

Chapter 10

workplace Technology and the Employment of Older Adults

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workplace Technology and the Employment of Older Adults

Introduction

The structure of the American economy has undergone major changes since the mid-1800s. In 1850, the largest sector of the economy was farming, which employed 64 percent of the labor force. Each farm worker of that era produced enough food for four people. As the mechanization of farm work progressed, more food could be grown and harvested by fewer workers. Machines such as the cotton gin, tractor, plow, and reaper revolutionized productivity to the point that although only 3.1 percent of today's workers are farmers, each farmer provides enough food for 78 people (37).

By the 1900s the mechanization of farming had substantially lowered the prices of many products. Spinning and weaving machinery, for example, combined with the cotton gin to reduce cotton prices. The concomitant decline in need for farm labor pushed workers into urban areas, where factory employment was available. By 1920, two of every five jobs were in the manufacturing industry, and the share of farm employment had fallen to 11 percent (37).

Today, the concentration of jobs in the economy is shifting once again; manufacturing jobs are giving way to service sector employment. During the manufacturing boom of the 1920s, service employment accounted for only 11 percent of the work force. In the 1980s, the growing number of two-earner families has spurred interest in dining out, traveling, and a range of other support services for busy families. As a result, new jobs in the service sector abound, and the proportion of jobs in this sector rose from 11 percent in 1920 to 22 percent in 1982. At the same time, the emphasis on efforts required by occupations within these industries has shifted from physical to mental as machines take over many manual functions.

Today, workers 45 and over (hereinafter called "older workers") are largely located in the industries and occupations that offered good job prospects at the time they chose their careers. Older workers are concentrated in manufacturing industries, which, though declining during the 1950s, continued to hold the largest proportion of workers. **Both service and trade were then expanding.** The country was experiencing growth and workers expected bright futures.

The unprecedented, explosive pace of recent changes in workplace technologies may, however, be threatening future job security of older workers. Advanced production technologies, computers, and robotics were not available when today's older workers were training for careers. New computer and technology-dependent jobs are becoming an increasingly larger share of the total job pool. Thus, workers lacking in appropriate technical skills have a decreasing number of employment opportunities. To remain employed, some older workers may be forced into low-skilled, low-paying jobs. Others may receive extensive on-the-job training but may be forced to retire. Older workers who lose their jobs are likely to have difficulty finding new employment at previous pay levels.

Technology may also oust older workers from jobs in declining industries and occupations. New technology in these industries is making some jobs obsolete as machines substitute for human labor. The most rapidly declining industries are in manufacturing, and many of the declining occupations are in private household services and farming—all of which hold high proportions of older workers.

But just as technology threatens some older workers' chances of continuing in jobs they cur-

rently hold, it may be a boon for others. Technology is creating additional jobs in many of the other industries and occupations in which older workers are concentrated, and new service sector and clerical jobs may provide opportunities to some older workers. These growing industries and occupations may also signal opportunities for part-time work, which is a goal of many older workers. It is also a goal of women of all ages, whose number in the labor force is rapidly increasing and who may be a source of competition for these jobs.

Technology can be particularly helpful to older workers who have physical impairments, by offering them assistive **devices to compensate for waning physical strength, eyesight, or hearing.** **Use of these devices can improve employment prospects for those not ready for retirement.**

Technology can also benefit workers who are involved in physically hazardous jobs or who work with dangerous chemicals or materials. Machines are likely to replace many workers who once risked disease, disability, or death from years of exposure, freeing them to take less hazardous jobs.

Technology, older adults, and employment opportunities

Workplace technologies vary from simple tools and implements for individual workers to complex production systems that involve thousands of workers. The effects of technologies are equally varied—they eliminate old jobs and create new ones, enhance working conditions for some and act as barriers to employment for others.

Employment and the effects technology may have on an individual's work and work opportunities can be examined in relation to the economy's various segments: nine industrial sectors, each of which contains up to nine classes of occupations that in turn include various types of jobs. Technology can influence work in any or all of these categories.

As the requirements of many jobs change, continuous training and skill updating are becoming necessary components of work. Few opportunities for retraining of workers are available today, but it seems that older workers, for a variety of reasons, have even fewer training or retraining opportunities offered to them. This practice could change in the future, however, as the work force ages and as retraining becomes more common.

Technology can thus both help and hinder older workers' ability to continue working. If, on the one hand, current trends in innovation and implementation of mechanization continue, technology is likely to reduce opportunities for older workers or, at best, be neutral. On the other hand, technology has the potential to expand opportunities for older workers and to improve their working conditions. The future growth of workplace technologies and their impact on older workers are likely to require scrutiny by policymakers to improve the quality of worklife and provide job security for the total labor force.

Each of the potential effects of technology may, in turn, have an effect on workers over 40.¹ Little research has been conducted on the special problems faced by older workers as a result of new and changing technology, but the current state of technological change does not appear to be a major concern for older adults.

¹For purposes of this study, most of which is focused on workers over 45, older workers are defined as employees aged 40 and over, because this is the age: 1) at which protection from discriminatory hiring and firing practices begins under the Age Discrimination in Employment Act (ADEA) of 1978; 2) at which many workers begin to notice changing occupational opportunities; 3) designated in much of the research literature as older employees; and 4) of those aged 40 to 45 in 1980 who will be 60 to 65 in 2000, the period generally covered in this study.

Technology and job opportunities

LABOR FORCE PARTICIPATION TRENDS OF OLDER WORKERS

Patterns of labor force participation of workers 45 and over have been changing steadily since the early 1900s. For men, labor force participation has declined across all older age groups over time. Between 1940 and 1983, participation of men 45 to 54 fell from 96 to 91 percent, participation of men 55 to 64 dropped from 87 to 70 percent, and the proportion of men over 65 in the labor force declined dramatically from 45 to 17 percent.

Patterns for women have taken a different course. The composition of the labor force has changed to include far more women; 43 percent of today's U.S. workers are women. In 1940, 24 percent of women aged 45 to 54 worked outside the home; this figure rose to 62 percent in 1983. The participation of women aged 55 to 64 also increased—from 19 to 42 percent—while participation of those over 65 remained relatively steady at 7 percent in 1940 and 8 percent in 1983.

According to 1983 data, large numbers of men and women over 65 were in the labor force but overall **participation** rates obscure substantial variation among more detailed age groupings. Although participation for men over 65 was shown to be 17 percent, 25 percent of those 65 to 69 were working compared with 17 percent of those 70 to 74 and only 8 percent of those over 75. The pattern is similar for older women. Aggregate data show participation rates to be 8 percent; this consists of 15 percent for women 65 to 69, 8 percent for those 70 to 74, and 3 percent for women over 75. This age-based trend is similar within each racial group.

Although participation *rates* of workers over 45 have fallen since early in the century, the **numbers** of those working have increased. In 1950, approximately 22 million workers were over 45; by 1983 the number of workers in this age group totaled almost 32 million. The 55-to-64 age group reached 12 million in 1983 (up from 8 million in 1950) and there were 3 million workers over 65 in both 1950 and 1983. These increases in num -

bers have occurred **despite drops** in participation rates.

Several factors are said to account for the decline in proportions of older workers. Some companies relieve the excess in their labor forces by offering incentives to older workers to retire early. Poor health has also been a limiting factor in work participation, as discussed later in this chapter. In addition, some legislation has supplied incentives to leave the labor force by age 65 or before. The availability of Social Security and private **pensions often makes it financially feasible for workers** to retire before 65.

Though the labor force participation rates of older men are expected to continue declining, current and proposed legislation that influences the choice to retire or remain employed does not encourage early retirement. Recent amendments to the Social Security Act raised the start-up age for collecting full retirement benefits from 65 to 67, which will be phased in between 2000 and 2022. The 1978 amendments to the Age Discrimination in Employment Act (ADEA) raised the age at which employees can be forcibly retired from 65 to 70. Recommendations to streamline the Medicare system have proposed raising the age of eligibility from 65 to 67 to encourage people to continue working in order to be covered by insurance plans.

INDUSTRY TRENDS

Since 1900, changing technology, coupled with shifts in consumer demand, has redistributed the concentration of jobs among industries. In 1900, 36 percent of jobs were in manufacturing, 16 percent in trade, and 11 percent in services; today only 20 percent of jobs are in manufacturing while the trade and service industries each account for 22 percent. Between 1969 and 1979, almost 90 percent of gains in total employment occurred in the service-producing sector.

These sectors—manufacturing, service, and trade—are those in which workers over 45 are most likely to be employed. Men between 45 and 64 are most likely to be involved in manufactur-



Photo credit Alonzo Zamorra

Some older workers are employed in trade or service occupations that have not been affected by technological change.

ing; men over 65 are most often employed in services; and women over 45 are most likely to have jobs in the service sector.

OCCUPATIONAL TRENDS

Major economic shifts can be seen in growth comparisons of white-collar, blue-collar, and service workers over time. In 1940, workers employed in these occupations accounted for 31, 57, and

12 percent of the labor force respectively. By 1980, these percentages had shifted to 54 percent, 34 percent, and 12 percent (13). This increase in both numbers and proportion of white-collar workers indicates that jobs are becoming less physically demanding and require more intellectual skills.

The potential effects of changing technology on older workers are seen in comparisons of occupational trends by age. Among male workers 45 to 64, the greatest number (21 percent) are in crafts, followed by managerial workers (19 percent), and professional/technical occupations (17 percent). The highest percentages of men over 65 are in management (18 percent, or 2 percent of all management workers), the next highest in professional/technical (15 percent, or 2 percent of all professional/technical workers), and service (13 percent, or 2 percent of all service workers) occupations.

The pattern for female workers is again very different. Employed women 45 to 64 are concentrated in clerical jobs; 40 percent of all working women 45 to 64 are clerical workers. Lower proportions are involved in service (21 percent) or professional/technical (19 percent) work. Women over 65 are most often found in clerical (25 percent, or 2 percent of all clerical workers) or service (21 percent, or 2 percent of all service workers) occupations; 10 percent of all private household workers are women over 65.

Regardless of the number of older workers across occupations, certain occupations, particularly farm, private household, and managerial occupations, have higher concentrations of older workers. Half of all farmers and farm laborers are men over 45 (14 percent are men over 65). Thirty percent of managers and administrators are men over 45. Among private household workers, 2 of every 5 are women over 45 (1 in 10 is over 65) and 1 in 5 of those employed in a clerical occupation is a woman over 45.

Large proportions of today's older workers are being affected by new technology as it rapidly changes the ways in which work is done. But little is specifically known about the extent of the influence of technology, or whether older or younger workers are more influenced by it. It is

clear, however, that workers of all ages will need to adapt to changing needs for skills.

Several examples illustrate this point. The nature of clerical jobs is undergoing significant change. Many offices are switching from electric typewriters, which process one page at a time, to computers and word processors that can edit, store, and print lengthy documents in seconds or minutes. The quality and speed of these document printers has increased from a printwheel print-time of 2 minutes per page to laser printers that produce typeset quality print in only 4 seconds per page. Executives of the future can expect to dictate directly into a sophisticated computer that understands spoken language and can type the document simultaneously as it is dictated. There may thus be fewer clerical workers needed in the future, and secretaries may need word processing, editing, and proofreading skills rather than typing skills.

Service jobs are also changing. For example, telephone operators' jobs are changing as companies install computerized switching equipment. Computers take incoming calls and distribute them to available operators. In some locations, though the human operator may take requests for specific phone numbers, the numbers are spoken to the requester by a computer-synthesized voice while the operator takes the next call.

Computers will make the jobs of some managers easier and may, in some companies, eliminate some middle-management positions. Computers allow greater and faster corporate access to information and the ability to monitor the work being performed by staff. In addition, experts believe that computers can widen the span of control of middle management so that fewer managers will be needed to supervise the same number of employees (5).

Computers may also simplify such professional/technical jobs as those of scientists. Quick access to data bases and the use of special software packages that perform difficult and time-consuming calculations and create special graphics are among some of the improvements. Architects can now rely on computer-generated renderings for some types of layouts, dramatically reducing the time required to produce the final blueprints.

Eventually, the jobs of many private household workers who are over 45 are likely to be directly affected by robots that can perform housekeeping chores. Some high-cost robots now available can be programmed to do such jobs as window-washing, floor-mopping, and vacuuming. Human workers may provide supervision and maintenance to these mechanical helpers.

Although technological change may reduce job opportunities for some older workers as new technologies continue to emerge, other older workers will be able to compete with younger workers for jobs that require new combinations of skills.

JOB TRENDS

In specific industries or occupations technological advances will both change the way people do their jobs and greatly reduce the number of jobs. When jobs are eliminated, the workers who held them are said to be displaced, i.e., unable to find the same type of work again.

Despite the absence of comprehensive data, it is clear that technology, as well as other factors, has displaced some laborers, service station attendants, stenographers, and workers in printing, agriculture, longshoring, communications, mining, and textiles (1,24,37,38,39,45). **Several hundred thousand metalworking positions and thousands of white-collar jobs are estimated to have been lost due to technological innovation over an extended period of time (8). For example, the crafts occupations—which include printing and some metalworking occupations—employ a large percentage of older workers. Because roughly one-third of workers in white-collar jobs are over 45, and the percentage of these jobs is expected to decline slightly through 1995, older workers in these occupations are also at risk of losing employment.**

A small degree of displacement among older workers has been documented, but the data on displacement do not distinguish between technological change and other causes of job loss. A longitudinal survey begun in 1966 found that 7 percent of men over 45 in a national sample had suffered an involuntary job loss over a 10-year period. Occupation, age, and education had little



Photo credit: Alonzo Zamorra

Technological advances are displacing some service station workers.

effect on the probability of older worker displacement. Displacement occurred more frequently in the private than in the public sector and less frequently in companies with pension benefits. Displacement rates were, however, higher in the manufacturing and trade industries, where older workers are most heavily concentrated (31).

The impact of technological change on currently employed workers is unclear. Many labor union officials contend that the use of robotics and other technological innovations will displace workers. Some industry officials estimate that computer-integrated manufacturing systems reduce labor requirements by between 3 to 1 and 20 to 1 (48). Manufacturers and users of these machines argue that any employment impacts will be considerably reduced by attrition, retirement,

and retraining of existing workers (45,50). Observers in the automobile industry argue that although technological innovations such as robots may cause immediate displacements, they will ultimately create more jobs by making the United States more competitive with foreign producers (8). Technological advances are also expected to create totally new areas of work.

Unemployment is a common consequence of displacement. Although one-third to one-half of those who lost jobs moved to new employment almost immediately, an additional one-third were unemployed up to 13 weeks, and the rest were unemployed longer than 13 weeks. The period of unemployment, however, was contingent on the economic conditions at the time of displacement. As might be expected, those unemployed in an unfavorable job market had longer periods of idleness than did workers displaced during better economic times. The state of the economy is thus likely to be very important to an older person's ability to keep or get work.

A 1980 report found unemployment significantly related to the decision to retire early; that "older male workers are being forced out of the work force by a variety of factors such as age discrimination, and technological obsolescence . . . Retirement legitimizes withdrawal from the work force in the face of difficulties finding suitable work" (6). Even when such factors as health, socioeconomic status, available income, etc., were taken into account, unemployment was associated with early retirement. The study also found that for white workers, 1 week of unemployment encouraged workers to retire to the same extent that \$1,000 in savings, stocks, and bonds would affect this decision.

one of the most striking effects of displacement and unemployment is the reported reduction in wages upon reemployment. The Parries longitudinal study found that the major lasting effect of displacement was lower wages; those who had been displaced experienced average earnings that were 22 percent below those workers who had not been displaced (31). A study of the automobile and steel industries found that when displaced workers became reemployed, they did so at lower earnings than they had previously enjoyed. The authors estimate that displacement resulted in a

permanent earnings loss ranging from 7 to 15 percent of annual income (20). Another study of displaced workers found hourly wages averaged 33 percent lower at reemployment (46).

Job tenure, which is strongly associated with age, also influences wages at reemployment. The longer the tenure, the greater the relative loss in earnings upon reemployment (20). The Congressional Budget Office estimated that displaced workers with fewer than 10 years seniority were, after 2 to 6 years, earning 91 percent of what they would have earned had they not been displaced. Workers with 10 to 20 or more years of service had wages 81 and 75 percent, respectively, of what they would otherwise have earned. Some experts estimate that \$50 for every year over age 25 is lost at reemployment after displacement (14).

Older workers also experience longer periods of unemployment than do younger workers (in 1981 the mean duration of unemployment was 14.8 weeks for workers 25 to 54, 18.3 weeks for workers 55 to 64, and 16.0 weeks for workers over 65). This long period of unemployment may result in discouragement, feelings of futility, and eventual discontinuation of efforts to find new employment. Data from the Bureau of Labor Statistics reveal the magnitude of the increase in unemployment rates when discouraged workers are included. The 1968-81 period showed an average increase from the adjustment of 0.5 percent for men and 1.2 percent for women in the 25 to 54 group; 0.5 percent for men and 1.5 percent for women in the 55 to 64 group; and 3.2 percent for men and 4.7 percent for women in the over-65 group. As a result of their discouragement, some older adults who have been displaced from their jobs may choose to retire.

Both displacement and unemployment can affect retirement income. If displacement occurs before one is fully vested in a pension, pension income can be completely lost. Furthermore, since Social Security benefits are calculated on the basis of earnings, lower wages at reemployment can lead to lower Social Security income following retirement.

The future

THE PROJECTIONS

Estimates of the size of the future labor force and levels of industrial and occupational employment are based on varying sets of official government projections. The most frequently used projections are those developed by the Department of Labor's Bureau of Labor Statistics (BLS). Industry, occupation, and labor force projections are available to 1995, although they are generally acknowledged to be reasonably accurate for no more than 5 or, at most, 10 years. High, middle, and low projections reflect varying assumptions about fertility, mortality, migration, and individual socioeconomic characteristics. occupations that are likely to be affected by automation are identified, but the BLS does not project the impact of automation on employment levels by occupation or determine the number of individuals likely to be displaced by technology.

Though projections of future employment (including labor force, gross national product, employment by industry, and employment by occupation) are invaluable for public planning and private decisionmaking, they depend on accurate anticipation of changes in the economy. Since it is impossible to correctly predict what may occur 10 years hence, three alternative sets of assumptions are developed in order to establish a range of possible outcomes.

Because the art of projection is predicated on the use of numerous assumptions, different combinations of assumptions can produce wide variations in outcomes. Four BLS projections of the 1980 labor force, made between 1965 and 1976, were below actual totals. Much of this discrepancy was due to difficulties in predicting the activities of specific groups. For example, projections of male participation rates were overestimated while female participation rates were greatly underestimated. The participation rate for women 25 to 34 in 1980 was a full 25 percent higher than projected in 1965. For women 35 to 44, projection underestimation errors ranged from 15.2

percent in 1965 to 7.2 percent in 1976. Another problematic projection was for men 55 to 64; the 1965 projections overshot their actual participation rate by 12.3 percent. The 1976 projections were off by only 1.1 percent.

Data Resources, Inc. (DRI), also forecasts civilian labor force participation. Although BLS projections were, on the whole, more accurate (mean absolute deviation between actual and projected figures was 2.0 for BLS v. 2.5 for DRI), the DRI projections were closer to actual participation rates for females, particularly those in the problematic age category of 25 to 34. DRI's least accurate projections, those for women 35 to 44, were still closer than those made by the BLS. Though projections by both organizations can be inaccurate, the BLS projections are used in this report in order to be consistent with Federal usage of these data for policymaking.

Projections of industry and occupation are unavailable by age, largely because of the difficulty of predicting individual job choices, which are based on numerous past experiences, future expectations, and personal decisions. There are thus no projections on which to base estimates of the influence of future industrial and occupational shifts on labor force participation of older workers. Yet certain possible effects can be anticipated, given what is already known about technological change and jobs held by current older workers.

LABOR FORCE PROJECTIONS

Current BLS middle-growth projections indicate that the size of the labor force will increase from 102 million in 1982 to 127 million in 1995. Most of this increase is expected to occur between 1982 and 1990 as the U.S. economy recovers from the recent recession. Between 1990 and 1995, employment is expected to climb, but at a slower rate (34).

Three general trends are projected (12):

- Over the next several years labor force participation rates for women 20 to 44 are expected to continue their recent upward spiral, after which they will return to a slower growth rate than that of the 1970s.
- Labor force participation rates for men over 55 are expected to continue declining, although at a slower rate than during the 1970s.
- Labor force participation rates for men 20 to 44 are expected to continue declining, also at a slower pace than during the 1970s.

The projected labor force for 1995 shows a continuing high percentage of workers under 45 and an increasingly smaller proportion of workers over 55. The group between 45 and 54 in 1995, which includes part of the baby boom cohort, is expected to grow by 4 percentage points, or 10 million workers, from its 1982 total. Middle-growth projections to 1995 suggest a slight growth in numbers of older workers in some age subgroups and a decline in others. In a total labor force of just over 131 million, workers over 45 would account for 30 percent of the labor force (39 million). Of this group, 11 million (8 percent of the labor force) would be 55 to 64 and 3 million (just over 2 percent of the labor force) would be over 65.

The growth in number and proportion of older workers will mean an eventual maturing of the labor force. The labor force reached its highest median age, almost 41 years, about 1960. The recent influx of baby boom workers has sharply decreased the median age to a low of 35 years in 1982. The median age will continue at about this level until 1995, when all the cohorts of baby boom workers will be over 35, boosting the median age to well over 37 years. This maturing of the labor force may enable industry to enjoy higher productivity and lower unemployment over the next 12 years as the individuals who make up the labor force become better educated, have a wider range of needed skills, and gain additional seniority (12).

The direction of future changes in labor force participation of older workers differs markedly by sex, but not by race. The labor force participation rates of men of all races over 45 are expected either to remain constant to 1995 or to decline, in some cases substantially. For instance, participation of white men 55 to 64 is expected to drop from 70 percent in 1983 to 66 percent

in 1995; among those over 65 it is expected to drop from 19 to 14 percent. Black men are expected to show similar patterns.

The proportion of women job holders over 45 in 1995 is expected to increase from 1983 levels. Participation rates for both white and black women 45 to 54 are expected to increase dramatically; a moderate increase is projected for women of both races aged 55 to 64. The participation of women over 65, however, is expected to decrease slightly.

INDUSTRY PROJECTIONS

BLS projections assume that “smokestack industries” will not vanish, and attribute their recent job losses to the economy. Yet manufacturing is expected to grow slightly, accounting for only one of every six new jobs between 1982 and 1995. In key manufacturing industries such as automobiles and steel, previous employment peaks are not expected to be regained. Increasing consumer demand will boost production, but productivity gains through advanced technology and management efficiencies are likely to limit employment expansion (34).

Most of the new jobs—an estimated 75 percent of those added through 1995—will be in the service sector. Within this broadly defined sector, medical care, business services, hotels, personal services, and nonprofit organizations are expected to account for one out of every three new jobs.

Employment patterns in other industries are also expected to change. The trade industry is expected to show large growth while both construction and finance/insurance/real estate are projected to grow moderately. The remaining industries should gain only slightly in employment, with the exception of agriculture, which is expected to decline slightly.

Assuming that the current industrial distribution of cohorts of workers now 45 to 54 and 55 to 64 remains the same in the future, and that labor force growth follows BLS projections, these workers are likely to be employed in industries with high or moderate growth rates. Manufacturing, which has the greatest concentration of workers over 45, is likely to grow moderately,

while services and trade are expected to grow very quickly. This growth in demand for labor could produce more job opportunities for older workers, unless younger workers and mechanization limit these opportunities. Furthermore, since service jobs engage a high proportion of other than full-time workers, and older adults report a desire to do part-time work, the high-growth service sector may play an increasing role in the employment of older workers.

The size of the employing firm has an important effect on the status of older workers. In 1979 about 72 percent of workers over 65 worked in firms employing fewer than 100 people; 39 percent of those 55 to 64 did so. This is particularly significant since about 78 percent of the employment growth in the private sector between 1978 and 1980 occurred in businesses with fewer than 100 employees (this figure does not represent the volatility of these businesses, which often fail within 3 years). The explosion of employment in these small businesses may provide new jobs for older employees who wish to continue working. These firms may be more flexible as to work structure, allowing alternative options to full-time work for employees. Older people are seeking and finding employment in these small establishments. Of those workers over 65 in wholesale and retail trades and the finance/insurance/real estate sectors, the vast majority work in firms with 25 or fewer employees.

OCCUPATION PROJECTIONS

Though demand for products is expected to provide greater impetus for employment shifts than labor-saving technology, automation is likely to change the distribution of occupations. The 1995 forecast for specific occupations shows that the largest redistributive effects will be among professional/technical workers, who are expected to gain just under 1 percent of jobs, and farmers/farm workers, who are expected to lose the same proportion. Operative employment and laborers are also likely to show an overall loss, and managers, craft, and service workers an overall gain. Some specific occupations are likely to decline. By 1995, the proportion of white-collar workers is expected to be 52 percent—close to today’s level. Blue-collar workers are expected to

decline from 34 percent in 1980 to 29 percent in 1995 and service occupations to increase slightly from 12 percent in 1980 to 16 percent in 1995 (42).

projections of the influence of high technology on job growth depend on which BLS definition is used. Under the broadest definition of "high-technology" industries,² technology-related employment could account for 17 percent of all new jobs between 1982 and 1995; under the most limited definition it would account for only 3 percent of these jobs (for specific growth expectations see technical memorandum D) (42).

The percentage growth of specific occupations within these fast-growing industries is particularly high in occupations dealing directly with new technologies. In middle-growth projections to 1995, most of the 20 fastest growing occupations center around computer programming, servicing, operating, and repair. Growth rates will also be high for electrical and mechanical engineers, physical and occupational therapists, and medical and banking clerks.

Growth in the *number* of jobs by 1995 affects a different set of occupations. According to BLS projections, only 40 of the existing 1,700 occupations will account for 50 percent of all employment growth. The greatest number of new jobs will be available to building custodians, followed closely by cashiers, secretaries, office and sales clerks, nurses, and waiters and waitresses. Some of these job categories are largely independent of new technologies and they are unlikely to be affected by technological change. A few, such as office work and nursing, may be notably affected. Most, however, are relatively low-wage manufacturing and service sector jobs,

²The BLS provides three definitions of high technology, ranging from very broad to very limited. They are, in order of magnitude from broad to limited, the following: 1) Any industry that utilizes technology-oriented workers accounting for a proportion of total employment of at least 1½ times the average for all industries. A total of 48 industries are included in this category, threequarters of them in manufacturing. 2) The proportion of technology-oriented workers relative to total employment in the industry is equal to or greater than the average for all manufacturing industries and the ratio of R&D expenditures to sales is close to or above the average for all industries. This group includes 28 industries, and excludes most nonmanufacturing industries. 3) The ratio of R&D expenditures to net sales is at least twice the average for all industries. This definition includes only six industries, all in manufacturing.

A number of occupations are projected to undergo rapid decline between 1982 and 1995, as a result of expected demographic and economic changes in the United States. Heading the list for declines are jobs related to transportation, such as railroad conductors and taxi drivers, probably due to declining demand for these modes of transportation. Numbers of private household workers and servants, child-care workers, college and university faculty, and graduate assistants are likely to decline due to the lower numbers of young people. Among the many occupations being threatened by technology are postal clerks, postmasters and mail superintendents, stenographers, typesetters and compositors, and rotary drill operators. If occupational employment patterns for current cohorts of workers 45 to 54 and 55 to 64 were to remain constant, future older workers would be unlikely to benefit from the projected new and additional jobs in high-technology fields. Most older adults are located in slow-growing professional, managerial, or craft occupations, and only small proportions of workers over 45 are currently employed in occupations such as scientists, computer programmers, or computer technicians. They are consequently less likely than younger workers to have the unique education and training necessary to compete for or to keep these jobs.

Older workers may, however, benefit from growth in the number of jobs in manufacturing and service sectors, which contain large numbers of older workers, and clerical or service occupations, where older workers are also concentrated. Other workers may see their job opportunities decline. The kinds of occupations that are likely to diminish in number are precisely those farm, professional, and specific craft occupations in which older workers tend to be employed.

Robotics are a major source of the controversy surrounding displacement of future workers. Some experts contend that industrial robots may increase from today's estimated 3,000 to as many as 25,000 in the automobile industry alone by 1990, and these may eliminate a large number of jobs (8,18). According to General Motors, a robot displaces 1.7 workers in an assembly plant and 2.7 workers in a manufacturing plant (27). A recent study by the American Society of Manufac-

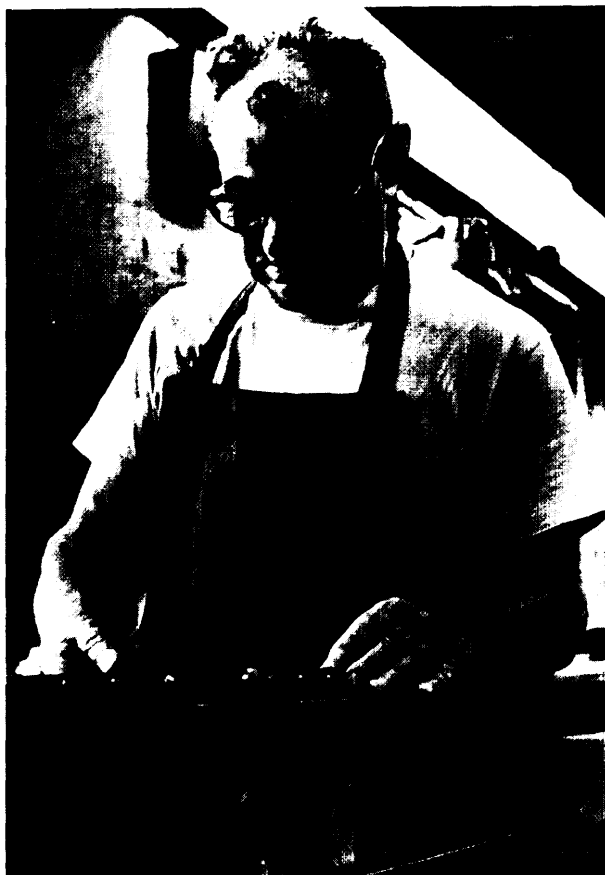


Photo credit" The Coach Leatherware Co., Inc.

Job opportunities for skilled craft workers are expected to decline in the future.

turing Engineers predicted that as many as 20 percent of existing jobs in the automobile industry could be performed by robots by 1985 (25). The large numbers of older people who are automobile workers or who work in other manufacturing and craft occupations may thus be at great risk of being displaced, although the need for robot maintenance and repair will create new jobs for some of these individuals.

Robotics may threaten jobs in areas other than automobile and steel manufacturing. Based on a survey of users and manufacturers of robots, Robotics International predicts that 3 percent of current packers and wrappers, 5 percent of welders and flamecutters, and 10 percent of production painters would lose their jobs (35). Similarly, a study of the Michigan auto industry finds that between 10,500 and 18,000 jobs, primarily welding

and production paint jobs, are destined to be eliminated over the next 10 years by technology. A Carnegie-Mellon study has identified 4 million factory jobs that robots will perform, and an additional 3 million jobs that robots might assume by the year 2000 (7).

The lack of specific information on older workers makes it difficult to determine which future older employees will be at risk of job loss due to technological change. Nonetheless, information about displaced workers in the Parries longitudinal survey provides the basis for possible future scenarios. In that study, displaced older workers were most likely to be employed in the trade and manufacturing industries. Because projections indicate that employment in both of these industries will grow, the future could provide many employment opportunities for older workers, either to remain in the labor force or to change jobs. If many of these new jobs are technologically oriented, however, some older workers may need training. For example, growth in manufacturing jobs is likely to be at either the high or low end of the skill and wage continuum: either low-paying occupations such as office clerks or custodians, or high-paying, high-skill occupations such as computer technicians. Most older workers need training to work in the higher end of the skill and pay scales because they are less likely to hold these kinds of jobs today. Without training, older workers may have an increasing number of jobs available to them but the jobs will be at lower wages and at lower skill levels.

Yet current displacement rates in these industries are high. In 1982, 51 percent of all layoffs and 28 percent of permanent job separations occurred in the manufacturing industry. Trade ranked a close second in separations, followed by services. If older workers continue to be displaced in these industries, the growth in these industries could result in net job losses for older workers.

Occupations with high concentrations of older workers also had a high mean displacement rate in the Parries study. Service, professional/managerial, and craft workers experienced involuntary job loss more often than other groups. Future employment in these occupational groups is likely to grow, although at varying rates. If technological change does not radically alter specific jobs

within these groups and older workers remain concentrated in the same industries, they may be at low risk of future displacement.

There is as yet little agreement on the overall number of workers who face displacement by technology. There is some consensus that technology will reduce the number of future jobs available in some occupations, but its effects on currently employed workers remain difficult to predict.

NATURE OF WORK

Replacement of workers with machines or robots may also change the nature of work itself by changing the number of hours people spend at work, the type of work done, the skills needed, and the sites at which work is performed.

At the turn of the century, workers often worked 14 hours a day, 7 days a week, 52 weeks a year. Today's standard 40-hour, 5-day workweek can be partially attributed to the mechanization of industry that increased the productivity of workers. Workweeks have been shortened even further in companies that have raised the number of hours worked per day while keeping constant the number of hours worked per week (40-hour, 4-day weeks with 10-hour days). Other companies have reduced both total hours and days worked per week (36-hour, 3-day weeks with 12-hour days). The BLS forecasts that the length of factory workweeks will be virtually unchanged in 1995 at 38.8 hours, compared with 38.9 hours today. For the private, nonfarm economy, average weekly hours are projected to fall from 35.1 in 1982 to 33.1 in 1995.

Future technology will also change the type of work and the skills needed in some jobs. For example, "paperless offices" of the future will hold all records and files in a central computer, eliminating the need for an employee to move between typewriter and copying machine. Conveyor belts to move bulky material between offices may become commonplace. Clerical workers will need word processing skills or skills in computer programming and operation.

Libraries are undergoing rapid change. Time-consuming information searches that once sent librarians to card catalogs and bookstacks can

now be done far more quickly and with minimal movement from behind a desk-top computer terminal.

Bank tellers may change from serving customers directly to servicing automatic tellers, with machines taking over mathematical calculations and recordkeeping while the human worker oversees their operation and replenishes supplies of money and paper.

In broader terms, managers may do more of their "managing" through computer monitoring of employees' work, increasing the number of people and amount of information managed by simplifying access to workers and their output. Decisionmaking itself is now entering the realm of the computer, which has already reduced the number of middle managers in some companies (23).

Technology can also change the nature of work by changing the requirements that work be done in specific locations. Typing or word processing that used to require secretaries to be at the workplace during working hours can now be done at home by using telephone-computer linkages. Hard copy could always be taken home for editing, or dictation typed directly into a computer and transmitted for print at an office work station. One corporate official estimates that the numbers of office workers who use some sort of electronic office equipment will rise from today's 5 million to 35 million within 10 years (7).

Advancing computer technology also allows work to be done while traveling, and communications technology, by the process known as "teleconferencing," can "assemble" meetings of people in far-flung locations without their having to leave home or office.

POSSIBLE IMPACT ON OLDER WORKERS

This evolution in job requirements maybe particularly beneficial to older workers by allowing wider use of alternatives to full-time work. Results of some surveys show that part-time work or other alternatives to full-time employment are favored by many older workers. In 1979, about 26 percent of married and 21 percent of unmarried adults aged 65 to 69 worked part-time. A 1981 Harris poll found that 57 percent of respondents

A New Industry Machines That See

Machines that “see” may change the jobs of some workers of the future. By combining a television camera and a computer (an “eye” and a “brain”), robot machines can be made to do my tasks that humans now do. Robots can handle tedious or dangerous jobs repeatedly and steadily without fatigue.

For example, a Westinghouse factory in Winston-Salem, NC, **plans to use sighted robots to** forge turbine blades. These robots select pieces of metal, place them in a furnace, then remove the hot metal and place it in a machine that shapes it into a blade. When the blade is finished, a robotic “eye” inspects it to be sure it is perfectly formed.

Other robots, which have arms, hands, and fingers, can select electronic components from

bins and place **them into** circuit boards with greater speed and accuracy than humans.

The computer microchips that control these machines currently cost less than \$10 each, which makes these robots and their capabilities attractive to employers. The systems themselves, however, are expensive—a **complete** vision system with only limited capacity often costs between \$15,000 and \$40,000.

Expanded use of these systems is expected to double or triple industry revenues from machine vision systems (\$20 million in 1982) each year for the next several years.

Workerless Factories

Conventional “fixed automation systems” in factories are slowly being replaced by “flexible manufacturing systems.” In a fixed system, machines **are programmed** to operate in a predefined sequence of steps to **make a product; flexible** systems alter their programs and hence their products, depending on such factors as the availability of materials, the speed of other machines making needed components, and the demand.

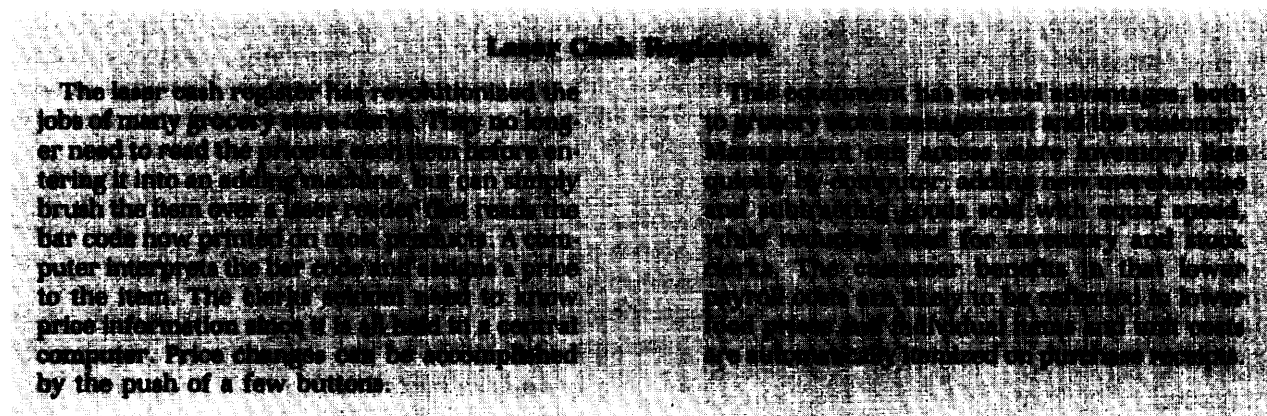
This new technology can increase **productivity** while employing fewer workers. For example, a system installed in a GE locomotive factory now produces a 2,500-pound motor frame job that once took 16 days—in 16 hours. While some workers were displaced by the new system, others have been retrained to monitor and control the computerized machinery. The “firm” foreman is now the console operator.

Flexible manufacturing enables some factories to operate with very few workers. A Japanese

toolmaker factory in Florence, KY, which would need workers with a conventional manufacturing system, now employs three shifts of day-shift workers, four controllers in an evening shift, and no workers at night.

Improved quality and lower capital equipment and operating costs are other benefits of flexible manufacturing. For example, the Air-Craft Co. **25 percent** less than a conventional system costs to operate (22).

The **benefits** **drawbacks** of **developing technology** for workers are unclear. Devices for in the work force could be designed to simplify jobs for workers with vision deficits or flagging muscle. At the same time, **technology** in manufacturing **jobs that currently employ** of older adults (21).



would consider part-time work after retirement (17). A 1980 Traveler's Insurance Co. survey reported that 85 percent of their employees wanted paid work after retirement; over half preferred part-time work (44). Although these surveys have limited utility due to: 1) the gap between what people report they would do and their actual behavior; and 2) the lack of information about the specific circumstances in which people would accept a job offer, i.e., commuting time, wages, type of work, and working hours, the data indicate that *some* people would both prefer and use these options, and that developing these alternatives in the work force would be beneficial to them.

Although these alternative work options are as yet rare, a study by the National Commission on Employment Policy suggests that employers will expand employment opportunities for older workers as their numbers increase. Initial programs are likely to be developed because they benefit both employer and employee (32,40).

Some employers have tailored a variety of employment options to the needs of middle-aged and older employees, including active job recruitment of older people, job-sharing, labor pools for part-time work, and phased retirement. Older workers seldom take advantage of these options for two reasons: managers do not adequately communicate their existence, and taking advantage of these options may result in reduced salary and benefits. Company use of such options depends on such factors as: 1) the desire of the company to project a positive image of older workers, 2) the character of labor-management relations, 3)

the need to meet productivity and labor demand, and 4) the condition of the economy. Fewer options are offered by companies in poor financial positions (32,40).

Some employers consider work options as employee benefits. Employment opportunities and new work options for older workers may be provided in order to attract older consumers, stabilize the younger work force with older role models, reduce absenteeism, gain experience in working with a generally older work force in anticipation of demographic changes, hire workers who will accept lower wages, encourage workers to stay at work to keep needed skills in their work forces, and respond to government policy (32,40).

Researchers who tapped the National Older Worker Information System at The University of Michigan (40) found data on 153 companies representing 309 programs and/or practices. These programs included six types: hiring for full-time employment (12 percent), hiring for part-time or temporary employment (51 percent), job/worker appraisal (5 percent), training (13 percent), job redesign (9 percent), and flexible scheduling (10 percent). On a national scale, few companies offer such options, but they are expected to become more plentiful as the number of older workers increases.

An important conclusion of these studies is that employers will provide options for older workers in the future, but only when it is to the firm's advantage to do so. As the older work force grows

and seeks these options from employers, their range and number are likely to grow, particularly as new technologies make it easier for employers to accommodate to shifts in workdays, hours, and the daily work force.

Older workers are especially likely to benefit from the changing nature of work. People who find it physically difficult or undesirable to leave home, due to disability or poor health, may be able to work at home doing clerical and office tasks, for example, or computer programming, writing, or research. Should bad weather, a long commute, or inability to drive or difficulty in using public transportation keep potential workers at home, such jobs could be ideal.

Some technological changes may enhance such alternative work options as job-sharing. Workers using computers could store their work for use by a subsequent employee. By pairing an older

worker with a younger worker, flexible scheduling could be beneficial for both workers. An older employee wanting to phase into retirement could train an upcoming employee to take his place, retaining needed skills for the employer.

Additional benefits of alternative work options include maintaining more people in the work force than would be possible if each worker had a full-time job, providing additional income tax and Social Security tax revenues, delaying collection by retirees of Social Security or pension benefits, and providing a higher income for older adults.

As these options become more common, competition for them is likely to increase between older and younger workers, especially women, who are currently seeking new work structures in order to accommodate pressing financial and family obligations.

Technology, retraining, and older adults

Retraining workers of every age is a matter for serious consideration by both industry and government. Some employers are expressing concern that the available pool of labor will not satisfy their needs for skills. In the quest to keep worker skills current, some older workers may need particular attention (33).

Information is meager about the extent of need for retraining older workers. Among the important questions are: 1) how well do older workers' skills match the skills needed in the labor market? 2) how quickly are older worker's skills becoming obsolete? 3) if older workers are retrained, how long will their skills be of value to the employer? 4) how are older workers differentially affected by employer policies for retraining due to advancing technology? 5) what effect does technology have on the working environment? and 6) will older workers, if retrained, be able to compete successfully with younger workers for jobs?

The need to update workers' skills will increase in importance as technology continues to change.

As the labor force ages, fewer younger people with recently learned skills will be available; in turning to other sources for skills, employers will need to focus on existing workers.

Jobs and the skills needed to do them are changing rapidly. Change may occur so quickly in the future that, according to one expert, in order to maintain their skills, workers may need to be retrained from five to eight times over the course of their careers (7).

Employers and their unions are beginning to recognize the growing need for new skills. In the spring of 1982 the United Auto Workers Union gained commitments from General Motors and Ford Motor Co. for \$20 million and \$25 million, respectively, to begin retraining programs for their workers. Is the access of older workers to these training programs comparable to that of younger workers? Will large numbers of older workers be retrained? Sources within the training industry indicate that older workers have fewer opportunities than younger employees to be retrained at employer expense. This unwrit-

ten standard concerning retraining may stem from a wide variety of causes—negative attitudes about older age, age discrimination, the belief that older workers will not want or be able to be retrained, or the belief that older workers will, by retiring in a few years, be relatively more expensive to retrain than younger workers.

Some efforts are being made to retrain existing workers. Employers are retraining both currently employed and displaced or unemployed workers to ensure their supply of skilled labor. Although no figures are available on how much is spent specifically on retraining or which employees receive it, the American Society for Training and Development estimates that employers spend about \$30 billion a year for all types of employee retraining (9).

There is no comprehensive information available on the types of jobs targeted for retraining, but a review of business and training publications suggests much employer-sponsored retraining of existing employees is for engineering and other scientific positions, clerical workers, and specialized technicians. For example, machine mechanics are retrained to repair robots; engineers are updated on computer applications and electronics; clerical workers learn to use word processing and other computer equipment; chemical process engineers receive additional training in biological processes; and copier-repair technicians learn to service high-speed printers.

Though identifying workers displaced by technology is difficult, when displacement does occur, many workers become eligible either for jobs requiring similar skills or for retraining. Robotics International concluded that 50 percent of workers displaced by robots could be trained for new jobs in the same plant and another 25 percent could do other jobs in the plant without special training (35). Some unemployed workers, such as auto workers, are being retrained for jobs in robot repair and maintenance, electronics, and microelectronics.

Many observers agree that the need for retraining will accelerate as technological change affects larger segments of the work force (9,15). One corporate analyst predicts that by 1990, nearly all manufacturing employees will spend 20 percent

of the workweek in training programs to keep up with technology (15). A TRW Co. official states that, "In this decade, virtually all of the Nation's workers, most of whom are now employed, will need to be retrained or have their skills sharpened" (9). With the changing composition of the work force, many of those needing retraining will be both experienced and middle-aged.

Benefits from training and retraining

Employers report two major benefits from retraining: 1) more efficient use of human capital, and 2) retention of useful employees who might otherwise be hired by other companies. Other benefits to employers include reduction in the costs of recruitment and placement of new workers, decreased loss of productive employees through attrition, maximum utilization of worker skills, an upgrading of the quality of worklife of the retrainers, and company perpetuation (36). In discussing company perpetuation in this context, one researcher says that "retraining strengthens the economic life of a company and increases its ability to compete effectively. Retraining is an organizational mechanism that permits a company to be more things to more people" (36).

For example, one company offered an introductory course in electronics to older engineers, with course completion to be taken into consideration in determining pay increases. Also, since a limited number of engineers in each department could attend the course, a certain degree of status was associated with being selected. Maintenance technicians completing an electronics maintenance and repair course were given pay increases and higher status job titles. A company that retrained welders upgraded their job titles, and the union later won a salary increase for this group of crafts workers (52).

Costs of training and retraining

Little information is available on the financial costs of training, and nonfinancial costs or negative elements of training tend not to be addressed in the training and retraining literature.

Managers often ask what training costs, and whether the cost is justified. Answering these questions requires itemization of program costs. Usual budget categories include expenditures for training-staff time, special materials equipment, travel time for personnel to take special courses, consultant fees, state-of-the-art expenses such as conferences, and expenses for the training process itself, such as salary costs of the training. Once an accounting of the specific cost is performed, the organization can judge the program's worth (51).

Who pays for the costs of retraining and how will they be borne by the company? Costs are often associated with company size and industry type. The larger the organization, the greater the outlays. Major costs include wages and salaries paid to workers being retrained, the time spent by other employees on integrating trainees into the work of the organization, wear and tear on equipment, and higher accident or product rejection rates. In the context of adopting a philosophy about who should pay training costs, one expert notes that "under competitive conditions, all of the firm's costs will be charged to the worker if the training increases his future productivity in other firms as much as in the firm in which he is training. Some fraction of costs will not be charged to the worker if the training contains elements of specificity, that is if it increases the worker's future productivity in the firm more than in other firms" (26).

Methods of training and retraining

The focus of methods of training older workers has shifted in recent years. As recently as the late 1960s the older trainee was portrayed as one with special learning problems associated with age. Today, researchers and some employers consider older persons just as capable of learning new skills as younger persons, if the training occurs in a supportive environment. The work opportunities of older trainees, however, may be fewer.

Many methods for training are used by industry (see technical memorandum C). In deciding on the most appropriate method or group of methods for a given training program, management should consider: 1) what the trainee must

do to successfully complete the program; 2) the extent to which trainees will be given an opportunity to discuss the training and measure their own progress; 3) the extent to which the trainers will be updated in their skills and given the chance to evaluate the training process; 4) the degree to which the training experience will approximate the job experience; 5) how the training method will adapt to differences in learning rates, availability of trainee time, and trainee attitudes; and 6) the cost of using the method(s) (51).

Concern about training the older worker first appeared in the mid-1960s in European publications; much of the literature that continues to be generated on this topic comes from Europe. In 1965, Belbin, the first expert to address the status of the older trainee, outlined difficulties shown by British workers in laboratory studies—problems associated with memory loss, rigidity in learning new material, lack of practice, and inadequate self-confidence. By the early 1970s, the literature posited that the older person does not necessarily face major problems in learning new skills, and that "in the past the problem has been that teachers did not adapt [to the needs of adult trainees] (3)." Learning success was described as being only partly dependent on the teaching method used with the older person. "The traditional methods of teaching based on exposition and presentation of theory followed by later application may work well with younger people . . . but it appears that these methods that are refined slowly through school life do not survive as natural and easy ways of learning once the individual has long left behind his schoolroom experience" (3).

An Aer Lingus (Irish Airlines) program is one example of retraining efforts created to meet the special needs of older workers. The airline changed an outdated cargo warehouse that used "shelves-and-forklifts" technology to a semi-automatic mechanism with electronically controlled storage and retrieval of freight and a computerized documentation system. Four elements in the retraining process were found to be valuable in retraining the older worker: 1) group participation by the trainees in using the new technology; 2) management's continuous communication with the workers on their progress and prob-

lems; 3) use of a “discovery method” of learning where the trainees learned about the new technology on their own, in contrast to learning through the lecture method; and 4) use of job-simulated experiences rather than abstract learning materials (29).

Factors affecting participation of older persons in retraining programs

The participation of older workers in retraining programs can be affected by requirements and conditions imposed by the training provider and by the attitudes and attributes of older workers themselves. Eligibility requirements and recruitment strategies often influence participation and vary from provider to provider. Employers consider job history or classification to be the most common eligibility requirement.

Often, as can be seen in the following case study examples, potential trainees must pass a screening test. When formal screening tests are not used, some providers screen possible participants to help ensure the success of training. Most providers claim they do not use age as a formal eligibility requirement. Years-of-service plays a minor role in determining eligibility; in some instances, workers participate in training sessions based on seniority. Income and employment status, e.g., being unemployed, are relevant in some cases. Though these conditions might only apply to the cases studied (see later section) they give an indication of the way companies are conducting recruiting for retraining.

Some of these eligibility criteria might work to the advantage of older workers while others might work against older workers. Years-of-service requirements, for example, might favor older workers, who often have longer tenure on the job. The use of formal screening tests might work against older workers whose education is less recent. Employers use a number of strategies to recruit and select participants for training. Some of these include a formal notification process as laid out in collective bargaining agreements, attendance at an initial information session, advertisement through company communication systems, and media or other third-party basis of disseminating information.

Employers may use both explicit and implicit incentives to encourage participation. Individuals successfully completing training may receive a salary increase, new personnel may receive wages while being trained, and classes may be offered free of charge. Implicit incentives related to job promotion possibilities and job security may also be provided.

Providers may also use informal encouragement or discouragement to guide individuals into or away from training opportunities, though there is no indication that this is used more often with older workers than with their younger counterparts.

Little research has been completed on factors affecting an older worker's participation in training and retraining. Twenty years ago, one study of a small sample of men identified four factors that tended to discourage workers from going to training: 1) family influence, 2) fatigue from evening classes, 3) latent apprehension about ability, and 4) nervous stress at the prospect of a more complicated job (30). A more recent study of printers (11) found that younger, healthier, and better educated men were more interested in learning new automated compositing techniques than were most older printers who were within 2 or 3 years of retirement. Both younger and older printers tended to base their interest in retraining on practical considerations—possibility for promotion or the cost of retraining prior to impending retirement.

Despite the paucity of factual data, the general perception is that older workers hold negative attitudes toward retraining. Some evidence suggests that older persons hold more negative attitudes toward automation than do younger people. Opinion Research Corp. found that unwillingness to accept increased automation in the workplace increased with age (15). Conversely, a General Motors executive believes that some older employees “have less fear of change than the young people coming along. I don't think acceptance of technology relates to age as much as it does to motivation (15). ”

Providers often feel that attitudes related to retraining are likely to limit the participation of middle-aged and older persons in training pro-

grams. Apprehension about operating new machinery skepticism about the outcomes of retraining, resistance to new technology, problems in rethinking how a job is done, momentum of involvement in work tasks that limit free time, and difficulty accepting young instructors were all identified by those asked in the case studies as attitudinal factors that might limit the older person participation in training. Nevertheless, providers did not feel the attitudes of middle-aged and older workers were significantly different from those of younger workers or that they posed major problems.

Dissatisfaction with a current job might influence the older individual's decision to seek retraining, but voluntary withdrawal from the labor force can be economically difficult for many workers. The lack of wages or a stipend may be a **potential** barrier to retraining the unemployed. Although participants may be able to receive unemployment insurance in some States while attending the retraining program, this income may be inadequate for middle-aged and older participants with numerous financial obligations.

Case study examples of retraining

Several types of programs are available to train or retrain workers. Some are developed for use within a certain company while others result from cooperation among industry, government, and educational facilities. Companies have thus far initiated programs because the available labor pool does not have the needed skills or because it is advantageous to update or train workers in these skills. Most programs are not designed specifically for mature workers or older unemployed individuals; in fact, because organizations providing retraining seldom even collect detailed trainee age data, little information is available on the characteristics of retrainers.

For this report, two types of training were identified —pre-employment and post-employment training. Each could be provided in-house or by outside providers. Most of the representatives of the training programs, despite the program's orientation, did not believe that older workers needed different training than younger workers.

A number of retraining programs were examined. The case study examples cited here describe current training and retraining programs. Some cases were high-technology companies or companies dealing with new technologies; others were not. Retraining was offered in order to update workers' skills. The electronic systems division of one large firm elected to retrain older employees instead of hiring new staff because retraining was believed to be less expensive. Fully 50 percent of the trainees were over age 40. The company found retraining both saved money in the long run by encouraging workers to continue working and kept needed skills within the company. one reason for deciding to retrain was that 40 percent of the company's work force would



Photo credit. Ted Horowitz

Retraining to update workers' skills benefits the company and the worker.

be eligible to retire within 10 years; the retirement of this segment was projected to be very costly. It was hoped that retraining would keep some workers on the job longer and thus stagger retirement benefit expenditures.

Another company was founded with the express purpose of training older executives to operate personal computers. As a result, more than 60 percent of the workshop attendees have been over 40.

Under the Investment in People Program, the State of California matches union and automobile manufacturers funds to retrain unemployed auto workers at a trade and technical college. Entry-level electronics, welding, and diesel automotive are course topics.

Workers of all ages participated in those programs. Company officials found few failures, regardless of age, to complete the coursework; younger and older workers did equally well in the classes.

The future

The future of training and retraining for workers of all ages will depend largely on the availability of skills in the labor pool. To the extent that older workers have the needed skills to do jobs, they will not be candidates for retraining. However, the changing industrial and occupational structure indicates that many workers will need training to operate machines and production processes that have never before existed. Methods of doing some jobs will change as technology shifts, and workers will need to be trained to keep up with these changes.

The need for retraining programs depends less on the current balance of workers' skills vis-a-vis required skills than it does on the expected future skill balance. If the work force cannot adapt itself to changes in needed skills through educational institutions, and new production technology does not fully replace the need for human operators, retraining programs will become an essential and common practice (16).

If training programs become commonplace in future years, the question then becomes whether older workers will participate in these programs. Though older adults may have gained considerable on-the-job experience over the years, they are likely to need formal retraining to change jobs or to compete for jobs with workers who have more up-to-date skills.

Whether employers will target these workers for skills upgrading is unknown. Employers may choose to retrain older workers, as was seen in some case study examples, if they believe it is to their advantage to do so. They may also provide retraining programs for all workers in which large proportions of workers over 40 participate. Older workers may not, however, be specifically targeted for retraining, though they may need additional skills or retraining as job requirements change.

Other evidence suggests that workers may have decreasing opportunities for retraining as they age. Some employers surveyed in the case studies believed that it was more advantageous to retrain younger rather than older workers because older workers were more likely to retire. Other employers would rather offer attractive retirement benefits to workers at or near retirement age than offer to help update their skills (33).

There is substantial agreement that the need for training and retraining for workers of all ages will increase with the acceleration of technological innovation, but the approaches to meeting that need remain under debate.

The success of future training endeavors appears likely to depend in large part on the willingness of government, business, labor, educational institutions, and other training providers to collaborate, and for older workers to accept and seek retraining opportunities. Some experts believe no one sector has the resources or expertise to tackle the problem singlehandedly and that traditional education and training approaches have not succeeded for some population groups, including certain types of older workers. Adaptation of training methods to respond to the learning needs of these subgroups could change this pattern.

Technology, health, and physical capacity

Health and physical capacity are important aspects of an individual's ability and desire to work. Decline in either of these areas often leads to labor force withdrawal. Though its importance varies in different national surveys, poor health is one of the most frequently cited reasons for the decision to retire or otherwise withdraw from the labor force.

many workers who retire for health reasons leave the labor force as a result of chronic conditions (e.g., cancer, diabetes, arthritis, or heart disease) (19), or because of physical impairments (permanent defects, usually static in nature). Still others leave work because of disability associated with chronic conditions, accidents, or injuries that limit their ability to work.

According to data from the National Center for Health Statistics, chronic conditions are more prevalent among those over 65 than among those 45 to 64. Women are more likely than men of the same age to suffer from most chronic impairments. Physical impairments that limit the ability to work include vision or hearing loss, absence of extremities, paralysis, or deformities and impairments of the back, or upper or lower extremities—all conditions that are more prevalent among those over 65.

The presence of chronic conditions may result in impaired functional ability, ranging from minor disability or limitation in activity to severe disability in which the individual is bedridden. Results of surveys regarding extent of disability in the population have varied over the years according to the ability of jobseekers to find employment at the time of the survey. They all agree, however, that a large majority of people 45 to 64 have no disabilities, and that more than half of those over 65 have none. Moreover, only small percentages of workers 45 to 64 and fewer than 1 in 5 people over 65 are unable to work due to physical disability (see app. E, table E-39).

The Retirement History Survey, which examined the relationship between individual characteristics and work disability, found that workers whose jobs were physically demanding were

more likely to report disability than those whose jobs were less so, and that the existence of work limitations often led to withdrawal from the labor force (47). Disability rates also were higher for workers with fewer years of schooling; because they are likely to have physically demanding jobs, they are more vulnerable to work disability with advancing age. Disability rates for those over 50 were higher for women than for men.

Although physical limitations keep many from working, others continue to work even though they have minor illnesses. Days of activity restriction due to sickness averaged 31 days per year for all workers over 45 in 1978-79, according to the Health Interview Survey. This number rose from about 23 days per year for those 45 to 54 to 46 days for those over 75. Yet the number of days a worker actually stayed home from work due to sickness decreased with age—from 5 days per person per year for those 45 to 64 to 4 days for those over 65. Though people who are older and still working may be healthier than others of their same age—because those in poor health have left the labor force—older workers still miss fewer days of work than their younger counterparts.

Although the role of technology in disability rates and the general health and well-being of workers remains ill-defined, modern production and manufacturing processes, as well as the machines themselves, may contribute to many occupationally related deaths. The National Institutes of Health estimates that 5 to 10 percent of cardiovascular deaths, 15 to 25 percent of cancer mortality, and 10 percent of deaths due to pulmonary dysfunction may be attributable to the types of jobs workers do (4). New production methods that did not exist 50 years ago may induce or exacerbate health problems of workers who have done the same job for many years. Moreover, occupational exposure to hazardous manufacturing processes is often not manifested as disease for 15 to 25 years, and some conditions may not be present until well after retirement. As a result, many of the victims are older adults. Yet most epidemiological studies of occupational

health do not include workers over age 55 in their samples (2).

Asbestos is a well-known example of a manufactured product that is correlated with occupational mortality. It is estimated that exposure to asbestos in shipyards and other industrial settings will be a factor in 2 million cancer deaths over the next 30 to 35 years (10).

Disease and impairment also result from technology in the workplace. Recent surveys of workers producing or working directly with asbestos found that 60 percent of older workers (mean age of 47.5 years) had some degree of respiratory limitation (4). Many chronic conditions in older adults, including hearing impairment, arthritis, respiratory problems, and dermatitis are either caused or made worse by the work environment.

Another example of technology-related impairment was observed in a study of workers required to perform repetitive motions using the wrist, such as might be experienced in assembly line work. Repetitive pressure, overexertion, and lifting, pulling, or throwing objects were found to result in injuries. These injuries can be quite costly; the mean cost per case for indemnity compensation was \$1,026 and the mean cost per case for medical payments was \$618. Heading the list for percent of wrist injury claims was the manufacturing industry (10.5 percent) followed by agriculture (5.4 percent). Since nearly one-third of men and one-fifth of women employed in manufacturing are between 45 and 64, older workers comprise a large at-risk group for such injuries.

Office automation may also disrupt physical health. Considerable controversy about health effects surrounds the use of video display terminals of minicomputers and word processing machines. When working over extended periods, some operators report visual strain or loss, and headaches. Back strain is also reported to result from inappropriate seating.

Work-related stress is another effect of technology. Computers are now capable of monitoring employee productivity, speed, and accuracy. For instance, the Communications Workers of America (CWA) notes that 150,000 of its members at American Telephone & Telegraph (AT&T), most of whom are operators using video display

terminals, are now monitored for speed and accuracy by computer. CWA estimates that by 1985 half of AT&T workers will be so monitored. In addition, approximately 25 percent of the new retail sales cash registers have monitoring capability. Employers use these systems to measure the output of employees and determine production bottlenecks. Use of such equipment can increase productivity by as much as 20 to 100 percent (7).

Although this equipment means savings for employers, there are potential costs to the individual workers who use these systems. Monitoring can increase the anxiety and fatigue of workers and lead to depression. According to a 1980 Blue Shield study, extreme monitoring can make employees "psychologically sick." Researchers found a higher incidence of anxiety, depression, irritability, fatigue, and anger among 250 monitored employees when compared with 150 unmonitored workers. These symptoms have been associated with more serious problems such as coronary and gastrointestinal ailments (7). Signs of stress at work include fatigue, nervousness, sleeping disorders, loss of appetite, dissatisfaction with job or life, and use of tranquilizers, which may increase in prevalence as the use of monitoring increases.

Despite the fact that technologies in the workplace may contribute to deaths, injuries, and disabilities, a National Institute for Occupational Safety and Health (NIOSH) study found that only 3 percent of occupational disease cases result in worker's compensation claims (28). Thus, many workers may depend on private insurance to pay for occupationally related health problems or, if they have no insurance, pay their medical expenses out-of-pocket.

The future

Contrary to popular belief, there is growing evidence that the increasing proportions of people now living to the oldest ages are not necessarily healthier than their counterparts in the past (41). Tomorrow's older workers may thus be just as likely to become physically disabled and unable to work as today's older workers. The Federal Government is currently providing benefits to

both retirees and the disabled; outlays for these benefits are likely to increase.

These patterns may, however, **change** for the better. Just as some workplace technologies may increase the risk of disability, others may reverse these negative health trends. The health of workers may improve in the future through greater understanding of physiological aging, medical technologies, better health habits and health maintenance technologies, and the careful implementation of workplace technologies. As current medical research intensifies and finds answers to some of the mechanisms of aging and disease, these answers will be disseminated by doctors, nurses, and other health care providers. Better and more efficient medical technologies will be developed to prevent or treat ailments more quickly. As society becomes better able to control health problems, overall health status may slowly improve. This will not, however, happen in the short term; decades are apt to pass before significant changes are seen.

Employers are becoming increasingly aware of the importance of a healthy work force. Absenteeism due to sickness can cost industry millions of dollars. In addition, the increasing costs of health care benefits have prompted employers to seek preventive measures to decrease these costs. Many companies are developing and implementing health promotion programs at the work site to improve the physical and mental well-being of their employees. Though good records are not kept and the effects of these programs have not been clearly documented, employers report many positive outcomes. For instance, an elaborate program at Pepsico Corp. has resulted in what company officials believe to be greatly improved productivity and attitudes of workers who take advantage of exercise facilities and employee health screening (49).

If the trend for employers to provide health promotion and disease prevention programs for workers continues, the workplace could become a major site for education and promotion of proper health habits. Improved health of employees, lower costs of health insurance, and additional years of productive work could result from these trends.

Workplace technologies can be a factor in improving worker health. The individual use of assistive devices can restore functional ability or compensate for physical deficits. (Technical memorandum A provides examples of currently used workplace devices.)

Technology can also improve worker health through the careful development, choice, and implementation of machines and production processes. Workplaces of the future could be designed to greatly reduce both accidents that may cause disability and exposure to noxious chemicals that may cause disease. Robots will increasingly be able to substitute for workers in dangerous jobs. Though some workers might, in theory, be displaced by automation, evidence suggests that the responsibilities of workers are usually shifted to other areas or jobs, depending on the types of occupations being examined (35). Moreover, retraining is not extensive in industry today, but both government and the private sector are giving retraining increased attention, and many programs have recently been initiated to retrain workers in new skills. Hence, controlled use of technology may significantly reduce physical injury and illness in the work force.

Technology thus has the potential to improve the health of all workers and safeguard the well-being of older adults. If the number of workers who retire prematurely due to poor health were to decline, individuals might still choose to retire at a predetermined age, but for different reasons. They could conceivably live their later years in better health and enjoy a greater sense of well-being. This positive effect could be important to government in that fewer dollars might be spent by Medicare and Medicaid for the care of the elderly.

Priority areas for research

Accurate information is needed about many aspects of worklife at older ages, including:

- specific, industry-by-industry effects of technological change on the older worker and the workplace;
- studies on attitudes and abilities that clearly delineate age subgroups of the older worker population;

- whether older workers are displaced as technology changes;
- precise epidemiological studies on the effects of hazardous working conditions on older workers;
- measurements of the capacities and abilities of older workers relative to those of younger workers;
- ways in which employer's perceptions affect

employment and retraining opportunities for older workers;

- the physical and psychological effects of unemployment, displacement, discrimination, and retirement on the older worker; and
- the effects of employer and employee incentives and disincentives to hire or retain older workers.

Issues and options

ISSUE 1: Should Congress foster the use of assistive workplace devices so that older adults with physical limitations might remain in the work force?

Options:

- 1.1: Congress could maintain its present level of support for workplace devices, as in efforts by the National Institute of Handicapped Research (NIHR).
- 1.2: Congress could require AoA, NIA, NIOSH, or another agency to provide a means for manufacturers of workplace and other devices to inform employers and the public of the availability and existence of these technologies. This agency could be required to collect and assemble this information, assess the quality of these products, and disseminate the information to the public.
- 1.3: Congress could require coordination among NIHR, the VA, and other rehabilitation centers to promote and provide workplace technologies for older workers.
- 1.4: Congress could require demonstration projects (possibly using Older Americans Act Title V participants) to show effective use of workplace technologies. The components of this project could be:
 - research on the effectiveness of the devices,
 - targeting to regions of high unemployment for older workers,
 - targeting manufacturing and service industries (due to the high concentration of older adults working in these industries), and
 - targeting to regions containing large proportions of older adults.
- 1.5: Congress could require NIA, AoA, DOL, NIOSH, or another appropriate agency to develop coop-

erative ventures with organizations for the handicapped. This effort would focus on information collection and dissemination of material on workplace devices.

- 1.6: Congress could provide tax incentives to employers to use individual workplace devices, adapt working environments, and increase the purchase of assistive devices for use by older workers.

ISSUE 2: Should Congress devote resources to retraining older workers for new skills?

Options:

- 2.1: Congress could maintain its present level of support for older worker retraining. Current effort is concentrated in Title V of the Older Americans Act and the Job Training partnership Act.
- 2.2: Congress could oversee the EEOC's enforcement of the Age Discrimination in Employment Act to ensure that employers provide equivalent retraining opportunities to older and younger workers.
- 2.3: Congress could encourage cooperative arrangements among educational institutions, corporations, and company-sponsored foundations to support research and demonstration projects to undertake retraining of older workers. Congress could provide financial assistance to educational institutions that cooperate with the private sector in developing training programs for older employees.
- 2.4: Congress could require AoA to fund retraining demonstration projects using trainers who are older, experienced, and highly specialized workers, such as members of the Senior Corps of Retired Executives.

2.5: Congress could provide financial, employment, and/or retraining assistance to older displaced workers through the following mechanisms:

- Congress could finance more cooperative public/private training programs with special targeting to older employees. One important component would be a job-finding service upon completion of the courses.
- Congress could provide tax incentives to displaced workers to become retrained or take job-related educational courses.

ISSUE 3: Should Congress foster the development of alternative work options?

Options:

3.1: Congress could maintain its current level of support for alternative work options.

3.2: Congress could reduce some of the barriers employers experience (e.g., heavier taxes for part-time workers, costly fringe benefits, etc.) when employing people other than full-time.

3.3: Congress could provide tax incentives for employers to develop more stable and permanent alternatives to full-time employment.

3.4: Congress could provide more low-interest loans, through such mechanisms as Small Business Administration loan programs, to individuals desiring to become self-employed. Persons over age 60 could be added to the target groups for receiving these loans.

Technical memorandum A: workplace devices¹

This appendix contains examples of devices used by older workers at some worksites. Though these are more commonly used by handicapped individuals, they can be adapted for use by workers of any age who have some magnitude of physical or sensory deficit.

Device: Optacon.

Description: Compact portable reading system that converts image of a printed letter or symbol into a tactile form that can be felt with one finger.

Cost: \$4,295. Additional lenses for CRT, calculator, typewriters, and magnification, \$195 to \$1,195.

Job tasks enhanced: Reading for severely visually impaired.

Advantages: Users report it to be a good machine. Allows blind persons to seek employment in wide variety of fields formerly closed to them.

Disadvantages: Cost. Requires special week-long training. Reading very slow with use of machine, blind may find it easier to have something read to them or tape recorded.

Available from: Telesensory Systems, Inc. (TSI).

Information sources: TSI. Fireman's Fund.

Device: Talking Computers.

Description: Speech synthesizers either incorporated in computer terminal circuitry or available as on-line adapters suitable for hookup to a variety of

computer lines; provide speech output of data on monitor.

Cost: \$4,500 to \$5,000 (incorporated in terminal)
\$4,900 to \$5,900 (device adapting to any terminal).

Job tasks enhanced: Computer or word processing activities by those with severe vision loss.

Advantages: Users report they generally work well. Translation accuracy of speech synthesizers about 90 percent.

Disadvantages: Cost. Some equipment does not provide speech for cursors, character attributes, or function codes. Speech quality varies.

Available from: Triformation Systems, Inc. Maryland Computer Services, Inc. Automated Functions, Inc.

Information sources: Lawrence Livermore National Laboratory. Telesensory Systems, Inc. BYTE.

Device: Digit-Cal Talking Caliper.

Description: Adaptation of Brown & Sharpe digital caliper; audioizes measurement functions from digital readout.

Cost: \$585.

Job tasks enhanced: Taking measurements for machinists, carpenters with total vision loss. Digital readout without speech synthesizer useful for people with minor or moderate visual impairment.

Advantages: Allows visually impaired persons to work in machinists and carpenters trades.

Disadvantages: Only one tool model available, which user found awkward. Nonvisually impaired machinists would only use it as a last resort. Talking box

¹ Information from Birute Skurdenis, Western Gerontological Society (43)

breaks frequently and available working diagrams are inadequate to allow machine shops to repair it themselves.

Available from: American Foundation for the Blind.

Information sources: Lawrence Livermore National Laboratory. American Foundation for the Blind. Larsen.

Device: Talking Height Gauge.

Description: Adapted Brown & Sharpe tool hooked up to speech synthesizer. Measures heights with great deal of accuracy.

Cost: Unavailable.

Job tasks enhanced: Height measurements for machinists and carpenters.

Advantages: User reports it to be a very good tool.

Disadvantages: prototype, not yet available on the market.

Available from: American Foundation for the Blind.

Information sources: American Foundation for the Blind. Lawrence Livermore National Laboratory. Larsen.

Device: Talking Cash Register.

Description: Digital display electronic cash register with speech synthesizer incorporated into circuitry.

Cost: Approximately \$5,000.

Job tasks enhanced: Blind cashiers, participants in Randolph-Sheppard Blind Vendors Program.

Available from: R. CO Allen.

Information sources: American Foundation for the Blind. American Council of the Blind.

Device: Talking Dial Indicator.

Description: Adaptation of Brown & Sharpe tool used in lathe work. Plunger reads distance from perimeter to center of the object on lathe. Speech synthesizer produces speech output of measurements.

Cost: Unavailable.

Job tasks enhanced: Lathe work for visually impaired machinists and carpenters.

Disadvantages: Cost. Market for speech output adaptors has not yet developed.

Available from: American Foundation for the Blind.

Information sources: American Foundation for the Blind.

Device: Therm-Voice Talking Thermometer.

Description: Speech synthesizer provides speech output of digital thermometer readout. Probes available for clinical or high temperature use.

Cost: Unavailable.

Job tasks enhanced: Measuring temperatures for visually impaired photo lab developers, X-ray technicians, chemists, bakers.

Advantages: Flexibility, first introduced clinically, new uses discovered.

Available from: American Foundation for the Blind.

Information sources: American Foundation for the Blind.

Device: Braille Output Printer.

Description: Converter unit provides braille output translation for computer terminal operations.

Cost: Unavailable.

Job tasks enhanced: Computer access for blind persons trained in braille.

Disadvantages: Only 5 percent of those with visual impairments read braille.

Available from: Triformation Systems, Inc.

Information sources: Lawrence Livermore National Laboratory.

Device: Tactile Braille Markings on Dials.

Description: Information on machine dials, e.g., lathes, milling machines, surface grinders, translated and etched in braille markings.

Cost: Minimal.

Job tasks enhanced: Machinists and carpenter work.

Advantages: Easy to use; nonvisually impaired users of the machinery learn to use them rapidly.

Disadvantages: Not available; homemade. Time-consuming process and not feasible if dial is welded on. Need to be familiar with machinery in order to make accurate adaptation.

Information sources: Larsen.

Device: Talking Paper Money Identifier.

Description: Machine reads denomination of paper money and hookup with speech synthesizer provides speech output of information.

Cost: Unavailable.

Job tasks enhanced: Cashiers with severe visual impairment.

Information sources: American Foundation for the Blind.

Device: Versabraille.

Description: Portable information system that can receive, store, and reproduce notes in braille from previously stored information such as ordinary audio cassettes on which braille information has been recorded or on computer and word processing terminals and printers.

Cost: Unavailable.

Disadvantages: Only 5 percent of people with visual impairment read braille.

Available from: Telesensory Systems, Inc. (TSI).

Information sources: TSI.

Device: Talking Numerical Control Drill Press.

Description: Allows computer programming of measurement specifications for drilling. Hookup with speech synthesizer provides speech output of measurements.

Cost: Unavailable.

Job tasks enhanced: Allows metal and woodwork machinists who have severe visual impairments to remain at work.

Disadvantages: Cost of putting it together. Made on-site, not available commercially.

Information sources: Lawrence Livermore National Laboratory.

Device: Closed Circuit TV (CCTV) Magnification Systems.

Description: Closed circuit television receives signals from camera transmitter held over copy to be magnified up to 60 times. Special lenses are available for use with computer terminals, typewriters, and microfilm.

Cost: \$1,895 to \$4,495.

Job tasks enhanced: Paper processing, computer use for clerical or professional staff who have diminished visual ability.

Advantages: Users report it works well. Allows higher degree of magnification than magnifying glasses. CCTV technology widely used, including in surgical medicine and research.

Disadvantages: More machines are purchased by individuals, family, and through State rehabilitation agencies than by businesses.

Available from: Apollo Electronic Visual Aids. Visualtek.

Information sources: Hughes. Sandia. Apollo. Visualtek.

Device: Large Print Computer.

Description: Microcomputer with display capable of magnification from 2 to 16 times.

Cost: Unavailable.

Job tasks enhanced: Computer use by visually impaired persons.

Advantages: Switch enables use with or without magnification.

Available from: Visualtek.

Information sources: Visualtek.

Device: **Magnifying** Reading Glass with Illumination.

Description: Magnifying glass with small lamp attached underneath to provide extra illumination to material being magnified.

cost. \$15.

Job tasks enhanced: Reading.

Advantages: User response good. Extra illumination Very useful for certain types of visual loss.

Available from: Bausch & Lomb.

Information sources: Sandia National Laboratory. Bausch & Lomb.

Device: Mounted Magnifying Glass.

Description: Six-inch diameter magnifying glass mounted on desk; able to swivel in a variety of positions.

cost: \$30 to \$110.

Job tasks enhanced: Reading fine print or for partial visual impairment. Also used in electronics circuit board assembly. Can be used with computer read-out and input.

Advantages: Users report it a good device.

Available from: Bausch & Lomb.

Information sources: Sandia National Laboratory. Fireman's Fund.

Device: Monoculars.

Description: Telescopic device with 8 x 20 magnification.

Cost: \$50 to \$60.

Job tasks enhanced: Person with partial visual loss can search files.

Advantages: Good, simple device.

Disadvantages: Often easier to relegate the task of file searching to another or to use a personally designed filing system with large markings.

Information sources: Sandia National Laboratory.

Device: Viewscan.

Description: Eighteen pound portable reading device, similar to CCTV, but screen is flat and small enough to fit in briefcase.

cost. \$3,500.

Advantages: User research found each feature was either very well liked or disliked by the users.

Disadvantages: Camera device that transmits information to viewer is sometimes difficult to use.

Available from: World Sensory Aids International.

Future: Video cassette books which will show print on Viewscan at speed and size desired by reader.

Information sources: Smith-Kettlewell.

Device: Telecommunications Devices for the Deaf (TDDs).

Description: A lightweight, portable printout or digital display unit with keyboard that connects by handset hookup to the telephone; allows hearing impaired persons to type and receive messages over the phone from other TDD users.

cost: \$500 to **\$1,000.**

Job tasks enhanced: Telephone communications for severely or totally hearing impaired persons.

Advantages: Portability, many models can be packed into a briefcase and carried from home to office. Information available from local phone companies.

A San Francisco Post Office mailing center installed one to permit deaf employees to call in if sick or late. This improved employee relations because difficulties formerly experienced by deaf employees in contacting work had made them seem irresponsible.

Disadvantages: Most models in use can only communicate with other TDDs. TDDs tend to be available in urban communities. Businesses are slow to adopt their use because they cannot justify benefit for the cost. If users have no prior experience with telephones because of deafness from birth or early childhood, they must be trained in rudimentary use of telephones (dial tones, busy signals, information services).

Future: Communication through computer terminals. Speech synthesization.

Available from: Local telephone companies.

Information sources: DCARA. Lawrence Livermore National Laboratory. Pacific Telephone. AT&T.

Device: volume Control Telephone Handset (Receiver),

Description: A telephone handset with adjustable volume control for reception.

Cost: \$0.56/month extra telephone charge (northern California).

Job tasks enhanced: Telephone communication for partially deaf persons.

Advantages: Inexpensive, most widely used of all devices for the hearing impaired.

Available from: Local telephone companies.

Information sources: DCARA. Hughes. AT&T.

Device: Amplified Speech Handset.

Description: Telephone handset with adjustable volume control for speech transmission.

Cost: Unavailable.

Job tasks enhanced: Communication for people who can only speak in soft voices.

Disadvantages: Very limited use.

Available from: Local telephone companies.

Information sources: AT&T.

Device: 5C Electronic Larynx.

Description: Device held to throat vocalizes throat sounds.

Cost: Unavailable.

Job tasks enhanced: Communication for people with laryngectomies who have not learned to vocalize or an assist for those who have.

Available from: Local telephone companies.

Information sources: AT&T.

Device: Canon Communicator Mark II.

Description: Portable communication aid for nonoral, motor-impaired persons. Letters/symbols are se-

lected on communicator's keyboard and are printed on paper tape display.

Cost: Unavailable.

Job tasks enhanced: Communication for people with both oral and motor impairment due to cerebral Palsy, stroke, etc.

Available from: Telesensory Systems Inc. (TSI).

Information sources: TSI.

Device: Tilt-top Work Table.

Description: 12" by 18" table top with adjustable height and tilt. Load capacity of 40 pounds. Elastic straps to hold material in place.

Cost: \$28 to \$37.

Job tasks enhanced: Electronic assembly, typing, and reading; holds computer printout-size material.

Advantages: Flexible use for different needs.

Available from: Able/Table Weir Enterprises.

Information sources: Tektronix. Weir Enterprises.

Device: Splints and Finger Gloves.

Description: Splints for wrist and elbow support. Finger gloves to fit one finger and provide protection when handling threads at high speeds.

Cost: Minimal.

Job tasks enhanced: Sewers and cutters in textile industry. Sewers and mechanics working with high-speed threads.

Advantages: Splints give support for repetitive actions.

Finger gloves provide protection from soft-tissue deterioration resulting from constant use in the same pattern of action; can be easily constructed using soft leather. Combining a glove or arm covering with the device provides warmth for improved circulation.

Available from: Prepared by rehabilitation counselor.

Information sources: Rehabilitation in Industry.

Device: Foam Sponge Grip.

Description: Piece of foam with hole cut through center slips around objects such as pens and knives to widen grip.

Cost: Minimal.

Advantages: Inexpensive. Can be constructed by anyone.

Available from: Prepared by rehabilitation counselor.

Information sources: Rehabilitation in Industry.

Device: Truck Cab Alarm System.

Description: Various systems to maintain driver alertness. Device mounted on vehicular equipment measures normal seat or steering wheel movements. A change in these movements sounds alarm. Device mounted on person registers alarms when head tilts in certain way.

Cost: Unavailable.

Job tasks enhanced: Driving alertness.

Advantages: Unobtrusive device that promotes safety and saves lives.

Disadvantages: Products not reliable. Not proven cost effective.

information sources: International Brotherhood of Teamsters.

Device: Vibrating Truck Cab Seat.

Description: Driver's seat provides gentle vibration to

keep blood from collecting in lower extremities.

Keeps driver alert and improves blood circulation,

Cost: Unavailable.

Job tasks enhanced: Driver alertness, especially in long-haul trucking

Disadvantages: Not proven cost effective or necessary.

Information sources: International Brotherhood of Teamsters .

Technical memorandum B: industries in detail

Agriculture, forestry, fisheries

Mining:

metal and coal mining

oil and gas extraction

nonmetallic minerals except fuel

Construction:

general building, heavy construction, and special trade contractors

Manufacturing:

Durable goods:

lumber and wood products

furniture and fixtures

stone, clay, and glass products

primary metals industries

fabricated metals

machinery except electrical

electric and electronic equipment

transportation equipment

instruments and related products

miscellaneous, i.e., jewelry, toys, and writing implements

Nondurable:

food and kindred products

tobacco

textile mill products

apparel

paper and allied products

printing and publishing

chemicals and allied products

petroleum and coal products

rubber and miscellaneous plastic products

leather and leather products

Transportation, communication, and

other public utilities:

railroads

local and interurban transport

trucking and warehousing

air transport

pipelines

transportation services

communication

electric, gas, and sanitary services

Wholesale and retail trade:

Wholesale trade

Retail trade:

general merchandise stores

food stores

apparel stores

furniture and home furnishings stores

eating and drinking places

Finance, insurance, and real estate:

banking

credit agencies

security, commodity brokers

insurance carriers

real estate

Services:

personal services

business services

motion pictures

health services

hotels

Public administration:

Federal Government

State and local government

Technical memorandum C: training methods¹ _____

Among the most widely used training methods in industry are: 1) lecture, 2) structured discussion, 3) unstructured discussion, 4) on-the-job training, 5) vestibule training, 6) case study, 7) incident process, 8) role-play, 9) in-basket exercise, 10) simulation, 11) management games, and 12) programmed instruction.

The first four techniques are self-explanatory; the remaining methods require some description. Vestibule training is on-the-job training (OJT) in an area where work is not being performed, freeing the trainee of the pressures created by the OJT experience. In the case study method, the trainee learns through analyzing and solving problems identified in a documented description of a real job situation. Incident process, a variation of the case study, requires the trainee to add needed information and solutions

to a partially explained work incident. Role-play permits the trainee to play-act working at the new job, as well as act out the roles of others at the work place. In-basket exercise is an appropriate method for training persons who will be dealing with a large load of documents. The trainee is presented with examples of materials for review and is asked to respond to each of them. Simulation is a version of OJT. Rather than work in the job environment, however, the trainee practices the tasks of the new job in a controlled work situation. Management games use the model of a business situation. Trainees are asked to play out the roles of managers in competing organizations. Lastly, programmed instruction involves the presentation of information to be learned in a series of short, sequential steps. The trainee continues to respond to the questions in the series until the desired skill is mastered (51).

¹Information from Paul and Coberly (33)

Technical memorandum D: projected job growth rates in high-technology industries _____

Projected job growth rates vary greatly among high-technology industries. Computer and data processing services, and research and development laboratories, the only manufacturing industries in the high growth group, are estimated to show some of the largest annual rates of increase—5.2 and 3.9 percent respective-

ly. Other rapid gainers are medical and dental instruments (4.2 percent), office and computing machines (3.7 percent), electronic components (3.2 percent), and engines and turbines (3.1 percent). By contrast, chemical industries and petroleum refining are projected to have substantially lower growth rates because of oil price effects. Employment in petroleum refining is projected to decline by 1.6 percent per year between 1982 and 1995.

¹Information from Perxmi(k) (34)

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