

The role of computers in reshaping the work force

Today's versatile computers have some impact on nearly every occupation and industry in the U.S. economy, unlike past technology which usually affected only specific jobs

Sheila McConnell

Computers may be the most profound technology since steam power ignited the Industrial Revolution. Computer technology is altering the form, nature, and future course of the American economy, increasing the flow of products, creating entirely new products and services, altering the way firms respond to demand, and launching an information highway that is leading to the globalization of product and financial markets.

In addition to affecting the methods of production among firms, computers are changing the relationship between labor and organization. The traditional pyramid-shaped organizational structure of most corporate firms is the by-product of the Industrial Revolution, which moved work from the individual or family unit to an organizational structure.

Computer technology challenges the traditional management hierarchy, moving many organizations from a pyramid-shaped structure to a flatter structure. Historically, decisions were passed from top management to the next management layer; today, computers permit companies to communicate throughout their organizations instantaneously, without regard for traditional management structures.¹ Such wider distribution of authority in some companies has put new emphasis on enhancing labor efficiency by replacing fragmented work with integrated work

tasks. This can lead to upgrading worker skills, as shifting flexibility among the production of various goods and services requires a more highly trained work force.²

This issue of the *Monthly Labor Review* explains how computers have affected jobs in selected manufacturing and services industries and in high-tech defense industries, and discusses an emerging market made possible by computers—the home market. This article presents an overview of the six articles included in this series; it begins by summarizing some of the rapid changes that have occurred in computer technology over the years.

Rapid computer technology

In the last 20 years, there have been dramatic changes in computer technology. In the 1970s, computers were time-sharing mainframe and mini computer systems which allowed dumb terminals to share information and computing services.³

The 1980s saw personal computing. The microprocessor-based computer brought computing power to the individual at the office and home. The development of user-friendly software applications allowed for more uses; however, for the most part, computing was still done in isolation. The use of local-area networks in the workplace helped users communicate beyond

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the desktops, but only to other users within the organization.⁴

Network computing arrived a decade later, ringing in the age of the information highway. The Internet, a confederation of interconnected networks, connects millions of computers using existing telephone lines.⁵ With the help of special software, a powerful new computing platform on which to build brand new computing applications is open to all types of computers.⁶ Network computing is possible because of speed and cost of the technology. The power of the devices and networks run by microprocessors and software is increasing at a rate never seen before, roughly doubling in performance every 18 months or so.⁷ This trend has caused the unprecedented reduction in the cost of microchip-based technology, allowing computers to be used more widely and rapidly.

The decline in costs has assumed a central role in the use of computers. As the production costs of hardware and software fall in comparison to the development cost, it makes sense for firms to sell their products at a lower cost to establish a market hold.

Production flexibility in manufacturing

Semiconductors. Computers have reshaped manufacturing plants, allowing manufacturing firms to serve many markets and produce a wider range of goods. Computer technology helps engineers, managers, and workers schedule the flow of materials, control quality, and change production lines as the demand for products changes.⁸ It allows manufacturers to respond quickly to demand, and deliver a larger variety of products more quickly. With computers, retailers can gather and aggregate sales data electronically, convert the data into orders, and transmit the information to manufacturers. Manufacturers with computer links to production systems, distributors, and customer networks can respond quickly to the market. For manufacturers, customized runs can now compete on a cost basis with production runs of standardized products with dedicated assembly runs.

All of this depends on the speed and function of a computer which "in turn is determined by the system design and the underlying capabilities of its components."⁹ Semiconductor devices are the basic functional components of computers upon which computer performance depends. In the first article of this series, Francisco A. Moris discusses technology in semiconductor manufacturing, and examines employment and other trends in the industry, including worker productivity, offshore employment, technology diffusion, and export growth. (See pages 6–17.)

Computer manufacturing. Computer manufacturing is an industry in which new rules of production call for redefining the value of a product for which the cost of raw technology is rapidly declining. Jacqueline Warnke explores consumers'

demand for computers, as prices for computers decline and the economy and society take advantage of this lower-priced and higher-quality resource. (See pages 18–29.)

Versatility in service industries

During the last two centuries, technological innovations in agriculture and manufacturing have increased output, improved productivity, and raised the standards of living for the industrial economies. This was mainly the case in the past, because for technological innovations to be effectively applied required an industry with a certain size and capital intensity. Typically, service industries were in a less favorable position to apply technological innovations because of the labor intensive nature of most of these establishments.

Due to its versatility and declining cost, computer technology has been applied in many unrelated service industries such as banking, power utilities, retailers, wholesalers, and health services. Computers can fill out and check mortgage-loan forms, transfer calls, and electronically gather and aggregate sales data for retail stores, to name a few uses. Investment by service producers in computer technology has steadily increased since 1975.¹⁰ As of 1993, the top four private sector industries ranked by the U.S. Bureau of the Census as having the greatest percentage of employees working with a computer were service-related industries.

Banking. Investment in computer-related technologies has caused employment adjustments. In commercial banks, for example, the application of automated teller machines (ATM's) and other related technologies have lessened the need for customers to use a bank teller. Teresa Morisi examines employment changes in commercial banks and discusses how commercial banks, forced to be more competitive after deregulation in 1980, use computer technology to cut costs and offer new products and services to attract customers. (See pages 30–36.)

Computer services and engineering. Computer technology has created economies of scale for many services industries, but, more interestingly, has generated a secondary effect called "economies of scope."¹¹ Many service producers have found that computer technology enables them to offer more services and attract a larger range of customers. (For example, commercial banks are able to offer several methods for their customers to access their accounts, such as automatic teller machines, debit cards and personal computers.)

However, some service industries are totally dependent on technology, such as computer and data processing firms which owe their existence to computer technology. William Goodman examines employment trends in computer services and engineering—two service industries that design a large

range of products and play important roles in creating and changing computer technology. (See pages 37–45.)

The home market

The computer has launched the information highway, creating a whole new market segment—the home market. It is now the home market that represents a new frontier for computer and software manufactures. This market is considered one of the major opportunities for business investment over the next 20 years.¹² As a result of the decline in cost of personal computers and the increased speed with which computers run, the buyer of a computer for the home now can obtain a high-powered machine that is able to run sophisticated software programs and link to the Internet. Laura Freeman explores this new market, examining the current market trend and its impact on employment. (See pages 46–56.)

High-tech defense

The modern computer originated during World War II when funds were provided to defense contractors to create military products for intelligence uses. Up to the end of the cold war, defense contractors were instrumental in the development of computer-related technologies such as those found in space vehicles and electronic guidance systems in aircraft, missiles, and rockets. Although still on the cutting edge of technology, defense contractors increasingly have fewer defense funds for development in areas such as computers and micro-electronics.

Ron Hetrick examines efforts to soften this impact on defense-related private sector employment in a post cold-war era economy. (See pages 57–63.)

IN SUM, computer technology is changing the nature and number of jobs. Its impact is extensive because the technology, network systems, and software is similar across firms and industries. This is in contrast to technological innovations in the past, which often affected specific occupations and industries (for example, machine tool automation only involved production jobs in manufacturing). Computer technology is versatile and affects many unrelated industries and almost every job category.

In some cases, computer technology displaces workers; for example, bank tellers are being replaced with ATM's. But, while the technology is eliminating jobs, it also is creating new ones. Job growth has occurred in semiconductor and computer manufacturing as well as in computer and engineering service industries. However, the rate of job growth in these industries has been decelerating as the technology continues to improve labor efficiency.

Computerization and the emerging information highway is transforming the American economy. Computers are changing the composition and distribution of labor, improving labor efficiency, and creating new markets and new forms of organizations. The series of articles that follow discusses in more detail how computer technology is affecting employment in selected industries. □

Footnotes

¹ Howard Isenberg, "The Second Industrial Revolution—The Impact of the Information Explosion," *Industrial Engineering*, March 1995, p. 15.

² Eileen Appelbaum and Ronald Schettkat, "The Impact of Structural and Technological Change: An Overview," in E. Appelbaum and R. Schettkat, eds., *Labor Market Adjustments to Structural Change and Technological Progress* (New York, Praeger Publishers, 1990), p. 5.

³ "Planet Internet—How the center of the computing universe has shifted," *Business Week*, Apr. 3 1995, p. 118.

⁴ "Planet Internet," p. 118.

⁵ "The Internet—The Accidental Superhighway," *The Economist*, July 1, 1995, p. 3.

⁶ "Planet Internet," p. 118.

⁷ "The Internet," p. 4.

⁸ Larry Hirschorn, "Computers and Jobs— Services and the New Mode of Production," in Richard M. Cyert and David C. Mowery, eds., *The Impact of Technological Change on Employment and Economic Growth* (Cambridge, MA., Ballinger Publishing Co., 1988), p. 382.

⁹ Francisco A. Moris, "Semiconductors the building blocks of the information revolution," *Monthly Labor Review*, this issue, page 7.

¹⁰ "Technology in Services," *Scientific American*, December 1987, p. 53.

¹¹ "Technology in Services," p. 53.

¹² Bart Ziegler, "Hard Drive —PC Makers Big Push into the Home Market Comes at a Risky Time," *The Wall Street Journal*, Nov. 1, 1995, p. A1.