Computer Chips and Paper Clips
Technology and Women's Employment

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Effects of Technological Change:
The Quality of Employment

EMPLOYMENT QUALITY

Early discussions of the impact of technological change focused primarily on the numbers and types of jobs that would be replaced or created (U.S. National Commission on Technology, Automation, and Economic Progress, 1966). Today the debate has expanded to consider the effects of the new technologies—particularly those that affect information—on the quality of employment. Do the new information technologies lead to the fragmentation of work or to its integration? To the deskilling of work or to more highly skilled work? To electronic monitoring of employees or to greater job autonomy? To the exploitation of workers with limited job opportunities or to the freedom to work at convenient times and places? These issues are especially germane to women, because as clerical workers, bookkeepers, nurses, librarians, and other direct users of information technology, they are likely to be affected in large numbers. In addition, their relative lack of power in the workplace suggests that if information technology has pernicious effects, they will bear its brunt. It would be desirable to establish whether information technology is used primarily to increase or decrease the quality of jobs and to determine the conditions under which it does one or the other.

Two images regularly appear in the research literature and public debate on the effects of information technology on employment quality. Some commentators, while acknowledging that technology can be used to improve job quality, believe that it has most often been used to undermine the quality of white-collar work. "Our recent research has, if anything, strengthened our earlier conclusions. More and more evidence...documents the deteriorating quality of
office work. . . . [T]he introduction of automated office equipment has extended management control over the work process to the detriment of workers' job satisfaction" (9-to-5, 1985:29). In this pessimistic view, information technology is associated with degraded, deskilled, and devalued jobs, stressful and dangerous work, employer monitoring of employees, and work speedups, in which workers are paid less for doing more.

A case from the Project on Connecticut Workers and Technological Change, described by Westin (1985), typifies the pessimistic image. A small, metropolitan-area mail-order jewelry firm, selling low-cost rings, used computers for inventory and automatic billing through an on-line data base. Order division clerks used video display terminals (VDTs) exclusively for data entry and retrieval. The managers monitored workers through automated analysis of their daily computer output and through television cameras focused on their work space. One worker recalled that "they used the cameras to watch how hard you seemed to be working, when you got up to stretch or take a break, and your 'attitude' at work" (Westin, 1985:29-30). Management's objective was to run its business at the lowest cost possible. Both an abundant labor supply and the minimal training needed to operate the equipment and to perform the order-taking job helped keep labor costs low, despite substantial employee turnover. Management succeeded in running a profitable business but at high cost to its workers.

The alternative image portrays information technology as a boon to both employers and employees: increasing workers' productivity, eliminating repetitive or mindless work, providing better tools, and offering intellectual challenge and possibilities for growth. Spinrad (1982) describes his office routine and illustrates with an almost science-fiction-like quality what life in the office of the future could be like. He flips a switch to read his messages on a screen. Communicating via computer mail with a colleague, who electronically forwards an old report, Spinrad then incorporates the report into a message he is writing and sends it to its destination. He then settles into a morning's work of computer-aided hardware design.

Poppel's analysis (1982) of the benefits of office automation for sales and information workers portrays a similar picture. After studying 15 large U.S. organizations, Poppel concluded that a salesperson's time is wasted on traveling, missing contacts, finding out information, and filling out forms, while the time of many managers and professionals is similarly wasted on meetings and clerical work. According to his analysis, office automation technology can rescue some of that wasted time and make jobs more rewarding. For example, he foresees that a salesperson equipped with a portable intelligent display terminal could compute an optimum route for sales contacts, display product and pending order information while at a client's office, calculate cost proposals, and keep in touch with headquarters through electronic mail.

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Between the two extreme images of the effects of information technology are analysts who believe that it has had little effect on employment quality except by changing the occupational mix. For example, several years ago Simon (1977) concluded that, in the aggregate, job satisfaction had not decreased over the preceding 20 years, a time of rapid technological change, and that office automation in particular did "not appear to change the nature of work in a fundamental way." Moreover, since office automation consists of labor-saving devices that eliminate jobs that are already relatively routine, he expected to see a decline in the percentage of employees engaged in routine clerical work and a corresponding increase in more satisfying jobs in service, sales, professional, and technical work.

This section asks whether technology, in both its narrow sense of hardware and software and in the broader sense that includes the organizational arrangements through which it is implemented, has increased or decreased employment quality in the aggregate. The focus is on the clerical work generally done by women, although many of the issues are similar for men and women in many kinds of jobs. Most of the available research to answer this question consists of studies of the introduction of technology in particular industries or particular firms. While they provide rich detail about the mechanisms through which technology combines with the organization of work to influence the quality of jobs, they are not systematic samples of either workers or establishments and are thus not helpful in determining which tendency dominates (Attewell and Rule, 1984). In addition, at the present time technology and people's attitudes toward both technology and job design are changing rapidly. These changes are likely to be spreading unevenly across sectors of the economy, further increasing uncertainty about prevailing tendencies.

Defining Employment Quality

Understanding how technology influences employment quality requires criteria for assessing employment quality. But the criteria depend on the perspective from which one defines it. Employers, who may want to optimize produc-

1Simon's data may have been wrong or outdated. The Quality of Employment Survey (Quinn and Staines, 1977) found no change in overall job satisfaction between 1969 and 1973 but an appreciable drop between 1973 and 1977. The more specific the topic area being queried (e.g., satisfaction with comfort, challenge, financial rewards, or promotion), the larger the decline. Only one question failed to show a drop in job satisfaction: "All in all, how satisfied would you say you are with your job?" Unfortunately, this single item was the typical measure of job satisfaction used in the studies on which Simon based his conclusions (U.S. Department of Labor, 1974). It is not known whether the measured drop in job satisfaction in the 1970s reflected changed work conditions (including but not limited to the effects of automation), changes in expectations of work, or changes in the demography of the labor force.
tivity, product quality, and worker dedication, undoubtedly have different criteria than employees, who may want to optimize intrinsically interesting work, compensation, job security, or pleasant working conditions. Among themselves, both employers and employees may also have different criteria, depending on their social and economic circumstances, group memberships, and individual preferences.

To some degree employment quality is subjective and idiosyncratic and reflects the fit between particular workers’ needs and the characteristics of particular jobs. Still, the literatures on job satisfaction, job performance, and job design suggest at least three broad factors that influence employment quality for most workers (Barnow et al., 1973; Locke, 1976; Hackman and Oldham, 1980): (1) job content; (2) working conditions, especially the social conditions, under which the job is done; and (3) economic considerations.

Job content encompasses those attributes that are intrinsic parts of the work. There are a number of attributes—summarized under the rubric of challenge, especially mental challenge (Locke, 1976)—that increase employment quality. Learning, creativity, autonomy, responsibility, variety, and coping with difficulties exercise workers’ conceptual faculties, while the lack of these qualities bores them. Job redesign programs try to infuse jobs with these qualities (e.g., Hackman and Oldham, 1980). For example, if all else is equal, jobs with variety tend to be more rewarding and better for many workers than those in which workers do repetitive work; autonomous jobs in which individuals can pace themselves and control what, how, and when to do their work are better than jobs in which all details are prescribed; integrated jobs in which an individual performs a range of tasks that produce a complete product are better than those in which an individual performs only one fragment of a task or performs a task that produces a fragment of a product. Finally, jobs with feedback, in which workers can evaluate their performance against some standard, are better than ones in which workers perform tasks without knowing how they are doing. When technology is introduced in ways that enhance these qualities, the jobs get better for most workers, as witnessed by an increase in their satisfaction with and commitment to their work (Hackman et al., 1978).

Working conditions are both physical and social. The precise physical conditions that make a job dangerous or uncomfortable vary greatly; they may include limb- or vision-threatening equipment as well as extremes of temperature, noise, and lighting. In introducing technology into white-collar work, workstation and office design have been major concerns, ranging from fears of permanent vision damage and problem pregnancies to discomfort with seating position and vision (National Research Council, 1983; Westin et al., 1985).

Social conditions that give workers satisfaction include being with other people on the job. On-the-job friendships are especially important sources of social satisfaction and support for white-collar workers because communication is often an integral part of their jobs (Panko, 1984). Social satisfaction and support from coworkers are among the reasons that people who are employed have better mental health than those who are not (e.g., Thouitz, 1983). To the extent that using new technology isolates workers, keeping them at terminals or at home away from others, it may disrupt this source of job satisfaction. On the other hand, like the telephone, it also opens up new occasions for and ways to communicate with others.

Another aspect of social conditions on the job is supervision. Supervision can be more or less close, more or less confining, and more or less helpful—with or without new information technologies. The new technologies do, however, facilitate more detailed electronic monitoring—of keystrokes per minute, for example—and may therefore contribute to closer, more onerous supervision. As noted above, autonomy and control over the pacing and methods of work are an important factor in job quality.

Economic considerations include both the absolute level of wages and salary, fringe benefits, security, and promotion possibilities that a job offers, and the fairness of these factors compared with the norms of an occupation and industry and with the inputs, such as seniority, education, and skill, that a worker provides. As technology changes the occupational mix in an industry and the skills demanded by particular occupations, it is likely to have a direct effect on workers’ perceptions of their job security. In addition, workers often believe that they should be compensated for the new skills they have acquired in using the new technology (Murphree, 1985).

How is information technology associated with these sources of employment quality? This section attempts an answer first by trying to assess workers’ satisfaction with information technology and the jobs that use it and then by examining the specific factors noted above: job content, especially job fragmentation and de-skilling; working conditions, such as computer monitoring and work pacing, telecommuting, and the electronic distribution of work, and ergonomic conditions (the interaction of equipment features and its use by humans); and economic considerations.

Workers’ Satisfaction and Attitudes

There is no research surveying a representative sample of workers in the United States about the technology they use to do their jobs and their perceptions of the quality of their jobs. One of the most thorough sources of information about employment quality, the University of Michigan’s Quality of Employment Survey, conducted in 1969, 1973, and 1977, provides little information on technology, and in 1977 it explicitly dropped questions about the effects of automation (Quinn and Staines, 1977). There have been several large-scale surveys, but one should be cautious in generalizing from them be
cause of likely biases in their sampling procedures, their sketchy detail about how and how much technology is used in jobs, the retrospective nature of the questions they asked, and the vested interests of some of the sponsoring organizations. These surveys have been commissioned or conducted by manufacturers, employers, labor groups, and academic researchers. For example, the Honeywell Corporation, a vendor of office automation equipment, commissioned a survey comparing the reactions to office automation of 937 managers and 1,264 secretaries in a national random sample of 443 establishments in information-intensive industries. The Minolta Corporation, a copier manufacturer, and Professional Secretaries International, a worker organization, commissioned a similar survey of more than 2,000 secretaries and their managers in 22 cities. Kelly Services, a supplier of temporary clerical and other workers for business, commissioned a survey of 507 secretaries in more than 500 establishments, and 9-to-5, the National Association of Working Women, a labor group, conducted a large-scale questionnaire survey focusing on job stress among women. Kling (1978) surveyed 1,200 managers, data analysts, and clerks in 42 municipal governments. Bikson and Gutke surveyed and interviewed managers, professionals, and clerical workers in 26 manufacturing and service organizations in California (Bikson and Gutke, 1983; Gutke et al., 1984; Bikson, 1986). Westin and his colleagues visited 110 business, government, and nonprofit establishments, conducting more than 1,100 open-ended interviews with end-users of VDTs, primarily at the clerical, secretarial, and professional levels, and with more than 650 managers and executives (Westin, 1985; Westin et al., 1985).

The major problem with most of these surveys is that their samples are not representative; and in no case did a survey provide a representative sample of a broad range of users of information technology. More importantly, because the researchers were haphazard in their respondent selection, because managers selected the workers to be interviewed, or because workers selected themselves, in most cases the reader does not know to whom the conclusions apply. For example, the Honeywell survey used a representative sampling of business establishments but not of the employees within the establishments: the chief executive’s secretary provided the names of secretaries and managers to be queried; the survey was limited to secretaries working for one or more managers; and secretaries who worked in secretarial pools were excluded. Uncontrolled biases in these selections directly influence the portrait of office automation that results from the survey. The Kelly Services survey had similar selection biases and restrictions.

The 9-to-5 survey on women and stress is based on a self-selected sample of women who responded to a questionnaire printed in four monthly women’s magazines. The ways in which these respondents differ from other working women who neither read the target magazines nor responded to the survey are unknown.

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The Bikson and Gutke survey and the Westin survey used opportunity samples—the researchers talked to people in organizations in which they could most conveniently make the necessary contacts and get the necessary permissions. These organizations may be very different from less convenient or less forthcoming ones. In addition, Westin concentrated on visiting organizations with “reputations as advanced and active” users of office systems technology, and [with] “good human resource policies” (Westin, 1985:3).

The second problem with these surveys is that the questionnaires may have introduced distortions because of the way some questions were asked. A number of the surveys asked the same respondent to compare work before and after the introduction of information technology and to attribute job-enhancing or job-degrading effects to the technology (Kling, 1978; Honeywell Corporation, 1983; Minolta Corporation, 1983; Kelly Services, 1984, 9-to-5, 1984a). The problem is that people often have difficulty remembering attitudes and atmosphere from the past, even the recent past, and have even greater difficulty accurately attributing causes to the changes they perceive taking place (Bom and McConnell, 1970; Nisbett and Wilson, 1977). Respondents are likely to reconstruct the past on the basis of their current environment and the theories of the impact of information technology, so workers may believe, for example, “I like my job now and everyone knows that word processors make jobs better, therefore before the technology my job must have been worse,” or, “I have occasional headaches and everyone knows that staring at a screen makes headaches worse, so I must have more now than I did before I got my terminal.”

In addition, the phrasing of some questions may have biased respondents’ answers. For example, the phrasing of questions in the Honeywell survey probably had the effect of portraying office automation equipment in a positive light: respondents were asked to agree or disagree with statements that automated equipment made tasks easier, made tasks faster, improved work flow, made jobs more challenging, and improved the quality of work. But respondents were not given similar opportunities to indicate that automated equipment made jobs less interesting, increased stress, or made tasks obsolete.

This direct bias in question design, however, was surprisingly uncommon given the vested interests of some survey sponsors. For example, the Kelly Services survey (1984) allowed respondents to indicate that they loved or hated word-processing equipment, that information technology made their jobs more or less stressful, and that they have had stress-related physical symptoms. Similarly, the 9-to-5 (1984a) survey allowed respondents to indicate that they were treated with respect or hostility by their managers, that the introduction of automated equipment decreased or increased job stress, or that they had great or little job autonomy.

The third problem with these surveys is that many factors that both influence the quality of employment and are associated with the use of information technology have not been adequately controlled in data analysis. Thus, such factors
as the industry in which employees work, the size of the establishment in which they work, their occupation, their seniority, and their age are rarely controlled for when examining the impact of information technology. In the insurance industry, for example, if it is true that a data-entry clerk has a worse job than does a claims adjuster and that, on average, a clerk uses information technology more than an adjuster does, an analysis that inadequately controls for occupation might mistakenly conclude that use of information technology rather than other aspects of an occupation is associated with poor jobs.

The fourth problem arises because large-scale surveys must generalize across different industries, occupations, technologies, and work arrangements; consequently, they lose qualitative detail about the processes through which information technology is introduced into the workplace and the effects it has. (This point is elaborated below.)

Despite these limitations, however, these surveys provide a valuable source of information about the range of conditions under which information technology is introduced and the distribution of its effects. If they are considered with these methodological reservations in mind, they can provide suggestions about general tendencies that are not derivable from the case-study literature. Overall, these surveys suggest that workers who use information technology are generally satisfied with it, because it allows them to do their work better and because it improves the jobs themselves or, at a minimum, does not degrade them significantly. For example, the Honeywell survey found that both managers and secretaries liked the technology, agreeing that it improved the quality of work, made routine tasks go faster, allowed more to get done each day, and freed time for more interesting and challenging work (Honeywell Corporation, 1983). The survey by the Minolta Corporation and Professional Secretaries International reported similar results: about 90 percent of the secretaries believed that office automation had made them more efficient and productive, and about 70 percent believed that it made secretarial jobs more fulfilling, providing more time to do challenging and interesting work (Minolta Corporation, 1983). Bikson and Gutek (Bikson and Gutek, 1983; Gutek et al., 1984; Gutek and Bikson, 1985; Bikson, 1986) and Westin and his colleagues (Westin, 1985; Westin et al., 1985) report similar results. The survey of women and stress by 9-to-5 (1984a) collected extensive information from 5,000 women workers. The majority of the respondents reported that their jobs were more interesting and enjoyable after automation (68 percent) and less stressful and pressured (54 percent); these perceived benefits of office technology were stronger for managerial and professional workers than they were for clerical workers. Health data, however, contrast with these attitudinal data: users of VDTs and microcomputers reported more frequent physical and psychological symptoms, such as eye strain, chest pain, tension, depression, and vision problems requiring a doctor’s consultation, than did nonusers.

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Kling’s (1978) survey covered workers at different levels in municipal governments who used computer-based reports, not on-line VDTs. The respondents attributed broader job content to computer use. Respondents also attributed increases in job pressure, but not closeness of supervision, to computer use. These effects increased as the respondents used computers more. As in the 9-to-5 survey, Kling found that computers enhanced the jobs of higher-level workers. Kraemer and Danziger (1982) also analyzed survey data from the same large sample of municipal government employees and found that about half the workers experienced an increased sense of accomplishment from computerized work, while few experienced a decreased sense of accomplishment.

One may distrust these studies and their generally sanguine conclusions because of the level of detail that such surveys achieve as well as for the methodological reservations listed above. By necessity, these studies asked questions at a very abstract level to generalize across different industries, occupations, technologies, and work arrangements. As a result, they have undoubtedly missed some of the behavioral changes in work caused by technological change and many of the mechanisms through which these changes occur.

The changes in work caused by technology can be subtle, unanticipated, and difficult to derive from any general theory of technological change or any survey of job satisfaction. For example, fears about the introduction of electronic cash registers in retail work center around the deskilling of sales workers, work speedup, and the continued growth of part-time, dead-end employment. Irrespective of the validity of these fears, other consequences of electronic cash registers were not anticipated. A cash register’s capacity to compute change determines the procedure cashiers use to return change to customers (and, as a likely consequence, their facility with mental arithmetic). With mechanical cash registers, cashiers often use a subtraction by addition rule, returning coins until an even dollar amount is reached and then returning bills; when the register computes the change, clerks return bills first (Fleming, 1985). Some of these subtle changes have substantial impact on the quality of jobs for cashiers. On mechanical registers, cashiers often key in all the items for one customer and then turn to bag them in a separate operation. With faster electronic registers, a “ring-and-bag” process is often used—each item is keyed in and bagged immediately. This process, which is faster since each item is handled only once, leads to pain and health problems: cashiers stand off balance and bag goods with only the left hand, putting disproportionate strain on the left side of the body. The more extensive introduction of electronic scanners at the checkout counter may relieve these health problems, because the goods can be pulled over the scanner and bagged with two hands (Ontario Retail Council, 1981; Wallersteiner, 1981; White, 1985). Zuboff (1982) offers additional observations on the subtle effects of information technology.
Aggregate studies may also generate misleading conclusions about the mechanisms by which technological effects occur. For example, commentators assume that if information technology increases management control of workers, it does so because managers use machines to gather more detailed information about their subordinates (9-to-5, 1985). However, Klingen and Iacono (1984) report that the need for accurate data to generate useful computerized reports redefines work activities, and subjects workers, regardless of their position in the corporate hierarchy, to tighter social controls. The many groups needing accurate information put pressure on those who generate it to work according to standard procedures (c.f., Baran, 1985).

When commentators discuss the changes in skill requirements associated with information technology, they often assume either that the technology subsumes substantive knowledge of a job and its procedures (e.g., Baran, 1985) or that it reintegrates jobs that had been previously fragmented for other reasons (e.g., Giuliano, 1982). But mastering the information technology may itself require skill, especially if the technology is powerful, complex, defective, or an imperfect fit to local conditions. For example, in his case study of the insurance industry, Attewell (1985) describes the emergence of an informal class of computer gurus or mavens—noncomputer professionals who become local experts in beating the system, in circumventing its bugs, and in coercing it to respond appropriately to nonstandard local conditions. Managers provided these experts with “nonproductive” time on the computer to learn its idiosyncrasies, and they, in turn, conducted informal seminars, translated headquarters’ instructions into understandable procedures, and invented procedures for getting around computer intransigence. As a result of their expertise, they gained substantial job satisfaction and sense of mastery and skill and substantial informal power in the organization.

Job Content: Job Fragmentation and the Deskilling Debate

Braverman’s seminal work (1974) has shaped the terms of the debate about the effects of information technology on the content of jobs. He argued that the introduction of technology into the office is a mechanism to rationalize and fragment office work. As in a factory, office work is broken into many subtasks, each performed by a “detail” worker, who loses the integrative contact with the total product and who loses variety in the job. The consequences from the employer’s perspective are to reduce the skill requirements of office work—that is, the average employment experience and education needed to adequately perform the job—and therefore to reduce labor costs. The consequences from the employee’s perspective are to reduce the quality of the job by reducing the variety of tasks performed, the mental challenge, and job autonomy and responsibility.

Studies have documented many episodes in which the introduction of new information technology coincided with a fragmentation of jobs and a decrease in the skill levels required to do them. For example, Murphy (1984) describes the fragmentation of the job of legal secretary in the large firm she studied. The fragmentation was not necessarily caused by the new technology, but it facilitated an ongoing process of routinizing work. The variety of tasks that made the job of legal secretary both interesting and highly paid were assigned to other workers: paralegal aides composed first drafts of simple contracts, specialized legal librarians searched for legal citations, and messenger services hand-delivered urgent documents. With word-processing equipment, even the task of producing a manuscript was divided into an initial data-entry stage and a later proofreading and editing one, with different personnel performing each function. Relieved of many of their duties, the legal secretaries found themselves doubled up, working for more than one lawyer, primarily in a gatekeeping role. In this case, new technology was a concomitant of decreased variety, less challenge, and less responsibility.

Researchers have also identified cases in which information technology incorporated substantive knowledge of a job and its procedures, an establishment, or an industry, leaving less for a worker to know. In the insurance industry, the skilled work of assigning risks or assessing claims has increasingly been codified into computer software, so that less skilled, less experienced, and less educated clerks can perform the work once performed by skilled clerks and professionals (Baran, 1985). In social science, sophisticated statistical analyses that once were done only by professionals are now performed by undergraduates or research assistants using a statistical analysis computer program. In supermarkets, knowledge of brands, in-store promotions, and arithmetic is less necessary to a checkout clerk using a bar-code reader and an intelligent cash register: for example, when produce is coded, the clerk need not know the difference between root parsley and horseradish. In these cases the uses of information technology have led to the creation of more routine jobs.

In contrast to these cases in which technology is a tool to restructure work and fragment jobs, other researchers have argued that new office technologies can reintegrate jobs that had been previously fragmented for other reasons (Matters, 1979; Strassman, 1980; Giuliano, 1982) and require more skill and responsibility of workers (e.g., Attewell, 1985; Baran, 1985). At the clerical level, for example, by using centralized data bases, customer service representatives can handle all of the transactions associated with a client’s account, taking orders, entering data, making adjustments, and answering inquiries (Baran and Toergarden, 1984; Baran, 1985; Feldberg, 1986). At a more professional level, using new workstations managers can have greater control over more stages of their
work through computer-based tools for searching corporate data bases, calculating the consequences of investment strategies, creating illustrations, outlining, writing, checking spelling, formatting, and sending a finished report to a mailing list of recipients (Spinrad, 1982).

Moreover, starting from the assumption that the most routinized jobs in an industry are the first to be automated, some analysts have argued (Adler, 1984a; Baran, 1985) that automation increases skill requirements for the remaining jobs, especially generalized cognitive and problem-solving skills; increases worker responsibility; and increases coworker cooperation. For example, if most routine banking operations are performed by customers themselves using automatic teller machines, the banking tasks remaining to human tellers are nonroutine, e.g., handling problem inquiries that may require considerable knowledge of banking procedures, problem-solving skills, and skill at dealing with people. Similarly, Baran (1985) notes that, as some work by insurance professionals is being deskillled and redistributed to clerks and machines, the remaining professionals function as exception handlers and do more skilled work. Attewell (1985) also notes that computerization is eliminating the routine work of insurance examiners, such as calculation of deductibles or identification of potential duplicate payment, while at the same time leaving examiners more time to make decisions about dubious claims. Similarly, social scientists using modern statistical software are relieved of the tedium of calculation and can undertake more challenging intellectual tasks.

From these studies it is clear that both job fragmentation and deskilling and job reintegration and upgrading are occurring, but it is not clear which trend is predominant. Aggregate data, although flawed, show little evidence of wide-scale deskilling either within particular industries or in the labor market as a whole and, indeed, show some evidence of increased skill requirements (Attewell and Rule, 1984). Like most of the research reviewed in this chapter, the data are suspect, and the conclusions based on them should be viewed as tentative. The wide variety of skills needed in the workplace and their uneven distribution across jobs and industries and over time makes comparison of skill levels exceedingly difficult. To assess the skill requirements of jobs, researchers have often resorted to the use of one or two proxy measures, such as years of experience or years of education of workers. These measures lose detailed qualitative and quantitative information about skill differences, and they may reflect changing tastes of employers or demographic shifts in the population unrelated to skill requirements of jobs (Rumberger, 1984).

Researchers using assessments of the skill requirement of jobs from the Dictionary of Occupational Titles (DOT) and similar sources have found little evidence for the deskilling of white-collar work, either within particular occupations or, more broadly, across occupations. For example, Attewell (in press), using the Bureau of Labor Statistics' skill-level categorizations for 13 occupa-

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What causes the contradictory impressions conveyed by the literature on job fragmentation and deskilling? In part the disagreements are the result of comparisons of experiences at different stages in the evolution of the technology, variations in the uses of the equipment, and differing social and economic circumstances under which new technology is introduced. Given rapid changes in the technology itself, its uses, and in the cumulative effects, conclusions from one wave of technology use may not generalize to later waves.

An examination of the social organization of word processing is an instructive case. Large pools of workers are much more likely to be the modal organization of personnel if the word-processing equipment is old (pre-1978) rather
than new (post-1981) and if the firm introducing the technology is large (Benoit et al., 1984). Women who work in large pools have more homogeneous and boring work than do other word-processing workers. They spend more than 90 percent of their time doing typing tasks, while those who serve several clients or who work as private secretaries for a single principal have a much greater variety of tasks (Benoit et al., 1984; Panko, 1984).

It is not clear whether these differences in the social organization of word processing reflect the differing technical capabilities of old rather than new equipment (i.e., minicomputer-based rather than microcomputer-based word processors) or changes in management philosophy resulting from experiences with previous implementations (i.e., a “learning curve”) or other social influences. But the point remains that researchers trying to understand the role of technology in job fragmentation would have come to different conclusions had they studied large or small firms using old or new equipment.

Levels of Analysis

A second cause of the disagreement in the research literature results from ignoring important level-of-analysis distinctions among the units of work that are being skilled or deskilled. The skills and skill requirements of tasks, individuals, jobs, occupations, firms, industries, and the labor force as a whole can change with the introduction of technology, but a change at one level has no necessary implication for changes at other levels. A particular task may require less skill to perform when it is done on a computer, but depending on the variety of tasks comprising the job and the knowledge of the worker in that job, the job itself may become more satisfying and challenging. This paradox may be compounded as tasks migrate between jobs and occupations and as new workers fill the transformed jobs.

For example, consider the use of a word-processing system. A standard word-processing system today allows text editing of manuscripts, formatting (e.g., centering, underlining, justification, pagination, and setting fonts and point sizes), sorting, and syntax and spelling checks. As a direct result of the word-processing system, the skill and educational requirements needed to perform some specified tasks have decreased: to sort the entries in a bibliography, a secretary needs less facility with the alphabet; to proofread a manuscript, less knowledge of spelling and grammar. In addition, some of the procedures needed to achieve a certain result have changed (e.g., centering or underlining text), although it cannot be determined in advance whether the change in procedure represents an increase or decrease in skill requirements. Finally, some tasks in creating a manuscript electronically have no counterpart in a typewritten manuscript: for example, setting the size and style of fonts is more similar to traditional production editing jobs than to typewriting jobs. It is not clear in the abstract what the net effect of these changes in tasks will be on the skill required to produce a manuscript. Even if, overall, less training, skill, and education are needed to create a manuscript using a word-processing system than using a typewriter, there is no necessary connection between this decreased skill requirement and the skill exercised by particular typists or secretaries, the skill requirements of the job of secretary within a particular establishment, or the skill or educational requirements of the secretarial occupation as defined in private and public occupational classifications.

The skill requirement of jobs depends on the way their tasks are organized. Some jobs may be composed only of tasks that have been clearly deskilled when new technology was introduced: for example, the typing, proofreading, and correcting functions have been separated, and a skilled job is replaced by several new ones, some of which clearly require less skill. In contrast, a secretarial job can be organized, as it is in many universities, so that secretaries perform many services for the principals for whom they work. In this case, the increased speed at performing some of the tasks may lead to more time and energy available for other tasks, including, in the case of university secretaries, advising students, monitoring grants and contracts, and maintaining records. This kind of change is likely to lead to skill enhancement for the job as a whole.

Again, the amount of deskilling or deskilling of tasks and jobs has no necessary implication for the skills that a particular job incumbent can use. Clearly, as new technology is introduced, work procedures will change, and some of a worker’s knowledge will become obsolete while new knowledge will have to be acquired. But knowledge change is not equivalent to deskilling. In the case of an individual, whether a deskilled job is one that is not challenging because it does not require the individual’s mental or physical capabilities is a function of both the skill level required by the job and the skill level brought to it by the job holder. When the same people hold jobs before and after the introduction of technology that lowers the skill requirements of those jobs, they are unable to use their knowledge, skills, and experience, and their jobs become less challenging and satisfying (see, e.g., Rogers and Friedman, 1980). But the introduction of technology that lowers a job’s skill requirements often affects new labor force entrants, rather than incumbent workers, who may retire or be promoted, transferred, or laid off (see, e.g., Rogers and Friedman, 1980). The new entrants—often with less employment experience and education—may
well be challenged by the level of work. Indeed, the deskilling of some white-collar jobs may be the vehicle by which less advantaged social groups gain white-collar work. And for the same reason, less advantaged workers may face greater job insecurity because those jobs may be at risk of further deskilling or elimination through new technology.

In addition to changing the skill level required to perform certain tasks, the introduction of new technology is often the occasion for the reorganization of existing tasks across job categories. In the law firm that Murphree (1984) studied, for example, the shifting of duties to specialized personnel (e.g., legal librarians using data-base computers) was one element in the deskilling of secretaries’ jobs. In universities many professors do much of their own typing on personal computers, taking on data-entry tasks from secretaries, while at the same time achieving more control over the form and content of their writing. In the insurance industry, some of the less skilled tasks that examiners once performed have been transferred to data-processing clerks, upgrading the jobs of both the examiners and the clerks (Attewell, 1985). When tasks are transferred between occupations, shifts in the skill requirements of one job may be associated with complementary shifts in the skill requirements of another.

Occupations are the aggregation of similar jobs across the economy. Determining whether an occupation has been deskilled entails problems similar to those in determining whether a job (rather than a task) has been deskilled. In addition, one must contend with shifts in the definition of the occupations. In particular, as noted in Chapter 3, the Census Bureau and the Bureau of Labor Statistics periodically adopt new occupational classifications. These changes have made all comparisons across time, for both the numbers of workers and quality of work, extremely difficult.

Finally, in asking whether the skills of the labor force as a whole have been affected by technology, one must remember that occupations and industries that require many or few skills can grow or shrink independently of changes in skill requirements for particular occupations. Thus, as Simon (1977) predicted, the skill requirements of the labor force as a whole could rise if low-skill jobs die out. Of course, the reverse could also happen. In this regard it is interesting to note that the greatest new job growth is expected to be in fairly low-skilled occupations, such as food handler and janitor.

**Conclusion**

Examples abound of both positive and negative effects on skills and job quality when new information technologies are introduced. Using the research literature to ascertain which tendency prevails is difficult because of the different, coexisting stages of technology, the variety of uses of technology, and the differing social and economic circumstances of the workplaces studied. Even the same technology is used in different ways in different workplaces. No study of technological change, the quality of employment, or the effects on skills is based on a representative sample of workplaces and technologies in use. Moreover, information technology and its use are currently changing rapidly; even a well-designed study might miss important new effects on skills.

The available research studies also differ in their levels of analysis. Changes in tasks that occur with new technological capabilities do not necessarily translate into new changes at the level of the job (or the labor force as a whole). As noted, easier word entry could make a typing job more boring and repetitive or it could make it more challenging if time is freed for other tasks. Thus, the available research literature and the methodological difficulties do not allow the panel to conclude whether there has been an increase or a decrease in the skills required or the quality of jobs with the use of new information technology. And whatever the overall net effect technology has on skill requirements, there will be some jobs that require less skill and experience after new technology is introduced while other jobs will require more. Consequently, the changing skill requirements associated with technology, regardless of the direction of change, are bound to produce gaps between the skills that job incumbents and entrants have and the skills that jobs require. These gaps are a problem that require attention on their own.

**Working Conditions**

**Monitoring and Work Pacing**

The new information technology increases the amount of evaluative information that managers collect and analyze about their workers; such information can enhance the detail, comprehensiveness, and speed of organizational control systems (Kling, 1980). Often this information has been used to assess the amount of work employees do and thus place pressures on workers to meet production standards. Clearly the new information technology can be used to monitor workers more closely, and the literature documents numerous cases where it is so used. The mail-order company described at the beginning of this chapter used both computer-generated reports and television surveillance. The U.S. General Accounting Office installed a computerized security system that was later used to monitor the arrival and departure times of its white-collar employees. The U.S. Army has used computer surveillance to monitor both work time and productivity of individual computer programmers (McDavid, 1985). Word-processing hardware and software often come with report capabilities for monitoring work load and “in the worst sites, centralized [word processing] . . . is designed as an industrial assembly line, emphasizing line counts and time spent on line” (Rice et al., 1983:8).

Whether to monitor the productivity of workers on an individual level is clearly a social choice. Even though they have the technical capability for such
monitoring, many organizations do not collect such data on individual workers. Johnson and her colleagues (Johnson et al., n.d.) report that among the 200 word-processing installations they surveyed in the early 1980s, 37 percent measured individual operator performance, and another 8 percent collected performance measures, but used them for planning and group evaluation rather than for individual employee evaluation. When individual measures were used, these were approximately equally spread between measures of quantity (line, pages, or document counts), measures of timeliness (turnaround time), and measures of author or user satisfaction. Thus, only 12 percent of the organizations surveyed collected and used quantitative measures of output as a basis for individual evaluation. Of course, monitoring productivity on either an individual or a group basis may have positive as well as negative effects. Members of work groups might use work-load information to help each other with peak loads. Monitoring individuals might substitute information for prejudice in performance evaluation.

As in the case of deskilling, the data on the overall extent of computerized monitoring are both sketchy and contradictory. Kling's (1978) study of municipal governments found that those workers who used information systems reported increased influence over others, but no overall increase in surveillance and rare monitoring of subordinates' work activities through computerized reports. Kling inferred that employees and managers used the computerized information systems to gain influence in negotiating with their peers and clients. But the 9-to-5 (1984a:4) survey of women and stress found that about 17 percent of women who use computers or VDTs on their jobs report that their work is "measured, monitored, 'constantly watched,' or 'controlled,' by machine or computer system." This effect was larger for clerical workers (20 percent) than for managerial and professional workers (14 percent). Those who reported computerized work monitoring had higher frequencies of a number of stress-related physical and psychological symptoms, including headaches, nausea and dizziness, digestive problems, chest pains, and depression. Furthermore, compared with women in nonautomated offices, women who used a computer or VDT at work were more likely to report that they were required to complete a certain amount of work per hour or day; this effect was also substantially larger for clerical workers than for managerial workers. Again, workers who were subjected to production quotas were much more likely to rate their jobs as very stressful, to report a number of stress-related symptoms and medical conditions, and to have missed work time due to health problems.

**Telecommuting and the Electronic Distribution of Work**

"Telework," remote work, or telecommuting is the use of computers and telecommunications equipment to do office work from homes or other locations away from a conventional, centralized office. The increasing numbers of women in the labor force with young children, the decreasing costs of computer and telecommunications equipment and services, the increasing amounts of information available in electronic form, and the increasing proportion of the work force performing information work are all trends consistent with increased teleworking (see Applebaum, 1985; Kraut, in press; and Kraut and Grabmshch, 1985, for alternate views). Telework is a work alternative that some people have claimed is especially appropriate for women who must combine family and paid employment responsibilities. In a large sample of home-based workers, Christensen (1985) notes that women with children often decided to remain at home with their children and used home-based work as a mechanism to uphold traditional family values while at the same time earning income or maintaining career paths.

A sharp debate exists between those who see women using telework as an alternative work style to combine paid employment with family and child care responsibilities (Olson, 1983; Pratt, 1984) and those who see electronic homework as continuing the traditional exploitation of isolated, predominantly female, home-based workers (Chamot and Zalusky, 1985). The latter observers fear that protective labor laws, which were instituted to curb child labor and other sweatshop abuses, are more difficult to enforce when employees work at home. For this reason, the AFL-CIO and 9-to-5 have called on the Department of Labor to institute a ban on teleworking for clerical workers.

Because so little telecommuting exists, it is impossible to get convincing evidence on this issue. According to the 1980 census, only 1.6 percent of nonfarm workers worked at or from home on their primary job, a number that has been declining since 1960 (Kraut and Grabmshch, 1985); undoubtedly, a much smaller percentage has been working at home using computers and telecommunications technology. However, the census is likely to underestimate somewhat the numbers of home-based workers: respondents are asked about the work location of only their primary job and their primary workplace, so the number excludes people who moonlight from home on a second job, who supplement office-based work with home-based work, or who work from home only occasionally. Whatever the overall prevalence, there are concentrated pockets of home-based workers who are likely to use information technology on their jobs, including owners and employees of typing and word-processing services and copy editors, indexers, and proofreaders in the book publishing industry.

One can draw some implications about telework from the limited number of corporate pilot projects on telework and from surveys of home-based workers generally. Telework pilot projects typically allow a small number of volunteers to work at or from home (see Olson, 1983, 1986; Pratt, 1984; Board on Telecommunications and Computer Applications, 1985). These projects probably overrep...
sent socially acceptable pilot projects from socially responsible employers, who are also the ones most likely to accept researchers. These projects have generally found that employees enjoy telework, that teleworkers are productive and can be supervised, and that a dominant motivation for employees to work at home is to mesh their working lives with their personal lives. For men, it often means working at places and times that are convenient; for women, it often means integrating paid employment with family responsibilities. As Pratt (1984:12) noted in her interview study of 46 teleworkers:

They wanted 24 hours in which to integrate their work and personal lives. By preference, they used daylight time to swim, play golf, or walk on the beach. Parents balanced their work and family responsibilities; for example, a father supervised two children so the wife could leave the house. Mothers put the clothes in the washer, the children down for naps, and then sat at the computer terminal to work.

When evaluations of pilot projects have examined conditions of work, they have found that home-based professionals (primarily men in these samples) retain their salary and benefits and job security, while home-based clerical workers (exclusively women in these samples) experience decreased pay, benefits, and job security (e.g., Olson and Primp, 1984; Olson, 1986). In particular, home-based clerical workers are often hired as contract employees and are paid on a piece-rate basis.

While the current controversy has focused on telework, one can illuminate it and place it in context by examining home-based work more generally. Indeed, many policy issues surrounding home-based work are identical regardless of the tools used to do the work; for many questions it is irrelevant whether workers use regular mail or electronic mail, voice telephone or data transmission, or typewriters or personal computers.

Kraut and Garmsch (1985) analyzed the demographic and economic situation of home-based workers as identified in the 1980 census. Their results suggest that homework is a work-style arrangement that people use to gain flexibility in employment, but that flexibility is gained at the price of lost income. In particular, women with young children are overrepresented among home-based workers, but only if they are married. The nature of gender roles in the United States means that women with children, especially young children, have exceptional constraints on their time, which are not shared by men. They often require increased employment flexibility to handle the dual demands of child care and paid employment. While unmarried women with children also need employment flexibility, they need money more and cannot afford the low pay associated with home-based employment. Other needs for flexibility also lead people to work from home; as a result, the elderly, the disabled, and people living in rural areas are overrepresented among home-based workers.

Home-based workers earn less than conventional workers, in part because they are far more likely to work part time or part of the year. But even among those who work full time, year round, workers at home earn only 76 percent as much as workers in conventional locations, even after controlling for self-employment, occupation, and many of the demographic and background characteristics that vary with income.

The causal link by which home-based workers earn less than conventional workers still needs to be established. Christensen (1985) notes that both clerical and professional home workers frequently work on a contract basis for a single employer. The employer, however, typically does not treat them as employees, providing no fringe benefits or guaranteed work. Historical comparisons suggest that home working is a mechanism by which employers pay those with few labor market alternatives less than they do other workers (Daniels, 1984). Kraut and Garmsch (1985), however, did not find that home-based working decreased earnings most for the most vulnerable groups; they found that it had a uniformly depressing effect on earnings, being the same for women and men and for all women regardless of family status or other demographic characteristics. While the effects of home working differed for different occupations, clerical and other relatively low-paying occupations with large proportions of women were not differentially affected.

Taken together, analysis of corporate pilot projects and analysis of census data suggest that telework, if it flourishes, will be used like part-time work and contract work (Applebaum, 1985) to provide flexibility for some women to meet two sets of demands: paid employment and household responsibility. This flexibility, however, is gained at a price, since people who work at home are likely to earn substantially less than those who work in conventional locations. Because telework may be increasing through the use of technology and because, historically, home workers and their families have been exploited, the extent of telework and the conditions of those who work at home need to be carefully studied.

Ergonomics: The Fit Between People and Technology

A major difference between the last wave of white-collar automation in the 1960s and early 1970s and the current wave is the style with which workers communicate with the new equipment. Gone are operators typing data and instructions on cardboard cards and receiving results hours later. One of the characteristics of the new information technologies is that many workers, both clerical and professional, spend much of their work time sitting in front of a VDT. This work style has been coupled with numerous complaints about visual system impairment, vision fatigue, muscular discomfort, and pregnancy problems (9-to-5, 1984b).

A recent National Research Council (1983) report concluded that VDT use is
unlikely to be associated with increased risk of ocular disease or abnormalities; it noted that the radiation levels emitted by current VDTs are far below current U.S. occupational radiation exposure standards, are generally lower than the ambient radiation to which people are continually exposed, and are unlikely to be hazardous. The Research Council panel was less sure about issues of visual fatigue, muscular and skeletal discomfort, and stress, both as to the extent of these conditions in VDT-intensive jobs and as to the causal role that VDT use plays in their occurrence.

VDT users report higher rates of frequent eyestrain, muscle strain, tension, anger, and depression than nonusers and are more likely to have been treated by a doctor for a vision problem (9-to-5, 1984a). But, as the Research Council panel suggested, at least some of this effect is due to occupations: clerical workers, who are the most likely to be using VDTs, have the most symptoms. Occupational effects are substantially larger than VDT effects (9-to-5, 1984a). As emphasized above, moreover, in many cases VDTs are introduced into jobs that would be poor regardless of technology. In addition, some of the problems are due to the tasks people perform, not to the technology they use; tasks requiring close visual work that does not use VDTs produce similar symptoms of ocular discomfort, difficulty with vision, and temporary changes in visual function.

The physical environments in which VDTs are used also contribute to the problems workers have with them. Too often VDTs are used in bright rooms with glare that cuts contrast and makes screens hard to read. Tables may be the wrong height for reading and typing and seats may be uncomfortable for extended periods of sitting and too inflexible to fit the contours of a particular worker. A number of guidelines and standards now exist to give guidance to both equipment manufacturers and equipment customers about the design of workplaces and workstations for VDT-intensive jobs (e.g., Armbruster, 1983; Helander and Rupp, 1984; M. Smith, 1984).

This is not to say that the VDT itself is unimportant. As Stark in his dissent from the National Research Council report noted, "I have never seen a video display terminal that was nearly as legible as the ordinary pieces of typewritten paper or copied reports that circulate in our paper world" (National Research Council, 1983: 235). Working many hours per day on a hard-to-read and inflexible device may be sufficient to cause a number of physiological and psychological complaints.

Economic Considerations

Two issues dominate concerns about the impact of technology on economic aspects of employment quality: compensation and job security. To the extent that technology increases productivity, workers expect to share in the economic gain (see Murphree, 1985; 9-to-5, 1985). In the long term, increases in productivity, whether caused by characteristics of the worker (e.g., education) or by decisions made by the employer (e.g., use of technology), generally translate into increases in wages. But this longer-term equilibrium between productivity and wages may mask shorter-term perturbations during which workers feel they are not being compensated for the increased number of pages they type, customers they service, or analyses they perform.

Employees also expect to be compensated for specific skills they must acquire to use new technology. Training other workers is one especially important work responsibility that is associated with the introduction of information technology and that may be hidden and not directly compensated. For example, in the Kelly secretarial survey (Kelly Services, 1984), more than 50 percent of respondents reported that teaching others to use the word-processing equipment was a regular part of their jobs. On the other hand, employers may be using technology in order to reduce the skill requirements of jobs in an effort to reduce labor costs or may feel that technological literacy, like literacy in general, is a basic and noncompensable job requirement. The economic value of specific technological skills certainly interacts with their supply. Employers may need to pay a premium early in the life cycle of the technology, for example, when hiring word-processing operators in place of typists, independent of the skills needed to operate computers or typewriters. Such a wage differential is likely to decrease as more people with technological skills enter the labor market or more current employees learn new skills.

Employees also expect to be compensated for the general education levels that technology-intensive jobs may require (Noyelle, 1985). In the 1970s, however, the increase in wages per year of college education declined; while some observers expect improvement in earnings return in the 1980s, there is some uncertainty about effects of education (Freeman, 1976).

Regardless of the impact of information technology on levels of employment and the structure of occupations in the economy as a whole, within specific firms and agencies technology has been used to reduce the absolute number of jobs and to redistribute employment among occupations. For example, Bizina (1986) found staffing reductions associated with new technology in about one-third of the offices she studied. When staffing changed, the numbers of clerical workers decreased and the numbers of technical workers increased. Certainly, as demonstrated in the previous chapter, the demand for some occupations is likely to vanish, even within particular firms. Employees' fears of job loss and employment dislocation that are associated with information technology can be reduced by a number of employer policies. The feasibility of these policies depends on business and other conditions. For example, employers can strive to ensure continued employment for employees whose jobs are eliminated or changed by technology by giving them preference for new openings and by
providing or subsidizing training that is needed for new or changed jobs. Staff reductions, if they are needed, can be attained through attrition rather than layoff.

CONCLUSION

This section has illustrated the range of outcomes that can occur when computer and telecommunications technologies are introduced in women’s jobs. The literature is rich with examples in which technology has been associated with either increased or decreased job quality. However, the lack of depth and uneven quality of the data prevent definitive conclusions. Overall, no compelling evidence was found that white-collar work in the aggregate has been getting either better or worse with the introduction of information technology. Because innovations can be implemented in broadly different ways, the major determinant of the effects of innovation appears to be management’s preexisting employee policies. The examination of several specific areas of concern about information technology—changes in skills and job content, working conditions, and economic considerations—does suggest that regardless of the overall direction of change associated with technology, managerial workers generally fared better than clerical workers.

Although the predominant effect on employment quality of introducing information technology into the workplace cannot be determined with certainty, the range of outcomes found indicates that technology can be implemented in both job-enriching and job-degrading ways. Currently available hardware and software can be used with a great deal of flexibility. Identical hardware and software introduced into different organizational settings have different effects. The same equipment in two locations can be seen as reliable or unreliable depending on social setting (Blomberg, 1986). Identical equipment can be distrusted by workers or welcomed; it can be introduced with worker involvement or passivity depending on previous management styles and local traditions (Gurstein and Faulkner, 1985). Within a single job in a single industry, management practices and methods of work can be much more powerful influences on employees’ job satisfaction than are the technological tools used to do the job (Herman et al., 1979). In sum, it is clear that any technology can be used in a number of ways and that social choices about its use are genuine.

IMPLEMENTING TECHNOLOGICAL CHANGE AND IMPROVING EMPLOYMENT QUALITY

This section first considers in more detail the process by which information technology is introduced to the workplace, focusing on the factors that lead technology to increase or decrease the quality of employment, especially for women clerical workers. Among the factors examined are the role of upper- and middle-level managers in decision making, including women’s influence, and the economic, technological, and organizational constraints on managers’ ability to consider and respond to employment quality. In brief, this examination, which is based on admittedly limited data, finds that the interests of managers and workers are likely to differ. The section then considers some mechanisms that can be used to ensure that workers’ interests are represented in technological decisions.

THE ROLE OF MANAGERS

The Dominance of Management

Currently, upper- or middle-level managers are often primarily responsible for deciding to introduce information technology in white-collar work, for determining how much and what kind of technology to adopt, and for influencing many of the details of implementation. The limited evidence available suggests that the decision to introduce new technology is typically dominated by economic considerations and that implementation decisions focus on productivity. Both Johnson and her colleagues (Johnson et al., n.d.; Rice et al., 1983), studying organizational issues in 200 word-processing centers, and Bikson and her colleagues (Gutek et al., 1984; Bikson, 1986), studying the implementation of office automation in 55 offices, conclude that managers primarily initiate and influence the introduction of technology and that hardware and software considerations dominate the decisions. Issues such as employee attitudes, skills, and behaviors or organizational effects are rarely considered important.

According to the 9-to-5 survey on stress (1984), almost two-thirds of the women who used automated equipment reported that they had no influence over the design, choice, or conditions of use of their equipment; female clerical workers reported substantially less influence than female managers. Clerical workers are more likely to be involved in or at least consulted about equipment in small rather than large organizations, but they rarely serve on vendor-selection committees or make final decisions in any companies (Minolta Corporation, 1983).

Even when managers are concerned about the human elements of new technology, the scope of their concern seems circumscribed. For example, Westin et al. (1985) interviewed both end-users of technology and managers in 110 business, government, and nonprofit organizations that were reputed to be advanced and active users of office automation; most were selected because they had “good human resource policies” (Westin, 1985:4). In this highly selective sample, policies aimed at good ergonomics were widespread—better terminals,
user-friendly software, adjustable workstations, and comfortable working environments—but even in these organizations, considerations of hardware and software dominated. Policies directed at job design—variety in tasks, discretion in pacing, or fair work standards—were less frequent and occurred mainly if human resource personnel joined data-processing and office automation personnel in planning for office automation. Almost half the sites that Westin and his colleagues visited had some formal employee participation programs (e.g., quality circles), although not necessarily oriented around technology. In only a quarter of the sites were such women’s issues as sex-segregated work groups, career ladders in clerical work, or pay equity addressed directly.

The dominance of management in the introduction of technology is, however, not inevitable. The adoption and implementation of some technologies—e.g., bullet-proof vests by police officers, microcomputers in schools (Yin and White, 1984), and instruments in laboratories (Von Hippel, 1978)—have been initiated by workers. In Europe, as discussed below, users’ interests are represented more directly.

Women’s Influence

Compared with other workers potentially affected by information technologies, women have less influence over their use in the workplace because of their low position within office hierarchies, their relative lack of technical expertise, and their relative lack of professional and union representation. Women are less likely to be in senior management positions in organizations that implement technology and thus not in a position to influence its use. In 1984 women occupied only 34 percent of managerial positions in the United States but more than 75 percent of administrative support positions (Bureau of the Census, 1985). And, as noted above, clerical workers have much less influence in office technology decisions than do managerial and professional workers. Given the ubiquity of the sex segregation of jobs within firms (Bielby and Baron, 1985) and the small number of women in managerial positions, many of the managers who make decisions about the technology that women will use have never held a job like the one in which the technology is being introduced. Thus, they are likely to have difficulty identifying both the full range of tasks that the technology needs to support (Suchman and Wynn, 1984) and the full impact that the technology will have on the quality of employment.

Job segregation and less technical training make women less influential than men in technical decisions about hardware and software both in research and development firms and in the organizations adopting technology. While women are well represented in the computer professions, they tend to be concentrated as low-level programmers and documentation writers in insurance and banking, rather than as systems analysts and designers in research and development organizations or as managers in management information systems (Kraft, 1977; Strober and Arnold, 1985; Kraft and Dubnoff, 1980). Women clerical workers do have the detailed job knowledge that is necessary to design and apply computerized equipment in the most useful way (Suchman and Wynn, 1984).

Organized workers have more influence over conditions of their work than do similar nonorganized workers (Golin and Schein, 1984), and most women are not represented by labor and professional organizations. In general, except in the public sector, white-collar workers are much less likely to be represented by labor organizations than are blue-collar or service workers. Within the relatively unorganized white-collar labor force, women are somewhat less likely to be in unions than are men: in 1980, 14.7 percent of female white-collar workers and 16 percent of male white-collar workers were in labor organizations. In occupations that are rapidly adopting information technology, only 8.6 percent of female secretaries, typists, and stenographers, 4.5 percent of female bookkeepers, and 5.3 percent of women in retail sales were in labor organizations (Bureau of the Census, 1983: Table 729).

The Role of Enlightened Management

It is generally assumed that managers introduce technology in economically rational ways to ensure the survival and growth of their organizations: by producing new and better goods and services, by reducing costs, by increasing market share, by increasing profitability, and so on. In the optimal case, they manage in an “intelligently selfish” way that benefits themselves as managers as well as owners, customers, and workers. In this case, managers should strive to introduce technology in humane ways to maintain a stable, motivated, and effective work force. Managers can adopt values and procedures to introduce technology into the workplace in ways that use the technology effectively, aid the general welfare of the organization, and enhance employment quality (e.g., National Research Council, 1986). Methodologies such as the sociotechnical design of work systems (e.g., Mumford and Weir, 1979; Taylor, 1986) have been developed to combine the effective use of technology with its humane use.

There is much that an organization with a concern for employment quality can do to implement technology consistently with that concern. Westin (1985) and Bjorn-Anderson and Kjærgaard (1986), among others, have developed guidelines. The guidelines include building a concern for people into an overall office technology plan and obtaining top management’s commitment to this concern; creating a task force to deal with people-oriented issues in implementation; formally involving workers in the design and implementation process; surveying ergonomic, health, and comfort conditions and upgrading offending situations, starting with the most technology-intensive jobs; establishing per
formance evaluations for technology users that are fair and avoid excessive monitoring; conducting employee-centered training for technology users and training their supervisors in methods to enhance employment quality; monitoring external developments in the policy, regulatory, and research communities to understand social concerns and to bring the organization into anticipatory compliance with the sound standards that emerge; designing technology-intensive jobs to allow variety, autonomy, and meaningful work; ensuring job security; and generally choosing and implementing the technology in a worker-oriented way.

For the use of VDTs, there is now sufficient consensus on standards for the functioning of the current generation of equipment to serve as a guide in selecting and deploying technology (Armbruster, 1983; Helander and Rupp, 1984; M. Smith, 1984). These standards encompass the issues of ambient lighting, glare, character size and legibility, character contrast, work placement, workstation flexibility, chair design, and the like. Undoubtedly, with changes in technological capabilities and with advances in research, the standards will need continuing updating.

Constraints on Managers

There are many reasons that managers do not act in the optimal way to maximize the effective and humane use of technology. Economic conditions, workplace cultures and traditions, technology, and conflicts between interest groups and values all influence the degree to which managers can and do emphasize employment quality in implementing technology.

Economic Conditions The economic condition of a firm is central to the technological implementation process and constrains the optimal case just described. Organizations that can pass any higher costs on to consumers—strong companies in a period of major industrial growth, companies with little international competition, and companies selling differentiable products and services that compete on design or quality—can often afford the resources necessary for implementing technology in humane ways. Conversely, weak companies—those in declining industries, those with major foreign competition, and companies selling commodities that compete primarily on the basis of price—may believe they cannot afford a longer-term view toward implementing technology humanely. The panel emphasizes, however, that it has found no evidence that implementing technology humanely is more costly and, indeed, some evidence that it is cost-effective (Commission of the European Communities, 1984).

Improved labor relations, decreased employee turnover, and more efficient operating systems are some economic benefits of taking quality of working life into account (Walton, 1975). As an example, Mirvis and Lawler (1977) have calculated the dollar savings (primarily from reduced training, less turnover, and lower absenteeism costs) of increasing average job satisfaction in one bank that they studied. It is likely, as Baran (1985), Bjorn-Andersen and Kjaergaard (1986), and Taylor (1986) argue, that a motivated and effective work force is especially important in an automated workplace because mistakes are more costly; errors have wider impact as shared data pass through an organization.

Organizational Culture and Behavior Of course the introduction of technology does not occur in an organizational vacuum. Even in his exemplary sample, Westin identified a minority of organizations in which top management's staffing approach was to encourage high turnover and pay in the clerical labor force. These policies existed prior to the implementation of new technology and were the milieu into which technology was introduced. As Westin (1985:29) concludes:

[The advent of office systems technology was almost never the source of the poor practices. These management had applied harsh personnel practices and engaged in sex discrimination before they had installed VDTs. Now they were extending their basic approaches into new-technology work settings [emphasis in original].

In addition, even in the context of good personnel policies, managers often have mixed motives and a lack of knowledge that leads them to decisions that fail to optimize their firm's welfare (see, e.g., Kling, 1980). For example, managers at different levels in an organization vie with each other for resources and influence on the direction of the whole organization and its components. Computerization is but one tool that managers can use in this competitive process.

Technological Constraints Except for specialized systems for relatively large organizations, the design and development of hardware is often controlled by equipment manufacturers and their research and development specialists, who are outside the workplace where the new equipment is to be used. Although software is more likely to be developed in-house by the data-processing departments of large corporations, much of the generic software (e.g., word processing, data-base management, graphics, spea....
vances: the development of microcomputers, decreases in computer-memory prices, increased transmission speeds between video displays and central processing units, and refinements in software. The recent changes in clerical work in the insurance industries depend on hardware and software improvements that allow integration of formerly separate data bases (Baran, 1985).

Improvements in technology are not necessarily technologically determined, however. The most effective designs are likely to have been informed by interactions with potential users of the product (e.g., Maidaque and Hayes, 1984; Maidaque and Zirger, 1984). This interaction often occurs through usefulness and usability testing in developers’ laboratories, through consultation with clients for whom a system is being developed, through the involvement of users in the development process, and through market feedback—some designs sell well and others do not. It is also possible for potential purchasers and users to influence design more directly. Large purchasers have enough purchasing power to set requirements on manufacturers for their automated equipment. Smaller purchasers and worker organizations can share evaluations of automated systems, as the National Education Association does for educational software and 9-to-5 does for VDTs.

In addition, some hardware and software have been designed to allow flexibility for the end-user. For example, some computer displays have adjustable character sizes and fonts as well as screens that rotate to reduce glare, and some computer programs adjust to the expertise of the user and allow the user to create new commands or to redefine old ones. Such flexibility is important to accommodate the personal preferences of individual users.

Constituent Conflicts and Value Contradictions It is inevitable that the interests of parties involved in the introduction of technology into the workplace will differ. As stressed above, the decision of top managers to invest in technology often stems from a desire to reduce labor costs or to increase market share or product quality. Westin (1985) notes that, in the sites he visited, managers saw the balance between needs for cost control and needs for an effective work force as crucial. When vast sums are at stake, one can imagine that employment quality may take a back seat to more immediate economic concerns. For example, in 1983 the Bell operating companies employed approximately 35,000 directory or information assistance operators, who handled approximately 5 billion calls per year. In deciding to invest in new technology, the telephone companies use as a rule of thumb that a second of an operator’s time costs 1.1 cents, which translates to $55 million per second for all directory assistance calls. These figures provided managers with powerful motivations to adopt technology and work procedures that reduce the time operators spend per call. The recent introduction of machine-generated reporting of telephone numbers to customers saves an average seven seconds per call; the dollar savings if this were introduced in all telephone companies would be more than one-third of a billion dollars per year. These potential savings, of course, must be weighed against increases in capital expenses and technical support; and, as Laco and Kling (1986) note, technology has traditionally been touted for potential labor savings that are often not realized.

Even when the motivation for adopting technology is improved product or service quality rather than labor savings, effective use of technology may conflict with improved employment quality. For example, in the early 1980s the U.S. Social Security Administration changed the computer support for some of its claims representatives from a batch-oriented system, in which claims representatives entered requests and received responses approximately four hours later, to an online system, in which the responses came within four minutes. With the online system, claims representatives could do a much better job of interviewing clients and establishing their entitlement to social security benefits in a timely way. But, as a result of the system, the claims representatives handled more cases per day, had more mental strain symptoms, and greater absenteeism (Turner, 1984). In this case it appears that better tools made worse jobs; increased interaction with clients and their problems and the difficulty of making decisions about them decreased job quality. Of course as the urban banking example of worker participation in implementation pointed out (Center for Career Research and Human Resources Management, 1985; reported in Chapter 2, this volume), the trade-off between improved productivity and improved employment quality is not inevitable. But even this generally favorable introduction of information technology was perceived as benefiting clerical staff more than it benefited the managerial staff, demonstrating the difficulty in making changes that have uniform benefits for everyone affected.

The Role of Workers

Although there is much that employers can do to implement technology in ways that preserve or enhance job quality, many factors constrain the ways in which computer and telecommunications technologies are introduced. In addition, as noted above, the goals that even the best-intentioned managers attempt to achieve are not necessarily compatible. Productivity, service quality, and employment quality do not necessarily go together. All of this implies that workers cannot simply rely on the goodwill of employers to ensure that technology is used humanely. Given the potential conflict between implementers of technology (usually managers) and workers, especially women workers, who use it on a day-to-day basis, workers need mechanisms to represent their interests in decisions affecting employment quality. This section first describes
types of worker participation in the design and implementation of technologies, then considers their general effectiveness, and finally provides some detailed examples of participation by organized workers.

**Worker Participation in Technology Design and Implementation**

The long tradition in American management—from the early joint employer/employee committees in the 1820s and 1830s (Guzda, 1984), to the Morse and Reimer (1956) study in the 1950s, to the present day (e.g., Katzell and Guzzo, 1983)—has documented that worker participation in what are traditionally thought to be managerial decisions (including work scheduling and the design of job activities) can lead to increases in workers' satisfaction with their jobs and to increases in organizational effectiveness. Worker participation affects employment quality and job satisfaction in two ways. First, it changes the contents of the decisions, because it provides a mechanism through which workers' interests are represented. Workers who will use information technology are often the only ones in a position to know enough about their jobs to design technology that articulates with those jobs; thus, their participation enhances the effectiveness of the new technology. Participation also helps ensure that information technology is not used in ways that decrease employment quality. Second, participation in decision making is intrinsically satisfying for many people and leads to increased commitment to decisions simply as a result of the process by which they were reached. Because worker participation generally has had positive effects in other contexts, it is likely to have positive effects when applied to technology as well.

Workers' participation can take two basic forms: informal participatory practices, which are the constantly evolving activities, knowledge, and expertise that workers bring to bear on many workplace policies; and formal rights giving workers an explicit role to play in company decision making concerning new technology (Howard and Schneider, 1985). The two forms are complementary. Without formal rights, informal participatory practices can be undermined or ignored when workers' interests collide with those of managers or technology designers. Without informal participatory practices, formal rights are rarely fully realized.

Many mechanisms exist for involving workers in design and implementation decisions. One of the most effective has been for workers to actively propose designs at both the research and development stages and then iteratively provide feedback for modifying the design of new generations of hardware and software products. This often happens in the professions, where workers have more control over the development of technology because of their status and expertise. As described in Chapter 2, such involvement is one route through which nurses have influenced the design of information technology in the medical professions. They communicated with each other about the technological possibilities, consulted with technology vendors, and became developers of technology themselves. It has also happened among craft workers where, for example, printers have joined with computer scientists to design an integrated text-and-image processing system for newspaper text entry, image enhancement, pagination, and layout (Howard, 1985).

It is instructive to consider the way in which computer programs that aid decision making about clients or patients have been used in different occupations and so have had different influences on the design and implementation process. For example, for physicians a program might accept as data a patient's symptoms and risk factors and the probability of a disease in the relevant population to categorize a patient as diseased or not. For a customer service representative in a utility company, the program might accept as data a customer's payment history with the company, the size of the current bill, and the probability of nonpayment in the general population to categorize the credit risk of a customer. While software for disease and credit-risk assessment could be very similar, they are in fact very different. Physicians' software is generally used to make diagnosis but to train medical students in diagnosis (Richer, 1986), to provide them with graphics tools allowing them to see the implications of their tests (Cole, 1986), and to offer a system that provides a secure opinion with explanations of discrepancies between a physician's judgment and that of the software (Langlotz and Shortliffe, 1983). In all of this software, the physician has access to the data and the rules that the software uses in ways that allow the physician to understand and challenge its assumptions and conclusions. In contrast, for a customer service representative in telephonic companies (Dumais et al., 1986), the software schedules a service representative's telephone contacts with customers based on such data as the size of the current bill, the length of time that a bill has been overdue, and the action to be taken without providing the representative fast access to either the data, the scheduling rules, or the application of the rules to a particular customer. Appelbaum (1984) and Baran (1985) find a similar lack of access to the software's decision-making rules in the insurance industry: the software makes decisions on whether to insure and at what rate based on data the insurance clerk enters. The clerk has very limited ability to interact with the software in understanding how decisions are made.

There are many reasons for the differences in these systems, but one is that physicians have been more involved in the design of the software as designers, consultants, and research funders. In addition, since physicians are generally discretionary users of computer software, they can limit their use to systems that aid them without usurping what they consider to be their responsibilities, autonomy, and expertise. Thus, to gain physicians as clients, software developers provided systems that do not impinge on physicians' autonomy.
The Effectiveness of Worker Participation

Evaluations of the effectiveness of user involvement in the design of information technology are sparse. They suggest that users' involvement in the design and implementation of information technology can be a mechanism to improve its effectiveness and to improve the jobs in which it is used. For example, in her study of the design and implementation of computer systems in six British organizations, Mumford (1981) notes that effort is expended on human goals such as job satisfaction during the system design and implementation processes only if they are explicit design goals. Those who participate directly in the early stages of the system design process are able to influence the nature of the goals set and hence the way in which the system ultimately operates. If users participate in or control the design of the system, the goals that are important to users, such as job satisfaction, are more likely to be attained. In several of the organizations that she studied, however, managers and system designers, not users, were responsible for trying to design information systems that would meet users' needs.

The effectiveness of worker involvement in information system design and implementation depends vitally on the organizational context in which participation takes place and on the procedures through which it is accomplished. Mechanisms for worker participation vary in the scope of workers' interests that are represented and the degree of influence that workers have. The Commission of the European Communities (1984) reports on the concept of "design space" developed by J. Bessant to help understand the range of issues open for negotiation when implementing technology; the concept has been elaborated by a group of researchers investigating worker involvement in five European countries (Commission of the European Communities, 1984). Design space can be thought of as the range of choices about technology, work, and work organization that are possible. Constraints that limit the choices include the available technology, the regulation of industrial relations, company character-

istics such as industrial sector, size, type of production process, and such environmental determinants as economic climate, competitors' behavior, state of the market, and availability of resources.

It is important to note that the range of available choices is itself a point for negotiation. The range of issues that can be included in the design space is broad. Analysis of European cases shows that it includes at least the following (Commission of the European Communities, 1984): changes in the organization of the firm and its investment in automation (e.g., company organization, degree and timing of automation), changes in the organization of work (e.g., division of labor, job composition and skill requirements, job autonomy and cooperation, pace of work, training, recruitment and promotion, grading and pay), and the actual hardware and software technology.

Decisions made early in the implementation process constrain the choices that can be made later (Mumford, 1981). For example, a decision to hire specialists to perform data-base searches in a law office constrains the work organization of legal secretaries and, therefore, the nature of the technology they use. This funnel of choice implies that if worker involvement in technological change is to be effective, it must include involvement at early stages.

Because users of computerized information systems are sources of expertise, information about the jobs that are to be automated, political actors whose acceptance of or resistance to information systems can determine their success, and workers whose knowledge, training, and skill in actually operating a system will determine if it is used effectively, a number of developers of information technology have involved potential users of their systems in design, implementation, and training. They have solicited their opinions during the design of the systems, informed and involved them during the implementation process, and provided them adequate training after the systems have been installed. The Digital Equipment Corporation, for example, advocates a user participation methodology developed with Enid Mumford and known as ETHICS—Effective Technical and Human Implementation of Computer-Based Systems (Mumford and Weir, 1979; Bancroft, 1982; Bancroft et al., n.d.). Once an office is slated for automation, a broad-based design group of workers analyzes their own workplace, proposes alternative ways of organizing work tasks, and helps select appropriate technology. This design group works in consultation with technical experts and under the guidance of a management steering committee that sets the design group's charter. But as Howard and Schneider (1985) note, these approaches are often ineffective in representing workers' interests because they are often used as marketing tools by vendors to sell products to skeptical buyers, rather than as genuine mechanisms to solicit information from users. Second, the "users," who are consulted are often first-line managers, that is, users' supervisors, rather than the day-to-day users of the technology. Third, the scope of what user groups are allowed to consider is constrained by manage-
Organized Worker Involvement

A number of techniques have been used in the United States to generally increase workers' involvement in managerial decision making. These include, among others, problem-solving groups and quality circles, whose purpose is to identify and analyze workplace problems and present solutions and implementation plans to management for approval; autonomous work groups, which collaborate in the completion of work tasks and have responsibility for implementing solutions and controlling the day-to-day scheduling, standards, and flow of their own work; and business teams, in which workers participate with managers in decisions affecting product development (Gorlin and Schein, 1984). Worker participation programs have been used primarily in manufacturing companies, generally with union representation. They have rarely dealt with technology design, often focusing on local quality-of-work-life issues, including employee morale, safety and environmental health, scheduling arrangements, absenteeism, overtime, bonus payments, job alignment, and, occasionally, product quality.

Both in the United States and in Europe, unionized workers have negotiated technology agreements that provide mechanisms for union involvement in the implementation of technology in their industries (see Chapter 2). Both procedural provisions about the manner in which technological change should occur and substantive provisions about the content of technological change are often included in these agreements. Typical agreements include the following (Evans, 1983):

- Management provides workers advance information about plans for technological change.
- Joint management/union committees discuss, monitor, and negotiate change at the corporate and establishment level.
- Unions have access to outside expertise to guide their technological decisions.
- Employers provide employment security following the introduction of new technology.

THE QUALITY OF EMPLOYMENT

- Employers provide adequate retraining to workers whose jobs are changed or eliminated.
- Joint management/union committees monitor the impact of new technology on the quality of working life.

For example, in the United States the 1980 contract between the Communications Workers of America (CWA) and AT&T set up shop-floor committees on the quality of work life, which could address local technology issues, and higher-level technology change committees, in which, according to the language of the formal letter of agreement, the unions could "discuss major technological changes with management before they were introduced" (reported in Howard and Schneider, 1985). The quality circles in the Bell system, like many others, have dealt primarily with matters affecting the immediate workplace environment, such as scheduling, management attitudes, and office environment, and, according to Howard and Schneider (1985:14), "have been an important vehicle for building workers' informal participatory practice at the local level." Technological change, however, has generally not been addressed.

The technology change committees, intended to be a forum for discussing broad policy issues about technology, have been generally ineffective: a 1983 study (reported in Howard and Schneider, 1985) found that during the first three years of the program nearly two-thirds of the committees had yet to meet. The agreement by AT&T to provide the unions with six months' advance notice of all major technological changes provided insufficient time for union influence on technologies that often required years between planning and implementation. In addition, the notification agreement gave unions no formal rights to participate in the conception, design, or testing of new technological systems. Finally, neither the union nor corporate representatives on the committees had timely information about the types of systems that were being developed. The corporate representatives were typically labor relations personnel with expertise in dealing with unions, not technology. Engineers, systems designers, and technical managers were rarely committee members.

European, especially Scandinavian, countries have higher levels of unionization than the United States; relatively homogeneous societies (compared with the United States); a tradition of industrial democracy, with a 20-year history of worker participation in many aspects of workplace decision making, and the reinforcement of contract provisions by parallel provisions in laws and regulations. As a result, technology agreements in Europe have been more elaborated and much more effective than in the United States. In contrast to the relatively limited and unsuccessful U.S. experiences in worker participation in technological change, many European examples show that worker participation can have substantial impact on how technology and work is designed.

Much of the evidence about participation in the design of technology comes
from the Scandinavian factory experiments of the 1970s (Norstedt and Aguren, 1973; Aguren et al., 1976; Thorsrud et al., 1976). In these projects, factory workers, both directly and through union representation, participated along with management and staff groups in the design of the workplace, the design and selection of the technology used to do jobs, and the design of jobs. They also made many of the day-to-day decisions about how tasks are organized and work is scheduled. For example, in the Volvo factory at Kalmar, Sweden, social goals were identified early (Pehr Gyllenhammar, quoted in Aguren et al., 1976:5):

- to organize automobile production in such a way that employees can find meaning and satisfaction in their work . . . [to] give employees the opportunity to work in groups, to communicate freely, to shift among work assignments, to be conscious of responsibility for quality, and to influence their own work environment.

These goals led groups of foremen, technicians, architects, and trade unionists to emphasize team assembly when they designed conveyance and assembly equipment, its controlling software, and work organizations. Within the constraints of the installed equipment, the teams could decide how assembly would be done. Evaluations suggest that by conventional criteria of quantity, quality, and costs, the new methods are acceptable; equaling conventional assembly methods. Some of the traditional problems of assembly work—absence and turnover—are reduced. In addition, the new methods changed the content of work, giving workers longer work cycles, job rotation, and more control over task allocation, for example. As a result, workers were very satisfied.

The involvement of the Norwegian Bank Employees Union (BNF) in the banking industry provides an example more relevant to women and information technology (Howard and Schneider, 1985). Women make up about one-half of the union membership. They generally hold the lowest-paying jobs, 68 percent have no professional training, and nearly 70 percent work part time. To ensure that these women would not be trapped in low-wage, dead-end jobs as technology transformed the banking industry, the union emphasized access to training in its technology policy. Union and management set aside 40 percent of the places at their joint industry training center for women, and the union negotiated special arrangements for training working mothers.

The BNF developed elaborate structures to guarantee workers' participation in technological development, and union representatives participated actively in the design of new computer-based systems. For example, in 1982, 80 bank employees, working in 10-person groups, developed the preliminary software specifications for a $70 million computer system for savings banks. When system designers proposed a new automated loan processing system, a union-management team evaluated its consistency with organization goals. They suggested such changes as retaining decision-making power to grant or withhold loans with loan officers rather than delegating these decisions to a computer algorithm. In addition, union representatives maintained informal relationships with bank technical personnel, both to educate them about the union's social goals and to influence the design process. Similar strategies are reported for female-dominated workplaces in Norway, such as the postal services and public libraries (Bermann, 1985).

These examples show that union involvement can be a mechanism for worker participation in technological design and implementation. However, given the large differences between European and U.S. societies, one might be skeptical about the applicability of the European experience to our own (but see Mumford and Weir, 1979, and Mumford, 1983, for a counterargument). Different mechanisms for worker involvement may be necessary in the United States, especially to ensure worker involvement among the highly nonunionized female labor force in service industries.

**Conclusion**

In the United States managers are generally responsible for decisions to introduce information technology. While there is much that enlightened managers can do to ensure that information technology is used in ways that enhance jobs, most managers do not include users of the technology in the decision-making process and rarely treat employment quality as an explicit and important determinant of their decisions. Women clerical workers in particular have little direct influence in implementation decisions, because of their position at the lower end of the organizational hierarchy, their lack of collective representation, and their generally lesser technical knowledge. The inevitable differences in interests between managers and workers suggest that workers need mechanisms to participate in technological design and implementation. Worker participation programs in both the United States and Europe have been used to improve both general organizational effectiveness and employment quality.

Worker involvement in the design and implementation of technology in general, and union involvement in particular, are not panaceas, however. Unions can be as autocratic and unrepresentative of their members as managers are of workers (Lipset et al., 1956). Direct participation by individual workers in the technological decisions that will affect their own jobs implies a limited scope for their influence, limited to the establishment in which they work and to technology already developed. If participation is to be effective, it must be involving, not merely formal, and strong ties between representatives and their constituencies must be maintained (Katz and Kahn, 1978). Managers, with their superior power and resources, can often manipulate workers while providing a facade of participation. These asymmetries in power may be especially important during a period of rapid technological change.