,442	1,576	11.6
Europe	803	911	1,110	1,225	1,324	1,432	1,538	1,656	8.3
Japan	668	705	809	967	1,043	1,105	1,162	1,219	8.5
Asia/Pacific	72	81	119	157	197	233	272	314	21.4
Rest of World	27	33	39	45	48	53	58	65	10.7
Year-to-Year Software Revenue Growth Rate (%)									
Worldwide, All Operating Systems		10.5	19.1	15.0	10.3	9.1	8.2	7.9	
Worldwide									
UNIX		16.3	20.7	13.8	8.5	5.7	5.5	5.2	
Windows NT		2787.6	120.9	112.1	60.9	52.8	31.4	25.8	
Personal Computer		6.6	13.6	11.0	7.2	6.1	5.2	4.9	
Host/Proprietary		-39.7	-15.1	-21.9	-32.2	-34.9	-30.8	-28.0	
All Operating Systems									
North America		11.5	16.7	14.6	12.8	11.4	9.9	9.2	
Europe		13.5	21.9	10.3	8.1	8.2	7.4	7.6	
Japan		5.6	14.7	19.5	7.9	5.9	5.2	4.9	
Asia/Pacific		11.1	47.9	31.6	25.5	18.3	17.0	15.4	
Rest of World		19.2	19.3	14.8	8.0	8.8	10.9	11.0	

Source: Dataquest (April 1996)

Table B-1
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	262,939	285,807	324,215	383,800	450,800	512,400	582,800	661,300	15
Seats	277,270	298,203	335,433	392,300	456,300	515,800	585,000	662,800	15
Year-to-Year Increase (%)	10	8	12	17	16	13	13	13	
Installed Base									
CPUs	994,856	1,143,415	1,305,196	1,502,100	1,759,900	2,011,300	2,227,600	2,378,300	13
Seats	1,088,152	1,227,984	1,380,040	1,566,200	1,814,900	2,060,300	2,273,800	2,420,500	12
Year-to-Year Increase (%)	16	13	12	13	16	14	10	6	
REVENUE DATA ($M)									
CPU Revenue	3,043	3,253	3,613	4,198	4,838	5,266	5,827	6,450	12
Terminal Revenue	224	201	153	118	75	49	34	25	-31
Peripheral Revenue	281	274	331	403	473	540	663	886	22
Hardware Revenue	3,548	3,727	4,097	4,719	5,386	5,856	6,524	7,361	12
Year-to-Year Increase (%)	-6	5	10	15	14	9	11	13	
Software Revenue	2,272	2,511	2,989	3,437	3,790	4,135	4,474	4,829	10
Year-to-Year Increase (%)	7	11	19	15	10	9	8	8	
Software Service	692	885	1,057	1,130	1,210	1,258	1,307	1,351	5
Hardware Service	730	720	779	852	942	975	1,033	1,095	7
Service Revenue	1,422	1,605	1,835	1,982	2,152	2,233	2,340	2,446	6
Year-to-Year Increase (%)	11	13	14	8	9	4	5	5	
Total Factory Revenue	7,241	7,843	8,921	10,138	11,328	12,224	13,337	14,636	10
Year-to-Year Increase (%)	1	8	14	14	12	8	9	10	

Source: Dataquest (April 1996)

Table B-2
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, UNIX

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	92,385	107,974	123,848	143,000	162,400	169,700	180,800	192,100	9
Seats	92,385	107,974	123,848	143,000	162,400	169,700	180,800	192,100	9
Year-to-Year Increase (%)	21	17	15	15	14	4	7	6	
Installed Base									
CPUs	333,724	415,622	506,349	612,900	738,900	862,800	944,100	965,000	14
Seats	333,724	415,622	506,349	612,900	738,900	862,800	944,100	965,000	14
Year-to-Year Increase (%)	28	25	22	21	21	17	9	2	
REVENUE DATA ($M)									
CPU Revenue	2,079	2,320	2,715	3,232	3,758	4,017	4,383	4,767	12
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	212	211	256	289	311	307	310	312	4
Hardware Revenue	2,291	2,531	2,971	3,520	4,069	4,324	4,693	5,079	11
Year-to-Year Increase (%)	7	10	17	18	16	6	9	8	
Software Revenue	1,589	1,848	2,231	2,539	2,755	2,911	3,071	3,230	8
Year-to-Year Increase (%)	11	16	21	14	9	6	6	5	
Software Service	569	742	902	959	1,011	1,016	1,019	1,008	2
Hardware Service	563	571	667	756	849	875	919	962	8
Service Revenue	1,132	1,313	1,569	1,715	1,860	1,891	1,938	1,970	5
Year-to-Year Increase (%)	26	16	19	9	8	2	3	2	
Total Factory Revenue	5,013	5,693	6,771	7,773	8,684	9,125	9,702	10,280	9
Year-to-Year Increase (%)	12	14	19	15	12	5	6	6	

NA = Not applicable
Source: Dataquest (April 1996)

Table B-3
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, NT/Hybrid

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	71	2,038	3,869	7,600	13,000	20,400	27,400	34,500	55
Seats	71	2,038	3,876	7,600	13,000	20,400	27,400	34,500	55
Year-to-Year Increase (%)	NA	2,788	90	96	71	57	34	26	
Installed Base									
CPUs	71	2,087	5,847	13,500	26,500	42,000	56,800	74,500	66
Seats	71	2,087	5,847	13,500	26,500	42,000	56,800	74,500	66
Year-to-Year Increase (%)	NA	2,857	180	130	97	59	35	31	
REVENUE DATA ($M)									
CPU Revenue	1	24	44	78	125	186	237	297	47
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	-	3	0	0	0	0	0	0	30
Hardware Revenue	1	27	44	78	125	186	237	298	47
Year-to-Year Increase (%)	NA	3,247	62	78	61	49	27	26	
Software Revenue	1	43	95	201	324	494	650	818	54
Year-to-Year Increase (%)	NA	2,788	121	112	61	53	31	26	
Software Service	0	14	26	53	89	142	193	251	57
Hardware Service	-	11	2	4	6	9	11	13	40
Service Revenue	0	25	29	57	95	151	204	265	56
Year-to-Year Increase (%)	NA	16,734	17	96	68	58	35	30	
Total Factory Revenue	2	95	167	335	544	831	1,090	1,380	52
Year-to-Year Increase (%)	NA	3,780	77	100	62	53	31	27	

NA = Not applicable
Source: Dataquest (April 1996)

Table B-4
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, Personal Computer

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	166,223	172,160	193,906	231,000	273,800	321,200	373,800	434,100	17
Seats	166,223	172,163	194,189	231,000	273,800	321,200	373,800	434,100	17
Year-to-Year Increase (%)	10	4	13	19	19	17	16	16	
Installed Base									
CPUs	634,771	701,666	772,314	858,500	979,800	1,093,100	1,214,100	1,327,200	11
Seats	634,771	701,666	772,314	858,500	979,800	1,093,100	1,214,100	1,327,200	11
Year-to-Year Increase (%)	16	11	10	11	14	12	11	9	
REVENUE DATA ($M)									
CPU Revenue	513	536	599	717	853	1,003	1,169	1,360	18
Terminal Revenue	-	-	-	-	-	-	-	-	NA
Peripheral Revenue	35	43	43	58	72	87	104	123	23
Hardware Revenue	549	579	642	775	924	1,089	1,272	1,483	18
Year-to-Year Increase (%)	6	6	11	21	19	18	17	17	
Software Revenue	451	480	546	605	649	689	725	760	7
Year-to-Year Increase (%)	2	7	14	11	7	6	5	5	
Software Service	63	56	62	66	69	71	73	75	4
Hardware Service	29	36	35	49	61	76	93	114	26
Service Revenue	92	92	98	115	131	148	166	188	14
Year-to-Year Increase (%)	72	0	7	18	14	13	13	13	
Total Factory Revenue	1,091	1,151	1,285	1,495	1,704	1,926	2,164	2,432	14
Year-to-Year Increase (%)	8	5	12	16	14	13	12	12	

NA = Not applicable
Source: Dataquest (April 1996)

Table B-5
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Worldwide, Host/Proprietary

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	4,260	3,635	2,592	2,100	1,600	1,100	800	600	-25
Seats	18,591	16,029	13,519	10,600	7,100	4,500	3,000	2,100	-31
Year-to-Year Increase (%)	-25	-14	-16	-22	-34	-37	-34	-30	
Installed Base									
CPUs	26,291	24,040	20,686	17,300	14,700	13,200	12,600	11,700	-11
Seats	119,588	108,609	95,530	81,400	69,700	62,300	58,800	53,800	-11
Year-to-Year Increase (%)	-7	-9	-12	-15	-14	-11	-6	-8	
REVENUE DATA ($M)									
CPU Revenue	449	372	256	172	102	61	38	26	-37
Terminal Revenue	224	201	153	118	75	49	34	25	-31
Peripheral Revenue	34	17	32	57	91	146	249	450	70
Hardware Revenue	707	590	441	346	268	256	321	501	3
Year-to-Year Increase (%)	-38	-17	-25	-21	-23	-4	25	56	
Software Revenue	230	139	118	92	62	41	28	20	-30
Year-to-Year Increase (%)	-9	-40	-15	-22	-32	-35	-31	-28	
Software Service	60	73	66	53	41	29	22	17	-23
Hardware Service	138	103	74	44	26	15	10	6	-39
Service Revenue	198	176	140	96	66	45	32	24	-30
Year-to-Year Increase (%)	-39	-11	-21	-31	-31	-33	-29	-25	
Total Factory Revenue	1,135	904	698	535	396	341	381	545	-5
Year-to-Year Increase (%)	-34	-20	-23	-23	-26	-14	12	43	

Source: Dataquest (April 1996)

Table B-6
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, North America, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	104,242	112,432	122,404	146,300	170,700	193,200	218,900	246,700	15
Seats	107,554	115,393	124,591	147,600	171,400	193,700	219,200	246,900	15
Year-to-Year Increase (%)	7	7	8	18	16	13	13	13	
Installed Base									
CPUs	398,422	450,828	508,586	577,700	667,900	754,700	832,200	888,100	12
Seats	430,038	477,118	529,232	593,000	679,300	763,800	840,400	895,800	11
Year-to-Year Increase (%)	14	11	11	12	15	12	10	7	
REVENUE DATA ($M)									
CPU Revenue	849	947	1,035	1,234	1,463	1,637	1,851	2,087	15
Terminal Revenue	55	48	34	20	11	7	5	4	-35
Peripheral Revenue	33	34	47	57	67	79	105	158	28
Hardware Revenue	938	1,030	1,116	1,311	1,541	1,723	1,962	2,249	15
Year-to-Year Increase (%)	-5	10	8	17	18	12	14	15	
Software Revenue	701	781	911	1,044	1,178	1,313	1,442	1,576	12
Year-to-Year Increase (%)	16	11	17	15	13	11	10	9	
Software Service	196	262	314	349	389	420	449	476	9
Hardware Service	200	205	217	242	275	293	318	343	10
Service Revenue	395	468	532	591	664	713	767	819	9
Year-to-Year Increase (%)	15	18	14	11	12	7	8	7	
Total Factory Revenue	2,034	2,279	2,559	2,947	3,383	3,749	4,171	4,643	13
Year-to-Year Increase (%)	5	12	12	15	15	11	11	11	

Source: Dataquest (April 1996)

Table B-7
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Europe, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	90,762	99,691	114,925	125,100	144,800	162,500	182,400	204,800	12
Seats	95,202	104,175	118,825	128,100	146,800	163,700	183,200	205,300	12
Year-to-Year Increase (%)	-4	9	14	8	15	11	12	12	
Installed Base									
CPUs	389,682	436,490	482,031	537,100	611,000	681,700	739,400	765,500	10
Seats	425,589	469,384	511,198	562,200	632,700	701,000	757,200	780,200	9
Year-to-Year Increase (%)	13	10	9	10	13	11	8	3	
REVENUE DATA ($M)									
CPU Revenue	1,074	1,193	1,334	1,427	1,625	1,767	1,956	2,176	10
Terminal Revenue	90	87	60	46	30	19	12	8	-33
Peripheral Revenue	91	79	107	128	158	193	253	353	27
Hardware Revenue	1,254	1,358	1,501	1,600	1,813	1,979	2,222	2,536	11
Year-to-Year Increase (%)	-17	8	10	7	13	9	12	14	
Software Revenue	803	911	1,110	1,225	1,324	1,432	1,538	1,656	8
Year-to-Year Increase (%)	-5	13	22	10	8	8	7	8	
Software Service	267	354	418	412	434	447	460	472	2
Hardware Service	264	266	289	289	314	324	343	365	5
Service Revenue	531	619	707	701	749	771	803	836	3
Year-to-Year Increase (%)	-6	17	14	-1	7	3	4	4	
Total Factory Revenue	2,588	2,889	3,318	3,526	3,886	4,183	4,563	5,029	9
Year-to-Year Increase (%)	-11	12	15	6	10	8	9	10	

Source: Dataquest (April 1996)

Table B-8
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Japan, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	53,672	57,126	64,794	80,700	93,400	103,800	116,200	130,300	15
Seats	59,748	61,404	69,025	83,600	95,300	104,800	116,800	130,700	14
Year-to-Year Increase (%)	40	3	12	21	14	10	11	12	
Installed Base									
CPUs	172,446	208,211	248,647	297,200	357,500	414,000	457,600	487,600	14
Seats	193,332	229,347	269,774	316,800	375,200	430,200	473,000	502,200	13
Year-to-Year Increase (%)	25	19	18	17	18	15	10	6	
REVENUE DATA ($M)									
CPU Revenue	1,001	979	1,066	1,298	1,453	1,519	1,620	1,725	10
Terminal Revenue	71	53	45	32	21	12	7	5	-36
Peripheral Revenue	146	149	159	191	210	217	230	257	10
Hardware Revenue	1,217	1,181	1,270	1,521	1,684	1,748	1,857	1,988	9
Year-to-Year Increase (%)	5	-3	8	20	11	4	6	7	
Software Revenue	668	705	809	967	1,043	1,105	1,162	1,219	9
Year-to-Year Increase (%)	11	6	15	19	8	6	5	5	
Software Service	199	234	276	310	320	317	315	313	3
Hardware Service	238	219	233	270	292	291	298	304	5
Service Revenue	437	453	509	581	611	608	613	617	4
Year-to-Year Increase (%)	35	4	12	14	5	-1	1	1	
Total Factory Revenue	2,322	2,339	2,588	3,069	3,339	3,460	3,632	3,823	8
Year-to-Year Increase (%)	11	1	11	19	9	4	5	5	

Source: Dataquest (April 1996)

Table B-9
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Asia/Pacific, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	11,780	14,081	19,281	28,300	38,000	48,400	60,200	73,700	31
Seats	12,084	14,552	19,957	29,300	38,600	49,000	60,600	74,000	30
Year-to-Year Increase (%)	66	20	37	47	32	27	24	22	
Installed Base									
CPUs	25,616	37,818	54,234	76,700	107,500	142,400	177,400	214,500	32
Seats	28,376	40,252	56,634	79,400	110,600	145,800	181,200	218,500	31
Year-to-Year Increase (%)	56	42	41	40	39	32	24	21	
REVENUE DATA ($M)									
CPU Revenue	91	100	137	189	239	280	328	382	23
Terminal Revenue	6	10	12	17	12	10	8	7	-11
Peripheral Revenue	9	9	13	21	28	38	52	78	44
Hardware Revenue	106	119	162	227	279	327	388	467	24
Year-to-Year Increase (%)	15	13	36	40	23	17	19	20	
Software Revenue	72	81	119	157	197	233	272	314	21
Year-to-Year Increase (%)	45	11	48	32	25	18	17	15	
Software Service	23	25	35	44	52	58	66	74	16
Hardware Service	21	23	29	39	47	53	60	67	18
Service Revenue	44	47	65	83	100	111	126	141	17
Year-to-Year Increase (%)	34	7	37	28	20	12	13	13	
Total Factory Revenue	222	247	346	466	575	671	786	922	22
Year-to-Year Increase (%)	27	11	40	35	23	17	17	17	

Source: Dataquest (April 1996)

Table B-10
CAD/CAM/CAE/GIS Software History and Forecast
Detail Mechanical Forecast, Rest of World, All Operating Systems

	1993	1994	1995	1996	1997	1998	1999	2000	CAGR (%) 1995-2000
HARDWARE SHIPMENT DATA									
Shipments									
CPUs	2,483	2,478	2,812	3,400	4,000	4,500	5,100	5,900	16
Seats	2,681	2,678	3,035	3,600	4,100	4,600	5,200	5,900	14
Year-to-Year Increase (%)	2	0	13	19	14	11	14	13	
Installed Base									
CPUs	8,690	10,067	11,698	13,600	16,000	18,500	21,100	22,700	14
Seats	10,818	11,883	13,202	14,800	17,000	19,500	22,100	23,700	12
Year-to-Year Increase (%)	14	10	11	12	15	15	13	8	
REVENUE DATA ($M)									
CPU Revenue	28	33	41	51	58	64	72	81	14
Terminal Revenue	2	2	2	2	1	1	1	1	-19
Peripheral Revenue	3	3	5	7	10	14	22	40	50
Hardware Revenue	33	38	48	59	69	78	95	121	20
Year-to-Year Increase (%)	-26	17	26	22	16	14	21	28	
Software Revenue	27	33	39	45	48	53	58	65	11
Year-to-Year Increase (%)	9	19	19	15	8	9	11	11	
Software Service	8	10	13	15	15	16	16	17	5
Hardware Service	8	8	10	12	13	14	15	17	10
Service Revenue	16	18	23	27	28	30	32	33	7
Year-to-Year Increase (%)	-11	17	27	14	7	4	6	6	
Total Factory Revenue	76	89	111	130	145	161	184	219	15
Year-to-Year Increase (%)	-13	18	24	18	11	11	15	19	

Source: Dataquest (April 1996)

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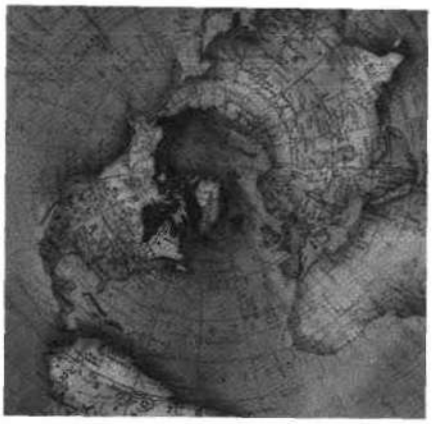

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1995 Mechanical CAD/CAM/CAE Market Share Update

Market Statistics

Program: Mechanical Applications Asia/Pacific
Product Code: CMEC-AP-MS-9601
Publication Date: August 26, 1996
Filing: Market Statistics

1995 Mechanical CAD/CAM/CAE Market Share Update

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Note: All tables show estimated data.

1995 Mechanical CAD/CAM/CAE Market Share Update

About This Document

This document contains Dataquest's detailed market share information on the mechanical CAD/CAM/CAE industry at the country level. This report is meant to supplement your worldwide mechanical CAD/CAM/CAE market share book by providing mechanical CAD/CAM/CAE market share detail for European and/or Asia/Pacific countries.

Definitions

This section lists the definitions specific to this document. For other definitions, we ask that you reference your worldwide market statistics book.

Europe

Western Europe

Includes Austria, Benelux, (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)

Eastern Europe

Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)

Asia/Pacific

Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)

Publishing Schedule

We publish market share and forecasting at the country level once each year. Our delivery schedule is as follows:

- Updated market share tables for 1995, based on data collection and analysis beginning in January 1996, are presented in this report. This information is presented at the country level for either Asia/Pacific and/or Europe, according to the services you have purchased from Dataquest. At this point, the market share database is frozen and will not be changed until the end of 1996.

- Forecast tables will be available electronically by September 2, and books will be shipped by September 30. These forecast tables will contain country-level information for Asia/Pacific and/or Europe.

A Final Note

Dataquest's policy is to continually update its market information, for current and past years, with any new data received in order to arrive at the most accurate market representation possible. Our ongoing commitment is to maintain an accurate and complete model of the entire CAD/CAM/CAE/GIS market, worldwide, and we welcome your input. Please feel free to contact any member of the CAD/CAM/CAE team if you have any questions or concerns.

Table A-1
1995 Top 30 Mechanical Software Companies, Worldwide, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	361.1	368.3	491.5	33.4	16.3
2	Parametric Technology	165.7	209.8	321.2	53.1	10.7
3	Autodesk	159.4	176.0	210.2	19.4	7.0
4	EDS Unigraphics	152.8	172.9	195.8	13.3	6.5
5	Dassault	133.4	154.2	190.6	23.6	6.3
6	Computervision	149.2	148.2	149.1	0.6	5.0
7	MicroCADAM	-	91.7	129.2	40.9	4.3
8	SDRC	93.9	103.3	117.6	13.8	3.9
9	MacNeal-Schwendler	76.6	90.8	114.0	25.5	3.8
10	Fujitsu	74.3	83.7	97.0	15.8	3.2
11	Matra Datavision	63.6	75.6	87.4	15.6	2.9
12	Info. Services Int'l. Dentsu*	50.5	66.0	85.2	29.1	2.8
13	Hewlett-Packard	70.9	74.5	81.5	9.4	2.7
14	NEC	54.3	61.7	72.9	18.1	2.4
15	Hitachi	63.9	66.7	70.9	6.4	2.4
16	Toshiba*	95.7	54.5	58.7	7.8	2.0
17	Intergraph	71.0	61.1	54.0	-11.6	1.8
18	Nihon Unisys	103.0	48.1	52.8	9.8	1.8
19	Hitachi Zosen Info Systems	77.3	34.5	38.7	12.1	1.3
20	Ansys	30.3	32.5	37.4	15.0	1.2
21	Applicon	29.6	29.6	31.1	5.2	1.0
22	C. Itoh Techno-Science*	30.4	34.6	30.8	-10.8	1.0
23	Hakuto*	21.2	23.6	29.8	26.5	1.0
24	Siemens Nixdorf Info systeme	26.2	24.7	25.2	2.2	0.8
25	Sherpa Corp.	12.0	18.8	20.6	10.0	0.7
26	Tecnomatix Technology	-	13.0	20.1	54.3	0.7
27	Marubeni Hytech*	15.1	18.3	19.9	8.9	0.7
28	Seiko*	17.4	18.0	19.7	9.3	0.7
29	ADRA Systems	17.5	18.0	19.0	5.7	0.6
30	Formtek	9.7	17.4	18.9	9.1	0.6
	All N.A. Companies	1,569.2	1,771.2	2,201.0	24.3	73.1
	All European Companies	282.9	293.3	336.5	14.7	11.2
	All Asian Companies	402.4	426.7	474.4	11.2	15.7
	All Companies	2,254.5	2,491.2	3,011.9	20.9	100.0

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-2
1995 Top 30 Mechanical Software Companies, Asia/Pacific, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	13.1	29.0	37.5	29.2	27.0
2	Autodesk	11.5	16.0	23.0	43.3	16.5
3	EDS Unigraphics	7.9	9.0	15.3	69.9	11.0
4	Dassault	8.0	10.8	13.3	23.6	9.6
5	Parametric Technology	0.3	0.1	9.6	14828.4	6.9
6	SDRC	8.2	6.2	7.1	13.8	5.1
7	Matra Datavision	1.9	2.6	7.0	164.3	5.0
8	Computervision	6.1	2.8	4.6	65.8	3.3
9	Investronica SA	3.5	3.8	3.9	4.8	2.8
10	MicroCADAM	-	3.0	3.9	29.8	2.8
11	Delcam International	2.1	2.3	2.8	21.4	2.0
12	MacNeal-Schwendler	2.8	1.8	2.4	31.5	1.7
13	Ansys	1.4	1.3	2.2	72.0	1.6
14	Intergraph	2.9	2.4	2.1	-12.6	1.5
15	MCS	2.3	1.3	1.8	36.5	1.3
16	Alias Research	0.6	-	1.7	NA	1.2
17	Cimatron	0.7	1.1	1.7	55.2	1.2
18	Straessle Informationssysteme	0.1	1.1	1.6	44.4	1.1
19	Design Automation	0.8	0.9	1.6	64.4	1.1
20	Sharp*	1.3	1.2	1.3	8.4	0.9
21	Gerber Systems	1.0	1.1	1.2	16.1	0.9
22	Camax Manufacturing	0.8	1.4	1.2	-13.4	0.9
23	Mechanical Dynamics	0.6	1.0	1.2	12.4	0.8
24	ADRA Systems	1.2	0.7	1.1	54.8	0.8
25	Bentley Systems	-	0.3	0.9	257.2	0.7
26	Hewlett-Packard	1.4	3.7	0.8	-78.1	0.6
27	Formtek	0.4	0.7	0.8	8.9	0.5
28	CNC Software	0.5	0.5	0.6	10.0	0.4
29	Spatial Technology	-	0.4	0.6	52.2	0.4
30	Surfware	-	0.3	0.5	85.2	0.4
	All N.A. Companies	61.4	80.5	117.7	46.2	84.8
	All European Companies	9.1	12.3	17.8	43.8	12.8
	All Asian Companies	2.5	2.5	3.3	30.5	2.4
	All Companies	73.0	95.3	138.7	45.5	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-3
1995 Top 20 Mechanical Software Companies, China, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	0.9	3.5	4.9	41.1	32.5
2	EDS Unigraphics	2.0	2.1	2.2	5.8	14.6
3	Dassault	1.1	1.5	1.9	23.6	12.7
4	SDRC	1.1	0.8	1.0	13.8	6.4
5	MacNeal-Schwendler	1.1	0.6	0.8	31.5	5.6
6	MicroCADAM	-	0.5	0.7	29.8	4.7
7	Autodesk	0.1	0.5	0.7	43.3	4.5
8	Computervision	0.8	0.4	0.7	65.8	4.5
9	Ansys	0.3	0.4	0.6	72.0	4.0
10	Matra Datavision	0.3	0.4	0.5	8.8	3.1
11	Gerber Systems	0.2	0.4	0.4	9.6	2.6
12	Cimatron	0.1	0.2	0.3	55.2	2.0
13	Spatial Technology	-	0.1	0.2	52.2	1.5
14	Mechanical Dynamics	0.3	0.5	0.2	-67.9	1.1
15	Delcam International	0.2	0.1	0.2	35.6	1.1
16	Intergraph	0.2	0.2	0.2	-12.6	1.0
17	Camax Manufacturing	0.1	0.2	0.1	-39.8	0.9
18	CAD Centre	0.1	0.1	0.1	79.5	0.6
19	Applicon	0.1	0.1	0.1	3.5	0.6
20	B.A. Intelligence Networks	0	0.1	0.1	3.9	0.5
	Other Companies	2.1	1.1	2.1	85.1	14.0
	All N.A. Companies	6.8	9.5	11.9	24.3	79.2
	All European Companies	0.7	0.8	1.0	29.4	6.8
	All Asian Companies	-	-	-	NA	-
	All Companies	9.6	11.5	15.0	30.7	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: *Dataquest* (June 1996)

Table A-4
1995 Top 18 Mechanical Software Companies, Hong Kong, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	0.9	2.3	3.0	29.2	28.0
2	SDRC	1.5	1.1	1.3	13.8	12.2
3	Autodesk	0.5	0.7	1.0	43.3	9.5
4	Computervision	1.0	0.5	0.8	65.8	7.3
5	MacNeal-Schwendler	1.1	0.6	0.7	31.5	6.9
6	MicroCADAM	-	0.5	0.7	29.8	6.6
7	Matra Datavision	0.3	0.4	0.5	8.8	4.4
8	Intergraph	0.5	0.4	0.3	-12.6	3.2
9	EDS Unigraphics	0.3	0.3	0.3	5.8	3.0
10	MCS	0.2	0.3	0.3	13.7	2.8
11	Gerber Systems	0.2	0.2	0.2	13.4	2.3
12	Vero International Software	0.1	0.2	0.1	-10.9	1.4
13	Cimatron	0	0.1	0.1	55.2	0.9
14	CNC Software	0.1	0.1	0.1	10.0	0.8
15	CIMLINC	-	-	0.1	NA	0.5
16	Delcam International	0.1	0.1	-	-100.0	-
17	Camax Manufacturing	0	0	-	-100.0	-
18	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	1.9	0.9	1.5	61.8	14.0
	All N.A. Companies	6.1	6.7	8.4	26.4	79.3
	All European Companies	0.5	0.8	0.7	-7.7	6.7
	All Asian Companies	-	-	-	NA	-
	All Companies	8.6	8.3	10.6	27.1	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-5
1995 Top 30 Mechanical Software Companies, Korea, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Dassault	5.7	7.7	9.5	23.6	31.9
2	IBM	0.9	5.4	8.2	53.5	27.6
3	Autodesk	3.1	4.1	5.9	43.3	19.7
4	SDRC	1.9	1.4	1.6	13.8	5.4
5	Delcam International	0.7	0.7	1.5	103.5	5.0
6	Straessle Informationssysteme	-	0.9	1.1	23.8	3.8
7	ADRA Systems	0.5	0.6	0.9	54.8	3.2
8	Matra Datavision	0.3	0.4	0.9	117.5	3.1
9	Computervision	1.0	0.5	0.8	65.8	2.6
10	MicroCADAM	-	0.5	0.7	29.8	2.3
11	Camax Manufacturing	0.1	0.4	0.7	92.5	2.3
12	Ansys	0.3	0.4	0.6	72.0	2.1
13	EDS Unigraphics	0.5	0.5	0.5	5.8	1.8
14	MCS	-	-	0.4	NA	1.5
15	Intergraph	0.5	0.4	0.3	-12.6	1.1
16	Mechanical Dynamics	0.3	0.5	0.3	-35.8	1.1
17	CIMLINC	-	-	0.2	NA	0.7
18	Applicon	0.2	0.2	0.2	3.5	0.7
19	Cimatron	0.1	0.1	0.2	55.2	0.7
20	Gerber Systems	-	0.1	0.2	17.6	0.6
21	Toshiba Engineering*	0.1	0.1	0.2	17.3	0.5
22	Concentra	0	0.1	0.1	137.9	0.5
23	Spatial Technology	-	0.1	0.1	52.2	0.4
24	Vero International Software	0	-	0.1	NA	0.3
25	CNC Software	0.1	0.1	0.1	10.0	0.3
26	Framasoft	0.1	0	0.1	60.0	0.2
27	DP Technology	0	0	0.1	49.4	0.2
28	Livermore Software Tech.	0	0	0	73.9	0.1
29	GRAPHSOFT	-	-	0	NA	0
30	Tebis	0.2	0.3	-	-100.0	-
	Other Companies	3.7	3.0	5.1	68.1	16.9
	All N.A. Companies	9.2	14.3	20.8	45.9	69.8
	All European Companies	1.3	2.5	3.8	49.8	12.8
	All Asian Companies	0.1	0.1	0.1	17.3	0.5
	All Companies	14.3	20.0	29.9	49.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
*Company statistics contain VAR/distributor revenue not counted in total.
Source: Dataquest (June 1996)

Table A-6
1995 Top 20 Mechanical Software Companies, Singapore, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	EDS Unigraphics	2.5	2.6	2.7	5.8	25.2
2	IBM	0.9	1.9	2.5	29.2	22.9
3	SDRC	1.9	1.4	1.6	13.8	14.8
4	MicroCADAM	-	0.5	0.7	29.8	6.5
5	Autodesk	0.4	0.5	0.7	43.3	6.2
6	Computervision	0.4	0.2	0.3	65.8	3.1
7	Delcam International	0.1	0.6	0.2	-72.9	1.5
8	B.A. Intelligence Networks	0.1	0.2	0.2	3.9	1.5
9	Concentra	0	0.1	0.1	137.9	1.3
10	Camax Manufacturing	0.1	0.2	0.1	-12.5	1.3
11	Ansys	0.1	0.1	0.1	72.0	1.2
12	Intergraph	0.2	0.1	0.1	-12.6	1.0
13	Cimatron	0	0.1	0.1	55.2	0.9
14	Vero International Software	0	0	0.1	154.7	0.8
15	CNC Software	0.1	0.1	0.1	10.0	0.8
16	DP Technology	0	0	0.1	49.4	0.5
17	Applicon	0	0	0	3.5	0.3
18	CAD Centre	-	-	0	NA	0.1
19	Matra Datavision	0.3	0.4	-	-100.0	-
20	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	1.9	1.2	1.5	25.0	13.5
	All N.A. Companies	6.4	7.5	9.0	19.9	83.3
	All European Companies	0.5	1.1	0.4	-68.2	3.2
	All Asian Companies	-	-	-	NA	
	All Companies	8.8	9.8	10.8	10.6	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

Table A-7
1995 Top 25 Mechanical Software Companies, Taiwan, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	Autodesk	3.0	3.5	5.0	43.3	22.7
2	IBM	0.9	3.1	4.3	40.4	19.6
3	Dassault	1.1	1.5	1.9	23.6	8.6
4	SDRC	1.9	1.4	1.6	13.8	7.3
5	MCS	1.0	1.0	1.0	-0.5	4.7
6	Cimatron	0.4	0.6	0.9	55.2	4.1
7	MicroCADAM	-	0.5	0.7	29.8	3.2
8	EDS Unigraphics	0.5	0.6	0.6	5.8	2.7
9	Computervision	0.7	0.3	0.6	65.8	2.5
10	Delcam International	0.6	0.4	0.5	35.6	2.3
11	Ansys	0.3	0.3	0.5	72.0	2.2
12	Gerber Systems	0.3	0.3	0.4	24.2	1.9
13	Hitachi Zosen Info Systems	0.4	0.3	0.4	12.1	1.8
14	Camax Manufacturing	0.2	0.5	0.3	-41.7	1.2
15	Intergraph	0.4	0.3	0.3	-12.6	1.2
16	Straessle Informationssysteme	-	0.2	0.2	23.8	1.0
17	Spatial Technology	-	0.1	0.2	52.2	1.0
18	DP Technology	0.1	0.1	0.2	49.4	0.8
19	CNC Software	0.1	0.2	0.2	10.0	0.8
20	B.A. Intelligence Networks	0.1	0.2	0.2	3.9	0.7
21	Livermore Software Tech.	0	0	0.1	83.6	0.4
22	Vero International Software	-	-	0	NA	0.1
23	GRAPHSOFT	-	-	0	NA	0
24	Matra Datavision	0.3	0.4	-	-100.0	-
25	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	4.7	3.2	4.8	48.2	21.8
	All N.A. Companies	9.2	11.9	15.2	28.3	69.1
	All European Companies	1.2	1.5	1.6	5.4	7.3
	All Asian Companies	0.4	0.3	0.4	12.1	1.8
	All Companies	15.4	17.0	22.0	29.7	100.0

NA = Not applicable

Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.

Source: Dataquest (June 1996)

Table A-8
1995 Top 26 Mechanical Software Companies, Rest of Asia, All Operating Systems (Revenue in Millions of Dollars)

Rank	Company Name	1993	1994	1995	1994-95 Growth (%)	1995 Share of Market (%)
1	IBM	0.7	12.9	14.6	13.2	29.0
2	Autodesk	4.5	6.8	9.7	43.3	19.3
3	EDS Unigraphics	2.0	3.0	8.9	200.5	17.7
4	Matra Datavision	0.2	0.5	5.1	920.1	10.2
5	Computervision	2.2	0.9	1.5	65.8	3.0
6	Intergraph	1.2	1.0	0.9	-12.6	1.7
7	MacNeal-Schwendler	0.6	0.6	0.8	31.5	1.6
8	Formtek	0.4	0.7	0.8	8.9	1.5
9	Mechanical Dynamics	-	-	0.7	NA	1.3
10	Delcam International	0.5	0.4	0.5	35.6	1.0
11	Ansys	0.2	0.2	0.4	72.0	0.8
12	MicroCADAM	-	0.3	0.4	29.8	0.7
13	Straessle Informationssysteme	-	-	0.2	NA	0.5
14	ADRA Systems	0.1	0.1	0.2	54.8	0.4
15	CNC Software	0.1	0.2	0.2	10.0	0.3
16	Research Engineers—Civilsoft	-	0.1	0.1	91.9	0.2
17	Cimatron	0	0.1	0.1	55.2	0.2
18	Algor Interactive Systems	0	0	0.1	44.5	0.1
19	DP Technology	0	0	0.1	49.4	0.1
20	RoboCAD Solutions	-	0	0	-17.4	0.1
21	GRAPHSOFT	-	-	0	NA	0
22	Pathtrace Engineering Systems	0	0	0	16.1	0
23	Camax Manufacturing	0.1	0.2	-	-100.0	-
24	Tebis	-	0.1	-	-100.0	-
25	Vero International Software	0	0	-	-100.0	-
26	Graphisoft Group	0	0	-	-100.0	-
	Other Companies	3.4	2.4	7.4	205.7	14.7
	All N.A. Companies	12.2	25.2	37.0	46.5	73.4
	All European Companies	0.7	1.1	6.0	443.6	11.9
	All Asian Companies	-	-	-	NA	-
	All Companies	16.3	28.8	50.4	75.1	100.0

NA = Not applicable
Note: Vendor data includes OEM revenue, so sum of vendors is greater than total.
Source: Dataquest (June 1996)

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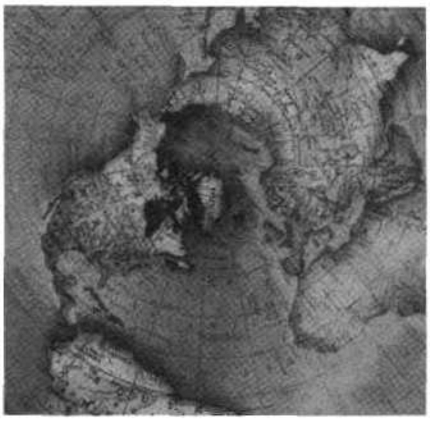

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CAD/CAM/CAE and GIS Market Definitions

Dataquest Guide

Program: Mechanical CAD/CAM/CAE Applications Worldwide
Product Code: CMEC-WW-GU-9601
Publication Date: February 26, 1996
Filing: Guides

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Chapter 1
Market Share Survey Overview

Each year, Dataquest surveys CAD/CAM/CAE/GIS vendors in order to estimate their annual revenue. The survey for 1995 covers 300 vendors worldwide by six main applications segments, four operating systems groups, four world regions, European and Asian countries, hardware, software, services, and distribution channels. This exercise provides input for Dataquest's dynamic database of CAD/CAM/CAE/GIS shipments/revenue by world region/country, operating systems, and applications segment. The information gained is supplemented by, and cross-checked with, Dataquest's other information sources.

The CAD/CAM/CAE market share survey takes place twice each year. The first survey in the fourth quarter is to prepare early estimates for the calendar year. This is followed by a second survey in the spring in order to finalize estimates for the previous calendar year. The first survey takes place from October to December. Our preliminary estimates are completed by the end of the calendar year under review, and the results are summarized in a fax report that is released in January of the following year and published in a Source: Dataquest document by January 31.

The second survey takes place during April. Our final CAD/CAM/CAE/GIS market share estimates are again published in a Source: Dataquest document by May 31. There is usually minimal difference between early and final rankings, as Dataquest makes every effort to ensure preliminary estimates are as accurate as possible. However, there are usually some surprises at year-end, and our numbers do change. It should also be noted that when new information becomes available concerning a previous year's numbers, the database is updated to reflect the best information available.

The categories for which CAD/CAM/CAE/GIS revenue is reported are defined comprehensively for the purpose of clarity and guidance to survey participants. These definitions may occasionally be revised, altered, or expanded to reflect changes in the industry. To support these definitions, Dataquest will send an annual survey guide to all participants in its CAD/CAM/CAE/GIS market share survey program. This document comprises the 1995 survey guide.

Methodology

Dataquest utilizes both primary and secondary sources to produce market share data. In addition to the annual market share survey, Dataquest uses the following sources in order to accurately quantify market activity:

- Information published by major industry participants
- Estimates made by knowledgeable and reliable industry spokespersons
- Government data or trade association data
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users

- Relevant economic data
- Information and data from online or CD-ROM data banks
- Articles in both the general and trade press
- Reports from financial analysts
- Annual reports, Securities and Exchange Commission documents, credit reports
- Reseller and supplier reports and reports from a vendor's competitors
- User studies

Dataquest also sums vendor revenue across other industries covered by Dataquest to make sure revenue is not credited twice, and checks with multiple sources at one company to cross-check data on that company.

Dataquest analysts have many years of experience in how to apply the tools described to get the most accurate information possible on a particular company (such as what to use when, and what industry averages are). It is the CAD/CAM/CAE/GIS group's policy to continually update our market information for any year, based on any new data received, in order to arrive at the most accurate market representation possible.

We survey worldwide, which involves more vendors and therefore presents higher total market revenue, lower market share per vendor, and a more accurate overall market picture.

Despite the care taken in gathering, analyzing, and categorizing the data in a meaningful way, careful attention must be paid to the definitions and assumptions used herein when interpreting the estimates presented in this document. Various companies, government agencies, and trade associations may use slightly different definitions of product categories and regional groupings, or they may include different companies in their summaries. These differences should be kept in mind when making comparisons between data provided by Dataquest and data provided by other suppliers.

Chapter 2
CAD/CAM/CAE/GIS Companies to Be Surveyed Worldwide for 1995

Dataquest will survey the following CAD/CAM/CAE/GIS companies throughout the world for 1995 data.

The North American Companies

- 3Soft
- Accel Technologies
- Accugraph
- ACTEL
- Adina R&D
- ADRA Systems
- ael Advance Graphics Systems
- ALDEC
- Algor Interactive Systems
- Alias Research
- Altair Computing
- Altera
- Analogy
- Ansoft
- Ansys
- Applicon
- Aptix
- Ashlar
- Aspec Technology
- Aspect Development
- Aspen Technology
- AT&T Bell Laboratories
- Auto-Trol
- Autodesk
- Autometric
- Avant!
- B.A. Intelligence Networks
- Bentley Systems
- Boothroyd Dewhurst

- CAD WORKS
- Cadence
- Cadis Software
- CADKEY
- CADSI
- CAE Plus
- CAMAX
- Carrier Corporation
- Cascade Design Automation
- CGTech
- Chronology
- Chrysalis Symbolic Design
- Cimlinc
- Cimplex
- Claritas/NPDC
- CMstat
- CNC Software
- Compact Software
- COMPASS Design Automation
- Computer Aided Design Software
- Computervision
- Concentra
- Contec Microelectronics
- Cooper & Chyan Technology
- CrossCheck Technology
- CSAR Corporation
- Data I/O
- Database Applications Inc.
- Deneb Robotics
- Design Acceleration
- Digital Equipment Corporation
- DP Technology
- Dynamic Graphics
- EA Systems
- Eagle Design Automation
- Eagle Point

- Earth Resource Mapping
- EDS-Unigraphics
- Enghouse Systems Ltd. (Canada)
- Engineered Software
- Engineering Mechanics Research
- EOSTAT
- EPIC Design Technology
- Equifax/NDS
- ERDAS
- Escalade
- ESRI
- ETAK
- Evolution Computing
- Fintronic
- Formtek
- Frontline Design Automation
- Genasys II
- Geo/SQL
- Geographic Data Technology
- Geomax International
- Gibbs and Associates
- Graftek Inc.
- GRAPHSOFT
- Harris EDA
- Hewlett-Packard
- Hibbit, Karlsson & Sorensen
- High Level Design Systems
- i-Logix Inc.
- IBM
- Ikos Systems
- IMSI
- Information Handling Services
- Intergraph
- InterHDL
- International Software Systems
- Intusoft

- ISICAD
- Landmark Graphics
- Livermore Software Technologies
- LSI Logic
- LV Software
- MacNeal-Schwendler Corporation
- Macon
- MapInfo
- MARC
- MCS
- Mechanical Dynamics
- Mentor Graphics
- Meta-Software
- Micrografx
- Microsim
- Minc Software
- Motorola
- Nextwave Design Automation
- NovaSoft Systems
- OEA International
- Optem Engineering
- Orcad
- Pacific Numerics
- PacSoft
- PADS Software
- Parametric Technology
- PCI Remote Sensing Corporation
- PRC
- Protel Technology
- Quantic Laboratories
- Quickturn Systems
- Radian Corporation
- Rebis
- Research Engineers—Civilsoft
- Royal Digital Centers
- Scientific & Engineering SW

- SDRC
- Sherpa Corporation
- SHL Systemhouse
- Sigma Design
- Silicon Graphics
- Silicon Valley Research Inst.
- SIMUCAD
- Simulation Technology
- Softdesk
- Spatial Technology Inc.
- Speed
- SpeedSim
- Spot Image
- SRAC
- Strategic Mapping
- Summitt Design Inc.
- Sun Microsystems
- Surfware
- Sweet's Electronic Publishing
- Synopsys
- Synplicity
- Systems Science
- T D Technology
- Tactician Corporation
- Tanner Research
- Terr-Mar Resource Information Systems
- Terra Sciences
- TYDAC Technologies Inc.
- Unicad
- Unisys Corporation
- Variation System Analysis
- Veritools
- Viagrafix
- Viewlogic Systems
- VISTA Environmental Inf.
- VLSI Libraries

- VLSI Technologies
- Workgroup Technology
- Xilinx
- Zeelan Technology
- Zycad

The European Companies

- ABB Industria
- Abstract Hardware
- ACA Ltd.
- ALS Design
- Anilam Electronics
- APIC Systemes
- ARKTEC SA
- ASCAD/ASCAM
- Assigraph
- CAD Centre Ltd
- CAD Lab S.p.A.
- Cad-Distribution AG
- CAD-UL
- Cadtronic Computer Systeme
- CATALPA Groupe Missler
- Cimatron
- CIMTEK SA
- Cisigraph
- Clemessy Innovation SA
- Complansoft CAD GmbH
- Computational Mechanics
- Computer Services Consultants
- Dapco SA
- Dassault
- debis Systemhaus GmbH
- Delcam Systems International
- Eigner+Partner GmbH
- Elstree Computing Ltd
- Engineering Computer Services
- Exapt

- FHECOR
- Fides Industrielle Automation
- Framasoft
- Gable CAD Systems
- Geometria GIS Systems House
- Graphisoft Software Development
- Ground Modeling Systems Ltd.
- Han Dataport
- Hochtief
- ICEM Technologies
- ICL Finland OY
- IEZ CAD-Systeme GmbH
- Investronica SA
- ISD Software und Systeme GmbH
- ISDATA GmbH
- ISKA
- Kloeckner-Moeller GmbH
- Kockums Computer Systems AS
- Laser-Scan
- M.O.C.
- Marcus Computer Systeme
- Matra Datavision
- mb Programme
- Moss Systems Group
- Nemetschek Programmsystem GmbH
- Norlinvest Ltd Visionics
- Number One Systems
- PAFEC
- Pathtrace Engineering Systems
- Poppenhaeger Grips GmbH
- PROCAD GmbH und Co.KG
- Radan Computational Ltd.
- RIB/RZB
- RoboCAD Solutions Ltd.
- Sagantec Europe BV
- Sener Ingenieria y Sistemas SA

- Serbi SA
- Siemens Nixdorf Informationssysteme
- Sinus Software GmbH
- Smallworldwide
- Soft-Tech Software Technologies
- Softronics
- Speed
- Star Infromatic
- Straessle AG
- Superdraft
- Sysdeco Innovation AS
- Tebis
- Technische Computer Systeme GmbH
- Triplan
- ULTImate Technology
- VEDA—Design Automation
- Vero International Software
- Whessoe Computing Systems
- Wiechers Datentechnik
- Ziegler Informatics

The Japanese Companies

- Andor
- ARGO Graphics
- C. Itoh Techno-Science
- Cadix
- Century Research Center
- CPU
- Design Automation
- Fujitsu
- Graphtec Engineering
- Hakuto
- Hitachi
- Hitachi Zosen Information Systems
- Information Services International Dentsu
- Informatix
- INS Engineering

- Kubota Computer
- Marubeni Hytech
- Mitsubishi Electric
- Mitsui Engineering
- Mutoh Industries
- NEC
- Nihon Itek
- Nihon Unisys
- Omron
- Pasco
- Ricoh
- Seiko Instruments
- Sharp System Products
- Sony
- Sophia Systems
- Sumisho Electronics
- Sumitomo Denko Workstation
- Tokyo Electron
- Toshiba
- Toyo Information Systems
- Uchida Yoko
- Wacom
- Zuken-Redac

Of the 302 companies to be surveyed, 179 are North American, 85 are European, and 38 are Japanese.

Chapter 3
Research Metrics

Definitions for the research metrics used in this survey are as follows:

- Total revenue with the original equipment manufacturer (OEM): The total amount of money received by a company for all goods and services sold into the CAD/CAM/CAE/GIS market. This figure is typically only released when requested.
- Distribution channels: Distribution channels are defined as follows:
  - Direct channel—The channel through which product moves directly from the manufacturer or vendor to the end user, usually by means of a professionally trained salesforce
  - OEM—The channel through which vendors or manufacturers sell their finished product to other companies for resale through an agreement. Once sold, the product is usually modified slightly and then resold directly to the end user or through an indirect channel. Vendors that resell nonbranded product differ from VARs in that they often add their name to the product and back up its warranties.
  - Indirect channels—All other channels through which the finished product moves to the end user, including VARs, dealers, and mass merchandisers
- Turnkey: Bundling hardware and software for sale as a unit
- Total factory revenue: Money received by a company for its goods, excluding OEM revenue or consulting revenue
- Hardware revenue: Revenue derived from the sales of CPUs (including operating systems), terminals (for host-dependent systems), and peripherals
- Software revenue: Revenue derived from the sales of bundled (part of a turnkey system) and applications software. It does not include operating systems revenue, which is part of the hardware revenue.
- Service revenue: Revenue derived from the service and support of CAD/CAM/CAE/GIS systems. Service revenue can be calculated in the market share tables by subtracting hardware and software revenue from total factory revenue. Service revenue includes the following:
  - Applications development—Adding new functionality through design and development of new customized CAD/CAM/CAE/GIS software applications, or the modification, enhancement, or customization of existing software applications
  - Consulting—Including an assessment of a company's CAD/CAM/CAE/GIS business IT needs and formulation of a plan based on needs identification
  - Integration services—Planning, implementing, migrating, and integrating software products
  - Maintenance—Fees for hardware and software

- Management and operations services—Includes help desk, education and training, disaster recovery, vaulting, facilities management, configuration management, and relocation services
- Service bureau—Includes construction of database, data conversion, product design, analysis, or manufacturing

- Seats: The number of possible simultaneous users
- Unit shipments: The number of seats delivered, excluding those sold to another company for resale (OEM). CPU shipments are defined as the number of CPUs delivered, which is the same as unit shipments for all platforms but host-dependent platforms.
- Average selling price (ASP): The average amount of money received by the factory for the sale of a turnkey/hardware system. The database forces reconciliation of a company's revenue and unit shipments with the average selling prices of each application and platform.
- Installed base: The total number of seats/CPUs in use, calculated by forecasting the previous year's installed base plus the year's unit/CPU shipments, less retirements.
- Compound annual growth rate (CAGR): A computed, compounded growth rate used in forecasting

Chapter 4

Worldwide Geographic Region Definitions and Exchange Rates

Dataquest divides the different geographic regions as follows:

- North America: Includes Canada, Mexico, Puerto Rico, and the United States
- Europe
  - Western Europe: Includes Austria, Benelux (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)
  - Eastern Europe: Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)
- Japan
- Asia/Pacific: Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)
- Rest of World: Includes Africa, Central America, the Caribbean, the Middle East, Oceania, and South America

When converting a company's local currency sales into U.S. dollars, or vice versa, it is important to use the 1995 exchange rates provided below (see Table 4-1). These rates will prevent inconsistencies in the conversion of offshore sales between each company. These are the exchange rates that will be used in the final 1995 CAD/CAM/CAE and GIS market share survey. Exchange rates for historical years are available on request.

Table 4-1
Average 1994 and 1995 Exchange Rates against the U.S. Dollar

Country	1994 Rate	1995 Rate
Austria (Schilling)	11.33	10.06
Belgium (Franc)	33.36	29.42
China (Renminbi)	8.68	8.35
Denmark (Krone)	6.31	5.59
ECU	0.84	0.77
Finland (Markka)	5.21	4.37
France (Franc)	5.54	4.97
Germany (Mark)	1.62	1.43
Hong Kong (Dollar)	7.73	7.74
Italy (Lira)	1,609.19	1,628.21
Japan (Yen)	101.81	93.90
Netherlands (Gulden)	1.81	1.60
Norway (Krone)	7.04	6.33
Singapore (Dollar)	1.52	1.43
South Korea (Won)	802.40	770.57
Spain (Peseta)	133.48	124.40
Sweden (Krona)	7.7	7.14
Switzerland (Franc)	1.37	1.18
Taiwan (Dollar)	26.46	26.48
United Kingdom (Pound)	0.65	0.63

Note: The annual rate is estimated as the arithmetic mean of the 12 monthly rates.
Source: Dataquest (February 1996)

Chapter 5

CAD/CAM/CAE/GIS Operating Systems Group Definitions

Dataquest segments CAD/CAM/CAE/GIS data by four main operating system groups. These groups are as follows:

- UNIX—UNIX is a 32-bit, multitasking, multiuser operating system, originally developed at AT&T Bell Laboratories. It is portable and can be found on most CISC and RISC MPUs, including the Intel 80xxx, Motorola 68xxx, and Sun SPARC. UNIX includes all UNIX variants. A complete list of UNIX operating systems can be found in Chapter 8.
- Host-dependent systems—These systems include all minicomputer and mainframe operating systems in which the functions of external workstations are dependent on a host computer. The dominant operating systems in this group are IBM's VM and Digital Equipment's VMS operating systems.
- Windows NT—Windows NT is Microsoft's multiplatform, 32-bit operating system (either Windows NT or Windows NT Advanced Server) for high-end PCs, servers, and workstations.
- Personal computer (PC)—This group includes MS-DOS, PC-DOS, or DR-DOS operating systems. MS-DOS was designed by Microsoft for the original IBM PC. It is the dominant operating system on PC and PC-clone computing systems. PC-DOS is IBM's version of the disk operating system for PC and PC clones. DR-DOS is the Digital Research (Novell) version of this operating system. Other proprietary DOS variants such as NEC-DOS and J-DOS are included in this category.
- Also in the personal computer group are Mac OS, OS/2, Windows 3.1, and Windows 95. Mac OS is Apple's proprietary graphical user interface (GUI) operating system. OS/2 is IBM's GUI operating system for high-end PCs and PC servers. Windows 3.1 and Windows 95 are Microsoft's GUI operating systems for the PCs and PC clones. Windows 3.1 is a 16-bit operating system that runs on top of DOS. It is the dominant GUI operating system for PC and PC clones. Windows 95 is Microsoft's 32-bit version of Windows. Windows 95 is intended to replace Windows 3.1 and does not require a DOS foundation.

Chapter 6
CAD/CAM/CAE/GIS Software Applications Definitions

Dataquest segments data by application types. They are as follows:

- Mechanical—This segment refers to computer-aided tools used by engineers, designers, analysts, and drafters working predominantly in discrete manufacturing industries. Common design applications include conceptual design, industrial design, structural or thermal analysis, and detail design. Common manufacturing applications include tool and fixture design, numerical control part programming, and off-line robotics programming.
- Electronic design automation (EDA)—This segment covers computer-based tools that are used to automate the process of designing an electronic product, including printed circuit boards, ICs, and systems. EDA includes electronic CAE, IC layout, and PCB/hybrid/MCM, as follows:
  - Electronic computer-aided engineering (CAE)—These are computer-aided tools used in the engineering or design phase of electronic products (as opposed to the physical layout phase of the product). Examples of electronic CAE applications are schematic capture and simulation.
  - IC layout—This is a software applications tool that is used to create and validate the physical implementation of an integrated circuit (IC). The IC layout category comprises polygon editors, symbolic editors, placement and routing (gate array, cell, and block), design verification tools (DRC/ERC/logic-to-layout), compilers, and module development tools.
  - Printed circuit board (PCB)/hybrid/multichip module (MCM)—This segment covers products that are used to create the placement and routing of the traces and components laid out on a printed circuit board. Also included in this category are thermal analysis tools.
- Architecture, engineering, and construction (AEC)—This segment covers the use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and other people associated with these disciplines to aid in designing and managing buildings, industrial plants, ships, and other types of nondiscrete entities.
- Geographic information systems (GIS)/mapping—This is a computer-based technology, composed of hardware, software, and data used to capture, edit, display, and analyze spatial (tagged by location) information.

Chapter 7

CAD/CAM/CAE Subapplications Segmentation

Additional surveys are conducted to further segment the industry with software revenue sales by subapplication. The applications are divided as follows:

Mechanical

Modeling Technology

The modeling technology applications are as follows:

- Solid modeling—The representation of a part or assembly capturing all relevant data describing solid characteristics of a project. This can include shape, weight, color, surface texture, and mass properties. Boolean operations are commonly used to add and subtract volumes together to define the final shape of the object.
- 2-D modeling—The representation of a part in two dimensions (it has an x and y coordinate). This format requires three or more views (top, front, and side) to depict all aspects of the part. 2-D is the most common geometric modeling format and is used extensively with a drafting function.
- 3-D modeling—The representation of a part in three dimensions, usually in a wire-frame format (it has an x, y, and z coordinate). This format is commonly used in high-level CAD systems to determine the placement and fit of components in an assembly. It is generally not used for final drafting, although some systems have the capability to translate the 3-D image to a 2-D standard drafting format.
- Integrated—The integration of all 3 modeling technologies

Mechanical CAD/CAM/CAE Subapplication

The mechanical CAD/CAM/CAE subapplications are as follows:

- Conceptual design
  - Industrial design—A process that provides a common environment for the entire conceptual design process, including painting, modeling, rendering, and visualization
  - Design layout—An initial design process in which the major components and part interfaces are defined
  - Styling—A detailed design process in which aesthetic considerations are foremost in importance
- Functional design
  - Component design—Design of the individual components in an assembly
  - Assembly verification—Integration of components' designs into an assembly to test the size/shape and function characteristics

- Linkage/mechanism—An assembly of components with two or more movable parts, usually providing some means of power, control, or fastening application
- Analysis—The analysis of a physical system, part, or assembly; includes structural, thermal, vibrational, composite, fatigue, stack-up, mass property, and quality-control analysis

■ Drafting and documentation

- Detail drafting—Representation of a part in standard geometric drafting format, including all part geometry dimensions and notations describing mechanical/structural, functional, and material characteristics
- Schematic/detailed diagrams—Schematics used to describe hydraulic and pneumatic systems
- Technical illustration—Drawing of a component or assembly that is generally intended for publication

■ Manufacturing engineering

- Tool design—The design of custom-made tooling to facilitate a manufacturing process
- Fixture design—The design of structural aids that hold the component or assembly during the manufacturing process
- Part processing design—The design of a series of manufacturing processes

■ Manufacturing process simulation

- Numerical control part programming—The programming of a numerical control machine tool or automated processing system
- Coordinating measuring machines—The programming of machines used to measure the physical dimensions of a part
- Offline robotics—A process simulation that graphically represents the sequence of steps to program a robot for a particular operation and downloads data to a robot to update its control program

■ System management and other tools

- Product data management (PDM)—Software typically used in an engineering or manufacturing environment to manage product data. Characteristics of PDM systems include product/structure management, workflow, and vault/document management capabilities.
- Engineering data management—Software with vault management capabilities and limited workflow capabilities designed for use within an engineering environment
- Component information systems—Software used to navigate within and manage a repository of engineering parts and associated data
- Knowledge-based engineering tools—Tools used to capture design intent and build standard practices for controlling, modifying, and automating design and manufacturing activities. Also known as rule-based engineering.

- Applications development environments—Programming tools to aid in the generation of user-defined programs that drive or interface with CAD/CAM/CAE.

EDA

For the past few years, Dataquest has subdivided the electronic CAE market in an entirely new way. The subdivisions are based on design methodologies such as gate-level design, register transfer (RT)-level design, and electronic system (ES)-level design.

Under the methodology, a design is first entered and simulated, usually at the RT level. It is then synthesized or compiled down to the level below it. This process continues (simulation and synthesis) until the design is placed and routed at the physical design level, at which point timing information is extracted from the physical design. At this point, the verification process begins.

For verification, the process flows in an upward direction. From the physical design level, timing information is extracted, and design rule checkers and logic rule checkers are used to ensure a correct design at the physical level. Verification continues in this upward fashion until the level at which the design process originally began is reached. The electronic design automation subapplications are as follows:

CAE

The CAE subapplications are as follows:

- ES level
  - ES-level design—Design at the conceptual level, including hardware/software co-design, design partitioning, and specification; it includes neither RT- nor logic-level descriptions.
  - Behavioral simulation—Nontiming-based simulation
  - Behavioral synthesis—Synthesis of an ES-level design description to the RT level
  - Formal verification—The process of mathematically proving that an RT-level description equates to an ES-level description (or less specifically, that any design representation equates to another)
- RT level
  - RT-level design—Tools designed to assist engineers in entering a design or analyzing the simulated results of that design. This includes the use of graphical symbols to represent RT-level VHDL or Verilog.
  - RT-level simulation—Simulation at the RT level
    - VHDL—Simulation using the VHSIC Hardware Description Language
    - Verilog—Simulation using the Verilog Hardware Description Language

- Logic synthesis—Synthesis or translation of an RT-level description to a gate-level description
- Target compiler—A translation of an RT-level description to the silicon implementation
- Timing analysis—Verification of the timing of a design; the process usually involves providing inputs to a physical circuit model or computer simulation to test the nondynamic functions of a design; static-timing verification does not require the use of test vectors to determine timing violations.
- Design for test tools—Tools used to determine, improve, or add to the testability of electronic circuits
- Silicon synthesis—Tools that estimate silicon-level performance at the RT-level by synthesizing the RT-level description to a virtual silicon implementation of that code and reflecting the estimated silicon performance back up to the RT level
- PCB synthesis—A process similar to silicon synthesis but without using synthesis technology. PCB synthesis uses a virtual representation of the PCB to estimate physical effects, bringing those effects back up to the CAE level of design.

- Gate level
  - Schematic capture—A design process that consists of graphical schematic entry and net-list extraction
  - Simulation—The use of representative or artificial data to reproduce conditions in a model that could occur in the performance of a system. Simulation is used to test the behavior of a system under different operating conditions.
    - Gate-level simulation—Simulation based upon a gate-level netlist (not VHDL or Verilog)
    - Analog simulation—Simulation in which both digital and analog inputs are used
    - Mixed-signal simulation—Simulation in which both digital and analog inputs are used
    - SPICE simulation—Simulation using a derivative of the Berkeley SPICE transistor-level simulator
  - Analysis tools—Tools used for the analysis of designs
    - Signal analysis (including transmission line and cross-talk analysis)—Analysis of high-speed coupling effects between signal line and reflection/degradation of the high-speed signal on PCBs, MCMs, or ICs
    - Power analysis—Analysis of the power consumption of PCBs, ICs, MCMs, and systems
    - Electromagnetic interference—Analysis of electromagnetic generation and interference for PCBs, ICs, and cables/connectors/packaging

    - Metal migration or electromigration—The unauthorized movement of metal in an IC because of excessive current density

- Miscellaneous
  - Accelerators—Dedicated hardware/software or optimized software used to speed up simulation, typically at the gate level
  - Emulators—Dedicated hardware/software that allows a designer to observe the function of a circuit or design prior to prototype
  - Fault simulation/grading—A process that determines which nodes in a design can be detected by a given set of test vectors
  - Interoperability tools—Software used for database, library, and tool management; they also include backplanes, file translators, and design environments (in general, all tools used specifically to integrate a set of EDA tools).
  - Libraries—Description of elements used in EDA designs (for example, components, simulation models, and symbols)
  - Field-programmable gate array (FPGA) toolset—Dedicated EDA software sold as a package for FPGA/complex-programmable logic device (CPLD) design
- IC CAD
  - DRC—The design rule and logic rule checkers used to perform final verification on an IC design prior to making masks
  - Floor planner—A tool that allows a designer to place elements of a design so that the designer can look at estimations of the effects of the final place and router.
  - FPGA place and route—Tools used to implement designs into the targeted FPGA or CPLD. These are also called "fitters" because they fit designs into the already existing logic structure of the targeted FPGA or CPLD.
  - IC place and route—Tools used to implement (lay out) designs into silicon
    - Gate array place and route—Tools used to lay out designs into a fixed-based array
    - Cell-based IC place and route—Tools used to lay out nonfixed, cell-based designs
    - Custom IC layout—Silicon design tools working at the transistor level. These tools can size transistors, accomplish analog design, and generally hand craft silicon implementation. Sometimes called "layout editors."
- PCB design
  - PCB design tools—Tools used to design, place, and route a PCB
  - MCM9 and hybrid design tools—Tools used to design, place, and route a multichip module or hybrid substrate

AEC/Architectural, Engineering, and Construction

The AEC, or architectural, engineering, and construction, subapplications are as follows:

- Architectural—Software used in the design and drafting of buildings and grounds
- Civil—Software for both site and structural engineering, typical for design and drafting of sites for buildings, roads, bridges, and airports and for the design of steel and concrete structures
- Facilities design/management—Software used to lay out, inventory, and manage assets such as personnel space, equipment, and utilities within a building or geographic service area
- Process plant design—Software used in design, analysis, drafting, and management of process, power, and manufacturing plants as well as ships

GIS/Mapping Software

GIS/Mapping Software is used to capture, edit, display, and analyze spatial (tagged by location) information. It can be categorized as follows:

- Base data—Software used to create baseline geographic data
  - Photogrammetry and surveying—Software used in developing original data for a GIS system based on ground surveying or on remotely sensed data. Examples include aerial photography or satellite imagery.
  - Data for resale—Includes both GIS software used to create data for resale to end users and revenue from the sale of geographic data
- Land information—Software used to gather and manage land data
  - Land records—GIS software used to manage land ownership or parcel information; the typical user is a tax assessor.
  - Planning and land use—GIS software used to manage land use; the typical user is a city planner.
- Biological—Software used to manage and analyze plant and animal life
  - Environmental public health and safety—GIS software used to manage natural resources and to monitor and analyze environmental factors that contribute to the welfare of the earth and its people
  - Forestry and agriculture—GIS software used for the management of forests and crops
- Geoscience (formerly energy exploration)—GIS software used to manage oil, gas, and mineral exploration projects. The emphasis of geoscience is typically on subsurface data.
- Infrastructure management—Management and analysis of man-made assets (not including utilities)
  - Transportation and logistics—GIS software used in transportation applications such as road or rail network modeling or route planning

- Emergency and dispatch services—GIS software used to manage emergency services such as "911" services and also for-profit dispatch management systems

- Automated mapping/facility management—GIS software used for managing utility industry networks, based on the following categories:
  - Telecommunications/telephone
  - Electric
  - Water and waste water
  - Other utilities (primarily gas)

- Business marketing and sales—GIS software used to promote and sell services and products, and to identify and evaluate opportunities in a competitive environment.
  - Demographic and location analysis—GIS software used to analyze problems in demographics or site characteristics. Examples include sales territory selection, site selection, or population analysis. Typical users are in advertising, marketing, insurance, banking, and real estate.
  - Sales and directional support—GIS software used to help salespeople locate targets of a sales effort (for example, to locate potential customers, specific properties for sale and driving routes to the properties). This also includes software used to help customers locate establishments, typically used as travelers' aids.

- Geopolitics—The sum of software used in defense/military and political districting applications
  - Defense/military—GIS software used to manage military or defense projects for the purpose of command and control
  - Political districting—GIS software used to manage the redistricting process based on census data

- Cartography—GIS software used in mapmaking applications

Chapter 8

CAD/CAM/CAE/GIS Operating System and Industry Segmentation

Additional surveys segment the software revenue by operating systems and by industry, providing yet another look at the CAD/CAM/CAE/GIS software market. These segments are as follows:

Operating Systems

- Apollo AEGIS
- Apple AUX
- Apple Macintosh/OS
- AT&T Systems V Derivatives
- CDC CYBER NOX/VE
- CONVEX UNIX
- CRAY UNIX
- Digital Equipment Corporation OSF
- Digital Equipment Corporation ULTRIX
- Digital Equipment Corporation VMS
- DOMAIN/Apollo UNIX
- DOS
- DOS with Windows
- Hewlett-Packard UX
- Hitachi HI-UX/G (UNIX)
- IBM AIX
- IBM VM/VMS
- Intergraph UNIX
- MIPS UNIX
- NEC EWS-UX (UNIX)
- OS2
- Prime PRIMOS
- Siemens-Host/Proprietary
- Siemens-UNIX
- Silicon Graphics Inc. UNIX
- Solaris
- Sony NEWS-OS (UNIX)
- Sun—UNIX/OS

- Windows
- Windows NT
- XENIX/SCO UNIX
- Others—UNIX
- Others
- All Operating Systems

Industry Sectors

- Aerospace, guided missiles, and space vehicles
- Agriculture, forestry, and fishing
- Automotive, motorcycles, and bicycles
- Chemical, allied, and petroleum products
- Computers, office equipment, and computer peripherals
- Conservation management and waste management
- Construction, contractors, and building
- Consumer electronics (TV, VCR, and CD)
- Education
- Electrical/electronic equipment (power, appliances, test, and measurement)
- Fabricated metal products, except machinery and transportation
- Finance, insurance, and real estate
- Government: environment and public health resource
- Government: general, executive, public order, and taxation
- Government: national security (defense)
- Government: public works and engineering
- Industrial and commercial machinery (engines and heavy equipment)
- Industrial controls, robotics, and AGVs
- Manufacturing not elsewhere classified (textiles, furniture, and foundries)
- Medical manufacturing (instrument/x-ray)
- Mining
- Semiconductors
- Service companies (including architecture firms, engineering consulting firms, and design services firms)
- Shipbuilding, ship repairing, and developing offshore rigs
- Telecommunications and data communications (telephone, radio, television, and cable)
- Transportation (rail, public transit, and freight transport)

- Utilities and pipelines (electric, gas, sanitary services, and water)
- Others
- All industries

Results from these surveys and the subapplications' surveys are scheduled to be published in mid-1996.

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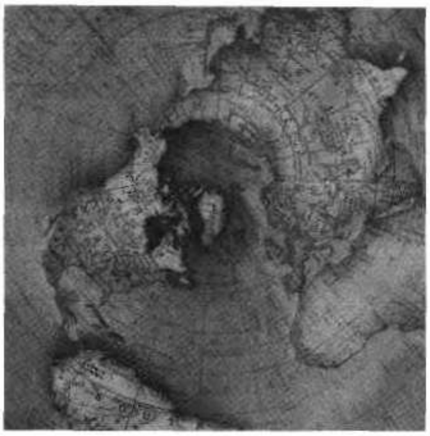

Dataquest

CAD/CAM/CAE and GIS Market Definitions

Dataquest Guide

Program: CAD/CAM/CAE/GIS Asia/Pacific
Product Code: CCAM-AP-GU-9601
Publication Date: February 26, 1996
Filing: Guides

CAD/CAM/CAE and GIS Market Definitions

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Program: CAD/CAM/CAE/GIS Asia/Pacific
Product Code: CCAM-AP-GU-9601
Publication Date: February 26, 1996
Filing: Guides

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Chapter 1
Market Share Survey Overview

Each year, Dataquest surveys CAD/CAM/CAE/GIS vendors in order to estimate their annual revenue. The survey for 1995 covers 300 vendors worldwide by six main applications segments, four operating systems groups, four world regions, European and Asian countries, hardware, software, services, and distribution channels. This exercise provides input for Dataquest's dynamic database of CAD/CAM/CAE/GIS shipments/revenue by world region/country, operating systems, and applications segment. The information gained is supplemented by, and cross-checked with, Dataquest's other information sources.

The CAD/CAM/CAE market share survey takes place twice each year. The first survey in the fourth quarter is to prepare early estimates for the calendar year. This is followed by a second survey in the spring in order to finalize estimates for the previous calendar year. The first survey takes place from October to December. Our preliminary estimates are completed by the end of the calendar year under review, and the results are summarized in a fax report that is released in January of the following year and published in a Source: Dataquest document by January 31.

The second survey takes place during April. Our final CAD/CAM/CAE/GIS market share estimates are again published in a Source: Dataquest document by May 31. There is usually minimal difference between early and final rankings, as Dataquest makes every effort to ensure preliminary estimates are as accurate as possible. However, there are usually some surprises at year-end, and our numbers do change. It should also be noted that when new information becomes available concerning a previous year's numbers, the database is updated to reflect the best information available.

The categories for which CAD/CAM/CAE/GIS revenue is reported are defined comprehensively for the purpose of clarity and guidance to survey participants. These definitions may occasionally be revised, altered, or expanded to reflect changes in the industry. To support these definitions, Dataquest will send an annual survey guide to all participants in its CAD/CAM/CAE/GIS market share survey program. This document comprises the 1995 survey guide.

Methodology

Dataquest utilizes both primary and secondary sources to produce market share data. In addition to the annual market share survey, Dataquest uses the following sources in order to accurately quantify market activity:

- Information published by major industry participants
- Estimates made by knowledgeable and reliable industry spokespersons
- Government data or trade association data
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users

- Relevant economic data
- Information and data from online or CD-ROM data banks
- Articles in both the general and trade press
- Reports from financial analysts
- Annual reports, Securities and Exchange Commission documents, credit reports
- Reseller and supplier reports and reports from a vendor's competitors
- User studies

Dataquest also sums vendor revenue across other industries covered by Dataquest to make sure revenue is not credited twice, and checks with multiple sources at one company to cross-check data on that company.

Dataquest analysts have many years of experience in how to apply the tools described to get the most accurate information possible on a particular company (such as what to use when, and what industry averages are). It is the CAD/CAM/CAE/GIS group's policy to continually update our market information for any year, based on any new data received, in order to arrive at the most accurate market representation possible.

We survey worldwide, which involves more vendors and therefore presents higher total market revenue, lower market share per vendor, and a more accurate overall market picture.

Despite the care taken in gathering, analyzing, and categorizing the data in a meaningful way, careful attention must be paid to the definitions and assumptions used herein when interpreting the estimates presented in this document. Various companies, government agencies, and trade associations may use slightly different definitions of product categories and regional groupings, or they may include different companies in their summaries. These differences should be kept in mind when making comparisons between data provided by Dataquest and data provided by other suppliers.

Chapter 2
CAD/CAM/CAE/GIS Companies to Be Surveyed Worldwide for 1995

Dataquest will survey the following CAD/CAM/CAE/GIS companies throughout the world for 1995 data.

The North American Companies

- 3Soft
- Accel Technologies
- Accugraph
- ACTEL
- Adina R&D
- ADRA Systems
- ael Advance Graphics Systems
- ALDEC
- Algor Interactive Systems
- Alias Research
- Altair Computing
- Altera
- Analogy
- Ansoft
- Ansys
- Applicon
- Aptix
- Ashlar
- Aspec Technology
- Aspect Development
- Aspen Technology
- AT&T Bell Laboratories
- Auto-Trol
- Autodesk
- Autometric
- Avant!
- B.A. Intelligence Networks
- Bentley Systems
- Boothroyd Dewhurst

- CAD WORKS
- Cadence
- Cadis Software
- CADKEY
- CADSI
- CAE Plus
- CAMAX
- Carrier Corporation
- Cascade Design Automation
- CGTech
- Chronology
- Chrysalis Symbolic Design
- Cimlinc
- Cimplex
- Claritas/NPDC
- CMstat
- CNC Software
- Compact Software
- COMPASS Design Automation
- Computer Aided Design Software
- Computervision
- Concentra
- Contec Microelectronics
- Cooper & Chyan Technology
- CrossCheck Technology
- CSAR Corporation
- Data I/O
- Database Applications Inc.
- Deneb Robotics
- Design Acceleration
- Digital Equipment Corporation
- DP Technology
- Dynamic Graphics
- EA Systems
- Eagle Design Automation
- Eagle Point

- Earth Resource Mapping
- EDS-Unigraphics
- Enghouse Systems Ltd. (Canada)
- Engineered Software
- Engineering Mechanics Research
- EOSTAT
- EPIC Design Technology
- Equifax/NDS
- ERDAS
- Escalade
- ESRI
- ETAK
- Evolution Computing
- Fintronic
- Formtek
- Frontline Design Automation
- Genasys II
- Geo/SQL
- Geographic Data Technology
- Geomax International
- Gibbs and Associates
- Graftek Inc.
- GRAPHSOFT
- Harris EDA
- Hewlett-Packard
- Hibbit, Karlsson & Sorensen
- High Level Design Systems
- i-Logix Inc.
- IBM
- Ikos Systems
- IMSI
- Information Handling Services
- Intergraph
- InterHDL
- International Software Systems
- Intusoft

- ISICAD
- Landmark Graphics
- Livermore Software Technologies
- LSI Logic
- LV Software
- MacNeal-Schwendler Corporation
- Macon
- MapInfo
- MARC
- MCS
- Mechanical Dynamics
- Mentor Graphics
- Meta-Software
- Micrografx
- Microsim
- Minc Software
- Motorola
- Nextwave Design Automation
- NovaSoft Systems
- OEA International
- Optem Engineering
- Orcad
- Pacific Numerics
- PacSoft
- PADS Software
- Parametric Technology
- PCI Remote Sensing Corporation
- PRC
- Protel Technology
- Quantic Laboratories
- Quickturn Systems
- Radian Corporation
- Rebis
- Research Engineers—Civilsoft
- Royal Digital Centers
- Scientific & Engineering SW

- SDRC
- Sherpa Corporation
- SHL Systemhouse
- Sigma Design
- Silicon Graphics
- Silicon Valley Research Inst.
- SIMUCAD
- Simulation Technology
- Softdesk
- Spatial Technology Inc.
- Speed
- SpeedSim
- Spot Image
- SRAC
- Strategic Mapping
- Summitt Design Inc.
- Sun Microsystems
- Surfware
- Sweet's Electronic Publishing
- Synopsys
- Synplicity
- Systems Science
- T D Technology
- Tactician Corporation
- Tanner Research
- Terr-Mar Resource Information Systems
- Terra Sciences
- TYDAC Technologies Inc.
- Unicad
- Unisys Corporation
- Variation System Analysis
- Veritools
- Viagrafix
- Viewlogic Systems
- VISTA Environmental Inf.
- VLSI Libraries

- VLSI Technologies
- Workgroup Technology
- Xilinx
- Zeelan Technology
- Zycad

The European Companies

- ABB Industria
- Abstract Hardware
- ACA Ltd.
- ALS Design
- Anilam Electronics
- APIC Systemes
- ARKTEC SA
- ASCAD/ASCAM
- Assigraph
- CAD Centre Ltd
- CAD Lab S.p.A.
- Cad-Distribution AG
- CAD-UL
- Cadtronic Computer Systeme
- CATALPA Groupe Missler
- Cimatron
- CIMTEK SA
- Cisigraph
- Clemessy Innovation SA
- Complansoft CAD GmbH
- Computational Mechanics
- Computer Services Consultants
- Dapco SA
- Dassault
- debis Systemhaus GmbH
- Delcam Systems International
- Eigner+Partner GmbH
- Elstree Computing Ltd
- Engineering Computer Services
- Exapt

- FHECOR
- Fides Industrielle Automation
- Framasoft
- Gable CAD Systems
- Geometria GIS Systems House
- Graphisoft Software Development
- Ground Modeling Systems Ltd.
- Han Dataport
- Hochtief
- ICEM Technologies
- ICL Finland OY
- IEZ CAD-Systeme GmbH
- Investronica SA
- ISD Software und Systeme GmbH
- ISDATA GmbH
- ISKA
- Kloeckner-Moeller GmbH
- Kockums Computer Systems AS
- Laser-Scan
- M.O.C.
- Marcus Computer Systeme
- Matra Datavision
- mb Programme
- Moss Systems Group
- Nemetschek Programmsystem GmbH
- Norlinvest Ltd Visionics
- Number One Systems
- PAFEC
- Pathtrace Engineering Systems
- Poppenhaeger Grips GmbH
- PROCAD GmbH und Co.KG
- Radan Computational Ltd.
- RIB/RZB
- RoboCAD Solutions Ltd.
- Sagantec Europe BV
- Sener Ingenieria y Sistemas SA

- Serbi SA
- Siemens Nixdorf Informationssysteme
- Sinus Software GmbH
- Smallworldwide
- Soft-Tech Software Technologies
- Softronics
- Speed
- Star Infromatic
- Straessle AG
- Superdraft
- Sysdeco Innovation AS
- Tebis
- Technische Computer Systeme GmbH
- Triplan
- ULTImate Technology
- VEDA—Design Automation
- Vero International Software
- Whessoe Computing Systems
- Wiechers Datentechnik
- Ziegler Informatics

The Japanese Companies

- Andor
- ARGO Graphics
- C. Itoh Techno-Science
- Cadix
- Century Research Center
- CPU
- Design Automation
- Fujitsu
- Graphtec Engineering
- Hakuto
- Hitachi
- Hitachi Zosen Information Systems
- Information Services International Dentsu
- Informatix
- INS Engineering

- Kubota Computer
- Marubeni Hytech
- Mitsubishi Electric
- Mitsui Engineering
- Mutoh Industries
- NEC
- Nihon Itek
- Nihon Unisys
- Omron
- Pasco
- Ricoh
- Seiko Instruments
- Sharp System Products
- Sony
- Sophia Systems
- Sumisho Electronics
- Sumitomo Denko Workstation
- Tokyo Electron
- Toshiba
- Toyo Information Systems
- Uchida Yoko
- Wacom
- Zuken-Redac

Of the 302 companies to be surveyed, 179 are North American, 85 are European, and 38 are Japanese.

Chapter 3
Research Metrics

Definitions for the research metrics used in this survey are as follows:

- Total revenue with the original equipment manufacturer (OEM): The total amount of money received by a company for all goods and services sold into the CAD/CAM/CAE/GIS market. This figure is typically only released when requested.
- Distribution channels: Distribution channels are defined as follows:
  - Direct channel—The channel through which product moves directly from the manufacturer or vendor to the end user, usually by means of a professionally trained salesforce
  - OEM—The channel through which vendors or manufacturers sell their finished product to other companies for resale through an agreement. Once sold, the product is usually modified slightly and then resold directly to the end user or through an indirect channel. Vendors that resell nonbranded product differ from VARs in that they often add their name to the product and back up its warranties.
  - Indirect channels—All other channels through which the finished product moves to the end user, including VARs, dealers, and mass merchandisers
- Turnkey: Bundling hardware and software for sale as a unit
- Total factory revenue: Money received by a company for its goods, excluding OEM revenue or consulting revenue
- Hardware revenue: Revenue derived from the sales of CPUs (including operating systems), terminals (for host-dependent systems), and peripherals
- Software revenue: Revenue derived from the sales of bundled (part of a turnkey system) and applications software. It does not include operating systems revenue, which is part of the hardware revenue.
- Service revenue: Revenue derived from the service and support of CAD/CAM/CAE/GIS systems. Service revenue can be calculated in the market share tables by subtracting hardware and software revenue from total factory revenue. Service revenue includes the following:
  - Applications development—Adding new functionality through design and development of new customized CAD/CAM/CAE/GIS software applications, or the modification, enhancement, or customization of existing software applications
  - Consulting—Including an assessment of a company's CAD/CAM/CAE/GIS business IT needs and formulation of a plan based on needs identification
  - Integration services—Planning, implementing, migrating, and integrating software products
  - Maintenance—Fees for hardware and software

    - Management and operations services—Includes help desk, education and training, disaster recovery, vaulting, facilities management, configuration management, and relocation services
    - Service bureau—Includes construction of database, data conversion, product design, analysis, or manufacturing

- Seats: The number of possible simultaneous users
- Unit shipments: The number of seats delivered, excluding those sold to another company for resale (OEM). CPU shipments are defined as the number of CPUs delivered, which is the same as unit shipments for all platforms but host-dependent platforms.
- Average selling price (ASP): The average amount of money received by the factory for the sale of a turnkey/hardware system. The database forces reconciliation of a company's revenue and unit shipments with the average selling prices of each application and platform.
- Installed base: The total number of seats/CPUs in use, calculated by forecasting the previous year's installed base plus the year's unit/CPU shipments, less retirements.
- Compound annual growth rate (CAGR): A computed, compounded growth rate used in forecasting

Chapter 4
Worldwide Geographic Region Definitions and Exchange Rates

Dataquest divides the different geographic regions as follows:

- North America: Includes Canada, Mexico, Puerto Rico, and the United States
- Europe
  - Western Europe: Includes Austria, Benelux (Belgium, the Netherlands, Luxembourg), France, Germany (including former East Germany), Italy, Scandinavia (Denmark, Finland, Norway, Sweden), Switzerland, the United Kingdom, and the Rest of Western Europe (Andorra, Cyprus, Gibraltar, Iceland, Liechtenstein, Malta, Monaco, San Marino, Spain, Sweden, Turkey, Vatican City, and others)
  - Eastern Europe: Includes all countries currently categorized as Central Europe in addition to Albania, Bulgaria, the Czech Republic and Slovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and the republics of the former Yugoslavia. Also included in this group is Russia and the other republics of the former Soviet Union (Belarus, Ukraine, Georgia, Moldova, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan)
- Japan
- Asia/Pacific: Includes Hong Kong, Korea, Singapore, Taiwan, and Rest of Asia (Australia, Brunei, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam)
- Rest of World: Includes Africa, Central America, the Caribbean, the Middle East, Oceania, and South America

When converting a company's local currency sales into U.S. dollars, or vice versa, it is important to use the 1995 exchange rates provided below (see Table 4-1). These rates will prevent inconsistencies in the conversion of offshore sales between each company. These are the exchange rates that will be used in the final 1995 CAD/CAM/CAE and GIS market share survey. Exchange rates for historical years are available on request.

Table 4-1
Average 1994 and 1995 Exchange Rates against the U.S. Dollar

Country	1994 Rate	1995 Rate
Austria (Schilling)	11.33	10.06
Belgium (Franc)	33.36	29.42
China (Renminbi)	8.68	8.35
Denmark (Krone)	6.31	5.59
ECU	0.84	0.77
Finland (Markka)	5.21	4.37
France (Franc)	5.54	4.97
Germany (Mark)	1.62	1.43
Hong Kong (Dollar)	7.73	7.74
Italy (Lira)	1,609.19	1,628.21
Japan (Yen)	101.81	93.90
Netherlands (Gulden)	1.81	1.60
Norway (Krone)	7.04	6.33
Singapore (Dollar)	1.52	1.43
South Korea (Won)	802.40	770.57
Spain (Peseta)	133.48	124.40
Sweden (Krona)	7.7	7.14
Switzerland (Franc)	1.37	1.18
Taiwan (Dollar)	26.46	26.48
United Kingdom (Pound)	0.65	0.63

Note: The annual rate is estimated as the arithmetic mean of the 12 monthly rates.
Source: Dataquest (February 1996)

Chapter 5

CAD/CAM/CAE/GIS Operating Systems Group Definitions

Dataquest segments CAD/CAM/CAE/GIS data by four main operating system groups. These groups are as follows:

- UNIX—UNIX is a 32-bit, multitasking, multiuser operating system, originally developed at AT&T Bell Laboratories. It is portable and can be found on most CISC and RISC MPUs, including the Intel 80xxx, Motorola 68xxx, and Sun SPARC. UNIX includes all UNIX variants. A complete list of UNIX operating systems can be found in Chapter 8.
- Host-dependent systems—These systems include all minicomputer and mainframe operating systems in which the functions of external workstations are dependent on a host computer. The dominant operating systems in this group are IBM's VM and Digital Equipment's VMS operating systems.
- Windows NT—Windows NT is Microsoft's multiplatform, 32-bit operating system (either Windows NT or Windows NT Advanced Server) for high-end PCs, servers, and workstations.
- Personal computer (PC)—This group includes MS-DOS, PC-DOS, or DR-DOS operating systems. MS-DOS was designed by Microsoft for the original IBM PC. It is the dominant operating system on PC and PC-clone computing systems. PC-DOS is IBM's version of the disk operating system for PC and PC clones. DR-DOS is the Digital Research (Novell) version of this operating system. Other proprietary DOS variants such as NEC-DOS and J-DOS are included in this category.
- Also in the personal computer group are Mac OS, OS/2, Windows 3.1, and Windows 95. Mac OS is Apple's proprietary graphical user interface (GUI) operating system. OS/2 is IBM's GUI operating system for high-end PCs and PC servers. Windows 3.1 and Windows 95 are Microsoft's GUI operating systems for the PCs and PC clones. Windows 3.1 is a 16-bit operating system that runs on top of DOS. It is the dominant GUI operating system for PC and PC clones. Windows 95 is Microsoft's 32-bit version of Windows. Windows 95 is intended to replace Windows 3.1 and does not require a DOS foundation.

Chapter 6
CAD/CAM/CAE/GIS Software Applications Definitions

Dataquest segments data by application types. They are as follows:

- Mechanical—This segment refers to computer-aided tools used by engineers, designers, analysts, and drafters working predominantly in discrete manufacturing industries. Common design applications include conceptual design, industrial design, structural or thermal analysis, and detail design. Common manufacturing applications include tool and fixture design, numerical control part programming, and off-line robotics programming.
- Electronic design automation (EDA)—This segment covers computer-based tools that are used to automate the process of designing an electronic product, including printed circuit boards, ICs, and systems. EDA includes electronic CAE, IC layout, and PCB/hybrid/MCM, as follows:
  - Electronic computer-aided engineering (CAE)—These are computer-aided tools used in the engineering or design phase of electronic products (as opposed to the physical layout phase of the product). Examples of electronic CAE applications are schematic capture and simulation.
  - IC layout—This is a software applications tool that is used to create and validate the physical implementation of an integrated circuit (IC). The IC layout category comprises polygon editors, symbolic editors, placement and routing (gate array, cell, and block), design verification tools (DRC/ERC/logic-to-layout), compilers, and module development tools.
  - Printed circuit board (PCB)/hybrid/multichip module (MCM)—This segment covers products that are used to create the placement and routing of the traces and components laid out on a printed circuit board. Also included in this category are thermal analysis tools.
- Architecture, engineering, and construction (AEC)—This segment covers the use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and other people associated with these disciplines to aid in designing and managing buildings, industrial plants, ships, and other types of nondiscrete entities.
- Geographic information systems (GIS)/mapping—This is a computer-based technology, composed of hardware, software, and data used to capture, edit, display, and analyze spatial (tagged by location) information.

Chapter 7
CAD/CAM/CAE Subapplications Segmentation

Additional surveys are conducted to further segment the industry with software revenue sales by subapplication. The applications are divided as follows:

Mechanical

Modeling Technology

The modeling technology applications are as follows:

- Solid modeling—The representation of a part or assembly capturing all relevant data describing solid characteristics of a project. This can include shape, weight, color, surface texture, and mass properties. Boolean operations are commonly used to add and subtract volumes together to define the final shape of the object.
- 2-D modeling—The representation of a part in two dimensions (it has an x and y coordinate). This format requires three or more views (top, front, and side) to depict all aspects of the part. 2-D is the most common geometric modeling format and is used extensively with a drafting function.
- 3-D modeling—The representation of a part in three dimensions, usually in a wire-frame format (it has an x, y, and z coordinate). This format is commonly used in high-level CAD systems to determine the placement and fit of components in an assembly. It is generally not used for final drafting, although some systems have the capability to translate the 3-D image to a 2-D standard drafting format.
- Integrated—The integration of all 3 modeling technologies

Mechanical CAD/CAM/CAE Subapplication

The mechanical CAD/CAM/CAE subapplications are as follows:

- Conceptual design
  - Industrial design—A process that provides a common environment for the entire conceptual design process, including painting, modeling, rendering, and visualization
  - Design layout—An initial design process in which the major components and part interfaces are defined
  - Styling—A detailed design process in which aesthetic considerations are foremost in importance
- Functional design
  - Component design—Design of the individual components in an assembly
  - Assembly verification—Integration of components' designs into an assembly to test the size/shape and function characteristics

- Linkage/mechanism—An assembly of components with two or more movable parts, usually providing some means of power, control, or fastening application
- Analysis—The analysis of a physical system, part, or assembly; includes structural, thermal, vibrational, composite, fatigue, stack-up, mass property, and quality-control analysis

■ Drafting and documentation

- Detail drafting—Representation of a part in standard geometric drafting format, including all part geometry dimensions and notations describing mechanical/structural, functional, and material characteristics
- Schematic/detailed diagrams—Schematics used to describe hydraulic and pneumatic systems
- Technical illustration—Drawing of a component or assembly that is generally intended for publication

■ Manufacturing engineering

- Tool design—The design of custom-made tooling to facilitate a manufacturing process
- Fixture design—The design of structural aids that hold the component or assembly during the manufacturing process
- Part processing design—The design of a series of manufacturing processes

■ Manufacturing process simulation

- Numerical control part programming—The programming of a numerical control machine tool or automated processing system
- Coordinating measuring machines—The programming of machines used to measure the physical dimensions of a part
- Offline robotics—A process simulation that graphically represents the sequence of steps to program a robot for a particular operation and downloads data to a robot to update its control program

■ System management and other tools

- Product data management (PDM)—Software typically used in an engineering or manufacturing environment to manage product data. Characteristics of PDM systems include product/structure management, workflow, and vault/document management capabilities.
- Engineering data management—Software with vault management capabilities and limited workflow capabilities designed for use within an engineering environment
- Component information systems—Software used to navigate within and manage a repository of engineering parts and associated data
- Knowledge-based engineering tools—Tools used to capture design intent and build standard practices for controlling, modifying, and automating design and manufacturing activities. Also known as rule-based engineering.

- Applications development environments—Programming tools to aid in the generation of user-defined programs that drive or interface with CAD/CAM/CAE.

EDA

For the past few years, Dataquest has subdivided the electronic CAE market in an entirely new way. The subdivisions are based on design methodologies such as gate-level design, register transfer (RT)-level design, and electronic system (ES)-level design.

Under the methodology, a design is first entered and simulated, usually at the RT level. It is then synthesized or compiled down to the level below it. This process continues (simulation and synthesis) until the design is placed and routed at the physical design level, at which point timing information is extracted from the physical design. At this point, the verification process begins.

For verification, the process flows in an upward direction. From the physical design level, timing information is extracted, and design rule checkers and logic rule checkers are used to ensure a correct design at the physical level. Verification continues in this upward fashion until the level at which the design process originally began is reached. The electronic design automation subapplications are as follows:

CAE

The CAE subapplications are as follows:

- ES level
  - ES-level design—Design at the conceptual level, including hardware/software co-design, design partitioning, and specification; it includes neither RT- nor logic-level descriptions.
  - Behavioral simulation—Nontiming-based simulation
  - Behavioral synthesis—Synthesis of an ES-level design description to the RT level
  - Formal verification—The process of mathematically proving that an RT-level description equates to an ES-level description (or less specifically, that any design representation equates to another)
- RT level
  - RT-level design—Tools designed to assist engineers in entering a design or analyzing the simulated results of that design. This includes the use of graphical symbols to represent RT-level VHDL or Verilog.
  - RT-level simulation—Simulation at the RT level
    - VHDL—Simulation using the VHSIC Hardware Description Language
    - Verilog—Simulation using the Verilog Hardware Description Language

- Logic synthesis—Synthesis or translation of an RT-level description to a gate-level description
- Target compiler—A translation of an RT-level description to the silicon implementation
- Timing analysis—Verification of the timing of a design; the process usually involves providing inputs to a physical circuit model or computer simulation to test the nondynamic functions of a design; static-timing verification does not require the use of test vectors to determine timing violations.
- Design for test tools—Tools used to determine, improve, or add to the testability of electronic circuits
- Silicon synthesis—Tools that estimate silicon-level performance at the RT-level by synthesizing the RT-level description to a virtual silicon implementation of that code and reflecting the estimated silicon performance back up to the RT level
- PCB synthesis—A process similar to silicon synthesis but without using synthesis technology. PCB synthesis uses a virtual representation of the PCB to estimate physical effects, bringing those effects back up to the CAE level of design.

- Gate level
  - Schematic capture—A design process that consists of graphical schematic entry and net-list extraction
  - Simulation—The use of representative or artificial data to reproduce conditions in a model that could occur in the performance of a system. Simulation is used to test the behavior of a system under different operating conditions.
    - Gate-level simulation—Simulation based upon a gate-level netlist (not VHDL or Verilog)
    - Analog simulation—Simulation in which both digital and analog inputs are used
    - Mixed-signal simulation—Simulation in which both digital and analog inputs are used
    - SPICE simulation—Simulation using a derivative of the Berkeley SPICE transistor-level simulator
  - Analysis tools—Tools used for the analysis of designs
    - Signal analysis (including transmission line and cross-talk analysis)—Analysis of high-speed coupling effects between signal line and reflection/degradation of the high-speed signal on PCBs, MCMs, or ICs
    - Power analysis—Analysis of the power consumption of PCBs, ICs, MCMs, and systems
    - Electromagnetic interference—Analysis of electromagnetic generation and interference for PCBs, ICs, and cables/connectors/packaging

    - Metal migration or electromigration—The unauthorized movement of metal in an IC because of excessive current density

- Miscellaneous
  - Accelerators—Dedicated hardware/software or optimized software used to speed up simulation, typically at the gate level
  - Emulators—Dedicated hardware/software that allows a designer to observe the function of a circuit or design prior to prototype
  - Fault simulation/grading—A process that determines which nodes in a design can be detected by a given set of test vectors
  - Interoperability tools—Software used for database, library, and tool management; they also include backplanes, file translators, and design environments (in general, all tools used specifically to integrate a set of EDA tools).
  - Libraries—Description of elements used in EDA designs (for example, components, simulation models, and symbols)
  - Field-programmable gate array (FPGA) toolset—Dedicated EDA software sold as a package for FPGA/complex-programmable logic device (CPLD) design
- IC CAD
  - DRC—The design rule and logic rule checkers used to perform final verification on an IC design prior to making masks
  - Floor planner—A tool that allows a designer to place elements of a design so that the designer can look at estimations of the effects of the final place and router.
  - FPGA place and route—Tools used to implement designs into the targeted FPGA or CPLD. These are also called "fitters" because they fit designs into the already existing logic structure of the targeted FPGA or CPLD.
  - IC place and route—Tools used to implement (lay out) designs into silicon
    - Gate array place and route—Tools used to lay out designs into a fixed-based array
    - Cell-based IC place and route—Tools used to lay out nonfixed, cell-based designs
    - Custom IC layout—Silicon design tools working at the transistor level. These tools can size transistors, accomplish analog design, and generally hand craft silicon implementation. Sometimes called "layout editors."
- PCB design
  - PCB design tools—Tools used to design, place, and route a PCB
  - MCM9 and hybrid design tools—Tools used to design, place, and route a multichip module or hybrid substrate

AEC/Architectural, Engineering, and Construction

The AEC, or architectural, engineering, and construction, subapplications are as follows:

- Architectural—Software used in the design and drafting of buildings and grounds
- Civil—Software for both site and structural engineering, typical for design and drafting of sites for buildings, roads, bridges, and airports and for the design of steel and concrete structures
- Facilities design/management—Software used to lay out, inventory, and manage assets such as personnel space, equipment, and utilities within a building or geographic service area
- Process plant design—Software used in design, analysis, drafting, and management of process, power, and manufacturing plants as well as ships

GIS/Mapping Software

GIS/Mapping Software is used to capture, edit, display, and analyze spatial (tagged by location) information. It can be categorized as follows:

- Base data—Software used to create baseline geographic data
  - Photogrammetry and surveying—Software used in developing original data for a GIS system based on ground surveying or on remotely sensed data. Examples include aerial photography or satellite imagery.
  - Data for resale—Includes both GIS software used to create data for resale to end users and revenue from the sale of geographic data
- Land information—Software used to gather and manage land data
  - Land records—GIS software used to manage land ownership or parcel information; the typical user is a tax assessor.
  - Planning and land use—GIS software used to manage land use; the typical user is a city planner.
- Biological—Software used to manage and analyze plant and animal life
  - Environmental public health and safety—GIS software used to manage natural resources and to monitor and analyze environmental factors that contribute to the welfare of the earth and its people
  - Forestry and agriculture—GIS software used for the management of forests and crops
- Geoscience (formerly energy exploration)—GIS software used to manage oil, gas, and mineral exploration projects. The emphasis of geoscience is typically on subsurface data.
- Infrastructure management—Management and analysis of man-made assets (not including utilities)
  - Transportation and logistics—GIS software used in transportation applications such as road or rail network modeling or route planning

- Emergency and dispatch services—GIS software used to manage emergency services such as "911" services and also for-profit dispatch management systems

- Automated mapping/facility management—GIS software used for managing utility industry networks, based on the following categories:
  - Telecommunications/telephone
  - Electric
  - Water and waste water
  - Other utilities (primarily gas)
- Business marketing and sales—GIS software used to promote and sell services and products, and to identify and evaluate opportunities in a competitive environment.
  - Demographic and location analysis—GIS software used to analyze problems in demographics or site characteristics. Examples include sales territory selection, site selection, or population analysis. Typical users are in advertising, marketing, insurance, banking, and real estate.
  - Sales and directional support—GIS software used to help salespeople locate targets of a sales effort (for example, to locate potential customers, specific properties for sale and driving routes to the properties). This also includes software used to help customers locate establishments, typically used as travelers' aids.
- Geopolitics—The sum of software used in defense/military and political districting applications
  - Defense/military—GIS software used to manage military or defense projects for the purpose of command and control
  - Political districting—GIS software used to manage the redistricting process based on census data
- Cartography—GIS software used in mapmaking applications

Chapter 8
CAD/CAM/CAE/GIS Operating System and Industry Segmentation

Additional surveys segment the software revenue by operating systems and by industry, providing yet another look at the CAD/CAM/CAE/GIS software market. These segments are as follows:

Operating Systems

- Apollo AEGIS
- Apple AUX
- Apple Macintosh/OS
- AT&T Systems V Derivatives
- CDC CYBER NOX/VE
- CONVEX UNIX
- CRAY UNIX
- Digital Equipment Corporation OSF
- Digital Equipment Corporation ULTRIX
- Digital Equipment Corporation VMS
- DOMAIN/Apollo UNIX
- DOS
- DOS with Windows
- Hewlett-Packard UX
- Hitachi HI-UX/G (UNIX)
- IBM AIX
- IBM VM/VMS
- Intergraph UNIX
- MIPS UNIX
- NEC EWS-UX (UNIX)
- OS2
- Prime PRIMOS
- Siemens-Host/Proprietary
- Siemens-UNIX
- Silicon Graphics Inc. UNIX
- Solaris
- Sony NEWS-OS (UNIX)
- Sun—UNIX/OS

- Windows
- Windows NT
- XENIX/SCO UNIX
- Others—UNIX
- Others
- All Operating Systems

Industry Sectors

- Aerospace, guided missiles, and space vehicles
- Agriculture, forestry, and fishing
- Automotive, motorcycles, and bicycles
- Chemical, allied, and petroleum products
- Computers, office equipment, and computer peripherals
- Conservation management and waste management
- Construction, contractors, and building
- Consumer electronics (TV, VCR, and CD)
- Education
- Electrical/electronic equipment (power, appliances, test, and measurement)
- Fabricated metal products, except machinery and transportation
- Finance, insurance, and real estate
- Government: environment and public health resource
- Government: general, executive, public order, and taxation
- Government: national security (defense)
- Government: public works and engineering
- Industrial and commercial machinery (engines and heavy equipment)
- Industrial controls, robotics, and AGVs
- Manufacturing not elsewhere classified (textiles, furniture, and foundries)
- Medical manufacturing (instrument/x-ray)
- Mining
- Semiconductors
- Service companies (including architecture firms, engineering consulting firms, and design services firms)
- Shipbuilding, ship repairing, and developing offshore rigs
- Telecommunications and data communications (telephone, radio, television, and cable)
- Transportation (rail, public transit, and freight transport)

- Utilities and pipelines (electric, gas, sanitary services, and water)
- Others
- All industries

Results from these surveys and the subapplications' surveys are scheduled to be published in mid-1996.

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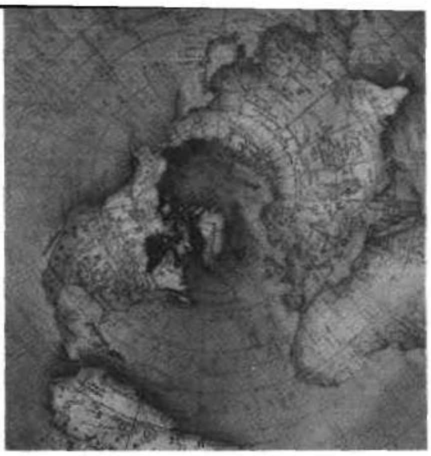

Dataquest

CAD/CAM/CAE Technology Today and Tomorrow—A User's Perspective

User Wants and Needs

Program: Mechanical Applications Worldwide
Product Code: CMEC-WW-UW-9501
Publication Date: February 5, 1996
Filing: User and Distribution Studies

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Chapter 1
Executive Summary

Introduction

Mechanical CAD/CAM/CAE is one of the more dynamic segments of the CAD industry. For mechanical CAD companies to be successful, they must have a thorough understanding of their target customer base. Each year, Dataquest's Mechanical CAD/CAM/CAE Worldwide program performs extensive surveys of mechanical designers and reports upon their shifting priorities, desires, and demands. The purpose behind Dataquest's User Wants and Needs studies is to provide our clients with the most in-depth, up-to-date information on the mechanical design community.

Study Objectives

This study provides an in-depth look at the users of mechanical CAD/CAM/CAE tools in Europe. The information presented here is the result of a mail survey of 309 designers, engineers, and CAD managers located throughout Europe.

The objectives of this study were as follows:

- To understand what trends are taking place in the mechanical design industries
- To investigate the design environment in which users work
- To examine end-user satisfaction with mechanical CAD/CAM/CAE tools
- To underscore some of the changes that will take place in the mechanical design market of the future

Dataquest Perspective

Our research of mechanical CAD/CAM/CAE end users provides us with an insightful look into their preferences and consumption patterns. Results from our survey indicate the following:

- Users are facing the point where they must decide whether to significantly expand their CAD/CAM/CAE systems. There is pent-up demand for more CAD systems, as users are working full-time on their existing systems and indicating potential for nearly a 60 percent increase in the number of CAD users at a site.
- Users are seeing the benefits of CAD/CAM/CAE technology, enabling them to solve more complex problems than two years ago.
- The mechanical design world is not all 3-D. There still exists, within the minds of some end users, the traditional impediments to adopting 3-D technology, including high cost and difficulty in learning and using 3-D systems.

- Users are piecing together their own systems. Fifty percent of survey respondents use more than one CAD vendor for their design work, and customization of CAD systems is being done at 75 percent of sites in our survey.
- Data translation is one of the hot buttons on the minds of designers and engineers. STEP is still not in widespread use (nor widely understood), and users, on the whole, are unhappy with their current data-translation packages.
- Overall, users plan to increase hardware, software, and service spending over 1995 levels. Product data management, conceptual design, and analysis software were frequently cited as the modules most likely to be purchased next.
- According to end users, Windows NT will make significant headway into the mechanical design community by 1999, at the expense of all other CAD operating systems. Adoption rates will vary significantly by country and industry.
- Vendors are closing the importance/satisfaction gap for CAD applications such as detailing, assembly design, and manufacturing applications.
- Software service and support remains one of the top issues in the minds of CAD/CAM/CAE users, with an importance/satisfaction gap much greater than 1.0.
- From the eyes of some end users, it is still too early to tell just what the benefits of product data management (PDM) are. Adoption rates for PDM will vary by country and industry. Much more end-user education and marketing needs to occur before PDM really takes off in Europe.

Structure of the Document

The remainder of this document is organized as follows:

- Chapter 2, "Study Foundations and Methodology," explains the research process employed by Dataquest in gathering the information and demographics of the respondents of this survey.
- Chapter 3, "Designers Today," characterizes the mechanical designer today and indicates what changes to expect in the future. We begin by examining the use of CAD/CAM/CAE within a company and the driving forces that play upon the daily lives of designers, including meeting market demands and reducing costs. We investigate 3-D design and the hindrances to its more widespread use, and we delve further into the STEP standard.
- Chapter 4, "The Designer's Environment," characterizes the environment in which the engineer works. We discuss hardware platforms, operating systems, and anticipated future spending for hardware, software, and service. We also investigate how quickly deployment of Windows NT operating system will take place in the mechanical design world.

- Chapter 5, "Mechanical Applications Perceptions," reveals how designers feel about their mechanical CAD/CAM/CAE tools. In particular, we investigate user-rated importance and satisfaction levels for a variety of CAD tools and identify the software improvements that designers most want.
- Chapter 6, "Product Data Management," takes an exclusive look at this fast-growing area. We characterize today's users of PDM tools, factors influencing PDM deployment, and potential for future growth.

Chapter 2
Study Foundations and Methodology

Survey Methodology

The survey questionnaire was developed by analysts from Dataquest's Mechanical CAD/CAM/CAE Worldwide program and comprised a total of 120 questions. The end-user data was gathered via a mail survey sent out in October 1995 by the leading mechanical CAD/CAM/CAE vendors in Europe on behalf of Dataquest. All major European vendors were invited to participate; however, one leading vendor declined participation. All survey responses were sent directly to Dataquest and not to the mechanical CAD vendors. When possible, the surveys were translated into that country's specific language. The results were entered into a statistical analysis package for analysis of the data. In total, 309 surveys were completed.

The specific respondent sample characteristics included the following:

- People involved in the decision-making process of new system purchases
- People who are currently or have been users of mechanical CAD/CAM/CAE tools
- People working in a major discrete manufacturing industry
- Employees in one of the major departments of potential use

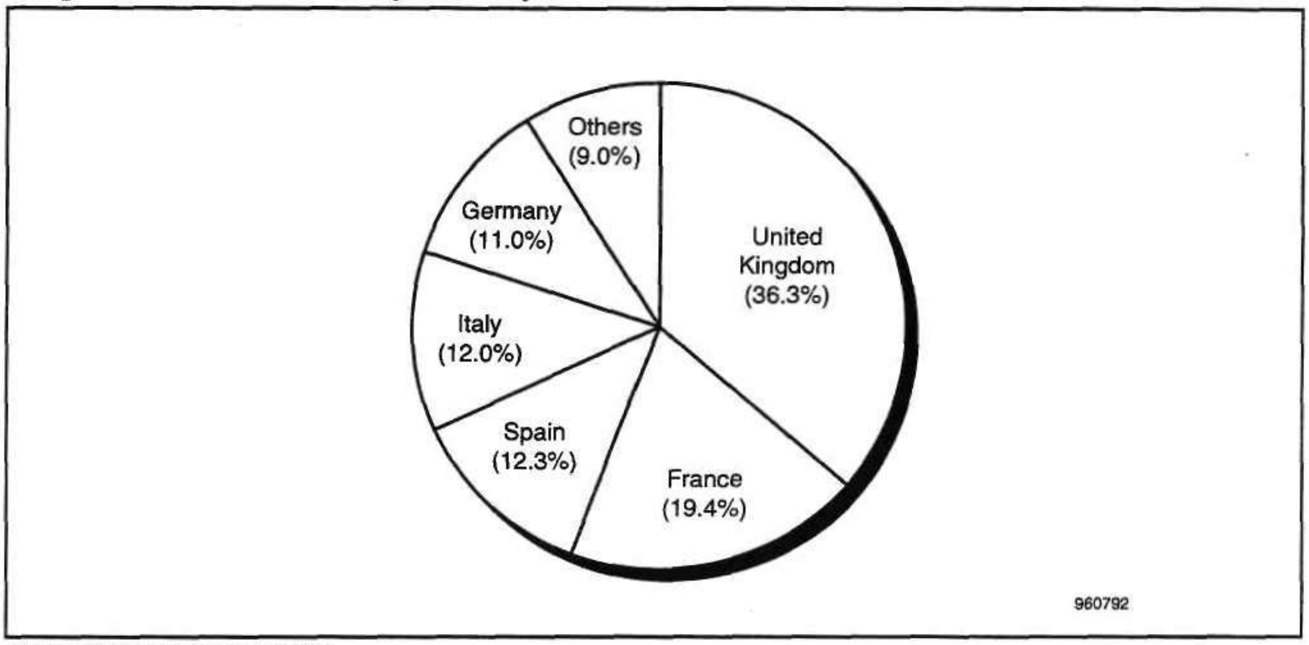
The survey results are presented in this report for the aggregate group. Any data point collected in the survey can form the basis of a cross-tabulation. Special cuts of the data (for example, by computer platform used or software package) are available to Dataquest's Mechanical CAD/CAM/CAE Worldwide program clients by special request. However, the identities of the end users surveyed are strictly confidential.

Respondent Demographics

Figure 2-1 indicates the country in which the respondent's office is located. Again, the total number of respondents to our survey was 309. The United Kingdom was the most widely represented country, followed by France, Spain, Italy, and Germany. The "others" category consists primarily of respondents from Austria, Finland, and Switzerland. Because of the small number of responses for some countries, the remainder of this report will not give individual country-level user-survey data for countries with fewer than 30 responses. Instead, this information will be grouped under the aggregate "others" category.

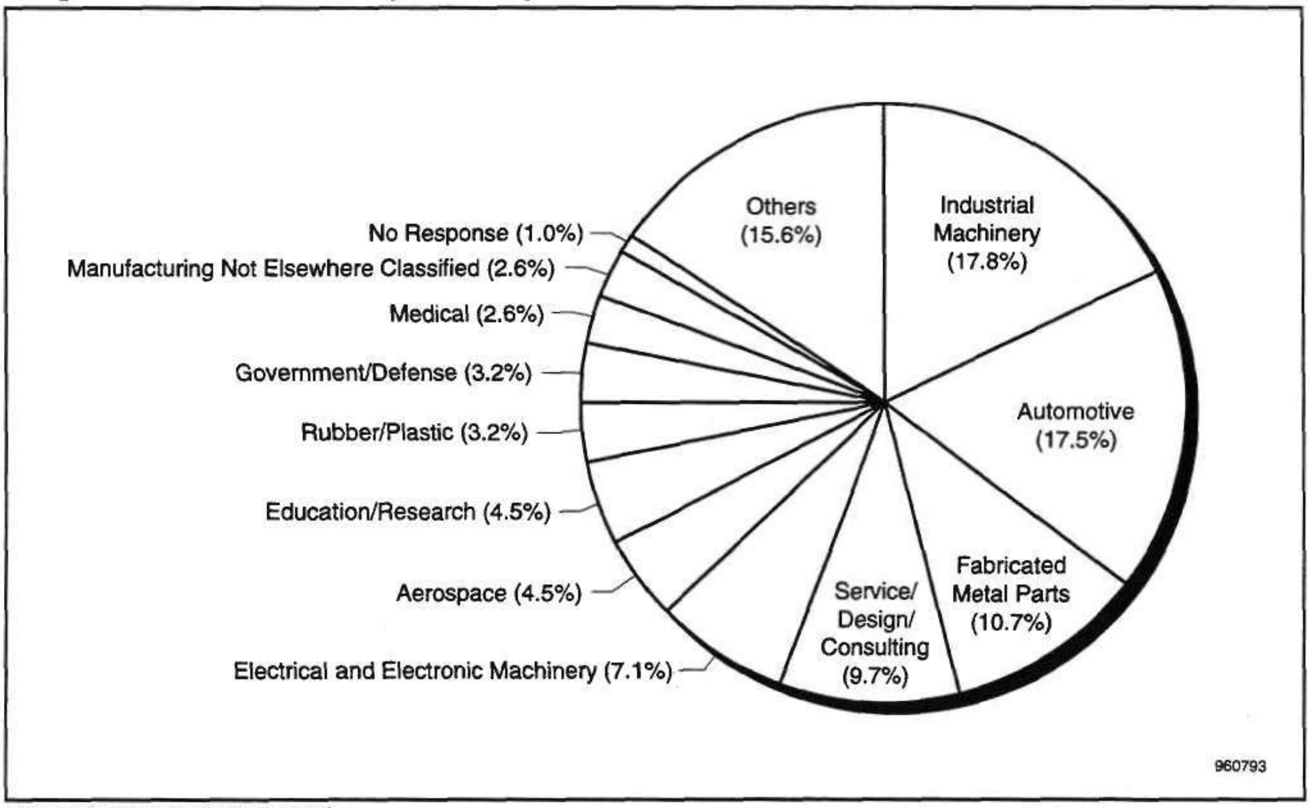
Figure 2-2 gives the respondent breakdown by industry. The data represents a wide cross section of prominent industries in Europe. The "others" category consists primarily of respondents in the computers and peripherals market and in telecommunications. Again, with the exception of Figure 2-2, we will not give industry-level end-user information for those industries with fewer than 22 respondents. Instead, this information will be grouped into the "others" category.

Figure 2-1
Respondent Breakdown by Country



Source: Dataquest (January 1996)

Figure 2-2
Respondent Breakdown by Industry

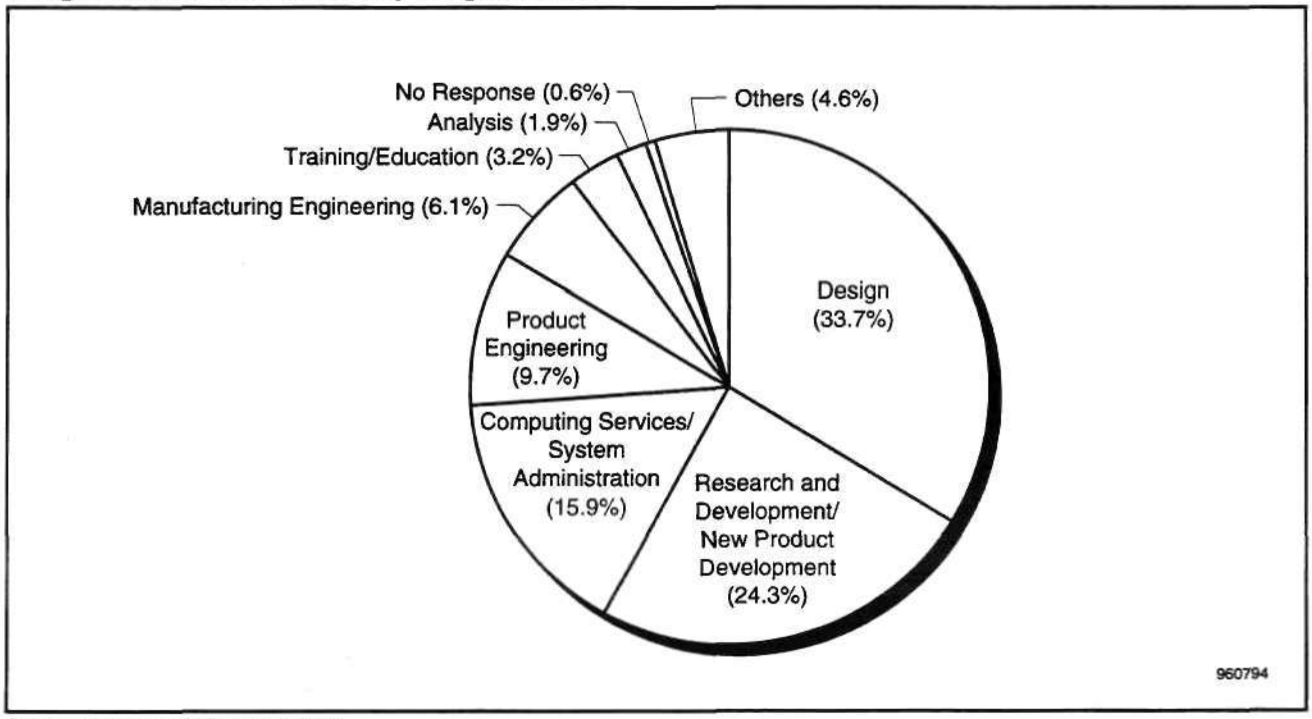


Source: Dataquest (January 1996)

Respondent breakdown by department is shown in Figure 2-3 and by job title in Figure 2-4. Our survey intentionally targeted those respondents in design, development, engineering, and computing services. We believed that workers in these departments would be most knowledgeable about CAD/CAM/CAE tools.

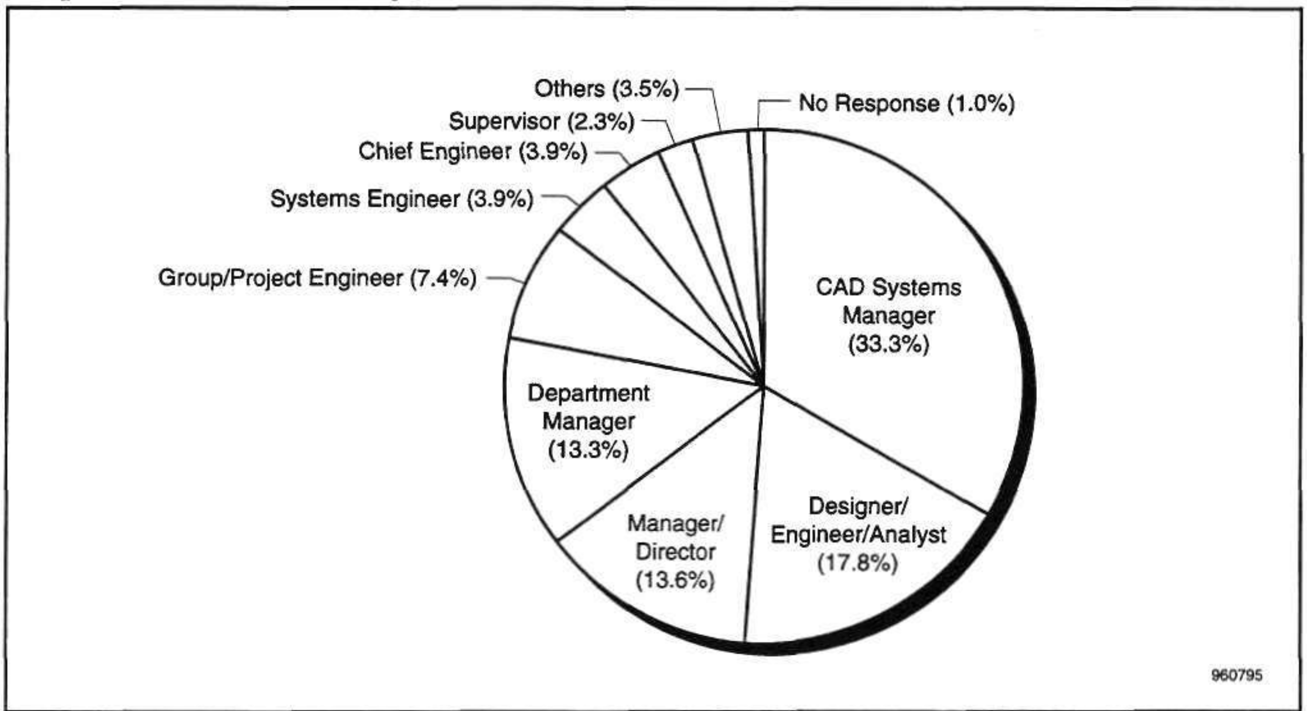
It is important to keep in mind that this survey was sent out by the mechanical CAD/CAM/CAE vendors in Europe on behalf of Dataquest. As we stated earlier, most of the leading European vendors participated in the survey. Figure 2-5 gives a breakdown by vendor of our survey responses. This information was gathered from the question, "Who do you consider to be your primary CAD/CAM/CAE vendor?" The results in Figure 2-5 are not meant to imply market share of CAD vendors in Europe but are shown in order to set a background for interpretation of the survey results.

Figure 2-3
Respondent Breakdown by Department



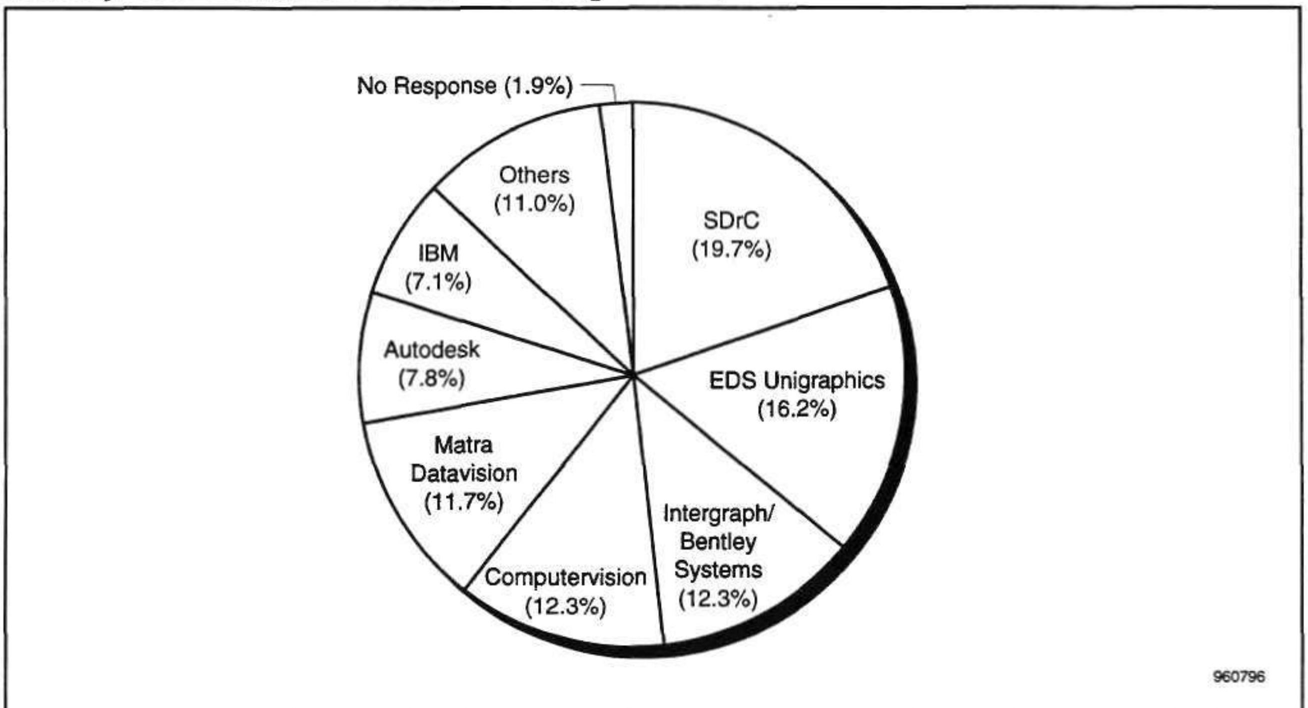
Source: Dataquest (January 1996)

Figure 2-4
Respondent Breakdown by Job Title



Source: Dataquest (January 1996)

Figure 2-5
Primary CAD/CAM/CAE Vendor of Respondents



Source: Dataquest (January 1996)

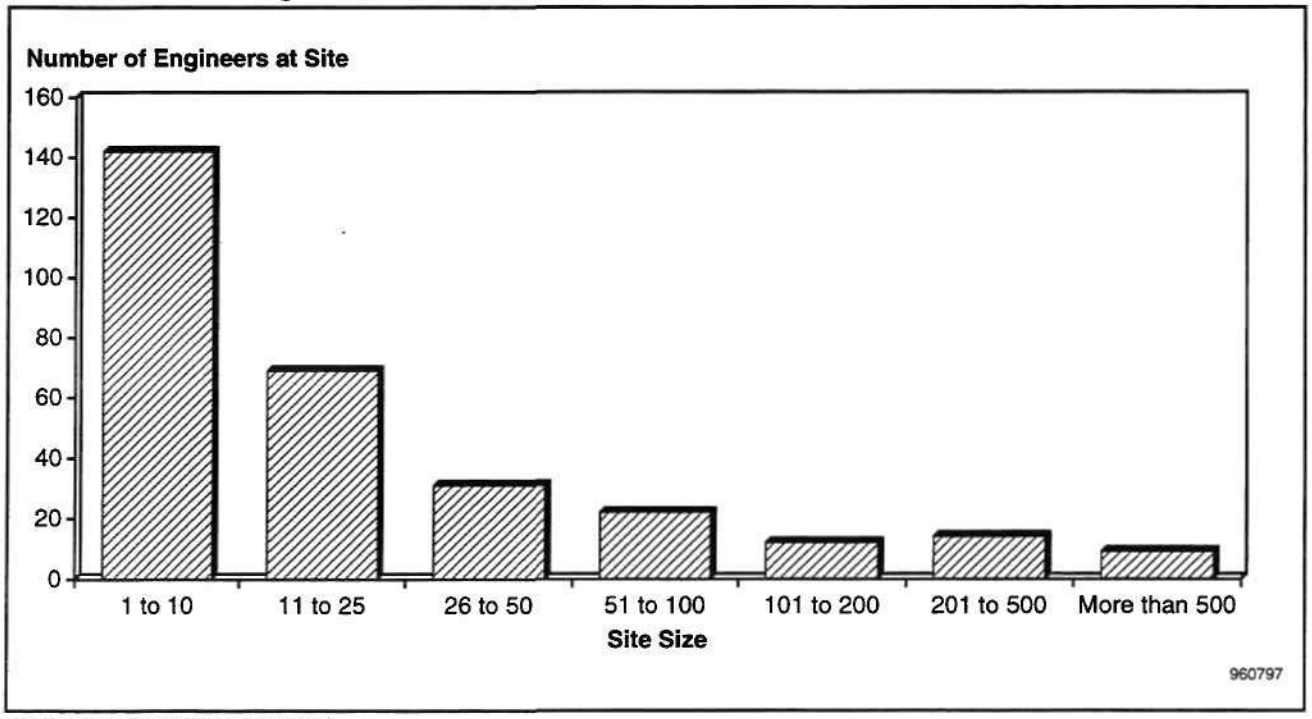
Chapter 3

CAD/CAM/CAE Technology Today—A User's Perspective

Use of CAD within the Company

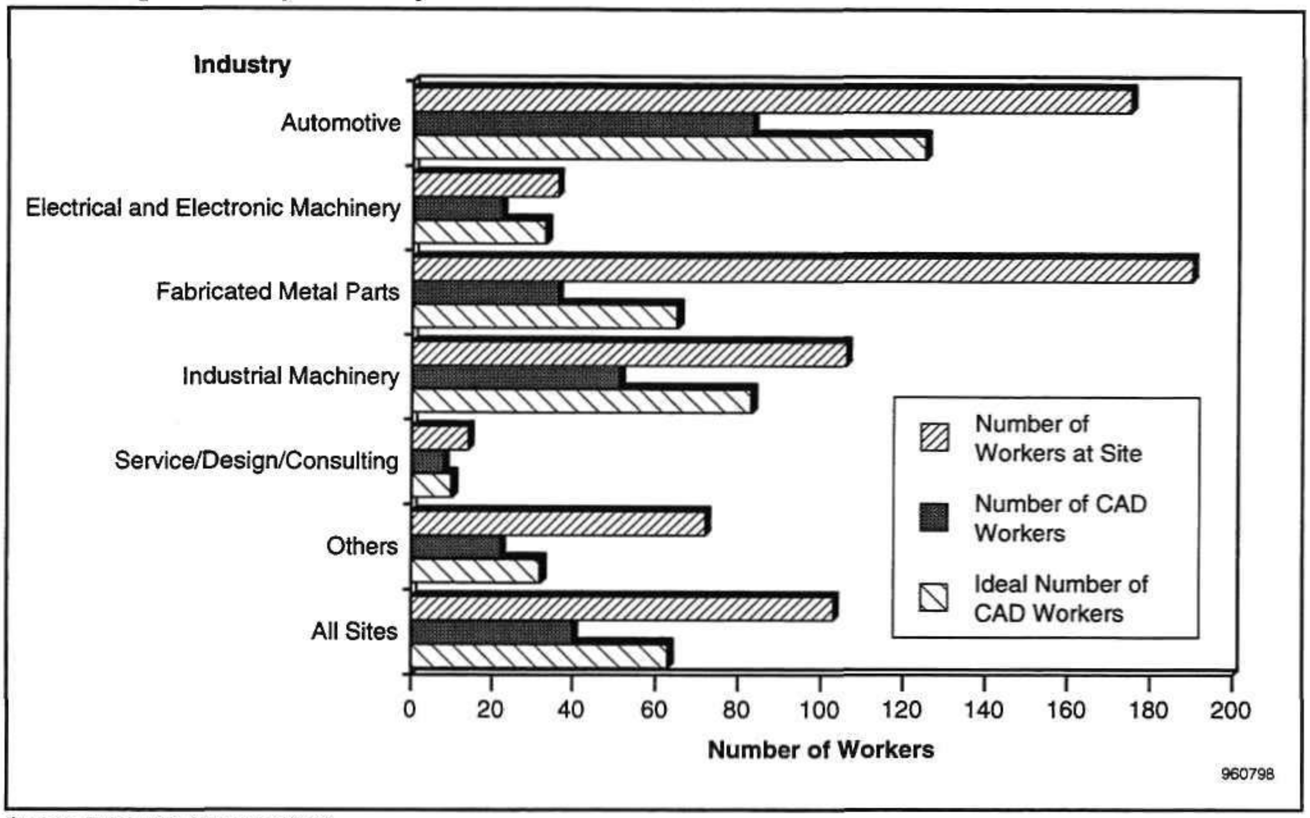
The number of engineers or designers on site at a given company ranged from one to 5000, with the average being 104 workers. The data was heavily weighted toward smaller sites; the median site size for all survey responses was 11 (see Figure 3-1). The number of engineers or designers actually working on a CAD system at a given site was 40. When asked how many engineers or designers would be at a given site under "ideal" circumstances, the average jumped up to 63. Figure 3-2 shows these averages by industry. Indeed, users desire significantly more CAD systems at their site, but as we shall see later in this document, they do not plan to significantly increase CAD spending. Respondents from the fabricated metal parts industry would like to see nearly a twofold increase in CAD workers while the number of workers in the service/design/consulting would show only a slight increase. Respondents reported nearly full-time use of their CAD systems. The average number of hours worked per week on a CAD system was about 39 hours for all respondents.

Figure 3-1
Distribution of Engineers at a Given Site



Source: Dataquest (January 1996)

Figure 3-2
Workers per Site by Industry



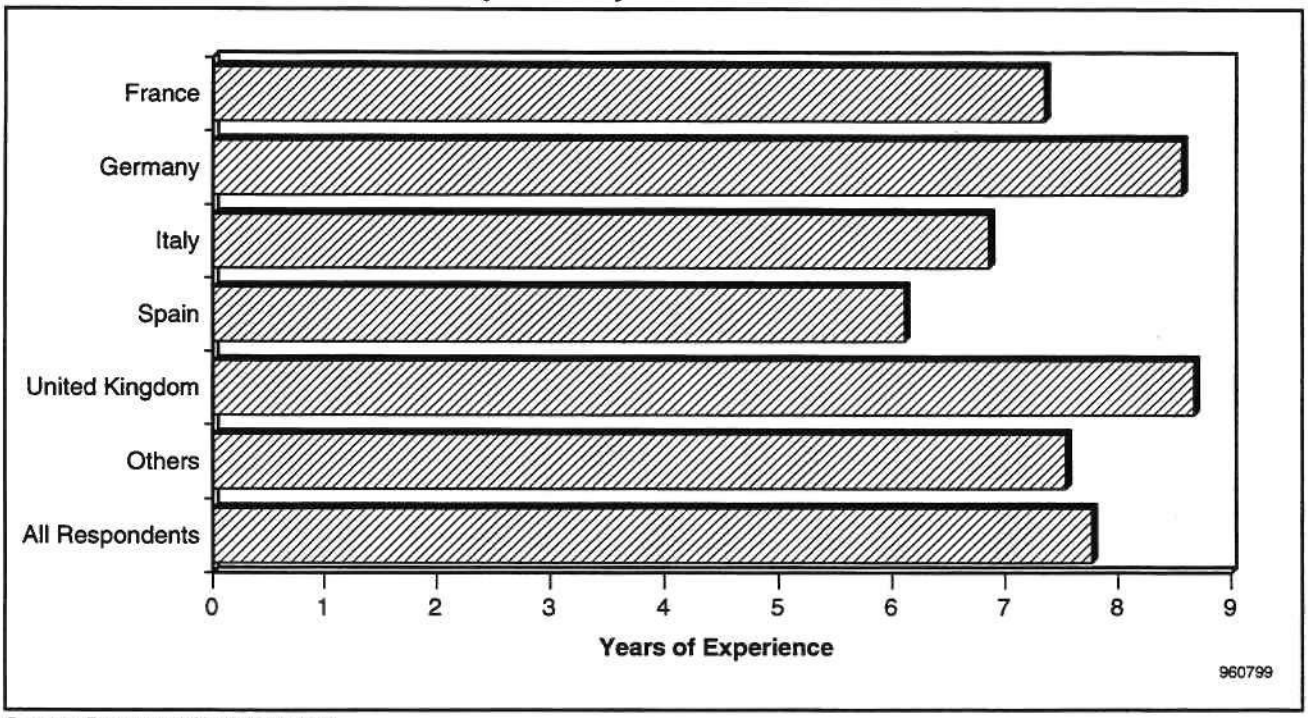
Source: Dataquest (January 1996)

Experience Base

The experience base of survey respondents was, on average, eight years. Only slight variation was seen by industry or by country, as indicated in Figure 3-3. The respondent group as a whole is well experienced with several years of hands-on use.

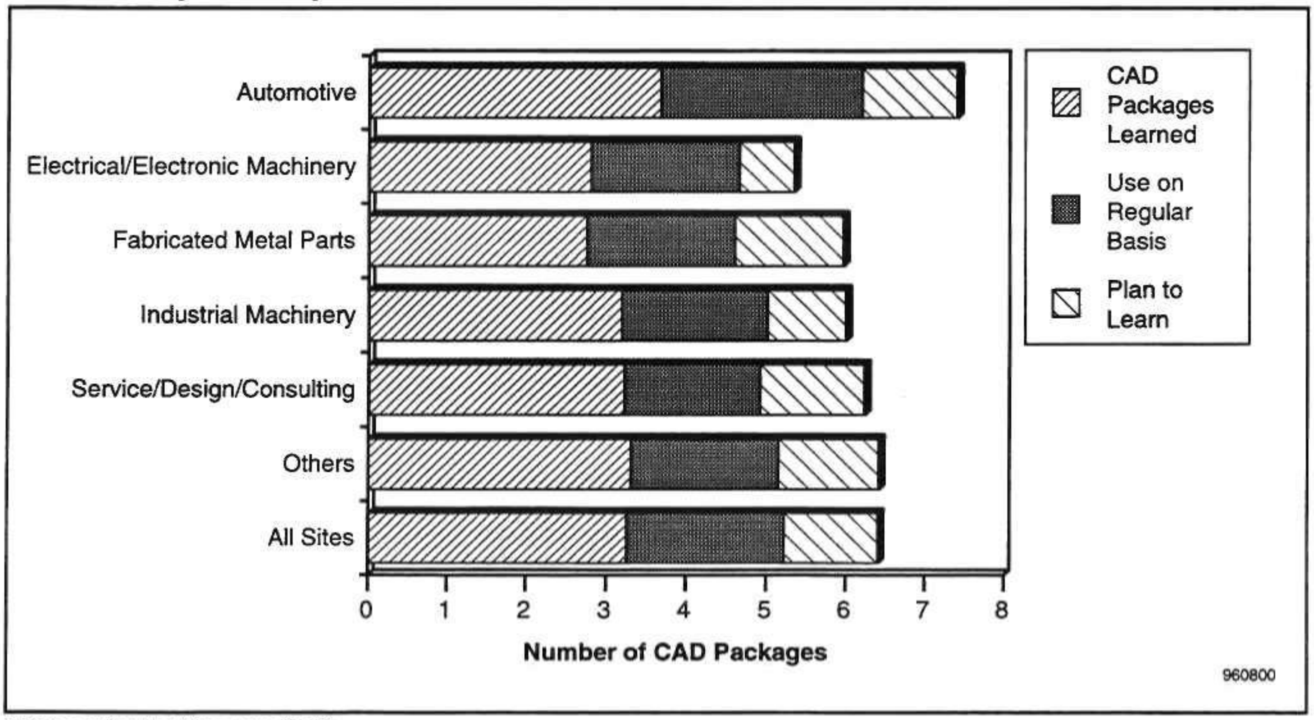
We asked respondents how many CAD packages they have learned, use on a regular basis, and plan to learn within the next two years. The results are shown by industry in Figure 3-4. The automotive users have learned and use regularly the greatest number of CAD packages. Those users in the fabricated metal parts industry expect to learn the greatest number of CAD packages over the next two years, followed closely by service/design/consulting bureaus.

Figure 3-3
Experience Base of CAD Users by Country



Source: Dataquest (January 1996)

Figure 3-4
CAD Use by Industry



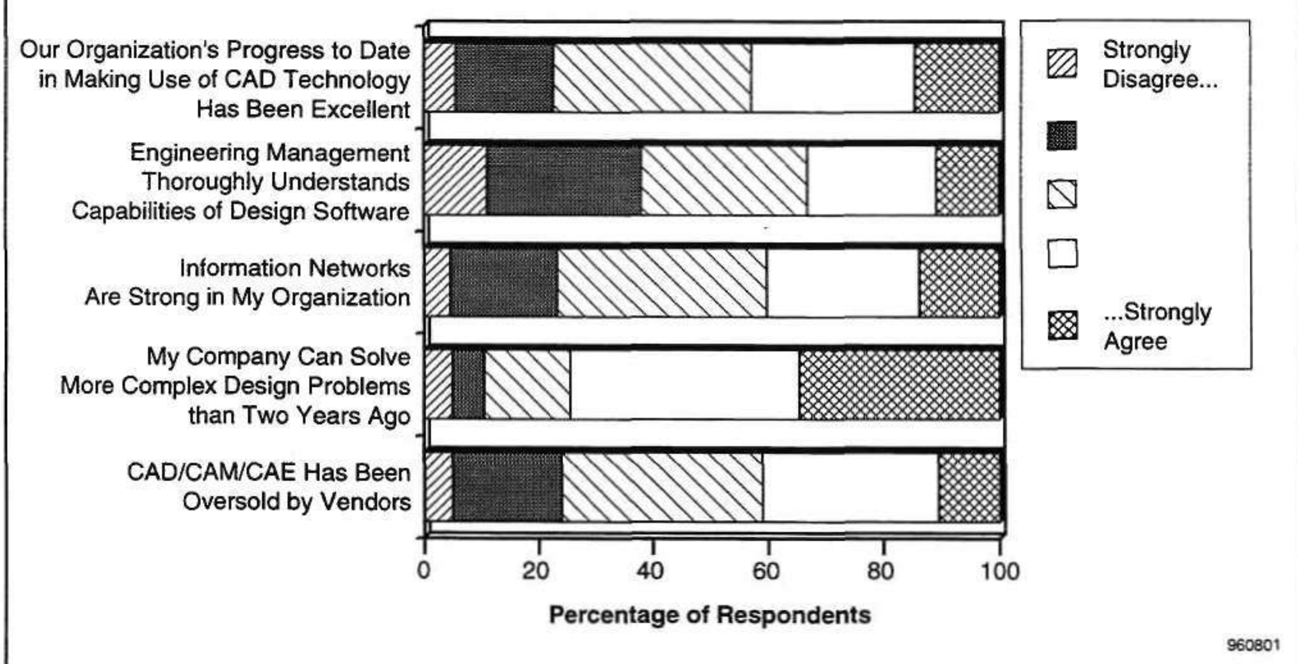
Source: Dataquest (January 1996)

User Expectations with CAD/CAM/CAE Technology

While CAD/CAM/CAE technology has promised many things to many users, we decided to investigate just what these benefits are and how well CAD/CAM/CAE is meeting user expectations.

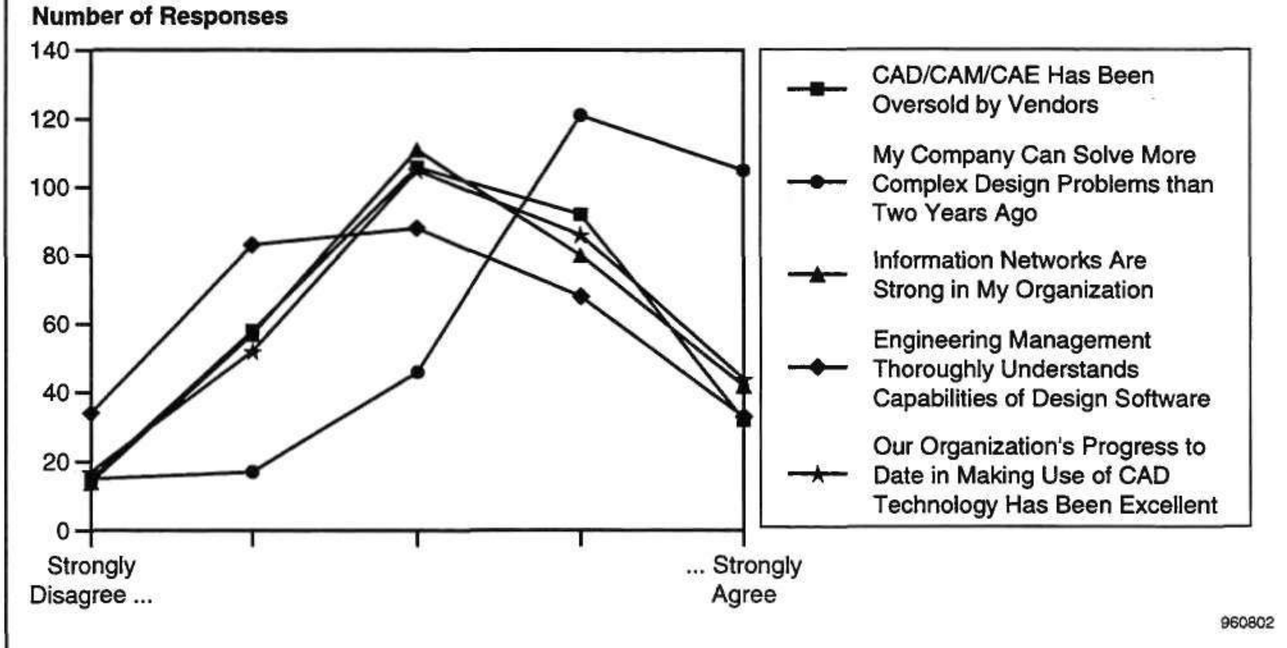
We asked respondents to what level they agree or disagree with a series of statements concerning CAD/CAM/CAE software, its role in the company, and its benefits. The results are displayed in Figure 3-5. Most respondents were neutral or tended to agree with the statements that "information networks are strong in my organization" and "our organization's progress to date in making use of CAD technology has been excellent." However, it is interesting to note that while respondents were neutral or tended to agree with the statement "CAD/CAM/CAE has been oversold by vendors," these same respondents strongly agreed that "my company can solve more complex design problems than two years ago." The statement "engineering management thoroughly understand capabilities of design software" incited the widest range of responses (See Figure 3-6).

Figure 3-5
CAD Perceptions (Percent of Respondents)



Source: Dataquest (January 1996)

Figure 3-6
CAD Perceptions (Number of Respondents)



Source: Dataquest (January 1996)

European Designers — 2-D or 3-D?

While the focus of vendors today has been on 3-D modeling, it appears there is still plenty of 2-D design being done among European end users. We asked respondents if they consider 3-D design to be their main form of design. A full 63 percent responded "yes" to that question. Details by country and by industry are given in Table 3-1. Both France and the United Kingdom report the highest usage of 3-D CAD, as do users in the electrical/electronic machinery and service/design/consulting.

We further explored this issue of 3-D design by asking those users whose main form of design is 3-D, what percent of those 3-D functions are used. The average response was 68 percent, and the median response was 70. Answers varied from 10 percent to 100 percent of functions used. Little difference was seen by either country or industry.

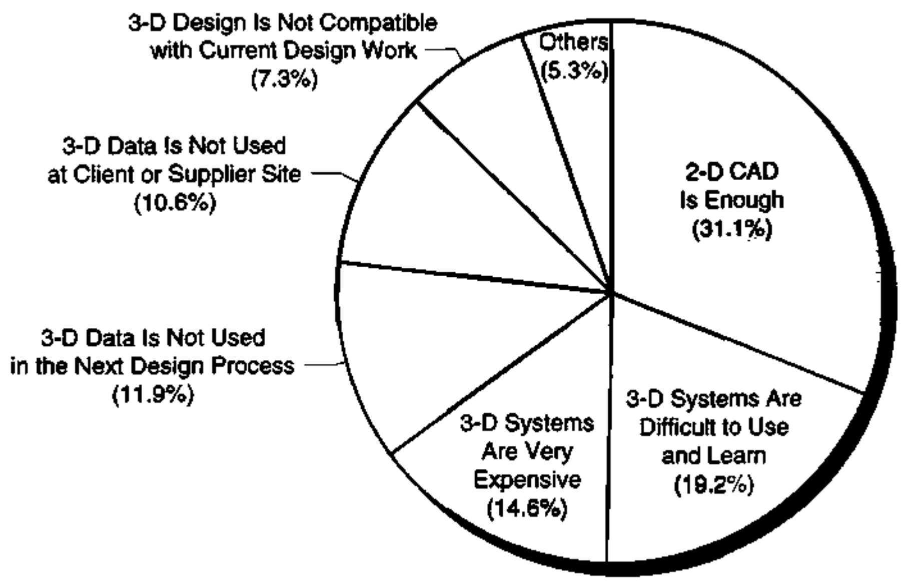
Of those users who do not consider 3-D to be their main form of design, we asked if it would become the main form by 1997. Surprisingly, only 41 percent of these respondents said yes and 59 percent said no. Users cited many reasons for not planning to change to 3-D CAD by 1997. The most commonly cited reason was that 2-D CAD is enough to meet their needs. All reasons are summarized in Figure 3-7.

Table 3-1
Whether 3-D Design Is the Main Method of Design (Percentage of Respondents)

	Yes (%)	No (%)
Country		
France	82	18
Germany	47	53
Italy	49	51
Spain	61	39
United Kingdom	66	34
Other Countries	54	46
All Sites	63	37
Industry		
Automotive	64	36
Electrical/Electronic Machinery	77	23
Fabricated Metal Parts	58	42
Industrial Machinery	44	56
Service/Design/Consulting	73	27
Other Industries	68	32

Source: Dataquest (January 1996)

Figure 3-7
Reasons Cited for Not Using 3-D by 1997



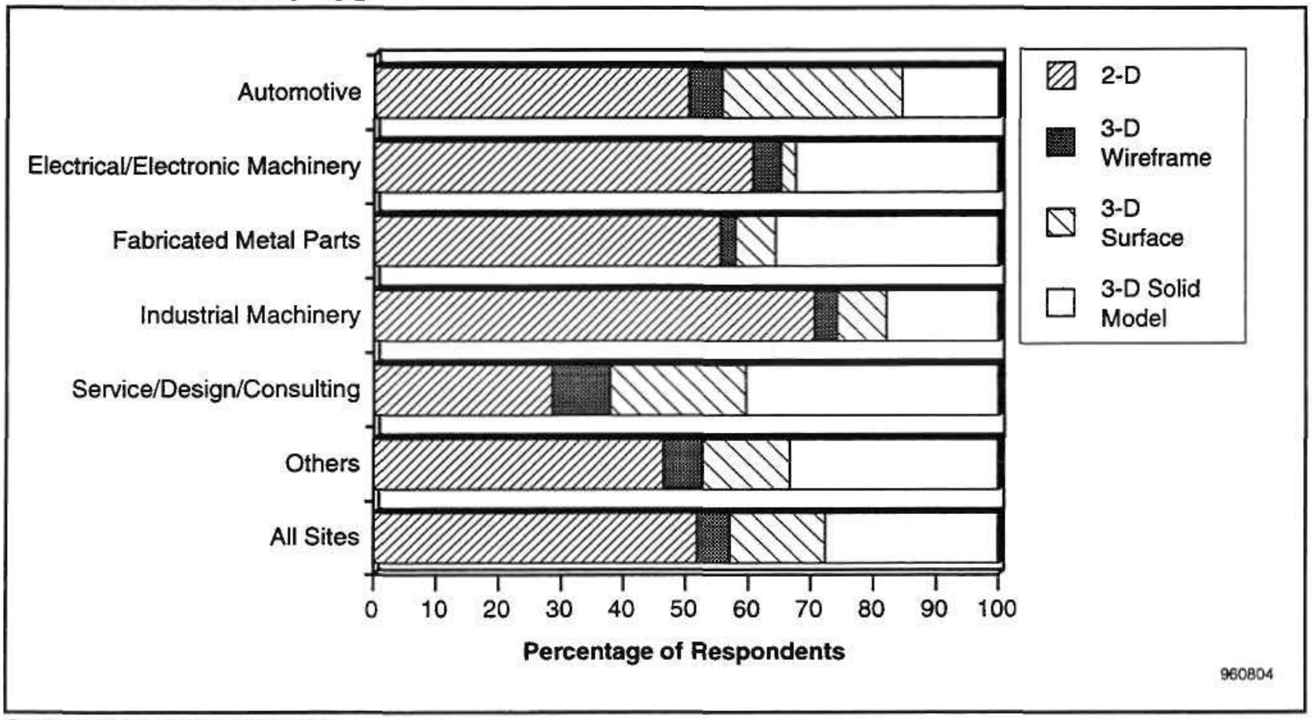
Source: Dataquest (January 1996)

File Types

The issue of data file storage is interesting for several reasons. First, disk manufacturers and systems integrators need to know the volume of files that need to be accessible on a daily basis. More importantly, the mix of data file types is key to gaining an understanding of the level of use of various modeling technologies and to suggesting the level of graphics performance necessary to view and edit information as it is retrieved.

The average number of active files at a given site for all users was 23,000, or an average of 221 files per user. Figure 3-8 shows the mix of files stored by modeling technology. All sites have a mix of 2-D or 3-D wire frame, surface, and solid model files. 2-D information dominates, with some sites having nearly all their files stored in 2-D. On average, about one half of files are stored as 2-D files, and one quarter are stored as 3-D solid models. As expected, the automotive and service/design/consulting industries show the highest percentage of files stored in some form of 3-D. To our surprise, users in the fabricated metal parts industry reported nearly 36 percent of their files are stored as solid models. Because 36 percent is so high and is a significant change from previous end-user surveys, we believe that this figure is an anomaly in the data and is not representative of the European fabricated metal parts industry.

Figure 3-8
Data Files Stored by Type



Source: Dataquest (January 1996)

Designing or Modifying

It is well known that mechanical CAD is not just designing, it is also modifying. Designers and engineers undoubtedly need to spend some of their time modifying existing parts and designs instead of always designing new parts. We asked respondents what is the proportion of new parts designed to existing parts that are modified. The results, by industry, are given in Table 3-2. On average, 59 percent of parts are completely new, and 41 percent are modifications. The amount of modifications done points to a need to preserve legacy data in a form that will be accessible in the future (We will explore file transfer formats and the STEP standard later in this chapter and in Chapter 4).

Table 3-2
New Designs versus Modifications

Industry	Design of Completely New Parts (%)	Modification of Existing Parts (%)
Automotive	55	45
Electrical/Electronic Machinery	59	41
Fabricated Metal Parts	62	38
Industrial Machinery	52	48
Service/Design/Consulting	72	28
Other Industries	62	38
All Sites	59	41

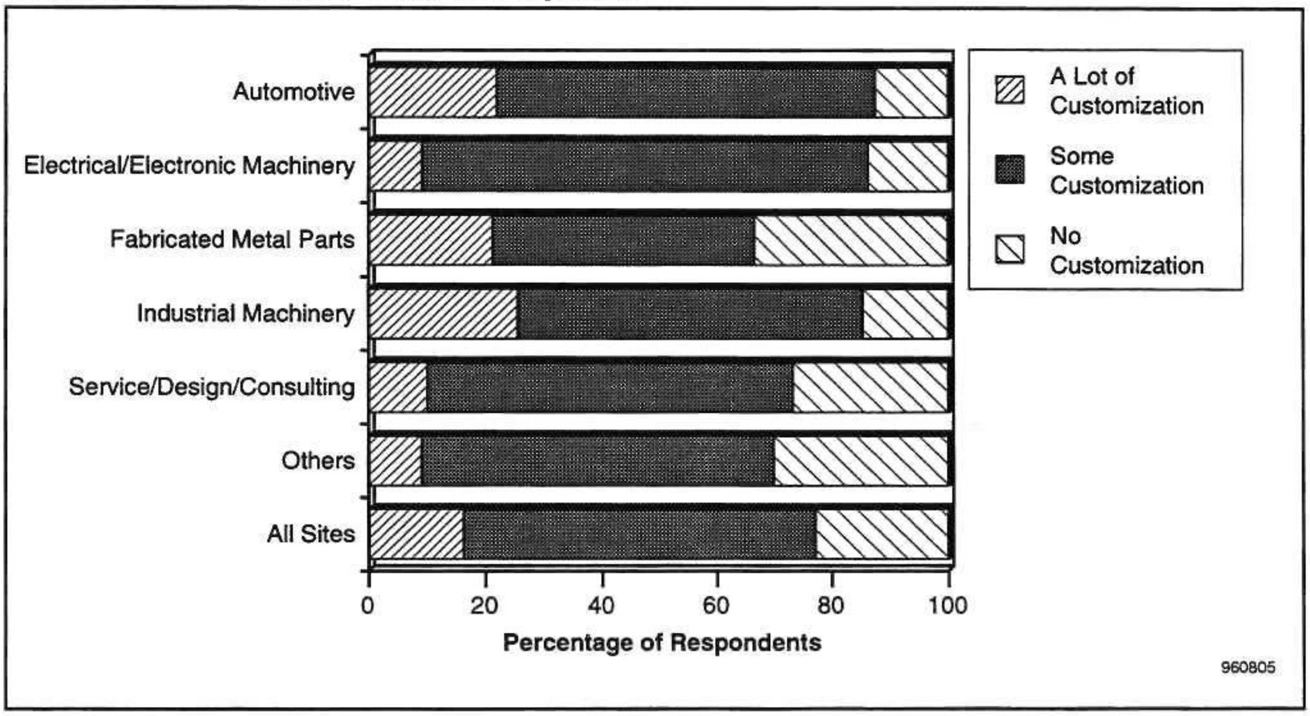
Source: Dataquest (January 1996)

Customization and Integration

The majority of CAD users continue to do some customization of their CAD/CAM/CAE systems. Those users doing the most customization ("some" or "a lot") came from automotive, electrical/electronic machinery, and industrial machinery industries (see Figure 3-9). More than one user pointed out that there was a general lack of integration between mechanical, electrical, and electronic CAD/CAM software, resulting in a great deal of custom-development work at their sites. We see this problem only getting worse as the electronic content increases in automotive and electrical products.

Some of this customization is attributed to the fact that users are often having to integrate one CAD package with another. About 50 percent of the survey respondents indicated that they use at least one other CAD/CAM/CAE package in addition to their primary vendor's package. Typically, these additional packages were used to either replace or supplement drafting, numerical control, and analysis. Some users indicated using other packages for conceptual design as well.

Figure 3-9
Customization of CAD/CAM/CAE Systems



Source: Dataquest (January 1996)

Product Development Delays

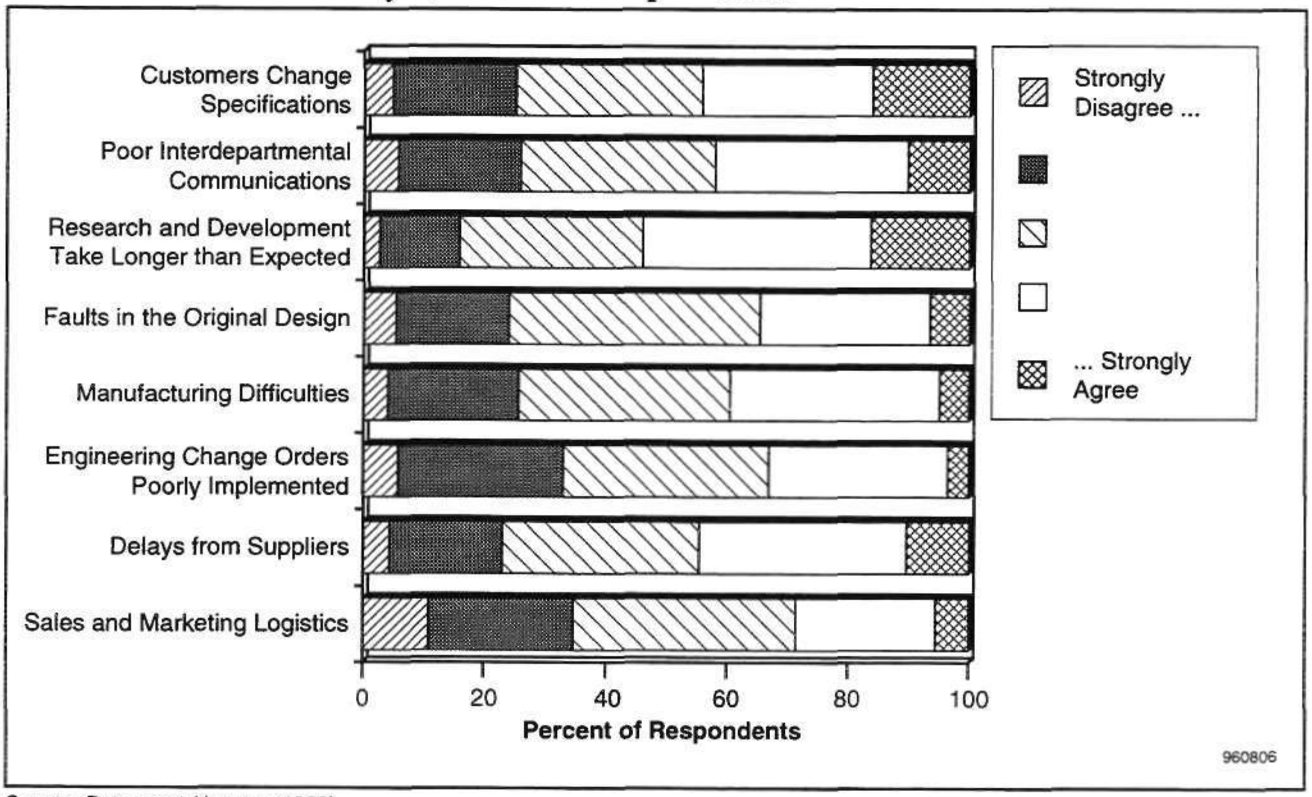
Previous end-user surveys have indicated that development times are getting shorter and organizations are under continual pressure to bring products to market faster. We investigated some of the typical causes cited for product delays, ranging from research and development to manufacturing to marketing/sales logistics. The results are summarized in Figure 3-10. Most respondents were fairly neutral toward the statements that product delays are caused by faults in the original design or sales and marketing logistics.

However, respondents tended to agree that poor interdepartmental communications created manufacturing difficulties and supplier delays tended to cause product delays. The strongest agreement came from the statement that "research and development takes longer than expected." The statements "customers change specifications" and "engineering change orders are poorly implemented" drew the widest range of responses (see Figure 3-11).

The Future of STEP

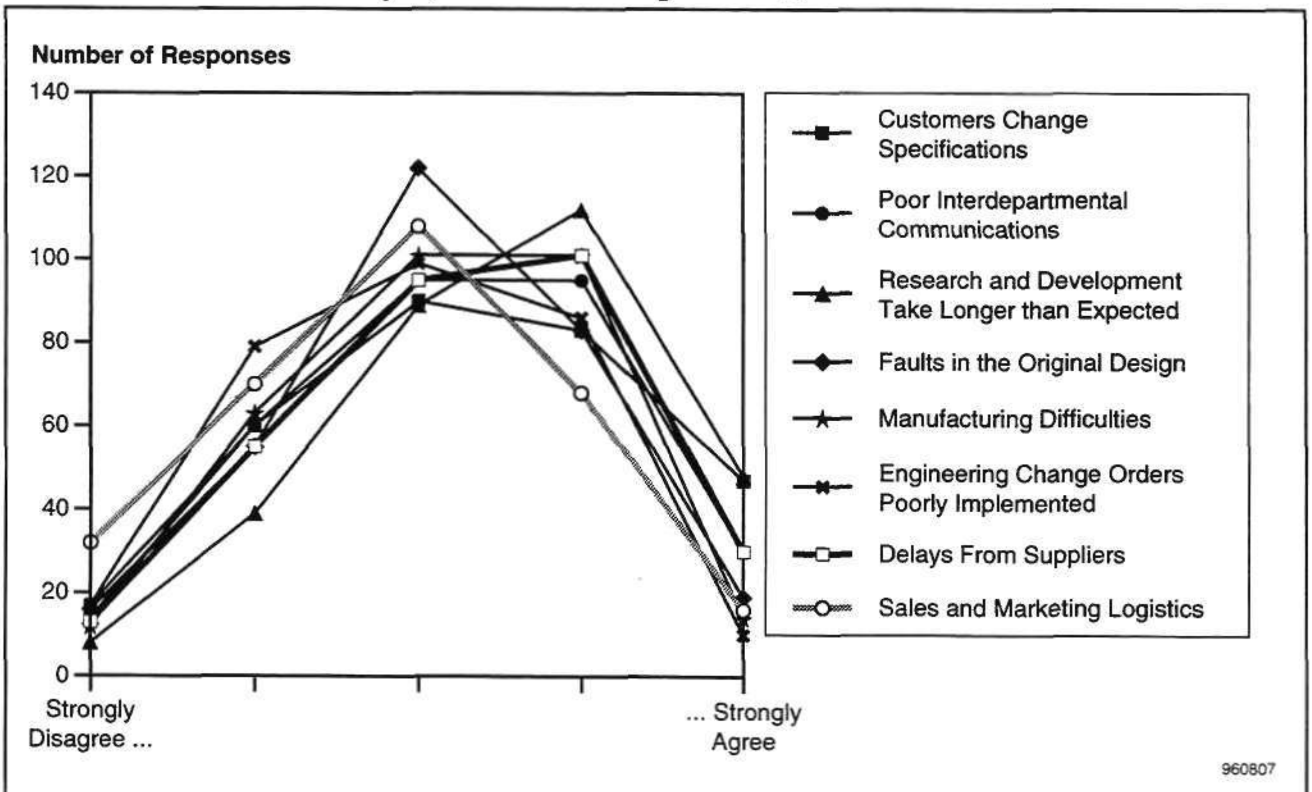
It is clear from the comments of respondents in the survey that data translation is a hot issue. More than one user commented about the lack of standardization between CAD and CAM. Respondents blamed vendors for not being open enough with one other to facilitate data exchange, a general lack of robust translators, and difficulties in integrating different CAD/CAM/CAE packages. Users want the ability to transfer data between different CAD systems with a minimum of fuss and rework.

Figure 3-10
Reasons for Product Delays (Percent of Respondents)



Source: Dataquest (January 1996)

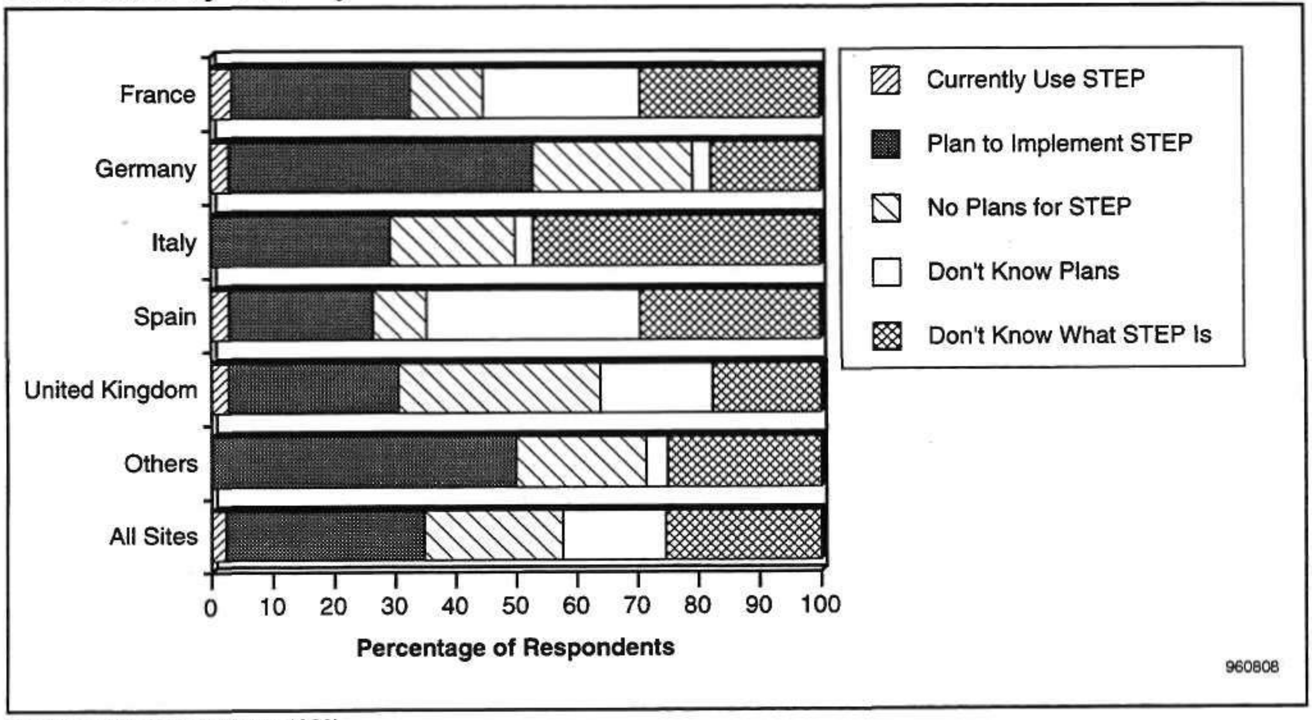
Figure 3-11
Reasons for Product Delays (Number of Respondents)



Source: Dataquest (January 1996)

The STEP standard has been viewed as one solution to the data translation problem. The STEP standard has been drawing interest of the mechanical CAD/CAM/CAE community for quite some time; however, our survey results show that it still has a long way to go until it is widely accepted and used. We asked users if they were using STEP translators. The results are displayed in Figure 3-12 and 3-13. The highest rates of STEP use or plans are among designers in Germany. This comes as no surprise, as much of the STEP development has been spearheaded by efforts in Germany (such as ProSTEP). Survey respondents in Italy and Spain showed the least awareness of the STEP standard.

Figure 3-12
STEP Plans by Country

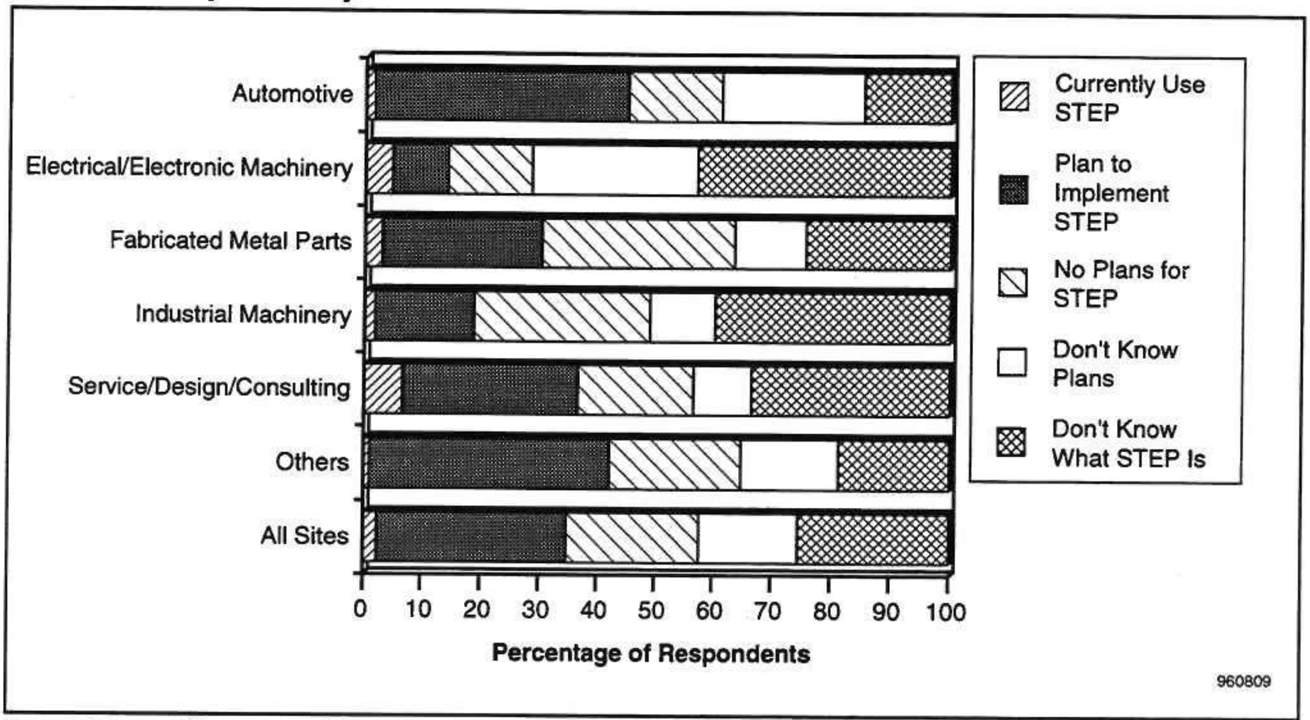


Source: Dataquest (January 1996)

Similarly, designers in the automotive industry showed the greatest use of or plans for STEP. Much of this awareness is again related to the efforts of STEP committees specifically targeting problems in the automotive industry. Those showing the least awareness of STEP are in electrical/electronic machinery and industrial machinery. All industries in the survey have some plans to implement STEP.

Closely related to the STEP issue is what other standards users are using today. The most commonly cited standard was IGES, followed by DXF/DWG format. Other popular standards mentioned in the survey were VDA (surfacing standard) and STL (rapid prototyping standard). Less common were internally developed exchange formats.

Figure 3-13
STEP Plans by Industry



Source: Dataquest (January 1996)

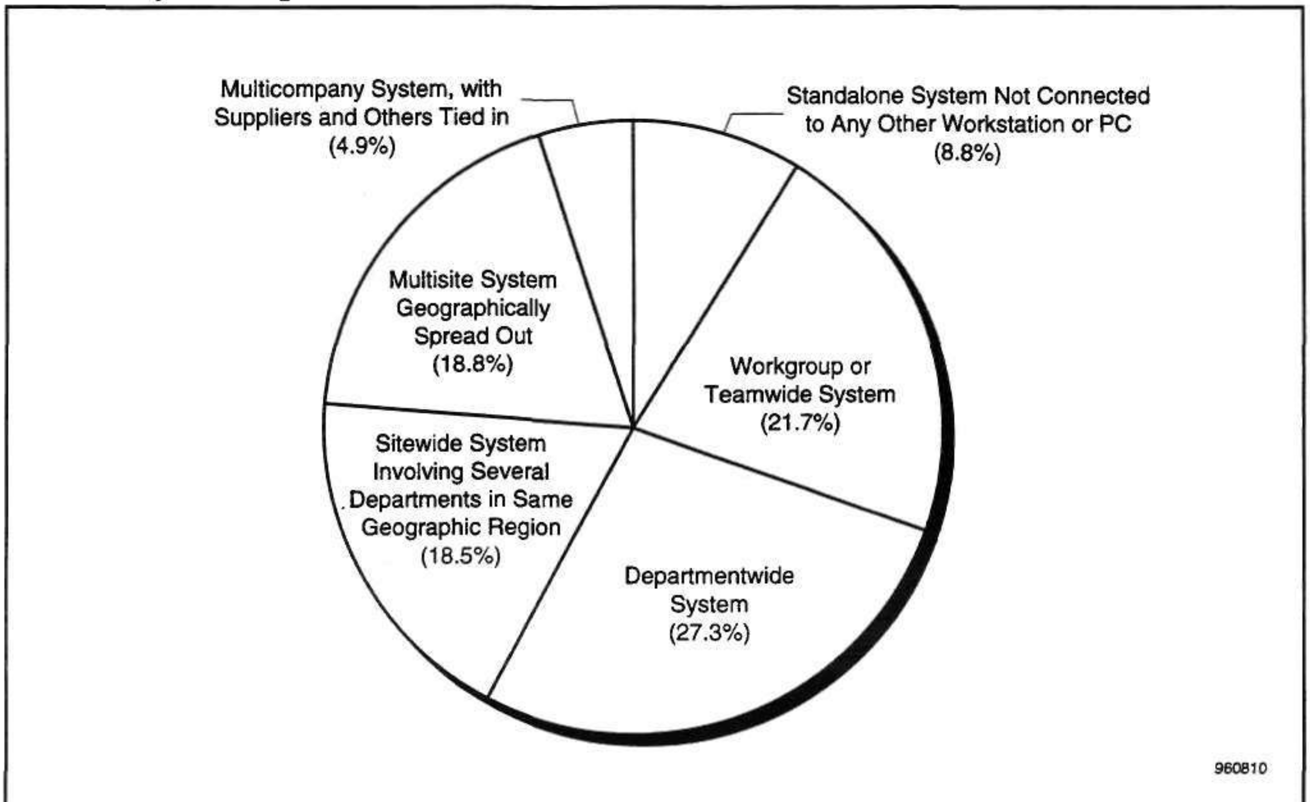
Chapter 4

The Designer's Work Environment—Today and Tomorrow

Level of System Operation

Respondents indicated a number of levels of CAD/CAM/CAE system operation. These responses are summarized in Figure 4-1. Most users operated in a teamwide or departmentwide system. Surprisingly, 5 percent of respondents have employed a system that ties in the CAD system to suppliers and others outside of the organization or site. We noted that these same people tended to be those at a company with a PDM system in place. We will further discuss PDM systems in Chapter 6.

Figure 4-1
Level of System Operation



Source: Dataquest (January 1996)

Data Transfer

The physical method by which data files are transferred ranged from paper to the Internet (see Table 4-1). Transfer within a site is most often accomplished by some type of LAN. Floppy disks and tapes are also popular. For transfer of data files outside of a site, floppy disks and tape were the most frequently mentioned methods. Most sites used more than one method for data transfer.

Table 4-1
Method of Data Transfer

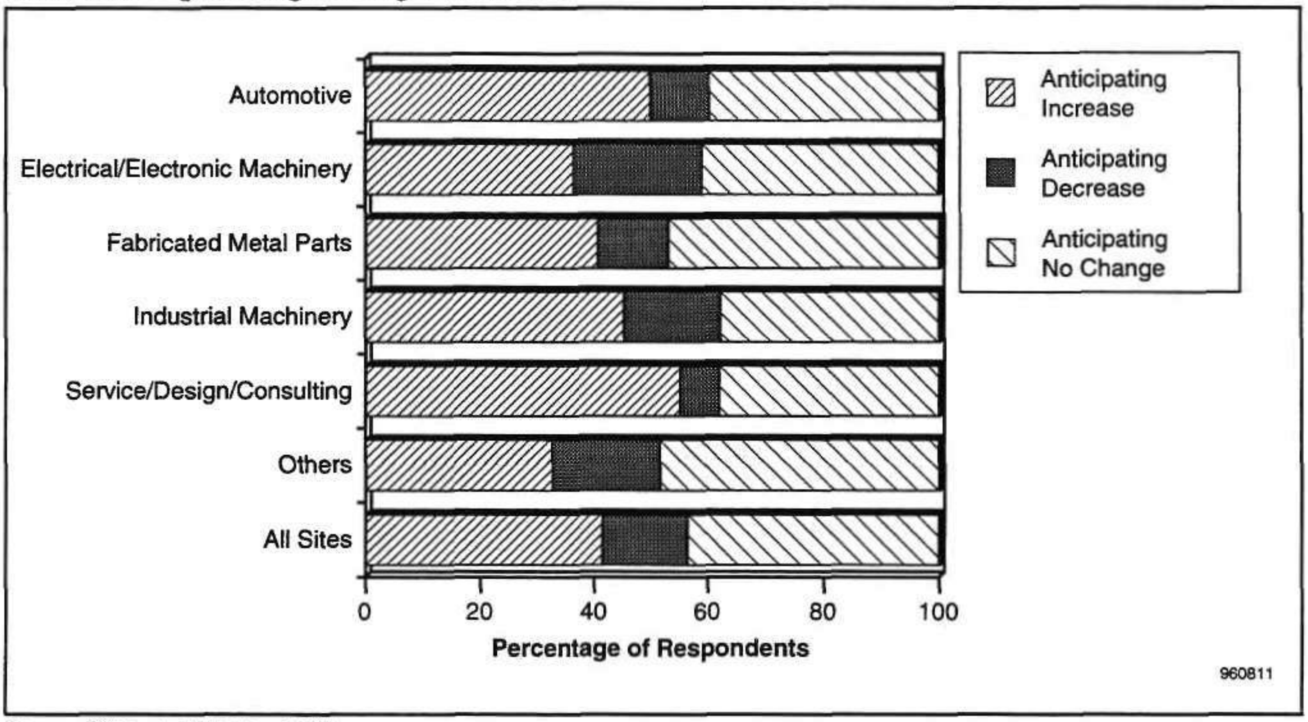
Method	Within Site (N = 374)	Outside of Site (N = 531)
Floppy Disk	68	184
Tape	46	185
Modem	7	81
Network (Not Internet)	233	22
Internet	10	47
Others	10	12

Note: Multiple responses were allowed.
Source: Dataquest (January 1996)

Future Hardware Purchase Plans

Hardware spending plans for 1996 will be a mix of increased spending or no change in spending from 1995. Here, hardware implies computers (for example, PCs, workstations, mainframes, and servers) as well as related peripherals (for example, plotters, and printers). Planned hardware spending changes for 1996 are illustrated in Figure 4-2. Only 15 percent of all industries are expecting decreases in hardware spending. Most are expecting increases or no change from 1995. The anticipated amounts of increases or decreases from 1995 budgets are given in Table 4-2.

Figure 4-2
Hardware Spending Changes for 1996



Source: Dataquest (January 1996)

Table 4-2
Hardware Budget Changes, 1995 to 1996

Industry	Amount of Increase (%)	Amount of Decrease (%)
Automotive	41	33
Electrical/Electronic Machinery	27	62
Fabricated Metal Parts	41	26
Industrial Machinery	29	53
Service/Design/Consulting	40	48
Others	41	54
All Sites	37	49

Source: Dataquest (January 1996)

CAD/CAM/CAE Seats Increasing

The number of hardware seats (PCs, workstations, or mainframe seats) used for all design and manufacturing applications varied greatly by industry and by country, as indicated in Table 4-3. As expected, manufacturing-intensive industries like automotive, fabricated metal parts, and industrial machinery have a high average number of seats. Germany's high average seat count results from the fact that for this survey, many of the German respondents came from automotive, fabricated metal parts, and industrial machinery companies.

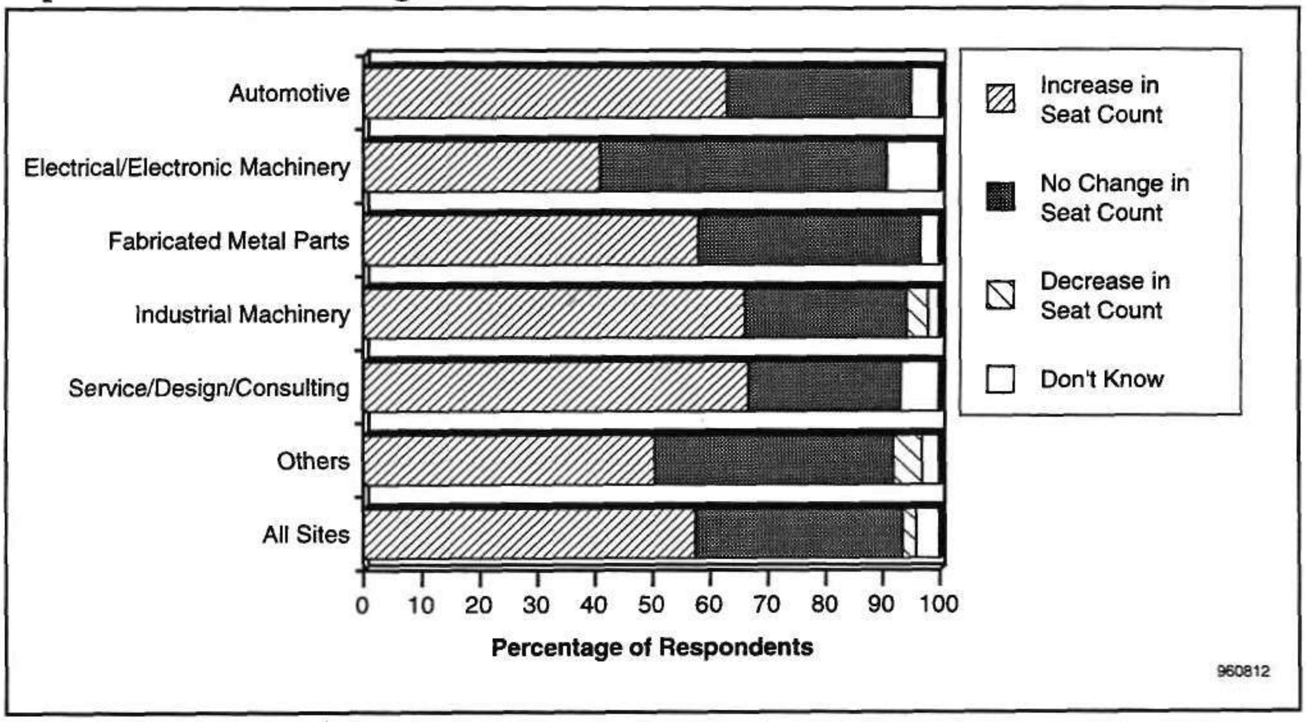
Table 4-3
Hardware Seats by Country and Industry

	Average Number of Seats
Country	
France	21
Germany	376
Italy	33
Spain	27
United Kingdom	86
Other Countries	71
Industry	
Automotive	113
Electrical/Electronic Machinery	39
Fabricated Metal Parts	111
Industrial Machinery	117
Service/Design/Consulting	11
Other Industries	32

Note: Number of seats used for design and manufacturing applications
Source: Dataquest (January 1996)

It is clear that users are expecting much of the hardware spending outlined in Table 4-2 to go toward more CAD/CAM/CAE seat purchases rather than hardware peripherals or servers. Overall, more sites are expecting seat count increases than seat count decreases from 1995 to 1997. As seen in Figure 4-3, little variation in seat count was seen by industry. However, the percentage change of anticipated seat count increases ranged from 25 percent in industrial machinery to 61 percent for service/design/consulting. Responses for the amount of percentage change in seat count decreases were too few to analyze.

Figure 4-3
Expected Seat Count Changes

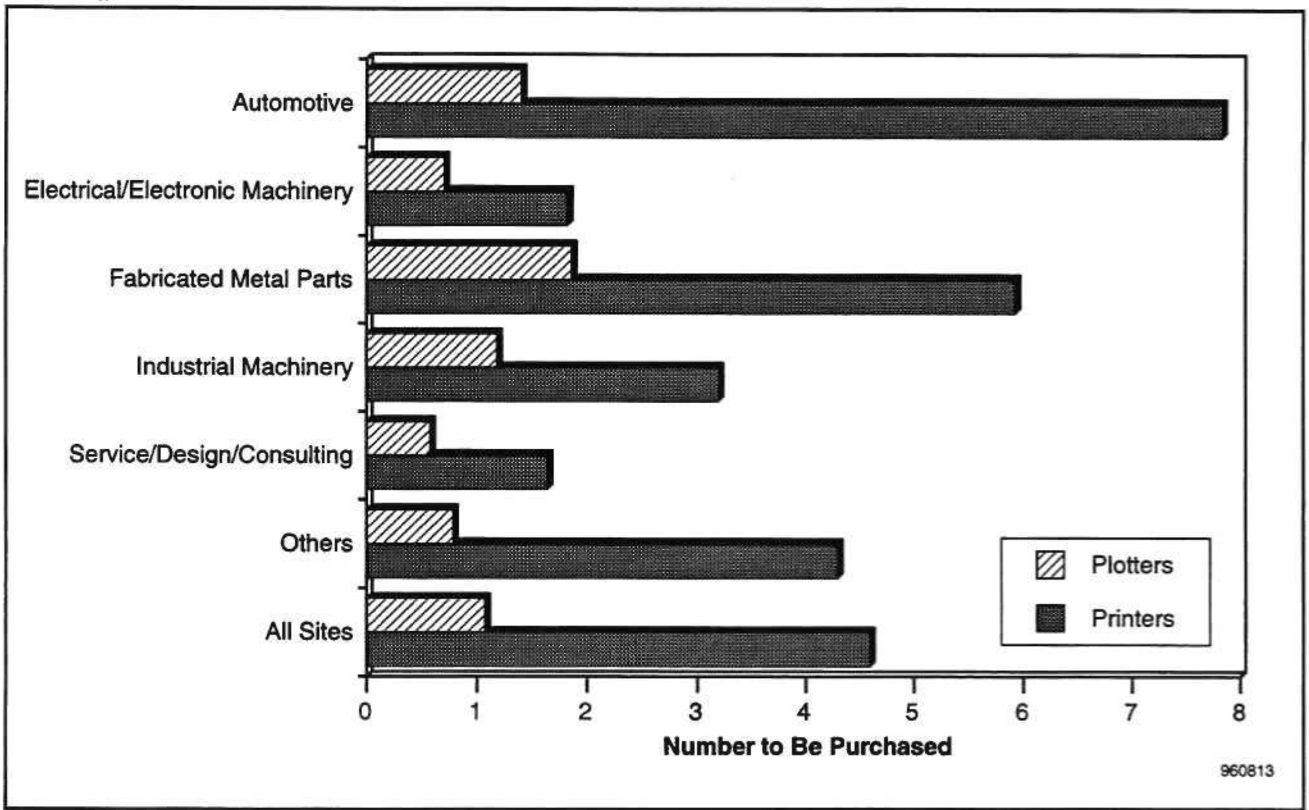


Source: Dataquest (January 1996)

Plotters and Printers

Any increase in the number of CAD/CAM/CAE designers and engineers within a company not only leads to new computer seats but also to purchases of new peripherals such as printers and plotters. Users in our survey plan to purchase, on average, one plotter and five printers over the next two years (see Figure 4-4). As a point of reference, we have included a summary of users' current plotter technology in Table 4-4. Pen plotters were the most frequently mentioned, followed by ink jet and electrostatic plotters.

Figure 4-4
Anticipated Plotter and Printer Purchases



Source: Dataquest (January 1996)

Table 4-4
Plotter Technology

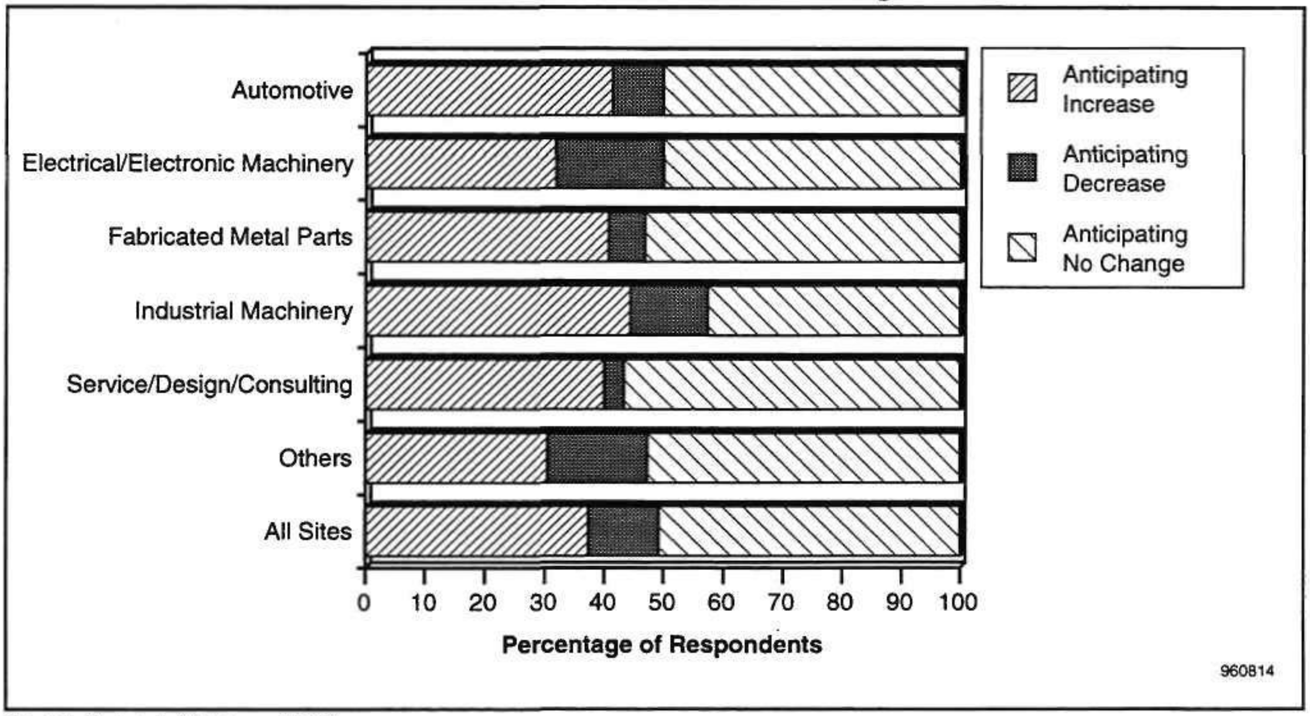
Plotter type	Number of Responses (N = 387)
Pen	130
Ink Jet	87
Electrostatic	73
Color Ink Jet	52
Thermal	33
Others	12
Total	387

Source: Dataquest (January 1996)

Software Spending — Which Areas Will Grow?

While hardware purchase plans look optimistic, the picture isn't quite as rosy for future software purchases. As seen in Figure 4-5, 51 percent of survey respondents indicate that software spending will not change from 1995 levels. Those users in service/design/consulting expect the greatest decrease in software spending.

Figure 4-5
Mechanical CAD/CAM/CAE Software Purchase Plan Changes for 1996



Source: Dataquest (January 1996)

A look at planned software retirements sheds further light on the software spending issue, because fewer retirements would affect the capacity to absorb new software. Table 4-5 shows the percentage of existing mechanical CAD/CAM/CAE software modules users expect to retire over the next two years. The automotive industry expects to retire 16 percent of its CAD software, well above the overall average of 11 percent.

While it would be natural to think that increased software spending should accompany increased hardware spending, it is important to remember several things. First, hardware can mean seats of CPU as well as plotters, printers, or servers. Second, when talking about increases and decreases, we are using the budget of the previous year (1995) as the basis for comparison. Third, users plan to retire little CAD/CAM/CAE software over the next two years, as we illustrate in Table 4-5, thus leaving little room for new applications and modules.

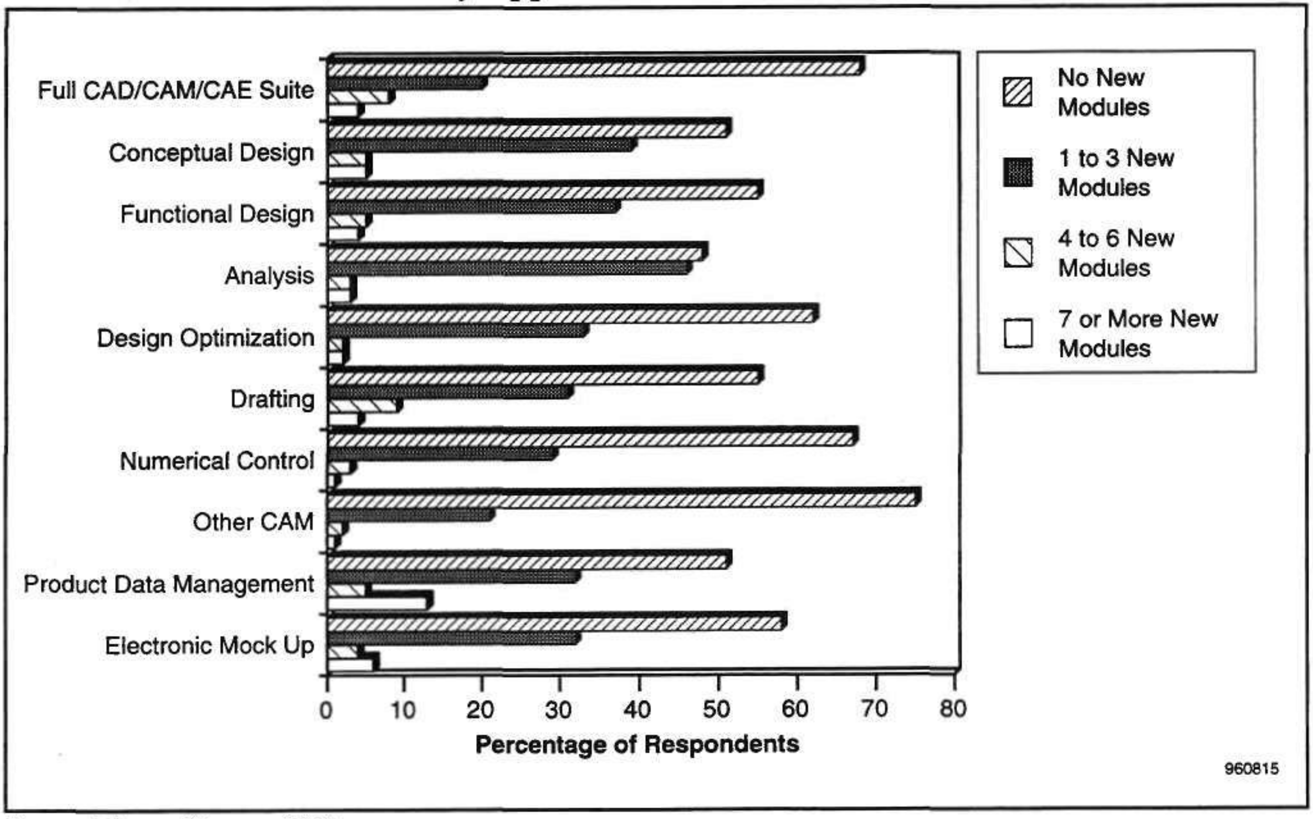
Table 4-5
Mechanical CAD/CAM/CAE Software Retirements

Industry	Software Retirements (%)
Automotive	16
Electrical/Electronic Machinery	11
Fabricated Metal Parts	10
Industrial Machinery	12
Service/Design/Consulting	11
Others	9
All Sites	11

Source: Dataquest (January 1996)

We asked users to identify which CAD/CAM/CAE applications they are planning to purchase in the next two years. The results are given in Figure 4-6. It appears as if users are tending to shy away from the full CAD/CAM/CAE suite of software in favor of application-specific modules. Most new module purchases will come from conceptual design, analysis, and PDM. Of those users planning to purchase PDM software, nearly 13 percent indicate that they intend to purchase seven or more modules, far greater than the average for all other CAD/CAM/CAE modules.

Figure 4-6
New Module Purchase Plans by Application



Source: Dataquest (January 1996)

Maintenance, Consultants, and Software Development

As we saw earlier, hardware spending is expected to increase over 1995 levels, and software is also expected to increase, but to a lesser extent. Services spending, too, will increase, but will be even less than software spending. We asked users about their plans for spending on several aspects of service, ranging form maintenance to software application development to consultants and systems integrators. The results are summarized in Table 4-6. If this table is any indication, the future looks stable but not growing for consultants and applications developers, with most users expecting budgets to remain the same for these areas over the next two years.

The planned increases in spending for maintenance is expected. As users add more computers, networks, and software to their CAD/CAM/CAE systems, maintenance and related service costs will undoubtedly increase. However, vendors will have to work hard to get these service dollars. We will see later in Chapter 5 that users value vendor service and support highly and expect to get better value for their support dollars.

Will It Be an NT Future?

Windows NT operating system entered the CAD world with a big splash in 1994, and vendors and users alike have been trying to ascertain exactly what effect Windows NT will have on the CAD/CAM/CAE market. It appears as if the European mechanical design community is ready to embrace Windows NT; these users are indicating that Windows NT will take market share away from all operating systems, but in particular, DOS and Windows.

We asked users which operating system they use today and what they believe will be their dominant operating system in 1997 and in 1999. The results for all respondents are shown in Figure 4-7. According to our survey results, DOS, Windows, OS/2, and VMS operating systems will shrink from 25 percent to 3 percent by 1999. UNIX will lose some ground, going from 73 percent to 63 percent, and Windows NT/Windows 95 will gain a secure foothold in the mechanical CAD world, growing from 2 percent to 34 percent by 1999. User comments reveal that much of the movement to Windows NT will be driven by the hope that CAD software running on Windows NT will be cheaper, faster, and easier to use.

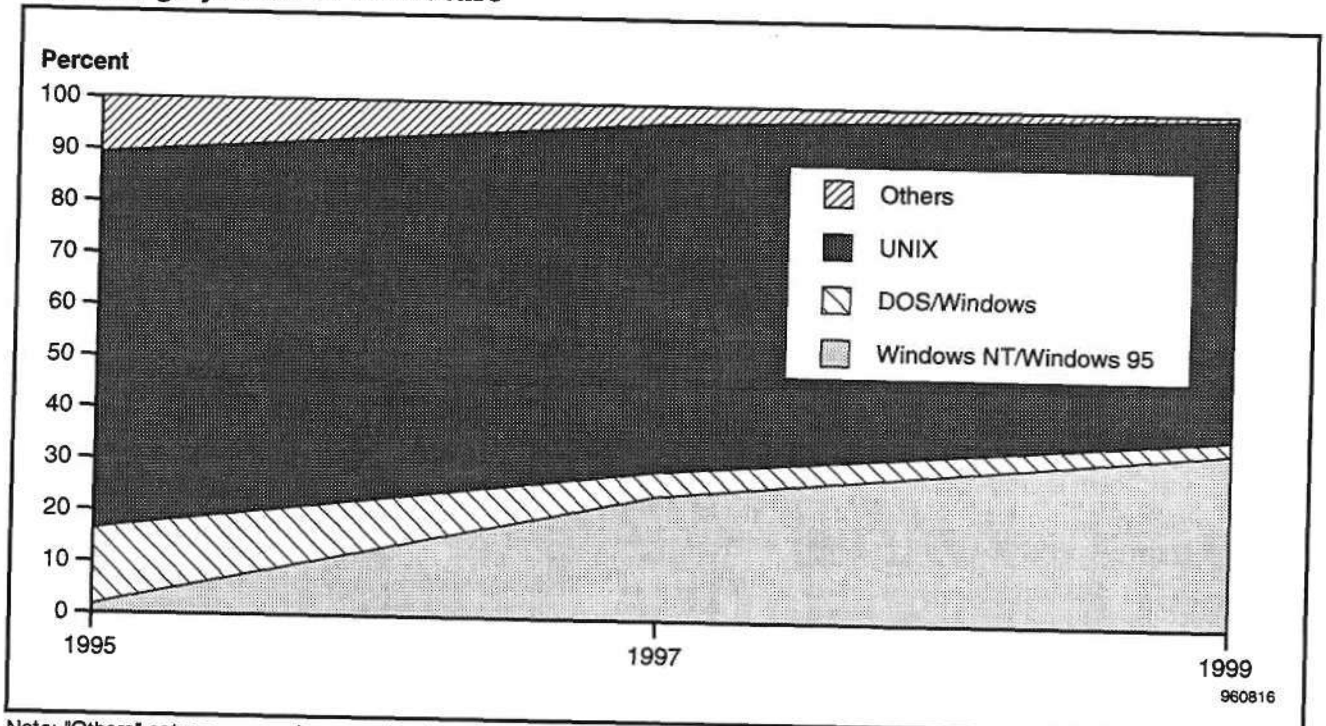
The overall numbers do not give the whole picture, however. It appears as though each country and each industry will adopt the Windows NT operating system at very different rates. From a country perspective, France, Spain, and the United Kingdom will all move to Windows NT at the expense of all of the operating systems. However, in the cases of Germany and Italy, these countries show that they will be holding onto their installed UNIX sites. We illustrate some of these country-level differences in Figures 4-8 and 4-9.

Table 4-6
Service Spending Changes

	Maintenance			Applications Development			Consultants/Systems Integrators		
Industry	Increase (%)	Decrease (%)	No Change (%)	Increase (%)	Decrease (%)	No Change (%)	Increase (%)	Decrease (%)	No Change (%)
Automotive	35	5	60	16	5	79	14	7	79
Electrical/Electronic Machinery	18	18	64	19	0	81	21	0	79
Fabricated Metal Parts	26	13	61	19	3	78	23	0	77
Industrial Machinery	24	13	63	19	2	79	16	6	78
Service/Design/ Consulting	34	14	52	40	4	56	20	8	72
Others	25	9	66	17	6	77	22	2	76
All Sites	27	10	63	19	4	77	19	4	77

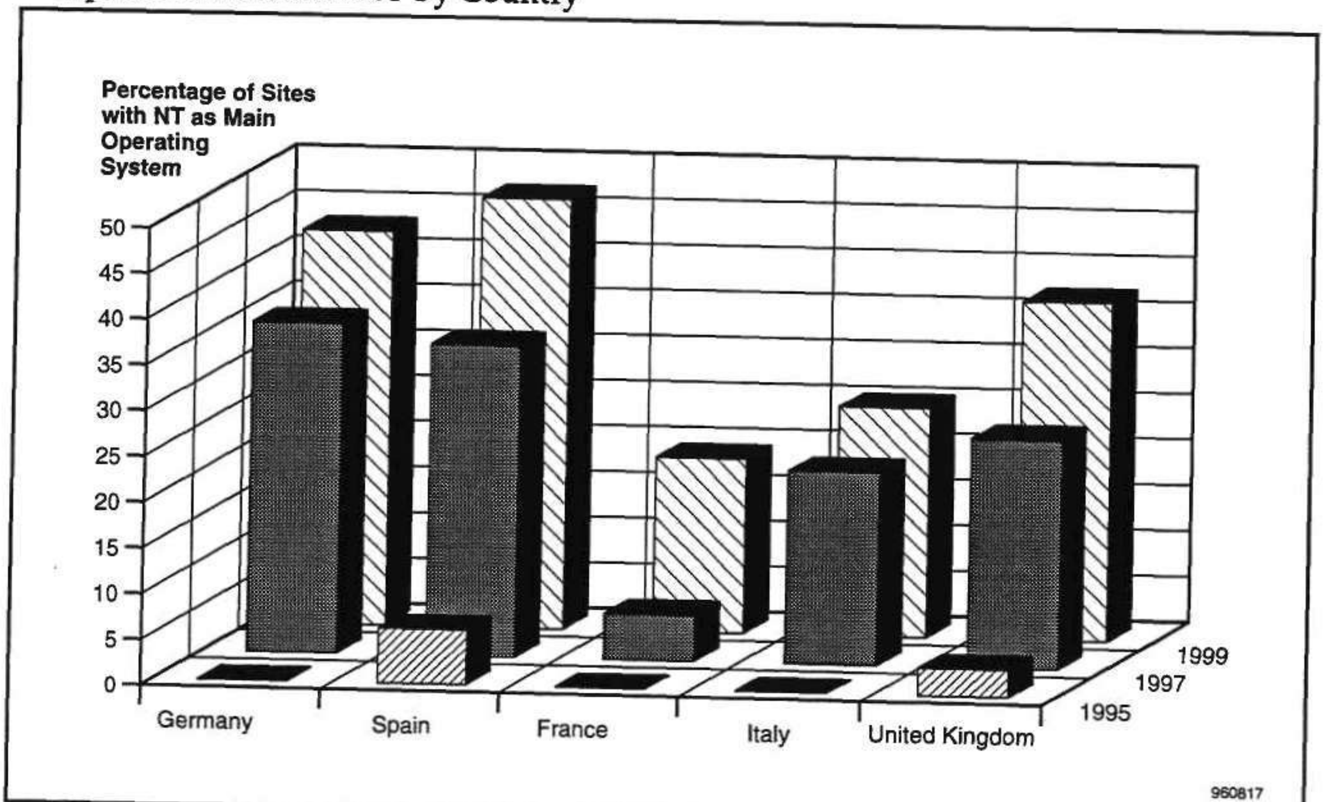
Source: Dataquest (January 1996)

Figure 4-7
Operating Systems of the Future



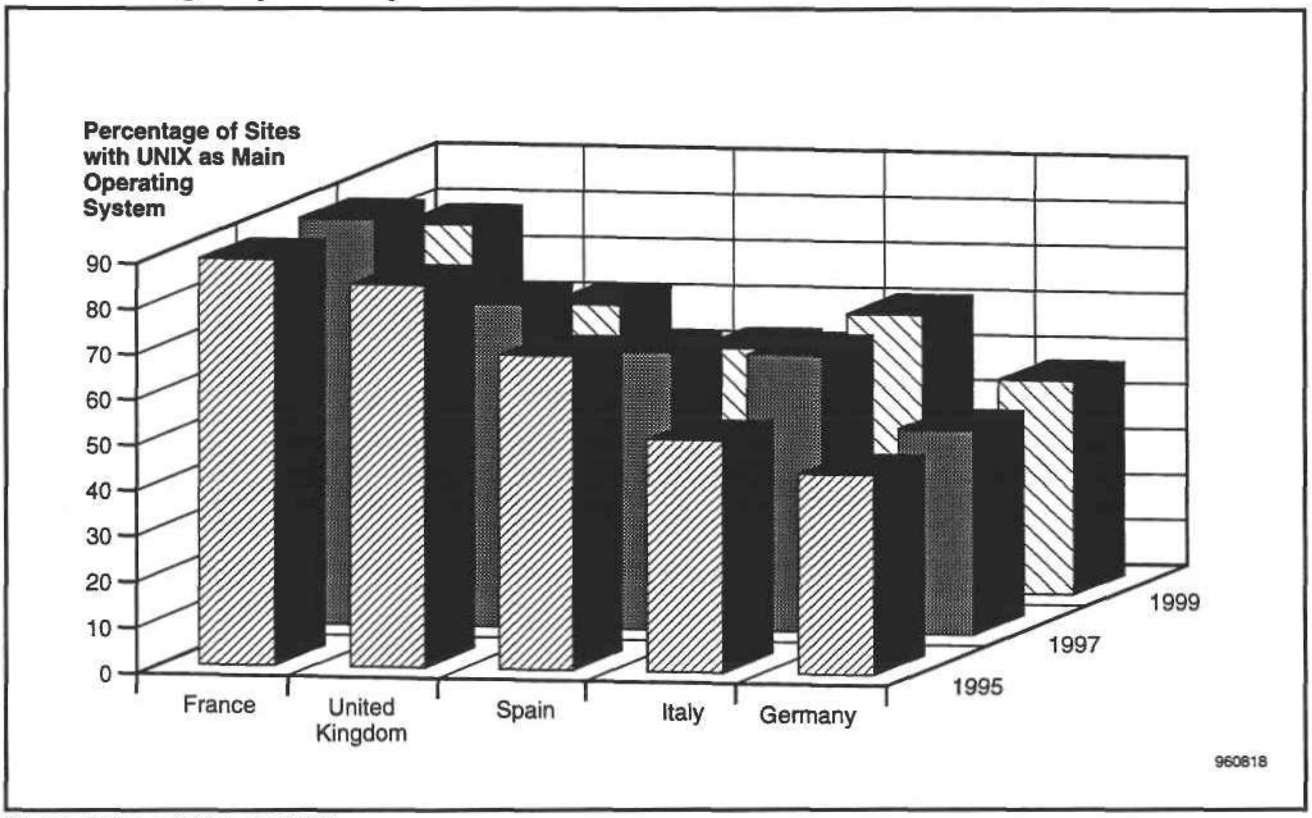
Note: "Others" category comprises mostly of VMS and some OS/2.
Source: Dataquest (January 1996)

Figure 4-8
Adoption of Windows NT by Country



Source: Dataquest (January 1996)

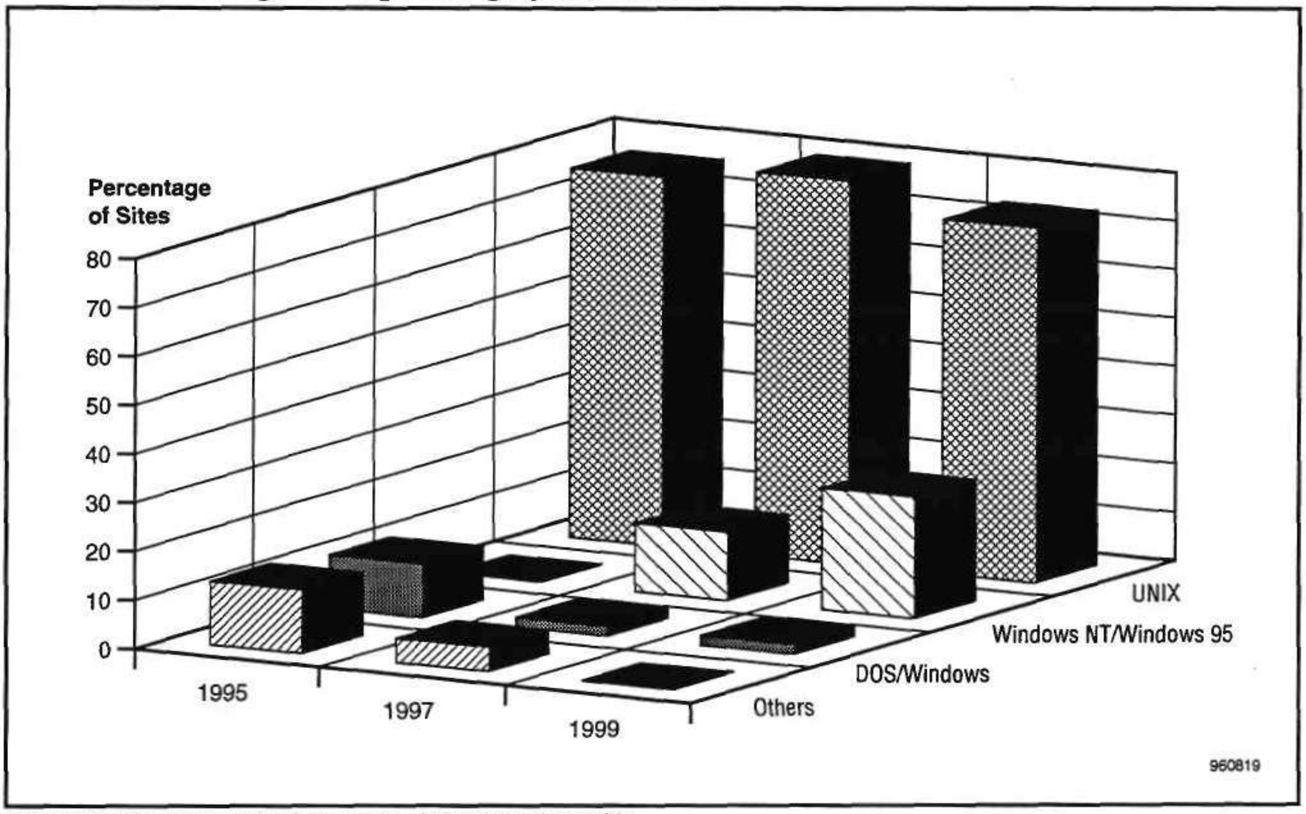
Figure 4-9
UNIX Changes by Country



Source: Dataquest (January 1996)

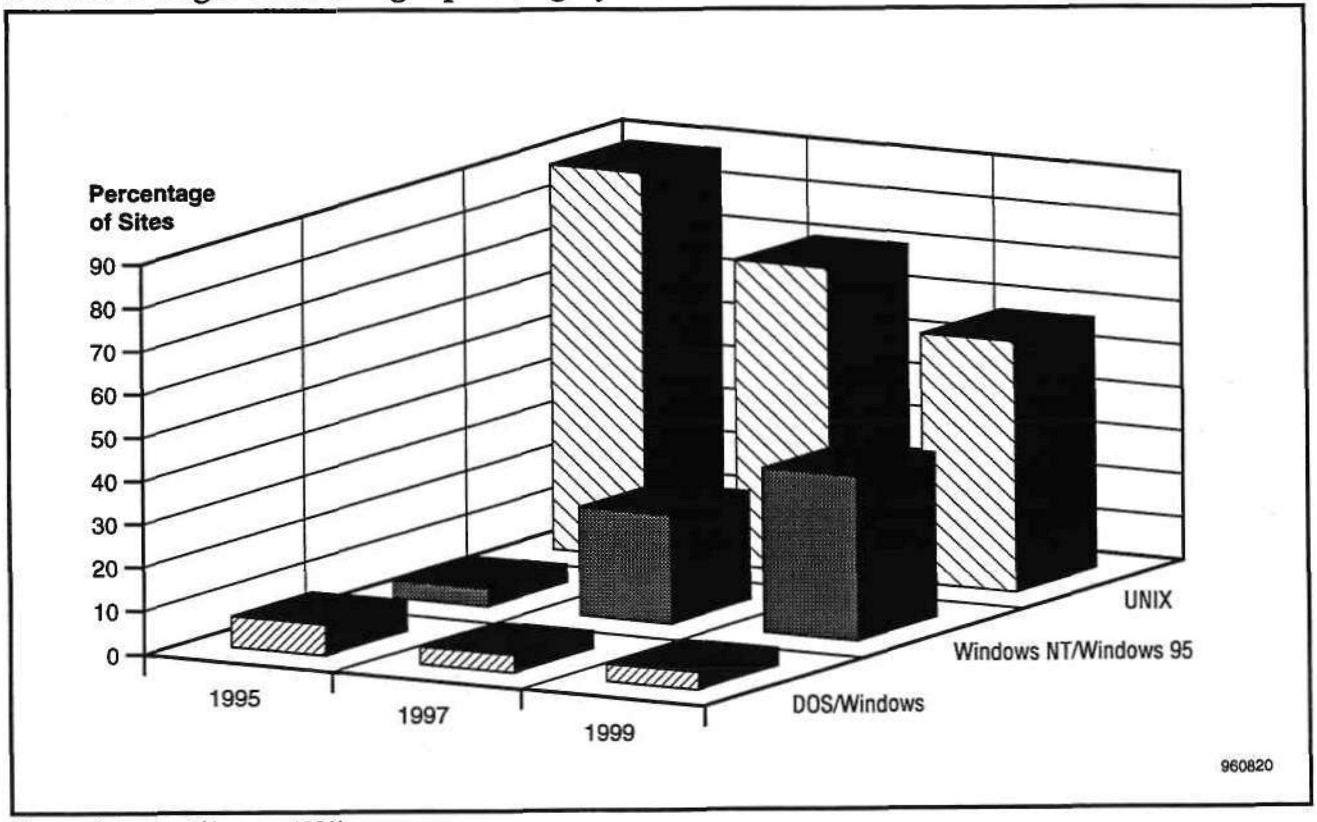
The same country-level movement will hold true at the industry level. Some industries, such as service/design/consulting and electrical/electronic machinery, will move to Windows NT rapidly and at the expense of UNIX. Other industries, particularly the automotive industry, will hold onto their UNIX installations. Movement to Windows NT will be slower and at the expense of operating systems other than UNIX. This comes as no surprise, as automotive sites tend to be larger sites that are well entrenched in UNIX and have the expertise and resources to maintain a UNIX-based system. Also, the automotive industry undoubtedly uses applications for which vendors have not yet announced a Windows NT solution. We have chosen to highlight the automotive and service/design/consulting industries plans for Windows NT in Figures 4-10 and 4-11.

Figure 4-10
Automotive Designers' Operating System Plans



Note: "Others" category comprises mostly of VMS and some OS/2.
Source: Dataquest (January 1996)

Figure 4-11
Service/Design/Consulting Operating System Plans



Source: Dataquest (January 1996)

Chapter 5

Mechanical Applications Perceptions

This chapter reveals how designers rate the mechanical applications that they use and provides insight into what software functionality and characteristics these users seek. In delving into these issues, we asked users a series of questions based on their satisfaction with the mechanical applications themselves (for example, analysis and assembly design), with specific CAD features (for example, Windows NT availability and data exchange capabilities), and with software characteristics (for example, absence of software bugs and ease of use). The results are explored in the following sections.

Mechanical CAD/CAM/CAE Applications—What Users Think

We asked designers to rate their CAD/CAM/CAE applications with respect to importance and satisfaction on a scale of 1 (not important or not satisfied) to 5 (very important or very satisfied). These applications were:

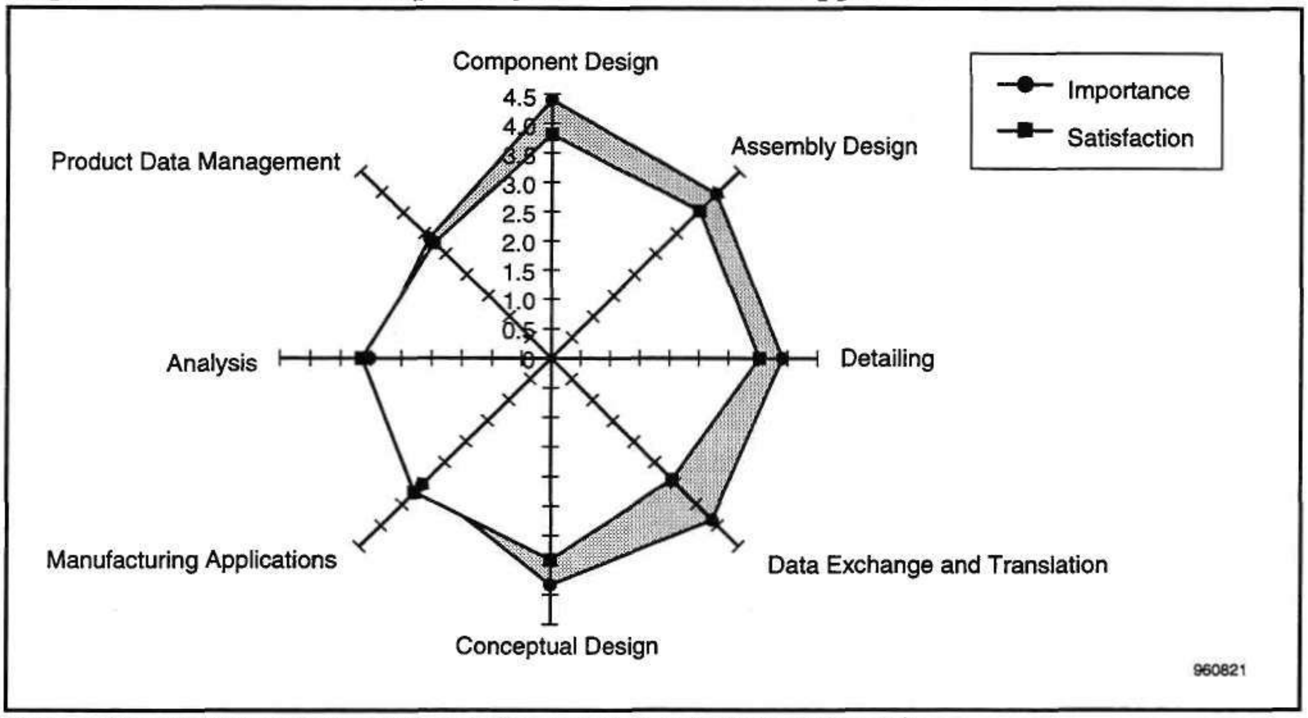
- Detailing
- Component design
- Assembly design
- Conceptual design
- Analysis
- Manufacturing applications
- Product data management
- Data exchange and translation

Figure 5-1 provides a visual interpretation of these user importance and satisfaction ratings. The most important characteristic, component design, is plotted on a 1-to-5 scale at the top of the chart, and the other applications, in order of decreasing importance, are plotted in a counterclockwise manner about the axes. The satisfaction rating for each application is mapped along the same axes as its corresponding importance rating. The gap, or difference, between the importance and satisfaction ratings for each application is indicated by gray shading, exposing the areas that need vendor attention and improvements.

In an ideal situation, importance and satisfaction ratings would be equal, and no gray area would appear because the two circles would coincide. However, when the two circles do not coincide at every point, users are not as happy as they could be.

The numerical values of the gaps are given in Table 5-1. While most of the gaps in Table 5-1 are not large, there are clearly some unmet needs out there. Once again, we see the importance of data translation software to designers and engineers. This application was ranked fairly high in importance by survey respondents, but this same group of people is very unsatisfied (nearly a one-point gap) with the translation products they use. This is clearly one area that needs vendor attention. Two applications, manufacturing applications and analysis, had positive gaps, thus indicating that users are satisfied. However, it is important to note that these applications were also ranked significantly lower in importance than the other applications in this survey.

Figure 5-1
Importance/Satisfaction Gap Analysis of Mechanical Applications



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (January 1996)

Table 5-1
Importance/Satisfaction Gap Analysis of Mechanical Applications

	Importance	Satisfaction	Gap
Component Design	4.40	3.81	-0.59
Assembly Design	3.95	3.55	-0.40
Detailing	3.92	3.53	-0.39
Data Exchange and Translation	3.87	2.91	-0.96
Conceptual Design	3.83	3.41	-0.42
Manufacturing Applications	3.03	3.21	0.18
Analysis	3.02	3.15	0.13
Product Data Management	2.88	2.77	-0.11

Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (January 1996)

Surprisingly, product data management did not rank high in importance among the survey respondents. It is true that PDM did not take off until 1994 or early 1995. Somehow, a message about the benefits of PDM is not yet getting across to the mainstream CAD users in Europe.

CAD Features and Functionality—What Users Want

Many factors can influence CAD software purchasing decisions. The technical abilities and robustness of the applications themselves are one area that users investigate before making purchases. Another area is CAD features and functionality, items that are relevant to any mechanical CAD application. For instance, we wanted to know if users are concerned about software prices, whether they are purchasing a drafting module or analysis module. We asked users to rate the following CAD features and functionality with respect to importance and satisfaction on a scale of 1 (not important/not satisfied) to 5 (very important/very satisfied):

- Software service and support
- High-performance 3-D graphics
- Low price of software
- Design optimization capabilities
- Parametric user interface
- Rapid prototyping interfaces
- Photorealistic imaging
- Windows NT platform availability
- Videoconferencing/whiteboarding

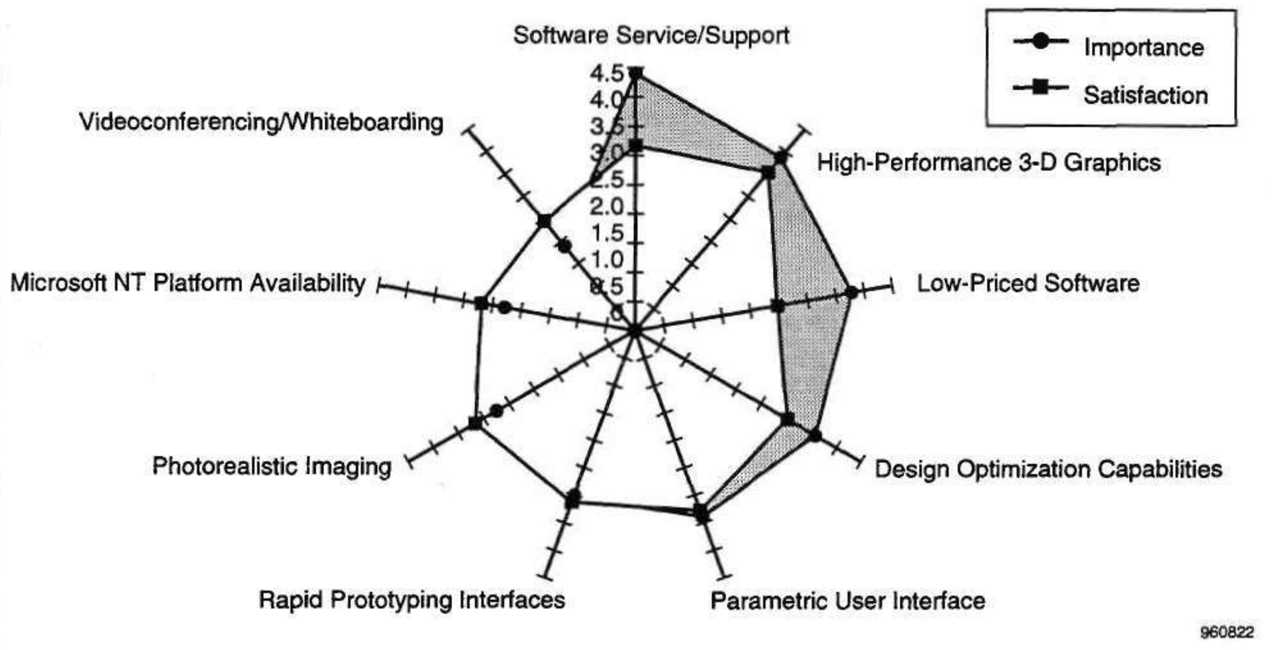
Figure 5-2 and Table 5-2 outline user ratings to the CAD features and functionality listed above. To no surprise, software service/support was ranked first in importance, with a gap greater than one. It is clear that users are looking for better support from their CAD vendors and systems integrators. Some users felt alienated from their vendors, wishing that their vendors would concentrate more on needs of their current customer base instead of trying to win new customers.

Software price is an issue that always ranks high in importance and low in satisfaction, no matter what type of software one is referring to, and CAD software is no exception. Price could be one factor that will help push Windows NT sales into the design community, as some of the vendors are charging an "intermediate" price for their Windows NT solution that is below their UNIX price, or are selling a Windows NT solution for the same price as a DOS/Windows-based solution.

3-D graphics remains important to the end users, but their satisfaction with graphics is fairly high. As companies take on more complex design problems and become more entrenched in 3-D design, it is natural that graphics will become more of an important factor in influencing purchasing decisions.

It is interesting to see that the European mechanical CAD users as a whole are not showing that much interest in Windows NT solutions, yet one-

Figure 5-2
Importance/Satisfaction Gap Analysis of CAD Features



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (January 1996)

Table 5-2
Importance/Satisfaction Gap Analysis of CAD Features

	Importance	Satisfaction	Gap
Software Service/Support	4.41	3.17	-1.24
High-Performance 3-D Graphics	3.87	3.54	-0.33
Low Price Software	3.78	2.48	-1.30
Design Optimization Capabilities	3.58	3.03	-0.55
Parametric User Interface	3.40	3.28	-0.12
Rapid Prototyping Interfaces	3.01	3.13	0.12
Photorealistic Imaging	2.75	3.17	0.42
Windows NT Platform Availability	2.29	2.69	0.40
Videoconferencing/Whiteboarding	1.89	2.45	0.56

Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (January 1996)

third of our survey respondents plan to move to Windows NT in 1997 or certainly by 1999. Respondents rated Windows NT application availability 2.29 in importance, putting it near the bottom of the list of important CAD features. One possible explanation for this low rating is that users are more concerned about the immediate issues facing them (such as software price and vendor support).

As we have seen in previous surveys, videoconferencing/whiteboarding solutions fall to the bottom of the list in importance. We have seen this happen both in Japan and in previous European/U.S. end-user surveys done within the last two years. While this technology could definitely be a catalyst for concurrent engineering, something—technology or marketing—is still missing.

A Wish List of Software Characteristics

Like mechanical applications and CAD features, software characteristics can be measured with respect to importance and satisfaction. For this survey, software characteristics imply such items as ease of use and integration of software with other mechanical applications. We created a "wish list" of software characteristics and asked users to rate the importance and satisfaction of the following 11 characteristics relevant to all mechanical applications:.

- Software has advanced features and functionality.
- Software is easy to learn and use.
- Software is bug-free and stable.
- Software is compatible with current environment.
- Software performs complex or compute-intensive tasks well.
- Software is easy to customize.
- Software has low cost per seat.
- Applications and modules are tightly integrated.
- Vendor is flexible in its licensing policies.
- Vendor is responsive to our needs.
- Users at our company favor this software.

Nearly every item on the list was ranked with an importance rating of 4.0 or higher (see Table 5-3). Vendors could choose to address any one of these issues, as all of the gaps are large (see Figure 5-3). We will discuss only some of these issues in the following sections.

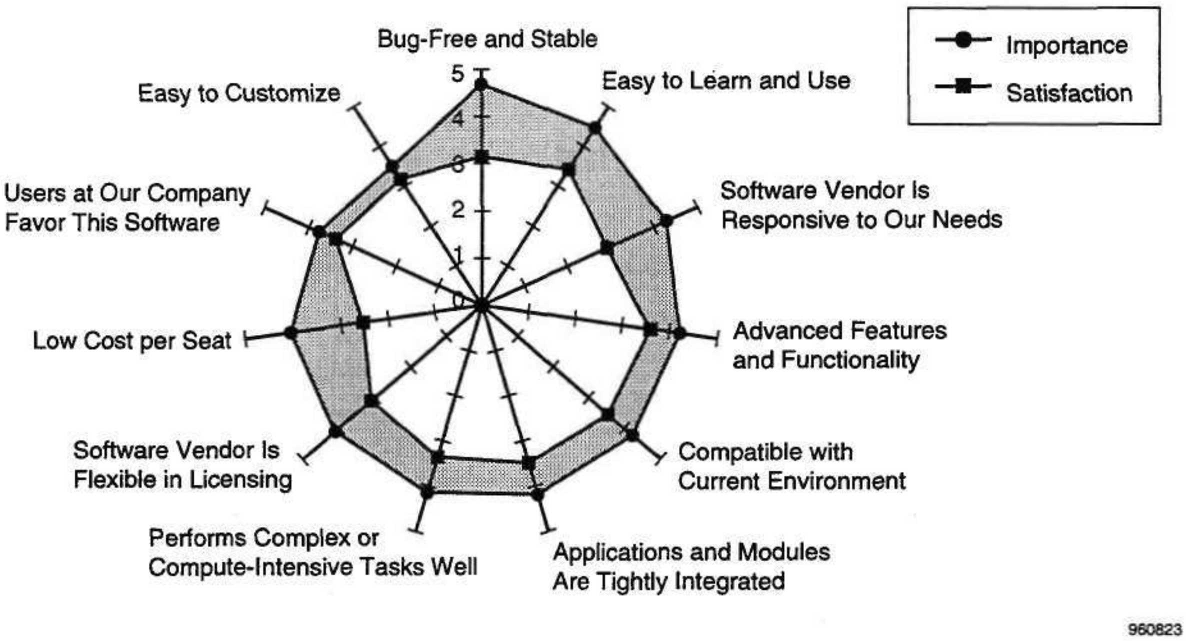
Topping the list in importance was the request for software that is bug-free and stable. The gap here is quite large (1.54). Software stability has always been an issue with the mechanical design community and can sometimes be an impediment to the adoption of new technologies and methodologies.

Table 5-3
Importance/Satisfaction Gap Analysis of Software Characteristics

	Importance	Satisfaction	Gap
Bug Free and Stable	4.69	3.15	-1.54
Easy to Learn and Use	4.47	3.42	-1.05
Software Vendor Is Responsive to Our Needs	4.29	2.93	-1.36
Advanced Features and Functionality	4.22	3.6	-0.62
Compatible with Current Environment	4.22	3.55	-0.67
Applications and Modules Are Tightly Integrated	4.19	3.49	-0.70
Performs Complex or Compute-Intensive Tasks Well	4.15	3.36	-0.79
Software Vendor Is Flexible in Licensing	4.10	3.10	-1.00
Low Cost per Seat	4.06	2.54	-1.52
Users at Our Company Favor This Software	3.77	3.39	-0.38
Easy to Customize	3.50	3.18	-0.32

Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (January 1996)

Figure 5-3
Importance/Satisfaction Gap Analysis of Software Characteristics



Note: Ratings on a scale of 1 to 5 (1 = not important/not satisfied, 5 = very important/very satisfied)
Source: Dataquest (January 1996)

Software that is easy to learn and use is also important to the design community. Engineers are always facing time-to-market pressures, and they have little time to spend learning new tools or applications. As we saw earlier, one impediment to the more widespread adoption of 3-D design methodologies is the user perception that 3-D systems are difficult to learn and use.

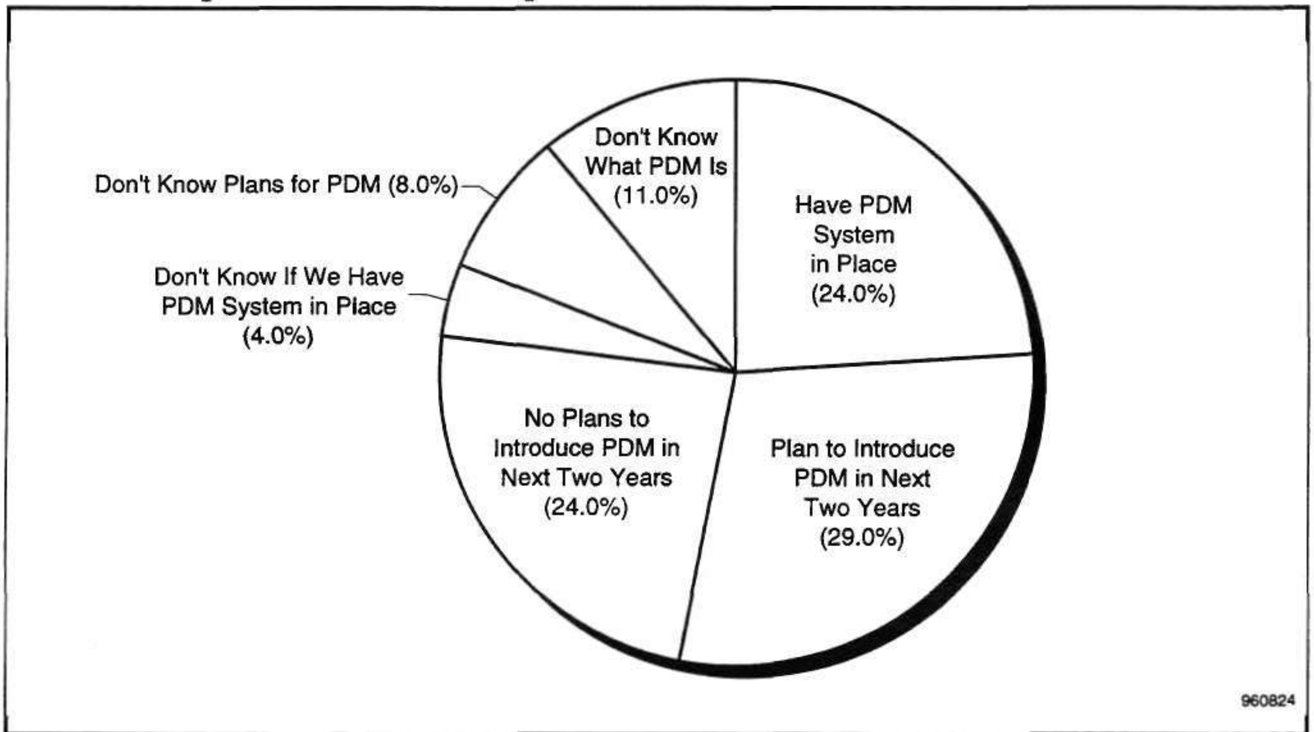
Closely linked to the software service and support issue of the previous section is software vendor's responsiveness to end-user needs. Again, as Figure 5-3 shows, this characteristic was ranked high in importance and has one of the larger satisfaction/importance gaps.

Chapter 6
Product Data Management

This year, we included a section in our survey on product data management. We asked a series of questions in order to better understand what types of companies and people are using PDM systems, the size of PDM installations, its costs, and what some of the benefits are from a user's perspective.

Surprisingly, the number of PDM users out there was greater than we had anticipated. Twenty-five percent of respondents said that they have a PDM system already in place, and 29 percent plan to introduce PDM within the next two years (see Figure 6-1). While the adoption rates for PDM were fairly similar from industry to industry, one exception was the service/design/consulting industry, which showed little planned adoption for PDM. This makes sense, given the small size of these companies and the nature of their work. Plans for PDM on a country-level basis varied significantly (see Table 6-1). On one end of the spectrum, over 40 percent of the German respondents indicated that they have a PDM system in place. On the other end, 37 percent of the Spanish respondents indicated that they did not know what PDM was. The rest of the countries in our survey fell somewhere in between those two extremes.

Figure 6-1
Planned Adoption of PDM in Europe



Source: Dataquest (January 1996)

Table 6-1
Planned Adoption of PDM by Country

Country	PDM System in Place (%)	Plans to Introduce PDM (%)	No Plans for PDM in Two Years (%)	Do Not Know If PDM System Is in Place (%)	Do Not Know Plans (%)	Do Not Know What PDM Is (%)
France	18	27	22	5	10	18
Germany	41	29	9	6	15	0
Italy	20	34	20	9	6	11
Spain	14	26	20	3	0	37
United Kingdom	29	28	33	3	5	2
Others	18	36	25	0	14	7
All Sites	25	29	24	4	8	11

Source: Dataquest (January 1996)

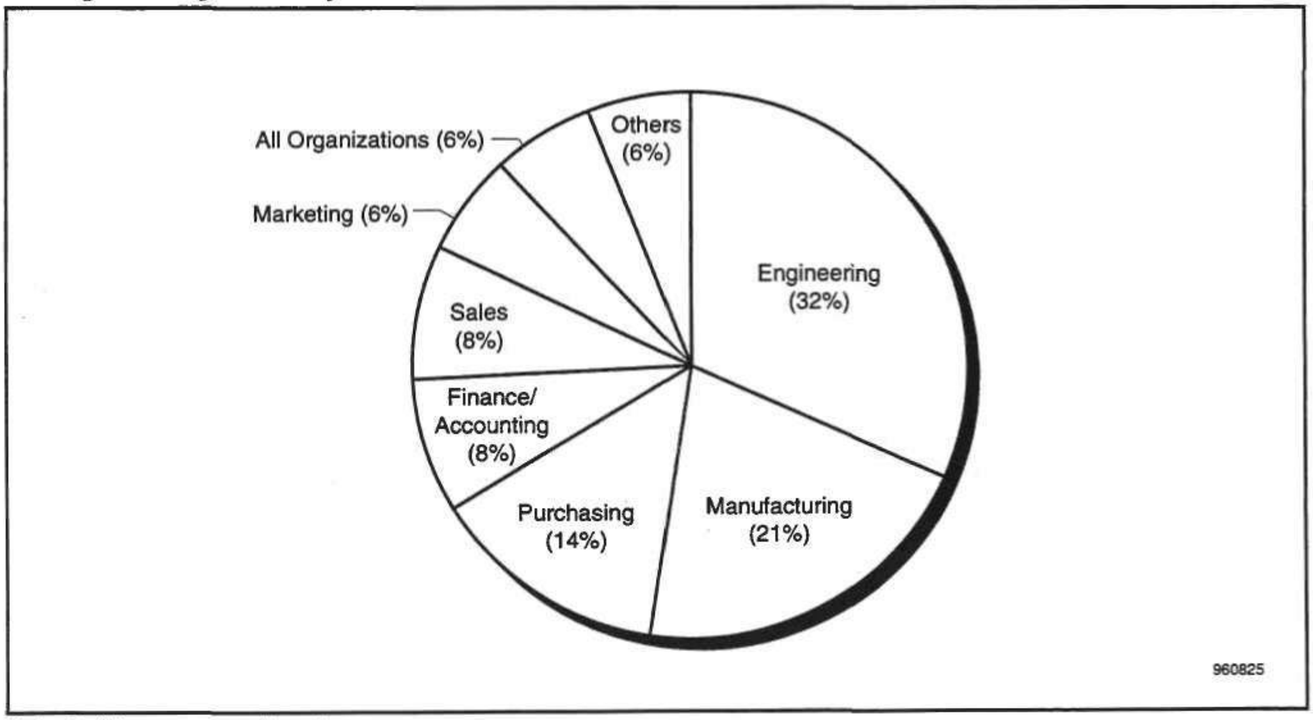
The following statements characterize the PDM sites in our survey:

- Forty-six percent of PDM systems are full production; 54 percent are pilot systems.
- The time to have system up and running ranged from one to 36 months. Ten months was average among all PDM sites, with 40 percent of users having the system running in five months or less.
- On average, 176 people have access to the PDM system. The number of people accessing the system ranged from one to 2,000; the median was 35 people.
- Engineering, manufacturing, and purchasing were cited most often as the groups using the PDM system on a regular basis (see Figure 6-2). Few sites had all groups within a company involved with the system. PDM systems were accessed about 62 times per day. The number of times the system was accessed ranged from one to 1,000, with the median being 11 times per day.
- The majority of the PDM systems were being acquired and set up at or under budget. About 63 percent of respondents said that their systems were at budget, 9 percent said they were below budget, and 28 percent said that their systems were over budget.

We asked users what improvements could be made to their PDM systems. The two most frequently cited answers were to improve the user interface of the system and to make it more integrated with their CAD system. Some users who were up and running on a PDM system were unclear as to what the system really does and what its purpose is.

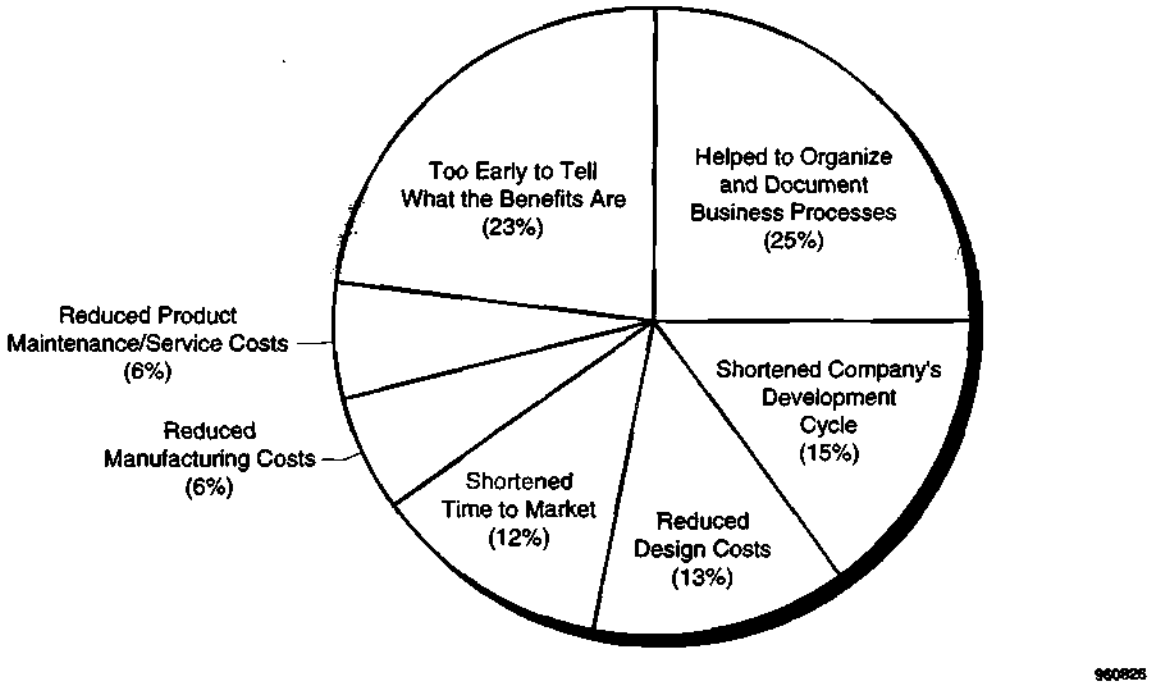
Figure 6-3 illustrates what PDM users think some of the benefits of their systems are. While we continually hear vendors touting the messages that PDM systems will help reduce product development times, lower costs, and help companies bring products to market faster, we rarely hear the message that PDM systems will help to organize a company's business processes. But from a user's perspective this is exactly the benefit that the users are seeing. Even more surprising is that for many users (nearly 25 percent), it is still too early to tell exactly what the benefits of the PDM system are.

Figure 6-2
Groups Using PDM System



Note: Multiple responses allowed
Source: Dataquest (January 1996)

Figure 6-3
User Perceived Benefits of PDM



Note: Multiple responses allowed
Source: Dataquest (January 1996)

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