Chapter 1

Summary

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The quality of the U.S. workforce matters now more than ever. Well-trained, motivated workers who can produce high-quality goods and services at low cost help enhance industrial productivity and competitiveness and keep American living standards high. In today's international economy, workers must be prepared to change the way they do their jobs in order to capture the benefits from rapidly evolving technology. Training goes hand-in-hand with productivity, quality, flexibility, and automation in the best performing firms.

Good training pays off—for the individual worker whose skills are upgraded, for the company seeking a competitive edge, and for the Nation in overall productivity and competitiveness. Conversely, inadequate training costs firms and workers—in downtime, defective parts or equipment, wasted material, health and safety risks, late deliveries, and poor customer service. Poor training also can delay the implementation of new technology or work reorganization.

When measured by international standards, most American workers are *not well* trained. Many in smaller firms receive no formal training. Larger firms provide more formal training, but most of it is for professionals, technicians, managers, and executives. Our major foreign competitors place much greater emphasis on developing workforce skills at *all* levels. Experienced production workers at Japanese auto assembly plants, for example, get three times as much training each year as their American counterparts.

American manufacturing and service workers have the skills for yesterday's routine jobs. But, these workers will need new skills to function well in the more demanding work environments that increasingly characterize competitive industries able to provide high-wage jobs. Skills and responsibilities are broadening. Competitive manufacturing and service firms will increasingly rely on employees with good higher order skills-reasoning and problem-solving. Work reorganization forces employees to take more responsibility, cooperate more closely with one another, understand their roles in the production system and in the organization, and act on that knowledge. These changes require good worker training.

The need for better training is clear in both manufacturing and service industries. American manufacturers have repeatedly lost out to foreign competitors who are able to make more reliable products with better features at lower cost. In many of the service industries, it is domestic competition, shifts in consumer demand, and deregulation that have forced companies to reassess their management and training policies. Like manufacturers, service firms compete on the basis of price (e.g., for insurance), quality (e.g., rapid but accurate response to customer inquiries), and flexibility (e.g., new banking products). Many services now depend on redesigned production systems built around dispersed computing power and on employees with the social skills to interact with customers. They need workers who are motivated, managed, and trained in new ways.

Simply providing more training will not promote industrial competitiveness, however. If work is not organized to tap employees' skills, the firm's investment will be wasted. In addition, training must be focused on workplace problems and delivered effectively. Techniques such as relating training more closely to business goals, following instructional development principles, and effectively using training technology can improve the quality of training and increase its chances of transferring back to the job. Yet, systematic efforts to apply these techniques are still rare outside of sophisticated firms with large training budgets. Most training programs lag far behind the state-of-the-art.

Demographic change is shaping training needs. Over the rest of the century, the labor force will expand more slowly than at any time since the 1930s. In 2000, the average worker will be nearly 40 years old, compared with 36 today. Keeping this slowly aging workforce up-to-date and flexible will require ongoing training. Many new entrants will come from minority groups that historically have received less education. New entrants in general need better basic skills, including reading, writing, arithmetic, and oral communication, as will many Americans already in the labor force. In part because

American workers are so mobile, especially when they are young, most companies offer training only sporadically, such as when introducing new equipment. Moreover, few American workers voluntarily upgrade their skills for job advancement.

Our major trade competitors provide more and better worker training. Their governments offer both financial and technical support to firms and workers for training. Our competitors also provide better basic education. On average, young Americans have lower academic competencies than young people in several other industrialized countries. Moreover, in other industrialized nations, training and learning on the job are seen as a continuing need. More than ever before, the international economy pits the U.S. workforce against those in other countries. The worse the United States fares in this competition, the more American industrial competitiveness and living standards will slide. American companies can move some of their operations abroad; few American workers have that choice.

Over the long term, improving the educational system and developing more effective ways to help young people make the transition from school to work will be crucial to the Nation's continued economic success. Yet, people already at work will comprise a majority of the workforce over most of the next two decades. In the near term, their training will have the greatest influence on national competitiveness. While the need to improve the schools has been the focal point for much debate, policymakers have only recently begun to turn their attention to the continuing training and education needs of employed workers.

The U.S. Government now does little to influence corporate training. With a few exceptions (e.g., small grants to demonstrate ways to improve the basic skills of workers), federally sponsored training programs focus on the unemployed or economically disadvantaged. State governments provide only very modest direct support to corporate training in economic development programs, plus indirect support through community colleges.

New institutional structures will be needed to make affordable training available to employees of small businesses and other firms with limited resources. A variety of approaches, including industry training consortia, involvement of employer organizations in training, State assistance programs, and joint labor-management programs promise to enhance the scope and quality of training. Such efforts currently are very limited, however.

For a slowly increasing number of businesses, training *is* becoming an integral part of competitive strategy-key to continued growth. When improving their production systems, however, most American firms focus on investments in hardware-equipment and physical plant—rather than on the people who will make the hardware perform. When managers treat their workforces as adjuncts to technology instead of as capital assets, they fail to capitalize on employee skills and to reap the rewards that can come from blue-collar innovation.

This assessment, requested by the Senate Labor and Human Resources Committee, the House Committee on Education and Labor, and the Senate Finance Committee, examines employee training issues from the standpoint of maintaining a competitive workforce. The assessment analyzes the forces that are shaping training today, and describes the extent of current U.S. employer-provided training compared with that of our major competitors. The assessment also examines trends in instructional technology and their use in training programs. Finally, it presents options Congress may wish to consider to encourage employer-provided training, improve the quality and effectiveness of training, link training and technology assistance, and provide retraining to individuals for career advancement.

THE CHANGING AMERICAN WORKPLACE

American firms are competing with foreign rivals that are much more competent today than just a few years ago. The competitive pressure will only grow stronger over the coming decades as more companies in more parts of the world master the skills needed to export or to compete with imports in their domestic markets.

Cost, quality, and flexibility determine competitive outcomes. Success in producing high-quality goods at low cost comes from highly developed production systems that effectively couple product and process design, work organization, and shop-floor management.

Many U.S. firms lag behind their competitors in introducing flexible automated production systems that can offer the variety that consumers expect and the just-in-time deliveries that corporate customers

demand. American firms also lag in the reorganization of work—and the worker training-needed to improve quality and flexibility. These problems show in the marketplace (e.g., when America's drivers purchase imported cars or when foreign banks underwrite bonds for American corporations).[1]

The higher the competitive standing of U.S. industries in the international economy, the higher will be average U.S. living standards. To pay wages commensurate with American living standards, U.S. firms must equal or surpass their foreign counterparts in productivity or quality. And, the competitiveness of small firms and the services matters even if their products do not trade internationally. Many of these businesses supply other firms that do export or compete with imports. Suppliers' costs, quality, and productivity directly affect those of their corporate customers. As most new jobs in the United States over the next several decades will be in the services, the strength of service industries will be critical to living standards. Small firms of all types also will create proportionately more jobs than their total share of employment.

Faced with ever more intense competition, U.S. firms are searching for strategies that offer sustainable long-term advantages. While the mass production era has not ended, the rules for success have changed (see table 1-1).[2] The changes summarized in table 1-1 and in the discussion below are in their early stages. A few American firms have already reorganized along these lines. Many others are taking tentative steps, experimenting with new approaches. Smaller U.S. companies, in particular, have been slow to grasp the new forces at work and their implications for training.

Some American companies that have radically altered how they do work have emulated Japanese production systems, which depend heavily on motivated and capable employees to prevent or catch product defects. Japanese firms also seek stable, long-term relationships with smaller groups of frost-tier suppliers that are expected to be sensitive to customers' day-to-day needs. To be responsive to shifting market demands and provide more customization for individual clients, Japanese companies also design products for ease and speed of manufacturing. Finally, they emphasize employee involvement and job rotation backed up with substantial—and ongoing-training. American companies that have adapted this model have found that their workers can achieve levels of productivity and quality equal to the best in the world.

U.S. multinational firms must achieve productivity levels equal or superior to their competitors abroad; everything else the same, such firms will locate plants in countries where costs are lowest and productivity and quality highest. Multinationals are seeking to combine operations in the major industrial nations into a globally integrated whole while geographically dispersing design, development, production, distribution, and marketing (see chs. 3 and 4). American workers might be expected to help schedule production to coordinate with foreign deliveries, or they may need to cooperate with their counterparts in factories overseas to solve quality problems. Globalization also can bring new workplace technology (e.g., computer networks for worldwide inventory control), rapid changes in the goods a factory produces, and frequent minor changes to accommodate national markets (e.g., labeling in local languages).

At the same time, the United States has special significance for foreign multinationals. As the largest market in the world, the United States is a magnet for goods and investment from abroad. Any foreign firm that aspires to global success must be competitive here. This means jobs and opportunities for American workers. It also means that foreign-owned plants in the United States will continue to be sources of new ideas in production management. Foreign-owned consumer electronics firms introduced new concepts during the 1970s and 1980s; more recently U.S. auto assembly plants operated by Honda, Toyota, and other have been trendsetters in productivity and training.

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[1]OTA's ongoing assessment of Technology, Innovation, and U.S. Trade involves three reports on competitiveness in manufacturing. The first in the series analyzes the role of manufacturing in the U.S. trade deficit; see *Paying the Bill: Manufacturing and America's Trade Deficit* (OTA-ITE-390). For policies to restore the technological leadership in manufacturing, see *Making Things Better: Competing in Manufacturing* (OTA-ITE-443). *The third* report, due in spring 1991, will examine the trade and industrial policies of Japan, other East Asian countries, and the European Community and their possible relevance to U.S. competitiveness. An earlier OTA report dealt with service industries; see *International Competition in Services* (OTA-ITE-329).

[2]A more comprehensive version of table 1-1 maybe found in ch. 4 as table 4-3.

Table I-I-Changing Organizational Patterns in U.S. Industry

Old model Mass production, 1950s and 1960s	New model Flexible decentralization, 1980s and beyond
Overall strategy	
• Low cost through vertical integration, mass production, scale economies, long production runs. • Centralized corporate planning; rigid managerial hierarchies.	• Low cost with no sacrifice of quality, coupled with substantial flexibility, through partial vertical disintegration, greater reliance on purchased components and services. • Decentralization of decisionmaking; flatter hierarchies.
Production	
• Fixed or hard automation. • Cost control focuses on direct labor. • Outside purchases based on arm's-length, price-based competition; many suppliers. • Off-line or end-of-line quality control. • Fragmentation of individual tasks, each specified in detail; many job classifications. • Shopfloor authority vested in first-line supervisors; sharp separation between labor and management.	• Flexible automation. • With direct costs low, reductions of indirect cost become critical. . Outside purchasing based on price, quality, delivery, technology; fewer suppliers. . Real-time, on-line quality control. . Selective use of work groups; multi-skilling, job rotation; few job classifications. • Delegation, within limits, of shopfloor responsibility and authority to individual and groups; blurring of boundaries between labor and management encouraged.
Hiring and human relations practices	
• Workforce mostly full-time, semi-skilled. • Minimal qualifications acceptable. • Layoffs and turnover a primary source of flexibility; workers, in the extreme, viewed as a variable cost.	• Smaller core of full-time employees, supplemented with contingent (part-time, temporary, and contract) workers, who can be easily brought in or let go, as a major source of flexibility. • Careful screening of prospective employees for basic and social skills, and trainability. • Core workforce viewed as an investment; management attention to quality-of-working life as a means of reducng turnover.
Job ladders	
• Internal labor market; advancement through the ranks via seniority and informal on-the-job training.	• Limited internal labor market; entry or advancement may depend on credentials earned outside the workplace.
Training	
• Minimal for production workers, except for informal on-the-job training. • Specialized training (including apprenticeships) for grey-collar craft and technical workers.	• Short training sessions as needed for core workforce, sometimes motivational, sometimes intended to improve quality control practices or smooth the way for new technology. • Broader skills sought for both blue-and grey-collar workers.

SOURCE: Office of Technology Assessment, 1990.

The new flexible decentralization model in table 1-1 has two central themes: 1) reorganizing production so that lot sizes can be smaller and production runs shorter with little sacrifice in efficiency, and 2) transferring decisionmaking authority downward and outward to semiautonomous divisions and/or the shopfloor. Both these trends are reinforced by U.S. industry's growing reliance on outside sources of labor (contract employees), expertise (engineering services), and tangible inputs to production (purchased components and sub-assemblies).

Those American firms that have redesigned their production operations most effectively have done so systemwide. The needed perspective encompasses not only selection of machines and factory layout, but design of products for efficiency in manufacturing, appropriate allocation of tasks among people and machines, and careful coordination of production flow. These firms are decentralizing, flattening their management hierarchies, and purchasing more on the outside, all in the interests of cutting costs, improving quality, and responding more quickly to market demands. To be effective, these changes require substantial training for employees at all levels.

THE NEED FOR TRAINING

Many American workers are ill-equipped for the sweeping changes industry must make to be competitive. Their jobs may not have required strong basic skills, teamwork, or higher order skills such as problem-solving. In the future, many more jobs will require these skills. But the need for training and retraining is not just a matter of meeting the needs of growing sectors, growing occupations, or companies hard-pressed by inter-

Photo credit: UAW-Ford National Education, Development and Training Center

Growing computer use means more workers need to develop their computer skills. This training facility is jointly sponsored by a cooperative union-management program.

national competition—it is critical throughout industry if the United States wants a high-wage, high-skill economy.

Training for the Workplace of the Future

Nearly half of business investments for capital equipment now go for computers and related technologies. Personal computers and other inexpensive terminals collect data on the factory floor, track inventories, and help schedule production. Statistical process control reduces variance in production by tracking process parameters (e.g., temperature, pressure) over time and examining the trends in those parameters to determine the limits beyond which product quality begins to deteriorate. Computer-aided design systems automate drafting and graphics and maintain databases of drawings and specifications. While computer-integrated manufacturing remains a dream more than a reality, companies are slowly but surely learning to capitalize on flexible automation. Service firms rely more and more on decentralized computer systems for data processing, for tracking inventory and sales, and for delivering their products.

To be used effectively, these technologies will require workers to learn new, very different skills. While some jobs become less demanding with automation, many others become more complex because of the mix of tasks assigned to workers and the speed of production (see box l-A). Emphasis on quality and prevention of mistakes requires employees to have a broader understanding of the production process. With statistical process control, for example, machine operators may also have to enter data and construct and interpret control charts. These tasks may require basic arithmetic skills as well as an understanding of how one step in the production process relates to others.

Companies with flexible design, development, and production systems rely on workers to anticipate possible problems, eliminate bottlenecks, avoid production shutdowns, and ensure quality. Increasingly these systems include continuous improvement *(kaizen)* programs that focus on cutting costs, improving quality, and reducing waste and scrap. Workers participate in group problem-solving meetings and employee involvement programs. They need strong social and communications skills to fit into a group, contribute effectively, and convey information about group actions or suggestions.

Many American firms have found training employees for new technology more difficult than anticipated. Many workers need to upgrade their basic skills before they can handle other training. Narrowly focused training, common in the past, is likely to be ineffective in achieving corporate goals for implementing new technology when the context is the total production system. Moreover, problem-solving and teamwork are new objectives for non-managerial training in the United States, and the most effective approaches have yet to be defined clearly.

New forms of work organization push responsibility and authority downward in the corporate hierarchy, from line managers and staff engineers toward the shopfloor. Information systems bring business data previously restricted to managers—incoming orders, unique customer requirements, production schedules, cost and sales projection directly to the factory floor. Shopfloor groups often must know how to interpret such information and apply it to their work. This change, more than any other, promises to fundamentally alter traditional workplace hierarchies and to create a new set of training requirements.

Job classifications are broadened, with tasks such as inspection and quality control, routine maintenance, and equipment calibration transferred to semiskilled workers. In the auto industry, for example, traditional U.S. assembly plants have 80 to 95 job categories, compared with 2 to 4 in the U.S.

Box l-A—Job Opportunities and Skills: Growing Mismatch

Will automation and other technological changes downskill the workforce-making jobs simpler, less demanding, hence less deserving of wage premiums? Or will a higher skill workforce be imperative for using technology in ways that will enhance competitiveness, hence raising wages and living standards? Does the machine-particularly the computer-automated machine in the factory or in the office-replace human skills, or extend and supplement them?

Such questions have been debated for years. The only unambiguous answer is "yes and no." The scale and complexity of the Nation's economy, along with poor measures of skill, make other conclusions hard to defend. And yet, what might seem an academic question has implications for training policy and for the careers of workers. This box summarizes findings from later chapters (especially chs. 3,4, and 6) concerning upskilling/downskilling questions, and the probable mismatch between the better job opportunities generated by the U.S. economy and the skills of much of the labor force.

Neither Upskilling Nor Downskilling, But Both

Technological innovations may raise skills needed for some jobs while stripping skill away from others. In the early years of numerically controlled (NC) machining, generating and debugging programs was quite difficult, and typically assigned to engineers or other specialists (see app. 4-A, ch. 4) Machining jobs were deskilled, in some cases to little more than machine monitoring. Today, preparing NC programs is easier, more like working with word processing equipment. Those machinists who now prepare their own programs (a few always have) find their jobs upskilled. The new skills are mental (planning a sequence of cuts and programming it) rather than manual (set-up, gaging, tool sharpening). But eventually, most of the simpler NC programs will themselves be prepared automatically. People will handle only the exceptions—make decisions that cannot be left to an automated system—resulting in another round of deskilling. As this example suggests, the overall dynamics of cycles of downskilling, upskilling, and reskilling are not easily predicted from short-term trends.

What about the aggregate picture? To get a handle on future skill and occupational needs, it is useful to think of the economy as consisting of just two groups: traditional and knowledge-intensive sectors (see app. 3-A in ch. 3). While the two groups now employ roughly the same number of people, the knowledge-intensive sectors (including high-technology manufacturing, health services, and business services) are growing more rapidly and will create more new jobs than the traditional sectors (e.g., retail trade, personal services, traditional manufacturing).

Of course, some jobs in the traditional sectors require a great deal of know-how (e.g., the skilled trades) and many jobs in the knowledge-based sectors require little knowledge or skill (hospital orderly). Moreover, jobs and skills in both sectors are affected by restructuring and automation (e.g., the computerized systems used for ordering, inventory control, and on the sales floor in retailing). But the traditional sectors create low-skilled and low-paying jobs in larger proportion. More of the jobs in the knowledge-intensive sectors are technical, administrative, or otherwise specialized; they are likely to require education/training credentials for entry. In health care, for example, job and skill categories continue to expand, in part due to new technologies. Some familiar jobs have changed dramatically-technicians in pathology laboratories now work with automated equipment alongside their microscopes, for instance-while diagnostic techniques like magnetic resonance imaging require new sets of skills for both maintenance and use.

Mobility and Demographics

The simplified two-sector picture of the economy-one sector in which skill requirements change relatively slowly (in both directions), the other characterized by more rapid flux-can now be contrasted with the labor market (also divided into two parts), As described in chapter 3, the lower tier of the labor market consists of poorly paid occupations (e.g., clerk, custodian, waitress) that have not generally required much education. The upper tier includes managerial, administrative, technical, and professional or paraprofessional occupations (many though not all quite well paid, but most requiring education/training credentials). The traditional sectors generate low-tier jobs in large numbers, along with some upper tier jobs. The knowledge-intensive sectors generate jobs in both tiers.

Atone time, people of ability and ambition could, with on-the-job experience, climb beyond the lower tier with relative ease. Today, specialized education or training may be required simply to enter a track promising upward mobility. Many employers even screen applicants for jobs usually regarded as unskilled for credentials that suggest trainability. Relatively speaking, there will be fewer opportunities for people without credentials to prove themselves in the workplace and then to advance.

These shifts mirror a population in which more and more Americans take some college courses. While the relation between years of schooling and job performance is loose, people who lack basic skills and/or the credentials to find a job that promises upward mobility will be left behind. In the years ahead, more young workers seeking entry-level jobs will be blacks and Hispanics who on average have received less education than whites. Some will be immigrants, with poor language skills. During the boom years of mass manufacturing, lack of schooling or poor basic skills were no handicap to getting a job in a textile mill or an auto plant. Today, they are. Automation and foreign competition have cut into blue-collar manufacturing jobs, and technological change has raised the skill requirements for many of those remaining. Many jobs in the services require employees at home in dealing with the public. Without substantial changes in the performance of the U.S. education and training system, the mismatch between jobs and job opportunities and the skills and abilities of the workforce will grow. There will be too many people who can qualify only for the least demanding of jobs, too many people who will not be able to move upward. There will be too few people with the skills needed to drive innovation and economic growth.
SOURCE: Office **of Technology** Assessment 1990.

plants operated by Japanese automakers (at a minimum, production and maintenance workers). When group members rotate among jobs, multiskill training becomes important. Job rotation not only adds flexibility (workers can help and cover for one another), it brings variety to the workplace and helps morale.

These changes also require new forms of management and professional training. First-line supervisors will spend more time on planning and coordination than direct oversight of production. They must be retrained to oversee work groups, which calls for skills in facilitating change and resolving conflicts. Supervisors and managers also need training in how to make the most effective use of retrained workers—how to follow up on worker training to ensure it transfers to the job, and how to help workers assume more responsibility. Product engineers and manufacturing specialists may be expected to join continuous improvement meetings and to act on suggestions from production employees. These employees will require not only teamwork training, but will have to accept new workplace roles. Training managers may also meet with corporate strategic planning groups-a situation unheard of a few years ago and one to which executives may have trouble adjusting.

Reorganizing along these patterns generally calls for good basic skills, a wider range of task-specific technical skills, and organizational training. The latter sets each individual's job in its overall context and demonstrates its importance for achieving the company's goals. Such training is difficult to deliver effectively.

Globalization also means new responsibilities. Flexible organizations that must respond quickly to local market conditions cannot wait for decisions from the home office. Local managers must be trained and informed to make decisions themselves. Companies also may need to train their employees in other cultures and languages, both to better understand their competitors and to operate in foreign markets.

These changing skill needs pose special difficulties for smaller fins. American companies are seeking stable, long-term relationships with relatively small groups of frost-tier suppliers. Xerox, for example, now purchases from 500 rather than 5,000 suppliers. Today, suppliers may be expected to provide just-in-time deliveries and guarantee quality control (e.g., with their own statistical process control and continuous improvement programs). They may be asked to install computer-aided design equipment compatible with the manufacturers' to facilitate shared engineering databases and rapid exchange of technical information. Suppliers that hope to be part of such a strategic partnership must hire more engineers and technicians and provide additional training for their workers. A few suppliers get technical and training assistance from corporate customers, but most must fend for themselves.

Training is not an end in itself, but a means to implement workplace change. With more training, workers find further learning easier and are better able to adapt to new technologies, processes, and organizational structures. Managers who recognize this and embrace the concept of continuous training have taken a major step toward continued competitive success.

Basic Skills in the Workplace

Any nation expecting to attract or retain new model industries of the sort discussed above must offer a flexible and trainable workforce. Many American workers—20 percent or more in some firms-are deficient in basic skills (reading, writing, arithmetic, and communication). The problem is seldom illiteracy, but that workers need to upgrade their basic skills to cope with changing job requirements. Workers need good basic skills to interpret and apply information in the workplace and to participate in both formal and informal training. Many firms have faced delays in implementing new technology or work practices (including training) until they upgraded their employees' basic skills. Workers without sound basics will find it increasingly difficult to advance beyond entry-level positions or to change jobs. (Ch. 6 discusses basic skills issues in detail.)

A 1986 survey of adults aged 21 to 25 found that 20 percent have not achieved 8th grade reading levels, and 38 percent cannot read at the 11th grade level. Many job-related reading materials (e.g., manuals) require 10th to 12th grade reading skills. Although some can be rewritten at lower proficiency levels, technical or complex information is difficult to convey at such levels.

An unacceptably high number of young adults-half or more—are not good at quantitative problem-solving of any complexity. While only 7 percent in the 1986 survey were unable to perform simple arithmetic operations (e.g., adding two entries on a bank deposit slip), around 35 percent were unable to reach the correct answer when the addition was part of a problem in which judgment had to be exercised to determine which numbers were relevant. Even among those with 2 or 4 years of college, 39 percent were unable to figure the cost of a specified meal from the prices on a menu, and determine the tip and correct change from a restaurant check.

The basic skills needed to perform job-related tasks can be quite demanding-more so than those needed in school. Workers often have to apply what they have read immediately or risk production problems or downtime. They also need to be able to ask questions and monitor their own comprehension when reading on the job, in part because they need to recognize and seek clarification of incorrect, misleading, or extraneous information. Thus, the concept of basic skills is enlarging to encompass problem-solving, the ability to adapt existing knowledge to new situations, and effectiveness in group interactions-skills traditionally associated with management. While some workers with limited education are excellent at these higher order skills, strong basics always help.

The costs of basic skills deficiencies are quite high for American companies. Although accurate estimates do not exist, the direct costs in lower productivity may include ruined parts and equipment, wasted material, and health and safety risks. Administrative costs for screening and hiring new employees also can be significant.

Companies would prefer not to have to upgrade employees' basic skills. The presence of a well-educated labor force is often a factor in firms' location decisions, whether domestic or overseas. Firms also can use technology to replace or deskill jobs to compensate for workers' inadequate basic skills. Many workers with poor basics learn to cope, often developing practical solutions to problems that would stump them if presented outside the job context (e.g., on a written test). Not all of these options are available to every company, however, and they do not necessarily further overall competitiveness.

Only a few U.S. companies now offer in-house basic skills training. Many large or medium-size companies test job applicants for basics and most do not hire those who fail. Other companies offer remedial programs in skills basic to specific jobs (e.g., blueprint reading, accounting principles). Still others may encourage workers to enroll in free courses offered by public agencies, but active support (e.g., giving employees paid release time) is rare. The total funding that employers, government agencies, unions, and workers dedicate specifically to improving employees' basic skills has never been accurately estimated. However, it probably does not exceed $1 billion per year. This compares with estimated total annual industry expenditures for formal training of $30 billion or more.

For many years, States have offered basic adult education, partly supported by Federal programs. Some States support workplace basic skills improvement activities with other kinds of customized industrial training programs (see discussion of the State role in providing training, below).

Recently, several workplace-oriented basic skills programs based on partnerships among government, employers, and/or unions have emerged. These include workplace literacy demonstration projects funded by the U.S. Departments of Education and Labor. Major expansion for workplace programs has been proposed in the 101st Congress as part of comprehensive adult literacy legislation (see discussion of policy options, below).

Workplace programs need to take into account the various levels of proficiency among workers. People with the most severe problems—who read or write at the 6th grade level or below—need extensive individualized help. Workers who need to upgrade basic skills benefit from programs that use work-related materials. The more successful workplace-oriented programs encourage transfer of learning back to the job by developing and using materials and tasks that relate to the learner's job (e.g., teaching arithmetic via blueprint reading). Such customized workplace programs are still rare, however.

Basic skills programs often can be enhanced through well-designed courses delivered via computers or other forms of instructional technology (see chs. 6 and 7). High-quality technology-based training takes less time to deliver than traditional classroom instruction, with equivalent or better learning gains and transfer to the job. Moreover, many workers like computer-based or interactive video instruction. Relatively little courseware now available is targeted toward adult learners, however, or toward workplace-oriented skills.

There is a clear need for more research, evaluation, and dissemination of findings on the most effective ways to upgrade basic skills. Not only would this aid firms in establishing their own programs, it would help policymakers determine how much public workplace-oriented efforts should depart from the traditional model of adult basic education.

Working definitions of the basic skills needed in a competitive economy will continue to broaden. Training employees in competencies such as cooperation and teamwork-skills rarely stressed explicitly in the educational system-can be expected to be a more frequent requirement in many fins.

Labor Mobility and Changing Demographics

The U.S. labor force has changed dramatically over the past decade. The baby boom entrance bulge is past, and overall labor force growth has slowed. The civilian labor force grew by nearly 3 million people each year during the late 1970s, but only by about 2 million annually during the late 1980s. Labor force participation has reached a new peak, with 67 percent of all Americans aged 16 and over working or actively seeking jobs; previously, labor force participation had remained stable for years at 58-60 percent. The increase is due primarily to the entry of women into the workforce; nearly twice as many women were working in 1989 as in 1969. The fraction of the workforce with part-time jobs increased from about 15 percent in the rnid-1960s to more than 20 percent in the mid- 1980s.

The overwhelming majority of people who will work in American industry at the beginning of the next century are working now.[3] In the next few years, the labor force will have fewer new entrants, and many entrants will be minorities or immigrants—groups that have been underserved by the educational system. Overall, the labor force will continue to be overwhelmingly white. Through the end of the century, women will account for nearly two-thirds of employment growth. There will be fewer younger workers (aged 16 to 24), although by the mid- 1990s this age group will begin to grow as the baby boomers' children begin entering the labor force (see table 1-2).

While labor force growth has slowed, labor mobility still is high. Americans change employers and occupations more frequently than workers in other advanced industrial economies. People move from job to job; entrepreneurs start new companies, with varying success; existing companies grow, promote people, transfer them. American companies must more or less continuously integrate new employees into their organizations. At least 15 percent of the labor force may need some new training each year simply because of mobility. They will not necessarily get it—mobility makes employers reluctant to train their employees. Many

[3]The Bureau of Labor Statistics estimates that workers from the 1988 labor force will Comprise 70 percent of the year 2000 workforce. The estimate depends in part on retirement decisions of workers and other variables. Judging from the age distribution of workers in table 1-2, the estimate could be low.

Table 1-2—The Changing Labor Force: 1976-2000

	Labor force share (percent of total)		
	1976	1988	2000'
Blacks	9.9%	10.9%	11.7%
Hispanics	4.4	7.4	10.1
Asians and other minorities	1.9	3.0	4.0
Young workers, al laged 16 to 24	24.3	18.5	15.9
Aged 25 to 54	60.8	69.0	71.8
Older workers			
All aged 45 to 54	17.7	15.7	21.8
All aged 55 and over	14.9	12.4	12.3
Women (all)	40.5	45.0	47.3
Total number of workers (million)	96.2	121.7	141.1

[a]Bureau of Labor Statistics moderate growth scenario.

SOURCE: HowardN. Fullerton, Jr., "New Labor Force Projections, Spanning 1988 to 2000," *Monthly Labor Review,* November 1989,table 1, p. 4.

firms try to get by with little or no training for new hires. Many firms also are reluctant to train older workers (age 45 and up). As baby boomers enter middle age, the United States also will need to find ways to keep a slowly aging workforce up-to-date and flexible.

Small enterprises have accounted for about 35 percent of total U.S. employment in recent years. But hundreds of thousands of these small firms appear, grow, and die each year, contributing to U.S. labor mobility. Over the next two decades, small firms will create more jobs than their share of employment might suggest. They face special problems in training. Many lack experience in training and often the resources to develop expertise or to pay for outside training. Further, these companies typically experience higher than average rates of turnover, and therefore are reluctant to invest in their employees. Small firms rarely have enough people who need training at any one time to justify a focused training effort. Public policies have provided little help in solving small firms' training problems.

Retraining for older workers will become more important as the workforce ages. Average retirement ages have been declining in most industrial nations; companies continue to encourage early exits and tailor most training for workers farther from retirement. Programs initiated under the Older Americans Act and Job Training Partnership Act have successfully placed older workers in jobs, but these programs offer no incentives to firms to train their older employees. The aging of the U.S. workforce will force both corporate officials and government policymakers to pay more attention to training for older workers and to capitalizing on their skills and experience.

Immigrants accounted for 22 percent of labor force growth between 1980 and 1987—more than twice their contribution during the 1970s when the labor force as a whole grew very rapidly. Immigrants are projected to account for an even higher portion of labor force growth over the next decade. While many are highly skilled professionals, such as engineers and doctors, roughly 33 percent have only an elementary school education and 13 percent have not progressed beyond the 4th grade. As many as 17 percent speak no English at all. Without basic skills upgrading, these people will be stuck in low-paying, unskilled jobs.

Younger American workers switch jobs more frequently than older workers. Because younger people are so mobile, larger firms tend to hire only those with 3 to 4 years stable work experience for career path jobs and most employers are reluctant to provide young workers with much training. Good training early can help motivate younger workers to continue learning-on the job and off—throughout their careers.

Nationwide, about 85 percent of workers are high school graduates, but the rate is lower among minority groups (see table 1-3) and as low as 50 percent in some geographic areas. Even among those who graduate from high school, however, the bottom third academically are poorly prepared for work. Groups with the most formal schooling have the lowest incidence of unemployment. Educational level also is seen as an important indicator of receptiveness to learning when workplace technologies are changing rapidly; better educated

Table 1-3-Educational Credentials of Employed Workers[a]

	Not a high school graduate	High school only[b]	One or more years of college
Whites[c]	15.8%	39.8%	44.4%
Blacks	22.7	42.4	34.8
Hispanics	39.0	33.5	27.4

[a]Employed during March 1988.
[b]Includes those with less than 1 year of college.
[c]Non-Hispanic whites only.

SOURCE: George Silvestri and John Lukasiewicz, "Projections of Occupational Employment, 1988-2000," Monthly *Labor Review*, November 1989, table 10, p. 83.

workers are viewed as more likely to know how to learn. Moreover, while U.S. workers' average number of years of schooling has risen, actual academic competencies of high school graduates have increased only marginally. Students in competitor nations score higher on academic skills tests than American students.

The United States also does not seem to be doing as much as our competitors to prepare non-college bound youth for the workworld. Graduates of secondary vocational education programs in this country often find their skills ill-suited to the workplace because the rapid pace of technological and organizational change in modern firms has outpaced curricula.

The best vocational education programs ***can*** produce graduates well-prepared for the modern workplace. These programs emphasize both practical and theoretical skills in a setting where students work together. They also typically involve access to--or a blend of—vocational and academic courses. Students can be taught basic skills such as arithmetic quite effectively within the context of vocational courses such as drafting. Employer involvement adds relevance to today's workplace (e.g., through assistance in curriculum development), as do real-world work experiences such as cooperative education or internships. Congress is considering legislation to encourage more vocational programs to adopt best practice approaches (see discussion of policy option 6 below and in ch. 2, and ch. 8).

Growth in jobs will be highest in the South and the West. Particularly in these regions, the mismatch between the capabilities of job seekers and the needs of the local economy will continue (see box l-A). The only way to cure this mismatch is through better education and training, particularly for minorities, women, older workers, and people from rural areas and inner cities.

Training and Human Resource Practices

Current human resource practices in most American firms place a low value on training. Many firms try to hire people with the skills they need rather than develop current employees' skills. Large firms do extensive screening, including tests and interviews, to measure prospective employees' skills. Firms that have reorganized to emphasize multiskilled work groups also test for higher order skills and performance in a group setting. People who do not pass are not hired. Larger firms often can pay above average wages to get the skills they need. When implementing new technology or processes, they can afford to-and sometimes do-hire new employees with the needed skills. Current employees with outdated skills or who have trouble adapting to new conditions may not be retrained or retained.

Small firms' access to new hires with good skills is much more limited. These companies usually pay less and cannot screen prospective employees extensively. When introducing new technology, smaller firms typically add new tasks onto existing jobs, with training provided informally or by the equipment vendor. These approaches seldom prove adequate, making it more difficult to capitalize on the investments.

When times are bad, companies often slash their training budgets. Few firms evaluate the costs and benefits of their training programs, either in terms of job performance or business outcome. Thus they have trouble justifying continuing their training programs during bad times. Moreover, most American firms of all sizes respond to economic downturns by laying off employees.

Some U.S. firms do retrain and redeploy their workers when they reorganize rather than laying off one group and hiring another. This strategy can be cost-effective. Reorganization and restructuring for increased competitiveness require employees who understand corporate goals and believe themselves important to achieving those goals. But employees will not feel coremitted to corporate goals if they believe their employer will respond to the next generation of automation or to economic downturns with immediate layoffs. Moreover, retraining and redeploying employees (e.g., assigning

Photo credit: UAW-Ford National Education, Development and Training Center

Reorganizing work to encourage employee involvement can improve morale and productivity.

them routine maintenance tasks) during slow times can be more cost-effective than laying them off and then rehiring them at the end of the slack period, particularly if many move on to other jobs.

A few companies have even begun to use downturns to provide concentrated training on company time. These firms believe that the upgraded worker skills will improve productivity and competitiveness when demand picks up again.

Relying more heavily on contingent workers (including contract labor and services) makes it easier to retain a core workforce if sales slump, but managers must balance this against the difficulty of integrating contingent workers into the organization when markets are booming again. Growing use of contingent workers poses special challenges, as these workers may not receive the training and benefits given to core workers.

It is difficult for firms to justify changing their human resource practices without understanding the relative costs and benefits. For training, in particular, such benefit/cost evaluations are necessary not only to provide a basis for corporate decisions about the level of investment in training, but to target the investments at specific business needs, to weigh alternate delivery systems for cost-effectiveness, and to improve the quality of training.

If new practices in workplace organization and training are to become a permanent part of the American industrial landscape, it will be because of top management understanding and commitment, backed up with funding. A 7-year business expansion has made it relatively easy for American industry to invest in training and experiment with innovations in production. The test will come in the inevitable downturn. Executives need to grasp what training can and cannot accomplish, and how reorganization and restructuring backed up with training can help their firms compete. Without direction from the top, inertia will prevail.

TRAINING APPROACHES: THE UNITED STATES AND OUR FOREIGN COMPETITORS

Corporate training in the United States is delivered unevenly across firms and among workers. On-the-job training-the kind most U.S. workers receive—usually is informal and unstructured, consisting of experienced workers showing newer employees how to carry out tasks. The U.S. Government has little influence on training of employed workers; Federal programs focus on the unemployed and economically disadvantaged. State support for industrial training is limited, though growing. Other nations, including West Germany and Japan, have more effective public and private training systems than the United States (see table 1-4). These competitor countries provide more training, take a much more systematic approach to training, provide government support for it, and train their workers to higher average standards. Box 1-B compares U.S. and Japanese training programs in automobile plants as an example.

In the sections below, American training practices and programs—by firms, for workers, and by the States—are first discussed. This is followed by analysis of foreign training practices, especially in Japan and West Germany.

Corporate Training in the United States

Reliable estimates of the extent and cost of U.S. worker training do not exist. The few company surveys that have been conducted have had very low response rates. Only a few large firms keep track of training expenditures and they account for training costs in very different ways. Estimates based on worker surveys depend on employees' recall of

Box l-B—Training in U.S. and Japanese Automobile Assembly Plants

Creative engineering abroad has meant heavy pressure on American firms to follow suit (e.g., automobiles with multivalve engines, electronically controlled transmissions, and antilock brakes). Not only must companies bring these technologies to market quickly, they must do so with minimum risk of recalls or product liability suits. This places a greater burden on workers to maintain quality. Training is a critical factor in achieving this goal.

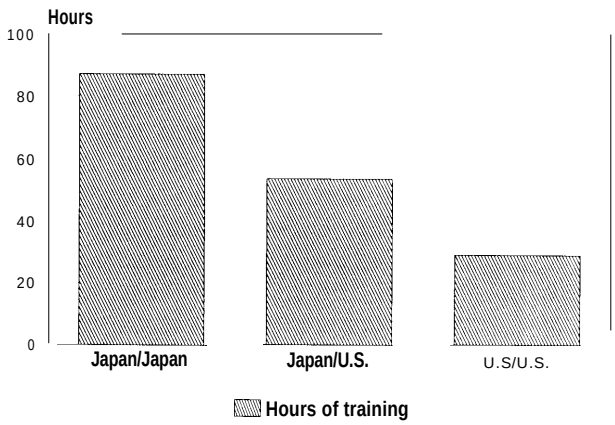
Figure 1-1 compares annual hours of training per employee for Japanese auto assembly plants in Japan (J-J), Japanese-owned plants in the United States (J-U.S.), and U.S.-owned plants in the United States (U. S.-U.S.). As shown in the figure, autoworkers in J-J plants get more than three times as much training each year as workers in U. S.-U.S. plants. The differences are even more striking for newly hired workers (figure 1-2). New employees in J-J plants get more than 300 hours of training in their first 6 months compared with fewer than 50 hours for U. S.-U.S. plants.

In pre-employment screening, Japanese automakers value willingness and ability to learn more highly than previous experience or specific skills. Their training programs emphasize individual and group responsibility along with job skills. U.S. automakers look more for experience and their training tends to stop with narrow technical skills for craft workers and brief on-the-job sessions for unskilled workers.

Japanese automakers combine just-in-time production with continuous improvement and quality circle programs. Their work organization is built around semi-autonomous groups with substantial training and careful attention to shopfloor management. Work groups serve as vehicles for communication between factory floor and engineering to help achieve design-for-manufacturability. In contrast, workers in U.S. plants have narrowly defined responsibilities. Organizational barriers still impede information exchange among product design, manufacturing engineering, and the shopfloor. Not surprisingly, Japanese auto manufacturers achieve higher productivity and quality levels than their U.S. counterparts.

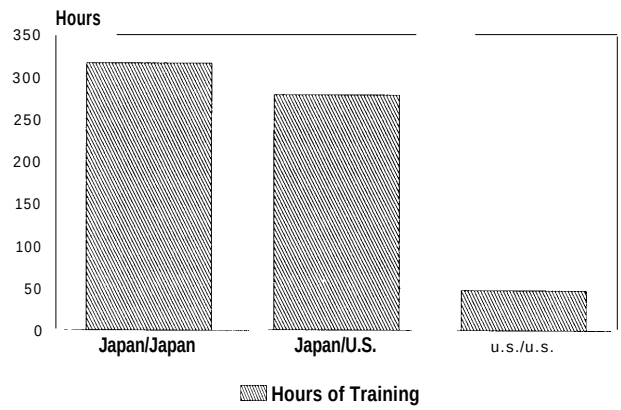
SOURCE: John F. Krafcik, "Training and the Auto Industry: International Comparisons," report prepared for the Office of Technology Assessment under contract N3-1910, February 1990.

Figure l-l—Annual Hours of Training Per Employee, Automobile Assembly Workers



SOURCE: John F. Krafcik, *Training and the Automobile Industry: International Comparisons,* contractor report prepared for the Office of Technology Assessment under contract N3-1910, February 1990, pp. 8-9.

Figure 1-2—Hours of Training, Newly Hired Automobile Assembly Workers



SOURCE: John F. Krafcik, *Training and the Automobile Industry: International Comparisons,* contractor report prepared for the Office of Technology Assessment under contract N3-1910, February 1990, pp. 8-9.

training events, which may be unreliable. Employers more often train workers informally on the job than in formal settings, and it may be difficult to differentiate between training time and work time. Therefore estimates of total employer investment in training vary greatly (see ch. 5).

The few data available suggest that U.S. employers' investments in formal training are between $30 billion and $44 billion annually. This range is equivalent to 1.2 to 1.8 percent of total private sector worker compensation ($2.4 trillion in 1988), 0.61 to 0.9 percent of 1988 gross national

Table 1-4-Worker Training Compared

	United States	Germany	Japan	Korea
School-to-work transition	Left mostly to chance; some employers have ties with local schools	Apprenticeship for most non-college-bound youth	Personal relationships between employers and local schools	Employers recruit from vocational and academic high schools
Vocational education				
Extent	Available in most urban areas	Universally available	Limited; mostly assumed by employers	Universally available
Quality	Wide range: poor to excellent	Uniformly good	Fair to good	Vocational high schools uniformly good
Employer-provided training				
Extent	Largely limited to managers and technicians	Widespread at entry level and to qualify for promotion	Widespread	Limited; employers rely on public vocational institutes
Quality	Wide range; some excellent, but more often weak or unstructured	Very good	Very good	Generally poor
Public policies	Federal role very limited; State aid to employers growing	Govern apprenticeship; encourage continuing training	Subsidies encourage training by small firms	Directive-some employers resist policies

SOURCE: Office of Technology Assessment, 1990.

product, and 10 to 14 percent of the national investment in primary, secondary, and higher education in 1987. Some companies spend much more on training, such as IBM and Xerox (4 percent or more of payroll), and Motorola (2.5 percent of payroll). Informal training may cost firms as much or more than formal, but the costs (e.g., lost production during training) and the benefits (improved quality or productivity) are difficult to tie directly to training and impossible to quantify.

Only about 35 percent of workers recalled taking skill improvement training in their current job, according to a U.S. Department of Labor study.[4] Professionals (e.g., lawyers, teachers, engineers) are the most likely to get continuing training for their jobs (see figure 1-3). Technicians are next most likely to get upgrade training, followed by executives and managers. Shopfloor and other blue-collar workers are less likely to receive such training in the United States.

U.S. employers are reluctant to provide training for several reasons. Many fear that employees will leave for better jobs and the firm will lose its training investment. Others lack expertise in training or have had unhappy experiences with poorly conceived training programs. Senior managers may not plan well enough for training when introducing new technology or process changes. Production managers are often reluctant to disrupt operations by releasing employees for training.

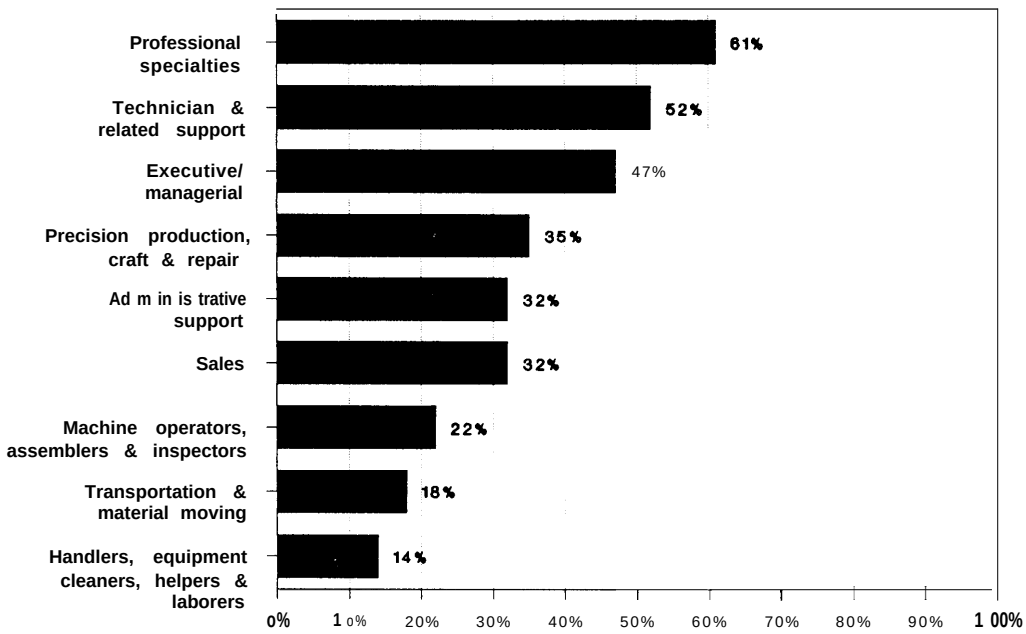
Larger firms are more likely to provide formal training than smaller ones. Large firms typically have lower labor turnover and more money for training. Moreover, they find that training tends to be associated with lower labor turnover.

Some large firms with organized training programs provide new hires with formal training-a preliminary to on-the-job training. Formal training may cover technical skills (both task-specific and generic) and workplace hazards. Some firms orient new employees on company policies, customers and product lines, and the fro's plans for the future. The purposes are to encourage employees to take responsibility and link workplace tasks to the company's overall goals, and to build loyalty to the organization.

Small firms are more likely to employ workers who have less education, or who are older or young. Jobs in small firms often involve a variety of quite different tasks. Lacking training budgets, small firms usually try to develop employee skills through unstructured informal training, which varies widely in quality. Those smaller firms that do invest in both

[4]The study was based on information obtained from special questions in the 1983 Current Population Survey; it has not been repeated since thin. See Max L. Carey, *How Workers Get Their Training,* Bulletin 2226, U.S. Department of Labor, Bureau of Labor Statistics, March 1985.

Figure 1-3—Upgrade Training by Occupation
(percent of workers reporting upgrade training in their current job)[a]



[a]Note: On average, 35 percent of all workers reported skill improvement training for their current job.

SOURCE: Max Carey and Alan Eck, *How Workers Get Their Training* (Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, 1985), pp. 18-19.

formal and informal training usually have a strong management commitment to training.

In addition to in-house training, U.S. workers get training from many sources, including equipment vendors, private training consultants, community colleges and other educational institutions, union programs, and technology-based courseware (e.g., computer-based training). U.S. fins' purchases of training from outside resources are estimated to total about $9 billion per year.

Only the vendor may have the expertise to train workers to use and maintain new equipment. Equipment vendors are not in the training business, however. They typically design courses to highlight a product's features rather than to prepare trainees for possible problems. Downtime due to employees' lack of skills can offset the gains in productivity that would otherwise result. from new equipment. Vendor training also tends to reach only a few workers, and not always those who will actually operate the new equipment.

Regardless of the source, training often does not transfer to work. Training is more effective when it is quickly reinforced on the job. Successful learning often occurs in practical and collaborative job settings, such as apprenticeship, where the concepts learned are applied to daily tasks. Training also is more effective when developed as part of an overall strategy linked to corporate goals.

Training technology can deliver quality on-demand instruction. Simulators, for example, can train workers to fix a wide range of malfunctions safely and without equipment downtime. Embedded training is valuable for malfunctions that occur infrequently and in situations where it is either impossible or not cost-effective to train everyone in all operational characteristics.[5]

[5]Embedded training is instruction tbat is an integral component of a product or system. An example would be a machine display panel with a diagram that shows the location of a malfunction and a list of the steps needed to fix it.

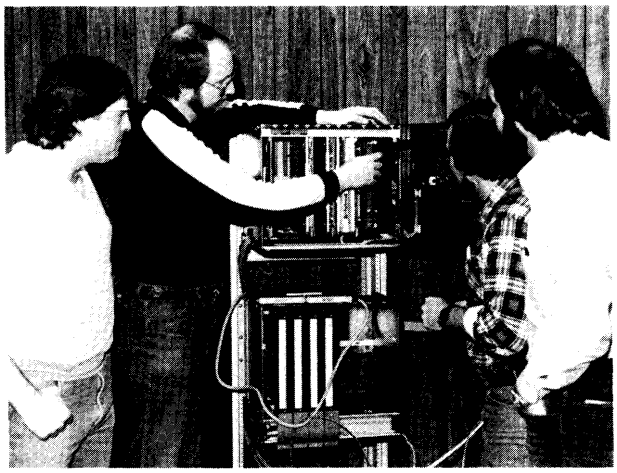


Photo credit: American Association of Community and Junior Colleges

Instructor explaining programmable controller to Alcoa employees.

Training quality also is directly affected by the expertise of training professionals and courseware developers. Many entrepreneurs are attracted to this low-overhead business with potentially high earnings. Some are highly knowledgeable training professionals that produce quality products; some hype ''new age' training methods whose effectiveness is unproven; a few are con artists.

Training and Workers' Careers

Training is important not only to companies, but also to individuals (see ch. 8). More than half (55 percent) of workers in the Labor Department study cited above said that they needed some specific training to obtain their current job. Most got the training at a school or informally on the job. Not surprisingly, nearly all professionals needed qualifying training, as did 85 percent of technicians, and most managers. Nearly two-thirds of those in the craft and skilled trades also needed training to qualify for their current job. The proportions vary not only by occupation, but also age, race and educational background. Minorities receive a disproportionately small share of training. Employers are hesitant to train young workers (aged 16 to 25) because of their mobility; older workers also get less training than their share of the workforce might suggest. Those with the most education to begin with get or take the most training.

Increased competitive pressures and the resulting restructuring of the national economy have made jobs and income less secure. Moreover, in many industry sectors, career ladders within companies have become fewer. Many manufacturing firms, for example, have cut back on the number of first-line supervisors-jobs often filled in the past by promotion of production workers.

People who do not have the appropriate blend of educational credentials, training, and experience will find it increasingly hard to win promotions and pay increases. The skills and abilities needed to gain entry onto an upward track tend to be broad and general, associated more with formal education than on-the-job training and experience. It will be more difficult than in the past for people without educational credentials to demonstrate through on-the-job performance that they deserve a chance to move upwards. The U.S. training system will have to begin delivering both task-specific skills ***and*** the broader problem-solving and social skills traditionally associated with managerial work if the system is to serve both workers and industry effectively.

The training workers get in firm- or equipment-specific skills may not transfer to other jobs. Employer-supported programs leading to formal credentials (e.g., apprenticeship, associate degree programs) are more transferable than other types of training. But, transferable training is hard to get.

At the post-secondary level, community colleges and other institutions offer widespread opportunities for vocational training. As these institutions work more closely with employers on customized training, their vocational curricula may become better matched with local labor market needs. At the same time, post-secondary vocational education should provide students with broad transferable skills.

Adult education is one of the strengths of the U.S. system, although under 15 percent of all adults participate in any year. About two-thirds of participating adults take courses for job-related reasons, with employers paying for nearly half of these courses. Other countries also stress adult education. One-fourth of adult Canadian workers participate in adult education. Japan has an effective adult education system, with many companies encouraging or requiring employees to attend night classes or take correspondence courses. The Japanese Government offers subsidies to employers who offer financial incentives to workers taking such courses.

The United States has long ranked near the bottom among industrialized nations in the number of workers who have completed apprenticeships. The total number of apprentices has remained about the same (300,000) over the last decade while the workforce has grown by 20 percent. Only 0.16 percent of the U.S. civilian workforce currently participates. By contrast, a majority of the West German labor force has completed an apprenticeship. U.S. apprenticeship is highly concentrated in a few occupations; over half of those in registered programs work in the unionized construction industry.[6]

Apprenticeship training is high in quality as measured both by workers' wages and productivity, and there is new interest in revitalizing the U.S. apprenticeship system. The apprenticeship model, combining classroom instruction with hands-on practice and skill-building, is a very effective approach to technical training. Because it relies heavily on informal but structured on-the-job training, which is the predominant training method in smaller companies, apprenticeship is particularly well-suited to these fins.

The major barrier to the creation of nonunion apprenticeship programs is financing. U.S. apprentices typically take evening classes two or three times per week, as well as receiving on-the-job-training, over a 3- or 4-year period. The formal instruction alone averages $2,500 per apprentice annually in some crafts. A single firm may be unwilling or unable to support such extensive and expensive training. Industry associations could overcome this barrier by soliciting voluntary contributions from member firms to support apprenticeships.

The U.S. Department of Labor (DOL) is examining ways both to strengthen traditional apprenticeships and to introduce the concept in industries that have not been active participants in the past. DOL calls the latter effort structured workplace learning. It includes various combinations of classroom and on-the-job training leading to a portable credential. DOL launched several pilot projects to demonstrate the concept in banking, health care, and small business in 1989. If successful, these demonstrations could encourage more employers in more industries to try similar programs in the future. However, DOL lacks the resources to strengthen traditional apprenticeships. More funding is needed at the Federal and State levels to improve outreach programs.

Photo credit: National Training Fund, Sheet Metal and Air Conditioning Industry

Apprentice practices welding while others observe.

Providing transferable skills also is a thrust of many joint union-management training activities. Although unions represent a small and declining share of the labor force (from a peak of 35 percent of nonagricultural workers in 1954 to 16.4 percent in 1989), they are still important in workplace training and in retraining displaced workers. Successful joint union-management training initiatives exist in both the automobile and telecommunications industries. In 1989 alone, five of these programs had a total of about $324 million available to support training activities. Enrollments ranged from 16 percent to over 50 percent of the 709,000 eligible workers. Most instruction is offered outside of regular working hours at the plant site. It typically focuses on topics such as basic skills, health and safety, computer literacy, and career and financial planning. Some training, however, is keyed directly to the workplace (e.g., offering basic arithmetic instruction off-hours to help workers taking statistical process control training on company time).

As with corporate training generally, joint union-management programs are of mixed quality and have not been evaluated rigorously. Efforts have

[6]Under the registration system operated by the Federal Bureau of Apprenticeship and Training and by State Apprenticeship Councils, apprenticeship programs may be sponsored by either a single employer or a group of employers, either unilaterally or jointly with a union.

begun to educate local training committees about techniques for design, delivery, and evaluation, and to encourage outside course evaluations. Joint training and teamwork programs have shown measurable benefits, nonetheless, including lower production costs, increased uptime, and expanded output without investments in more modern equipment.

Older workers have even less access to on-the-job training and outside courses and programs than younger workers. Training declines with age within the older worker population, in part because employers believe they will not recoup their training investment before a worker retires. Many managers and executives also rate older workers low on flexibility and adaptability. Yet older workers also are perceived as having a strong work ethic and good work habits; they also change jobs less often than young workers.

The increasing proportion of older workers in the labor force makes it important both to prepare this population for technological change and to understand how advancing age affects job performance and learn how to compensate for any negative effects. Despite gradual physiological changes (e.g., reduced sensation and perception, motor control, and memory), age-related declines in performing traditional tasks in most occupations seem to be slight. Efforts to compensate can focus either on the worker or on the job. Older workers' health-and job performance-can be improved through company-based health promotion and awareness programs. Training can compensate for some age-related deficits. Jobs also can be modified to facilitate retention of older workers.

Most older workers, however, are more in need of training to upgrade skills that have been outpaced by technological change. Federal support for older worker training programs is limited and companies have shown little interest in developing training tailored to older workers' needs. Training methods that minimize stress (e.g., self-paced learning) and reduce the need for memory (e.g., embedded training) are especially beneficial for older workers. Educating managers about age-related issues also can be effective in changing their perspectives on training older workers. The great variability among workers in the same age range means that policy with respect to the older worker should be flexible and individualized rather than uniform.

The Growing State Role

In the United States, most direct government assistance to firms to train their workers comes from the States. In fiscal year 1989, 44 States operated over 51 customized training programs (those tailored to needs of specific industries or companies) costing approximately $375 million (see ch. 5). Additional State expenditures on worker training are embedded in industrial recruitment programs and in support for vocational-technical institutes and community colleges. The States report increasing demand for upgrade training of employed workers; almost one-third spent more than 35 percent of funds on training workers at existing firms.

State customized training programs have an uneven record in meeting employers' needs for worker training. The States expect such programs to serve mixed, often conflicting goals-attracting new industries, aiding in expansion of existing fins, enhancing workers' careers, and providing broader societal benefits. Customized training for existing employers must compete for scarce State resources with efforts aimed at these diverse goals. Programs focused on a single goal-such as assisting employers with specific training needs or enhancing the performance of existing firms—are most successful.

State funds can help companies overcome many barriers to providing their own training, including limited access to training experts, poor understanding of how training can improve business performance, concerns about losing trained workers to other fins, and bad experience with prior training efforts.

About 10 States also currently spend a combined total of between $25 million and $40 million a year on industrial extension services, which provide technical assistance to small manufacturers. Current State technology transfer programs are limited in scope and poorly linked with State training assistance. Most will refer clients to training agencies, but of five that OTA surveyed, only one provides integrated training and technical assistance and helps businesses obtain funds from State training programs.

One of the largest *regional* efforts to assist small business is the Southern Technology Council's Consortium for Manufacturing Competitiveness. Formed in 1988 with some Federal support, the

Consortium has 14 members—all State-supported schools that offer technical associate degrees-who extend services to employers and help leverage private funding. A key purpose is to transfer new manufacturing technology. Member institutions also provide training support, such as mobile training vans and skills assessments.

While States are becoming more involved in both training and technology assistance to small firms, funding is still very limited. Both types of programs are inadequate to meet growing employer demand for services. The average State training program helps just 64 companies and fewer than 4,000 workers annually (see table 1-5). Most of the assistance goes to firms with more than 200 employees.

Training Among Our Competitors

One of the reasons companies in the Federal Republic of Germany (FRG) and Japan are able to compete so effectively with U.S. firms is that their workers are well-trained (see ch. 3). Thus, companies in those countries are well equipped to take advantage of flexible production systems turning out high-quality products at low cost. Moreover, training is explicitly supported by their governments' policies.

In the FRG, for example, about two-thirds of the employed workforce has completed an apprenticeship program. These programs-as good as any in the world—are financed jointly by public and private investments. The government works with trade associations and unions to define uniform national curricula and examinations for apprentices in over 400 occupations. Policies and traditions also give status and respect to blue- and grey-collar workers.

West Germany's Federal and Lander (State) governments offer substantial incentives to firms to provide training to their workers. The Lander typically provide the formal schooling portion of apprenticeship at no cost to the employer. Both Federal and Lander governments also defray some on-the-job training costs. The Federal Government picks up half the costs of special training centers set up by trade associations to serve the apprenticeship and continuing training needs of small business.

The FRG's education and training system contributes in a major way to both high labor productivity and product quality. A comparison of skills training and cost, productivity, and competitiveness in West German and British firms in several industries clearly showed that, when factors such as production machinery are held constant, the West German workers have higher productivity, are more adept with computerized equipment, and can adapt better to short production runs of specialized goods because they get more and better training than their British counterparts.

The Japanese excel at integrating on-the-job training with day-to-day operations. Managers and supervisors deliver most training on the shop-floor with little loss of working time, and provide continuing followup and evaluation. Managers who serve as instructors can stay in closer touch with factory operations and also can keep workers abreast of company plans; it also gives managers frost-hand experience with the usefulness of training. Long-term employment relations (common in many Japanese companies) allow firms to train core workers with little fear of losing them. Training is more than a means for advancement; corporate and cultural pressures encourage continuous learning with workers often participating on their own time.

Table 1-5—State-Financed Customized Training Programs[a] (most recent fiscal year)

	Median	Low	High
Number of contracts with firms			500
Average contract amount per program	$43,313	$6,500	$1,046,000
Range of total program expenditures among States	$2,400,000	$111,700	$106,000,000
Number of employees trained	3,940		55,243
Expenditure per enrollee	$460	$75	$3,461

[a]Based on 51 programs in 44 States.

SOURCE: Peter A. Creticos, Steve Duscha, and Robert G. Sheets, *State Financed, Customized Training Programs: A Comparative State Survey,* report prepared for the Office of Technology Assessment under contract L3-3081O, 1990, tables 4,6.

Japanese Government assistance is less pervasive than West German assistance; companies and individuals absorb most of the training costs. The Ministry of Labor (MOL) provides some subsidies for companies and industry groups with an approved skill development plan. Small firms qualify for larger subsidies (e.g., half the cost of hiring teachers and purchasing in-house training materials, versus one-third for bigger companies). Japan's prefectures spend about two-thirds as much on training as the MOL, supporting vocational colleges, skill development and training centers, and testing and certification programs. Special subsidies go to companies that train employees aged 45 and older. Quasi-public industry groups, such as the Japan Industrial Training Association, the Japan Management Association, and the Japanese Efficiency Association also provide training.

South Korea and other developing Asian nations are making worker training a central element in economic development policies. Training in South Korea draws heavily on the German example; indeed the FRG helped South Korea establish one of its first vocational training institutes. The South Korean Government offers construction financing, low-cost land, subsidies for instructors' salaries, and free training equipment for trade associations. Skills tests and preferential hiring for certified workers help to counter biases against vocational education.

Levies are used by several nations-West Germany, France, South Korea, and Japan among them-to support training. In some countries, firms only pay the levy if they fail to spend an equal amount on training their employees. In other cases, the levy finances training programs conducted for various purposes by public agencies.

TRAINING TECHNOLOGY

Large companies such as IBM, Ford Motor Co., and Motorola expect that by the late 1990s over half of their corporate training and education will be delivered outside the traditional classroom using some form of instructional technology. Flexibility and savings in time and money are the major reasons technology-based training is catching on. Such training might be delivered at a worker's desk or on the shopfloor, at a training center, or in an electronic classroom. It may be undertaken individually, or in small or large groups. The courseware may cover all aspects of a job or task, or it may review only those steps a worker needs to perform a particular task. It might involve basic, technical, or interpersonal skills (e.g., sales, job orientation).

Well-designed technology-based training can provide greater mastery of the material in less time and with higher employee satisfaction than the average classroom lecture. These benefits, combined with delivery and content flexibility, add up to savings in travel expenses and employee time off for training. IBM was able to avoid $150 million in training costs by streamlining its education programs, including expansion of its technology-based learning systems. NCR Corp. expects to save over $70 million annually in this way.

Today, most companies use some form of 'technology' for delivering training or reminding workers how to perform tasks. Such technology spans the low- to high-tech spectrum, from traditional lecture/lab instruction and job aids such as templates, to elaborate simulators and advanced electronic classrooms with interactive teleconferencing. Even informal on-the-job training typically involves hands-on practice with equipment or models of it. Table 1-6 presents some examples of the work-related applications of training technologies.

Classroom instruction, however, is still the most common formal training method in the United States. Even training professionals learning about new training technologies are most likely to do so in a traditional classroom setting. Yet, in terms of labor costs (and often travel), classroom instruction generally is the most expensive form of training to deliver.

Several considerations promise to spur continued growth in the use of technology-based training. The hardware and software have matured and their costs have become affordable to most large and medium-sized firms. A wide selection of courseware is available commercially and is increasingly interactive. Personal computers are becoming more portable, more powerful, and less expensive. Their pervasive presence in the workplace will make it difficult and expensive *not* to use them as training tools. Advances in computer literacy among today's students also will tend to encourage the future expansion of technology-based training. Finally, the limitations of most classroom training in terms of retention and transfer to job performance will lead managers to be more open to technology-based

Table 1-6—Work Related Applications for Training Technology

Setting/representative examples	Characteristics
Worksite applications:	
Shop or office floor refresher training	
• emulator for computer numerically controlled machine tools allowing training on different brands of programmable controllers	• immediacy, proximity to worksite helps transfer information to job tasks • more uniform, predictably reliable guidance than informal consultation with coworkers or supervisors
. interactive videodisc showing correct methods for tracking status of overnight shipping packages	. many training programs can be used at worksite computer terminals not acquired for training, thus keeping costs down
Performance support/enhanced job aids	• worker often must initiate use on own
• work station video displaying procedures for parts assembly	
. display identifying correction steps for copy machine paper jam	
• expert system job aid for identifying automobile malfunctions	
. interactive video showing correct safety procedures for forklift operation	
Corporate learning center or classroom support:	
. Basic skills upgrading using computer-based or interactive video courseware to supplement instructor capabilities	. instructional technology can supplement instructor's subject matter expertise or sometimes stand-alone
• Sales training pratiice sessions using interactive videodisc and video display of trainee responses, with feedback from sales instructor	flexible scheduling is possible for practice or stand-alone applications . well-conceived programs reduce training time away from job
. Use of simulators to train recovery boiler maintenance personnel and operators to adjust operating conditions to avoid downtime or emergencies	• telecommunications allows corporatewide or outside interaction with authoritative experts without need for trainees to travel to a central site
. Knowledge updating of engineers through distance learning courses, with audio hook up	• reliable information can be packaged and distributed throughout the corporation
• Managerial training using electronic classrooms and corporate satellite television networks for teleconferencing	. off-the-shelf programs may not meet specific corporate needs, while customized products are too expensive for most training applications . dedicating equipment specifically for training is expensive
Home study applications for computers, television, video:	
. Continuing professional education	. allows self-paced learning at individual's discretion
. Basic skills, GED preparation	• convenient
. Distance learning courses for degree programs	• uses widely available consumer electronics
• Occupational correspondence courses leading to a recognized certificate	• Progress highly dependent on individual motivation . individuals need sound advice on product quality

SOURCE: Office of Technology Assessment, 1990.

approaches—particularly those that bring training to the work station.

Yet, there continue to be barriers to the use of training technology. Most corporate trainers have too little experience with it to use it confidently or to design courses around it. Early experience with clumsy or unreliable technologies has soured many firms on this approach. The cost of technology-based training can be high, often too high for smaller fins. Even for large fins, customized courses can be expensive. Creating good instructional material-especially interactive courseware (see box l-C)-can require substantial development time and a team of experts, including instructional designers, subject matter experts, computer programmers, and sometimes video, audio, or other technicians.

Several trends promise to reduce the cost of technology-based training. Tools such as authoring systems and other instructional design programs, CD-ROM resource discs, advanced database formats, and expert systems can both speed up the process and reduce the needed programming expertise. Current authoring systems allow instructors with no programming background to create computer-based courseware. The more sophisticated systems also automate many of the tasks previously performed by technicians, such as integrating graphic

Box l-C—Measuring Interactivity

Interactivity refers to the give-and-take that occurs between the learner and the training program (usually videodisc or computer-based). Conceptual models are used to classify the types of things an interactive course lets the learner do. In these models, "level" means the courses' instructional sophistication. Often, however, sales literature uses 'level' to describe the kind of hardware needed to run a program rather than how much interactivity it delivers.

Under one such conceptual model of sophistication, five levels or generations of interactivity are defined according to three groups of instructional design factors: presentation, practice, and adaptation. The groups are subdivided further into specific factors such as use of illustrative examples, relevance to job tasks, frequency and effectiveness of practice and feedback, and ability to adapt to individual learning rates. The levels are:

1. First-generation courseware is the least interactive. It may lack graphics and usually provides few examples. Feedback typically indicates only whether answers are right or wrong, and opportunities for practice are rare. The program cannot adapt to the trainee's learning pace or branch to different topics. An example would be a computer-based tutorial that plunges into its first point without an overview, proceeds with dozens of text screens without a break or branch, does not summarize them, asks a few multiple-choice or fill-in-the-blank questions at the end, and includes no opportunities for practice.
2. Second-generation courseware provides more relevance to job tasks, but is still limited in content and design. Examples and opportunities for practice are more frequent, but graphics are still scarce. Feedback is as limited as in first-generation. Learners gain some control over the selection of topics, but neither the learner nor the system can modify exercises or tests. An example would be a computer-based or videodisc tutorial that allows learners to select one of several lessons or to leave a lesson at any time, but does not allow review of individual points without starting over. Practice might consist of around five questions at the end of each lesson.
3. Third-generation courseware is much more relevant to job tasks, provides unit overviews and summaries, has effective visuals, and offers both positive and negative examples. Learners receive clear definitions and procedures. The course provides frequent and relevant practice, and adapts to users' learning rates. Typically a third-generation program includes pretests and mastery tests, and allows learners to select among individual topics and from lessons within those topics. Each lesson ends with an exercise that simulates the skill being taught.
4. Fourth-generation courseware has all the benefits of third-generation plus it integrates full-scale simulation into the instruction. That is, the design allows trainees to practice job tasks in a simulated environment without risking mistakes that might cause havoc in the real world. Examples include a course on a particular piece of software that allows the learner to practice using the software without the potential for damaging actual data, or a maintenance training program that allows the learner to simulate repairs before actually using the machinery.
5. Fifth-generation also simulates actual job conditions, but adds artificial intelligence to observe, guide, and coach individual learners and mod@ the instruction accordingly. It critiques learners' reasoning and adapts to their cognitive style. Learners usually are offered more than one simulation. Fifth-generation courseware is in its infancy; at present, courses have been developed for medical and military applications.

SOURCE: "The Other Generation Gap," ***Training: The Magazine of Human Resource Development,*** **October 1989, vol. 26, No. 10, p. 17.**

overlays, audio, and video. Advanced systems under development will automate more of the front-end design and analysis tasks. Expert systems will augment designers' experience. When these tools are available, the time and skill required for instructional design should decrease further.

Other trends include equipment and courseware leasing and similar concepts that reduce the front-end costs for training that is delivered infrequently. Some professional associations are promoting the concept of ''shareware' for training materials. Learning centers offer services such as satellite links, and computer and videodisc training stations with accompanying courseware.

As with its classroom counterpart, the quality of technology-based training always will be a concern. The potential cost savings will not materialize if the training fails to impart appropriate skills, includes irrelevant information, or fails to accommodate varying trainee backgrounds and learning styles. Adherence to instructional design and development principles can help make a training program relevant, complete, and suitable.

Although most training developers now follow proven instructional development principles, there is much to learn about designing effective training materials. One problem is the lack of evaluative data. Few companies have the time or resources to

Box l-D—Future Prospects for Training Technology

New developments promise to stimulate broader use of training technology and enhance its capabilities. Over the next few years, as more people become accustomed to computers in work, education, and entertainment, their use as instructional tools will grow naturally. Computer-based training could become more responsive to individual needs with the use of intelligent tutors and expert systems. Advances in optical storage will greatly extend the possibilities for multimedia instruction. Expanded storage and advanced data management systems will make huge databases of instructional or background information easier to learn and use. More companies will develop electronic classrooms to facilitate the use of training technology. Embedded training and other sophisticated job aids will bring electronic instruction to the workstation.

In the near term, these changes will mean learning on demand-usually at the normal workstation but increasingly in the field or at home. The learner will be more likely to control the training, and multimedia training will be responsive to individual trainees' learning style and pace. In the long term, these developments also could profoundly change the way many people work (e.g., by eliminating the need for a fixed irregular worksite in service industries)as well as the way they learn. Training would become even more integral and no longer would be considered an activity separate from work.

In the long-term (5-20 years), broadband digital telephone networks will allow information of any type-text, graphics, audio, video-to be transmitted to any location at an affordable cost. Advanced embedded training systems will be designed that take advantage of workers' intuitive skills while helping them develop a deeper understanding of the processes they work with. Researchers also are working on systems that will allow people to feel immersed in 3-dimensional computer-generated worlds and to manipulate elements of that world by moving their bodies in a natural manner. This would provide an entirely new environment for simulations and for manipulating remote environments.

For these developments to be widely used in the long term, training professionals (instructors and managers) will need to become more sophisticated about instructional technology. Senior management and human resource development departments must place a high emphasis on training technology. Corporations and the Federal Government will have to increase R&D funding for instructional technology. Research also is needed on adult learning and instructional design, and on how instructional technology relates to issues such as retraining, basic skills, team training, participative management, and multiculturalism.

SOURCE: Office of Technology Assessment, 1990.

evaluate technology-based training's effectiveness compared with traditional methods.

A more fundamental problem is the limited application to training of basic knowledge about how adults learn. Despite the enormous sums spent on education and training and despite the shortcomings evident in both systems, learning research has never been well-supported outside the military.

If designed carefully, technology-based training has the capacity to provide environments that accommodate the wide diversity among adults and their learning styles, and that promote learning and work simultaneously. Much technology-based training can be delivered at the work station in collaborative settings that facilitate learning. Good interactive computer or video courseware provides relevance, participation, practice, and feedback. Advanced videodisc courses combine audio, video, text, and graphic material. Future technological developments will greatly enhance capabilities and reduce costs further (see box l-D).

FEDERAL POLICY OPTIONS

As challenges to American competitiveness grow, debate has intensified on the best approaches to improve worker training and on the appropriate level of Federal involvement. The need for improvement spans the public education system, integration of young people into the workforce, and upgrading employed workers' skills. But, because the great majority of the workforce of 2000 is employed now, upgrading employed workers' skills will have the greatest competitive impact in the near and medium term.

Currently, the Federal Government plays little direct role in assisting firms or their employees with training. The Department of Labor provides limited support for apprenticeships. Some Federal vocational and adult education funds support up-

grading of employees' skills. Most Federal training programs, however, focus on displaced workers, the economically disadvantaged, or people with special needs.[7]

Corporations, adult education programs, and workers themselves will play critical roles in upgrading employees' skills. Indeed, worker training will remain largely a private sector responsibility. Yet proposals for greater Federal involvement are increasing. They have come from various national commissions, the executive branch, and Congress. They range from providing better information about training, to support for industrial training consortia, to skills certification programs, to tax credits for training expenses, to payroll levies. In 1989, the Labor Department announced a 7-point 'agenda for action" to improve workforce quality. Several bills under consideration in the 101st Congress touch on aspects of employee training, such as industrial training consortia and workplace literacy. The Nation's Governors also are debating how to address workforce skills in their ongoing efforts on national education goals as a followup to their 1989 ' 'education summit" with President Bush.

The pros and cons of these proposals need careful assessment—in terms of the need for an expanded Federal role and its costs and benefits. If American firms and workers saw a need and were taking action to upgrade skill levels there would be little rationale for government involvement in employee training. However, despite some notable exceptions, the prevailing view among workers and employers is that little training is needed to develop the skills required to perform most jobs. The view is that, when new skills *are* called for (e.g., to operate new equipment), firms usually provide it.

Such a view fails to take into account the growing realization that American companies will have to make fundamental changes in work organization to become more competitive in international markets and maintain a high-wage economy. These changes require a workforce comfortable with working in groups, and with both good basic and technical skills as well as higher order skills such as problem-solving. Some pioneering companies (e.g., Aetna, Motorola, Digital Equipment Corp., Hewlett-Packard) that are making these changes place major emphasis on training and development of their employees.

Yet, the good results that can be achieved by such firms (see ch. 4) are not likely to be replicated on a widespread basis unless some training gaps are closed. To review some of these: the proportion of American workers in apprenticeship, long lower than nearly all other advanced industrial nations, fell by nearly one-half in the 1970s and 1980s with no equivalent system of vocational education springing up to take its place (see ch. 8). While a serious basic skills problem exists in the workplace, few employers evidence much interest in acting on their own to remedy the problem at the scale needed (see ch. 6). Often, firms that stand to gain the most from training-related productivity and quality improvements are in a poor position to train their workers (see ch. 3). Moreover, the quality of training is spotty, and firms often do not make good use of training (see chs. 5 and 7).

There also are steep barriers to corporate investment in training. High U.S. labor mobility, for example, makes employers see such investments as risky. Firms also lack information about how to go about providing good training. In small firms, these problems are compounded by lack of human and capital resources to support training.

Many other advanced industrial economies have put in place government policies that, in effect, protect a firm's training investments by assuring that other firms make similar investments. Similar policies have not been adopted here. Nor, by and large, does the recognition yet exist here that there is a broader public good in having a well-trained workforce that extends beyond the benefits to any firm or worker.

Some studies show that, compared with their untrained counterparts, workers with training can expect higher wages, less likelihood of unemployment and shorter duration of joblessness if they do become unemployed. While other factors affect these outcomes, training can be expected to contribute to broad societal benefits stemming from a highly productive workforce. To the extent that such

[7]Programs for retraining and reemploying displaced workers were addressed in previous OTA reports. See *Technology and Structural Unemployment: Reemploying Displaced Adults* (OTA-ITE-250), *Plant Closings: Advance Notice and Rapid Responses* (OTA-ITE-321), and *Trade Adjustment Assistance: New Ideas for an Old Program* (OTA-ITE-346). Better coordination of these programs, and their integration with any new training initiatives, is needed.

a workforce might command better wages, and their employers' realize higher profits, government tax revenues would increase to defray part of the public's investment in training. There also are likely to be reductions in public costs associated with unemployment.

U.S. society has a categorical interest in seeing to it that a high skill industrial system, one able to justify high wage jobs and rising living standards, is developed and maintained. This is a fundamental justification for public investments in training.

As it considers possible policy directions, Congress might wish to evaluate the degree to which proposed actions support not only industry training but also contribute to broader societal goals. For example, actions to improve the overall skills in the workforce would help not only firms but also workers adjust to the demands of new technology and changing competitive circumstances in the coming years. For workers without much formal education, workplace training can be a major source of learning and the last chance for upward mobility.

The American system of federalism offers numerous alternatives for allocating responsibilities among levels of government and the private sector. State governments, for example, are better positioned to provide direct services to fins. The States already provide modest assistance in customized worker training, as well as technology and industrial extension services and support to community colleges. In the long-term, States may beef up these programs as well as expand assistance into other areas; for now, their scope is small, and both scope and quality vary greatly from State to State.

There are aspects of training support that need to be carried out at the national level, either to achieve equity or uniformity, or to promote national goals. The Federal Government, for example, is in the best position to gather and analyze data about national trends in training. There also is a clear Federal role in research, evaluation, and dissemination of best training practices, especially since the military and some other Federal agencies maintain their own training programs and are major supporters of training research. State programs generally are motivated by competition for economic development; Federal assistance and policies could help dilute the rivalry. As mentioned, other countries' national policies help protect firms' training investments by ensuring that other firms are making similar investments. Only the Federal Government could take meaningful action to accomplish such a broad objective. A well-trained and educated workforce contributes to a broader public good—a higher standard of living and a healthy national economy with a satisfactory balance of trade-that transcends the interests of any State or industry.

Within this context, OTA examined 16 policy options that address four broad issue areas:

A. reducing barriers to company training,
B. upgrading individual workers' skills,
C. providing training and technology assistance, and
D. enhancing the quality and effectiveness of training.

Table 1-7 lists these 16 options and indicates the approximate level of Federal involvement and expenditure, as well as the policy goals they would promote. The options are discussed briefly below; additional detail may be found in chapter 2.[8]

Some options would extend existing but very limited Federal support for worker training; others would significantly expand the Federal role. None are mutually exclusive, although some combinations would require free-tuning. Indeed, packages of options could be devised that represent differing degrees of Federal involvement. An incremental package that builds on current Federal assistance for training research and demonstrations, program evaluation, and best practice dissemination, for example, represents a modestly supportive but indirect Federal role. A broader version of such a role would add programs such as workplace basic skills demonstration projects and permanent tax incentives for employer-paid tuition. A still broader approach might add new initiatives such as support for industry training consortia, funding for State clear-

[8]Even if fully implemented, these options comprise only a portion of a national strategy for human resource development. Other segments related to displaced workers have been addressed in previous OTA reports cited in footnote 5. Several OTA reports also address issues associated with education. See *Power On! New Tools for Teaching and Learning (OTA-SET-379), Linking for Learning: A New Course for Education* (OTA-SET-340), *High School Vocational Education: Measures of Program Performance* (OTA background paper), *and Elementary and Secondary Education for Science and Engineering (OTA-TM-SET-41).* For a discussion of human resources in manufacturing, see *Making Things Better: Competing in Manufacturing* (OTA-ITE-443), ch.4; for services, see *International Competition in Services* (OTA-ITE-329), *chs. 7* and 8.

Table 1-7—Summary of Federal Policy Options

	Degree of increase in level of Federal involvement[b]	Change in level of Federal expenditure or revenue loss[c]	Policy goals promoted[a]						
			Encourage all private training	Help small firms	Promote high skill work organization	Improve knowledge of best practices	Help upgrade basic skills	Encourage State programs	Improve training data
Issue Area A: Reducing Barriers to Company Training:									
1. Help firms set up training consortia	M	S-M	X	X	X	X	X	?	?
2. Expand technical assistance to trade associations and others	M	S-M	X	X	X	X	X	?	?
3. Establish limited tax credit for corporate training	M	L	X	X	X	?	X	?	X
4. Phase-in payroll-based national training levy	A	S	X	X	X	?	X	X	X
Issue Area B: Individual Workers and Retraining:									
5. Expand apprenticeship concepts	M	M	X	X	X	X	?	X	?
6. Fully fund Federal vocational programs	M	M	X	X	X	X	X	X	?
7. Fund workplace basic skills programs	M	M-L	X	X	X	X	X	X	?
8. Provide favorable tax treatment for continuing training	S	M-L	X	X	?	?	?	?	?*
9. Evaluate ways to help workers finance continuing education[d]	S	S	X	X	?	?	?	?	?
Issue Area C: Training and Technology Assistance:									
10. Coordinate technology and training assistance	S	S-M	X	X	X	X	?	X	?
11. Help States include training in industrial extension services	S	M-L	X	X	X	X	?	X	?
12. Support creation of an employer institute for workplace-based learning	M	M	X	X	X	X	X	?	?
Issue Area D: Improving the Effectiveness and Quality of Worker Training:									
13. Encourage adoption of best practice approaches and technologies	S	S	?	?	X	X	?	X	?
14. Fund the Federal Training Technology Transfer Program	S	S	X	X	X	X	X	X	?
15. Fund more civilian learning and training technology research	M	M	?	X	X	X	X	?	?
16. Improve the data about work-based training	S	S	?	?	?	?	?	?	X

[a]X = would clearly further goal; ? = little or unclear effect.
[b]S = small; M = moderate; A = aggressive.
[c]S = small ($10 million or less); M = moderate ($10 to $100 million); L= large ($100 million plus); a range indicates that it depends on how the option is implemented.
[d]Note that this option refers only to evaluation; actual implementation would be more aggressive and costly.

SOURCE: Office of Technology Assessment, 1990.

inghouse services, or legislative mandates for technical assistance.

Incremental approaches would have low initial implementation costs; many of their features are in place or being considered by Congress. However, if funding stayed at the initial level only, they would do little to change companies' fundamental training practices. The States would play the primary government role, with implementation priorities likely to vary greatly, and corporate training would continue to be delivered unevenly. For long-term effectiveness, even an incremental strategy would need to lead to sustained Federal support for meaningful impact. Thus, as shown in table 1-7, many options that might initially involve relatively small Federal expenditures (under $10 million) might need to expand in time to over $100 million annually to have much impact.

To overcome the barriers that inhibit American companies from providing widespread training, Congress would have to choose more far--reaching initiatives. The largest single potential impact on corporate training with little or no direct effect on Federal revenues would come from a payroll-based levy.[9] A levy would fundamentally change training practices among *all* employers (including government and small business). But many firms would see it as an unwarranted intrusion. Business cooperation might be more forthcoming if a new institution-outside existing government agencies—were chartered to work with industry and labor on issues related to new technology, work organization, and training. Other options, including direct assistance or tax incentives for workers and firms to undertake specified forms of training, would have less pervasive impacts than a levy. Moreover, if not formulated carefully, tax options could have great potential for abuse (e.g., writing off executive seminars at a resort as training). Nonetheless, all these measures would give national attention to worker training for competitiveness in the new international economy.

Issue Area A: Reducing Barriers to Company Training

Barriers to company training arise from limited funds to support training, inadequate understanding of training needs, lack of knowledge about good training practices, and reluctance to train young and older workers. There are several approaches Congress might consider to alleviate structural barriers to company training. One possibility would be to encourage firms to participate in training consortia (Option 1). A bill introduced in the 101st Congress (S.2114) would establish a Labor Department training program to provide start-up grants to firms interested in establishing consortia. A program of this sort, if initially funded at a level of a few million dollars per year, could be a low-cost means for the Federal Government to encourage joint ventures that would help share the risks of training, increase the resources available to small firms, and allow more cost-effective development of training materials. The Federal Government might also earmark some funds to consortia that emphasize transferable skills (e.g., basic skills, apprenticeship or other certification).

A related possibility would be to expand technical assistance to trade associations and other industry groups and to joint labor-management organizations to aid in developing training programs for their members (Option 2).

Congress might also give the Department of Labor (which now funds such services on a more or less ad hoc basis) an explicit mandate to provide technical assistance for work-based learning and charter an office to provide support services on a continuing basis. With more funds, the office could work to increase industry involvement in developing training materials.

The Federal Government also could use tax inducements to make training investments more attractive. A limited tax credit for certain kinds of training+. g., basic skills training or classroom training associated with apprenticeships-might encourage more firms to engage in these forms of training (Option 3). Unless carefully defined and monitored, however, a tax credit could involve sizable revenue losses to the U.S. Treasury without a corresponding increase in the desired training activities. Congress might first instruct the Treasury Department, in cooperation with the Department of Labor, to study the optimal design of such a credit. To better predict the behavior of firms, a field test

[9] In the short term, there could be some reduction in Federal revenues from corporations if firms use otherwise taxable income to cover a training levy. Over the longer term, Federal revenues might increase if productivity improvements accruing from a better trained workforce led to greater profitability.

could be conducted in which companies would be reimbursed for eligible training costs at a level equivalent to a tax credit. If the study showed that a credit would increase and improve worker training, Congress could then decide whether the benefits outweighed the expected revenue losses.

A national training payroll levy, perhaps more than any other action, could guarantee increases in training—and could do so with no direct loss in Federal revenues (Option 4). Companies would choose between either spending a specified percentage of their payroll (say, 1 percent initially) on particular types of training, or contributing that percentage to a national fund for training initiatives. Several other countries (including France, West Germany, Ireland, and South Korea) use payroll-based levies of various types to encourage employers to train workers. In the United States, four States now raise training funds through a small payroll-based levy.

As an alternative to immediate implementation, Congress might phase in a training levy. The initial stage could be devoted to developing industry-sector information about training costs and aiding firms in identifying their training needs. During the initial period—perhaps 3 years-firms could either report their annual training expenditures or pay the 1 percent payroll levy. As reporting firms would not pay the levy even if they spent nothing on training, the main burden of the requirement would be the paperwork involved in calculating training costs. The reporting requirement would alert firms to the need to develop a training strategy. At the end of the 3-year period, Congress would then have information on training norms within industry sectors that would be helpful in fine-tuning the levy before full-scale implementation.

Issue Area B: Individual Workers and Retraining

Although the United States has an extensive adult education system, the employer is still the primary source and incentive for education and training for many employees. Most large and medium-sized firms provide broad training for professionals, technicians, and managers. But few firms train production workers (except for specific needs), younger entry-level workers (those most likely to move to another job), and older workers (the fastest growing segment of the U.S. workforce). Minorities also get less training. Despite growing corporate concern about basic skills, few employers have remedial programs or offer support (e.g., paid leave) to workers who participate in public programs. Federal policies that would encourage greater investment in transferable skills training would be beneficial to employees and employers alike.

Apprenticeship has long been one of the best examples of a training program that develops the technical skills firms need while at the same time providing workers with a credential that leads to a better paycheck. Yet, the American apprenticeship system is stagnating. The Department of Labor has been looking at ways to revitalize traditional apprenticeship and also at ways to apply apprenticeship concepts—including portable credentials-to industries with little history of apprenticeship (e.g., service industries). Yet funds (in real terms) and staff for the Bureau of Apprenticeship and Training have fallen. More funding will be needed if the Bureau is to do much to revitalize traditional apprenticeships. The Department of Labor also might work with industry to develop national standards for certification of skills for trainees in industries that do not have apprenticeship traditions (Option 5).

Congress also could expand assistance available to firms for certain activities+. g., basic skills training and vocational skills upgrading-that make it easier for employees to participate in training (Option 6). The major Federal vocational education law is undergoing reauthorization in the 101st Congress. In the summer of 1990, a conference committee reported a vocational education measure that reconciled differences between bills passed by the House and the Senate. If enacted, the measure would charnel more support for integrating secondary school vocational and academic curricula. It also would authorize some support for upgrading of skills of employed workers (including apprenticeships). Because of the measure's breadth, it is unclear whether funds will be adequate to support all these activities.

Congress is also considering a major new literacy initiative, which, if passed, would greatly expand the available Federal assistance for workplace basic skills (Option 7). A Senate-passed bill (S.1310) would increase funding for basic skills training under the Federal Adult Education Act and would authorize $50 million for the Education Department's workplace literacy demonstration grant pro-

gram (current funding is ***$20*** million). A House-passed measure, Title V of H.R. 5115, also would increase Adult Education Act funding, and would establish a new ''national workforce literacy strategies program.' The bill would authorize up to $40 million per year in grants to improve current workforce skills on a regional, statewide, or industry-wide basis. Both bills would also expand literacy activities in other areas (e.g., research) as well. Whatever approach is taken, Congress may wish to ensure that the special needs of workers in small business are also addressed, and that research on, and evaluation and dissemination of, the most effective approaches are required.

Another existing law—a provision in the tax code that exempts workers from paying taxes on educational assistance from their employers—will expire in 1990 unless renewed by Congress. Continuing the exemption (Option 8) would cost the Treasury an estimated $255 million in fiscal year 1991, with the amount possibly rising after that, but would mean that few workers would halt their own retraining efforts for tax reasons.

While employer assistance programs only reach a small portion of workers, and many workers cannot afford to finance their own continuing education, the Federal Government administers a number of student aid programs that workers might use to finance continuing education. For the most part, however, these programs are more oriented toward full-time students, than employed adults. Special incentives have been suggested to extend these programs to workers' continuing education needs, such as proposals to loan workers education funds that would be paid back through an income tax surcharge. Other alternatives would guarantee all Americans some level of financing for post-secondary education at some time during their lives. Because they could be expensive and because they have significant potential for abuse, such proposals would need careful evaluation before decisions were made (Option 9).

Issue Area C: Training and Technology Assistance

Training can make or break the effectiveness of new technologies and work practices. While knowledge about the most effective training approaches is increasing, the process of diffusion can be quite slow—few firms share successful techniques with potential competitors. Expansion of government efforts to disseminate information and provide technical assistance could help speed diffusion.

Several Federal agencies—including the Departments of Commerce, Labor, and Education—now have demonstration projects and other small programs that provide training or technology assistance to firms (either directly or through the States). If Congress expanded these efforts, it might designate a lead agency (e.g., the Department of Commerce) to work out coordination among these programs so as to provide greater benefits to firms (Option 10).

In addition, the Federal Government could help State governments expand their training assistance to firms (Option 11). States have long used training subsidies to entice firms to relocate. Now, as part of their efforts to retain firms and reduce unemployment, many States have modest training programs to help existing firms upgrade their workforces. A handful of States give workforce skills development a prominent place in their growth strategies. While such State activities are promising, there has been little in-plant evaluation of their training programs. At a modest cost, the Federal Government could provide funds for such evaluations and dissemination of the results to other States and the private sector.

Some States also help firms with production technology and management. Such State industrial extension programs could help firms identify their training needs as well, but, aside from referrals, few now do. Moreover, as discussed in the recent OTA report, ***Making Things Better,*** total State funding for such programs in 1988 was only $58 million. A small Federal grant program was authorized under the 1988 Trade Act, but funds were not appropriated until fiscal year 1990, and then only to the tune of $1.3 million. If Congress decides to appreciably increase this funding, it might encourage States to experiment with different ways to combine or more closely coordinate their training and technology services. Funds to finance such experimentation could be made available to the National Institute of Standards and Technology (NIST) in the Commerce Department (Option 11). NIST also might provide expanded training to workers and managers at its national manufacturing technology transfer centers. Such activities could help achieve better coordination in the delivery of both technology and training services to fins.

The human resource development issues related to the organization of work and workplace learning currently receive scattered and sporadic attention. No single institution at present addresses workplace learning issues over the range from research and development to and best practice dissemination issues. A new organization, with an explicit charter to address such concerns, might bring new visibility to the need for employers to adopt more effective human resource development practices (Option 12). A National Institute on Workplace Learning, to be effective, would need to have extensive employer involvement. In fact, to have the greatest impact on industry, such an organization might well need to be outside the traditional agency structure of the Federal Government. Startup Federal funding would be needed. In time, employers might fund such an institute on their own if the benefits were clear.

Issue Area D: Improving the Effectiveness and Quality of Worker Training

Increased Federal support for work and learning research and for development and dissemination of new training technologies could bring, in time, substantial benefits to the entire training system, both public and private, at comparatively modest cost. The quality of training varies greatly. Some U.S. firms are world leaders in training. However, most firms (and many training institutions) know little about the best practices for training or about the latest training techniques and technologies. Moreover, research on how adults learn-research that could, over the long term, lead to improvement in the efficiency and quality of training-often fails to be integrated into training practices. One possibility (Option 13) would be for Congress to direct Federal agencies with education and training programs (e.g., Defense, Education, Labor, Commerce, Health and Human Services) to develop and disseminate information about best practice approaches and technologies. Congress could, for example, support efforts by NIST to gain industry acceptance of operating standards for training technologies and related software. Such standards, if adopted, would facilitate use of training products. It also might support Federal agency efforts, now informal, to disseminate information on training technology.

The Federal Government, historically, has played a major role in developing new instructional technologies and approaches for the Defense Department and other Federal agencies (see box l-E). Increased efforts to disseminate federally developed

Box l-E—The Military and Training

The military **is the** largest single institution in the United States that recruits and trains young people (see report appendix). The military model for skills training is similar to apprenticeship, except that the "related instruction" which takes place simultaneously with on-the-job training in traditional apprenticeship is front-loaded in the military. That is, recruits receive intensive classroom instruction after basic training, followed by on-the-job training coupled with written and practical skills tests.

There are several basic differences between military and conventional private-sector training. Private firms expect young workers to move on within a year or two, while the military recruits for 3- to 4-year tours of duty. A small percentage stay in the military for a 20- to 30-year career. Further, the military model is "up or out"; if recruits do not pass training and move up, they typically are discharged. Military training also is based more on job analysis and job-specific performance standards than most private-sector training. Military training is constantly evaluated, with feedback from the users of the training-the trainees' commanders. Also, instructors are rotated, conducting training for 3 or 4 years at a time and then returning to the field. Thus they maintain and upgrade their duty *skills.*

Instructional technology is more prevalent in military training than in the civilian sector. The military has a high interest in training technology for several reasons. It has an extremely high turnover rate but a large population worldwide. Instructional technology provides both the portability and consistency to meet the needs of this type of population. The military also frequently introduces new equipment that has increasingly sophisticated and complex capabilities. In addition, it can afford the startup costs associated with hardware and software development.

Although the bulk of training is still lecture/lab with practice on real or simulated equipment, the military is rapidly adopting more sophisticated training technology. Current changes in training systems requirements and technologies include trends toward simulators, networking for team training, and embedded training systems.

SOURCE: Office of Technology Assessment 1990.

or sponsored training materials and expertise to the civilian education and training communities have been underway for several years, with limited success. In the 1988 Trade Act, Congress directed the Department of Education to establish a training technology transfer office, but did not appropriate funds. The Administration also has been slow in setting up the office. Thus, implementation cannot be expected to begin in earnest until fiscal year 1991 at the earliest. Initial funding of this office-at least at the $3 million level originally called for in the Trade Act-could help launch this program effectively (Option 14).

Even if such efforts are stepped up in the years to come, the need for more evaluation of workplace training and the educational system would remain. Promising techniques need evaluation so that best practices can be disseminated with some confidence to potential users. Various proposals have been made to set up a national institute for learning technology and research, either through an existing Federal entity or outside of the normal Federal structure (Option 15). The Education Department also could expand its support for education research and development centers to include more emphasis on workplace and adult learning issues. The National Science Foundation could support research on human resource development, work organization, and issues associated with training technology adoption. While Federal funding for such activities would need to be sustained over a period of years, the potential benefits could be substantial. The Federal support could lead to more effective training practices in the longer term. Given the fact that the workforce is aging, remarkably little research has been conducted on the most appropriate training practices to meet older workers' learning needs. Earmarked support for such research may be needed if it is to be sustained.

Finally, information about the extent and effectiveness of workplace training is very poor. If Congress would like more knowledge about worker training trends, it could direct the Census Bureau, the Labor Department, and the Education Department to develop and periodically update information on workplace training (Option 16). Data collection could be done through separate directives to these agencies or as part of an overall review of Federal statistical priorities. The impacts of worker organization and worker training on productivity, efficiency, and competitiveness are pervasive. Sound policies in the future will depend on knowledge of effective practices and their extent.