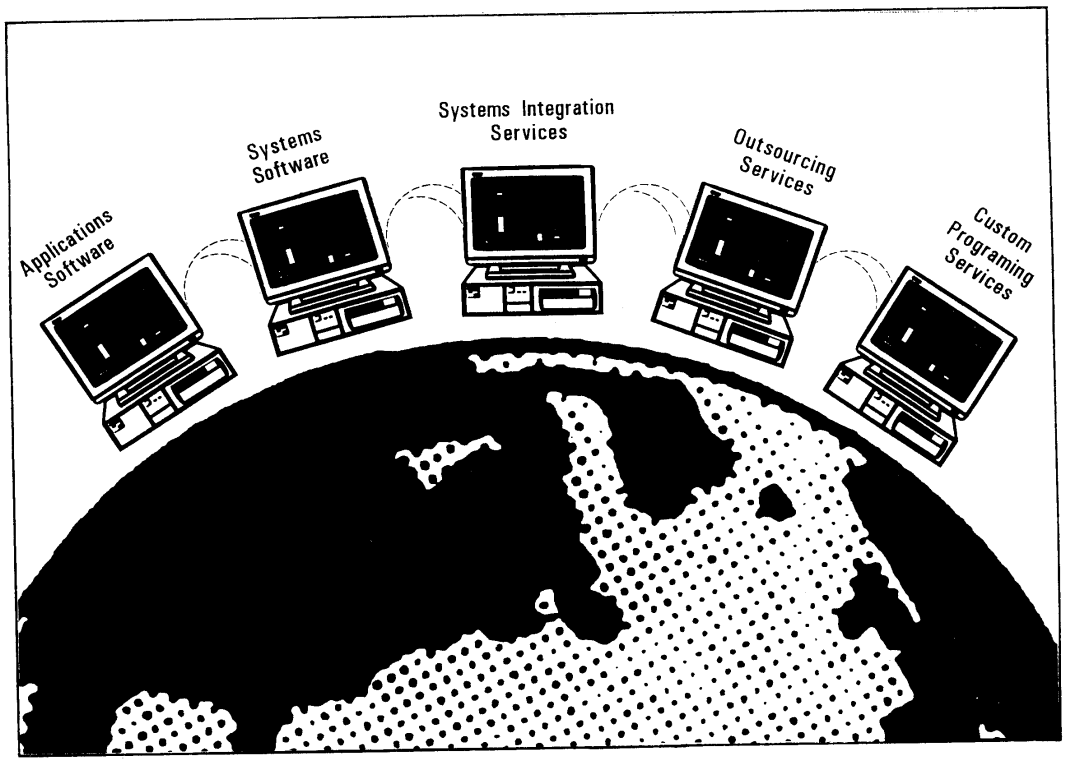
Staff Research Study

21

Office of Industries
U.S. International Trade Commission

Global Competitiveness of the U.S. Computer Software and Service Industries

June 1995



The views expressed in this staff study are those of the Office of Industries, U.S. International Trade Commission. They are not necessarily the views of the U.S. International Trade Commission or any of the Commissioners.

Office of Industries
Vern Simpson, Director

Project Manager
Lori Hylton Brown

Principal Authors
Lori Hylton Brown
Christopher Johnson
William Warlick

Services, Electronics, and Transportation Division

TABLE OF CONTENTS

TABLE OF CONTENTS-*Continued*

Page

TABLE OF CONTENTS-*Continued*

Page

Figures

TABLE OF CONTENTS-*Continued*

Page

Tables

EXECUTIVE SUMMARY

This staff study assesses the global competitiveness of the U.S. computer software and service industries through an examination of five distinct market segments: applications software, systems software, systems integration services, outsourcing services, and custom programming services. The study examines several external factors that impact these industries, such as government policies and education trends, as well as certain internal or company-specific factors, such as cost management strategies and product development techniques. The analysis focuses principally on the computer software and service industries in the United States, Europe, and Japan, which together are responsible for over 95 percent of global production. Competitiveness in each industry segment is assessed by comparing the global market share positions of major firms.

Industry Conditions

The global market for computer software and services reached approximately $277 billion in 1994. The United States is both the predominant supplier and the primary consumer of these goods and services. Europe and Asia account for a combined 46 percent of the global market, but only an estimated 20 percent of total production. The market for software and services is expected to continue strong growth as consumers strive to upgrade current software and enhance competitiveness through effective use of technology. Growth appears particularly strong for interoperable software products designed for networks of downsized hardware platforms, such as personal computers and workstations. Significant expansion opportunities also exist for computer service providers that offer customized solutions and streamlined operations for corporate and government clients.

- The global computer software market is expected to expand at an average annual rate of nearly 12 percent over the next 4 years, reaching approximately $140 billion in 1998. Applications software, which accounted for 52 percent of the 1994 software market, is the primary driver of market growth. Systems software, which accounted for the remaining 48 percent of the 1994 market, is projected to expand more slowly.

- Growth in the global computer services market is projected to be slightly lower than in the software market, primarily due to slowing demand for custom programming services. Data suggest that the services market will expand at an average annual rate of nearly 11 percent over the next 4 years, reaching an estimated $280 billion by 1998. In 1994, systems integration services accounted for 30 percent of the market, outsourcing services 33 percent, and custom programming services 37 percent.

Competitive Position of U.S. Firms

Spurred by early leadership in the computer hardware industry and strong research and development opportunities generated by government contracts, U.S. firms have dominated the software and service industries since their inception. Early recognition of the need to "unbundle" sales of hardware, software, and services launched a successful independent software industry in the United States in the late 1970s. Over time, U.S. firms have maintained leadership positions in each of the five market segments discussed in this report, despite relatively low barriers to entry for potential

competitors. Although many non-U.S. firms have emerged, most remain focused on domestic or regional markets and have not posed significant global threats to U.S. firms.

With respect to applications software developers, this report finds that:

- U.S. firms are highly competitive in the global market for applications software, particularly in business productivity programs such as word processing, spreadsheets, presentation graphics, and database systems. Early adoption of computer hardware standards in the United States and a large, sophisticated domestic market encouraged the development of a dynamic independent software industry. Although several non-U.S. firms have emerged as global competitors, including German-based SAP AG and Japanese-based Fujitsu, few have been able to match the early success of U.S. developers. Primary factors affecting the market position of firms competing in this segment include price, product quality, and time-to-market.
- Leading applications software vendors include traditional hardware companies, such as International Business Machines Corp. (IBM) and Digital Equipment Corp. (DEC), as well as rapidly growing independent software vendors such as Microsoft Corp., Computer Associates Inc., Novell Inc., and Lotus Development Corp. Firms that do well in the industry have devised effective strategies to reduce costs, improve product development methods, and establish powerful alliances.

With respect to systems software developers, this report finds that:

- U.S. vendors also are highly competitive in the global market for systems software. Although several European firms, such as Cap Gemini Sogeti, Finsiel, and Siemens-Nixdorf, have demonstrated some success in this market segment, many of their programs are designed for lower growth platforms such as mainframes. Further, a number of Japanese firms have developed software programs for large-scale hardware platforms, but most are designed to operate on proprietary systems that are not widely used in the global market. As firms vie for market share, key competitive factors include interoperability and ease-of-use for software products.
- Key firms in the systems software industry include IBM, Microsoft, Computer Associates, Novell, and Oracle. In response to increasing demands for interoperable and intuitive programs, vendors are establishing alliances that promote product compatibility and are improving responsiveness to customer demands by developing easy-to-use graphical user interfaces.

With respect to systems integration service providers, this report finds that:

- U.S. firms have established a strong reputation in the global market for systems integration services. Although several non-U.S. firms are gaining momentum in their home markets, only a few (e.g., Cap Gemini, Siemens-Nixdorf, and SHL Systemhouse) have emerged as global competitors. In some cases, foreign service providers are important partners for U.S. firms operating overseas, providing insight with respect to specific needs of the home market. Key factors affecting the market position of firms competing in this segment include vertical market expertise (e.g., specializing in integration needs for specific industries, such as financial services or manufacturing) and price. Vertical market expertise is particularly important as an increasing number of clients choose to enhance their competitiveness through effectively integrated information technology systems.
- Principal firms in the systems integration market include IBM's Integrated Systems Solutions Corporation (ISSC), Electronic Data Systems (EDS), Andersen

Consulting, and DEC. To meet growing demands for industry specific integration and competitive prices, systems integration firms are focusing on strong employee skill bases, alliances, and internal cost management skills.

With respect to outsourcing service providers, this report finds that:

- Of the five market segments, U.S. vendors are most competitive in the global market for outsourcing services. Market entry costs for outsourcing firms are considerably higher than in other market segments (based on investments required for sophisticated hardware and data processing facilities), but that alone does not explain the early dominance and continued strength of U.S. firms. This report finds that the key factors affecting firm competitiveness are contract price and the range of service offerings.
- Key firms include EDS, Computer Sciences Corp. (CSC), IBM/ISSC, and Automatic Data Processing (ADP). Successful firms appear to have developed unique pricing strategies, and many have expanded service offerings for clients who request one-stop shopping for all computer-related services.

With respect to custom programming service providers, this report finds that:

- Firms offering custom programming services face the most competition in the global market. Although revenue levels suggest that U.S. firms still dominate the industry, several non-U.S. firms, including the Indian-based Tata Consultancy Services, have increased their visibility and reputation in the global market. The primary factor affecting firms' ability to compete in this market segment is price.
- Currently, the industry is led by revenue giants IBM/ISSC, EDS, Andersen Consulting, and CSC. Given the labor-intensity of most custom programming projects, the easiest way for firms to reduce price is to minimize labor costs. Many non-U.S. firms have been very effective in reducing labor costs while maintaining quality output, thus improving their position in the market. Expanded electronic communications among countries also has improved opportunities for small, non-U.S. companies to compete in the global market. However, the strength of U.S. custom programming firms lies in their ability to manage complex projects and high-end programming.

External Policies Affecting the Industry

The most significant policies affecting the software and service industries are those related to the protection of intellectual property rights (IPR), telecommunications regulations, government research programs, export controls, government policies affecting capital formation for small businesses, and international education trends.

- Government efforts to promote IPR protection are extremely important to software developers. The U.S. software industry estimates annual losses of approximately $12.8 billion due to inadequate protection of software. The industry supports such multilateral accords as the new World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), which requires WTO members to adopt adequate copyright laws for software programs. In addition, bilateral efforts authorized by the "Special 301" provision of the 1988 Omnibus Trade and Competitiveness Act also are encouraged and supported by software developers. The Special 301 provision authorizes the Office of the U.S. Trade Representative to impose trade sanctions against countries that deny adequate and effective protection of intellectual property rights to U.S. persons. Industry representatives hope that efforts such as these will further reduce international piracy rates.

- Certain telecommunications regulations reportedly impose undue burdens on computer outsourcing firms. Competition appears to be most dynamic in countries with few regulations. Outsourcing firms are encouraging countries across the globe to liberalize leased line access rules for data transmission and to liberalize voice telephony, which is becoming an increasingly important component of outsourcing services.

- Government research programs designed to support the development of the software industry have generated mixed results. Early defense research programs were highly focused and, in some cases, resulted in important commercial applications. Other programs designed to incorporate both government and private sector participation have generated fewer positive results. It appears that government programs in the future will be most effective when setting broad objectives and reducing regulatory barriers. For example, plans underway in the United States, Europe, and Japan to develop national communications infrastructures likely will benefit the industry by establishing new distribution options for software and encouraging interoperable network standards.

- Government controls on the export of software with encryption capabilities remain an important issue for the industry. While government officials note that such controls facilitate overseas surveillance capabilities, industry representatives estimate that billions of dollars are lost in revenue every year from such restrictions.

- Government policy affecting capital formation for small businesses is a key factor influencing the competitiveness of start-up firms in these industries. Because small firms traditionally have served as important innovators in the software industry, capital formation to support small businesses is key. The U.S. market historically has generated greater levels of venture capital funding than other countries, and current initiatives under consideration in Congress may further encourage capital formation options in this creative segment of the industry.

- The complexity of the technology surrounding the computer software and service industries and the shortage of qualified personnel suggest that education opportunities may impact the competitiveness of software and service firms. Although many U.S. students reportedly fall below international averages in certain skills that are fundamental to programming and software development (e.g., mathematics and science), widespread use of computers and software in U.S. secondary schools likely will encourage the development of critical skills. Further, the abundance of U.S. schools offering degrees in computer science appears to confer a certain advantage to U.S. students, though the number of degrees received by foreign students at U.S. institutions is increasing more rapidly than those received by U.S. students.

Outlook

Prospects for the future of the software and service industries are both exciting and uncertain. As technologies supporting the telecommunications, cable, and computer industries converge, new products and specialized services are appearing on the market. As a result, new international players may emerge in tomorrow's industry. This study finds that three immediate trends likely will impact the future course of the software and service industries: consolidation of the information technology industry, an increased focus on the home/education market, and increased specialization among service providers.

- The convergence of computers, entertainment, and communications toward an interactive multimedia industry is forcing a consolidation within the information technology industry. Alliances among information content providers and software

developers have already been established and will continue as long as demand for multimedia options appears strong. U.S. firms are well-placed to benefit from the convergence of these industries, given their current control of network standards and operating systems.

- The prospering home and school markets will drive much of the software supply trends over the next few years. CD-ROM software titles, on-line banking, and the appearance of specialty databases will encourage home and school use of new types of software. While U.S. firms have the potential to dominate many of these emerging markets, competition from foreign firms may intensify. The success of Japanese game makers such as Nintendo and Sega suggests that the home entertainment market will be characterized by fierce competition.

- The computer services industry will become increasingly specialized over time. Already many service providers are developing in-house specialties to address the needs of different vertical markets. In the future, however, more computer service firms will enter into joint ventures with clients to develop industry-specific services. Spin-off firms growing out of joint ventures are likely to emerge as competitive providers of specialized information technology services in such industries as financial services and health services.

CHAPTER 1
Introduction

Purpose of Study

The purpose of this study is to assess the nature of competition in the global computer software and service industries.[1] These industries rank among the fastest growing high-technology sectors in the United States, with annual revenue and employment growth rates consistently surpassing growth rates for the U.S. economy as a whole (see figure 1-1). As both a consumer and a vendor of advanced technological processes, the software and service industries influence productivity and process innovation at all levels of the global economy. Increasingly, these industries contribute to the creation of competitive advantages in other sectors of the economy, enabling end-user firms to offer goods and services more efficiently and at lower costs to consumers. In many respects, therefore, the computer software and service industries are the quintessential high-technology industries.

This study attempts to provide policy makers and other interested parties with a thorough and methodical assessment of the factors influencing the ability of U.S. firms to compete in global markets for computer software and computer-related services. Context for this assessment is provided throughout the study on several levels, with special attention given to an examination of prevailing industry trends, firm strategies, government policies, and recent technological developments.

Approach

This study analyzes the computer software and service industries by examining five distinct industry segments: applications software, systems software, systems integration services, outsourcing services, and custom programming services (see Scope of Study). Within each segment, the study identifies and analyzes both firm-specific factors and factors external to firms that influence competitiveness. Firm-specific factors include company skills such as cost management techniques, marketing efforts, and product development strategies. External factors include government policies and national education systems. Global market share is examined to assess the competitive positions of firms within each of the five industry segments.

Competitiveness Defined

Competitiveness has been defined in a variety of ways, but one common element runs through most definitions: competitiveness is the ability of a nation, national industry, or firm to produce goods and services that customers choose over competing alternatives.[2] Some definitions add the caveat that a firm must also be able to operate on a profitable basis.[3] Several indicators are commonly used to assess competitiveness. Indicators such as global market share, profitability, trade balances, and shipments may reflect the degree of success that firms have found in world markets.[4] Relatively high wage

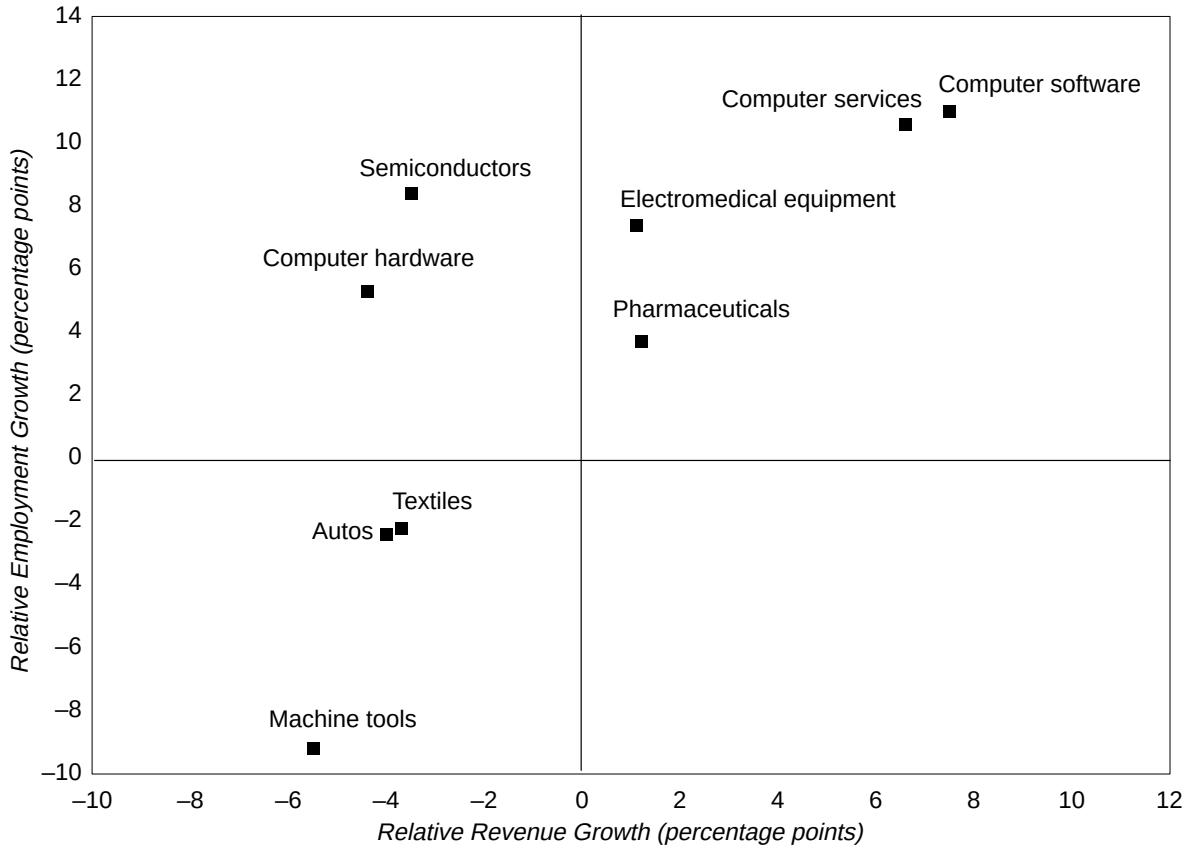
[1] The U.S. International Trade Commission (USITC) previously has examined global competitiveness in the following U.S. advanced-technology industries: electromedical equipment (1994), computers (1993), cellular communications (1993), large civil aircraft (1993), communications technology and equipment (1991), pharmaceuticals (1991), and semiconductor manufacturing and testing equipment (1991). Reports on these industries are available from the USITC.

[2] President's Commission on Industrial Competitiveness, *Global Competition—The New Reality*, vol. 1 (Washington, DC, Jan. 1985), p. 6; and Competitiveness Policy Council, *Building A Competitive America: First Annual Report to the President and Congress* (Washington, DC, Mar. 1992), p. 1.

[3] Theodore W. Schlie, *Analysis of Studies of the International Competitiveness of Specific Sectors of U.S. Industry*, draft prepared for Competitiveness Policy Council (Bethlehem, PA, Jan. 26, 1993), p. 8.

[4] Trade data are not considered in this study due to the inefficiencies that exist in measuring software imports and exports. The reported value of traded goods represents only the estimated value of the media upon which the recordings are made (e.g., a disk). The value of the recording content (e.g., a software program) is not considered in calculating the product's customs value. As a result, the value of imported and exported software is understated and does not provide an effective measure of competitiveness.

Figure 1-1
Recent growth of selected U.S. industries[1], 1988-92



[1] Relative revenue growth is the difference between the average annual revenue growth rates of a selected industry during 1988-92 and the average annual growth rate of U.S. gross domestic product. Relative employment growth is the difference between the average annual employment growth rate of a selected industry and the average annual growth of U.S. private sector employment.

Source: USITC staff and U.S. Department of Commerce, *1994 U.S. Industrial Outlook* (Washington, DC: GPO, 1994).

and employment levels may also reflect this success. Other indicators, such as productivity and the rate of product innovation, are factors thought likely to enhance competitiveness.[5]

While no single indicator captures everything that is implied in the term "competitiveness," this report focuses primarily on the global market share of firms, because market share gives a direct indication of the relative success of firms in attracting customers. Further, comparable data are more readily available for market share than for other potential indicators, in part due to international differences in firm structure and accounting procedures.[6] Recognizing

[5] For more information on the role of productivity measures in determining competitiveness see, Lester C. Thurow, *Head to Head: The Coming Economic Battle Among Japan, Europe, and America* (William Morrow and Company, Inc.: New York, 1992), pp. 163-168; and Paul Krugman, "The Myth of Asia's Miracle," *Foreign Affairs* (Nov./Dec. 1994), pp. 67-68.

[6] Similar conclusions are reached in Franklin M. Fisher, Joen E. Greenwood, and John J. McGowan, *Folded, Spindled, and Mutilated: An Economic Analysis of U.S. vs. IBM* (Cambridge: MIT Press, 1983). A number of studies that address the issue of competitiveness suggest or use market share as a measure of firm performance. For instance, see U.S. Department of Commerce, *The Competitive Status of the U.S. Electronics Sector* (Washington, DC: Government Printing Office (GPO), Apr. 1990); and Gary L. Guenther, "Industrial Competitiveness: Definitions, Measures, and Key Determinants" (Washington, DC: Congressional Research Service, Feb. 1986). Moreover, certain industry representatives have supported the use of market share as an indicator of competitiveness.

that there are certain limitations to the use of this indicator,[7] market share remains the most suitable indicator of firms' performance in the global computer software and service markets.

Data Sources

Information for this analysis has been collected from a wide variety of sources. Commission staff conducted interviews in the United States and Europe with principal computer software and service suppliers, research consortia, industry analysts, and government officials.[8] Information also was gathered from an extensive review of literature on the industry.[9]

Scope of Study

The computer industry as a whole consists of three principal components: the computer hardware industry, the computer software industry, and the computer service industry (figure 1-2).[10] As stated previously, the focus of this study is the computer software and computer service industries. Trends and developments within the computer hardware industry receive treatment only insofar as they affect competition in the computer software and computer service markets.[11]

This study reviews the performance of computer software and service suppliers in each of the five distinct market segments: applications software, systems software, systems integration services, outsourcing services, and custom programming services. Figure 1-3 lists the largest firms in each market segment. These markets are considered separately because each industry segment includes products with distinctive characteristics and because firm strategies, technology trends, and customer needs combine to affect the competitiveness of firms differently.

Applications software products are packaged programs used to support home, business, or other institutional functions. These products may be used on a variety of hardware platforms, including mainframes, minicomputers, workstations, and personal computers (PCs).[12] The applications software segment encompasses everything from widely used business productivity programs (e.g., word processing, spreadsheets, graphics) to more complex programs such as company accounting and human resources packages that often are written to run on high-powered mainframes and minicomputers.

Systems software products form the bridge between computer hardware and applications software, and between the computer and its users. Systems software commonly includes PC and network operating systems, system management tools, programming languages, and database management software. System management tools and programming languages allow users to build custom applications to meet their particular computing needs.[13]

Systems integration (SI) services involve the consolidation of heterogenous hardware and software products into seamless computer networks, generally designed to meet specific end-user requirements. Systems integration providers are responsible for all levels of a project, including system design, hardware and software recommendations, system installation, software customization, and end-user training. The growing number of diverse products available on the market has created significant demand for these types of "solution" services.

---

[7] There are acknowledged weaknesses in using market share as an indicator of competitiveness. First, firms may seek to maximize their profits rather than market share. Second, assessing competitiveness in terms of market share, calculated on the basis of sales revenue rather than units, may understate the market success of firms that reduce prices more aggressively than competitors. Third, market entry by new firms may reduce the market share of established firms without reflecting any decline in the factors that make those firms competitive.

[8] See appendix A for the list of firms, associations, and government agencies interviewed by Commission staff during the course of this investigation.

[9] See appendix B for a bibliography of sources used in the study.

[10] A brief discussion of the evolution of these industry components, and their interrelationships, is presented in chapter 2. The computer service industry considered here includes services used to operate computer hardware. It does not include any on-line electronic information services.

[11] For a fuller treatment of the computer hardware industry see USITC, *Global Competitiveness of U.S. Advanced-Technology Industries: Computers* (investigation No. 332-339), USITC publication 2705, Dec. 1993.

[12] See appendix C for definitions of terms related to the software and service industries.

[13] These tools often are used in combination with large-scale database management programs to help end users develop customized views of information drawn from diverse computers or multiple databases within a single computer.

Outsourcing encompasses external processing services and external systems management services. Processing services, such as data entry and disaster recovery, often are outsourced to take advantage of a remote processing center's capacity and/or technology. Outsourcing firms and clients often access remote sites by transmitting data over telephone lines. Outsourcing services also include external systems management (also called facilities management), whereby a client transfers responsibility for some or all of its information technology division from in-house control to a third-party vendor. The vendor assumes responsibility for operating, managing, and maintaining a client's information systems. Systems management can be carried out at either the client or vendor location. Overall, outsourcing services have gained popularity as firms focus on their core competencies and relinquish high-cost business activities in which they have insufficient expertise.

Custom programming services involve the compilation of code to create or customize software programs. These projects range widely in size. For example, a custom programming assignment may entail the development of an entirely new application, or it may involve customization of an existing packaged software product. Data used for custom programming in this study include revenues from training and consulting projects. However, revenue from custom programming services makes up the bulk of this service segment.

Organization of Study

Chapter 2 lays the groundwork for the analytical component of the study by providing a brief history of the software and service industries and examining prevailing industry trends. This chapter also provides a baseline analysis of the global industry, offering perspective on its size and growth, as well as the relative competitive position of U.S. firms.

Chapter 3 examines the nature and impact of external factors, namely government policies and education systems, that affect computer software and service firms in principal supplier countries. Key government policies include intellectual property rights (IPR) protection, telecommunications regulations, research programs, export controls, and policies affecting small businesses.

Chapter 4 analyzes the competitive performance of the U.S. computer software and service industries. The assessment provides a framework of the most important factors influencing firms' competitive position, then it identifies critical firm strategies that lead to market share gains in each of the five industry segments.

Finally, chapter 5 presents the study's principal findings concerning the present competitive position of U.S. firms. The chapter also includes an industry outlook section that offers insight into the future competitive position of U.S. firms in the global software and service industries.

CHAPTER 2
The Computer Software and Service Industries

Introduction

This chapter is designed to provide an overview of the evolution of the computer software and service industries, including an examination of regional market size and projected growth trends. In addition, it assesses the current competitive position of U.S. firms, based on global market position. Finally, the chapter reviews prevailing trends in the software and service industries and the effects these trends have on firm strategies.

Industry Evolution

Over the past two decades, the structure of the global software and service industries has been fundamentally altered. Above all, the evolution of the industries reflects the combined impact of two sets of historical forces. First, there have been rapid technological changes culminating in the growth of personal computer (PC)-based networks as the predominant computing platform for customers around the world. Second, there has been an intensification of supplier competition brought about by heightened demand for new products and services designed to help decentralized networks of desktop computers work together effectively.

During the first 25 years of the modern computer era, from the introduction of the first commercially viable systems in the early 1950s until the appearance of early microprocessor-based personal computers in the late 1970s, the software and service industry[14] was dominated by a small number of integrated computer hardware manufacturers (see figure 2-1).[15] Companies such as International Business Machines Corp. (IBM), Burroughs, Univac, and Honeywell manufactured computer hardware based on proprietary design specifications and offered software and services to support only their own proprietary machines. Software applications, often delayed in development by laborious programming techniques, were almost always written on a customized basis for large corporate and government computer users. Early programming and systems integration (SI) services were provided exclusively by the major hardware vendors and small staffs of information technology specialists at the customer's computing site. By all measures, the early computer industry was highly concentrated, and the so-called "bundling" of software and services with computer hardware was common.

By the mid-1960s, however, some significant changes in technology and company strategy signalled the emergence of new competitive forces in the global software and service industry. IBM's introduction of its *System 360* line of mainframe computers in 1964 represented the first effort by a hardware manufacturer to create a family of computers based on a common set of technical standards. By establishing a common architecture capable of running the same software on several different types of machines, IBM helped lower software development costs and boosted the number of software applications available to mainframe users worldwide. The significance of software's role in the computing environment was further accented by

[14] Originally, computer hardware, software, and services comprised a single industry since they were "bundled" together for sale as a unit. Today they generally are considered to be three distinct industries.

[15] Much of the early growth of the computer industry took place in the United States due to high levels of demand from the Department of Defense. For a detailed history of the industry's early years and the role of the U.S. Government in supporting computer-related research, see Kenneth Flamm, *Targeting the Computer: Government Support and International Competition* (Washington, DC: Brookings Institution, 1987).

Figure 2-1
Key dates in the evolution of the computer software and service industries

1950s	First commercially successful computers are sold, principally to government and large corporate customers. Software and services are bundled with the hardware for sale as a customized unit. Software typically constitutes a small part of the total system's value. Large hardware manufacturers are essentially the sole providers of software and services.
1964	IBM introduces its groundbreaking System 360 line of computers, emphasizing compatibility and interoperability of software applications across different IBM computers. Interoperability leads directly to steep declines in the cost of software development.
1960s	Federal Government agencies launch the systems integration industry in the United States by hiring outside firms to coordinate, design, and install large-scale data systems. Federal contracts dominate the systems integration market through the early 1980s.
1965-69	A new generation of less expensive minicomputers, designed by companies such as Digital Equipment Corp., expands the installed base of computers and creates new opportunities for user interaction with computer systems. Customer demand for software running on this new computer platform grows rapidly. Software begins to represent a much larger part of a computer system's value.
1969	IBM begins pricing software separately from hardware. By "unbundling" sales of computer systems, IBM stimulates growth of an independent software industry.
1969	A team of U.S. programmers working at Bell Laboratories in New Jersey releases the first version of Unix, a new brand of operating system software designed to make communications among networks of heterogenous computers easier.
1971	Intel Corp., a small California-based chip maker, unveils its first microprocessor. This new type of integrated circuit creates opportunities for computer companies to manufacture smaller and much less expensive machines.
1977	Apple Computer introduces the first commercially successful personal computer (PC), the microprocessor-based *Apple II*. The *Apple II* 's operating system software is bundled with the machine.
1980s	With new levels of technology and products available on the market, private sector companies turn to systems integrators to streamline heterogenous computing systems. Companies also rely on systems integrators to enhance corporate competitiveness by customizing networks according to industry-specific needs. The private sector becomes the largest and fastest growing market for systems integration services, surpassing the historically larger Federal market.
1981	IBM selects Microsoft as the supplier of the operating system software for IBM's personal computer. The selection of Microsoft lays the foundation for further growth of independent software vendors. The IBM design, with Microsoft's *Disk Operating System (DOS)* at its core, becomes a standard for personal computers developed throughout the 1980s.
1982-84	Hundreds of independent software developers, including Lotus Development and WordPerfect, grow rapidly in response to explosive demand for new types of software applications running on the PC platform.

Figure 2-1—*Continued*
Key dates in the evolution of the computer software and service industries

1984	Apple introduces the *Macintosh* operating system for its line of personal computers. The system incorporates a graphical user interface (GUI), making user interaction with the computer more intuitive. Developers of *Macintosh*-based software quickly flood the market with new products.
1989	Outsourcing emerges as a key service business in the United States when Eastman Kodak becomes the first large company to turn over its internal information systems management completely to an outside contractor (IBM). As corporate downsizing gains popularity in the United States, the market for firms offering outsourcing services expands rapidly.
1990	Microsoft launches *Windows 3.1*, a graphical user interface running on personal computers that quickly becomes a standard around which thousands of PC-based software applications are developed. By late 1994, over 65 million copies of *Windows* are installed on personal computers around the world.
1993	Microsoft builds upon the success of Windows with the release of a network-based operating system, *Windows NT*. This product release reflects the rapidly growing demand for distributed computing platforms, particularly client/server-based systems.

Source: USITC staff.

IBM's decision in 1969 to "unbundle" its hardware sales, pricing software as a separate and distinct product.[16] Toward the end of the decade, the emergence of the minicomputer as a scaled-down and less expensive alternative to the mainframe expanded significantly the installed base of computers and software in corporations, government agencies, and educational institutions. Centralized data processing remained common as a computing paradigm in this period, and custom software development and systems integration services were still largely in the hands of the hardware manufacturers.

It was not until the mid-1970s that industry fragmentation began. The catalyst for this transformation was the growing power of the microprocessor—a single silicon chip capable of controlling powerful but much less expensive types of computers. The introduction of new microprocessor-based personal computers, built by start-up companies such as Apple Computer in the late 1970s, helped usher in a period of transition in which mounting demand for new software products and services led to the emergence of thousands of new companies.[17] The industry's transformation was accelerated when IBM launched its own personal computer in 1981. IBM's choice of Microsoft Corp. as the developer of the new PC's operating system represented an enormous step toward the creation of an entirely new software industry led by independent developers of increasingly popular PC-based programs.[18]

The rapidly growing popularity of personal computers running Microsoft's *Disk Operating System (DOS)* and, subsequently, Apple's graphically based *Macintosh* operating system marked the appearance of a radically new computing philosophy built around the non-technical individual user's ability to interact with computers in a more intuitive fashion. Independent software vendors such as

[16] Organization for Economic Co-operation and Development (OECD), *Software: An Emerging Industry* (Paris: OECD, 1985), p. 180. Several companies filed complaints against IBM for its single pricing policy of hardware and software, alleging that this practice violated the Sherman Act. (See 302 F. Supp. 796 (1969)). Aware of these complaints, IBM began to price its hardware and software separately in 1969. IBM official, telephone interview by USITC staff, Mar. 6, 1995.

[17] Small start-up companies have remained a dynamic force in the industry ever since this period. While revenues continue to be highly concentrated among the top 5 to 10 large firms in the industry, the research and innovations developed by smaller competitors have made significant contributions to the progress of both software and services.

[18] Up to this point, most software had been developed by U.S. hardware companies and research institutions. As a result, the United States had the largest supply of skilled programmers with which to launch an independent software industry.

Microsoft Corp. and Lotus Development Corp. grew quickly in response to the explosive demand for new PC-based computer applications. Although the large hardware manufacturers also increased software sales, their close ties to mainframe and minicomputer platforms made them less responsive to customer demands for PC-based applications.

By the late 1980s, the popularity of personal computers led to the creation of electronic networks linking powerful desktop PCs and workstations.[19] These decentralized computing environments connect several "clients" (usually PCs or workstations) to a central "server" (usually a workstation). The server is responsible for storing data and distributing applications to the client machines. These "client/server" systems have decreased the number of tasks traditionally handled by mainframes and have increased computing power and access for individual users at the desktop. Client/server networks also increase the need for applications and system software products capable of optimizing the power of decentralized computing resources. The encouragement of interoperability—smooth communications between diverse software and hardware elements in a network—quickly became a principal objective of many software firms worldwide.

During the late 1980s and early 1990s, the increasing complexity of computer networks created a need for new types of computer services. Service providers such as Electronic Data Systems, Inc. (EDS) and Andersen Consulting grew rapidly in response to increasing technological complexity and customers' desires to reduce the cost of in-house data processing and system design. While many of these companies had emerged long before as providers of systems integration services to government agencies, their importance in the commercial sector grew throughout the 1980s and early 1990s as the computing power and savings associated with network-based systems became apparent.[20]

By the early 1990s, therefore, distinct software and service industries had emerged in the United States and in the leading computer markets of Europe and Asia.[21] The largest hardware manufacturers—including IBM, Digital Equipment Corporation (DEC), and Unisys in the United States; ICL and Siemens-Nixdorf in Europe; and Fujitsu in Japan—have moved aggressively to expand their software and service offerings in an attempt to capture the higher profit margins associated with these businesses.[22] These firms, however, are still constrained by their commitment to large-scale computing platforms—namely, mainframes and minicomputers. For thousands of independent software vendors and service providers, on the other hand, prospects for sustained growth in revenues and profits remain bright as worldwide demand for increasingly complex and fully interoperable network-based computers continues to grow at a strong pace.

Size and Growth of the Global Software and Service Markets

Over the course of the past 5 years, the global market for computer software and services has grown by nearly 70 percent, reaching an estimated $277 billion in 1994.[23] The United States historically has been responsible for the majority of global market demand. In computer software, the United States accounts for an estimated 56 percent of the overall market, followed by Europe with approximately 30

[19] Workstations are similar in appearance to PCs, but generally offer greater processing capacity. For more information, see the glossary in appendix C.

[20] Although government contracts dominated the U.S. market for SI services during the 1960s and 1970s, commercial customers now drive the industry. The commercial market for SI services is projected to expand at over twice the rate of the government market through 1998. Projections are based on data provided by INPUT, Inc.

[21] Recognition of software and services as distinct industries occurred more gradually in Europe and Asia than in the United States. In Europe, independent software vendors were slow to emerge, causing a delay in widespread use of packaged applications. In Japan, meanwhile, lack of a common set of technical standards to which software firms could direct their development efforts hindered the growth of an independent software industry. As recently as 1992, the Japanese Ministry of International Trade and Industry (MITI) issued a directive calling for Japanese companies to unbundle their software from computer sales in an effort to encourage the emergence of an independent software industry. MITI, "Urgent Proposal: The New Age of Software," Industrial Structure Council, Information Industry Committee, Draft White Paper, 1992.

[22] IBM offers computer services through a subsidiary called Integrated Systems Solutions Corporation (ISSC). A 1956 Consent Decree required IBM to establish a separate subsidiary for the provision of services and barred the subsidiary from carrying IBM's name or receiving any price breaks on IBM equipment. *United States v. International Business Machines Corp.*, 1956 CCH Trade Cases ¶ 68,245 (S.D.N.Y. 1956). IBM currently is seeking to have the decree lifted. Thomas Hoffman, "IBM Services Hitting the Mark," *Computerworld*, (June 27, 1994), pp. 1, 28.

[23] Based on data provided by INPUT, Inc.

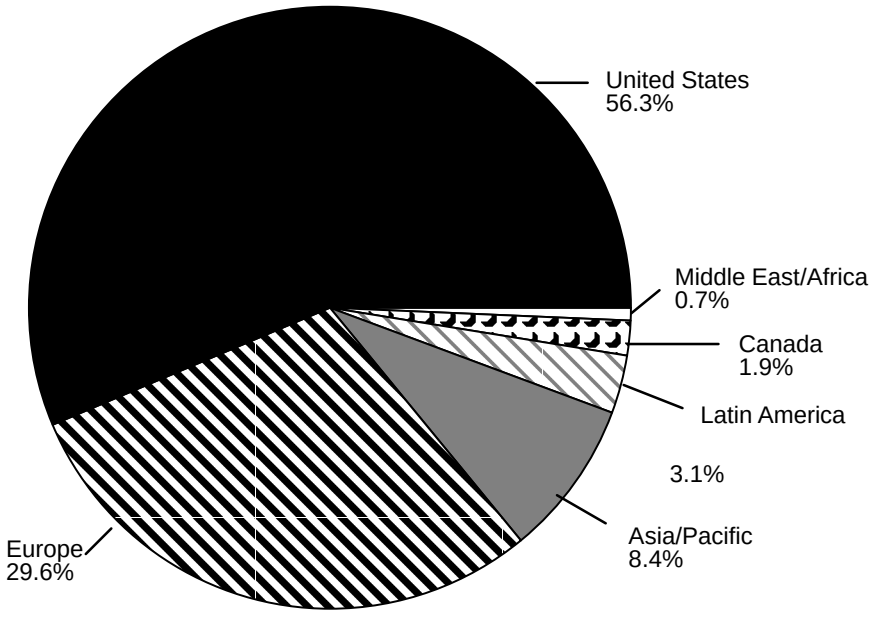
percent (figure 2-2). This software demand pattern reflects the maturity of computer hardware markets in both the United States and Europe. Historically strong hardware demand in both regions, particularly in the area of PC hardware, has encouraged a complementary expansion of packaged software sales. The Asia/Pacific region currently accounts for less than 10 percent of the global software market. This primarily is due to a lower overall hardware penetration rate[24] and a regional tendency to rely more on custom-programmed software.[25] However, sales of software in the Asia/Pacific region are forecast to expand at an average annual rate of 16 percent during 1994-98 as the popularity of interoperable personal computers and inexpensive packaged software grows.[26] Examined by segment, the United States

[24] For example, the Japanese Ministry of Posts and Telecommunications (MPT) reports that only 6 percent of Japanese homes have personal computers (compared to 16 percent of U.S. homes), and only 9 percent of computers in Japan are linked to local area networks (compared to 52 percent in the United States). MPT, *Japan Scope* (Summer 1994), p. 14.

[25] Clients often need custom-programmed software to operate proprietary Japanese hardware systems. Unlike the U.S. industry, where *de facto* standards emerged rapidly in the PC market, most Japanese hardware systems have remained proprietary and, as such, have slowed opportunities for widespread growth of independent software vendors and packaged software products. This is changing as Japanese versions of U.S. operating systems such as *DOS/V* and *Windows 3.1* compete for control of the market.

[26] Software sales also are expected to increase as illegal copying (piracy) of software titles decreases. See chapter 3 for more information on this issue.

Figure 2-2
Global market for computer software, by major country or region, 1994[1]



Global market = $90 billion

[1] Includes markets for applications and systems software.

Source: Compiled from data provided by INPUT, Inc.

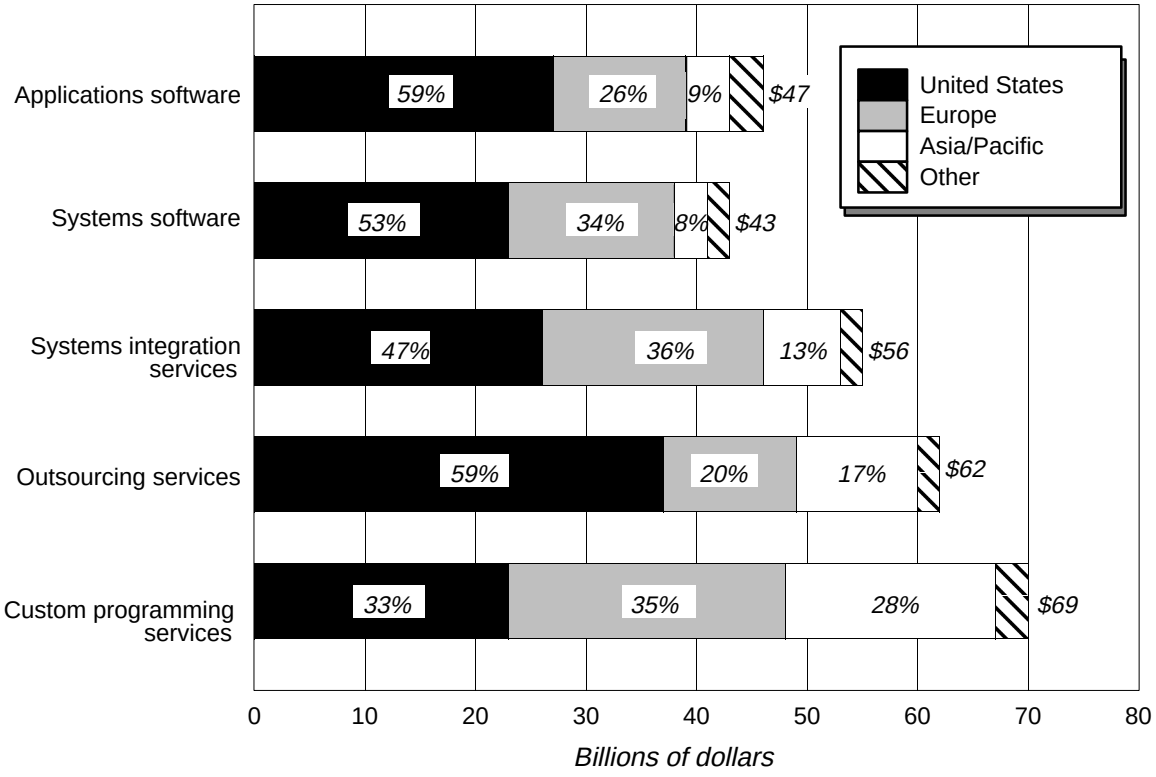
accounts for the majority of the applications and systems software markets, though Europe's share of the systems software market is significant due, in part, to the large installed base of mainframes, minicomputers, and computer networks in European Union (EU) member countries (see figure 2-3).[27]

A regional analysis of the global market for computer services reveals many similarities with the global software market. The United States again accounts for the largest single share, with an estimated 46 percent of the total market (figure 2-4). Service markets in Europe and Asia also are strong, however, with shares of 30 percent and 20 percent, respectively. Examined by segment (figure 2-3), Europe maintains a substantial share of the market for systems integration services (36 percent), reflecting the expansion of client/server technology among customers in the EU. Installation of client/server networks often requires assistance from third-party service firms to integrate the heterogenous hardware and software technology. The Asia/Pacific region currently accounts for a considerably smaller share of the SI market (13 percent). However, as the number of interoperable hardware and software systems available in this region increases, the complexity of interconnection likely will fuel growth in systems integration sales.

In outsourcing services, the United States dominates the global market with a 59-percent share of worldwide demand. This is indicative of the importance U.S. companies currently place on the

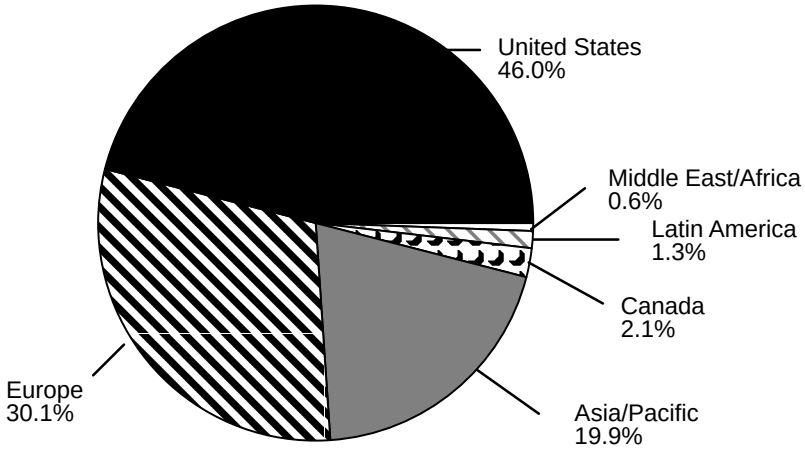
[27] Client/server networks and other forms of distributed computing rely on a variety of systems software products for efficient operation.

Figure 2-3
Regional markets for computer software and services, 1994



Source: Compiled from data provided by INPUT, Inc.

Figure 2-4
Global market for computer services, by major country or region, 1994[1]



Global market = $187 billion

[1] Includes markets for systems integration, outsourcing, and custom programming services.

Source: Compiled from data provided by INPUT, Inc.

concept of corporate restructuring.[28] Restructuring often entails the outsourcing of non-core components of a business, including information technology. This trend slowly is expanding into Europe, and the outsourcing market for that region is projected to grow at an average annual rate of 11 percent during 1994-98. To date, outsourcing has been less popular in the Asia/Pacific region, where companies traditionally are vertically integrated[29] and prefer to handle information technology in-house. However, recessionary trends in the region increasingly are forcing companies to consider outsourcing certain services to cut operating costs.

Finally, Europe's share of the global custom programming market is slightly larger than the U.S. share.[30] This is explained by Europeans' historical reliance on custom programming over packaged software for many of their program needs.[31] This reliance is changing, however, as the expense of custom programming relative to low-priced packaged applications is motivating consumers to purchase packaged software, mirroring an existing trend in the U.S. market. Asia's share of the custom programming market also is significant (28 percent). Strong regional demand in Asia reflects consumers' need for programs capable of running on proprietary hardware and their preference for customized systems over standard applications, particularly in Japan.[32]

The United States and Europe clearly dominate the global markets for software and services in terms of relative market size. In spite of this position, however, growth in the smaller markets of Latin America and the Middle East/Africa will outpace growth trends in the North American and European

[28] Restructuring generally involves reorganizing corporate structures to eliminate waste and improve efficiency. Common synonyms for this process include corporate "downsizing," "rightsizing," and "business process re-engineering." Industry representatives, interviews by USITC staff, Washington, D.C., Sept.-Oct., 1994; and INPUT, Inc., conference on information technology, Sept. 21-22, 1994, Vienna, VA.

[29] Vertically integrated companies generally produce both key product components and final products, such as semiconductors and computers.

[30] Data for custom programming also include consulting, education, and training revenue. Custom programming accounts for over 60 percent of the total.

[31] Packaged software prices historically have been higher in Europe than in the United States, primarily because the fragmented European market has failed to generate the necessary economies of scale for a strong domestic industry of independent software vendors. This has encouraged wider use of custom programming by consumers in that market.

[32] In 1993, packaged software products accounted for only 10 percent of the Japanese software market, compared to 34 percent of the U.S. market. INPUT, Inc., *Worldwide Information Services Forecast 1993-1998*, p. 133.

markets over the next several years.[33] Figure 2-5 forecasts regional growth trends for 1994-98.

Competitive Position of U.S. Industry

The opportunities presented by the large and growing markets for software products and services are reflected in the number of companies active in the industry. Worldwide, the number of firms offering primarily software or computer services is estimated to be over 100,000,[34] many of which are small entrepreneurial companies with less than 100 employees.[35] There is a significant concentration of revenues among the top 15 firms.

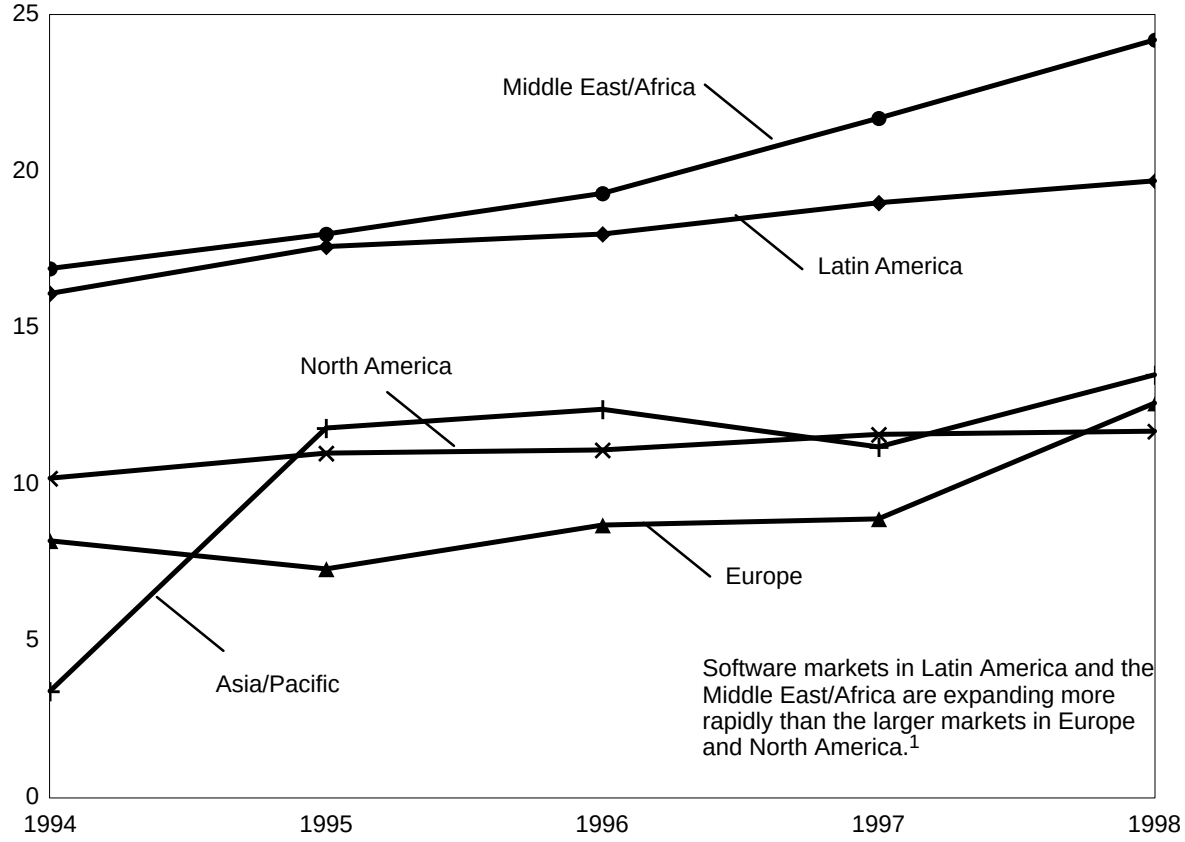
[33] North America includes the United States and Canada. Mexico is included in Latin America.

[34] USITC staff estimate based on data from the Bureau of the Census, *Census of Service Industries*, 1992.

[35] Low barriers to market entry have permitted small businesses to become a significant component of the computer software and service industries. Many entrepreneurs have kept start-up and overhead costs at an absolute minimum by developing software businesses out of home offices.

Figure 2-5
Annual growth rates in regional software and service markets, 1994-98

Annual growth (percent)



[1] North America includes the United States and Canada.

Source: Compiled from data provided by INPUT, Inc.

In the global industry, U.S. firms account for the majority of sales of software and services. Unlike the computer hardware industry, where European and Japanese firms historically have been major competitors of U.S. companies, the software and service industries have not generated a large number of global contenders outside the United States.[36] Figures 2-6 and 2-7 show the top 10 vendors for each of the major industry segments studied in this report. Global revenue leaders such as IBM, IBM/Integrated Systems Solutions Corp. (ISSC), Microsoft, Unisys, and DEC, dominate much of the industry, and few non-U.S. firms appear on these charts. For example, 8 of the top 10 applications software firms are headquartered in the United States, as are 7 of the top 10 systems software firms. In computer services, 7 of the top 10 systems integration firms are U.S.-based, as are 9 of the top 10 outsourcing firms, and 8 of the top 10 custom programming vendors.

European companies have been somewhat more successful than Japanese firms in competing against U.S. companies in the global market. Several German firms, namely SAP AG and Siemens-Nixdorf, are ranked among the top 10 software companies, and Software AG falls within the top 20. Software AG established itself in the U.S. market before distributing its products extensively in Europe, a strategy that some analysts suggest contributed to its global success.[37] On the services side, German-based Siemens-Nixdorf and French- based Cap Gemini Sogeti have gained

[36] The development of such a large industry in the United States is attributed to several factors, including the availability of government and defense contracts for early research, the strength of the U.S. computer hardware industry, the existence of a large and sophisticated market, and the widespread acceptance of the English language as a basis for programming. For more information on this phenomenon, see Stephen E. Siwek and Harold W. Furchgott-Roth, *International Trade in Computer Software* (Westport, CT: Quorum Books, 1993).

[37] Software AG currently is ranked second only to SAP AG in software sales to the German market. Alfred Vollmer, "Germany's Software Market Slows," *Electronics*, June 27, 1994, p. 14; and industry representatives, interview by USITC staff, Darmstadt, Germany, May 19, 1993.

Figure 2-6
Leading vendors in the global market for applications and systems software, 1994

Applications software

Company *(country)*	Global market share
IBM Corp. *(U.S.)*	24%
Microsoft *(U.S.)*	18%
Computer Associates *(U.S.)*	6%
Lotus *(U.S.)*	6%
WordPerfect Corp. *(U.S.)*	4%
Fujitsu *(Japan)*	4%
SAP AG *(Germany)*	3%
Digital Equipment Corp. *(U.S.)*	2%
Borland *(U.S.)*	2%
Dun & Bradstreet *(U.S.)*	2%

Systems software

Company *(country)*	Global market share
IBM Corp. *(U.S.)*	21%
Microsoft *(U.S.)*	14%
Computer Associates *(U.S.)*	9%
Novell *(U.S.)*	6%
Cap Gemini Sogeti *(France)*	4%
Oracle *(U.S.)*	4%
Unisys *(U.S.)*	3%
Finsiel *(Italy)*	2%
AT&T *(U.S.)*	2%
Siemens–Nixdorf *(Germany)*	2%

Source: Compiled from USITC staff estimates and data provided by INPUT, Inc.

Figure 2-7
Leading vendors in the global market for systems integration, outsourcing, and custom programming services, 1994

Systems integration services

Company *(country)*	Global market share
IBM Corp./ISSC *(U.S.)*	18%
EDS *(U.S.)*	11%
Andersen Consulting *(U.S.)*	11%
Digital Equipment Corp. *(U.S.)*	6%
Unisys *(U.S.)*	6%
Cap Gemini Sogeti *(France)*	4%
Siemens–Nixdorf *(Germany)*	4%
Science Applications Int'l Corp. *(U.S.)*	3%
Computer Sciences Corp. *(U.S.)*	3%
Fujitsu *(Japan)*	2%

Outsourcing services

Company *(country)*	Global market share
EDS *(U.S.)*	12%
Computer Sciences Corp. *(U.S.)*	7%
IBM Corp./ISSC *(U.S.)*	6%
Automatic Data Processing *(U.S.)*	4%
First Financial Management Co. *(U.S.)*	4%
First Data Corp. *(U.S.)*	4%
Digital Equipment Corp. *(U.S.)*	3%
Martin Marietta *(U.S.)*	3%
Equifax *(U.S.)*	2%
SHL Systemhouse *(Canada)*	2%

Custom programming services

Company *(country)*	Global market share
IBM Corp./ISSC *(U.S.)*	12%
EDS *(U.S.)*	11%
Andersen Consulting *(U.S.)*	11%
Computer Sciences Corp. *(U.S.)*	8%
Cap Gemini Sogeti *(France)*	4%
Digital Equipment Corp. *(U.S.)*	4%
Unisys *(U.S.)*	4%
Finsiel *(Italy)*	3%
AT&T *(U.S.)*	3%
Hewlett–Packard *(U.S.)*	3%

Source: Compiled from data provided by INPUT, Inc.

prominence in the global market by moving beyond traditional country borders to increase sales across Europe and beyond. In addition to these European companies, Canadian-based SHL Systemhouse has been expanding its share of the global market by increasing sales in the United States and overseas through a variety of acquisitions and joint ventures. SHL has done particularly well in the outsourcing service segment of the industry. Fujitsu, the lone Japanese company ranked in any of the five segments, has gained some global success by expanding its presence in the U.S. market rather than concentrating exclusively on Asia. Fujitsu operates several offices in the United States and has established alliances with certain U.S. firms to enhance its position.

Although the global market is dominated by U.S. companies, competition intensifies somewhat when individual regional markets are examined. This phenomenon is most evident in Europe, where a number of non-U.S. firms that are not active globally are important players regionally. In the software industry, for example, Olivetti, Groupe Bull, ICL, GSI, SAP AG, and Software AG are key competitors to U.S. firms. The same holds true in services, where Groupe Bull, Sema Group, ICL, Olivetti, Sligos, and Finsiel maintain relatively strong positions in their domestic markets. As a result, successful U.S. firms in the European market frequently enter into alliances with well-established domestic companies to increase the marketability of their services. Similarly, in the Japanese market, U.S. vendors face competition from the large Japanese hardware companies such as Mitsubishi, NEC, and Hitachi. U.S. firms must compete effectively against the growing number of contenders in regional markets in order to maintain global dominance of the industry.

Global Trends in the Software and Service Industries

Trends in the Software Industry

Two broad trends in the global marketplace for computer software are currently leading software developers to rethink approaches to improving competitiveness. First, the widespread popularity of powerful and relatively inexpensive PCs and workstations, linked together in networks, is fueling strong demand for software products designed specifically to run on PCs, workstations, and network server platforms. Second, growth in the number of interoperable products designed to run on the rapidly growing installed base of desktop computers has increased price competition, forcing software firms in the United States and abroad to look for new ways to streamline operations and reduce costs. Together, these two complementary trends are shaping the operational and organizational decisions made by software vendors around the world.

Technology in Transition

The ongoing shift in the hardware buying patterns of customers around the world, away from once-dominant mainframes and minicomputers toward decentralized networks of microprocessor- based computers, continues to boost worldwide demand for PC- and workstation-based software products. This shift, which can be identified generically as “platform transition” or “downsizing,” reflects the impact of technological forces that have altered fundamentally the structure of the computer industry in recent years.[38] Dramatic and sustained improvements in the performance of micropro- cessors, the most critical microelectronic components in personal computers and workstations, have made it possible for individual computer users to harness levels of processing power once available only in the most expensive mainframes and minicomputers.

Rapid increases in the installed base of PCs and workstations worldwide have boosted demand for popular PC-based business productivity software applications such as word processing and spreadsheet programs, while growth in the home computer market has sparked interest in new types of home entertainment and educational software. Steady increases in the relative growth of PC- and workstation-based software products in the worldwide software market can be seen in figure 2-8. Growth rates in sales of mainframe and minicomputer-based software to corporate computer users have declined substantially in recent years, from 14 percent in 1990 to an estimated 8 percent in 1994. Over the same period, annual growth rates for PC software increased from 15 percent in 1990 to an estimated 36 percent in 1994.[39]

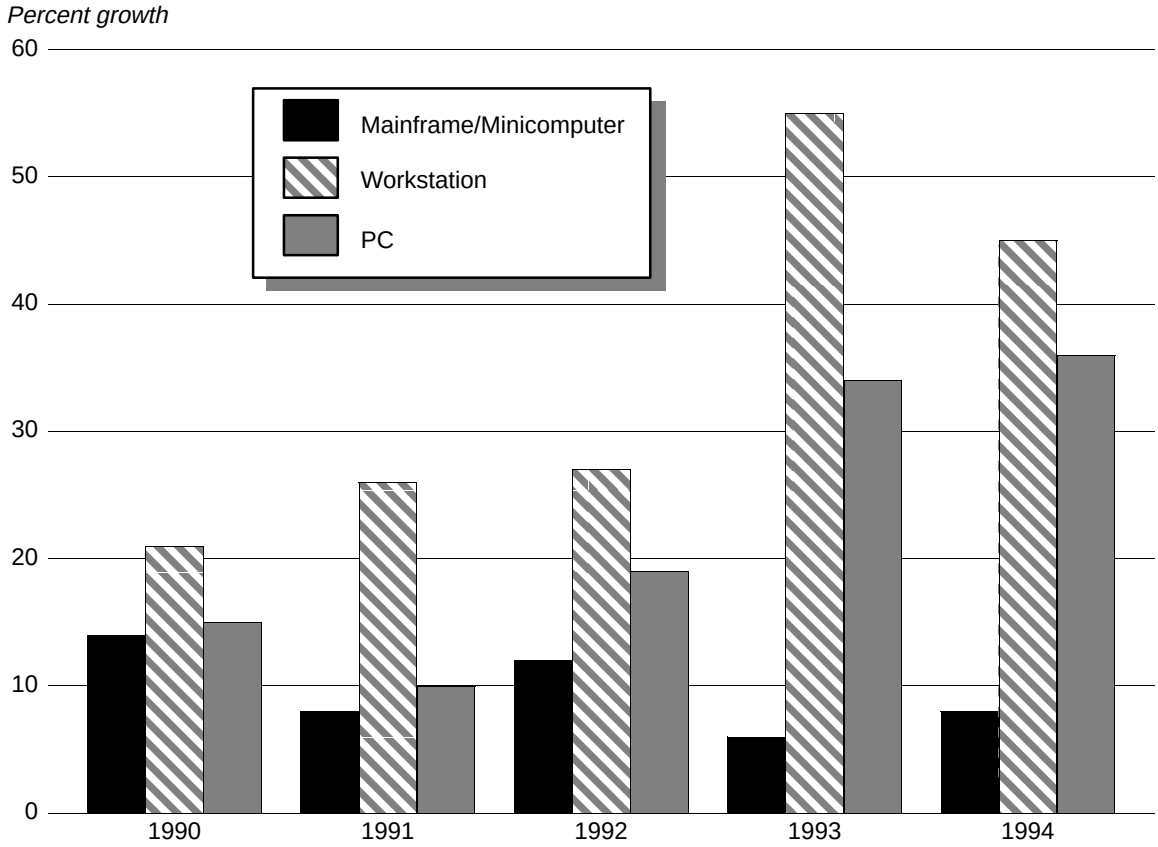
Meanwhile, advances in networking technology and the establishment of technical standards allowing computers to communicate more effectively have expanded the universe of data accessible by personal computers and workstations. Unlike mainframes and minicomputers, which offer massive processing power but poor interaction with users, client/server networks allow individuals to customize interaction with computers, thereby improving access to large databases through programs written for easy use on the desktop. Programs employing a graphical user interface (GUI), exemplified by Microsoft *Windows* and a rapidly growing base of *Windows*-based applications, have widened the range of options available to computer users seeking greater control over the way their data are processed and presented.

---

[38] For a full discussion of ways in which recent technological change has affected the computer hardware industry, see USITC, *Global Competitiveness of U.S. Advanced Technology Industries: Computers*, (investigation No. 332-339), USITC publication 2705, Dec. 1993.

[39] Data provided by Sentry Market Research, Westborough, MA.

Figure 2-8
Software market growth rates, by hardware platform, 1990-94



Source: Compiled from data provided by Sentry Market Research.

As a result of these technological changes, the primary goal of software developers in the 1990s is to offer applications and systems software products that run efficiently on decentralized networks and client/server platforms. For most consumers, especially information technology divisions in large companies and public institutions, the creation of seamless networks linking desktop computers, servers, and more powerful mainframes and minicomputers is an essential goal.[40] The complexity of network-based systems has helped boost global demand for systems software products—including network operating systems, network management tools, and database management systems—that facilitate communication among diverse hardware and software elements in a network.

Pricing Pressures and Signs of Industry Maturation

The second trend, the growing intensity of price competition in global software markets, is a logical outgrowth of global industry conditions. Several factors have contributed to the importance of price competition. First, as the number of software suppliers has increased in recent years, so too have the product options available to consumers. This supply increase has resulted in downward pressure on both applications and system software prices.

[40] For more information on complexity and the need for seamless networks, see the section in this chapter entitled "Applying Complex Technology to Vertical Markets."

Second, the high price elasticity of demand for software has forced firms to reduce prices in order to increase unit sales. Finally, software prices have been affected by declining hardware prices. As customers have witnessed a rapid fall in the average price paid per unit of hardware processing power, they have come to expect similar declines in software prices. Indeed, with many powerful desktop PCs selling for less than $1,500 by early 1995, most software buyers avoided high-priced software programs costing as much as one-fifth of the price of the hardware upon which they run.

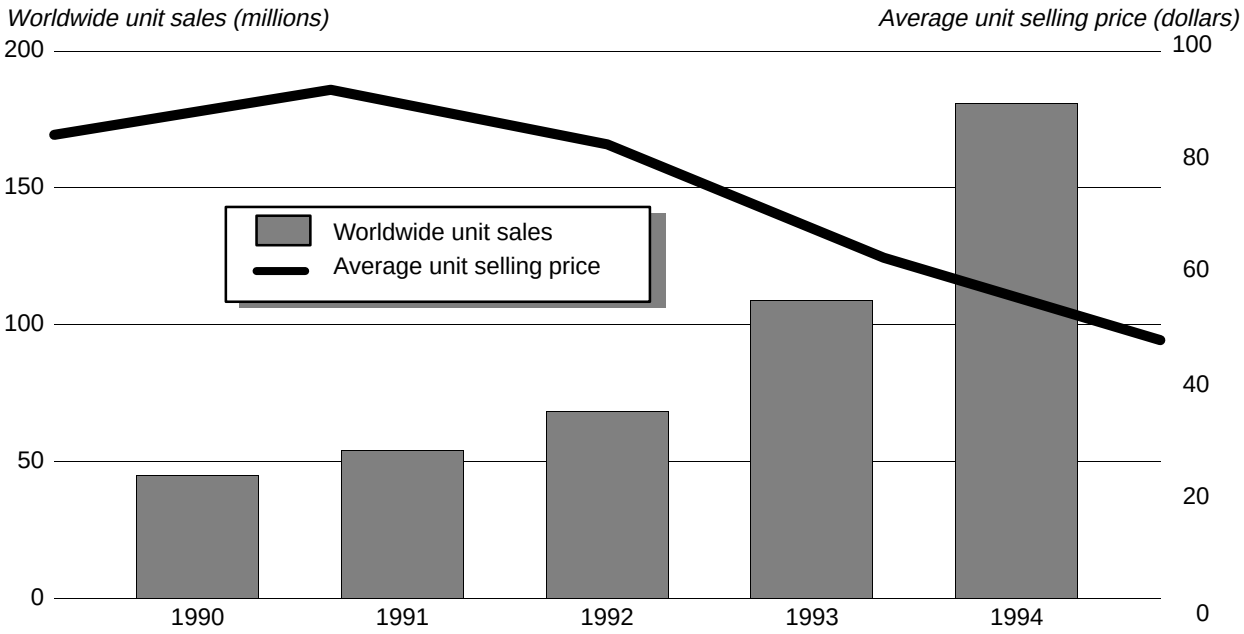
Consumers have responded favorably to marketing innovations introduced by the larger software vendors to satisfy price-conscious buyers. The software "suite," a bundle of four or five popular business applications marketed by a single vendor, has given computer users an opportunity to purchase several programs in the form of one competitively priced package. Firms have continued to cover product development and marketing costs, but their per-program profit margins have declined. Still, since the marginal costs associated with marketing suites are low, and because software vendors are likely to boost unit sales greatly as a result of lower prices paid by consumers, this innovation may ultimately improve the profitability of major suite suppliers. Opportunities for the establishment of long-term consumer brand loyalty and the potential for increased revenues from product upgrades help offset the initial impact of lower profit margins on suite sales. Both Microsoft and Lotus have increased software suite revenues through extensive marketing campaigns, and Novell began a new advertising initiative to support its new suite of applications in late 1994.[41]

Pricing, therefore, has become a decisive factor in shaping software industry competition. In many cases, software vendors are in a good position to pursue discount pricing strategies, since the marginal production and distribution costs for most software products are quite low. However, sharp declines in the average selling price of software have put more pressure on firms to cut fixed costs. Figure 2-9 shows how declines in average selling prices have accelerated in recent years.

---

[41] Microsoft's *Office* suite outsold Lotus' *Smartsuite* by a large margin through late 1994. Novell, through its WordPerfect subsidiary and Borland International, also introduced a suite, *PerfectOffice*, in 1994. See Chapter 4 for more details on the use of suites as a marketing tool.

Figure 2-9
Worldwide unit sales and average unit selling price of PC software, 1990-94[1]



[1] Full-year 1994 figures are based on data from the first two quarters.

Source: Compiled from data provided by the Software Publishers Association.

On a broad level, this intensification of price competition reflects an inevitable maturing process in the global software industry. Just as the shift away from mainframes and minicomputers has contributed to a commoditization of computer hardware markets, so too is the shift in consumer preferences toward interoperable software for PCs and networks changing the competitive dynamics of the global software market. The result of this trend is that computer software vendors worldwide must find new ways to slash unit production, development, and distribution costs in order to remain price competitive. This trend is perhaps most apparent in the case of PC- and workstation-based applications software, but developers of systems software are feeling similar pressures.

Trends in the Computer Service Industry

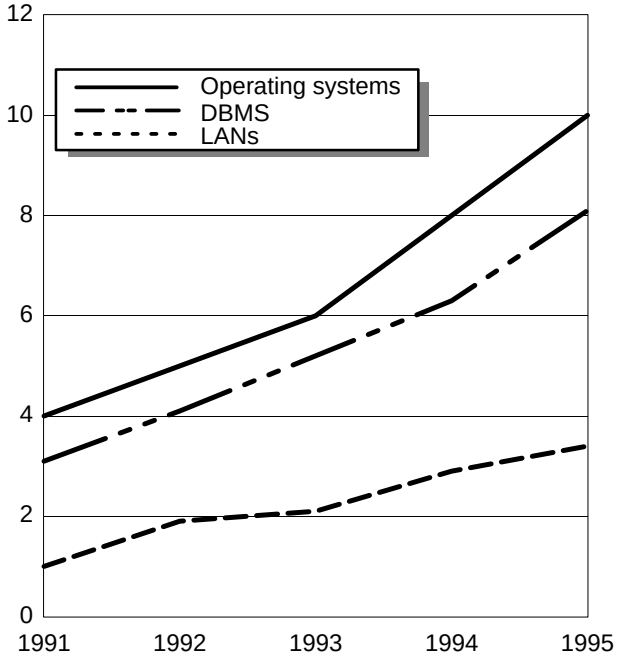
As U.S. and foreign companies increasingly deploy technology to gain a competitive edge, demand for computer service providers capable of effectively implementing the latest software products has expanded dramatically. Two unique trends underway in the industry are fueling the expansion of the service market and changing the competitive strategies of service providers. First, the complexity associated with new types of computer technology has created a large and increasingly sophisticated market for providers of systems integration services. SI service providers are, as a result, revising business strategies to meet new demands for custom-tailored computing solutions. Second, the growing pressure on global firms to restructure business practices, streamline operations, and reduce costs is contributing to new demands for outsourcing service providers. These trends are discussed below.

Applying Complex Technology to Vertical Markets

As computer technology becomes increasingly complex, users are turning to systems integrators to coordinate the diverse products and standards currently available on the market. Whether a project involves updating an old system, interconnecting existing but incompatible systems, or installing completely new equipment, systems integrators are faced with a plethora of hardware and software options. Figure 2-10 demonstrates the wide array of products that are available in the market and the

Figure 2-10
Increasing complexity in the software market, 1991-95

Number of products/vendors per site



Examples of available products

Operating Systems (OS)	Database Management Systems (DBMS)	Local Area Network (LAN) Systems
Windows 95	Sybase	Windows NT
HP/UX	Oracle	Sun NFS
Solaris	MS SQL95	Netware
OS/2	Powermaker	LS OS/2
AIX	DB2	Vines
Open VMS	Access	Lantastic
OSF/1	Informix	Pathworks
MVS	Gupta	UB Net/One
Windows	dBASE	
PC-DOS	IMS	

Source: Compiled from data provided by Sentry Market Research.

increasing number of systems currently installed at customer computing sites. Jobs that were once easily handled by in-house information technology divisions often are turned over to outside SI firms, since the latter have more time to develop expertise on the variety of product offerings.[42]

One of the principal forms of technological complexity currently fueling demand for outside expertise is the platform downsizing effort inherent in client/server computing.[43] While the cost and performance benefits associated with client/server platforms are luring many customers away from mainframe systems,[44] most companies lack the in-house capabilities to effectively construct these powerful network-based systems. By relying on the more comprehensive expertise of systems integrators (many of whom focus exclusively on client/server technology), companies avoid the risk of installing hardware and/or software products that are outdated or inappropriate for their needs. As the technology underlying new computer hardware and software continues to advance, demand for SI expertise likely will maintain its current rapid growth rate.

Systems integrators are not only expected to be knowledgeable about the latest technology available for a project, they also must be able to apply and customize the technology according to different vertical market specifications (see figure 2-11).[45] This trend has been fueled by customers who, increasingly, are turning to technology to boost

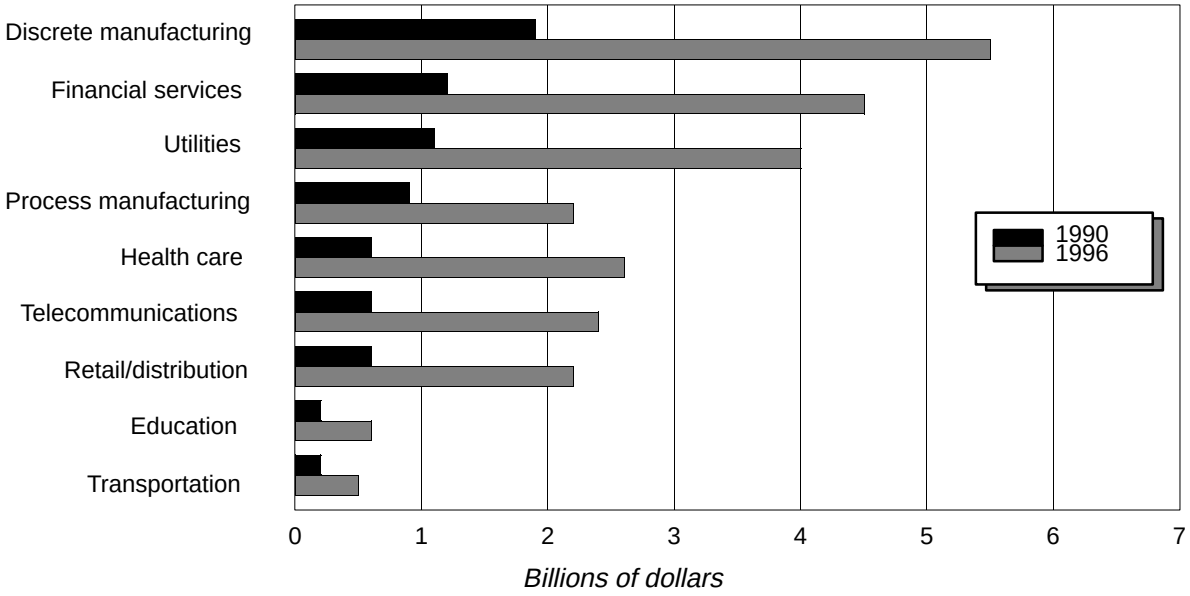
[42] Industry representative, interview by USITC staff, Washington, DC, Feb. 1994.

[43] While most corporations traditionally have relied on mainframe computers to process large business applications (e.g., payrolls), the same type of work can now be per- formed on a downsized network of machines, linked together in a client/server configuration. For more information on this issue, see "Technology in Transition" in this chapter.

[44] There is debate in the industry over whether the transformation to client/server platforms is actually less expensive for a company than long-term maintenance of mainframes. However, most agree that the versatility and efficiency of client/server networks will continue to fuel the demand for this platform. Industry analyst, interview by USITC staff, Boston, MA, Oct. 20, 1994.

[45] Vertical markets refer to specific industries, such as the manufacturing industry, the financial services industry, or the telecommunications industry. Software and services often are marketed toward a specific vertical market, since needs vary significantly among different end users. Contrast this concept with horizontal markets, such as the word processing market or the spreadsheet market, where there is no need to differentiate among vertical functions.

Figure 2-11
Vertical market demand for systems integration services: Spending by Fortune 1000 companies



Source: G2 Research, as presented in *Electronic Business,* Apr. 1992.

their companies' competitive edge.[46] For these customers, systems integrators must develop unique systems that are tailored to the needs of a company's core business. This is in direct contrast to the traditional systems integration project of 15 to 20 years ago that involved relatively straightforward system installation, generally using widely available software products.[47]

Fueling this trend toward vertical market customization is the shift in user demand from "back office" to "front office" systems integration. Initially, most companies devoted a large part of their information technology budgets to the improvement of conventional back office business applications, such as standardized company payroll and accounting systems. However, the speed and processing power realized through the integrated back office have become standardized features and no longer confer a significant competitive advantage to any firm. Increasingly, therefore, systems integrators are introducing front office applications that directly affect the strategic business functions of a customer.[48] Unlike payroll and accounting systems, front office applications are handled differently by each corporation, and customized interconnection of these applications can significantly affect overall competitiveness in terms of cost and service quality. Familiarity with unique vertical market requirements facilitates integration of front office computer systems. For example, EDS and Andersen Consulting target manufacturing industries, whereas IBM targets the financial services industry. SI firms thus are changing their strategies to incorporate the skills necessary to respond to new and more sophisticated customer demand patterns.

Corporate Restructuring Trends Fuel Growth in Outsourcing Services

From small firms to global Fortune 500 corporations, the pressure to streamline operations is being felt by all levels of the international business community. The increasing intensity of global competition in virtually all industries has resulted in a now popular trend of corporate restructuring.[49] Defined broadly, this concept involves reorganizing corporate structures to eliminate waste and improve efficiency. Restructuring calls for reduced levels of hierarchical management, simplified work flows, and a variety of other cost-cutting techniques. While the overall merits of such restructuring efforts frequently are debated, many business strategists continue to support certain cost-cutting components of the program, such as outsourcing. Indeed, consultants often advise clients to outsource corporate functions that are not part of a company's core business. For example, an equipment manufacturer might outsource some of its marketing and distribution responsibilities in order to concentrate solely on the manufacturing process. For the purposes of this study, however, outsourcing refers exclusively to those services traditionally handled by the information technology division of a company. This definition includes everything from data processing to the day-to-day operations of a company's computer systems.[50]

The cost of maintaining an in-house staff to handle the demands of advanced corporate computing has expanded exponentially in recent

[46] In many cases it appears that service markets, such as telecommunications, retailing, and financial services, have the most to gain from integrated computer systems. This is primarily because their competitive position in end markets is determined largely by their ability to generate and transport information rapidly and efficiently. For more information on this issue, see USITC, "Systems Integration Services Enhance U.S. Global Competitiveness," *Industry, Trade, and Technology Review,* Aug. 1994, p. 7.

[47] The Federal Government market dominated the systems integration industry for many years, with numerous contracts for standard infrastructure, integration, and implementation projects. Beginning in the early 1980s, however, the perceived competitive advantage of effectively integrated technology spurred new growth in the private sector. Since then, the commercial sector has placed rigorous demands on systems integrators, asking them to customize projects according to specific industry needs.

[48] Examples of front office applications might include customized software for managing client accounts in a financial organization, or programs to facilitate paperwork and record-keeping in an insurance or health care company. An airline or travel agency may enhance efficiency by integrating customer databases with incoming reservations, thus eliminating the time required to repeat addresses and seat preferences.

[49] Many restructuring programs encourage companies to focus on core competencies and to outsource business processes where the firm has limited expertise. These outsourced processes often include the management of information technology.

[50] Control of the day-to-day operations of a company's computer systems may also be called "facilities management" or "systems operations."

years. As computing power increasingly is transferred to the desktop, expenses for help desk personnel and general maintenance staff have become significant components of corporate budgets. Recent data show that companies spend anywhere from 3 to 12 percent of gross revenues on information technology, the largest component of which goes to personnel.[51] In some cases, outsourcing the management of a corporation's network system may lower these costs by reducing the number of in-house specialists that need to be maintained.[52] Figure 2-12 shows the projected cost savings and benefits of several recent outsourcing contracts.

[51] Approximately 38 percent of information technology budgets is spent on personnel. Industries with the highest levels of information technology spending (as a percent of total revenues) include the airline industry, government agencies, and office equipment companies. Daniel Minoli, *Analyzing Outsourcing* (New York: McGraw-Hill, Inc., 1995), pp. 14-15.

[52] All companies must evaluate the potential benefits of outsourcing according to their specific needs. Cost savings may not result in every case.

In addition to the cost factor, however, outsourcing demand also is expanding in response to rapid advances in technology. Rather than constantly purchasing the latest hardware and software for corporate applications, many firms have opted to outsource certain processes that require the speed and efficiency only high-powered machines can generate. For example, the German-based chemical manufacturer Hoescht AG outsources complex molecular modeling calculations to one of EDS's information processing centers in Ruesselheim, Germany.[53] Here, EDS maintains all the latest hardware and software necessary for handling these large applications, including a supercomputer that is able to process extremely large quantities of complex calculations in a short period of time. Further, EDS can afford to update its facilities as technology changes because of the economies of scale generated by its processing of many corporate accounts. While outsourcing is not necessarily the economic solution for all companies, the demands of corporate streamlining and the growing complexity of technology make it a viable choice for many.

[53] EDS, *Annual Report*, 1989, p. 4.

Figure 2-12
Selected outsourcing contracts and projected client benefits

Outsourcing firm	Client firm	Contract description	Contract date	Projected client benefits
EDS	Xerox Corp.	To manage Xerox's internal network. The 10-year contract is valued at $3.2 billion.	1994	Xerox expects to reduce IT costs by as much as 25 percent.
IBM/ISSC	Esprit de Corp.	To manage mainframe processing and legacy applications on a transitional basis while company switches to a client/ server environment.	1994	Esprit expects to reduce costs by 15 to 25 percent.
Digital Equipment Corp.	General Electric Aircraft Engines	To provide systems management and technical consulting for GE's midrange computing environment.	1994	GE expects to reduce costs and increase productivity as a result of this contract.
Computer Sciences Corp. (CSC)	British Aerospace (BA)	To provide all IT services necessary to support the company's aerospace and defense businesses. The 10-year contract is valued at approximately $1 billion.	1993	BA expects to streamline costs and efficiency by transferring 1,500 employees and much of the company's IT assets to CSC.

Figure 2-12—*Continued*
Selected outsourcing contracts and projected client benefits

Outsourcing firm	Client firm	Contract description	Contract date	Projected client benefits
IBM/ISSC	McDonnell Douglas	To manage the majority of the company's IT demands.	1993	McDonnell Douglas expects to reduce its IT employment by 1,450 workers as a result of the contract.
SHL Systemhouse	Canadian Postal Services	To migrate postal services to a client/server environment. The 10–year contract is valued at $800 million.	1993	The postal service expects to improve its operations by installing new systems.
Coopers & Lybrand	Taco Bell	To provide help desk services during peak period overloads.	1993	Taco Bell was able to relieve its services staff from overwhelming help desk responsibilities, allowing the staff to focus instead on other IT needs for the company.
Computer Sciences Corp. (CSC)	British Home Stores (BhS)	To operate and manage the store's data center. The 10-year contract is valued at $200 million.	1993	BhS reportedly benefits by focusing on its core strengths in the retail industry, leaving the burden of deciphering the latest techologies to IT firms that specialize in that area.
IBM/ISSC	Eckerd Corp.	To install and manage a client/server computing system. The 10–year contract is valued at $380 million.	1993	Eckerd expects to reduce costs significantly by outsourcing this project. External bid estimates were considerably lower than internal estimates to complete the project in–house.
EDS	Hoescht AG	To provide processing services for complex calculations.	1989	Hoescht does not have to invest in a supercomputer for its complex molecular calculations.

Source: USITC staff.

CHAPTER 3
External Factors Influencing the Software and Service Industries

Introduction

This chapter reviews two types of external factors that affect the competitiveness of software and service firms—government policies and education trends. Analysis of these factors suggests that government policies related to intellectual property protection, telecommunications regulations, export controls, research programs, and small businesses most affect firms' ability to compete in world markets.[54] Differences in education systems and patterns of student achievement can also influence the success of software and service firms.

Figure 3-1 identifies the segments of the software and service industries that are impacted most by these external factors. For example, government policies on intellectual property protection are very important to the competitiveness of almost all industry segments, since piracy and inadequate enforcement of copyright laws negatively influence the revenue intake of U.S. software and service firms alike. The telecommunications regulations of certain countries primarily impact the computer outsourcing industry, since outsourcing firms require access to leased lines for data transmission. U.S. export controls on software with encryption capabilities reportedly have an adverse impact on U.S. software firms and systems integrators, which rely heavily on software exports to maintain international market share positions. Finally, external policies related to research programs, small businesses, and education also influence the competitiveness of various sectors of the U.S. software and service industries, as discussed below.

[54] USITC staff also examined the effects of antitrust regulations and tax incentives. These policies do not appear to affect global competitiveness significantly and therefore are omitted from the present discussion. The outcome of a current antitrust case against Microsoft Corp. remains undecided. As such, its impact on competitiveness has not been determined.

Government Regulations and Policies

Intellectual Property Protection

According to U.S. software developers, the principal external factor affecting global competitiveness is intellectual property protection. Because U.S. firms are global leaders in developing new software, inadequate protection of intellectual property rights (IPR) in the United States and in important overseas markets has a particularly adverse effect on the U.S. industry.[55] Figure 3-2 shows the administrative and enforcement structures of intellectual property protection in the United States and selected foreign countries. A recent survey by the U.S. software industry showed that software companies lose more than $12.8 billion annually due to inadequate software protection.[56] The significance of IPR protection and global efforts to improve enforcement measures are discussed below.

Importance of IPR Protection

Industry representatives regard a sound legal framework for the protection of creative expressions embodied in computer software as perhaps the single most important factor affecting software development.[57] Although the level of intellectual property protection granted to software varies greatly

[55] U.S. industry representatives and analysts, interviews by USITC staff, Washington, DC, Mar. and Oct. 1994.

[56] Business Software Alliance (BSA), "Software Piracy Worldwide Percentages and 1993 Losses," *Software Review*, June 1994, p. 6.; and BSA, "Software Piracy Costs Industry $35 Million Each Day," *News Release*, Nov. 14, 1994, pp. 1-2.

[57] U.S. industry representatives, interviews by USITC staff, Washington, DC, Mar. and Oct. 1994; and Alliance to Promote Software Innovation and BSA officials, *Press Briefing*, Sept. 8, 1994.

between the United States and its major trading partners, a consistent set of basic objectives underlies the development of most IPR-related policies.

The key objective of software protection is to promote technological innovation and creativity by rewarding authors with a period of exclusive commercial rights.[58] Strong economic incentives exist for software users and competing software developers to copy elements of a popular program to reduce the cost of software acquisition or share profits with the original program developer.[59] In the absence of copying, these profits would accrue solely to the original developer. Thus, strict guarantees of a software developer's original authorship rights are an essential part of ensuring the developer's return on investment.[60] Without such protection, resources normally applied to continued research and development likely would be redirected and incentives to innovate would be reduced significantly.[61]

The principal vehicle for software-related intellectual property protection traditionally has been the copyright.[62] The copyright confers upon the author of a creative work the sole right to copy, distribute, or display that work.[63] It also grants an exclusive right to create derivative works. Since the 1970s, statutory recognition of software as a copyrightable work has offered an automatic, low cost mechanism to software developers to protect their programs from improper adaptation or theft.

The patent also contributes to the legal protection of intellectual property in software. Patents safeguard the inventive processes associated with software development, such as functions, methods, and algorithms. Although patents are important IPR safeguards in the United States, copyrights still play a preeminent role in the global market, where most IPR infringements are the result of direct disk-to-disk copying.[64]

In most respects, the United States has led the world in devising a credible and enforceable framework for the legal protection of software.[65] Foreign governments also have worked toward protection for software innovators, but other objectives frequently shape government policies in countries where a globally competitive software industry has not yet emerged.[66] Government policies in these countries often are aimed at promoting the interests of software developers seeking to improve upon other authors' products.[67]

Global Anti-Piracy Efforts

The largest single threat posed by intellectual property infringement is direct copying of software for both commercial and non-commercial distribution in markets around the world. This type of illegal copying is commonly referred to as "software piracy."[68] There are three key reasons why piracy

[58] This concept is embodied in the 1980 Computer Software Copyright Act, Pub. L. No. 96-517, §117, 94 Stat. 3028 (1980). Codified at 17 U.S.C. § 117 (1988).

[59] Stephen E. Siwek and Harold W. Furchgott-Roth, *The U.S. Software Industry: Economic Contribution in the U.S. and World Markets*, prepared for the Business Software Alliance, Washington, DC, Spring 1993, p. 38.

[60] For a discussion of the economics of intellectual property, see Anthony Lawrence Clapes, *Softwars: The Legal Battles for Control of the Global Software Industry* (Westport, CT: Quorum Books, 1993), pp. 54-70.

[61] Ibid.

[62] The first software copyright was issued by the U.S. Copyright Office in 1964. Since then, most legal battles over software-related IPR have centered on the applicability of copyright protection for software. See Clapes, *Softwars*, p. 20.

[63] The rights conferred upon the author extend to the programmer's employer as well. Clapes, *Softwars*, p. 27.

[64] Beyond copyrights and patents, firms also rely on "trade secrets" to protect certain confidential company information that may relate to software. For more information, see USITC, "Computer Software and the U.S. Copyright Regime: Setting Limits for Intellectual Property Protection," *Industry, Trade, and Technology Review*, Feb. 1994, p. 17.

[65] The 1980 Computer Software Copyright Act codified and expanded U.S. copyright protection to software and other computer-generated works. It did this by modifying existing copyright laws to explicitly identify computer software as copyrightable material, thereby giving software developers the same protection as authors of literary works. By avoiding the creation of an entirely new set of laws and regulatory bodies to govern software protection, Congress established a preeminent role for the courts to determine the boundaries of copyright protection for software and other computer works. See the Computer Software Copyright Act, Pub. L. No. 96-517, §117, 94 Stat. 3028 (1980). Codified at 17 U.S.C. § 117 (1988). For more information on the development of the U.S. IPR regime, see USITC, "Computer Software and the U.S. Copyright Regime," p. 17.

[66] See, for example, Coopers and Lybrand Consulting Group, *A Competitive Assessment of the Canadian Software Product Industry*, prepared for Industry, Science, and Technology Canada, Ottawa, 1991, pp. 28-33.

[67] Governments also may seek to help software consumers by encouraging the dissemination of creative works and guarding against anticompetitive behavior by owners of software-related copyrights or patents. Clapes, pp. 288-289.

[68] In connection with national governments, BSA has initiated hundreds of lawsuits, audits, and raids to enforce copyright laws in North America, Europe, Asia, and Latin America. BSA, "1993 Anti-Piracy Highlights," *News Release*, Feb. 18, 1994, p. 1.

represents an especially difficult competitive problem for software firms.[69] First, software is easy to copy.[70] Copyists require only blank diskettes and a personal computer to reproduce a program. Second, the pirated version cannot be distinguished easily from the original. As a result, users have little reason to reject pirated software on the basis of quality. Finally, profits can be very large.

From a public policy standpoint, successful anti-piracy efforts ultimately require a commitment on the part of national governments to enact strong copyright and patent laws and develop credible enforcement procedures.[71] The most significant step in this direction is the recently concluded World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs).[72] Negotiated during the Uruguay Round of multilateral trade negotiations, the TRIPs accord calls on WTO members to explicitly recognize software as a literary work, eligible for full legal protection against copying or other improper use.[73] The TRIPs accord places little burden on the United States to alter its copyright or patent laws, but other WTO members are required to improve legal protection substantially.[74] All signatories, including developing countries, are required to offer national treatment to all foreign owners of intellectual property by January 1, 1996.[75]

In addition to multilateral IPR protection efforts, the U.S. Government pursues IPR violations on a bilateral basis with important trading partners. Under the so-called "Special 301" process, the United States identifies and, if appropriate, imposes sanctions against countries that fail to offer adequate IPR protection for U.S. products. The Special 301 provision, part of the 1988 Omnibus Trade and Competitiveness Act, authorizes the Office of the U.S. Trade Representative to impose trade sanctions against countries that deny adequate and effective protection of intellectual property rights, or fair and equitable market access to U.S. persons that rely upon intellectual property protection (see table 3-1).[76]

IPR protection also has been addressed by key U.S. trading partners. Major software firms welcomed the implementation of the European Union (EU)

---

[69] William Neukom, Vice President of Law and Corporate Affairs, Microsoft Corp., "Competition in the Computer Industry," testimony before the Subcommittee on Economic and Commercial Law, Committee on the Judiciary, U.S. House of Representatives, Oct. 13, 1993.

[70] Although many software publishers used to incorporate measures that prevented easy copying of programs, most discontinued this practice for mass-marketed consumer products because of the inconvenience it posed for everyday users.

[71] U.S. industry representatives, interviews by USITC staff, Washington, DC, Mar. and Oct. 1994.

[72] Neukom, "Competition in the Computer Industry." Prior to January 1, 1995, the WTO was referred to as the General Agreement on Tariffs and Trade (GATT).

[73] Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), Including Trade in Counterfeit Goods, Annex IC, Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations. The agreement seeks to provide for, *inter alia*, adequate standards and principles concerning the availability, scope, and use of trade-related intellectual property rights; means for enforcement of such rights; procedures for the multilateral prevention and settlement of disputes between governments; and a multilateral framework of principles, rules, and disciplines dealing with international trade in counterfeit goods. For more information, see *Uruguay Round Trade Agreements, Statement of Administrative Action*, submitted on Sept. 27, 1994, 103d Congress, 2d Session, pp. 312-332.

[74] Ibid. The United States will make minor changes to its patent laws to conform to the Uruguay Round Agreement. The primary changes include national treatment for inventive activity in member countries of the World Trade Organization, and an extension of the patent term from 17 years to 20 years. These changes became effective on June 8, 1995, in accordance with the GATT Uruguay Round implementing legislation (P.L. 103-465). For more information, see U.S. Department of Commerce, Patent and Trademark Office, "GATT Uruguay Round Patent Law Changes."

[75] The Uruguay Round Agreements became effective Jan. 1, 1995. For more information on the impact of this agreement on the U.S. computer industry, see USITC, *Potential Impact on the U.S. Economy and Industries of the GATT Uruguay Round Agreements* (investigation No. 332-353), Volume I, USITC publication 2790, June 1994.

[76] Section 182 of the Trade Act of 1974 (19 U.S.C. 2242), as amended by section 1303 of the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418), requires that the U.S. Trade Representative identify, on an annual basis, those countries that "deny adequate and effective protection of intellectual property rights or deny fair and equitable market access to United States persons that rely upon intellectual property protection." Section 302(b) of the Trade Act of 1974 requires the USTR to initiate a section 301 investigation within a period of 30 days after the identification of a priority country that has been found to offer inadequate IPR protection, except when the USTR determines that initiation of such an investigation would be detrimental to U.S. economic interests (19 U.S.C. 2412(b)).

Software Directive,[77] which seeks the harmonization of copyright laws among EU member states.[78] As of April 1995, all member states but Luxembourg had enacted strong software copyright measures.[79] Enforcement of legal protection for software remains a large problem in the southern countries of the EU, particularly Spain and Portugal.[80] However, improvements in law enforcement efforts in countries such as Italy, where piracy has been a problem in the past, have boosted hopes among U.S. software firms that significant increases in legal sales are likely throughout the EU.[81]

In Japan, a legal debate is underway to determine the future treatment of software under the Japanese copyright law. At its core, this dispute involves the legal standing of a process known as decompilation—the systematic disassembly and adaptation of computer programs. Decompilation (also referred to as "reverse engineering") represents one of the most problematic areas for software developers seeking protection for their works under copyright statutes.[82] Through decompilation, software firms seeking to build upon, interface with, or improve existing programs could disassemble the program to reveal "source code," the lines of programming language in a computer program. Although some countries may permit decompilation for the development of complementary or compatible programs, these instances are limited (see figure 3-2).

In July 1993, Japan's Agency for Cultural Affairs announced that it would set up a council to study possible revisions in Japanese copyright law that might permit decompilation of software programs.[83] The initiative was withdrawn after receiving wide criticism from interested parties in the United States and Europe.[84] However, U.S. industry officials are concerned that a more recent initiative by Japan's Ministry of Posts and Telecommunications (MPT) to study the relationship between intellectual property rights and standardization efforts dealing with the convergence of communications and broadcasting could revive the issue.[85]

In addition to difficulties associated with revisions in the Japanese copyright law, persistent piracy problems throughout Asia reportedly continue to depress the revenues of U.S. software firms. China was cited for excessive copying of software and other recorded media following a Special 301 investigation in 1994 (table 3-1).[86] Following extensive negotiations and the threat of U.S. sanctions, the United States and China reached an agreement for improved IPR protection on February 26, 1995.[87] Practices in Indonesia, Korea, and the Philippines, also have come under international scrutiny following

---

[77] *Directive 91/250 on the Legal Protection of Computer Programs*, *Official Journal (OJ)* No. L 122 (May 17, 1991), p. 42.

[78] Software Publishers Association (SPA) and Business Software Alliance (BSA) officials, telephone interviews by USITC staff, Dec. 30, 1994 and Jan. 3, 1995.

[79] EU officials, telephone interviews by USITC staff, Nov. 30, 1994 and Mar. 16, 1995; and BSA official, telephone interview by USITC staff, Jan. 3, 1995.

[80] International Intellectual Property Alliance (IIPA), *1994 Special 301 Recommendations and Estimated Trade Losses*, submission to the United States Trade Representative, Feb. 18, 1994, p. 89.

[81] Ibid, pp. 82-84.

[82] BSA, SPA, and Alliance to Promote Software Innovation (APSI) officials, telephone interviews by USITC staff, Jan. 1995.

[83] IIPA, *Special 301 Recommendations*, p. 21.

[84] Criticisms emerged due to widespread belief in the software industry that legalization of decompilation would make it possible for Japanese firms to quickly break down the elements of successful programs, rebuild them into competing products, and take profits away from innovative software industry leaders. BSA, SPA, and Alliance to Promote Software Innovation (APSI) officials, telephone interviews by USITC staff, Jan. 3, 1995.

[85] The new MPT group held its first meeting on Oct. 29, 1994 and is expected to complete its work by June 1995. Specifically, the group will consider: (1) the role of standards organizations and how IPR should be handled in relation to standardization efforts; (2) the interplay between *de facto* standards and IPR; and (3) Japan's vision in light of existing European and U.S. IPR policies. BSA official, telephone interview by USITC staff, Jan. 3, 1995.

[86] Office of the U.S. Trade Representative (USTR), "USTR Kantor Will Take Retaliatory Trade Action Against China if Intellectual Property Concerns Not Addressed," Press Release, Dec. 31, 1994.

[87] USTR, "USTR Mickey Kantor Orders 100% Tariffs on More Than $1 Billion of Chinese Imports: Cites China's Failure to Protect U.S. Intellectual Property," *Press Release*, Feb. 4, 1995; USTR, "United States and China Reach Accord on Protection of Intellectual Property Rights, Market Access," *Press Release*, Feb. 26, 1995; and Michael Kantor, United States Trade Representative, remarks before U.S. Council for International Business conference on *Intellectual Property Protection in the Year 2000*, Washington, DC, Mar. 15, 1995.

Table 3-1
Summary of activity on Special 301 investigations related to software during 1990-95

Country	Issue	Docket no.	Initiation date[1]	Status as of April 1995
China	Intellectual property protection, Market access	301-92	June 1994	On June 30, 1994, China was identified as a priority foreign country market access under Special 301. China's identification as a priority country was primarily based on its failure to create an effective intellectual property enforcement regime and provide market access to persons who rely on intellectual property protection. On February 4, 1995, the USTR ordered the imposition of 100 percent tariffs on $1.08 billion of imports of certain Chinese products, to become effective on February 26, 1995. Sanctions were averted when an agreement on improved IPR protection was signed on February 26, 1995. The USTR is monitoring compliance with this agreement pursuant to section 306(a)(2) of the Trade Act (59 FR 10225).
Brazil	Intellectual property protection	301-88	May 1993	On May 28, 1993, Brazil was identified as a priority foreign country under Special 301. Brazil's identification as a priority country was based on policies and practices of the Brazilian Government that deny adequate and effective protection of intellectual property rights. On February 28, 1994, on the basis of measures and assurances offered, the USTR decided to terminate this investigation and authorized the revocation of Brazil's identification as a priority foreign country. The USTR is monitoring Brazil's implementation of these measures pursuant to section 306(a)(2) of the Trade Act (59 FR 10225).
Taiwan	Copyright laws	301-89	May 1992	On May 29, 1992, Taiwan was identified as a priority foreign country under Special 301. Taiwan's identification as a priority country was due to certain acts, policies, and practices related to its protectionof intellectual property rights, including that of software. On June 5,1992, the USTR terminated the investigation after reaching an agreement on providing improved levels of protection for patents, copyrights, trade secrets, layout designs of integrated circuits, and industrial designs. In addition, the USTR decided that the information in the agreement reached with Taiwan warranted revocation of the identification of Taiwan as a priority foreign country. The USTR ismonitoring compliance with this trade agreement pursuant to section 306(a)(2) of the Trade Act (57 FR 25091).
India	Copyright laws	301-85	May 1991	On May 26, 1991, USTR self-initiated a section 301 investigation with May 1991 respect to certain acts, policies, and practices of the Government of India that deny adequate and effective protection of intellectual property rights and fair and equitable market access to U.S. persons and companies, including software and service companies, that rely upon intellectual property protection. On February 26, 1992, the USTR determined that the Government of India's denial of adequate and effective protection of

See footnote at end of table.

Table 3-1—*Continued*
Summary of activity on Special 301 investigations related to software during 1990-95

Country	Issue	Docket no.	Initiation date[1]	Status as of April 1995
India—*Continued*				
				intellectual property was unreasonable and burdened or restricted U.S. commerce. The USTR further determined that, while no responsive action was appropriate at the time, action may be necessary and instructed the Trade Policy Staff Committee to develop appropriate options.
Thailand	Copyright laws	301-82	Dec. 1990	USTR initiated an investigation of the Thai Government's practices Dec. 1990 relating to the enforcement of copyrights on December 21, 1990. Consultations were held between the United States and Thailand, and on December 21, 1991, the USTR determined that copyright practices were burdensome to U.S. trade. The Thai Government improved its enforcement laws, and USTR decided to terminate the investigation and monitor the implementation of the Thai laws. Early in 1993, the Thai Government began steps to enforce existing copyright law. Despite progress, the USTR announced on April 30, 1993, that Thailand would remain a priority foreign country because of its failure to provide adequate patent and copyright protection. In May 1993, Thailandagreed to bring its intellectual property law up to GATT standards set out in the Uruguay Round. Based on these actions and other commitments, the USTR removed Thailand from the priority foreign country list on September 7, 1993. USTR continues to monitor that government's implementation of measures to improve enforcement procedures and combat copyright piracy, including that related to software.

[1] Dates reflect the month and year USTR initiated an investigation.

Source: Compiled by USITC staff.

mass production and re-export of pirated software products.[88]

Latin America also has emerged as a focal point for anti-piracy efforts. Piracy rates in Brazil and Argentina are reported to be very high as a result of strong demand for PC-based programs and lax enforcement efforts by local legal authorities.[89] Mexico, on the other hand, is considered to be a bright spot for U.S. software firms seeking greater legal protection and enforcement authority.[90] IPR-related provisions in the North American Free Trade Agreement (NAFTA) make it easier for U.S. firms to pursue software pirates in Mexican courts. U.S. industry representatives have cited NAFTA as a model for future international agreements addressing the intellectual property issue.[91]

Telecommunications Regulations

The principal external factor affecting computer service firms, particularly outsourcing firms, is telecommunications regulations.[92] The most important issues identified by U.S. computer outsourcing firms are the policy variations among countries regarding (1) the construction and use of private telecommunications networks[93] and (2) the regulations surrounding the provision of voice telephony.[94] This section briefly examines existing regulations that most affect outsourcing firms, competitive implications for U.S. firms, and industry proposals to reduce regulatory impediments to outsourcing.

Private Networks

Private networks, usually composed of leased lines, allow service providers to reduce communications costs by maximizing line efficiency. Private networks are most economic when dedicated lines are leased from public telecommunications operators (PTOs)[95] at flat rather than volume-sensitive rates, and when companies using leased lines have the freedom to resell excess capacity to other companies.[96]

Leased lines are available in most industrialized regions, but they remain accessible only from monopoly providers in many countries, including Austria, France, Germany, Italy, and Spain.[97] Further, while leased lines are usually available on a flat-rate basis, installation delays and high tariffs may inhibit the use of such lines.[98] U.S. outsourcing firms with

---

[88] The software industry has recommended that Indonesia be named a priority foreign country under Special 301 for 1995. The country has gained notoriety for facilities that supply copied software manuals and programs for several Asian markets. The software industry also monitors the markets in Korea and the Philippines, where software piracy is particularly high. For more information, see BSA, "Indonesia—Software Industry Priority In Annual Special 301 Filing," *News Release*, Feb. 13, 1995.

[89] IIPA, *Special 301 Submissions*; and BSA, *Report on Copyright Protection in Latin America*, 1992.

[90] SPA and BSA officials, interviews by USITC staff, Washington, DC, Feb. 1994. Although enforcement mechanisms are in place, piracy in Mexico reportedly still exists and is monitored by the software industry. See BSA, "Indonesia—Software Industry Priority In Annual Special 301 Filing," *News Release*, Feb. 13, 1995.

[91] SPA and BSA officials, interviews by USITC staff, Washington, DC, Feb. 1994.

[92] This section applies specifically to those computer outsourcing firms that provide processing services in off-site facilities.

[93] For the purposes of this report, constructing private telecommunications networks principally refers to putting together networks of leased lines and interconnecting them with public switched networks. Firms have to connect their private networks to public lines in order to have universal calling ability.

[94] For more information on these issues, see USITC, "Computer Outsourcing Services: Telecommunication Regulation Affects Global Competitive Position of U.S. Firms," *Industry, Trade, and Technology Review*, Aug. 1994, p. 1.

[95] PTOs are state-sanctioned monopoly telecommunications providers. Most were created by local governments to provide postal and telecommunications services.

[96] For more information on the advantages of private networks, see Andrew Adonis, "Company Cash Filters Through Political Bars," *Financial Times*, Mar. 17, 1994, p. 15; and U.S. Congress, Office of Technology Assessment (OTA), *U.S. Telecommunications Services in European Markets* (Washington, DC: U.S. Government Printing Office (GPO), 1993), pp. 56-57.

[97] International Telecommunication Union (ITU), *World Telecommunication Development Report 1994* (Geneva: ITU, 1994), p. 58.

[98] For example, in 1993, a survey of 34 countries revealed that 22 of them required more than 30 days to provide leased lines. Furthermore, 25 of these countries reportedly leased lines at prices that appeared to bear little or no relationship to cost. Cost-based (or flat) rates are believed to result in more efficient private line service than volume- or usage-sensitive rates. Kenneth W. Leeson, IBM internal report, *Changing Telecommunications Structures: A Global Status Report*, Aug. 30, 1993, p. 13.

operations in Europe, such as IBM/ISSC, claim that high-grade leased lines are typically scarce, PTO billing is inaccurate or irregular, and leased lines generally are not interconnected with the fastest data networks.[99] Outsourcing firms also note difficulties in attaining leased lines in countries such as China and India. Without the right to employ more cost-efficient private networks, computer outsourcing firms are forced to use public switched networks whose access and pricing policies are under the control of PTOs. This may place outsourcing firms at a competitive disadvantage with PTOs that are able to use and control network access when bidding against outsourcing firms for service contracts.

Government restrictions on data flow over international leased lines pose additional challenges to outsourcing firms. For instance, Fiat SPA (Italy) experienced difficulties transferring employee data from France to Italy for processing because of prohibitions on transmitting confidential employee data across international borders. Fiat's problem was resolved eventually, but similar difficulties reportedly persist. National data protection laws sometimes interfere with data transmission across international borders. Many U.S. outsourcing firms are concerned that the EU's privacy directive[100] will hinder their ability to provide services internationally.[101]

[99] OTA, *U.S. Telecommunications Services in European Markets*, p. 7; and industry representative, interview by USITC staff, Washington, DC, Apr. 14, 1994.

[100] *Amended Proposal for a Council Directive on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of Such Data* (COM (92) 422 Final-SYN 287, Oct. 15, 1992). For the positive and negative implications of the proposed directive, see M. Nanette Di Tosto, "International Data Protection Landscape," July 23, 1993, pp. 1-4.

[101] Despite discussion of the proposed privacy directive at several EU Internal Market Council sessions in Luxembourg during the summer of 1994, there remained a number of stumbling blocks to the agreement, including transmission of data to third countries and the scope of the directive. After a Council meeting on June 10, 1994, the text was referred to the Committee of Member States' Permanent Representatives where it was still pending as of March 1995. "Internal Market: Data Protection: Presidency Pulls Out All the Stops in the Search for Compromise," *European Report*, no. 1958, June 15, 1994, pp. 1-2; "Internal Market: No Agreement in Council on Personal Data Protection," *European Report*, No. 1959, June 17, 1994, p. 12; and EU officials, telephone interview by USITC staff, Dec. 1, 1994 and Mar. 20, 1995.

Voice Telephony

Although most outsourcing firms focus solely on data transmission, voice telephony services and the regulations surrounding them are becoming an increasingly important component of the industry. Outsourcing firms, such as IBM/ISSC, DEC, and EDS state that customers increasingly prefer to grant data processing contracts to firms that also provide voice transmission services.[102]

Computer outsourcing firms have an incentive to transmit voice as well as data over private networks because a greater volume of information transmitted over leased lines increases the cost efficiency of their private networks. In addition, real-time voice services[103] are a natural extension of the data transmission and value-added services[104] these computer service firms may currently offer. Although many countries are in the process of liberalizing restrictions on voice and data communications, there are less than 10 countries worldwide that currently permit competition in voice services markets.[105] Figure 3-3 shows the relative regulatory climate in several important markets.

Computer Outsourcing Firms' and Users' Policy Proposals

In response to efforts to liberalize telecommunications regulations worldwide, U.S. computer outsourcing firms have made several suggestions to foreign telecommunications authorities regarding future policies.[106] First, they recommend nondiscriminatory access to public switched networks by all firms. This would allow outsourcing firms to take full advantage of the cost savings afforded by

[102] Industry representatives, interviews by USITC staff, Washington, DC, Apr. 14, 1994, Dec. 30, 1994, and Jan. 3, 1995.

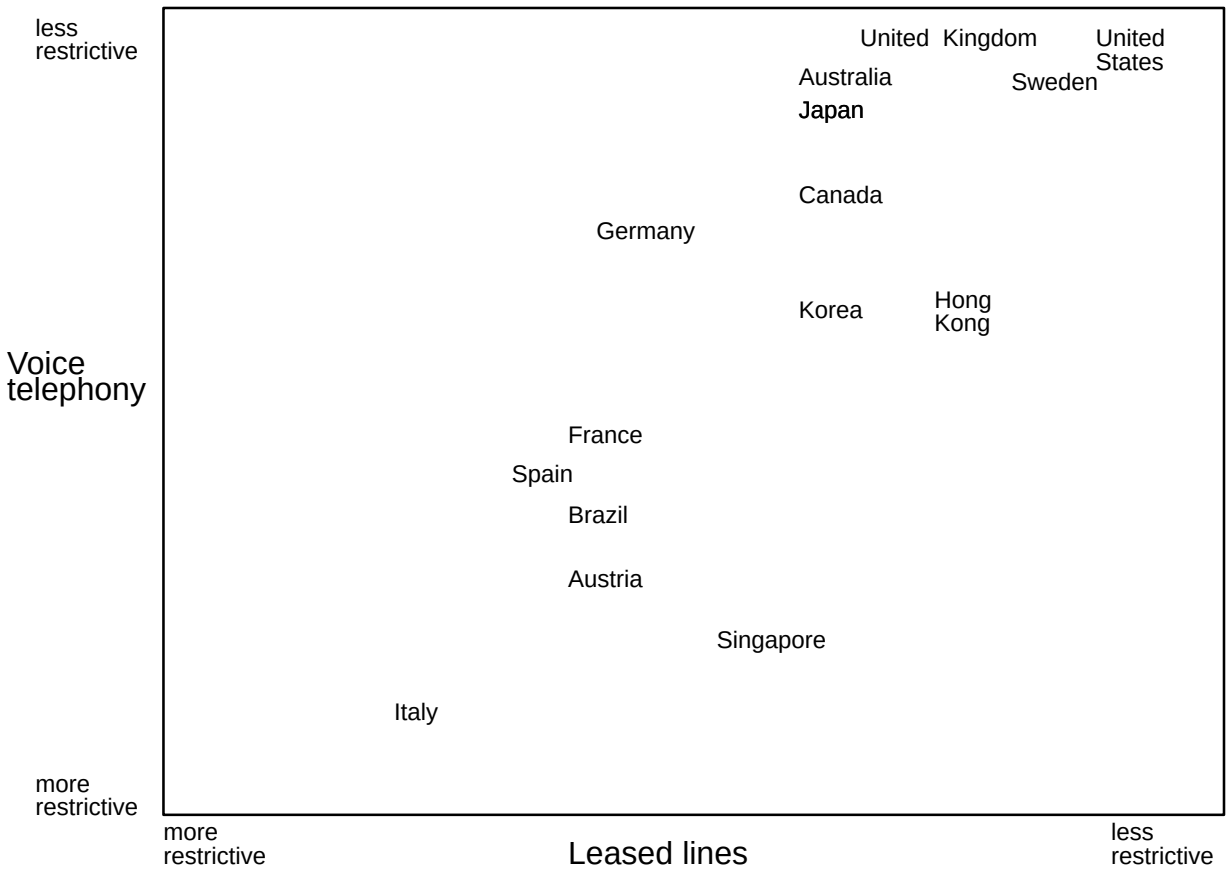
[103] Real-time voice service is the transmission of voices as conversations occur.

[104] Value-added services provide collection, selection, formatting, processing, or selective delivery of transmitted material. They provide "value" to otherwise basic transmission of voice or data over telephone lines. OTA, *U.S. Telecommunications Services in European Markets*, p. 1.

[105] ITU, p. 60. Multilateral negotiations on the provision of basic telecommunications services have begun. These negotiations are scheduled to conclude in April 1996, and many hope progress there will further aid U.S. outsourcing firms in overseas ventures.

[106] Industry representatives, interviews by USITC staff, Washington, DC, Apr. 14, 1994, Dec. 30, 1994, and Jan. 3, 1995.

Figure 3-3
Relative competitive opportunities for outsourcing firms in major markets, based on telecommunications restrictions[1]



[1] Relative restrictions in voice telephony were assessed by examining the levels of competition allowed in basic telephony services, value added services, and the ability of individual customers to own telephony equipment. Relative restrictions in leased lines were assessed by examining the regulations on connecting leased lines to a public network, the extent of competitive safeguards, independence of regulatory authorities from PTOs, availability of flat-rate fees, time required for acquiring leased lines, the availability of cost-based pricing, the ability to resell unused capacity, and the ability to switch calls through a third country.

Source: Data compiled by USITC staff.

private networks. In addition, outsourcing firms are encouraging nondiscriminatory cost-based pricing of leased lines.[107] Current pricing, usually based on call volume, gives the PTOs an advantage over computer services firms that are competing directly for outsourcing contracts. Because PTOs and outsourcing firms increasingly compete with one another, outsourcing firms also are seeking prohibitions on cross-subsidization of competitive business with funds from monopoly business.[108] Lastly, outsourcing firms propose more timely and transparent notification of technical changes required by companies operating private networks to access the public network.

[107] The costs associated with providing leased lines are calculated by individual telecommunications firms. Although many telecommunications providers now base their flat rates on these calculations, the rates of

[54]—*Continued*
comparable leased-line services vary too greatly to conclude that all providers use costs as a basis for prices.

[108] Cross-subsidization occurs when state-sanctioned monopolies competing in competitive market segments use excess monopoly profits to subsidize their price-competitive markets.

Whereas some progress toward regulatory reform has been achieved,[109] U.S. outsourcing providers are anxious to see further progress.[110] User groups, such as the International Chamber of Commerce, the Information Technology Association of America, the International Telecommunications Users Group, and the European Virtual Private Network Users Association, continually encourage further liberalization around the globe.

Export Controls on Software with Encryption Capabilities

Another external factor significantly affecting the competitiveness of software firms is government export controls.[111] U.S. software industry officials assert that foreign software producers are afforded a competitive advantage because of outdated U.S. export control regulations[112] pertaining to software with encryption capabilities.[113] The U.S. Government originally imposed export controls after World War II to limit sales of high-technology goods to Communist countries.[114] Although many of these controls have been revised or lifted, controls on software with encryption capabilities remain in place.[115]

Encryption ensures the security and integrity of electronic communications and files. Data are scrambled using mathematical formulas so that only authorized recipients who hold the code necessary to unscramble the data can obtain sensitive information.[116] Because of the increasing importance of information security to many businesses, many domestic and foreign customers look for encryption capabilities when purchasing software.

The most popular encryption method is based on the Data Encryption Standard (DES). DES has been adopted as a Federal standard for the protection of the U.S. Government's unclassified information. It is considered virtually impossible to break into encryption products of DES-strength or greater.[117] For this reason, many firms, domestic and foreign, desire DES strength encryption software.

U.S. and Foreign Controls

Software with encryption capabilities is controlled as a munitions item by the U.S. State Department and is subject to National Security Agency review.[118] The U.S. Government's reason for maintaining controls on exports of cryptographic software is to protect its overseas surveillance capabilities. Currently, U.S. companies are allowed to offer encryption as a feature in software sold in the United States. However, they generally are prohibited from including encryption of DES-strength or greater in mass-marketed software program exports.[119] Although overseas banks, other financial institutions, and foreign subsidiaries of U.S. companies receive exemptions to the encryption ban, most other businesses do not. In general, applications for the export of encryption software of DES-strength

[109] An example of such a step is the EU directive in which competition in voice services is to be allowed by 1998. *Commission Directive on Competition in the Markets for Telecommunications Services, OJ* No. L 192 (July 24, 1990), p. 10; and *Council Directive on the Establishment of the Internal Market for Telecommunications Services Through the Implementation of Open Network Provision, OJ* No. L 192 (July 24, 1990), p. 1.

[110] Industry representatives, interviews by USITC staff, Washington, DC, Apr.-May 1994.

[111] Export controls on software with encryption capabilities also impact U.S. service firms. For example, a systems integrator may be denied an export license for encryption products that are necessary to create a secure network for an overseas client. Information Technology Association of America (ITAA), *The National Information Infrastructure*, Sept. 1994, p. 6.

[112] U.S. export controls are administered under the Export Administration Acts of 1979 and 1988, as amended (50 U.S.C. app. 2401, et seq., 1988). The Export Administration Regulations implement the Export Administration Act (15 CFR 774.1).

[113] Business Software Alliance (BSA), "U.S. Software Companies Competitiveness Threatened by Outdated Export Control Regulations: $6 to $9 Billion in Annual Revenues at Risk," *News Release*, Oct. 11, 1993, p. 1.

[114] "Export Control Reform," *Statement by the Press Secretary*, the White House, Mar. 30, 1994; "U.S. Chamber of Commerce Opposes Export Control Bill," *Press Release*, U.S. Department of Commerce, Aug. 11, 1994; Denise Claveloux, "Cocom Initiates Reforms," *Electronics*, Nov. 22, 1993, p. 1; "U.S. Liberalizes Export

[61]—*Continued*
Controls for China," *The China Business Review*, May-June 1994, p. 4; and U.S. government officials, telephone interview by USITC staff, Nov. 17, 1994.

[115] "Export Control Reform," *Statement by the Press Secretary*, the White House, Mar. 30, 1994; and "U.S. Chamber of Commerce Opposes Export Control Bill."

[116] SPA, "Export Controls on Encryption Software," *Government Affairs Briefing*, Dec. 1993, p. 1.

[117] Industry representatives, interview by USITC staff, Washington, DC, Feb. 1994.

[118] Curtis E.A. Karnow, "Encryption and Export Laws," *Software Publisher*, Nov./Dec. 1994, pp. 52-54.

[119] BSA, "U.S. Software Companies Competitiveness Threatened," p. 1.

or more are denied by the U.S. Government, even for exports to allied countries.[120]

Most other countries, including the major allies of the United States, maintain export restrictions only for certain proscribed countries (terrorist nations).[121] For instance, companies in France, Germany, and Japan can easily ship software products with encryption capabilities to the United States. However, U.S. firms cannot export such products to those countries without receiving special licenses.

Current Effects and Proposed Changes of U.S. Export Controls

Unilateral U.S. controls on the export of software with encryption capabilities are not effective, according to many industry analysts.[122] This is because sophisticated encryption technology and products are widely available from foreign manufacturers. A study by the Software Publishers Association (SPA) identified 215 foreign hardware and software products from non-U.S. manufacturers in at least 20 foreign countries that now encrypt text and other data.[123] Of those, 84 used the DES standard.[124] Because DES or DES-strength software is widely available across the globe, industry officials assert that the principal effect of U.S. export controls on software containing such encryption capabilities is to deny sales to U.S. software companies. According to a 1993 study prepared for the Business Software Alliance (BSA), U.S. software publishers could lose $6 to $9 billion in annual revenues due to such controls.[125]

[120] Ray Ozzie, President, IRIS Associates, on behalf of the Business Software Alliance, testimony before Subcom- mittee on Economic Policy, Trade, and the Environment, Committee on Foreign Affairs, U.S. House of Representa- tives, hearing on "Export Controls on Mass Market Soft- ware" (Washington, DC: GPO, Oct. 12, 1993), pp. 33-47.

[121] The two exceptions to this are the United Kingdom and France, who reportedly maintain export controls on a slightly larger number of countries. U.K. software and services firm, letter to USITC, Nov. 22, 1994; and U.S. industry representative, telephone interview by USITC staff, Jan. 3, 1995.

[122] James Daly, "Export Guides Hinder U.S. Encryption Trade," *Computerworld*, Sept. 20, 1993, p. 161; and Scott Mace, "Companies Would Buy Foreign Software for Data Encryption," *Infoworld*, Oct. 11, 1993, p. 12.

[123] Ozzie, "Export Controls on Mass Market Software," pp. 33-47.

[124] DES software is also available worldwide through the Internet and by file transfers through telecommunications networks.

[125] BSA, "U.S. Software Companies Competitiveness Threatened," p. 1.

In 1994, Congress considered a revision of the Export Administration Act, the most important piece of legislation related to export controls. One representative introduced legislation that would have eliminated the requirement for a validated export license for most software with encryption capabilities. This bill, however, would have retained restrictions on software that potentially could be used by foreign military sources or terrorists.[126] Although the proposed legislation was supported by the software industry, it was dropped late in the 103rd Congress in an apparent compromise with the Administration on another related issue.[127] Although legislation to revise the Export Administration Act was introduced again in January 1995 (H.R. 361), action is not expected on the bill before late 1995.[128]

Government Research Programs

Governments in the United States, Europe, and Japan all have supported research programs to promote software development (figure 3-4). Some of the most successful government initiatives have been defense-related software research programs in the United States. Some analysts suggest that these programs have succeeded because they have had

[126] H.R. 3627, "A Bill to Amend the Export Administration Act of 1979 with Respect to the Control of Computers and Related Equipment," introduced in the U.S. House of Representatives, Nov. 22, 1993.

[127] The compromise involved a change in the Administration's position on another type of encryption standard, popularly known as the "clipper chip." On February 4, 1994, the Administration had announced that it would support a royalty-free public-domain Digital Signature Standard for encrypted electronic data. Products utilizing the new standard would not be subject to export controls. However, industry officials asserted that the "clipper chip's" coding was easy to unscramble and provided the U.S. Government with a means for electronic surveillance. As such, the chip would have a difficult time competing in domestic and foreign markets against encryption software which does not permit such surveillance. David T. Bottoms, "U.S. Government Adopts Encryption Standard," *Electronics*, Feb. 14, 1994, p. 11. On July 20, 1994, the Administration indicated that it was willing to consider alternatives to its "clipper chip" technology. Letter dated July 20, 1994, from Vice President Albert Gore to U.S. Rep. Maria Cantwell.

[128] U.S. Government and industry officials, interviews by USITC staff, Mar. 15, 1995; and Thomas M. Lemberg, Vice President and General Counsel, Lotus Development Corporation, remarks before U.S. Council for International

Business conference on *Intellectual Property Protection in the Year 2000*, Washington, DC, Mar. 15, 1995.

clearly defined military objectives and high levels of organization.[129]

By contrast, cooperative efforts between government and private industry in civilian-oriented research have been much less successful in achieving their overall goals. Factors limiting success include the difficulties of (1) managing large, complex programs;[130] (2) predicting changes and future directions in the market;[131] (3) obtaining the full cooperation of private-sector participants;[132] and (4) including small innovative firms in major projects.[133] Disagreement by participants on research agendas also has been a major problem. Despite these difficulties, some of the civilian-oriented research programs did provide indirect benefits by advancing and diffusing knowledge in various software technologies.[134]

[129] U.S. industry analysts, interviews by USITC staff, Washington, DC, May 1993 and Aug. 1994.

[130] Stephen E. Siwek and Harold W. Furchgott-Roth, *International Trade in Computer Software* (Westport, CT: Quorum Books, 1993), pp. 153-154.

[131] M.A. Cusumano, *Japan's Software Factories* (New York: Oxford University Press, 1991), p. 419.

[132] U.S. industry analysts, interviews by USITC staff, Europe and Washington, DC, May 1993 and Aug. 1994; and European Commission officials, interviews by USITC staff, Europe and Washington, DC, May 1993 and Sept. 1994.

[133] The EU's European Court of Auditors found that 12 companies received over 95 percent of ESPRIT's available funding in 1992. Denise Claveloux, "European Union Financial Watchdog Slams Esprit Program," *Electronics*, Feb. 14, 1994, p. 14; and Cusumano, *Japan's Software Factories*, pp. 388-420.

[134] In the United States, civilian government agencies credited with diffusing software technology include the National Science Foundation, whose support for computer science research was widely dispersed among U.S. universities; the National Aeronautics and Space Administration; and the National Institutes of Health. In Japan, the Ministry of International Trade and Industry (MITI), the Ministry of Posts and Telecommunications, and the Ministry of Education have been the principal civilian agencies promoting computer science research. William Aspray and Bernard O. Williams, "Arming American Scientists: The Role of the National Science Foundation in the Provision of Scientific Computing Facilities for Colleges and Universities," forthcoming, in *Annals of the History of Computing*, 1995; David Mowery, Professor, University of California, Berkeley, telephone interviews by USITC staff, Aug. 1994; and MITI officials, telephone interviews by USITC staff, Oct. 13, 1994.

Based on the limited success of most government-funded research programs, many countries now are focusing on broader initiatives to encourage advances in the software and service industries. Many governments are replacing direct research support with indirect support to promote development of their nations' information infrastructures.[135] For example, one of the most recent government initiatives affecting software and services in the United States is the National Information Infrastructure (NII). Congressional and Administration proposals for the NII (figure 3-5) advocate implementation of a nationwide telecommunications and computer network capable of carrying voice, data, and video over a high-speed digital infrastructure. The so-called "information superhighway" is expected to bring the benefits of information technology to residences as well as the workplace.

Computer industry officials state that the proposed NII would stimulate demand for software, custom programming, and systems integration services. Interest in software products would increase as more users gained access to computer networks. Further, the connection of various components of the national network likely would require custom programming and systems integration services. The network could also serve as an effective distribution outlet for software.[136] Industry analysts suggest that the government's role in the NII should be indirect, limited to such tasks as removing legal and regulatory hurdles, coordinating standards activities, and assuring universal access to the network.[137] According to these analysts, actual development and implementation of new technologies and services in connection with the NII should be reserved for private sector firms competing in the marketplace.[138]

Government policy makers in Europe and Japan have made similar proposals for developing their nations' information infrastructures (figure 3-5). The goal of the EU's Research and Development in Advanced Communication Technology for Europe (RACE) program is to develop an integrated

[135] Siwek, *International Trade in Computer Software*, pp. 153-154.

[136] U.S. industry representatives, interviews by USITC staff, Silicon Valley, CA and Seattle, WA, Apr. 14-24, 1993.

[137] ITAA, *National Information Infrastructure: Industry and Government Roles* (Arlington, VA: ITAA, 1993), pp. 1-23.

[138] ITAA, *The National Information Infrastructure: Overcoming the Obstacles: Financial, Regulatory, and Technical* (Arlington, VA: ITAA, Sept. 1994), pp. 33-34;

and U.S. industry representatives, interviews by USITC staff, 1993 and 1994.

broadband communications system. The program's objective is to provide the EU with the infrastructure needed to make it a major player in world information technology markets, including markets for software and services.[139] In Japan, the Ministry of Posts and Telecommunications has announced the construction of a national information-communications infrastructure to link every home and business in that country by 2010.[140] Although the Japanese Government expects the private sector to build the network, it is considering a number of incentive programs, including the provision of interest-free loans and tax incentives to motivate private businesses.[141]

Government Policies Affecting Small Businesses

Government policies that specifically affect small businesses are important factors influencing the competitiveness of the software and service industries. This is due in large part to the continuing importance of entrepreneurship in the development of viable software and service firms worldwide. Because these industries are still quite young relative to other sectors of the global economy, government policies designed to encourage small business growth have a relatively large effect. An estimated one-third of global software and service revenues are generated by small businesses, and small firms are likely to play a large role in these industries for many years to come.[142]

It appears that international differences in the availability of capital for financing new ventures, shaped in part by tax policy and other government measures aimed at encouraging capital formation, have had significant impact on the competitive success of small software and service firms. By most accounts, the U.S. venture capital system has reached a high level of institutional maturity and liquidity that puts small U.S. firms in a better position to raise capital and expand operations.[143] In addition to a traditional venture capital industry that invests from $3 to $4 billion annually in about 3,000 U.S. ventures, some experts suggest that there is an "invisible" venture capital market consisting of high net worth individuals who invest an estimated $10 to $20 billion annually in up to 30,000 U.S. ventures.[144] It is believed that a significant number of software and service firms benefit from such financing. Figure 3-6 illustrates the variety of non-government sources of capital available to new computer software firms in the United States.

While the cost and availability of capital are matters of concern for all software and service firms, they appear to be particularly important issues for smaller businesses which often lack collateral assets and a proven market record. This situation can complicate the task of securing venture capital financing and commercial bank loans. Two recent Congressional proposals are intended to improve the availability of capital for small U.S. firms in advanced technology industries. The first of these measures would relax numerous restrictions on the ownership of privately held firms organized as "Subchapter S" corporations.[145] Most importantly, this proposal would

---

[139] EU industry representatives, interviews by USITC staff, May 12, 1993; Laura D'Andrea Tyson, *Who's Bashing Whom?: Trade Conflict in High-Technology Industries* (Washington, DC: Institute for International Economics, 1992), p. 246; and "Information Superhighways," *European Information Technology Observatory (EITO)* (Frankfurt: EITO, 1994), pp. 101-104.

[140] Japan Telecommunication Council, *Reforms Towards the Intellectually Creative Society of the 21st Century: Program for the Establishment of High-Performance Info-Communications Infrastructure*, May 1994, p. 1.

[141] "MPT Establishes Special Loans for the Development of the Subscriber Optical Fiber Network," *MPT News*, vol. 5, No. 20, Jan. 23, 1995.

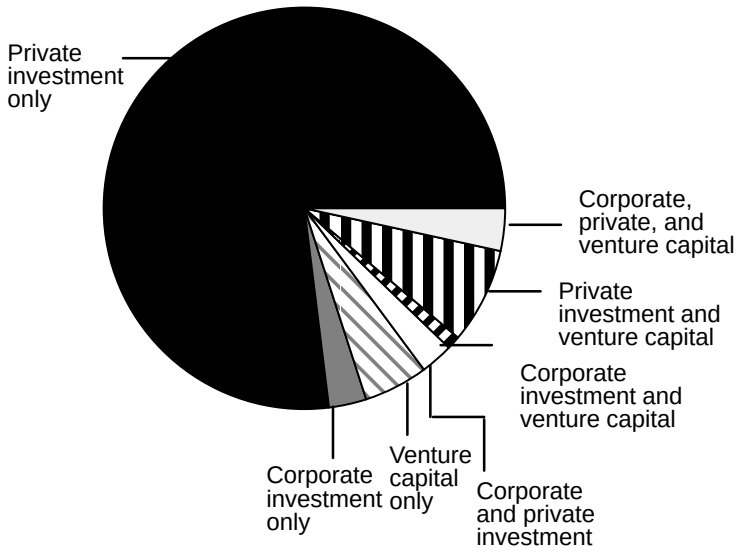
[142] According to the Small Business Administration, any company having less than $14.5 million in average annual revenue is considered a small business in the software and service industries (based on SIC codes 7371, 7372, 7374). See 13 CFR 121.601.

[143] This perception of the U.S. venture capital system is shared by some international commentators. In its 1992 White Paper on the software industry, Japan's Ministry of International Trade and Industry (MITI) notes that the competitive strength of the U.S. software industry "can be attributed in part to the availability of large amounts of risk money, including venture capital." MITI, "A New Era of Software: Urgent Proposals," by the Basic Policy Subcommittee, Information Industry Section, Industrial Structure Council, Dec. 1992, pp. 27-28.

[144] William E. Wetzel, Jr., Director, Center for Venture Research, University of New Hampshire, testimony before the Subcommittee on Capital Markets, Securities, and GSEs, Committee on Banking and Finance, U.S. House of Representatives, Mar. 2, 1995.

[145] The Subchapter S Corporation Act of 1982 (P.L. 97-354, 96 Stat. 1669, 26 U.S.C. 1361 et seq), Oct. 19, 1982. Entrepreneurs may choose one of several methods to create a legal structure for their company, including proprietorships, partnerships, corporations, or S corporations. S corporations carry certain benefits in terms of tax treatment, and certain restrictions as to the number of shareholders and class of stock that can be offered. Although a number of small businesses may start out as

Figure 3-6
Sources of capital for new computer software companies, 1990[1]



[1] Data refer to non-government sources of capital. Private capital includes investments by individuals or other non-corporate entities. Corporate capital refers to investments by corporations. Venture capital refers to investments by venture capital firms.

Source: National Science Board, *Science and Engineering Indicators-1991*, p. 448. Derived from the Core Tech database, Corporate Technology Information Services, Inc.

increase the limit on the number of shareholders in a Subchapter S corporation from 35 to 50 and permit tax-exempt organizations, financial institutions, and nonresident aliens to own stock in the firm. Representatives of the software and service industries see this measure as an important step toward easing access to capital for small, growing firms.

In 1993, a House subcommittee also explored the possibility of expanding government provision of equity financing through venture capital markets for high-technology start-up firms.[146] While some observers contend that there recently has been an overall decline in the amount of early-stage equity financing available for start-up technology firms (figure 3-7), little agreement exists on whether and how it might be appropriate for government to become directly involved in the capital market to address a possible shortage.[147]

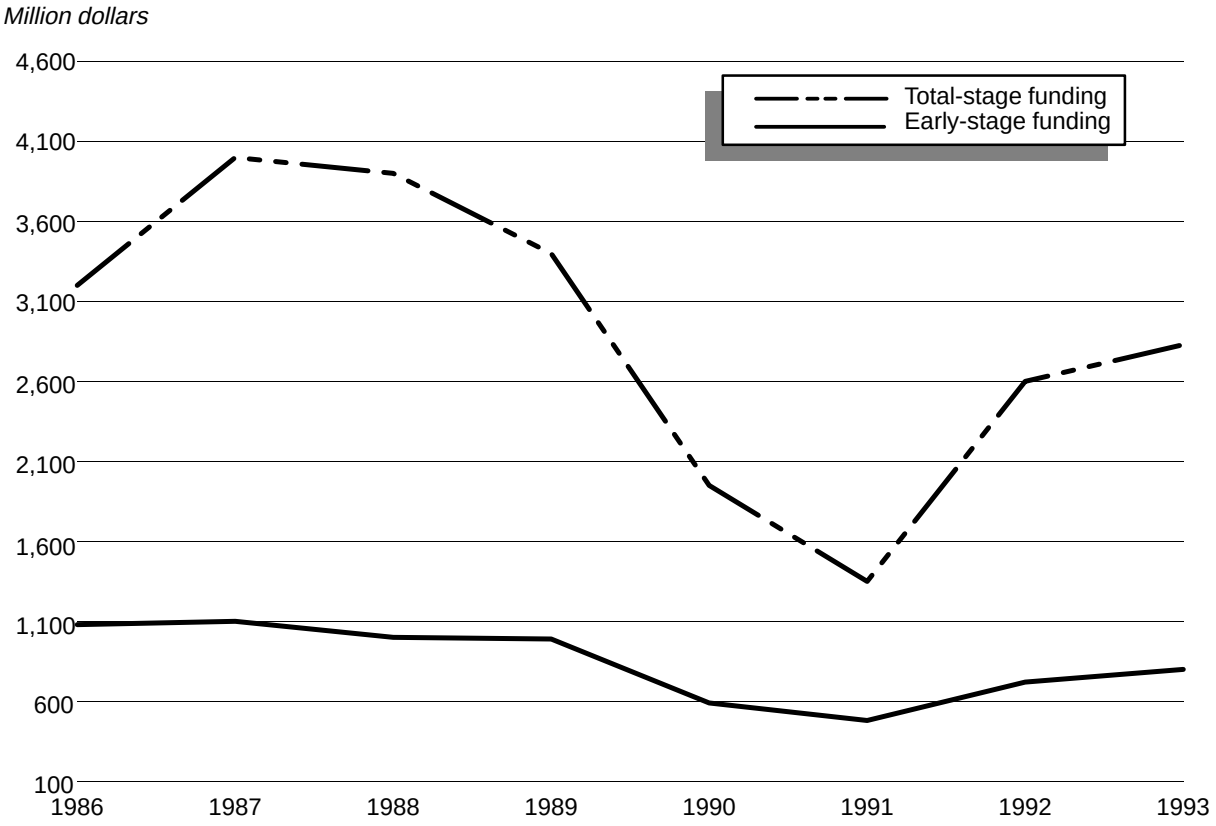
92—*Continued*
S corporations, most will later elect to be treated as C (or regular) corporations as they grow. Fenwick & West, *Venture Capital: A Strategy for High Technology Companies* (Palo Alto, CA: 1992), p. 4.

[146] U.S. House of Representatives, Report on the Hearing on Equity Investments, Venture Capital, and the

93—*Continued*
Federal Role in the Availability of Financing for High-Technology Companies before the House Committee on Banking, Finance, and Urban Affairs Subcommittee on Economic Growth and Credit Formation, Nov. 16, 1993; and U.S. House of Representatives, Report on the Hearing on The Availability of Financing for New-High-Technology Companies before the House Committee on Banking, Finance & Urban Affairs, Subcommittee on Economic Growth and Credit Formation, Oct. 26, 1993.

[147] For discussions on the relative merits of a government role in financing venture capital, see Cynthia A. Beltz, *Financing Entrepreneurs* (Washington, DC: AEI Press, 1993).

Figure 3-7
U.S. venture capital investment, 1986-93



Source: Compiled by USITC staff based on data from the National Venture Capital Association.

In addition to the Congressional proposals above, government sources of capital available to start-up firms in the United States include a new U.S. Small Business Administration program that offers "micro" loans of up to $25,000, and a number of quasi-government state development agency programs, funded by certain states in partnership with corporate backers.[148] The Small Business Administration has provided over $40 million to start-up firms over the past decade and, in April 1994, initiated a new Small Business Investment Company (SBIC) program that will offer more than $1 billion a year to infant enterprises through venture capital firms.

[148] SBICs are largely owned by banks and have been involved in the establishment of a number of successful firms in the computer and electronics industry, including Apple Computer and Intel Corp. Anne B. Fisher, "Raising Capital for a New Venture," *Fortune*, June 13, 1994, pp. 99-101.

Although European and Japanese governments also have concerned themselves with problems of capital formation in high-technology sectors,[149] such policies primarily have benefited larger, well-established companies, perhaps to the detriment of smaller competitors.[150] In Germany, for instance, there is evidence that the emergence of new computer software firms has been stymied by poor access to capital markets.[151] Policies pursued by national

[149] American Enterprise Institute (AEI), "Financing Venture Capital: Is There a Government Role," *Conference Summary* (Washington, DC: AEI Press, Apr. 15, 1993), p. 2.

[150] EU officials, interviews by USITC staff, Europe, May 12, 1993; and EU official, telephone interview by USITC staff, Jan. 3, 1995.

[151] Siwek, *International Trade in Computer Software*, p. 112.

governments in Europe to address the problem of capital formation in high-technology sectors have in the past included various types of financial support designed to help "national champion" firms compete successfully against more profitable U.S. and Japanese companies. Such policies are now generally regarded as ineffective,[152] as evidenced by the relative lack of market share accounted for by "national champion" firms in computer hardware and software markets.[153] Consequently, certain European governments are adopting different approaches to revitalizing high-technology firms. For instance, the French Government, which provided direct capital support to Groupe Bull for many years, is now soliciting bids for privatization of the company.

A number of studies have attempted to compare the economy-wide cost of capital in the United States with that in Japan, focusing on possible factors contributing to higher rates of capital formation in Japan.[154] Two analysts have found that Japanese capital markets typically offer lower risk premiums on investments, thereby reducing capital costs for relatively risky ventures involving the commercialization of new technologies.[155] These analysts conclude that the U.S. system has, on a broad level, discouraged high-risk investments and favored debt over equity as a financing vehicle. However, critics of the Japanese tax system have pointed out that Japanese policies have favored larger firms.[156] In many cases, larger Japanese hardware firms have benefited from capital formation while small software companies have not. Several analysts assert that, compared to the United States, Japan barely has a venture capital industry capable of supporting entrepreneurial efforts in computer hardware and software.[157] According to Japanese estimates, 77 software companies folded during the first 9 months of 1992 due to slowing software demand and a tight financial market.[158]

In addition to the above capital formation issues, U.S. tax policies, particularly those related to tax treatment for capital gains, may have a significant effect on small firms in the software and service industries. Some industry analysts suggest that elimination of preferential tax treatment for capital gains income in the United States has hurt small businesses in a disproportionate way, primarily because small firms typically must rely more heavily on equity (rather than debt) financing.[159] Because equity investors must demand a higher rate of return in order to offset greater risk and capital gains tax obligations, the relative cost of capital for small software and service firms may be higher. Analysts note that last year's 50 percent reduction in taxes on capital gains earned on investments

---

[152] The Futures Group, *The Impact of Foreign Industrial Targeting on the U.S. Computer Industry*, Report 701-138-03 (Glastonbury, CT: The Futures Group, Apr. 30, 1985), pp. 2-14; Kenneth Flamm, "Globalization in the Computer Industry," background paper for experts meeting at the OECD, Paris, Dec. 17, 1990, p. 19; European industry representatives and EU officials, interviews by USITC staff, Munich, Ivrea, Paris, London, and Brussels, May 6-24, 1993; and EU industry official, telephone interview by USITC staff, Nov. 30, 1994.

[153] Michael F. Oppenheimer, "Computers" and "Software" chs. in *Nontariff Barriers: The Effect on Corporate Strategy in High-Technology Sectors*, (Boulder: Westview Press, 1987), pp. 61-82, 119-139.

[154] B.D. Bernheim and J.B. Shoven, "Taxation and the Cost of Capital: An International Comparison," *The Consumption Tax: A Better Alternative?* (Cambridge, MA: Ballinger Publishing Co., 1987), pp. 61-86; K.R. French and J.N. Porterba, "Are Japanese Stock Prices Too High," paper presented at the Center for Research Security Prices, Seminar on the Analysis of Security Prices, Chicago, IL, May 4, 1989; G.N. Hatsopoulos and S.H. Brooks, "The Cost of Capital in the United States and Japan," paper presented at the International Conference of Capital, Kennedy School of Government, Harvard University, Cambridge, MA, Nov. 19-21, 1987; and T. Tachibanaki, "The Taxation of Income from Capital in Japan," ch. in *Government Policy Towards Industry in the United States and Japan* (Cambridge: Cambridge University Press, 1988), pp. 51-96.

[155] B. Douglas Bernheim and J.B. Shoven, "Comparing the Cost of Capital in the United States and Japan," ch. in *Technology and the Wealth of Nations*, ed. Nathan Rosenberg, Ralph Landau, and David C. Mowery (Stanford: Stanford University Press, 1992), pp. 151-174.

[156] U.S. industry analysts and representatives, interviews by USITC staff, Silicon Valley, CA, Apr. 14-24, 1993; and U.S. software industry analyst, telephone interview by USITC staff, Nov. 30, 1994.

[157] Christopher Wood, *The End of Japan Inc.* (New York: Simon and Schuster, 1994), pp. 157-158.

[158] Edmund Klamann, "Japan Confronts New American Import: Price Competition," *Japan Economic Almanac 1993*, p. 84.

[159] "U.S. Tax Policy Has Contributed to Higher Capital Costs," testimony by Mark A. Bloomfield and Margo Thorning, American Council for Capital Formation, before the House Ways and Means Committee, Mar. 5, 1990. In many cases, small start-up software firms rely more on equity (rather than debt) financing because they have fewer tangible assets that can be used as collateral.

in certain entrepreneurial ventures is a step in the right direction.[160]

Education

Differences in education systems and patterns of student achievement also may influence the competitiveness of software and service industries. Because such industries on average create higher paying jobs and expand gross domestic product at a faster pace than many other industries, such educational differences also can have an important effect on a country's overall economic welfare. This section will compare selected features of the education systems of the United States, Europe, and Japan that appear to be relevant for software, services, and other high-technology sectors.

United States

The U.S. education system has a number of advantages over other countries' systems. Currently, well over 90 percent of U.S. elementary and secondary schools possess computers, compared with less than an estimated 40 percent in Europe, and 35 percent in Japan.[161] The increasing use of personal computers in U.S. elementary and secondary schools provides U.S. students with more experience in using a variety of hardware and software packages than students in other countries.

The United States also has the most comprehensive network of universities, colleges, and technical institutions in the world providing courses and degrees in computer science.[162] Thus, U.S. students have substantially more opportunities to obtain education and pursue careers in such fields as computer programming, systems integration, and computer engineering than students in other countries.[163]

Further, U.S. college students generally receive a broader education than do students in other countries.[164] Even those students specializing in technical fields such as computer science and engineering often are required to round out their education with liberal arts and humanities courses. Many experts attribute the greater success and creativity of the U.S. software industry to the broader education received in the U.S. education system.[165]

Finally, a much larger percentage of U.S. secondary school students continue on to college or other postsecondary institutions than do students in Europe (figure 3-8). European education systems tend to separate their higher and lower performing students at an earlier stage than occurs in the United States, targeting the lower performing students for vocational careers.

Despite the advantages that U.S. students have, a growing percentage of students enrolled in graduate courses in computer science and engineering in the United States during recent years has been non-U.S. citizens. In the 1989-90 school year, almost 29 percent of all master's degrees granted in computer science and engineering at U.S. universities were granted to nonresident foreigners.[166] The National Science Board reported that of the 1,837 doctoral degrees granted in computer science in 1991, 45 percent went to

---

[160] This applies to investments in entrepreneurial ventures held for 5 years or longer. Wetzel, testimony before the Subcommittee on Capital Markets, Securities, and GSEs, Mar. 2, 1995. A key recommendation made before the subcommittee was that Congress should revive the seed capital provision of the 1993 Enterprise Capital Formation Act (S. 368). This provision would increase the rewards for early-stage investment by reducing the capital gains tax from 50 percent of the normal rate to zero for certain investments. Ibid.

[161] Official of the U.S. Department of Education, telephone interview by USITC staff, Feb. 22, 1994; and Japanese and European industry and government officials, telephone interviews by USITC staff, Nov. 30 and Dec. 1, 1994. A study conducted for the SPA showed that there were 4.4 million personal computers installed in the nation's school districts in 1992. SPA, "Technology in Education," *Government Affairs Briefing*, Washington, DC, Oct. 1993, pp. 1-2.

[162] Official of the U.S. Department of Education, telephone interview by USITC staff, Feb. 22, 1994; Karen P. Juliussen and E. Juliussen, *Computer Industry Almanac* (Incline Village, NV: Computer Industry Almanac, 1993), pp. 243-54; and Siwek, *International Trade in Computer Software*, pp. 103-106.

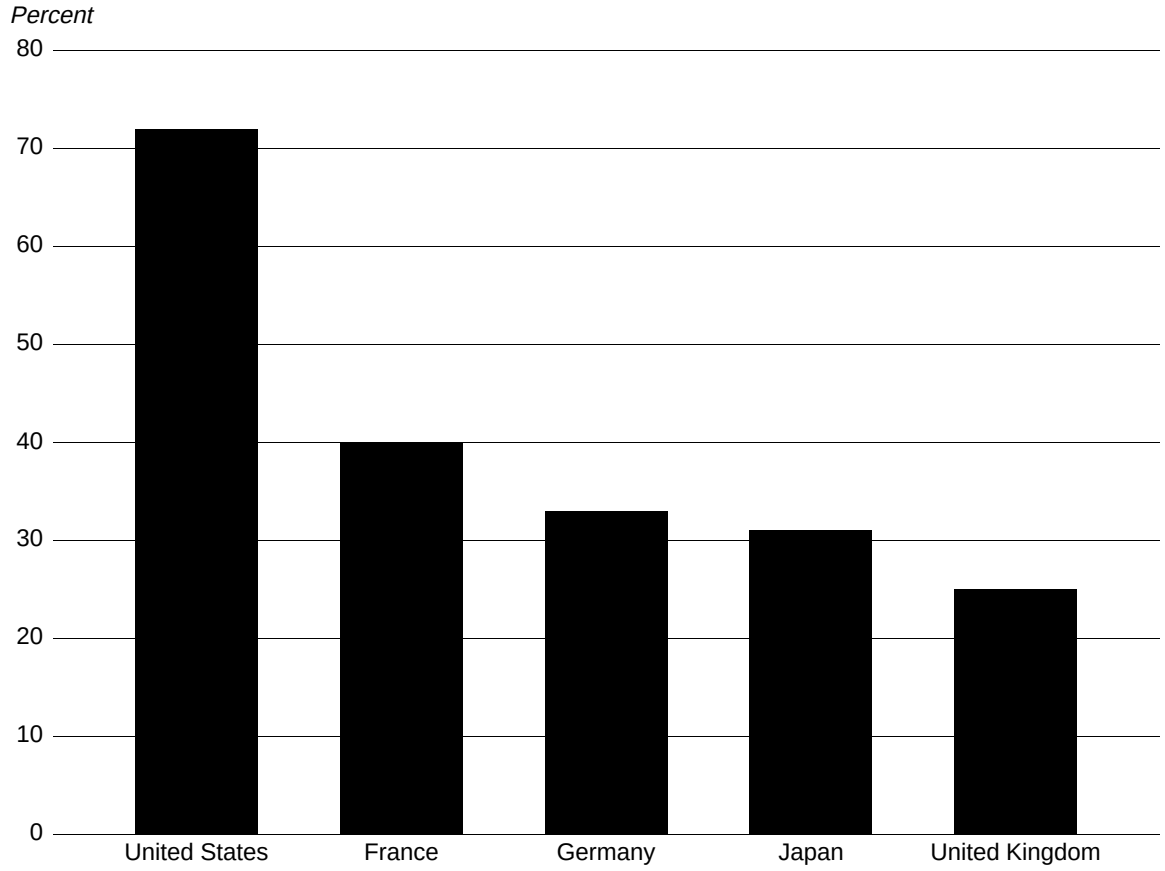
[163] Ed Feigenbaum, "The Japanese Software Industry: Where's the Walkman," ch. in *The Future of Software* (Cambridge: MIT Press, 1995), pp. 215-227.

[164] Official of U.S. Department of Education, telephone interview by USITC staff, Feb. 22, 1994.

[165] U.S. industry representatives, interviews by USITC staff, Silicon Valley, CA and Seattle, WA, Apr. 14-24, 1993.

[166] U.S. Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics, *Race/Ethnicity Trends in Degrees Conferred by Institutions of Higher Education: 1989-90*, 1991.

Figure 3-8
Percentage of 20- to 24-year-old population enrolled in colleges, universities, and technical schools in selected countries, 1990



Source: U.S. Department of Education, *Digest of Education Statistics: 1993,* Table 385 (Washington, DC: GPO, Oct. 1993), p. 411.

non-U.S. citizens on temporary visas (figure 3-9).[167] However, upon graduation, many foreign computer science students are hired by U.S. firms and remain in the United States.[168]

One reason for declining attendance by U.S. students may be that graduates of U.S. secondary schools reportedly lack important fundamental skills. For example, many educators assert that U.S. students are entering colleges and technical schools with fewer mathematics and science capabilities than students in Europe and Japan.[169] Skills in these areas are extremely important for students pursuing advanced engineering and computer science courses.

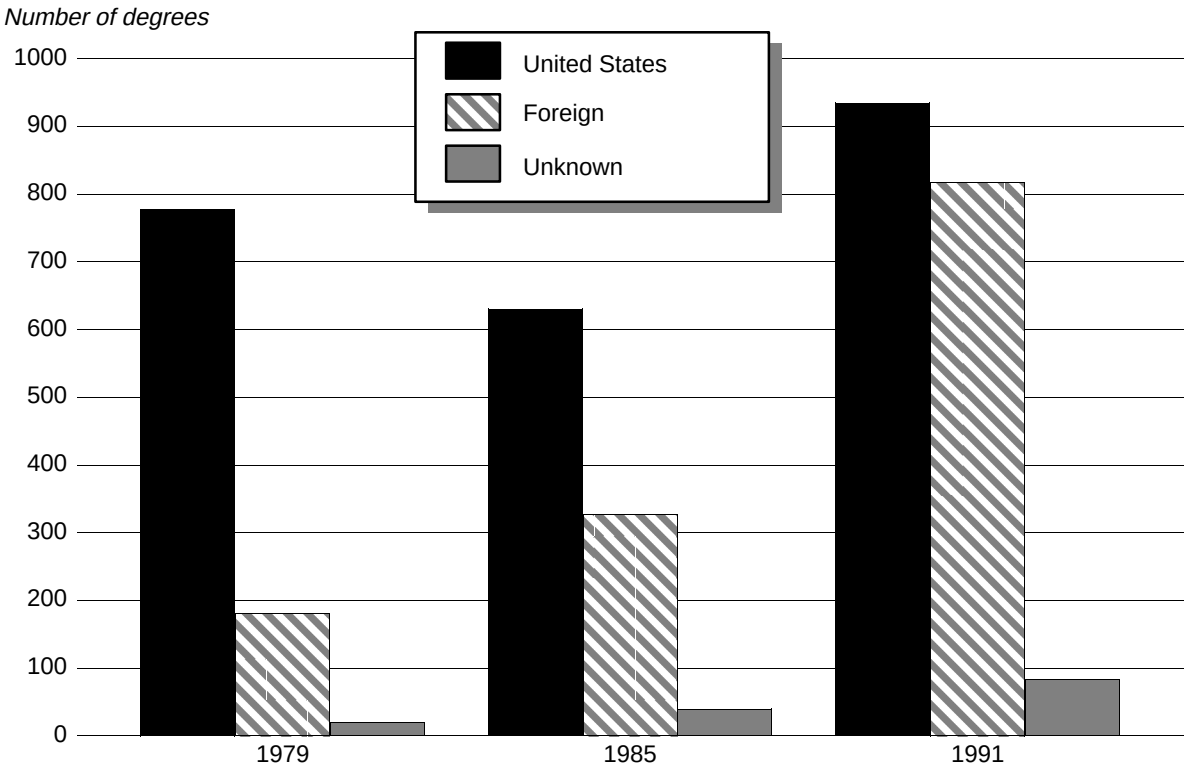
U.S. policy makers increasingly are concerned that the U.S. education system is not preparing students adequately for employment in high-

[167] National Science Board, *Science and Engineering Indicators* (Washington, DC: GPO, 1993), appendix table 2-28, pp. 286-287; and ITAA, *The U.S. Information Technology Industry: Profile 1992* (Washington, DC, 1993).

[168] Siwek, *International Trade in Computer Software*, pp. 103-109. As overseas software industries have become more established, the number of foreign computer science students returning to their home country to work has increased. In spite of this, industry analysts report that the majority of off-shore programming contracts are for low-end projects and thus pose little threat to the U.S. industry. Industry representatives, telephone interviews by USITC staff, Washington, DC, Mar. 9, 1995.

[169] Official of the U.S. Department of Education, telephone interview by USITC staff, Feb. 22, 1994.

Figure 3-9
Number of doctoral degrees in mathematics and computer sciences awarded by U.S. universities to U.S. and foreign citizens, 1979, 1985, and 1991



Source: National Science Foundation (NSF), *Science and Engineering Doctorates: 1960-91*, Detailed Statistical Table, NSF 93-301 (Washington, DC: NSF, 1993).

technology industries.[170] A number of bills have been introduced in the U.S. Congress to encourage cooperation among national, state, and local governments with respect to improving technology support for schools and enhancing science and mathematics curriculum (figure 3-10). Software industry officials suggest that such legislation will not only help prepare future programmers and other computer industry specialists, it also will increase schools' funding for purchases of software and services.[171] Consequently, the legislation should be beneficial to the software and service industries.

Europe

Certain characteristics of the education systems in many European countries help assure that secondary

[170] ITAA asserted recently that "...the U.S. educational system does not produce enough qualified people to staff our most competitive companies." ITAA sees the U.S. computer software industry as "absolutely dependent on a steady increase in the number of computer programmers and software engineers," and therefore supports more liberal immigration laws that will allow continuation and expansion of the influx of educated and skilled computer programmers, analysts, and software engineers into the United States. ITAA, *The National Information Infrastructure*, pp. 7, 22-24. Conversely, many companies suggest that there are numerous skilled programmers in the United States. Industry representatives, interviews by USITC staff, San Francisco, CA, Mar. 1994.

[171] A recent study by SPA showed that of $1.98 billion spent on educational technology in the 1992/93 school year in the United States, $570 million was used for purchases of educational software. SPA, "Technology in Education," *Government Affairs Briefing*, Oct. 1993, pp. 1-2. The value of software bought by schools throughout the United States is expected to top $1.45 billion by 1996. "Educational Software: Teacher's Pet," *The Economist*, Dec. 10, 1994, p. 67.

Figure 3-10
U.S. legislation for education reform

Proposal	Sponsors	Objectives	Status
S. 1040 Technology for Education Act of 1994	Jeff Bingaman (D-NM) (U.S. Senate)	To support systemic improvement of education and the development of a technologically advanced citizenry and an internationally competitive work force. To be accomplished by establishing a comprehensive system through which technology-enhanced curriculum, instruction, administrative support resources and services, and national education standards are provided to schools throughout the United States.	Introduced in U.S Senate on May 27, 1993. Not voted on in 103rd Congress. Likely to be resubmitted in some form in 1995.
H.R. 1804 S. 1150 Goals 2000: Educate America Act	Dale E. Kildee (D-MI) (U.S. House of Representatives); Edward M. Kennedy (D-MA) (U.S. Senate)	To improve learning and teaching by providing a national framework for education reform, to promote the research and systemic changes needed to ensure equitable educational opportunities for all students, to promote the adoption of a voluntary national system of skill standards and certifications, and for other purposes.	Introduced in the U.S. House of Representatives on April 22, 1993 and in the U.S. Senate on June 23, 1993. Signed by the President on March 31, 1994. Became Public Law No. 103-227 (108 Stat. 125).
H.R. 2728 Technology Education Assistance Act of 1993	Thomas C. Sawyer (D-OH) (U.S. House of Representatives)	To authorize a program of grants to states to improve the use of technology in elementary and secondary schools.	Introduced in U.S. House of Representatives on July 23, 1993. Not voted on in 103rd Congress.
H.R. 6, S. 1513 Improving America's Schools Act of 1993	Dale E. Kildee (D-MI) (U.S. House of Representatives); Edward M. Kennedy (D-MA) (U.S. Senate)	To reauthorize the Elementary and Secondary Act of 1965. The proposal establishes high educational standards for disadvantaged elementary and secondary school students, improves teaching of mathematics and science, and establishes demonstration projects in educational technology, among other things.	Introduced in U.S. House of Representatives on September 23, 1993 and in the U.S. Senate on October 4, 1993. Signed by the President on October 20, 1994. Became Public Law No.103-382 (108 Stat. 125).

Source: Compiled by USITC staff.

school graduates arrive at universities and technical schools with above average skills in mathematics and science.[172] In a number of European countries, students who demonstrate little interest or aptitude in advanced coursework are separated from students preparing for universities or technical schools and provided vocational and apprentice training. This may increase the quality of education provided to college-bound students, ensuring that they have acquired important fundamental skills prior to entering universities.

On the other hand, European countries are often criticized for closing opportunities for educational advancement.[173] Analysts point out that a far lower percentage of the population obtains a university

[172] Andy Green, *Education and State Formation: The Rise of Education Systems in England, France, and the USA* (New York, NY: St. Martin's Press, 1990), pp. 1-353.

[173] Joseph Ben-David, *Centers of Learning: Britain, France, Germany, United States* (New York: McGraw-Hill, 1992), pp. 1-208; and Georgeanne B. Porter, *Federal Republic of Germany: A Study of the Educational System of the Federal Republic of Germany and A Guide to the Academic Placement of Students in Educational Institutions of the United States* (Washington, DC: American Association of Collegiate Registrars and Admissions Officers, 1986), pp. 1-181.

education in Europe than in the United States.[174] The United Kingdom, for example, has been accused of creating a school system geared exclusively to the few students judged to be capable of advanced study.[175] Thus, even though European students entering universities generally are better prepared than U.S. students in mathematics, science, and other fundamental skills, they represent a much smaller percentage of the population.

A recent report on the European information technology market notes the need for more widespread use of computer technology in the European education system to provide for the technical skills that will be needed in the future.[176] Although the number of European universities offering computer science programs has been increasing, the current number of such programs still represents only a small fraction of those available in the United States.[177]

Japan

Some analysts have described the Japanese education system as a coherent system from primary school to employment, where high degrees of training relevant in the workplace are evident.[178] Companies are the primary supporters of this "pull-through system," though it is not a vocational system.[179] Compared to U.S. and European schools, the Japanese primary and secondary school system is well regarded for providing fundamental skills in mathematics, science, and other subjects to all of its students.[180]

A major criticism of Japanese schools is that they rely on rote teaching methods and memorization to a much greater extent than do U.S. and European schools.[181] As a result, they tend to produce students with better fundamental skills but possibly with less creativity than U.S. and European students.[182] The Japanese Government is concerned that lower levels of creativity in Japanese graduates could place them at a disadvantage in developing high-level skills in such areas as computer programming and systems integration.[183]

The number of computer science programs in Japanese universities is growing; however, as in Europe, the number of such programs does not approach U.S. levels.[184] Nonetheless, Japanese officials are reportedly well aware of the importance of computers in education and have launched a major program to promote the use of them in all schools by making computer literacy a compulsory requirement at every scholastic level.[185]

---

[174] The level of higher education graduates in the United States was about 25 percent in 1988. This compares to 16 percent in the United Kingdom, 13 percent in Germany, and 12 percent in France. *OECD Indicators: Education at a Glance* (Paris: OECD, 1992), pp. 98-99.

[175] Mike Howarth, *Britain's Education Reform: A Comparison with Japan* (London: Routledge, 1991), p. 11.

[176] *European Information Technology Observatory,* p. 19.

[177] Official of the U.S. Department of Education, telephone interview by USITC staff, Feb. 22, 1994; and European industry and government officials, telephone interviews by USITC staff, Nov. 30 and Dec. 1, 1994.

[178] Howarth, *Britain's Education Reform: A Comparison with Japan,* pp. 16, 142.

[179] Ibid.

[180] Ibid.; and Ryo-ichi Kuroha, "Introduction: The Present Status of Education," ch. in *Non-University Sector Education in Japan*, ed. Yoshiya Abe (Hiroshima: Takahashi-Toshado, 1989), p. 6.

[181] Howarth, *Britain's Educational Reform: A Comparison with Japan*, p. 16.

[182] Ibid.; and Edward R. Beauchamp, *Japanese and U.S. Education Compared* (Bloomington: Phi Delta Kappa Educational Foundation, 1992), pp. 9-32.

[183] Ibid.; Wood, *The End of Japan Inc.*, pp. 17, 18, and 158; and Japanese Government officials, telephone interviews by USITC staff, Oct. 13, 1994.

[184] Japanese government and industry representatives, telephone interviews by USITC staff, Dec. 1, 1994; and Feigenbaum, "The Japanese Software Industry," pp. 215-227.

[185] *European Information Technology Observatory,* p. 19.

CHAPTER 4
Competitive Assessment

Introduction

This chapter assesses the performance of U.S. software and service companies. The assessment is provided in five separate and distinct discussions, each pertaining to a different segment of the software and service industries. Separate discussions are merited since the nature of competition varies across segments. The five discussions generally have a parallel structure, which is described below.

The Competitive Assessment Framework

Figure 4-1 illustrates this study's framework for assessing performance in each segment of the computer software and service industries. Discussions begin with a summary of the recent performance of predominant firms in each segment. Each discussion then identifies the terms of competition and assesses the skills or strategies that most significantly affect firms' abilities to maintain or increase global market share, which is used as the measure of competitiveness. Terms of competition, shown in the third column of figure 4-1, are the factors that are most important to consumers. For example, *price* is the most important factor for purchasers of applications software products. As a result, vendors of applications software look for strategies, such as a reduction in sales and marketing expenditures, to achieve low prices (column 4). Each discussion concludes with an outlook section that assesses the opportunities for U.S. firms based on current trends in the industry.

Vendors of software products, which include hardware companies such as IBM and Digital Equipment Corp. (DEC), and independent software vendors such as Microsoft Corp. and Lotus Development Corp., are striving to meet the demands of consumers through unique strategies. For applications software firms, strategies include the revision of sales and marketing approaches to satisfy customer demands for lower prices, and the creation of innovative product development techniques to ensure timely product releases. Purchasers of systems software, meanwhile, are trying to overcome the complexities inherent in the market by demanding simplified software options. To achieve this, systems software vendors are listening closely to user needs and creating intuitive graphical user interfaces and basic software tools. Finally, the formation of alliances is important in both applications and systems software firms, since they allow for the sharing of ideas and resources necessary to create high-quality and interoperable products.

Demand for services, meanwhile, is flourishing as users struggle to increase the utility and interoperability of installed hardware and software investments. The $187-billion global market for computer services comprises systems integration services (30 percent), outsourcing services (33 percent), and custom programming services (37 percent).[186] Although some firms specialize in one of these discrete categories, most of the large service providers such as Electronic Data Systems (EDS), Andersen Consulting, and Computer Sciences Corp. (CSC) offer a combination of all of the above services.

Corporate and government clients are turning to third-party service vendors in order to overcome technological complexity in the hardware and software marketplace and achieve a competitive advantage through optimized, industry-specific use of information technology (IT). In order to meet these objectives, service providers rely on unique skills, strategies, and pricing policies to improve market share. Price is an important factor to consumers in all three service categories, though vendors in each segment respond with different techniques. Systems integration (SI) firms and custom programming firms, for example, rely on internal cost management techniques, while outsourcing firms focus on creative pricing strategies to appeal to clients. Expertise is also important in two of the three service segments. SI firms must provide vertical market expertise[187] to satisfy customer demand for optimized front office applications, while outsourcing firms must offer

[186] Compiled from data provided by INPUT, Inc.

[187] Vertical markets refer to specific industries, such as the manufacturing industry or the financial services industry.

expertise in a range of services, and be capable of meeting multiple client needs. The sections that follow discuss the key terms on which firms in each of the individual software and service segments compete, and strategies for satisfying these terms.

Applications Software Firms

Introduction

The global market for applications software products reached an estimated $47 billion in 1994, a 13-percent increase over the corresponding 1993 figure.[188] U.S. firms continue to dominate the worldwide market for packaged applications software, accounting for approximately 75 percent of global revenues in 1994.[189] Although significant changes have taken place in the relative competitive positions of individual U.S. software firms over the past decade, the general pattern of U.S. leadership in the world industry has not been altered.

The competitive position of U.S. software firms is particularly strong in PC- and workstation-based applications, where a small group of U.S. firms controls an overwhelming share of the global market. The strength of these firms is evident not only in markets for PC-based business productivity applications,[190] such as word processing, spreadsheet, database, and presentation graphics programs, but also in the rapidly growing markets for educational and home entertainment software.[191] Virtually all leading segments of the applications software market, including relatively new areas such as electronic mail and document management (sometimes referred to as "workflow" software or "groupware"), are led convincingly by U.S. firms.[192] Indeed, out of the top 100 independent software vendors in the world, 92 are U.S. firms.[193] A list of the top 10 independent software vendors, ranked by global revenues, is provided in table 4-1.

Four U.S. firms—Microsoft, Lotus Development, Novell (through its WordPerfect subsidiary), and Borland International—have achieved strong market share positions in the lucrative and highly visible market for business productivity applications running on PCs, workstations, and the networks that link them.[194] Microsoft alone accounted for an estimated 45 percent of the world market for all PC-based applications in 1993.[195] Lotus, Microsoft's largest competitor in the market for business productivity applications, accounted for an estimated 12 percent of the world PC applications market in 1993, while the shares held by WordPerfect and Borland stood at 8 percent and 5 percent, respectively.[196]

In addition to these independent software vendors, which focus exclusively on the development and marketing of packaged software, major hardware manufacturers—including IBM, DEC, Fujitsu, and NEC—derive a large amount of revenue from sales of applications software products. All of these major hardware manufacturers, however, continue to rely heavily on sales of applications that run on mainframes and minicomputers, hardware platforms that historically have generated the lion's share of revenues for these firms. The competitive position of firms such as IBM and DEC in world software markets thus has been eroded as a result of the

---

[188] Revenue estimate based on data from INPUT, Inc., "Worldwide Information Services Forecast," Mountain View, CA, 1994, p. A-5.

[189] Market share estimate provided by International Data Corp., Framingham, MA.

[190] This term represents the largest category of PC-based applications in an office environment. Rick Whiting, "Full-Scale PC Software Price War Will Continue," *Electronic Business*, Jan. 1993, pp. 80-81.

[191] Steven L. Eskenazi, "New Media: An Evolutionary Investment Opportunity," research report for Alex. Brown and Sons, New York, Sept. 29, 1992, pp. 11-16. Japanese companies such as Nintendo and Sega have a notable share of the game segment of the home entertainment market. Although this segment of the applications industry is relatively small at present, it is growing rapidly with the expansion of the home multimedia market and the need for advanced graphics capabilities. For more information about the future of this segment of the industry, see the "Outlook" section in chapter 5 of this study.

[192] Software Publishers Association (SPA), International Data Program, various issues, 1993-94. Lotus Development has made significant gains in market share in the two key "groupware" applications with *cc: Mail* and *Notes*.

[193] J. William Semich, "Software's Big 100," *Datamation*, Sept. 15, 1993, pp. 38-44. This group of 100 independent software vendors was ranked on the basis of worldwide software revenues.

[194] "Top 100 Independent Software Vendors: Corporate Information," *Software*, July 1994, pp. 114-119.

[195] USITC estimates based on figures from Dataquest, San Jose, CA.

[196] Standard and Poor's, *Industry Survey: Computer Software*, Oct. 1993, p. C113.

Table 4-1
Top 10 independent software vendors worldwide, 1993

Firm	Headquarter country	Global packaged software revenues[1] (million dollars)	Total employment
Microsoft Corp.	U.S.	3,780	13,976
Computer Assoc. Int'l Inc.	U.S.	2,055	7,210
Oracle Corp.	U.S.	1,315	10,648
Novell Inc.	U.S.	1,036	4,435
WordPerfect Corp.	U.S.	981	4,905
Lotus Development Corp.	U.S.	672	5,481
Borland International Inc.	U.S.	460	2,035
SAS Institute Inc.	U.S.	420	2,897
Legent Corp.	U.S.	417	2,404
SAP America Inc.	Germany	414	3,595

[1] Includes applications and systems software.

Source: *Software Magazine*, July 1994.

ongoing shift away from proprietary mainframes and minicomputers to decentralized networks of PCs and workstations built on open standards.[197] Demand for mainframe and minicomputer-based applications, such as company-wide accounting and human resources packages, has fallen in response to the declining popularity of the centralized computers for which they are written. Worldwide demand for PC- and workstation-based applications, on the other hand, continues to grow rapidly. This trend has forced hardware manufacturers in the United States, Japan, and Europe to devise alternative software development strategies in an effort to restore revenue growth.

The effects of platform downsizing (i.e., the shift away from mainframes and minicomputers to PCs and workstations) and the transition to standards-based computing are also being felt acutely in Japan and Europe. Leading Japanese and European hardware manufacturers, like their U.S. counterparts, have focused almost exclusively on applications designed to run only on their own hardware. In Japan and Europe, moreover, few large independent software vendors have emerged to meet demand for new types of PC- and workstation-based applications.

Developers of applications software products compete primarily in terms of price, product performance, and timeliness of product releases. In order to gain a significant competitive advantage in one or more of these areas, firms have taken a number of strategic steps. First, in an effort to respond to intense price competition and pressure on profit margins, successful firms have adopted a variety of cost management strategies, including revised sales and marketing plans that exploit low-cost, high-volume product distribution channels. Second, in order to improve product performance while reducing time-to-market, firms have concentrated on establishing product development techniques that tap the creative potential of the firm while keeping research and development (R&D) costs stable and development cycle times short. Finally, successful firms have recognized the power of alliances and cooperation on standards as ways to minimize product development risk and deliver high-performance, interoperable products to customers.

[197] For more information on this downsizing trend, see chapter 2, "Technology in Transition."

Factors Affecting Competitiveness

Revised sales and marketing strategies

As noted in Chapter 2, intense price competition in computer hardware markets has triggered a similar decline in software prices, particularly in the area of PC-based business productivity software. Because the marginal costs of production for packaged applications software (and for software in general) are typically quite low, and because unit profit margins are usually high, software vendors can benefit greatly from high sales volume. At the same time, however, sales and marketing expenses are usually the single

largest cost item on a software firm's financial statement—often representing over 40 percent of the firm's total revenues (figure 4-2).[198] In a price-sensitive environment, therefore, one of the most critical problems for software firms is finding low-cost sales and distribution channels that also allow the firm to boost sales volume significantly.

Perhaps the most visible innovation in this respect has been the shift away from in-house direct sales forces as the principal software marketing vehicle. Instead, most of the largest applications developers are using hardware manufacturers, mass market retailers, and value-added resellers as new low-cost channels to increase sales volume.[199] Lotus Development, for example, has emphasized sales and marketing partnerships with other firms selling complementary products. Reliance on so-called alternate channels is exemplified by an alliance formed in October 1994 between Lotus and Sun Microsystems, a major workstation manufacturer.[200] Under the marketing agreement, Sun will bundle a copy of Lotus' *Notes* workgroup document-sharing application with every *SPARCserver* network server product sold by Sun in 1995. The agreement reflects Lotus' desire to reduce per-unit sales and marketing costs while expanding the installed base of *Notes*, the company's key client/server product.[201]

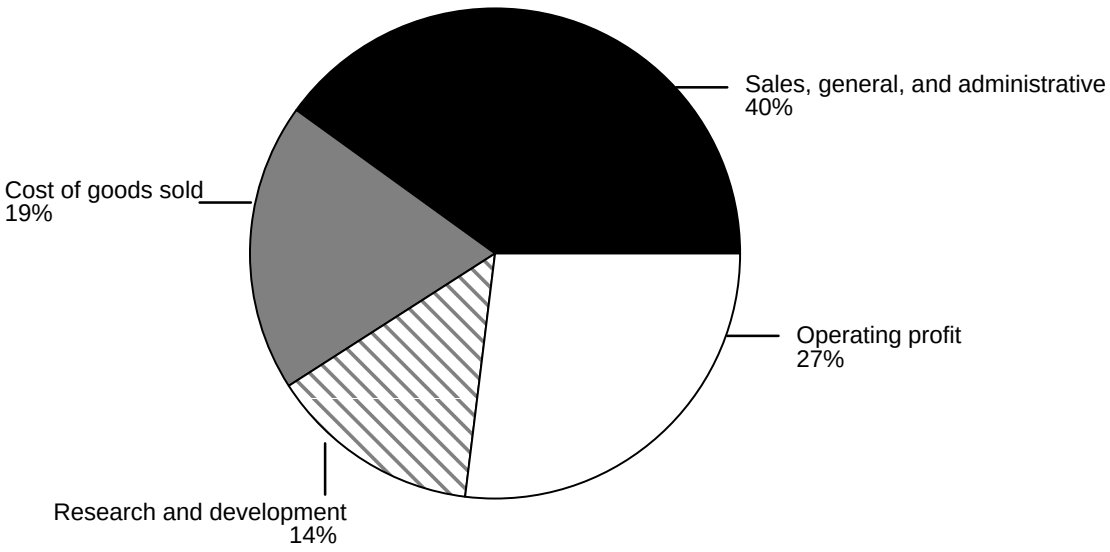
[198] Data are based on sales, general, and administrative (SG&A) expenses reported in company annual reports. Research shows that marketing, sales, and advertising costs are the single largest component of SG&A expenses reported by the software industry. Semich, "Software's Big 100," p. 38.

[199] Larry Jordan, "Retail Ain't Everything," *Software Publisher*, Sept.-Oct. 1994, pp. 48-51.

[200] Lynda Radosevich, "Notes/Sun Bundling Deal Targets Workgroup Users," *Computerworld*, Oct. 17, 1994, p. 16.

[201] Lotus Development Corp., *Form 10-K*, 1994.

Figure 4-2
Operating expenses and profits for major U.S. software firms, as a percent of total sales, 1993



Source: USITC staff, based on averages from Microsoft, Novell, and Lotus Development annual reports.

Among many smaller and younger software firms involved in the development of multimedia applications, high-volume retailers and mail-order outlets have quickly developed as low-cost sales and marketing channels.[202] Rapid growth in software sales at computer superstores such as CompUSA, Computer City, and Egghead Software, as well as mainstream retailers like Wal-Mart, has been encouraged by the emergence of an increasingly knowledgeable and price-sensitive group of applications software customers. It is estimated that the share of U.S. PC software sales handled by computer superstores alone will grow from 8 percent in 1992 to 24 percent in 1996.[203]

Given the depth and diversity of the software distribution system in the United States, it is not surprising that U.S. firms appear to possess a distinct competitive advantage in their ability to reduce sales and marketing costs. Smaller competitors in Europe and Asia, most of whom lack the opportunity to exploit sales and distribution scale advantages in their home markets, have lost ground to their U.S. competitors as a result of the fast pace of change in U.S. distribution strategies.

Since high-volume retail channels remain relatively underdeveloped in Japan, for example, Japanese packaged software vendors are unable to shift to low-cost channels.[204] A few non-U.S. firms, notably the German client/server applications vendor SAP AG, have recognized the significance of a U.S.-style sales and marketing approach and have broadened their ties with U.S. hardware manufacturers and resellers to boost the brand appeal of their products.[205] Most foreign software firms, however, still rely almost exclusively on in-house direct sales staffs to market their products. According to officials of Germany's Software AG, for example, only about 1 percent of the firm's 1993 sales were made through alternate channels such as hardware firms or value-added resellers.[206]

Another marketing innovation employed only by the largest U.S. firms is the suite of business productivity applications, which brings together distinct word processing, spreadsheet, database, and graphics programs into a single integrated package (figure 4-3). Software suites have been introduced by several multi-product firms at significantly discounted prices.[207] The marketing appeal of such packages lies in their ability to offer customers superior integration of several PC applications. Microsoft, Lotus, and Novell (combining products from WordPerfect and Borland) are all using suites to draw customers away from so-called "best-of-breed" applications in a particular software category.[208] Microsoft, for example, has priced its *Office* suite aggressively in an effort to steer users away from popular programs like Lotus Development's *1-2-3* spreadsheet package and WordPerfect's highly successful word processing program.[209] Although increased sales of suites reduce profit margins on individual applications, leading developers see suites as an effective means of encouraging customer loyalty and increasing sales of upgraded products in future years.

For hardware manufacturers, many of which continue to develop software primarily for proprietary mainframe and minicomputer platforms, the transition to low-cost marketing channels has been slowed by long-standing reliance on direct (in-house) sales and marketing staffs. Since firms like IBM, Fujitsu, and Siemens-Nixdorf sell most software products to support their own proprietary hardware, opportunities for alliances with other vendors are more limited than in the case of platform-independent products marketed by independent software vendors.[210] Because support for proprietary products and extensive direct contact with customers are critical to these firms' software marketing strategies, substantial reductions in in-house sales expenses have been difficult for hardware vendors to achieve.

---

[202] Barbara Jorgensen, "Taking a Bath in Software," *Electronic Business*, Aug. 1993, pp. 47-50.

[203] Ibid., p. 47.

[204] Ed Feigenbaum, "The Japanese Software Industry: Where's the Walkman," ch. in *The Future of Software* (Cambridge: MIT Press, 1995), pp. 215-227.

[205] European software industry representatives, interviews by USITC staff, Germany, May 1994. See also Rosemary Cafasso, "SAP and D&B Simplify Client/Server App Prices," *Computerworld*, Sept. 26, 1994, p. 12.

[206] Software AG representatives, interview by USITC staff, Darmstadt, Germany, May 19, 1993.

[207] Wendy Pickering, "Can Suites Fill Groupware Needs?," *Datamation*, Jan. 7, 1994, pp. 27-28. In some cases, the price of a suite is close to the price of a single application.

[208] Best-of-breed software refers to applications programs that have gained widespread popularity and customer loyalty. For example, the *DOS* version of *Lotus 1-2-3* was considered the best-of-breed spreadsheet program for many years.

[209] Michael Vizard, "Microsoft Takes Suite Step with Excel 5.0," *Computerworld*, Jan. 10, 1994, p. 4.

[210] Sentry Market Research representatives, interview by USITC staff, Westborough, MA, Oct. 20, 1994.

Figure 4-3
Leading applications suites and their software components, 1994

Title	Company	Components	Functions
SmartSuite 3.0	Lotus Development Corp.	Lotus 1–2–3 Release 5.0 AmiPro 3.1 Freelance Graphics 2.1 Approach 3.0 Organizer 1.1	Spreadsheet Word Processing Program Presentation Graphics Database Personal Information Manager
Office 4.3	Microsoft, Corp.	Excel 5.0 Word 6.0 PowerPoint 4.0 Mail 3.2	Spreadsheet Word Processing Program Presentation Graphics Electronic Mail
PerfectOffice 1.0	Novell, Inc./WordPerfect	Quattro Pro 6.0 WordPerfect 6.1 Presentations InfoCentral GroupWise	Spreadsheet Word Processing Program Presentation Graphics Personal Information Manager Workgroup Document Sharing

Source: Compiled by USITC staff.

Innovative product development techniques

Just as pricing pressures have led software firms to explore new approaches to sales and marketing, concerns regarding product performance and timely product releases have led many firms to make improvements in the software development process. As product cycle times[211] have become shorter, firms have looked for ways to speed up the development process while achieving the goal of high-quality software that is free of defects, known as "bugs."

Recent market trends suggest that a firm's failure to introduce a product before its competitors quickly results in a decline in market share. In the PC spreadsheet market, for example, Microsoft's speed in introducing its highly popular *Windows*-based *Excel* product helped give the company a sizable market share lead over Lotus. Despite the traditional strength of *Lotus 1-2-3* in the *DOS*-based spreadsheet market (approximately 70 percent market share in 1993), Excel's early appearance and the rapid response of customers to new technology helped Microsoft capture an estimated 56 percent of the *Windows*-based spreadsheet market in 1993, versus 34 percent for Lotus.[212]

In response to this type of competitive pressure, some of the largest U.S. software firms have achieved a time-based competitive advantage by applying innovative software development techniques. At Microsoft, for example, the nature of the development team organization appears to have had a big influence on the performance and timeliness of Microsoft applications software products. The typical Microsoft product development team is quite small and operates rather informally with a minimal amount of involvement by high-level management. The nucleus of an effective Microsoft team—such as the one that worked on Microsoft's *Excel* spreadsheet—is a project manager who seeks to build consensus within the development team on such issues as scheduling and product features.[213] Responsibility for key managerial tasks, such as setting milestones for the development project, is usually pushed down to the lowest levels of the company, thereby combatting the problems associated with emerging bureaucracies in a rapidly growing firm.

[211] This refers to the generational lifespan of a product. As the processing power of PCs and workstations has grown, pressure to build new applications that take advantage of faster computers has grown. As a result, cycle times have been shortened. Charles H. Ferguson and Charles R. Morris, *Computer Wars: How the West Can Win in a Post-IBM World* (New York: Times Books, 1993), pp. 159-69.

[212] Standard and Poor's, *Industry Survey: Computer Software*, Oct. 1993, pp. C113-C115. For information about the differences between *DOS* (a character-based operating system) and *Windows* (a graphical user interface), see the glossary in appendix C.

[213] Roger W. Sherman, "Shipping the Right Products at the Right Time: A View of Development and Testing at Microsoft," *American Programmer*, Feb. 1995, pp. 15-21; and Chip Anderson, Microsoft Consulting, Inc., presentation at *Software World '94*, San Francisco, CA, Feb. 28, 1994.

At its core, the Microsoft development philosophy is built around the idea that close cooperation among programmers at the lowest level of the company is critical in developing a high-quality product.[214] Microsoft's track record in this regard has been outstanding. Despite high levels of growth in revenues and employment over the past decade, the firm notes that it has preserved a high degree of autonomy and dynamism in its product development teams.[215]

Efforts to improve product quality also may be influenced by a development team's willingness to respond to customer feedback. Intuit, a California-based developer of personal finance software, uses customer feedback to highlight product features that may need to be improved, added, or abandoned in future product versions.[216] By encouraging candid and thorough responses to customer surveys, and by reaffirming its commitment to customer support, Intuit and other firms are bolstering the role of quality assurance in product development.[217]

In Japan, attempts to improve product quality and time-to-market through software development programs based on expanded use of automation have been largely unsuccessful. Since the late 1960s, in fact, all of the major Japanese computer companies—including Fujitsu, NEC, Hitachi, and Toshiba—have attempted to apply to software development the automated factory concepts that worked well in traditional manufacturing.[218] Ultimately, however, Japanese process automation has not translated into commercial success. Considerable evidence suggests that many of the intangible and creative aspects of software development, such as those stressed by Microsoft and other U.S. firms, have a greater impact on product quality and time-to-market than automation.[219]

[214] Sherman, "Shipping the Right Products at the Right Time," p. 16.

[215] Microsoft, Corp., *Annual Reports*, 1992 and 1993.

[216] Presentation by Intuit representatives, *SPA Software Symposium*, San Francisco, CA, Mar. 13, 1994.

[217] Industry representatives, interviews by USITC staff, San Francisco, CA, Mar. 13-16, 1994.

[218] Michael A. Cusumano, *Japan's Software Factories: A Challenge to U.S. Management* (New York: Oxford University Press, 1991), pp. 3-22.

[219] Industry analysts, interviews by USITC staff, Washington, DC, 1994.

Alliances and standards

As the transition to a new generation of computer platforms is proceeding, applications software firms feel growing pressure to improve product performance and enhance the interoperability of heterogeneous programs designed to operate in networked computing environments. At the same time, developers must discover ways to reduce prices by curtailing development costs. In order to compete more effectively in terms of both quality and price, many applications software developers have focused on two other strategic alternatives: (1) alliances with other firms that control unique technology or marketing expertise and (2) cooperation in the establishment of product standards that allow software products to work together more effectively. Many firms have sought out partners in an effort to minimize development-related risks and costs by taking advantage of the technical skill base possessed by other firms. In addition, industry-wide standards-setting efforts have become an important part of developers' efforts to reduce uncertainty about new product lines. Most applications developers still lack the market power to move independently in establishing technical standards for the software products of the future.[220]

The task of developing truly interoperable applications—capable of working effectively on various computer platforms—has become very complex. This is due in large part to the widening reach of client/server systems, file sharing, and worldwide communications networks. Developers such as Novell and its recently acquired WordPerfect unit have recognized the importance of joining forces in an effort to create a more complete and fully interoperable set of high-quality applications.[221] In March 1994, Novell announced that it had purchased WordPerfect and the spreadsheet business of Borland for an estimated $1.5 billion.[222] In so doing, Novell took a step toward completion of its line of integrated applications, highlighted by WordPerfect's word processing and document- sharing applications and Borland's *QuattroPro* spreadsheet. Industry analysts suggest that Novell's traditional strength in networking software, meanwhile, seems to bolster the competitive position of *WordPerfect* and *QuattroPro* as customers search

[220] See Melinda-Carol Ballou, "Standards Set to Take Hold," *Computerworld*, Dec. 27, 1993, p. 91.

[221] Lynda Radosevich and Elisabeth Horwitt, "Desktop Leaders Face Off," *Computerworld*, Mar. 28, 1994,
pp. 1, 14.

[222] Ibid.

for readily networkable applications capable of sharing data seamlessly.[223] None of the leading foreign software vendors, by contrast, have forged such extensive alliances with leading U.S. software developers.[224]

Wider cooperation on standards-setting, aimed at improving product quality and lowering development costs, can perhaps best be seen in the emerging area of object-oriented programming.[225] Efforts to standardize object-oriented development techniques are well underway. The vehicle that may ultimately standardize the use of objects in the applications of the future is Microsoft's object linking and embedding (OLE) standard, which has been embraced by many applications developers.[226] At the same time, IBM, Apple, Novell, WordPerfect, and Borland are the leaders of the OpenDoc consortium, which is attempting to establish a set of common specifications for the creation of objects in order to counter Microsoft's work on OLE. Given the existence of these competing efforts, a single standard interface for object-oriented development may not emerge for many years. Despite its tendency to approach the standards-setting process inde- pendently, Microsoft appears to have a substantial lead in determining the way in which applications of the future will be written.[227]

No foreign software vendors are participating in either the OLE or the OpenDoc standards-setting alliance. However, Japanese firms are demonstrating interest in standards-setting efforts in other parts of the applications development world. In March 1994, Toshiba and Fujitsu announced plans to invest in the U.S.-led General Magic standards-setting consortium.[228] General Magic is widely seen as the most likely source of standards for upcoming multimedia and wireless communications products. The move by Toshiba and Fujitsu to license General Magic technical protocols reflects a commitment by these firms to establish a strong foothold in the future of multimedia software.[229]

Outlook

With few exceptions, U.S. software firms continue to lead their international competitors in making the strategic adjustments that frequently translate into competitive advantage. Sales and marketing innovations such as applications suites and the use of high-volume retail channels, as well as extensive use of new product development techniques, and standards-setting alliances, have contributed to the ability of U.S. firms to maintain a clear market share lead in all major applications software segments. This advantage is most evident in the largest categories of PC-based business productivity applications, where Microsoft, Lotus, Borland, and WordPerfect/Novell hold a command- ing global market share lead.

The worldwide market for applications software products continues to grow at a rapid rate, though less quickly than in previous years. The global applications market is expected to grow at an annual rate of nearly 15 percent during 1994-98.[230] Among the three largest regional markets, Asia is likely to grow most rapidly during this period. Asia's projected annual growth rate of over 16 percent reflects the impact of growing demand for PC- and workstation-based applications—particularly in Japan.[231] Applications software markets in North America are expected to grow at an annual rate of approximately 15 percent through 1998, while market growth in Europe is expected to remain slightly below the worldwide average, at about 13 percent annually.[232]

In light of maturation in the North American and European markets, U.S. software firms can be expected to focus more attention on the development of sales and distribution channels in rapidly growing markets in parts of Asia and Latin America. Major challengers to the largest U.S. vendors, however, have emerged only in West European markets, where

---

[223] Jon Udell, "Novell's Campaign," *Byte*, Feb. 1995, p. 42.

[224] Even the most successful European vendors, such as SAP and Software AG, have yet to establish a foothold in mass-market business productivity applications. SAP, for example, has continued to focus on business data access applications.

[225] Object-oriented programming is a process whereby reusable, self-defined software modules are strung together to create a program. Modules are created out of standard lines of code that form the basis for functions that are used in a variety of programs.

[226] Stuart J. Johnston and Ed Scannell, "Microsoft Sets OLE Apps Aid," *Computerworld*, Jan. 24, 1994, p. 1.

[227] Dan Rahmel, "Microsoft's Object Technology," *American Programmer*, Feb. 1995, pp. 11-14.

[228] Andy Reinhardt, "The Network with Smarts," *Byte*, Oct. 1994, pp. 51-64.

[229] Heather Pemberton, "General Magic Brings Together Industry Giants," supplement to *CD-ROM Professional Magazine*, Apr. 1993, p. 2; and industry representative, telephone interview with USITC staff, Jan. 1994.

[230] Compiled from data provided by INPUT, Inc.

[231] Ibid.

[232] Ibid.

growth rates are expected to follow a path similar to those in the United States and Canada. Over the near term, significant competitive challenges to U.S. firms are likely to come mainly from larger European vendors such as Germany's SAP and the United Kingdom's ACT Group.[233] Both of these firms have gained significant market share positions in certain narrowly defined segments of the applications software business, though their annual software revenues fall far short of the leading U.S. firms.[234]

Systems Software Firms

Introduction

As in the case of applications software, the U.S. competitive position in global systems software markets is extremely strong. U.S. dominance extends not only to PC operating systems, where Microsoft controls an estimated 90 percent of the global installed base, but also to network operating systems, system management tools, programming languages, and database management software. In all of these segments of the systems software industry, U.S. firms are unchallenged as market share leaders. Although mainframe- and minicomputer-based systems software products still account for a large share of global systems software demand, growth rates in global sales of PC- and workstation-based products are now much higher. This trend is contributing to the competitive strength of U.S. independent vendors, which rely heavily on sales of PC- and workstation-based products.

With regard to desktop computers—namely PCs and workstations—a battle is underway to determine the future of operating system software. The industry stands on the threshold of a major transition as more powerful 32-bit operating systems, such as Microsoft's *Windows NT*, IBM's *OS/2*, and Novell's *UnixWare*, seek to unseat *DOS* and the *Windows 3.1* environment as the market leader.[235] Briefly stated, each of the 32-bit operating systems offers advanced networking capabilities, works efficiently in a client/server environment, and supports faster and more sophisticated applications.[236] All of the major players in this lucrative part of the systems software industry are U.S. firms.

Similarly, the global market for network operating systems software, estimated at $3 billion in 1993, is dominated by a small number of U.S. firms. Novell Corp. holds a large market share lead over its nearest competitor, Banyan Systems. As a result of its early presence in the market and strong customer loyalty, Novell's *Netware* has become the *de facto* standard network operating system worldwide.[237] Further, Novell's 1992 acquisition of Unix Systems Laboratories gives it a powerful role in the Unix market and strengthens the position of *Netware* as an industry-standard product capable of working effectively in Unix-based network environments that link millions of computers around the world.[238]

The four worldwide leaders in database management systems (DBMS) are all U.S. firms—Oracle, Sybase, Informix, and The Ask Group.[239] The DBMS market represents a particularly strong market opportunity for U.S. firms, given the anticipated increase in market demand for software designed to manage large volumes of corporate data stored on network servers. As client/server computing grows in popularity, sales of DBMS software can be expected to grow rapidly, and the four U.S. market leaders are likely to benefit from this trend. In addition to the DBMS market, U.S. firms also maintain a strong position in the market for programming languages and applications development tools. Key firms in this market include Borland, Microsoft, and Symantec.

---

[233] ACT Group has established a strong European market position in financial software.

[234] Only eight European firms had annual software revenues exceeding $100 million in 1993, compared to approximately 40 U.S. software firms. See European Association of Manufacturers of Business Machines and Information Technology (EUROBIT), *European Information Technology Observatory 94* (Frankfurt, Germany, 1994); and "Top 100," *Software Magazine*, July 1993, p. 75.

[235] Standard and Poor's, *Industry Survey: Computer Software*, Oct. 1993. Operating systems based on 32-bit architectures offer superior performance features over their 16-bit counterparts.

[236] "Make Way for the 32-Bit Heavy Hitters," *Datamation*, Apr. 15, 1993, pp. 34-41.

[237] Dwight B. Davis, "Noorda: Leaving When Times Get Tough," *Electronic Business*, Dec. 1993, pp. 50-58.

[238] Novell has made an effort to unify the Unix community behind one set of applications programming interfaces. Jean Bozman, "Merger of Unix Groups Expected," *Computerworld*, Mar. 7, 1994, pp. 1, 14.

[239] See J. William Semich, "RDBMS Prices Are in for a Fall," *Datamation*, Aug. 1, 1993, pp. 30-34; and Michael Vizard and Kim S. Nash, "Software Vendors Converge on Database Market," *Computerworld*, Nov. 29, 1993, p. 29.

In the systems management software market, large U.S. firms such as Computer Associates possess a market share lead over smaller rivals, including the largest German software firms, SAP and Software AG.[240] Both of these German firms have made clear commitments to move beyond the European market to compete directly with larger U.S. rivals in North America and Asia. SAP's rapidly growing presence in the U.S. market demonstrates the combined impact of technological innovation in its client/server-based network management tools and an aggressive global marketing effort.[241]

The only other part of the global systems software market in which foreign firms have a substantial presence is in mainframe and minicomputer-based software. As in the case of U.S. hardware companies such as IBM, the largest foreign hardware manufacturers—including Fujitsu, NEC, Siemens, and Groupe Bull—have historically derived significant revenues from sales of systems software products designed to run proprietary hardware in large corporate data centers. As this segment of the global software market diminishes in importance, the leading hardware makers are losing market share relative to competing independent software vendors. The declining growth rate of large system-based software relative to client/server and desktop systems has resulted in the generally deteriorating competitive position of non-U.S. firms, which still rely heavily on sales of mainframe and minicomputer-based applications.

Systems software vendors compete worldwide largely in terms of their ability to develop products that are both interoperable (i.e., capable of working effectively with hundreds of other complementary hardware and software products) and easy to use. As the technical complexity of networked computing environments grows, customers continue to search for systems software products that make their computing tasks easier, and technical solutions that allow them to work with a variety of heterogeneous products. Developers of operating systems running on networks of microprocessor-based PCs and workstations, for example, look for ways to allow a single product to function well when running on any of five or six different microprocessors (e.g. Intel, Motorola, IBM, DEC, Sun Microsystems, and others)—each with a distinct set of technical specifications affecting the software's performance.

[240] Thomas Hoffman, "CA's Mainframe Revenue Keeps Growing," *Computerworld*, Jan. 3, 1994, pp. 85-86.

[241] SAP, *Annual Report*, 1993; and SAP representatives, interview by USITC staff, Waldorf, Germany, May 1993.

Considerable technical obstacles may therefore limit a firm's ability to achieve the complementary goals of product interoperability and ease-of-use.

In order to excel in these areas, firms typically concentrate on two sets of strategic alternatives that appear critical in determining competitive advantage: (1) alliances and acquisitions designed to facilitate the development of industry-standard products that work well on various types of computer hardware (i.e., interoperable products) and (2) careful responsiveness to customer needs in designing products that are both interoperable and easy to use. Specific examples of the ways in which these factors influence competitiveness are presented below.

Factors Affecting Competitiveness

Alliances and acquisitions

By encouraging expanded contacts between software engineers in different firms, alliances and acquisitions make it possible for firms to break down many of the technical barriers that hinder interoperability. Recent cooperative efforts undertaken by desktop operating system vendors reflect the importance of encouraging technical cooperation, minimizing investment risk, and speeding development time. One of the most noteworthy of these alliances is the effort of IBM and Apple to develop jointly an object-oriented 32-bit operating system (*Taligent*) for the PowerPC chip and other advanced RISC processors.[242] The joint IBM-Apple effort on *Taligent* represents a significant step toward harmonization of operating standards and the creation of a truly portable operating system that runs effectively on many different types of microprocessors. Both partners have recognized that establishment of industry standards is a task that can rarely be accomplished by one firm acting alone.[243]

A similar effort to harmonize standards and pool development skills is being undertaken by Sun Microsystems and Next Computer, Inc. in the Unix market. In November 1993, Sun announced its intention to invest $10 million in Next as the companies share techniques developed for object-oriented applications development technologies.[244]

Acquisitions also appear to be gaining popularity—especially among U.S. vendors—as firms try to capture scale advantages by pooling their own resources with those of another firm. Frequently the two firms are pursuing complementary product strategies, or have access to skill bases that reinforce the competitive advantages of their partners. Sybase, a leading developer of database management software, acted to address a gap in its product offerings by acquiring Powersoft, the leading developer of client/server database tools, in November 1994.[245] Through the acquisition, Sybase sought to boost the market appeal of its core product by delivering a more fully integrated and interoperable database product without incurring massive new product development costs.[246]

Attempts to create cross-industry alliances also will be critical in improving the interoperability and market appeal of future products. Oracle, for example, announced in January 1994 that it plans to ally with Bell Atlantic, a communications firm, in establishing database access technologies for new mass-market "video-on-demand" applications. Oracle's strategy is designed to help the company move beyond the traditional boundaries of the computer industry to develop products for rapidly growing consumer markets.[247]

Other systems software vendors whose fortunes traditionally have been tied to proprietary mainframe and minicomputer platforms are now using alliances and acquisitions as a way to improve the interoperability of their products. In late 1993 and early 1994, several leading U.S. developers of mainframe-based systems management tools announced plans to team up with leaders in the client/server field. For example, BMC Software, a Texas-based developer of mainframe software,

[242] For information on the IBM-Apple alliance and the development of the object-oriented operating system called *Taligent*, see "Advanced Operating Systems," *Byte*, Jan. 1994, pp. 116-117. A reduced instruction set computing (RISC) processor is a type of microprocessor that performs at a rate 15 to 50 percent higher than traditional PC microprocessors (complex instruction set computing processors), due to their streamlined instruction set. See the glossary in appendix C for more information.

[243] Industry representatives, interviews by USITC staff, San Francisco, Mar. 1, 1994.

[244] "Sun and Next Operate from the Same Side," *Electronics Weekly*, Dec. 1, 1993, p. 2.

[245] Kim S. Nash and Rosemary Cafasso, "Alliance Raises Hopes, Red Flags," *Computerworld*, Nov. 21, 1994, pp. 1, 15.

[246] Ibid.

[247] Dataquest Inc., presentation in Washington, DC, Jan. 31, 1995.

purchased Patrol Software in January 1994 in an effort to enhance the integration of BMC products with Unix-based network systems.[248]

For foreign systems software developers, strategies based on alliances and acquisitions have been much less successful. This is due in part to a certain reluctance on the part of large firms like Fujitsu and Hitachi to move beyond traditional systems software products designed to run on proprietary mainframe and minicomputer platforms. Indeed, the pressures to forge alliances in developing software for proprietary computer systems have been quite weak given the lack of interest in product compatibility. However, the growing importance of interoperable systems software, not only in the North American market but worldwide, is slowly pushing foreign firms in the direction of alliances and acquisitions.

The largest Japanese hardware manufacturers rely heavily on wholly owned subsidiaries for some of their software development strategies. Fujitsu, for example, has about 100 software subsidiaries, typically employing staffs of between 100 and 500 each.[249] For Fujitsu, Hitachi, and the other big Japanese computer firms, however, subsidiaries are viewed primarily as "assistants," which work best on low value-added parts of a software development project.[250] This pattern contrasts sharply with alliances in the U.S. industry, where smaller companies are frequently given technology-intensive tasks to speed the process of developing interoperable products with the best technology available.

Responsiveness to customer needs

The success or failure of a systems software firm depends upon its products' performance in a demanding networked environment. Accordingly, vendors whose product development and marketing teams successfully address the concerns of users frequently gain a quality-related competitive advantage.

Much of the success of the Apple *Macintosh* and Microsoft *Windows* operating environments can be attributed to superior technical features and user-friendly design.[251] Similarly, the strength of Unix-based operating systems developed by Sun, Hewlett-Packard, IBM, and the Santa Cruz Operation lies in their ability to satisfy the needs of demanding customers who frequently require superior technical performance to run sophisticated networked applications. All of these firms traditionally have emphasized basic research and product development as a foundation for competitiveness.[252] As seen in figure 4-4, many of the major operating system vendors spend close to 15 percent of total revenues on research and development.

Among developers in the highly competitive database management system segment, skill in product development is often shaped by the software firm's network of customer contacts. Oracle Systems, for example, has developed a family of server-based database management products that satisfy users' needs by providing support for many computer platforms operating side-by-side in a large corporation. With a typical Oracle corporate system selling for several thousand dollars, high levels of product quality are essential for market success.[253] Oracle's development teams work closely with user focus groups to identify and meet the complex needs of users in a heterogeneous computing environment, where many different types of systems are required to work together seamlessly.[254]

---

[248] Thomas Hoffman, "BMC Buys into Distributed Systems Management," *Computerworld*, Jan. 24, 1994, p. 29. Three other companies—CompuWare Corp., Legent Corp., and Platinum Technology, Inc.—have recently made similar acquisitions to get a foothold in the client/server database tools market.

[249] Feigenbaum, "The Japanese Software Industry," pp. 215-227.

[250] Ibid.

[251] James Daly, "The Mac's 10th Anniversary," *Computerworld*, Jan. 10, 1994.

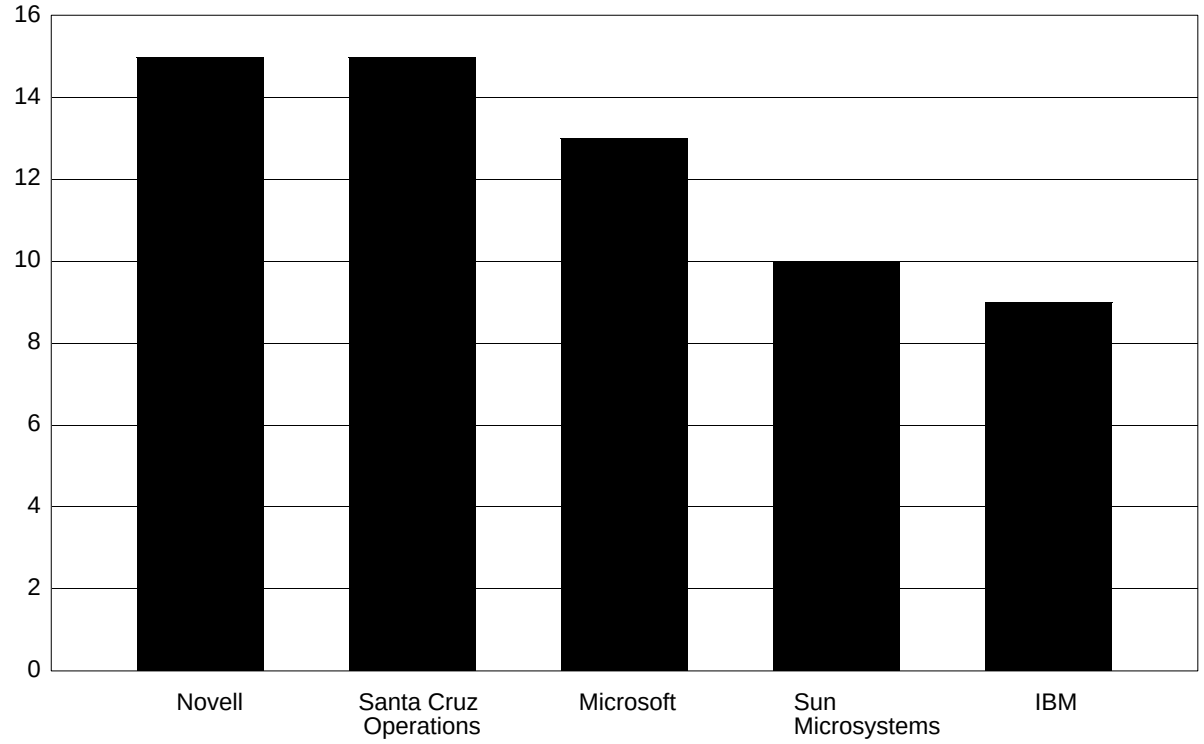
[252] Research and development expenditures often go toward upgrades for current programs rather than expansion of the product line. Faced with short product cycle times, companies must constantly improve and enhance existing systems.

[253] J. William Semich, "RDBMS Prices Are in Free Fall," pp. 30-34.

[254] Ibid.

Figure 4-4
Research and development expenditures by major operating systems vendors, 1993

Percent of total revenues



Source: USITC staff, based on company annual reports.

One of the most significant examples of vendor responsiveness to user needs in recent years has been the graphical user interface (GUI), a concept which quickly became a standard element of most types of systems software in the early 1990s. Through extensive use of graphical icons that users can respond to intuitively, GUIs fundamentally have changed the way that users interact with computers.[255] Graphical icons essentially break down the learning curve barriers to computer access that are presented by character-based operating systems such as Microsoft's *DOS*. Recognizing this, Apple Computer (with its *Macintosh*-based PC operating system) and ultimately Microsoft itself (with the *Windows* GUI) tapped a huge global market for easy-to-use systems software.[256]

The impact of this type of timely adjustment to customer needs also has been felt by developers of network-based systems software. Banyan Systems, Inc., a developer of network operating systems and services, is an example of a firm that has responded quickly to evolving user requirements. As the installed base of local area networks (LANs) has expanded rapidly in the 1990s, customers have come to expect a greater return on network investments.[257] These high returns, in the form of user productivity gains, often can be realized when so-called network services products allow diverse resources on a network to be shared more effectively. Recognizing the importance of network services running on the more popular network operating software designed by competing firms like Novell, Banyan notes that it has adapted its marketing strategy to emphasize network services instead of its traditional LAN software products.[258] This type of flexibility appears to be a decisive determinant of competitive advantage as software firms attempt to keep pace with constant improvements in technology and shifts in user demand patterns.

In Japan, firms have been less responsive to customers in systems software development. The hierarchical, vertically integrated structure of the

[255] Industry representatives, interviews by USITC staff, San Francisco, CA, Mar. 1, 1994.

[256] Ibid.

[257] Banyan Systems, Inc. representatives, interviews by USITC staff, Westboro, MA, Oct. 20, 1994.

[258] Banyan appears to be placing more emphasis on its Enterprise Network Services (ENS) products, which run on top of Novell's industry-standard *Netware* network operating system. Banyan Systems, Inc. representatives, interviews by USITC staff, Westboro, MA, Oct. 20, 1994.

Japanese computer industry has resulted in a somewhat less responsive product development process.[259] At Fujitsu, for example, a traditional concentration on proprietary hardware and software systems, a slow acceptance of open systems, and a hierarchical corporate structure has kept the firm from offering "open architecture" database management systems. Without such a product, the firm will have few opportunities to sell outside of Japan. The same type of rigidity in product development and responses to customers is evident at Hitachi, NEC, and Toshiba.[260]

Outlook

Superior responsiveness to customer needs, close inter-firm cooperation on standards, and considerable market experience have combined to put U.S. systems software firms in a very strong competitive position worldwide. In the critical areas of desktop operating systems, network operating systems, database management software, and applications development tools, U.S. firms face very little competition from foreign firms. High switching costs for systems software users strongly suggest that U.S. dominance in this area will continue for many years to come.

The worldwide market for systems software continues to grow at a healthy pace—approximately 7 percent in 1994. However, growth rates have diminished sharply for systems software designed for mainframe and minicomputer platforms. In 1994, sales of PC- and workstation-based systems software grew by an estimated 18 percent over the previous year in the United States, but sales of mainframe- and minicomputer-based systems software grew by only 4 and 1 percent, respectively.[261] This trend seems to bolster the competitive position of U.S. independent vendors, which already supply an overwhelming share of PC-based systems software.

On a regional basis, growth rates in North America and Europe are likely to fall short of corresponding growth rates in Asia over the next few years. As in other major markets, the highest growth rates in Asia are being achieved in PC- and workstation-based systems software—notably desktop operating systems, a market segment dominated by U.S. firms. Few non-U.S. challengers appear likely to emerge as viable competitors in this market over the near term.

[259] Feigenbaum, "The Japanese Software Industry," pp. 215-227.

[260] Ibid.

[261] Compiled from data provided by INPUT, Inc.

Systems Integration Firms

Introduction

U.S. firms dominate the global market for systems integration (SI) services, controlling an estimated 60 percent of global SI revenues.[262] Of the top 10 firms in the worldwide SI industry, 7 are headquartered in the United States. U.S.-based Integrated Systems Solutions Corp. (ISSC), EDS, and Andersen Consulting are the three largest systems integrators and together hold an estimated 40 percent of the global market.

Foreign competition primarily consists of SHL Systemhouse of Canada and several European service providers. SHL Systemhouse maintains its global position through strong sales in Canada and the United States, and through gradually expanding sales overseas.[263] European firms such as Cap Gemini Sogeti of France, Siemens-Nixdorf of Germany, and Sema Group of the United Kingdom and France concentrate primarily on sales in the European market. Although these firms together hold only a 7-percent share of the world market, they are responsible for an estimated 16-percent share of the European market.[264] Few Japanese firms are active in the global SI market, though many of the traditional hardware manufacturers such as NEC, Mitsubishi, and Fujitsu have begun to supply services for domestic customers.

In Europe, large U.S. firms generally hold a significant share of the systems integration market due to their size, reputation, and experience. U.S. firms' competition in this market comes primarily from the European firms listed above, and also from smaller companies that are not necessarily active internationally. Demand for SI is expanding in the region, particularly in countries such as the United Kingdom where the software industry is highly developed, and in Spain where mergers in the financial industry are creating a need for industry-customized solutions. Although European providers of SI services suffered as a result of decreased demand during the recent recession, they expect demand to improve with renewed economic activity.

In Asia, systems integration services are expanding gradually. Most companies historically have handled services in-house or have purchased them together with a hardware system from one of the large computer manufacturers such as NEC or Fujitsu. However, as client/server systems gain popularity in the Asian marketplace, the role of third-party integrators is expanding. Demand in Asia also is fueled by private sector efforts to improve productivity, particularly in the financial services sector where transactions with overseas banks necessitate sophisticated computer integration.[265] U.S. firms, such as ISSC, EDS, and Andersen Consulting, have moved into the market to respond to this growing demand, often through partnerships with Asian firms.[266]

Competitors to U.S. firms in the Asian marketplace primarily include traditional Japanese hardware vendors that are trying to offset declining mainframe revenues through sales of services.[267] NEC, for example, offers services through its "Solution 21" division, and Fujitsu is marketing its "Message 90s" services.[268] Some clients note that these vendors are now charging for services that commonly were included in hardware sales. Competitors also include subsidiaries of securities firms and banks, such as The Japan Research Institute of the Sumitomo Bank Group, and The Fuji Research Institute of the Fuji Bank Group.[269] Independent systems integrators also have emerged, such as Japanese-based Argotechnos 21, a spin-off of Nippon Univac, and CSK Corp., a company that focuses on SI services for the financial services and distribution industries.[270]

---

[262] Data provided by Gartner Group, Inc., Stamford, CT.

[263] SHL Systemhouse, which dominates the Canadian market for systems integration, is one of the few non-U.S. firms active in the U.S. market. SHL Systemhouse accounted for an estimated 26 percent of the Canadian information services market in 1994. Other large service providers in Canada include Bell SYGMA and Information Systems Management Corp. The Yankee Group, "The Canadian Outsourcing Market: A 1994 Perspective," *Yankee Watch Management Strategies*, vol. 4, No. 9, Sept. 1994, p. 10.

[264] Based on 1992 data from Gartner Group and INPUT, Inc.

[265] Industry representative, interview by USITC staff, Washington, DC, Oct. 14, 1994.

[266] For example, in Taiwan EDS has established an alliance with China Management Systems and Hewlett-Packard has created a partnership with Golden Technology Company. U.S. Department of Commerce (DOC), "The Computer Systems Integration Market in Taiwan," *Market Research Reports*, National Trade Data Bank (NTDB), Apr. 1994.

[267] "Japan Confronts New American Import: Price Competition," *Japan Economic Almanac 1993*, p. 85.

[268] Ibid.

[269] Ibid.

[270] Feigenbaum, "The Japanese Software Industry," pp. 215-227.

As noted earlier in this report, demand for systems integration services is driven by the need for third-party assistance to manage the complex technology available in the market, including the migration toward client/server platforms. Increasingly, clients rely on third-party providers to fully exploit information technology for competitive, industry-specific gains. In order for a systems integrator to customize a computer system according to demands of a particular vertical market (e.g., financial services or manufacturing), it must be proficient in understanding the needs of the end-user. Thus, to be competitive, SI firms must maintain skilled employees or enter into alliances with firms possessing skills in certain technical fields and vertical markets.

Price is also an important consideration for purchasers of systems integration services, especially as corporate IT budgets decline. Indeed, systems integrators often are competing for contracts not only with other outside firms, but also with client companies' internal IT divisions.[271] As a result, systems integrators are increasingly focusing on internal cost controls.

Providers of systems integration services thus compete primarily in terms of vertical market expertise and price. SI firms focus on maintaining their expertise by hiring and training skilled employees and by entering alliances with companies offering other skill sets. SI firms offer competitive prices through a variety of cost management techniques, including use of packaged software and object-oriented programming. These strategies, discussed in more detail below, are essential to SI firms hoping to remain competitive in the worldwide market.

Factors Affecting Competitiveness

Employee Skill Bases and Alliances

The types of services provided by systems integrators depend largely on the strengths and abilities of their staffs, or on efficient access to necessary skills through alliances with other firms. While it is essential that SI vendors excel in all the latest technologies, it is equally important that they offer expertise in applying technology to vertical markets; this factor is expanding in importance as more and more businesses strive to exploit information technology for industry-specific competitive gains. In order to develop and maintain the appropriate expertise, systems integrators must develop programs to recruit, train, and retain skilled employees. If skills are more easily accessible through another company, systems integrators must establish effective alliances.

Many SI firms strive to build vertical market expertise through effective hiring and training methods. SHL, for example, hires a large percentage of its employees from the IT divisions of typical end-user firms (e.g., manufacturing companies or banks). As a result, employees enter SHL with 5 to 10 years of experience in implementing technology specific to their industry and are able to use these skills in SHL's industry-customized integration projects.[272] Conversely, Andersen Consulting prefers to hire less experienced applicants and then provide them with the industry-specific training required for the job. One of Andersen's primary training resources is an electronic program called ENACTS.[273] The program is used to distribute the company's industry-specific knowledge and successful methodologies to its staff worldwide.[274] As SI firms create industry expertise among employees, they are able to customize information systems according to the vertical market requirements of their clients and gain a competitive advantage over SI firms that offer no specialty. Examples of vertical market specialization include the skills of EDS and Andersen Consulting in integrating information technology for the manufacturing industry, and of ISSC in integrating operations of the financial services industry.[275]

---

[271] For instance, a recent contract to replace an existing mainframe-based system at Amoco attracted bids both from outside systems integrators and the IT division of Amoco. In this particular case, the internal IT division won the contract and now performs all of Amoco's data processing needs on a fee basis. Ellis Booker, "How IS Beat the Outsourcers at Amoco," *Computerworld*, Jan. 10, 1994, p. 77.

[272] Industry representative, interview by USITC staff, Washington, DC, Oct. 14, 1994.

[273] ENACTS stands for "ENable, AChieve, and Then Sustain change for clients," Andersen Consulting, *Annual Report*, 1993, p. 30.

[274] SHL also uses an electronic training program, "Transform," to disseminate information to employees. SHL Systemhouse representative, interview by USITC staff, Washington, DC, Oct. 14, 1994.

[275] Other examples of vertical market specialization include Unisys' expertise in financial services, airline, and telecommunications industries, and the expertise of Computer Task Group (CTG) in integrating manufacturing plants. CTG places a heavy emphasis on training, spending an estimated $5.3 million on education in 1992.

See Unisys Corp, *Annual Report*, 1992, p. 13 and CTG, *Form 10-K*, Dec. 31, 1992, pp. 6-7.

In some cases, SI firms will enter into alliances to attain the vertical market expertise necessary to win a contract. For example, while DEC has notable skills in certain vertical markets (e.g., retail banking) the company often enters into alliances when it bids on contracts for other industries.[276] When bidding on a systems integration contract for an electric company in Australia, DEC allied with several local Australian companies that had experience in the local utility industry.[277]

European and Asian firms usually compete in much smaller markets and thus have fewer opportunities than U.S. competitors to develop sufficient economies of scale to specialize in specific industries. However, most companies at least recognize the importance of specialization and have made an effort to promote unique skills. Groupe Bull of France, for example, notes its proficiency in the financial industry based on capabilities its employees have developed to meet the industry's data security requirements.[278] ICL attributes its ability to specialize in retail, financial services, and public administration to the competence of its skilled employees.[279] Finally, in Japan, Enicom Co. has built on expertise from its parent company (the Enicom steel group) to specialize in factory-automated manufacturing integration services.[280] Although these firms are not global giants, they recognize trends in the industry and intend to increase their competitiveness by employing these strategies.

Cost Management Skills

Increasing emphasis on price has forced systems integrators to reduce costs to stay competitive. Although the high level of skills offered by systems integrators originally created an industry that was, in many ways, less price sensitive than other industries, price has nevertheless become a significant consideration for purchasers. Indeed, the importance of price competition has grown as the number of firms providing SI services has increased, and as

[276] Industry representative, interview by USITC staff, Washington, DC, Oct. 1994.

[277] DEC, "Digital Wins $30 Million Integration Project at Australian Utility," *Press Release*, Maynard, MA, Sept. 21, 1993.

[278] Groupe Bull, *Annual Report*, 1993, p. 14.

[279] ICL representative, letter to USITC staff, Nov. 29, 1994. ICL invested approximately $30 million in 1993 in employee training. ICL, *Annual Report*, 1993, p. 3.

[280] DOC, "The Systems Integration Service in Japan," *Market Research Reports*, NTDB, June 1991.

corporate purchasers struggle to reduce overall IT spending. In response, many SI firms are working to manage their costs effectively through increased use of packaged software and object-oriented programming.

A fundamental method of controlling costs is the use of packaged software in addressing customer needs. While SI firms certainly have the skills to provide extensive custom programming services, it is more economical to design a project around packaged software, inserting a minimal layer of the more labor-intensive customized code later (figure 4-5). Systems integrators thus substantially decrease the level of resources necessary for software development and testing when they use low-cost packaged software to meet project goals.[281] In general, systems integrators in the United States have far more exposure to packaged software alternatives than non-U.S. competitors. U.S. firms often enter into agreements with software vendors that result in significant price discounts. For instance, EDS receives a 25 to 50 percent discount on software licensed from PeopleSoft, Inc., a developer of client/server applications.[282]

By contrast, many foreign firms continue to rely heavily on custom programming for SI projects, increasing the time and costs necessary to complete the effort. Although a number of foreign firms are shifting toward increased use of packaged products, they continue to lack the same degree of access available to U.S. companies.[283] Further, software packages tend to retail at a higher price in foreign markets, such as Europe,[284] so any cost saving realized through the use of packaged software is less significant for European systems integrators than for U.S. firms. Asian systems integrators, meanwhile, are moving much more slowly toward use of packaged software since it is not a prevalent commodity in their marketplace. Indeed, most integration work in Japan still relies on custom programming for the majority of the project.

Another cost-saving mechanism cultivated by U.S. firms is the use of object-oriented programming and the creation of reusable object software libraries (see figure 4-5). Object-oriented software refers to reusable lines of software code that can be strung

---

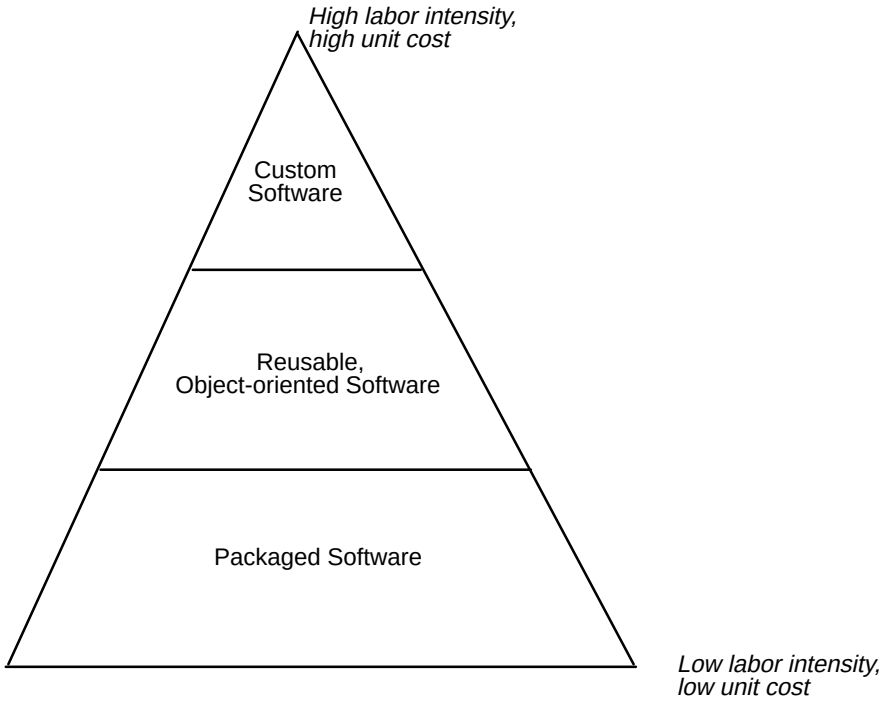
[281] Industry analysts, interviews by USITC staff, Washington, DC, Feb. 1994.

[282] PeopleSoft, Inc., *Form 10-K*, Mar. 15, 1993, p. 7.

[283] Industry representative, interview by USITC staff, Washington, DC, Mar. 1994.

[284] Presentation at the *SPA Software Symposium*, San Francisco, CA, Mar. 13-16, 1994.

Figure 4-5
Systems integration services: Managing programming costs



A cost-effective systems integration project reportedly consists of packaged software and reusable objects. By adding only a small layer of custom software, SI firms minimize the time and cost necessary to complete a project.

Source: USITC staff.

together rapidly to create a new program. As lines of code, or objects, are created, they are saved in a central library for later use in other programming projects. By building on software code that already has been written and tested, substantial cost savings can be realized. Further, by using object-oriented software, the systems integrator has more time to customize other aspects of the final system to better meet the specific needs of the customer.

The rapid expansion of the commercial SI market in the United States has provided U.S. systems integrators with the opportunity to observe areas where clients' programming needs overlap, and thus where reusable objects could be profitably developed. In many cases, objects are developed for reuse in specific industries. For example, a systems integrator that specializes in the financial services industry might use previously written financial software objects as a basis for future bank contracts. Digital Equipment notes that the development and use of objects is not a new phenomenon for its programmers. DEC reportedly always has encouraged its staff to store and share successful programming efforts on the company's global private network and recently has formalized this system into an "object library."[285] Similarly, SHL Systemhouse

[285] DEC representative, interview by USITC staff, Maynard, MA, Oct. 20, 1994.

also has established a "central object repository" (CORe) and is working to expand its collection of available modules for systems integration projects. By reducing the time and cost associated with redundant custom programming, this strategy is expected to minimize operating expenses and enhance the global competitiveness of the North American SI industry.

European firms also are working toward increased use of objects. However, the smaller and more fragmented markets of Europe reportedly have limited opportunities for European companies to standardize modules and establish large, reusable object libraries. Japanese service providers have libraries of reusable code, but most are based on proprietary systems and have little global market potential.

Outlook

Vertical market expertise and effective cost-cutting strategies, such as use of packaged software and object-oriented programming, have helped U.S. systems integration firms maintain a lead in the global systems integration market. Competition from large foreign firms is likely to increase, however, as more computer manufacturers seek alternatives to the slim margins in hardware markets. Mitsubishi Electric Corp. of Japan announced plans to phase out all mainframe production and created four new divisions in 1994 to concentrate on network development and system integration services.[286] The French computer hardware manufacturer, Groupe Bull, entered the systems integration market in 1991 and by 1993 systems integration revenues accounted for 10 percent of corporate revenue.[287]

In spite of this, U.S. firms are likely to remain the world market leaders in systems integration. Firms such as ISSC, EDS, and Andersen Consulting benefit from established reputations and customer loyalty around the world. They are recognized as systems integrators that have practical experience with many types of hardware, software, and numerous industry applications. U.S. firms are likely to continue increasing their market share, particularly in the rapidly growing markets of Europe and Asia.

[286] David Kellar, "Mitsubishi to Leave Mainframes Behind," *Computerworld*, Jan. 25, 1993, p. 49.

[287] Groupe Bull, *Annual Report 1993*, p. 22; and Melinda-Carol Ballou, "Integration Focus Paying Off for Restructured Bull," *Computerworld*, Mar. 15, 1993, p. 133.

Some analysts suggest that systems integrators may be adversely affected by the development of open, standards-based systems. These analysts note that, if true open systems are achieved, firms would have less need for third-party systems integrators because hardware and software would be more compatible and computer systems easier to design. However, industry representatives estimate that there are at least 6,000 viable combinations of hardware, operating systems, user interfaces, and other options available to firms implementing open systems.[288] Therefore, it appears likely that systems integrators will continue to generate significant revenues over the foreseeable future. The global systems integration market, estimated at $56 billion in 1994, is expected to increase 12 percent annually to reach $88 billion in 1998.[289]

Outsourcing Firms

Introduction

U.S.-based EDS, Computer Sciences Corporation (CSC), and ISSC, and the Canadian firm SHL Systemhouse lead the worldwide outsourcing market. Although European firms are the strongest competitors to North American outsourcing firms, they have not expanded successfully beyond the European market. U.S. firms hold 9 of the top 10 positions in the world outsourcing market, with SHL Systemhouse as the only non-U.S. firm ranked among the top 10. Several European firms fall within the top 20 suppliers. Japanese firms, meanwhile, are not active in the global market for outsourcing.

Clients turn to outsourcing firms to cut costs, increase processing capacity, and maintain operations during equipment upgrades and technological transitions. Outsourcing service providers perform a variety of tasks for their clients, including data processing and long-term or transitional management of IT operations.[290] Outsourcing services account

[288] Peggy Wallace, "Client/Server Computing Requires Top Corporate Developer Training," *InfoWorld*, Nov. 8, 1993, p. 64.

[289] Compiled from data provided by INPUT, Inc.

[290] Long-term outsourcing contracts generally indicate a decision by the client to relinquish responsibility for the IT division completely. Transitional outsourcing, on the other hand, occurs when a client needs to upgrade its facilities. For example, many companies have outsourced IT operations temporarily while transitioning to client/server platforms.

for over one-third of all computer services and are growing in popularity as firms in all industries look for ways to streamline operations. The popularity of corporate restructuring and pressures to focus on core competencies have fueled growth of the outsourcing industry in the United States and are beginning to encourage growth in the European outsourcing market. Approximately 550 U.S. firms are actively outsourcing some portion of their IT requirements, and many other companies have announced plans for outsourcing.[291] The market for these services is expanding more gradually in Europe. In the United Kingdom, one of the more mature information technology markets in Europe, an estimated 45 percent of IT users expect to use outsourcing services sometime in the near future, compared with less than 20 percent of German and Italian users.[292]

Outsourcing is often an option when in-house resources are not adequate to handle all of a company's fluctuating data processing needs. For example, EDS is able to provide Nielsen Information Services with twice as much processing power as Nielsen previously was able to access in-house during peak periods.[293] In other instances, firms temporarily turn to outsourcing while they upgrade from mainframe-based systems to client/server networks. In this capacity, outsourcing firms provide equipment and personnel to temporarily take over the data processing needs of a company while new technology is installed. For example, Computer Sciences Corporation is temporarily performing the processing formerly done by Sun Microsystems' mainframe operations while Sun develops and installs a worldwide client/server system.[294] Many firms continue to use outsourcing services until they train computer staffs to run the new client/server systems. Swiftly changing technology also has encouraged some firms to contract their data processing to outsourcing firms instead of investing in equipment that is quickly outdated. Further, U.S. tax policies actually encourage firms to outsource data processing because those costs can be deducted as a current business expense, while investments in computer hardware must be depreciated over 3 to 5 years.[295]

Based on the above objectives, outsourcing firms must present alternatives to traditional in-house processing that will reduce client costs and increase IT efficiency. To compete in these terms, the most essential competitive factor is contract price. Although outsourcing firms enjoy certain natural cost advantages over in-house providers, based on economies of scale in both equipment and employees, price competition with other outsourcing providers remains intense.[296] Most outsourcing firms are developing creative pricing strategies in order to compete successfully in this price-sensitive environment.

In addition to price, outsourcing firms compete based on the range of services they are able to offer clients. In many cases, outsourcing clients desire one-stop shopping for systems integration, IT consulting, and outsourcing capacity. To meet these needs, outsourcing firms must either expand their services to encompass several sectors of the computer service industry, or be able to establish alliances with companies in other essential service sectors.

Factors Affecting Competitiveness

Pricing Strategies

Strong demand for outsourcing services stems from worldwide economic pressures on all industries to reduce costs. Firms have turned to outsourcing providers for cost-effective systems management and processing services. In order to compete with other independent service providers and in-house capabilities, outsourcing firms are offering clients creative and distinctive price options, such as performance-based fees, joint-investment contracts, and customized payment schemes.

---

[291] Daniel Minoli, *Analyzing Outsourcing* (New York: McGraw-Hill, Inc., 1995), p. 22.

[292] EUROBIT, p. 125. Although the software and service markets in the United Kingdom, France, and Germany are all very advanced, the United Kingdom maintains a lead in overall IT penetration and in the assimilation of new technologies and services such as outsourcing. INPUT, Inc., *Worldwide Information Services Forecast 1993-1998*, pp. VII-258 to VII-260.

[293] In addition, EDS reduced Nielsen's report delivery time from an average of 15 days to 11 days. Mark Halper, "Nielsen Outsourcing Plan Races to the Finish Line," *Computerworld*, Nov. 8, 1993, p. 68.

[294] Computer Sciences Corporation, *Annual Report*, 1993, p. 11; and industry representative, telephone interview by USITC staff, Mar. 15, 1995.

[295] Industry representatives, interviews by USITC staff, Washington, DC, Feb. 1993; and Standard & Poor's, *Industry Survey: Computer Software*, Oct. 1993, p. C106.

[296] For more information on price competition in this industry, see John Verity, "IBM: A Bull's-Eye and a Long Shot; For Services, Pay Dirt at Last," *Business Week*, Dec. 13, 1993, p. 88; and Wendy Zellner, "Can

EDS Shed Its Skin?" *Business Week*, Nov. 15, 1993, p. 57.

Performance-based pricing (or "gain sharing") occurs when an outsourcing firm bases its fees on the cost-savings or increased revenue realized by the client as a result of an outsourcing contract. In other words, rather than basing contract price on the exact cost of processing cycles and capacity requirements, outsourcing firms derive price formulas based on the impact the contract has on a client's bottom line. For example, EDS reports that in 1989 the city of Chicago was looking for a firm capable of managing the information technology necessary for parking ticket fee collection. Under city management, unpaid fines and tickets added up to millions of dollars of lost revenue. EDS won the contract based on its promise to accept as payment the increased revenues generated from improved collection of parking ticket fines. EDS modernized the hardware and software used in Chicago's parking enforcement system and was able to process the data for a percentage of the city's previous operating costs. This mutually beneficial agreement increased parking ticket revenues by 50 percent and decreased city management operating costs by $5 million a year.[297]

Similarly, joint-investment contracts exist when an outsourcing firm agrees to share some of the client's risk in an outsourcing venture. For example, when Banc One decided to outsource its credit card processing operation, it looked for a company that would be willing to share the risk, costs, and rewards of developing a new and effective software system.[298] In 1990, therefore, Andersen Consulting and Banc One jointly invested in the development of "Triumph," a software system that facilitates credit card processing. In addition to sharing the risk, a better product emerged from the combination of advanced information technology and banking expertise.[299] This joint effort resulted in a product and system that Banc One has used to improve efficiency in credit card processing and increase revenues through sales of the service to other banking and financial firms.[300]

Finally, customized pricing schemes also are used to encourage clients to outsource IT operations. This mechanism is most useful for outsourcing firms that are less inclined to share investment or risk with clients. SHL Systemhouse, for example, notes that it will finance the cost of a project over the life of the contract, rather than charging all costs as they accrue.[301] By protecting the client from the potentially high costs generated at the onset of the contract, outsourcing firms create a financially appealing option. Another pricing strategy is to charge only for exact usage of various software systems. For instance, outsourcing firms often manage IT operations for several clients from a central location. The outsourcing provider is responsible for guaranteeing the most effective use of software licenses and desktop capacity at client locations. Thus, to reduce costs associated with software licenses, an outsourcing firm might download certain programs to certain machines only when necessary, charging only for time used. In other words, if a client's marketing office only needs access to financial software during budget time, the outsourcing firm downloads the financial software for that division only during that period. This can reduce client expenditures on software considerably. Such pricing schemes often encourage clients to consider outsourcing options over internal management of IT divisions and may increase the size of the market for outsourcing providers. Aside from SHL, few non-U.S. firms have made creative pricing a priority in their marketing efforts.

Range of Service Offerings

As noted earlier, outsourcing contracts can range from simple data processing arrangements to more complex situations where entire IT divisions are turned over to third-party management. While a basic processing contract can be handled by any IT firm with excess capacity, it is the high value-added end of the outsourcing market that is growing most quickly. Most high-end contracts (e.g., those involving more than basic data processing) require the outsourcing firm to upgrade equipment to client/server technology and improve overall IT efficiency, in addition to reducing costs for the client. As a result, clients increasingly expect

[297] EDS, *Annual Report*, 1990, p. 11; and Stephen Kindel, "Blowing Through the Barrier," *Financial World*, July 6, 1993, p. 26.

[298] Deidre Sullivan, "Bankers Choose Their Partners Wisely," *Beyond Computing for Bank Management*, Apr. 1993, pp. A4 to A9.

[299] Jacqueline Day, "Andersen's Triumph: A Long Time Coming," *Bank Systems & Technology*, Oct., 1993, p. 6.

[300] Ibid. Joint investments often lead to the formation of third companies capable of marketing industry-specific IT solutions. For example, CSC partnered with Mutual Life Insurance Company of New York (MONY) in 1994 with the objective of improving MONY's IT operations. In addition, the two companies agreed to form an "Insurance

[115]—*Continued*

Technology Center" that will develop and market software tools to help life insurance companies improve operations. "CSC and Mutual of New York Announce Technology Alliance," *Business Wire*, Oct. 5, 1994.

[301] SHL Systemhouse representative, interview by USITC staff, Washington, DC, Oct. 14, 1994.

outsourcing firms to offer a wide range of services, broadly encompassing the technical skills of systems integrators, the training skills of consultants, and the equipment capacity of traditional outsourcing firms. Additionally, any multinational client likely will seek a global outsourcing firm. Demand for a wide range of services has caused outsourcing firms to expand the range of their service offerings or to ally with other firms in areas where skills are lacking.

Many firms have enhanced competitive positions by providing a wide range of services. For instance, one of the largest outsourcing projects ever awarded outside of the United States was the 10-year contract issued by Inland Revenue, the British tax collection agency. Although several European firms bid on the contract, it was ultimately awarded to the U.S.-based EDS because EDS was able to offer the comprehensive services necessary to fully implement this complex project.[302] Similarly, SHL Systemhouse is striving to expand its range of services beyond traditional infrastructure operations to include skills in transition management, client/server technology, and solution development. SHL acquired the Canadian firm Nidak Associates Inc. in 1993 to gain skills in project planning and open systems computing.[303] This broad range of services has helped SHL remain market share leader in Canada. When the Canada Post Corporation was looking for an outsourcing firm that could manage the postal system's nationwide computing network while, at the same time, shifting the country's mail services to a client/server environment, it considered several U.S. and Canadian firms. SHL, having both the project management skills and client/server expertise, won the $1 billion contract in October of 1993.[304]

---

[302] For this project bid alone, EDS reportedly assembled a team of up to 79 systems engineers, tax specialists, government analysts, and others, bringing together a wide range of skills and services. Ralph T. King, Jr., "High-Tech Edge Gives U.S. Firms Global Lead in Computer Networks," *The Wall Street Journal*, Sept. 9, 1994.

[303] SHL also has used acquisitions to expand its global capacity, acquiring a minority interest in Tong Yang Information and Communications Corporation in Korea in late 1993. SHL Systemhouse Ltd., *Annual Report 1993*, pp. 2-3.

[304] The Yankee Group, "The Canadian Outsourcing Market," pp. 9-10.

Some outsourcing firms, such as CSC, EDS, and Price Waterhouse, include corporate restructuring and management consulting in their service offerings. CSC considers such business services and expertise an essential prerequisite to effectively managing a client's IT operations.[305] On the other hand, several outsourcing firms have stopped just short of offering management consulting or restructuring services due to a perceived conflict of interest. While numerous outsourcing contracts emerge from corporate restructuring, some companies suggest that a vendor's ability to legitimately recommend outsourcing and be the outsourcing service provider is limited. DEC, for example, avoids such conflicts of interest by excluding management consulting from its many service offerings while maintaining unofficial alliances with many of the large consulting groups such as McKinsey & Co. and Ernst and Young.[306]

Worldwide, most of the top outsourcing firms are those capable of offering a wide range of services. Among the European outsourcing firms ranked globally, both Sema Group and Cap Gemini Sogeti have expanded offerings through alliances and acquisitions to enhance their global position. Cap Gemini, for example, expanded into management consulting through the acquisition of Gemini Consulting. Firms that offer a more limited range of services tend to have less of a presence in the global market. For example, the German-based Datev maintains a very successful domestic market share by focusing almost exclusively on data processing, but it is less effective on a worldwide scale.

Outlook

Effective pricing strategies and multiple service offerings have helped propel EDS, CSC, and ISSC, to the forefront of the global outsourcing market. All three firms continue to increase their contract revenues worldwide. ISSC and McDonnell Douglas recently signed a 10-year, $3 billion outsourcing contract, which is considered to be one of the largest outsourcing contracts in the world.[307]

U.S. firms also are competing successfully in the European market. In 1993, CSC and EDS won

[305] CSC, *Annual Report*, 1993, p. 4. EDS also is expanding into management consulting services. Since mid-1993 the company has acquired six small consulting firms, adding 1,300 management consultants to its business. "The Changeling," *Economist*, Nov. 26, 1994, p. 69.

[306] DEC representative, interview by USITC staff, Maynard, MA, Oct. 20, 1994.

[307] Phillip N. James, "Wendell Jones on Outsourcing," *Information Systems Management*, Fall 1993, p. 73.

10-year contracts to run most computer operations at British Aerospace and Britain's Inland Revenue, respectively. Each contract is worth over $1 billion, representing some of the largest outsourcing agreements in Europe.[308]

The global outsourcing market is expected to reach $99 billion in revenues by 1998, growing 12 percent annually. The largest market is the United States, providing 61 percent of outsourcing contract revenue. Europe accounts for 20 percent of the world market. Although the Asia/Pacific market remains small, it is expected to increase by an estimated 16 percent annually during the next 4 years and will represent approximately 20 percent of worldwide outsourcing revenues by 1998. Currently the region accounts for 17 percent of the global outsourcing market.[309]

Custom Programming Firms

Introduction

Custom programming accounts for approximately 25 percent of the global computer services market.[310] Programmers provide clients with software that is tailored to specific computing needs, either by writing new software code or by adapting existing packaged software. Custom programming projects include industry-specific adaptations of packaged software,[311] custom software designs for new systems, and basic coding and debugging for existing software, such as re-writing code to run on different operating systems.

ISSC, EDS, and Andersen Consulting are the top three custom programmers in the U.S. market in terms of revenue.[312] Service providers such as these generally concentrate on large programming contracts and long-term projects that are granted in conjunction with other service contracts.[313] In addition to these firms, many small custom programming shops are extremely active, operating out of home offices and focusing on niche projects. The prevalence of so many small programming shops in the United States is a direct result of the large installed computing base in the U.S. market. The large-scale systems that dominated the U.S. market for many years demanded high levels of labor-intensive coding and programming. The result of these efforts was the creation of a highly skilled workforce of programmers, many of whom today operate small programming shops.

As in the U.S. industry, several of the large European service providers such as Sema Group, Finsiel, and Cap Gemini offer custom programming in conjunction with other service contracts. However, there are also a number of foreign firms, such as Scitex of Israel and Tata Consultancy Services of India, that focus primarily on custom programming services. Non-U.S. firms such as these may provide services for overseas subsidiaries of U.S. companies, send programmers to the United States for short-term assignments in programming shops, or operate across global information networks, transmitting final programming products electronically to overseas contractors.

Custom programmers compete principally in terms of price. The price of a custom programming project generally is tied to the number of programmer hours required to complete it. The majority of custom programming work is labor and time intensive.[314] Consequently, the easiest way for programming companies to reduce prices is to control labor costs. Varying wage rates in different countries have resulted in more competition for U.S. producers in this segment of the industry than in any other computer service sector covered in this study.

---

[308] Kristen Hedlund, "CSC Awarded $1.2 Billion Outsourcing Contract: List of Huge Pacts to Reshape Integrators," *Computer Reseller News*, Nov. 22, 1993; and Mark Halper, "UK Tax Agency Will Outsource to EDS," *Computerworld*, Nov. 29, 1993, p. 16.

[309] Compiled from data provided by INPUT, Inc.

[310] Data for custom programming also encompass revenues from other professional services, such as computer consulting and training. Custom programming accounts for over 60 percent of total revenues in this category.

[311] As companies make the transition from mainframes to distributed systems, custom programmers will be needed to integrate heterogenous platforms and make adjustments to packaged software products that are expected to run on all the client's computers. Suzanne Colvin, "Real World Accounting," *PC Magazine*, Oct. 26, 1993, p. 273.

[312] Compiled from data provided by INPUT, Inc.

[313] Industry representative, interview by USITC staff, San Francisco, CA, Mar. 1994.

[314] For certain high-end custom programming projects, quality and turn around time may be considered more important than price. However, much of the high-end customization takes place during systems integration projects and is handled by SI vendors. Low-end custom programming tasks are more likely to be contracted to third-party programmers, making price a more important consideration. Industry representatives, interviews by USITC staff, Washington, DC, Oct. 1994.

Factor Affecting Competitiveness: Labor Cost Management

The average amount of time necessary to complete a custom programming project ranges from a few weeks to several months. Programmers generally are paid according to the amount of time they spend on a project. Thus, the labor intensity of this market segment makes labor cost a key consideration for custom programming firms. In the United States, hourly billing rates range from $50 to $75 per programmer. Some foreign programmers charge considerably less, with Indian programmers available for $15 to $25 per hour, and Irish programmers for $35 to $60 per hour.[315] Figure 4-6 ranks several foreign countries that are actively involved in the custom programming industry. These countries are listed according to programming labor costs, beginning with the least expensive.

The importance of price and labor costs has resulted in the development of a competitive custom programming industry outside of the United States. India ranks second to China in offering the least expensive programming labor costs, but India derives an advantage over China as a result of widespread availability of English-speaking programmers.[316] Although much of the custom programming performed in India is accomplished through subsidiaries of U.S. companies (e.g., DEC and Texas Instruments), the number of Indian-owned firms is growing rapidly. Indian-based companies such as Tata Consultancy Services (TCS), Datamatics, and Reesan Information Management Resources have built successful export businesses through the use of a highly skilled, low-cost workforce.[317] TCS led the industry in 1994 with computer service revenue projected at over $100 million.[318] Approximately 90 percent of these revenues were from custom programming projects, such as the $14 million re-engineering project performed for the United Kingdom's Sunlife Assurance Company.[319] Datamatics reported $4 million in revenue from custom software exports in 1992, much of which was accounted for by ongoing contracts with companies such as General Electric and Ericsson.[320] Indian firms market their low-cost, high-quality services through contracts and employees worldwide. Most offer both remote and on-site services, with the majority of exports going to the U.S. market.[321] The improvement of data communications between U.S. clients and Indian programmers has facilitated the transfer of programming services, with many projects transmitted electronically from one computer to another.[322] Custom programming shops in the Philippines, Singapore, Israel,[323] and Hungary also have been successful exporters of programming services as a result of highly skilled and inexpensive labor.

It is difficult for U.S. programming firms to compete in terms of price with the low-cost contracts offered by these overseas challengers. Some U.S. firms have brought foreign programmers into the United States on temporary contracts in order to keep programming costs down and boost market share, but concerns over labor and visa laws have

[315] Gary H. Anthes, "Not Made in the U.S.A.," *Computerworld*, Dec. 6, 1993, p. 124. Some analysts use other measures of comparison. Capers Jones of Software Productivity Research notes that Indian programmers cost $125 per unit of software, versus $925 for U.S. programmers. W. Wayt Gibbs, "Software's Chronic Crisis," *Scientific American*, Sept. 1994, p. 94.

[316] English language abilities are important to the industry for several reasons. First, most software programming languages are English-based. Second, software documents and technical manuals often are in English. Finally, English is the most common language for software science publications and instruction.

[317] Many companies maintain a highly-skilled workforce through extensive training. For example, TCS spends as much as 8 percent of revenues on training programs for its programmers every year. Nagy Hanna, *Exploiting Information Technology for Development, A Case Study of India*, World Bank Discussion Paper #246, p. 72.

[318] Ashok Soota, "Technology in India," *IEEE Spectrum*, Mar. 1994, p. 36.

[319] Ibid.

[320] "Trade Reforms Make India Reliable Software Source," *Computer Products*, Mar. 1993, p. 392.

[321] Gibbs, "Software's Chronic Crisis," p. 94.

[322] Ibid; and "Trade Reforms Make India Reliable Software Source," p. 386.

[323] As in the United States, military research in Israel spurred growth of a significant commercial software industry. Although programming wages in Israel are slightly higher on average than those found in Asian and Central European countries, the English language ability and programming skills that are available have resulted in many foreign contracts. Israel also has acquired talented custom programmers in the form of Russian emigres from top Moscow institutes. Wages for Israeli programmers average approximately 30 percent less than those for U.S. programmers. Neal Sandler, "Israel: The Promised Land for Programming Services," *Electronic Business Buyer*, Sept. 1993, p. 150.

reduced this practice.[324] Instead, many U.S. and European firms now sub-contract work to low-cost countries or set up subsidiaries to perform programming work.[325] Although some analysts warn that expanded education efforts overseas and gradually improved telecommunication infrastructures will erode U.S. advantages in custom programming, others suggest that U.S. programmers will remain competitive by virtue of their high levels of expertise and their proximity to the most dynamic market.[326] U.S. programmers likely will maintain a significant advantage in projects requir- ing familiarity with vertical market end uses and in large projects focusing on new technologies.[327]

While both U.S. and European firms have turned to off-shore programming to decrease labor costs, Japanese companies continue to rely heavily on domestic programmers. Custom programming is the primary form of software development in Japan, and loyalty to Japanese firms often takes precedence over price as the most important factor.[328] Companies such as NTT Data, Fujitsu, and Nomura Research maintain affiliated programming subsidiaries to perform software development tasks. Essentially all high-level programming is performed by these subsidiaries and the resulting software rarely is separated from the proprietary hardware for which it was developed. The independent software shops in Japan, meanwhile, tend to receive lower level programming chores.[329] Overall, the limited applications of these proprietary projects has prevented expansion of custom programming as a global industry for Japanese companies.

Productivity levels in many overseas programming shops are considered comparable to U.S. firms for basic program code development.[330] Although incompatible measures of productivity preclude direct comparisons among companies, general levels of output per hour are considered similar for much of the basic programming that takes place overseas.[331] For large projects, U.S. and foreign firms alike are looking for ways to increase productivity through object-oriented programming and improved production techniques. For example, several firms have implemented a quantitative quality control process approved by the Software Engineering Institute called the "Capability Maturity Model" (CMM).[332] Some companies, such as Raytheon's software division, reportedly doubled productivity once the model was in place. Interestingly, one of the firms which is ranked highest according to CMM benchmarks is Motorola's Indian programming team in Bangalore.[333]

[324] A group called "Californians for Population Stabilization" filed a lawsuit against the Indian company TCS and the U.S.-based firm Hewlett-Packard in 1993, alleging circumvention of U.S. labor laws relative to minimum pay levels. Ashok Soota, "Technology in India," *IEEE Spectrum*, Mar. 1994, p. 31. Others in the industry believe immigration laws should be liberalized, given a generally perceived shortage in the supply of qualified U.S. programmers. ITAA, *The National Information Infrastructure*, p. 7.

[325] Firms such as AT&T, DEC, Hewlett-Packard, IBM, Motorola, Texas Instruments, Unisys, and Siemens AG have established subsidiaries or joint ventures in India to perform programming tasks. The appeal of low cost programming and processing also appeals to firms outside the IT industry. Companies such as Swissair, General Electric, and Turner Broadcasting also are reducing costs by turning to off-shore providers. Soota, "Technology in India," p. 33; and "Trade Reforms Make India Reliable Software Source," p. 386.

[326] For additional information on this subject, see Stephen E. Kruse, "Foreign Skills Put U.S. Workers to Shame," *Computerworld*, Nov. 1, 1993, p. 122; and Anthes, "Not Made in the U.S.A.," p. 123.

[327] Industry analysts suggest that U.S. programmers will maintain an advantage in areas involving large network applications, mobile computing, and any multimedia/virtual reality tasks. It is also recommended that U.S. programmers undergo at least 1 month of training per year to stay on top of the industry. Ed Yourdon, presentation at *Software World '94*, San Francisco, CA, Feb. 28, 1994.

[328] Feigenbaum, "The Japanese Software Industry," pp. 215-227. In a few limited cases, Japanese firms have decided to take advantage of low wage development options. For example, Japanese-based Sharp and Toshiba have invested in software development projects in Israel. Neal Sandler, "Israel: The Promised Land for Programming Services," *Electronic Business Buyer*, Sept. 1993, p. 150.

[329] Feigenbaum, "The Japanese Software Industry," pp. 215-227.

[330] Ed Yourdon, presentation at *Software World '94*, San Francisco, CA, Feb. 28, 1994.

[331] Global comparisons of productivity are difficult, since there is no agreed-upon standard of measure. Some firms refer to lines of code generated per programmer, while others examine "function point" output. However, these measures do not consider the number of programming errors ("bugs") that are generated, nor are they capable of comparing output among programmers using different programming languages. Gibbs, "Software's Chronic Crisis," p. 93.

[332] For more information, see "Software Process Improvement," *American Programmer*, Sept. 1994.

[333] Also ranked high is Loral's (formerly IBM's) on-board space shuttle software project. Both Motorola and Loral scored a "5" (out of 5) on the CMM scale.

Outlook

U.S. firms will face increasing competition from foreign programmers in India, the Philippines, Israel, and other relatively low-cost locations, especially as global telecommunication networks improve data transmission capabilities. Current projections suggest that the market for overseas programming will grow by 50 percent in 1994,[334] and much of that expansion is expected to be in the area of low-end projects. For example, Apple Computer recently decided to hire Ukrainian programmers to translate software for IBM-compatible computers. The cost of using Ukrainian programmers is estimated to be one-quarter that of using U.S. programmers.

U.S. strengths in custom software planning, analysis, and project management likely will sustain domestic programmers' ability to win contracts for certain high-end projects. U.S. programmers will need to offer added value and quality to compensate for cost differences with overseas programmers.[335] Further, even as foreign programmers expand their presence in the industry, they are far from attaining a spot in the global market next to large revenue earners such as EDS and Andersen Consulting. Unless foreign programmers keep up with technology and advances in software development techniques, the wage differential may prove to be only a short-term advantage.

The global market for custom programming services is projected to reach $92 billion by 1998, reflecting a relatively low average annual growth rate (7 percent) in comparison to the other service sectors discussed in this study. U.S. and foreign programmers face slowing markets for their services in Asian and European markets in particular.[336] The proliferation of new and improved packaged software products and advances in various programming tools are decreasing the need for third-party programmers. Further, as companies shift to downsized client/server networks, custom programming tasks associated with complex coding for large-scale mainframes are declining. Those programming jobs that do remain will be high-end tasks requiring programmers with the latest skills in new programming languages and techniques.

---

[334] Anthes, "Not Made in the U.S.A.," *Computerworld*, Dec. 6, 1993, p. 124.

[335] Ed Yourdon, presentation at *Software World '94*, San Francisco, CA, Feb. 28, 1994.

[336] Standard & Poor's, *Industry Survey: Computer Software*, Oct. 1993, p. C104. Compared to the United States, European companies traditionally have relied more on custom programming than on packaged software for many business applications. However, as the cost of packaged software in Europe has declined and recessionary trends have cut into corporate IT budgets, many European clients are decreasing their expenditures on custom programming.

CHAPTER 5
Principal Findings and Outlook

Introduction

The commercially independent software and service industries have existed for over a decade, during which time U.S. firms have established themselves as competitive leaders in world markets. Chapters 3 and 4 have identified a number of critical factors that influence the global competitive position of U.S. and foreign computer software and service firms. Some of these factors, such as government protection for intellectual property and education systems, are external to the firm, or beyond its immediate control. Other factors, such as product development and cost management techniques, are controlled directly by the firms themselves. An assessment of the relative importance of these factors is necessarily general, taking into account the experiences of many firms in the United States and overseas. Based on information presented in this report, however, it appears that government policies and other external factors typically play a less significant role than firm strategy and technology in shaping the competitive strengths of software and service firms worldwide.

The findings of this report suggest that U.S. firms in particular have boosted their global market share by adapting their strategies to address technological change, price competition, and the product performance concerns of increasingly savvy customers worldwide. External factors, though often important in establishing an environment within which competition could flourish, have had a less dramatic effect on the competitiveness of software and service firms. Specific findings of the report with respect to discrete industry segments and the impact of government policies are presented in the following sections. The final section of the chapter will discuss the outlook for future competitive developments in the global software and service industries, focusing on emerging demand for home-based interactive software applications and new opportunities for service providers to serve fast-growing markets for industry-specific computer solutions.

Overall U.S. Competitive Position

Computer Software

Overall, the U.S. position in the global market for applications and systems software remains very strong, reflecting the ability of U.S. firms to respond quickly to changing technologies, new pressures to reduce costs, and shifting consumer demand patterns. Ranked in terms of global market share, 8 of the world's top 10 applications software vendors and 7 of the top 10 systems software vendors are U.S. firms.[337] The other global leaders in these markets owe their position in large part to strong sales in the European and Japanese markets for mainframe and minicomputer-based software. Only one Japanese vendor, Fujitsu, has attained a top 10 global market share position in applications software. No Japanese firms rank among the 10 leading providers of systems software.

U.S. applications software developers have thrived as a result of their ability to compete in terms of price, product quality, and timeliness. Revised sales and marketing strategies, the establishment of strategic partnerships, and the introduction of innovative product development techniques all have contributed significantly to U.S. firms' success. At the same time, U.S. systems software firms have excelled largely because of their ability to produce interoperable and easy-to-use products that perform well in complex networks of heterogeneous hardware and software. Systems software vendors have relied heavily on alliances, acquisitions, and rapid responsiveness to customer needs in developing globally competitive products.

Computer Services

The global market share position of U.S. computer service firms is also extremely strong. U.S. systems integrators, outsourcing firms, and

[337] Compiled from data provided by INPUT, Inc.

custom programmers have responded rapidly to price pressures and sophisticated customer demand by reducing costs and by broadening the range of services available to information technology divisions in private and public institutions worldwide. Ranked in terms of global market share, the world's top five systems integrators are all U.S. firms, while the top nine global outsourcing firms are headquartered in the United States.[338] Eight of the top ten custom programming market share leaders are also U.S. firms. The leading non-U.S. competitors in these market segments still derive only a small percentage of revenues from sales of services outside their home markets.

Based on information gathered for this report, systems integrators compete primarily in terms of price and their ability to provide industry-specific (vertical) service solutions to customers in such areas as manufacturing, banking, and health services. Highly skilled staffs, alliances with other firms, and cost management efforts have combined to help U.S. systems integration firms provide competitive services worldwide. In the market for outsourcing services, the report finds that firms compete primarily in terms of contract prices and the breadth of service offerings. U.S. outsourcing firms in particular have excelled in the global market by employing innovative pricing policies and by expanding the range of outsourcing services available to customers. Finally, in the market for custom programming services, firms compete largely in terms of price. Labor cost management appears to be a primary determinant of success in custom programming services. This fact may ultimately erode the strong U.S. position in certain custom programming markets, as new sources of low-wage programming talent become available outside the United States. However, high-end programming projects likely will remain in the United States.

Government Policies and Other External Factors

Two types of government policy initiatives in particular appear significant in influencing the global market success of software and service firms. First, U.S. software firms note that they have benefited

[338] Ibid.

from enforcement of intellectual property rights in the United States, and increased anti-piracy efforts in key foreign software markets likely will have a positive impact on the competitive position of U.S. firms. Second, with respect to telecommunications deregulation, efforts to reduce the market power of public telephone monopolies in Europe and Asia have spurred competition in computer service markets. U.S. market leaders in outsourcing services stand to increase revenues in foreign markets as foreign PTOs are forced to expand the access of outside firms to leased line services.

Direct government funding for software-related research projects appears to have had little impact on the global success of firms in the United States, Europe, and Japan. Governments may have more success, however, in pursuing broad-based initiatives aimed at improving information infrastructures and establishing a sound competitive environment for emerging software and service firms to grow and flourish. The National Information Infrastructure (NII) proposals in the United States, as well as similar initiatives in the European Union and Japan, are examples of broad-based policies that are likely to accelerate the development of new types of network-based software and services.

Finally, education systems in the United States and overseas continue to lay the groundwork for the development of strong information technology industries. The outstanding record of U.S. universities in computer science has clearly had a positive effect on the growth of competitive U.S. software and service industries. Expanded access to technology in elementary and secondary schools around the world likely will lead to strong growth in computer science program enrollments in the years to come.

Outlook

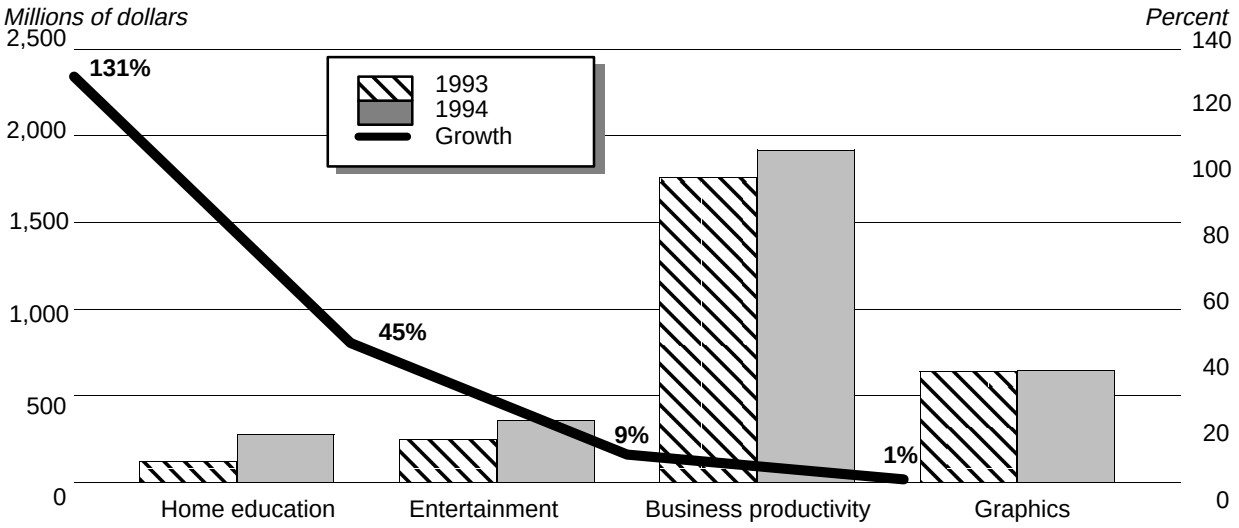
Future growth prospects for the global software and service industries appear quite favorable, and U.S. firms are generally well positioned to benefit from growing consumer interest in an entirely new generation of products and services. Underlying this positive outlook is the ongoing convergence of technologies linking the computer, communications, and entertainment industries, which together make it possible for software and service firms to tap rapidly growing markets for information and entertainment in offices, schools, and homes worldwide.

The competitive implications of these shifts in technology and global demand patterns can be summarized briefly in four main points: (1) consolidation of the information technology industry likely will accelerate as the largest firms invest heavily in the development of new products and capitalize on scale advantages; (2) software development efforts largely will be focused on high growth sectors, such as PC-based home and education markets; (3) computer service providers likely will face increasing pressure to specialize in vertical markets as customers demand greater expertise in the development of industry-specific computing solutions; and (4) continued growth in demand for software products and services through the end of the decade in the United States should continue to bolster the global market share position of U.S. firms, which historically have faced very limited competition from foreign suppliers in the U.S. market.

Pressure to develop and market the new generation of interactive, multimedia products has already resulted in a far-reaching web of alliances linking computer and telecommunications firms with network service providers, cable firms, and producers of entertainment and educational “content.” Many U.S. software firms, in particular Microsoft, have taken numerous steps to strengthen contacts with firms in other industries so that networked multimedia applications can be quickly developed and delivered. U.S. leadership in computing, communications, and entertainment is likely to give the largest U.S. firms an enormous advantage in reaching the new consumer technology markets rapidly. Opportunities to exploit economies of scale should quickly force prices down, making it difficult for many smaller firms to remain profitable. Although start-up firms and small businesses will continue to be an important and innovative component of the overall industry, a certain degree of consolidation and a further shake-out in the global IT industry likely will continue through the end of the decade.

The emergence of the home PC as an important high-growth platform for future software applications, complete with audio and video support, is likely to benefit U.S. firms that have devoted substantial resources to the development of entertainment, education, and home office applications (figure 5-1). In 1993 alone, Microsoft’s

Figure 5-1
Growth rates in sales of PC software programs in North America, 1993-94[1]



[1] Data based on retail sales during the first three quarters of 1994 compared to sales during the first three quarters of 1993. Business productivity software includes word processing, spreadsheet, database, and project management programs.

Source: Compiled from data provided by the *Software Publishers Association*.

consumer software division doubled its sales of home-based PC entertainment and educational titles. Still, threats from international competitors are significant. Japanese game developers, including Nintendo and Sega, have already gained strong positions in the home entertainment market by responding quickly to customer demand for high-performance products. Moreover, software development initiatives at Fujitsu and other large foreign firms currently are targeted at the fast-growing home-based multimedia market. Ultimately, however, U.S. firms are well placed to gain a product development-related advantage as a result of extensive contact with customers in the large U.S. home PC market. Early adoption of interactive multimedia applications by U.S. consumers will generally favor U.S. firms. Indeed, Dataquest reports that U.S. consumers accounted for 65 percent of worldwide shipments of PCs with multimedia capabilities in 1994. Rapid expansion in the installed base of multimedia-ready CD-ROM drives, estimated to have increased three-fold during 1993-94, will continue to drive global market demand for multimedia software.

For computer service firms, the competitive outlook through the remainder of the decade will be shaped not only by emerging technologies, but also by increasingly sophisticated customer demand patterns. Most of the largest service providers have already discovered that success in winning a systems integration, outsourcing, or custom programming deal depends greatly on the service provider's understanding of the customer's business. Design and administration of IT systems is no longer a generic undertaking, and in the future service firms' ability to customize solutions for specific industry needs will be critical. Many of the largest service firms have already established in-house teams that specialize in the computing problems of customers in a particular industry (e.g., banking, health services). As customers seek greater returns on IT investments, pressures on service firms to deliver specialized solutions will mount. Indeed, industry fragmentation may expand as alliances forged between service providers and clients lead to an increasing number of spin-off firms that develop specialized products for specific industries. These new spin-off firms will thrive on the combined expertise of IT service providers and individual industry end users. Although U.S. firms may ultimately face greater competition from foreign firms that successfully translate specialized vertical market expertise into improved customer satisfaction, the extremely strong market share position of U.S. companies will be difficult to erode.

With respect to future global demand patterns, the United States likely will remain the preeminent market for both software and services through the end of the decade.[339] As figures 5-2 and 5-3 illustrate, the projected U.S. share of the global software and service market in 1998 will surpass by a large margin the shares of all other regional markets. Meanwhile, Europe's share of the global software market is projected to decline from 30 percent in 1994 to 27 percent by 1998.[340] Given that European firms sell mainly in their domestic markets, this shift in global demand is likely to improve the relative competitive position of U.S. software firms *vis-a-vis* their principal European challengers. Moreover, U.S. software and service firms have demonstrated their ability to gain market share more effectively than European competitors in the rapidly growing markets of Asia and Latin America. By 1998, these two regions together will account for an estimated 14 percent of global software consumption and 22 percent of global services consumption (figures 5-2 and 5-3).

The global software and service industries again stand on the threshold of a new era in computing, one defined by radically different technologies, new modes of information delivery, and a changing set of customer requirements. Above all, as the facts presented in this report suggest, the distinguishing characteristic of information technology markets during the next decade is likely to be great uncertainty. While some firms may claim to comprehend the future course of technology and demand, the fundamental unpredictability of developments in these industries is now a widely accepted fact. In the end, those firms that display the greatest flexibility in responding to constantly changing competitive problems still stand the greatest chance of achieving success in the years to come.

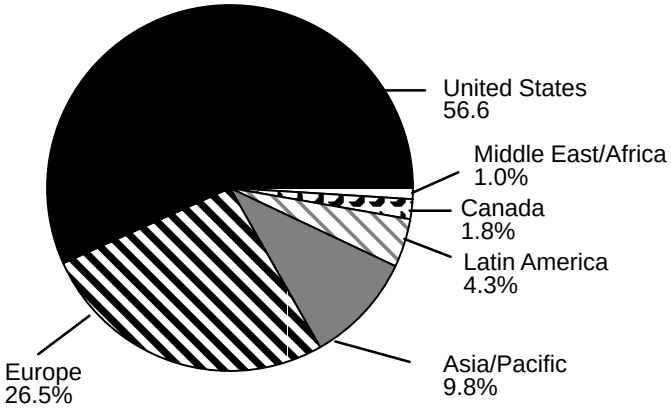
---

[339] Estimates of future regional demand growth are compiled from data provided by INPUT, Inc.

[4] For comparison purposes, see 1994 market share positions as presented in figures 2-2 and 2-4 of chapter 2.

[340] Estimates of future regional demand growth are compiled from data provided by INPUT, Inc.

Figure 5-2
Projected global market for computer software, by major country or region, 1998[1]

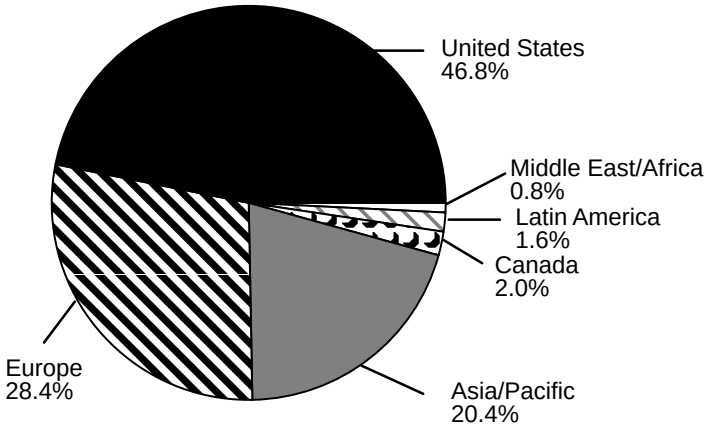


Projected global market = $140 billion

[1] Includes markets for applications and systems software.

Source: Compiled from data provided by INPUT, Inc.

Figure 5-3
Projected global market for computer services, by major country or region, 1998[1]



Projected global market = $280 billion

[1] Includes markets for systems integration, outsourcing, and custom programming services.

Source: Compiled from data provided by INPUT, Inc.

APPENDIX A

LIST OF CONTRIBUTING COMPANIES, ASSOCIATIONS, AGENCIES, ACADEMIC INSTITUTIONS, RESEARCH FIRMS, AND CONSULTANTS

Companies

AMR Corp.
Acer America Corp.
Aldo Ventures, Inc.
Amdahl Corp.
American Management Systems Deutschland GmbH (Germany)
The Applications Group Inc.
Atlas Venture
Banyan Systems Inc.
Bear River Associates
Borland International, Inc.
CBIS
Compagnie Des Machines Bull (France)
Compagnie IBM France (France)
Compaq Computer Corp.
Compaq Computer Europe (Germany)
Compaq Manufacturing Ltd. (United Kingdom)
Digital Equipment Co. Ltd. (United Kingdom)
Digital Equipment Corp.
Epic Megagames
GE Information Services
GST Software PLC (United Kingdom)
Hewlett–Packard Corp.
Intel Corp.
International Business Machines Corp.
International Computers Ltd. (United Kingdom)
Intuit
Kleiner, Perkins, Caufield, & Byers
Masterclips, Inc.
McQueen Inc.
Microsoft Corp.
Motorola, Inc.
Olivetti & C., S.p.A. (Italy)
PowerPC Alliance
Rational, Inc.
SAP AG (Germany)
SHL Systemhouse (Canada)
Siemens–Nixdorf Informationssysteme AG (Germany)
Silicon Graphics, Inc.
Software AG (Germany)
Sun Microsystems, Inc.
Tandem Computers, Inc.
Texas Instruments Inc.
Unisys Corp.

Associations

Alliance to Promote Software Innovation (APSI)
American Council for Capital Formation
Business Software Alliance (BSA)
European Association of Manufacturers of Business Machines and Data Processing Equipment (Eurobit)
Information Technology Association of America (ITAA)
International Intellectual Property Alliance (IIPA)
Massachusetts Software Council
Microelectronics and Computer Technology Co. (MCC)
National Venture Capital Association

Software Publishers Association (SPA)
United States Council for International Business

Agencies

Commission of the European Communities
Industry and Science Canada, Information Technologies Industry Branch
Institute of International Education
International Association for Evaluation of Educational Achievement, The Hague
Japanese Embassy (Washington, DC)
Japanese Ministry of International Trade and Industry
Japanese Ministry of Posts and Telecommunications
Organization for Economic Co–operation and Development (OECD)
U.S. Consulates General (Edinburgh, Hamburg, Milan, Munich)
U.S. Department of Defense
U.S. Department of Education
U.S. Embassies (Bonn, Brussels, London, Paris, Rome)
U.S. and Foreign Commercial Service
U.S. Mission to the European Communities
U.S. Small Business Administration
United Kingdom Department of Trade and Industry, Telecommunications and Posts Division

Academic Institutions, Research Firms, Investment Firms, and Consultants

Alex. Brown & Sons, Inc.
American Enterprise Institute for Public Policy Research
The Brookings Institution
Corporate Computing, Inc.
Database Decisions, Inc.
Digitalk
Ernst and Young
Gartner Group, Inc.
Goldman, Sachs, & Co.
Hambrecht and Quist
INPUT, Inc.
Institute for International Economics
Mass High Tech
McKinsey & Company, Inc.
Nomura Research Institute
Sentry Market Research
Software Productivity Research, Inc.
Stanford University, Center for Economic Policy Research
Stanford University, International Computer Software Industry Project
Stratacom, Inc.
Syntrex Technologies, Inc.
Syracuse University
University of California at Berkeley

APPENDIX B

SELECTED BIBLIOGRAPHY

Adonis, Andrew. "Company Cash Filters Through Political Bars." *Financial Times*, March 17, 1994, p. 15.

Aspray, William and Bernard O. Williams. "Arming American Scientists: The Role of the National Science Foundation in the Provision of Scientific Computing Facilities for Colleges and Universities." Forthcoming in the *Annals of the History of Computing*, 1995.

Beauchamp, Edward R. *Japanese and U.S. Education Compared*. Bloomington: Phi Delta Kappa Educational Foundation, 1992.

Ben-David, Joseph. *Centers of Learning: Britain, France, Germany, United States*. New York: McGraw-Hill, 1992.

Bernheim, B.D. and J.B. Shoven. "Comparing the Cost of Capital in the United States and Japan." In *Technology and the Wealth of Nations*. Ed. Nathan Rosenberg, Ralph Landau, and David C. Mowery. Stanford: Stanford University Press, 1992, pp. 151-74.

Bernheim, B.D. and J.B. Shoven. "Taxation and the Cost of Capital: An International Comparison." In *The Consumption Tax: A Better Alternative*. Cambridge, MA: Ballinger Publishing Co., 1987, pp. 61-86.

Bloomfield, Mark A. and Margo Thorning. American Council for Capital Formation. "U.S. Tax Policy Has Contributed to Higher Capital Costs." Testimony before the Committee on Ways and Means, U.S. House of Representatives, March 5, 1990.

Bottoms, David T. "U.S. Government Adopts Encryption Standard." *Electronics*, February 14, 1994, p. 11.

Business Software Alliance. "Software Piracy Costs Industry $35 Million Each Day." *News Release*, November 14, 1994.

Business Software Alliance. "Software Piracy Worldwide Percentages & 1993 Losses." *Software Review*, June 1994., p. 6.

Business Software Alliance. "U.S. Software Companies Competitiveness Threatened by Outdated Export Control Regulations: $6 to $9 Billion in Annual Revenues at Risk." *News Release*, October 11, 1993.

Clapes, Anthony Lawrence. *Softwars: The Legal Battles for Control of the Global Software Industry.* Westport, CT: Quorum Books, 1993, pp. 54-70.

Claveloux, Denise. "Cocom Initiates Reforms." *Electronics*, November 22, 1993, p. 1.

Claveloux, Denise. "European Union Financial Watchdog Slams Esprit Program." *Electronics*, February 14, 1994, p. 14.

Competitiveness Policy Council. *Building A Competitive America: First Annual Report to the President and Congress.* Washington, DC, March 1992.

Cusumano, M.A. *Japan's Software Factories.* New York: Oxford University Press, 1991.

Daly, James. "Export Guides Hinder U.S. Encryption Trade." *Computerworld.* September 20, 1993, p. 161.

Di Tosto, M. Nanette. "International Data Protection Landscape." July 23, 1993.

European Information Technology Observatory. Frankfurt: European Information Technology Observatory, 1994.

Feigenbaum, Ed. "The Japanese Software Industry: Where's the Walkman," ch. in *The Future of Software*. Cambridge: MIT Press, 1995.

Fisher, Franklin M., Joen E. Greenwood, and McGowan. *Folded, Spindled, and Mutilated: An Economic Analysis of U.S. vs. IBM*. Cambridge: MIT Press, 1983.

Flamm, Kenneth. "Globalization in the Computer Industry." Background paper for experts meeting, OECD, Paris, December 17, 1990.

Flamm, Kenneth. *Targeting the Computer: Government Support and International Competition*. Washington, DC: Brookings Institution, 1987.

French, K.R. and J.N. Porterba. "Are Japanese Stock Prices Too High." Paper presented at the Center for Research Security, Seminar on the Analysis of Security Prices, Chicago, IL, May 4, 1989.

The Futures Group. *The Impact of Foreign Industrial Targeting on the U.S. Computer Industry.* Report 701-138-03. Glastonbury, CT, April 30, 1985.

Green, Andy. *Education and State Formation: The Rise of Education Systems in England, France, and the USA*. New York: St. Martin's Press, 1990.

Guenther, Gary L. "Industrial Competitiveness: Definitions, Measures, and Key Determinants." Washington, DC: Congressional Research Service, February 1986.

Harvey, John R., Cameron Binkley, Adam Block, and Rick Burke, eds. "Export Controls on Mass-Merchant Software with Encryption," ch. in *A Common Sense Approach to High-Technology Export Controls*. Stanford: Stanford University, March 1995.

Hatsopoulos, G.N. and S.H. Brooks. "The Cost of Capital in the United States and Japan." Paper presented at the International Conference of Capital. Kennedy School of Government, Harvard University, Cambridge, MA, November 19-21, 1987.

Howarth, Mike. *Britain's Education Reform: A Comparison with Japan.* London: Routledge, 1991.

Information Technology Association of America. *National Information Infrastructure: Industry and Government Roles.* Arlington, VA, 1993.

Information Technology Association of America. *The National Information Infrastructure: Overcoming the Obstacles: Financial, Regulatory, and Technical.* Arlington, VA, September 1994.

INPUT, Inc. *Worldwide Information Services Forecast 1993-1998.* Mountain View, CA: 1993.

"Internal Market: Data Protection: Presidency Pulls Out All the Stops in the Search for Compromise." *European Report*. No. 1958, June 15, 1994, pp. 1-2.

"Internal Market: No Agreement in Council on Personal Data Protection." *European Report*. No. 1959, June 17, 1994, p. 12.

International Intellectual Property Alliance. *1994 Special 301 Recommendations and Estimated Trade Losses*. Submission to the United States Trade Representative, February 18, 1994.

International Telecommunication Union. *World Telecommunication Development Report 1994*. Geneva: International Telecommunication Union, 1994.

Japan Telecommunication Council. *Reforms Towards the Intellectually Creative Society of the 21st Century: Program for the Establishment of High-Performance Info-Communications Infrastructure*, Tokyo, May 1994.

Juliussen, Karen P. and E. Juliussen. *Computer Industry Almanac*. Incline Village, NV, 1993.

Karnow, Curtis E.A. "Encryption and Export Laws." *Software Publisher*, Nov./Dec. 1994, pp. 52-54.

Leeson, Kenneth W. IBM Internal Report. *Changing Telecommunications Structures: A Global Status Report*, August 30, 1993.

Mace, Scott. "Companies Would Buy Foreign Software for Data Encryption." *Infoworld*, October 11, 1993, p. 12.

Miller, Arthur. "Copyright Protection for Computer Programs, Databases, and Computer-Generated Works: Is Anything New Since CONTU." *Harvard Law Review.* Vol. 106, March 1993, pp. 977-1073.

Mills, Elinor. "Annulling Compton's Patent Helps PTO Earn Industry's Trust." *Infoworld*. Vol. 16, issue 46, November 14, 1994, p. 38.

Ministry of International Trade and Industry (Japan). "Urgent Proposal: The New Age of Software." Industrial Structure Council. Information Industry Committee. Draft White Paper, Tokyo, 1993.

Ministry of Posts and Telecommunications (Japan). *Japan Scope*. Summer 1994, p. 14.

Minoli, Daniel. *Analyzing Outsourcing*. New York: McGraw-Hill, Inc., 1995.

National Science Board. *Science and Engineering Indicators*. Washington, DC: U.S. Government Printing Office, 1993.

Organisation for Economic Co-operation and Development. *Software: An Emerging Industry*, Paris, 1985.

Ozzie, Ray. President, IRIS Associates. On behalf of the Business Software Alliance. Testimony before Subcommittee on Economic Policy, Trade, and the Environment, Committee on Foreign Affairs, U.S. House of Representatives, hearing on "Export Controls on Mass Market Software." Washington, DC: U.S. Government Printing Office, October 12, 1993.

"Patent Commissioner Outlines Steps to Help Avoid Disputes Over Software." *Wall Street Journal*, April 11, 1994.

Porter, Georgeanne B. *Federal Republic of Germany: A Study of the Educational System of the Federal Republic of Germany and A Guide to the Academic Placement of Students in Educational Institutions of the United States.* Washington, DC: American Association of Collegiate Registrars and Admissions Officers, 1986.

President's Commission on Industrial Competitiveness. *Global Competition—The New Reality.* Vol. 1. Washington, DC, January 1985.

Rushing, Francis W. and Carole Ganz Brown, eds. *Intellectual Property Rights in Science, Technology, and Economic Performance: International Comparisons*. San Francisco: Westview Press, 1990.

Schlie, Theodore W. *Analysis of Studies of the International Competitiveness of Specific Sectors of U.S. Industry.* Draft prepared for Competitiveness Policy Council. Bethlehem, PA, January 26, 1993.

Siwek, Stephen E. and Harold W. Furchgott-Roth. *International Trade in Computer Software*. Westport, CT: Quorum Books, 1993.

Software Publishers Association. "Export Controls on Encryption Software." *Government Affairs Briefing*, December 1993.

Software Publishers Association. "Technology in Education." *Government Affairs Briefing*. Washington, DC, October 1993.

Tachibanaki, T. "The Taxation of Income from Capital in Japan." ch. in *Government Policy Towards Industry in the United States and Japan*. Cambridge: Cambridge University Press, 1988, pp. 51-96.

Thorning, Margo. "The Economic Impact of the Corporate Alternative Minimum Tax: Questions and Answers." Washington, DC: American Council for Capital Formation, Center for Policy Research. August 1991.

Tyson, Laura D'Andrea. *Who's Bashing Whom?: Trade Conflict in High-Technology Industries*. Washington: Institute for International Economics, 1992.

U.S. Congress, Office of Technology Assessment. *U.S. Telecommunications Services in European Markets*. Washington, DC: U.S. Government Printing Office, 1993.

U.S. Department of Commerce. *The Competitive Status of the U.S. Electronics Sector.* Washington, DC: U.S. Government Printing Office, April 1990.

U.S. Department of Education. *Digest of Education Statistics: 1993*. Washington, DC: U.S. Government Printing Office, 1993.

U.S. Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics. *Race/Ethnicity Trends in Degrees Conferred by Institutions of Higher Education: 1989-90*. Washington, DC, 1991.

U.S. International Trade Commission (USITC). *Global Competitiveness of U.S. Advanced-Technology Industries: Computers (investigation No. 332-339)*. USITC publication 2705, December 1993.

U.S. International Trade Commission (USITC). *Potential Impact on the U.S. Economy and Industries of the GATT Uruguay Round Agreements (investigation No. 332-353)*. USITC publication 2791, June 1994.

"U.S. Liberalizes Export Controls for China." *The China Business Review*, May-June 1994, p. 4.

Weil, Vivian and John W. Snapper, eds. *Owning Scientific and Technical Information: Value and Ethical Issues*. New Brunswick: Rutgers University Press, 1990.

Wood, Christopher. "Computers, Electronics, and Telecommunications—Left Far Behind," ch. in *The End of Japan Inc., And How the New Japan Will Look.* New York: Simon and Schuster, 1994, pp. 157-181.

Yourdan, E. *The Decline & Fall of the American Programmer.* Englewood Cliffs, NJ: Yordon Press, Prentice-Hall, 1992.

APPENDIX C

GLOSSARY OF TERMS RELATED TO THE COMPUTER SOFTWARE AND SERVICE INDUSTRIES

Applications development tools: Development tools include programming languages and other specialized software used to speed the process of creating software applications. These tools are employed by software vendors and by custom programming specialists in end-user firms. Examples of widely used development tools include C, C++, COBOL, and Smalltalk.

Applications software: Applications software products are packaged programs used to support home, business, or other institutional functions on a variety of hardware platforms, including mainframes, minicomputers, workstations, and personal computers. Applications software includes everything from widely used business productivity programs (e.g., word processing, spreadsheets, graphics) to more complex programs such as company accounting and human resources packages, which often are written to run on high-powered mainframes and minicomputers.

Architecture: Computer architectures are the standards that govern the interaction of computer components and software. Computer architectures determine how components communicate with programs and how data is exchanged between applications software and operating systems. Architectures can be open (e.g., the IBM-compatible PC architecture) or proprietary (e.g., Apple's Macintosh operating system). As software is written for established architectures, early or widely available architectures can become de facto industry standards.

Back office applications: Back office applications typically include large, data-intensive processing tasks, such as payroll and accounting functions. The software required to carry out these applications is fairly standard among companies in different industries. Although many companies are updating and downsizing the technology behind back office applications, there is little unique competitive advantage to be gained through these efforts. Contrast with front office applications.

Best-of-breed: Best-of-breed software refers to applications programs that have gained widespread popularity and customer loyalty. For example, the DOS version of Lotus 1-2-3 was considered the "best-of-breed" spreadsheet program for many years. Applications vendors are trying to develop new marketing strategies to lure customers away from traditional name brands. See also suites.

Bugs: Informal term used to describe defects that impede the operation of software programs. Some software developers try to reduce the number of bugs by building programs out of object-oriented software modules that are pre-tested.

Bundling: Software sold in conjunction with hardware is considered a "bundled" unit. Bundling was the primary means of software distribution in the early years of the computer industry, since most hardware was proprietary and required customized code to run effectively. Once hardware products became more compatible, hardware vendors were encouraged to treat hardware and software as separate products. Today some hardware and software products are bundled as a marketing technique.

Business productivity programs: These are popular PC-based programs, such as wordprocessing and spreadsheet applications, that typically are used to increase office productivity. These programs are the most widely used programs in the office computing environment.

Capital formation: The process by which savings and investment are tapped by firms to fund new capital spending programs and the expansion of operations. The encouragement of capital formation is crucial for small software and service firms, which depend heavily on external sources of financing. International differences in tax policy can have a large effect on levels of capital formation.

Client/server networks: A computer platform comprised of client machines (typically PCs or workstations) and a central server used to store data and distribute applications. These decentralized networks allow relatively low-powered and inexpensive machines to handle tasks that previously were handled only by high-powered mainframes. This system, in which the server provides applications programs and central storage to client computers, often is referred to as distributed computing and is the impetus behind the platform downsizing trend. As companies downsize their hardware platforms, demand for software designed to operate on PCs and workstations has increased dramatically.

Code: The instruction set behind all software programs consists of lines of code. The coding varies depending on the computer language used by software programmers. In an effort to reduce the amount of time necessary to write programs, software developers now rely more heavily on object modules that contain numerous lines of code that can be re-used in different programs. See also object-oriented programming.

Compatibility: Compatibility refers to the ability of software or hardware to work with products designed by other manufacturers. The development of compatible PC hardware in the United States enabled independent software vendors to enjoy large economies of scale in the production of software programs. This is in direct contrast to Japan, where widespread use of incompatible computers has forced consumers to rely more on custom programming than on packaged software. Contrast with proprietary.

Copyright: A copyright is the most common method of legal protection employed by developers of computer software and other creative works. The copyright represents the exclusive right of an author (programmer) or his employer to copy, distribute, or prepare derivations of an original creative work. Copyrights protect a product for the lifetime of the developer plus 50 years. Software developers lose billions of dollars annually as a result of inadequate foreign copyright protection or enforcement.

Core competencies: Core competencies refer to the fundamental strengths and objectives of public and private organizations. For example, some companies' core competencies include efficient manufacturing procedures, while others include dynamic sales and marketing strategies. As companies downsize and streamline operations, many have decided to focus exclusively on core competencies and to surrender control of tasks that could be more efficiently handled by independent contractors. In many cases, companies outsource their computer operations to service providers whose core competency is information technology.

Cost-based pricing: This is a method of pricing that is based exclusively on the costs associated with providing a service. Outsourcing firms, which often lease lines from telephone companies in order to transmit data, are encouraging more effective and widespread use of cost-based pricing for leased line services in international markets.

Cost of capital: The cost of capital is the cost of debt capital plus the cost of equity capital, weighted by the relative amount of each in a company's capital structure. There are debates among economists with respect to the question of whether or not costs of capital differ significantly for firms in different countries. A lower cost of capital can convey relative competitive advantages to certain nations.

Custom programming: Custom programming services involve the compilation of code to create or customize software programs. Custom programming may entail the development of an entirely new application, or the customization of an existing packaged software product. While firms in the United States rely more on packaged software programs for basic business productivity applications, many consumers in Europe and Japan rely heavily on custom programming. This trend is changing, however, as computer systems in Europe and Japan become increasingly compatible and allow use of standard programs.

Database management systems (DBMS): DBMS is specialized software developed to facilitate the organization and interpretation of very large amounts of information on business transactions, customers, or employees. Software developers have focused considerable attention on the movement of DBMS programs from mainframes and minicomputers to client/server networks. Most large business and government computer users write supporting programs to customize the operation of DBMS software.

Data encryption standard (DES): DES is the most popular encryption method used in computer software and data transmission. It is widely used by individuals and businesses, and has been adopted as a Federal standard for the protection of the U.S. Government's unclassified information. It is considered to be virtually impossible to break into encryption products of DES-strength or greater. See also encryption.

Data processing: One of the primary functions of computers, data processing refers to the manipulations and calculations required to analyze data productively. Data can be processed by high-powered supercomputers and mainframes (centralized processing), or by client/server networks (distributed processing). Many public and private organizations outsource data processing tasks to IT service providers that can generate economies of scale in remote processing centers.

Data transmission: This refers to the electronic transfer of information from one point to another, by wire or radio frequency. Current technology allows users to transmit data across the street or around the globe. Data transmission issues, such as privacy laws, are of great concern to outsourcing firms that rely on data transmission processes to perform data processing for clients at remote locations.

Decentralized computing: Decentralized computing refers to a network of computers, generally a combination of PCs and workstations, that can operate in unison or independently, depending on the task. With the appropriate software, such networks are capable of handling complex processing jobs that previously had been reserved exclusively for centralized computers (i.e., mainframes and minicomputers). This concept also is referred to as distributed processing. The advantages of decentralized computing include improved communication between computers and a number of end users. See also client/server network.

Decompilation: Decompilation is the process of methodically disassembling software program code to discover specific programming techniques. In some cases, decompilation is useful in allowing software developers to create compatible programs. However, in many cases decompilation negates efforts by software developers to protect unique programs through copyrights.

Digital signature standard (DSA) (clipper chip): The DSA standard is a new royalty-free public-domain standard supported by the U.S. Government for encrypted electronic data and software. Popularly known as the "clipper chip," products utilizing the new standard would not be subject to export controls. However, industry officials assert that the chip's coding is easy to unscramble and provides the U.S. Government with a means for electronic surveillance. As such, the chip could have a difficult time competing in domestic and foreign markets against encrypted software which does not permit such surveillance. See also encryption and export controls.

Disk operating system (DOS): DOS is a single user, character-based operating system developed by Microsoft Corp. and used in IBM-compatible PCs. Although several companies have developed operating systems to compete with DOS, over half of all PCs use DOS. Recently, however, many consumers have begun to shift to newer operating systems, such as Windows. The transition away from DOS, a character-based PC operating system, to Windows, a graphical interface designed to make personal computing more intuitive, presented substantial product development problems for applications software firms. Firms such as Lotus were forced in the early 1990s to rewrite DOS programs to run successfully in the graphical Windows computing environment.

Downsizing: The replacement of mainframes, minicomputers, or supercomputers with smaller, often less powerful machines, that are attached to a server through a network. The platform downsizing trend has caused a shift in demand from software designed for mainframes and minicomputers to software designed for PCs and workstations. It has also increased the demand for computer services, especially systems integration and outsourcing services.

Encryption: Encryption ensures the security and integrity of electronic communications and files. Data is scrambled using mathematical formulas so that only authorized recipients who hold the code necessary to unscramble the data can access sensitive information. Because of the increasing importance of information security to many businesses, many domestic and foreign customers look for encryption capabilities when purchasing software. Software with such capabilities is known as encrypted software. See also export controls.

Export controls: Export controls are government controls on the export of high-technology goods, such as computer hardware and software, to prevent such technology from reaching certain proscribed countries. The U.S. Government and other Western countries imposed export controls after World War II to limit sales of high-technology goods to Communist countries. Although such controls have

been loosened considerably since the collapse of the Soviet bloc, controls continue to be imposed to prevent technology from falling into the hands of certain countries that are believed to use such technology for the purposes of expanding nuclear programs or to support terrorism. Export controls continue to be imposed on encrypted software and certain data communications products. See also encryption.

Facilities management: See outsourcing.

Flat-rate pricing: A common method of pricing whereby service providers charge a fixed fee for services. Business consumers and outsourcing firms that lease telephone lines from operators often prefer flat-rate pricing over volume-sensitive pricing, since the latter varies according to the amount of traffic generated over the leased lines. Contrast with volume-sensitive pricing.

Front office applications: Front office applications are those software programs that are used for decision support and business-specific functions in a company. Unlike back office applications, such as payroll and accounting systems, front office applications generally are customized to support industry-specific requirements, such as customer file organization in a health care facility. Systems integrators increasingly focus efforts on customizing industry-specific front office software to create a competitive advantage for clients. Contrast with back office applications.

Gain sharing: See performance-based pricing.

Graphical user interface (GUI): GUI software allows individuals to communicate with their computers on a more intuitive level, through icons and other visual images on the screen. The GUI concept contrasts sharply with character-based, command-line software such as the DOS operating system. Apple Macintosh and Microsoft Windows applications employ the GUI to give programs a more user-friendly look and feel.

Groupware: Software designed to allow employees in an organization to share and distribute data more easily. Groupware provides a framework within which documents can be exchanged electronically, thereby reducing paperwork and improving the productivity of a workgroup.

Independent software vendors (ISVs): Unlike the major hardware vendors that sell both computer hardware and software (e.g., IBM Corp.), independent software vendors focus exclusively on software (e.g., Microsoft Corp.). ISVs grew rapidly in response to new generations of compatible hardware products, especially personal computers (PCs). After many years of bundled hardware and software, there were finally computers on which software developed by vendors other than the hardware manufacturer could operate. The emergence of ISVs has been much more rapid in the United States than in Europe or Japan.

Information technology (IT): The technology incorporated in computer and communications hardware and software generally is referred to as information technology. Offices that handle electronic communications and computer requirements within an organization generally are referred to as information technology (IT) divisions, or information systems (IS) divisions. As technology becomes increasingly complex, many organizations choose to outsource all or part of their IT requirements to third-party service providers.

Integrated circuit: Integrated circuits are a collection of transistors, diodes, capacitors, and resistors attached to a silicon chip in a precise format to perform specific electronic functions. There are several types of integrated circuits, often called chips, including memory chips and microprocessors. See also microprocessor.

Interoperability: Computer hardware and software products are interoperable when, through manipulation of operating systems and software interfaces, they can exchange data and run successfully on the same network. Customers now demand interoperability among different devices as they expand their computer systems and attempt to make existing software run on various types of hardware.

Intellectual property rights (IPR): Intellectual property rights are the rights granted to the ideas and concepts embodied in goods and services. The creative expressions incorporated in computer software generally are considered intellectual property. Intellectual property is protected through legal vehicles such as copyrights, patents, and trade secrets. Copyrights confer upon the author or the author's employer the exclusive right to copy, distribute, or improve upon an original work. Patents protect the inventive elements of software. Trade secrets protect against theft of commercially valuable company information. The key objective of software protection is to promote technological innovation and creativity. The United States is working with its major trading partners to ensure adequate IPR protection for software.

Leased lines: Telephone lines that are leased from telecommunications operators for exclusive use by a third party service provider. Outsourcing firms often rely on leased lines to transmit data for remote data processing.

Local area network (LAN): A system of interconnected computers, usually PCs, attached to a server. The increasing use of networks in businesses has increased demand for systems software products. See also networks.

Mainframe: Mainframe computers are built around high-powered, centralized processors. They typically support a large number of user terminals at one time and are primarily used by large organizations for general-purpose software applications such as payroll, accounting, and decision support. Because users are moving away from centralized processing, mainframe producers are attempting to link mainframes with distributed networks in an effort to ease access to mainframe-based data.

Microprocessor: A microprocessor is a high-powered and inexpensive integrated circuit that is used in PCs and workstations as the central processing unit (CPU). Advances in microprocessor technology are usually translated into new generations of PC hardware and PC-based software. See also integrated circuit.

Minicomputer: Similar to mainframes in their centralized architecture, they serve as the central processor for multiple terminals, but generally have less processing power and memory than mainframes and are available at a lower price. Minicomputer market growth has been slowed as high-end workstations and network servers gain popularity.

Mission critical applications: These include any large applications that are considered fundamental to daily operations within an organization, such as payroll or accounting functions. Traditionally, most mission critical applications have been handled by mainframes. As companies downsize hardware, however, effective software is being developed to manage large applications on networks of workstations and PCs.

Multimedia: Multimedia refers to the communication of information through multiple types of media, including audio, video, text, telephony, and graphics. Digital technology allows the convergence of these media, often creating richer and more effective communication than a single medium. Interest in multimedia applications is creating demand for new types of software and services, particularly new software titles that integrate text, images, and sound in a single program.

Network management software: These are programs designed to ease the task of linking the diverse elements of a computer network in an effort to optimize data transmission speed and the smooth exchange of data between users on a network. The increasing complexity of local and wide-area networks has quickly boosted demand for network management products.

Networks: Networks are a system of interconnected computers, often PCs attached to a server (local area network), or multiple computer systems connected through telephone lines to a remote server and information distributor (wide area network). Many new networks are being installed to replace aging mainframes, and they are contributing to the shift toward smaller computer systems. See also client/server.

Object-oriented programming: Object-oriented programming is a process whereby reusable, self-defined software modules are strung together to create a program. Modules are created out of standard lines of code that form the basis for functions that are used in a variety of programs. Rather than rewriting the same code over and over, a prepared module is used as a building block for the program. Many software developers and systems integrators, realize that substantial cost savings can be realized by building new programs upon software code that already has been written and tested.

Open systems: Hardware and software systems that are compatible with products from other vendors are used to create open systems. Unlike proprietary systems that do not readily allow interoperability among products, open systems are more easily used in network situations. Unix-based networks of workstations, built around widely accepted standards, are examples of open systems.

Operating systems: Operating systems serve as the bridge between computer hardware and applications software programs. Examples include Microsoft's MS-DOS, Apple's Macintosh operating system, and Unix for workstations. Most major operating systems were originally developed by U.S. companies.

Outsourcing services: Outsourcing encompasses external processing services and/or external systems management services. Processing services, such as data entry and disaster recovery, often are "outsourced" to take advantage of a remote processing center's capacity and/or technology. Outsourcing services also include external systems management (also called facilities management), whereby a client transfers responsibility for some or all of its information technology division from in-house control to a third-party vendor. The vendor assumes responsibility for operating, managing, and maintaining a client's information systems. Systems management can be carried out at either the client or vendor location. Overall, outsourcing services have gained popularity as firms are encouraged to focus on their core competencies and relinquish high-cost business activities in which insufficient expertise is available.

Packaged software: Packaged software refers to an applications or systems software product that is written in a generic form for the use of many different customers (unlike custom programs). The most familiar software programs are packaged products that can be purchased either from the software vendor, a value-added reseller, or through retail channels.

Patent: A legal guarantee of intellectual property ownership granted to the inventor of a unique machine or process. Unlike copyrights, which are automatic upon authorship of a program, patents are granted only after an application and review process. Once in place, patents remain in effect for 20 years under the new World Trade Organization (WTO) regulations. While patent protection is important within the United States, firms primarily rely on copyrights to protect software overseas, since most foreign IPR infringements consist of illegal copying of programs.

Performance-based pricing: This is a method of pricing whereby a service provider bases its fees on the savings generated by improved use of information technology. This method is a marketing tool employed by outsourcing and systems integration companies to ensure clients that some cost savings will be realized. Also called gain sharing.

Personal computer (PC): Sometimes referred to as microcomputers, PCs are microprocessor-based computer systems that can operate either on the desktop or in a portable fashion (e.g., notebook computers, personal digital assistants). PCs can operate both as stand-alone machines for single users and as nodes on a local area network. Typically, they run personal productivity applications, such as word processors and spreadsheets. The low cost and growing processing power of PCs are fueling a dramatic surge in demand for the product.

Piracy: Software piracy refers to the improper adaptation or theft of copyrighted software programs. The most common type of piracy is the unauthorized, direct copying of software for both commercial and non-commercial distribution in markets around the world. Software piracy costs the software industry billions of dollars annually.

Platform: This refers either to the type of hardware (e.g., mainframe, minicomputer, supercomputer, workstation, or PC) or the hardware/operating system combination upon which a particular product

(software or peripheral hardware device) operates. Platform downsizing is the replacement of more expensive, centralized machines such as mainframes with workstations or PCs. See also downsizing.

Proprietary systems: Proprietary systems are built around the manufacturer's unique data architecture and are generally not compatible with other types of hardware and software. Increasingly, consumers are demanding open systems that allow companies to more easily interconnect their hardware and to use the same software on a variety of products. Contrast with open systems.

Public telecommunications operators (PTOs): PTOs are state-sanctioned monopoly telecommunication providers. Most were created by national governments to provide postal and telecommunications services.

Reduced Instruction Set Computing (RISC): This is a type of microprocessor that, because of its streamlined instruction set, performs at a rate 15 to 50 percent higher than traditional PC microprocessors, which generally are based on more complex instructions.

Restructuring: Also referred to as "business process re-engineering," "downsizing," or "rightsizing," this concept involves the reorganization of corporate structures to eliminate waste and improve efficiency. Many corporate restructuring programs encourage companies to focus on core competencies and to outsource business processes in which the firm has limited expertise. These outsourced processes often include the management of information technology. Restructuring efforts fuel much of the demand for outsourcing contracts in the United States and, increasingly, in Europe and Asia.

Server: A server is one of the central computers in a network that distributes and stores information in connection with a number of less powerful client systems. The server, together with other network management hardware and software, often acts as a "traffic cop" by directing data from one user to another. Any computer can act as a server as long as it has the required processing and memory capabilities to fill the needs of its network.

Solutions: Solutions refer to unique combinations of computer products and services that provide a tailored response to the customer's special business problem. This term is often used as a marketing buzzword by software developers and computer service providers.

Standards: Standards are a widely accepted data architecture or set of technical features that facilitates interoperability between different computer products. In a largely unregulated industry, most standards are "de facto" standards that have evolved in response to consumer preferences and market conditions. Companies attempt to influence new de facto standards for emerging products.

Suite: Software suites combine several business productivity applications, such as word processing, spreadsheets, and graphics, in a single package that is sold for a discounted price. Suites are an increasingly popular means of marketing packaged software and drawing customers away from best-of-breed applications.

Systems integration: Systems integration is the consolidation of heterogenous hardware and software products into seamless computer networks, generally designed to meet specific end-user requirements. Systems integration services may be provided for all levels of a project, including system design, hardware and software recommendations, system installation, software customization, and end-user training.

Systems software: Systems software commonly includes PC and network operating systems, system management tools, programming languages, and database management software. Systems software products form the bridge between computer hardware and applications software, and between the computer and its users.

Trade secrets: Along with copyrights and patents, trade secrets provide legal protection for software products. Trade secrets guard against theft of information that is vigorously defended by a company as a source of competitive advantage. Trade secret coverage is not extended to published information.

Value-added reseller (VAR): VARs are service firms that combine hardware products with software solutions for specific industries. VARs are utilized as a primary sales and distribution channel by original producers of computer hardware and software.

Value-added services: Value-added services provide collection, selection, formatting, or processing of transmitted information. They provide "Value" to otherwise basic transmission of voice or data over telephone lines.

Venture capital: Venture capital is high-risk capital that is frequently invested in small, start-up firms, particularly in promising high-technology industries. U.S. software and service companies have benefited from a well- established venture capital system that has reached a relatively high level of institutional maturity and liquidity.

Vertical markets: Vertical markets refer to narrowly defined sectors of the economy, such as the financial services industry or the telecommunications industry. Software and services often are marketed toward a specific vertical industry, since precise information technology needs vary among the many different sectors.

Voice telephony: The science of transmitting voice over long distances. Basic voice telephone services include public switched voice telephony and basic data transport. Although real-time voice telephony services are provided by monopoly operators in most countries, many outsourcing firms are suggesting that the industry be opened to competition, since a growing number clients reportedly prefer to select an outsourcing firm that is capable of providing both telecommunications services and computer services.

Volume sensitive pricing: A method of pricing leased line services whereby clients are charged according to the level of voice or data traffic that travels across the lines. Outsourcing firms generally do not prefer this type of pricing. Contrast with flat-rate pricing.

Windows: Windows is a graphical-based operating system developed by Microsoft Corp. for personal computers. Windows is considered to be user-friendly because of its use of icons instead of characters. Although the DOS operating system remains widely used, Windows gradually is replacing it as the primary operating system in PCs.

Workstation: Similar in appearance to PCs and often attached to networks, these computers have greater processing capabilities. Although workstations were first developed for use in the engineering profession, they now are used in all industries. Workstations also are used as servers in networks, as well as in high-speed parallel processing.