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5 Technology and Work

Throughout history, many things have shaped the occupations people have held and the work they have done. Today, as in the past, one of the most important of these is technological change. The technologies used in the workplace exert a powerful influence on the kinds of tasks performed, how they are organized, and the kinds of skills needed to perform them. Technological advance also has helped propel another major change in work patterns by expanding the boundaries of economic, social, and cultural relationships. One common term for this expansion is *globalization*. We will take on globalization in the next chapter, but first, we will consider the interaction of technological change with employment and unemployment, the occupational structure, and the distribution of power and authority in the workplace.

Defining Technology

In the preceding chapters, we saw how first the Agricultural Revolution and then the Industrial Revolution profoundly altered work and life. In both cases, technological change was one of the major driving forces of these transformations. In the case of the Agricultural Revolution, the adoption of plant cultivation transformed humans from nomadic gatherers and hunters into sedentary farmers. Thousands of years later, the Industrial Revolution fundamentally altered the economy and society through the intertwined development of new machines, power sources, production processes, and methods of work organization.

It is often said that we are currently undergoing a third, technologically driven revolution that has given rise to a "postindustrial" economy and society.[1] To a certain extent, this is indisputable. As we saw in previous chapters, the primary and secondary sectors have been eclipsed by the service sector, numerically, as the most important source of jobs in the American economy. As with the two earlier revolutions, this one did not happen overnight, but its long-term effects have been profound. Less than a century ago, the majority of the workforce was employed in farming, the extractive industries, and manufacturing, leaving only 36.4 percent of workers in the service sector.[2] In the decades that followed, millions of these jobs were lost as a result of technological change, yet widespread unemployment did not occur because these losses were offset, and then some, by the emergence of a great number of new service-sector occupations. The rise of the service sector as the dominant source of employment represents one of the most important transformations of life and work in human history, and we will trace its consequences many times in the pages to come.

There is no need to belabor the point that technological change has been a crucial source of these economic and social transformations, but what exactly is meant by *technology?* Technology is more than machinery and other artifacts, and it goes well beyond the electronic devices that are sometimes equated with it, as in the Wall Street term *technology stocks.* To begin, technology can be defined in the most general way as the use of knowledge and organization to produce objects and techniques for the attainment of specific goals.[3] Such a schematic definition necessitates the elaboration of several of the words contained in it. In the first place, what sort of "knowledge" serves as a foundation for technological applications? Scientific knowledge is often thought to be paramount, as when technology is commonly defined as "applied science." But this is at best a partial truth. Many technologies, both past and current, have been created and developed without any help from science. To take a few examples, early mechanisms such as water wheels and textile looms were developed through trial and error—empirical, but not exactly scientific processes. More complex technologies also were developed with no scientific inputs, as when ironworkers were able to make high-quality steel for centuries without possessing what today would be considered the most basic metallurgical knowledge.[4] And long before steel was produced, makers of beer and wine had no idea of how the ingredients they used were converted into alcoholic beverages. Even today, many technologies are created and developed through cut-and-try processes that owe little to science. This practice-based source of technological advance is particularly relevant to a discussion of the relationship between work and technology because many new products and new ways of doing things have been created by engineers, technicians, and shop-floor workers who have made little or no use of scientific knowledge.[5]

Another important issue in the above definition of technology is embedded in the phrase "for the attainment of specific goals." Here, we need to ask *whose* goals are being pursued and how these goals have been chosen. For more than a generation, economists have understood that technological advance has been one of the most—if not *the* most—important sources of aggregate economic growth.[6] But, while improvements in productive technologies have propelled economic expansion, not everyone has benefited equally from them. As we shall see, some technologies have caused considerable injury, economic and otherwise, to particular groups and individuals.

Many times, the damage is unintentional, but in some cases, particular technologies have been used as weapons wielded in conflicts between contending parties.

A lot, therefore, depends on who has the power to shape the course of technological innovation. If nothing else, recognizing that technological change often has a political dimension serves to undermine the notion that technology is an independent force in human affairs. Belief in the autonomy of technology in effecting social change is known as *technological determinism.* Its rejection doesn't mean, of course, that technology and technological change have been of no consequence; the most cursory glance at the modern world demonstrates technology's influence on our daily lives through everything from antibiotics to zippers. What matters for gaining a deeper understanding of technology's significance is the willingness and ability to understand how specific technologies came into being; who promoted them; who resisted them; and how they affected the distribution of wealth, status, and power.

A focus on the social and political dimensions of technology also helps us recognize the merits and limitations of "technological fixes." A technological fix is the use of a technology to solve a problem that is not purely technological in nature. For example, billions of dollars are spent annually on devices and dietary supplements aimed at helping people lose weight. But an individual's weight is governed by a host of factors—body type, metabolism, lifestyle, eating habits, and general attitudes about food. Under these circumstances, there is no technological "silver bullet" that can guarantee a slim figure, no matter what miracles are promised by marketers of such products.

Equally important, even a technological fix that does rectify a problem is likely to yield some negative consequences. To take one example, from the 1920s onward, American railroads took a financial beating as cars, buses, and trucks took away a substantial portion of the market for the movement of goods and people. But in the mid-1930s, the diesel-electric locomotive began to replace the venerable steam locomotive, and the ensuing cost savings did much to restore the financial health of the railroads. At the same time, however, the new locomotives made the work of the traditional fireman unnecessary. Their displacement was temporarily averted by the requirement that a fireman ride along in the locomotive, even though there was little or nothing for him to do—a practice that railroad management derided as "featherbedding." The ability of locomotive firemen to resist the negative consequences of technological change was hardly typical of the relative power held by workers and management, however. As we shall see later in this chapter, workplace technologies have at times been developed and applied by enterprise managers not simply because they were more efficient but because they strengthened management's hand. But before we take up this issue, we need to explore another fundamental issue of work and technology: the fear that technological advances will result in long-term, permanent unemployment.

Technological Unemployment

For centuries, workers have worried about the destruction of their jobs by machines and other technological innovations. Sometimes, they did more than just worry. As we saw in Chapter 3, textile workers in early 19th-century England—collectively known as "Luddites"—rose in rebellion, smashing machines and destroying the homes of the factory owners who had installed them.[7] Many more recent incidents of job losses caused by technological advance can be cited. In the music industry, for example, the use of electronic synthesizers has drastically reduced the number of studio musicians because one operator can take the place of a large ensemble of musicians.[8] Throughout the manufacturing sector, advanced production technologies have allowed employers to maintain or even increase production while reducing the number of workers. To note just two examples, the Ford Motor Company was able to make as many vehicles in 1988 as it did in 1978 while employing half as many workers.[9] No less dramatic was the case of the steel industry, which from 1955 to 1960 increased production by 20 percent even as it was eliminating 17,000 jobs.[10]

Concerns about the replacement of human workers by machines occasionally have motivated governments to try to put the brakes on technological innovation, as happened in 1638 when the government of England banned "engines for working of tape, lace, ribbon, and such, wherein one man doth more amongst them than seven English men can do."[11] Fears about the job-destroying potential of labor-saving technologies were not confined to the preindustrial past; they forcefully reemerged in the 1930s when a severe economic depression seemed to portend an era of permanent unemployment on a massive scale.[12] Although few blamed technological advances as the sole cause of the depression, some government officials seriously considered implementation of a "technotax" to be levied on firms that replaced employees with new equipment.[13] The issue of unemployment induced by technological change did not disappear with the return of prosperity after World War II. During the 1950s, the newly coined term *automation* was associated with the spectre of permanent unemployment. Advances in computers, sensors, materials handling, and automatic machine tools appeared to be ushering in a new era of industrial production that required little or no input from human workers.

As we have just seen with the example of "featherbedding" on the railroads, organized labor has at times been able to avert or at least delay the loss of jobs caused by technological change. Today, technological changes even more far-reaching than the introduction of new kinds of locomotives can be found in many industries, carrying the threat of job losses along with them. But do new, labor-saving technologies necessarily result in unemployment? In fact, there is some basis for optimism. In the first place, new technologies open up new employment possibilities. After all, there were no jobs for X-ray technicians before the development of X-ray technologies or for webpage designers before the creation of the Internet. Second, technological advances within an existing industry can increase employment through productivity improvements that lower the price of its products, which may in turn induce people to buy more of them. Increased sales may not result in the retention or stepped-up hiring of production-line workers, but it may expand employment opportunities in sales, shipping, administration, bookkeeping, and so on.

Even in the digital age, hands-on factory work is still needed. For a number of decades now, engineers, managers, and economists have foreseen a new era of fully automated industrial plants where machines would run themselves in factories, with scant need for human workers. To some extent, this prophecy has come true, as computer-controlled machinery has taken over many of the jobs that previously had been done by flesh-and-blood workers. But glib portrayals of the "lights-out factory" have proven to be overblown. Although robots are now doing many of the jobs previously performed by welders, spray painters, and other factory operatives, plenty of industrial operations remain the province of working men and women. Even when automated processes have become well entrenched, a substantial need for human operators remains. Problems inevitably arise that need human intervention, often by workers who stand rather low in the official hierarchy.[14] Meanwhile, a large number of industrial operations remain stubbornly resistant to automation. Manufacturing processes involving the assembly of components of varying size and shape are especially hard to automate, and some firms have even scrapped computer-controlled machinery in favor of human workers, who have proven to be faster, more accurate, and even less expensive than the robots they replaced.[15]

At a more fundamental level, an optimistic perspective on technology and employment hinges on making a clear distinction between *work* and *jobs*. It is undeniable that some technologies have rendered certain jobs obsolete and will continue to do so. Employment in the buggy-whip industry plunged as mass automobile ownership took hold, and there was not much hope for assemblers of vacuum-tube–based radios after the commercial diffusion of the transistor and other solid-state electronic devices. But the loss of particular jobs, either through the obsolescence of an entire industry or the replacement of workers by labor-saving technologies need not result in increased unemployment. In the case of one industry giving way to another, the economic resources tied up in dying firms or industries can be transferred to more dynamic ones, creating new jobs in the process. In the vivid phrase of the Austrian economist Joseph Schumpeter, economic advance is often the product of "creative destruction," the process whereby obsolete industries, materials, processes, and jobs are replaced by new and better ones.[16]

One of the costs of a growing economy is, therefore, the loss of particular jobs. But the loss of these jobs, individual tragedies though they often are, is not the same thing as the loss of work as a whole. Technological change, in addition to giving rise to new industries, also can create new employment opportunities indirectly. Labor-saving technologies are used because they diminish production costs. These lower costs can result in lower prices for consumers, greater profits for owners, higher wages for the remaining workers, or a combination of some or all of these. All these situations improve the financial situations of the parties who have benefited from the reduced costs. A considerable portion of their increased incomes will likely be spent on other goods and services, and these expenditures will pay the wages and salaries of the people who produce the goods and services that are purchased. Alternatively, the extra income may be invested in capital equipment, but this also translates into jobs in the industries that receive the investment funds.

The erroneous equation of technological change with widespread unemployment is in part based on what economists have labeled "the lump of labor fallacy." Here, the underlying idea is that within any particular economy, there is only so much work to be done and, hence, a fixed number of jobs. Accordingly, if labor-saving technologies take over some of that work, the result must be more unemployment. In recent years, a few governments bought into this idea by mandating shorter workweeks in order to create more work opportunities for the unemployed. There are several good reasons for moving to shorter workweeks, but stimulating employment isn't one of them. The idea that there is only so much work to be done is properly labeled a fallacy because there will never be a shortage of essential tasks. Today, for example, many jobs could be filled in the course of rectifying environmental damage, rebuilding crumbling transportation infrastructures, and providing healthcare for underserved groups. The absence of these employment opportunities can be attributed both to the lack of appropriate skills among the unemployed and the inability or unwillingness of a society to pay for the work that needs to be done. But the idea that there is an unchanging amount of work to be done doesn't stand up to scrutiny, and there is no inherent reason why new work opportunities cannot be expanded in order to alleviate unemployment caused by technological change.

Developing New Skills

As just noted, a major obstacle to putting unemployed workers in new jobs may be the lack of needed skills. Although there may be an abundance of new jobs, there is no guarantee that workers displaced by labor-saving technologies will be able to fill those jobs; the "creative destruction" wrought by technological change necessitates the development of new skills as it renders obsolete the relevance of other skills, a particularly difficult situation for older workers. While this mismatch between existing and needed skills is problematic for individual workers, especially those over the age of 50, it also threatens future economic growth for the nation as a whole. In 2002, there were about 62 million people aged 55 or older. By 2025, there will be an estimated 103 million of them, and many in this cohort will need to develop new skills to match the requirements of new technologies and a changing economy.[17]

Developing new skills for veteran workers is a difficult but not insurmountable task. An abundance of psychological research has shown that the ability to learn new things declines from early adulthood onward. It would, therefore, seem to be a quixotic hope that older workers will be able to develop the skills needed to successfully work with new technologies. But relative differences in learning need not be fatal impediments; old dogs can learn new tricks, although it may take them longer to do so. When older workers fail to develop new skills, it may be the result of a self-fulfilling prophecy whereby employers offer few retraining opportunities because they believe that their older employees would not benefit from them. Yet it seems evident that most older workers do not have an inherent resistance to learning, as shown in a study of a number of state agencies in Pennsylvania where older workers demonstrated a greater willingness to learn new office technologies than their younger counterparts did.[18] Another study focused on facility with the use of computers, often thought to be the special domain of young workers. In fact, this study found no significant differences in computer use between younger workers and workers who were in their 50s. Computer use did drop off for workers in their 60s, but this apparent lack of interest may be an indication of a significant obstacle to the retraining of older employees: if a worker anticipates being excluded from new workplace opportunities or is close to retirement, he or she is not likely to devote time and energy to the acquisition of new skills.[19]

Technology and Managerial Authority

Although technological change may be acquitted as a source of across-the-board unemployment, it is not an unqualifiedly benign force. For one thing, it has been indicted as a major source of widening income inequalities, an issue that will be taken up in Chapter 10. It also may be the case, as some have argued, that the trajectory of technological change has reflected and reinforced differences in economic power and that specific technologies have been used to advance the interests of one group over another. In regard to the organization of work, critics have pointed out that on numerous occasions, new technologies have been developed and applied in order to consolidate or increase managerial control over workers. This process was particularly evident in the early 20th century with the rise of mass-produced industrial products. One of the key elements of mass production was the use of specialized machine tools that allowed the production of standardized, interchangeable components by workers with minimal skills. This made for cheaper consumer products, but it also strengthened the hand of management by reducing the need for skilled workers, whose difficult-to-replace skills helped insulate them from the exercise of managerial power. In sharp contrast, unskilled workers could be treated as though they themselves were interchangeable parts. As one Ford engineer who was involved in the early development of mass-production technologies put it, his firm had "no use for experience." Rather,

> it desires and prefers machine-tool operators who have nothing to unlearn, who have no theories of correct surface speeds for metal finishing, and will simply do what they are told, over and over again, from bell-time to bell-time.[20]

According to Marxist-oriented scholars, this ability to employ an unskilled and easily controlled workforce made mass-production technologies especially appealing to enterprise owners and managers. This has been reflected, say the critics, in ongoing efforts to develop and deploy industrial technologies that "deskill" their employees.[21] One of the ways to accomplish this has been through the division of manufacturing work into a series of small, repetitive tasks that demand little more than regular attendance at a workstation and the willingness to do the same thing over and over again. Once again, a prime example of this approach can be found in the early years of the Ford Motor Company, where

> the assembling of the motor, formerly done by one man, is now divided into eighty-four operations . . . in the chassis assembling [room] are forty-five separate operations or stations. The first men fasten four mudguard brackets to the chassis frame; the motor arrives on the tenth operation and so on in detail. Some men do only one or two small operations, others do more. The man who places a part does not fasten it. . . . The man who puts in a bolt does not put on the nut; the man who puts on the nut does not tighten it.[22]

Ford did not invent the division of labor, even in this extreme form, but he did pioneer another revolutionary productive technology: the assembly line. As noted in Chapter 3, Ford and his associates transformed automobile production by having the work come to the worker instead of the other way around.[23] The result was dramatically lower production costs that put the purchase of a Ford Model T within the financial means of a large segment of the American population. Some of the purchasers of these cars were the workers who built them. The cars were reasonably priced, and Ford employees earned a wage that was well above the earnings of the average manufacturing employee. But assembly line work exacted a toll. The line moved relentlessly, the work was monotonous and physically taxing, and the noise level could be deafening. Even young, able-bodied workers were physically exhausted at the end of the day. As the wife of one worker complained in a letter to Henry Ford,

> The chain system that you have is a *slave driver. My God!,* Mr. Ford. My husband has come home & thrown himself down & won't eat his supper—so done out! Can't it be remedied? That $5 a day is a blessing—a bigger one than you know, but *oh* they earn it.[24]

While mass production technologies based on unskilled labor brought material benefits at the cost of exhausting work performed in an oppressive work environment, other innovative technologies were being developed to increase productivity while at the same time enhancing managerial control. As David Noble has argued, numerically controlled (NC) machine tools allowed faster and more accurate shaping of metal components, but their key appeal to management lay in reducing the influence and autonomy of skilled machinists. Although the automatic operation of machine tools could have been effected by recording the actions of human machinists, managers preferred to reserve the task for engineers who were part of the managerial team. As one manager asserted, "With NC, control over the process is placed firmly in the hands of management—and why shouldn't we have it?"[25]

Electronic technologies also may enhance managerial power when they are used to monitor workers and keep track of the work they do. For example, many commercial word-processing programs include a function that counts key strokes in order to determine a typist's productivity. Monitoring technologies are also widely used outside the clerical realm, as when GPS-based technology is used to continuously track the location of long-distance truck drivers. To some observers, then, "computers are the electronic equivalent of an assembly line to mechanically pace and control workers rather than a tool to enhance a job."[26]

Although some employers and managers continue with their attempts to control their workers through close monitoring or deskilling or both, many industries still need a cadre of skilled workers who enjoy a fair amount of autonomy as they go about their work. For all its use of mass-production technologies and routinized work, the automobile industry still finds it necessary to employ significant numbers of millwrights, machinists, tool and die makers, and other skilled workers, whose skills continue to confer a fair degree of independence. According to the recollections of one industry executive,

> These fine old tool makers worked hard and were very proud of their craft. They kept their big tool boxes right underneath their work benches. If you looked at them the wrong way or dealt with them in any manner other than a man-to-man, professional fashion, they would simply reach under their work benches without saying a word, throw their tools into the big box, lock it up and leave. That was it. Each guy figured, "What the hell. I don't have to take this from anybody. I'm a pro. I know this business and I am not depending on you or anyone else.[27]

Today, the autonomy enjoyed by skilled manual workers has been replicated in some occupations through the widespread use of computers. Although computerization has facilitated both deskilling and monitoring, it also has increased the capabilities of many rank-and-file workers and has undercut managerial authority in the process. The crucial element has been the facility with which computers can gather, sort, analyze, and distribute information. By making information inexpensive and readily available, computers have threatened a key source of managerial authority. As one manager mused in an interview with Shoshana Zuboff,

> The classic managerial role has been that of the handler, manipulator, dealer, and withholder of information. An issue that the technology is forcing us to face involves the loss of managerial control. . . . Suddenly you are vesting in folks at the control station, folks who are interfacing with a tremendous technology power—power to see all the functions of the operation. That is kind of scary to some managers.[28]

The loss of some of their powers may be a disturbing prospect for some managers, but it can be argued that deskilling employees and keeping them on a short leash are poor business practices that hinder the effective operation of a firm. As noted above, no productive process runs itself; breakdowns, unforeseen disruptions and opportunities, and novel situations always crop up, and these require the intervention of a skilled, well-motivated cadre of employees.[29] Moreover, many of today's businesses are primarily service providers, and a firm is not likely to prosper if its employees are incapable of responding to the needs of clients and customers in an intelligent and creative fashion.

The ongoing need for interventions by skilled workers even in highly mechanized operations presents something of a conundrum for the managers of these facilities. On the one hand, they need a cadre of effective workers to keep everything on an even keel, but at the same time, it is evident that hard-to-replace skills and freedom of action can invest workers with a potential source of power in the workplace. Although some critics may have overstated the extent to which deskilling has been a deliberate managerial ploy, conflicts over the possession and control of skills will inevitably accompany the course of technological change in the workplace.

Work, Skill, and Today's Technologies

As we have seen, only a relatively small portion of the labor force works in the manufacturing sector today. Once again, technological change has contributed to a radically new work environment, as a large number of productive tasks are now done by robots and other automated processes. As has happened in the past, the introduction of new technologies has had mixed consequences as far as skill requirements are concerned. In some cases, the introduction of computers into the workplace has done little to stimulate the development of new skills. Sitting in front of a computer monitor while doing data entry is not as physically taxing as working on an assembly line, and the work environment is likely to be more pleasant, but the skill requirements are still minimal. Under these circumstances, workers are not likely to have much more control over their jobs than assembly line workers do. At the same time, however, many recent technological developments have required the ministrations of workers with advanced levels of technical skill.

Given these conflicting tendencies, do 21st-century jobs require more or less in the way of skill than required in times past? The issue is hard to resolve because "skill" is an elusive concept with a multiplicity of meanings, and the widely different skill requirements of different industries further complicate things. Although it cannot be taken as the last word on the subject, one study found that workers' skills in recent years have increased in some occupations while they decreased in others and that the two trends have largely cancelled each other out, leaving no net change either way.[30] Another study was more optimistic, concluding that from 1960 to 1985, the jobs done by American workers had moved in the direction of greater cognitive and interactive skills.[31] Finally, to return to the automobile industry, another research project concluded that advances in mechanization and automation had eliminated many low-skill jobs and increased the number of workers in skilled occupations.[32]

The above discussion should help reinforce the point that technological change may influence the distribution of workers' skills, but it does not operate as an independent agent. As ever, it is important to avoid falling into the trap of technological determinism. In the realm of work, the power dimension always has to be taken into account when assessing technological trajectories. In any industry or individual firm, the distribution of power will strongly affect the choice of technologies, as will the attitudes and beliefs of those in positions of power. When managers believe they should call the shots in a work environment where the employees are viewed as hostile and unreliable, they will be attracted to production technologies based on the use of unskilled, easily replaced employees who can be controlled by the use of routinized procedures and electronic monitoring. When, on the other hand, workers are seen as essential resources to be valued and cultivated, there is a much greater likelihood that the technologies chosen will require a fair amount of skill and initiative on the part of the workforce.

Telework

In recent years, significant numbers of workers have made use of new technologies that have the potential to confer greater control over their work environments while at the same time partially alleviating the conflicting demands of work and home. All this has become possible because, as already noted, many of today's employees do not work with or produce anything with a physical substance. Their primary tasks center on the production, reception, interpretation, and analysis of information and then acting on the basis of that information. To put it more concretely, what writers, accountants, journalists, computer programmers, diagnosticians, bookkeepers, teachers, and researchers all have in common is that they work with information of some sort.[33] Today, relatively new communications technologies such as fax machines and e-mail, together with the long-established telephone system (which has benefited from greatly reduced charges for long-distance calls), allow the transmission of information rapidly and inexpensively from one place to another. This means that an employee may not have to show up at a central office day after day but can work at home instead.

Dubbed *telecommuting* or *telework,* this mode of employment has grown in recent years. In 2010, more than 34 million workers—24.4 percent of employed adult Americans—worked at home at least occasionally.[34] The actual time spent working at home is limited, however; most teleworkers do it only 5 or 6 days a month.[35] These figures should be taken as only a rough approximation, as definitions and survey procedures can affect the tally, but they do give a general idea of the extent of telework.

An obvious advantage of telework is that it allows workers with young children to take care of them while working at home, and in fact, working parents are more likely to engage in telework than workers without children are.[36] As with many other aspects of work, the extent of telework reflects gender divisions in society and the differential responsibilities of parenting. On average, mothers spend more time on parenting than fathers do, and it is, therefore, not surprising that women are more likely to be teleworkers than men are.[37]

Although it is based on modern electronic technologies, telework represents a return to typical patterns of work and residential life that existed before industrialization, urbanization and suburbanization, population growth, and new transportation technologies combined to separate the workplace and the home, making commuting a way of life for the majority of workers. Although in times past, the home served as the workplace of skilled craftsmen working at their own pace, it also was the scene of sweated labor, where miserably paid workers put in 12-hour days in cramped cottages and noisome tenements. Memories of the exploitative nature of this variety of homework initially caused telework to be greeted with scepticism and even hostility by organized labor. As a practical matter, unions also had a long history of opposition to work done in the home because dispersed and easily replaced workers have been difficult to organize and recruit as members of unions. This is not necessarily the case today, as seen in the comments of the president of the National Treasury Employees Union, who in 2010 noted at a White House forum on workplace flexibility that telework "allows employees to avoid long, expensive, and tiresome commutes, enables them to better balance work and family life, and increases job satisfaction."[38]

Although some contemporary teleworkers remain poorly paid and have little opportunity for advancement, the majority of these workers appreciate that telework can reduce some of the stresses of trying to reconcile the demands of work and family. At the same time, however, telework can produce new stresses by creating an environment in which work and family responsibilities may frequently collide, and worker-parents may not be able to pay full attention to either role. Many telecommuters report that they are more productive when working at home because they have fewer distractions and interruptions,[39] but offsetting these advantages are a number of drawbacks. The home environment can be just as distracting as the workplace—sometimes even more so—with consequent deleterious effects on worker productivity. Under these circumstances, the demands of working at home can be the source of considerable family tensions over the allocation of time between work and family responsibilities.

Telework may also inhibit career advancement. For many workers, extended periods of absence from the workplace, even when they do not result in diminished output, put them at a disadvantage in regard to promotions, pay raises, and assignments to new projects. Working exclusively at home makes it difficult to gather information, to form working relationships with other employees, and to participate in job-related networks. In many kinds of jobs, being physically present is essential for effectively working with others. As Joel Mokyr notes of conventional working relationships,

> Proximity in a plant or office created personal familiarity and thus conditions of trust and believability. There is always a role of body language, intonation, and general demeanor in human communications.[40]

In short, modern communication technologies allow the effective implementation of many tasks, but they cannot completely obviate the need for "face time" at work.

Although telework has both advantages and disadvantages for individual workers, its contribution to reducing the individual and collective costs of daily commuting should also be taken into account when assessing its overall value. One economist has reckoned that the time spent commuting comes to 25.4 billion person-hours. If that time had been spent on gainful employment at $14/hour, it would have amounted to $356 billion.[41] Commuting also entails psychic costs in the form of stress, but it confers some benefits as well. For some, commuting offers a time to be by oneself and a reminder that the home and the workplace are separate spheres of existence. For many others, however, it may mean a crowded bus or gridlocked traffic, so the stresses of commuting are piled onto the ones endured at work.

Frustrating traffic, along with higher energy prices, may motivate more workers to work at home whenever possible. At the same time, the ongoing development of communication technologies will surely improve the effectiveness of teleworkers. These forces will likely propel an expansion in the extent and scope of telework. Even so, a large-scale merger of home and workplace is not likely to happen anytime soon.

Technology and Globalization

The next chapter will address one of the most powerful forces affecting work today: globalization. Globalization has many dimensions, but in the final section of this chapter, we will confine ourselves to the interplay between globalization and technological change.

Advancing technological capabilities have been essential to globalization, past and present. An earlier phase of globalization, the European "discovery" of the New World, owed much to the development of oceangoing vessels and improved navigational techniques, while its subsequent colonization was secured by firearms, the destructive power of which was complemented by diseases against which indigenous peoples had no natural defenses.[42] Today's globalization also owes much to radically improved transportation technologies. Where trips from one country to another may have taken days or even weeks a century ago, superhighways and high-speed trains allow them to be completed in a few hours today—while air travel puts entire continents less than a day's journey apart.

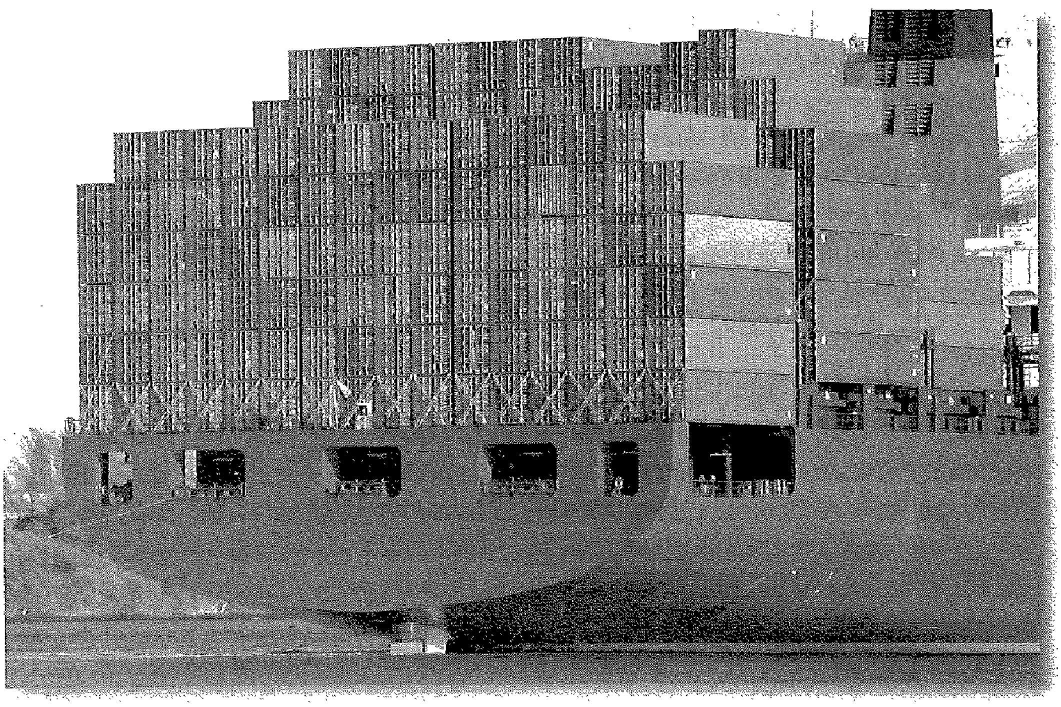
Although they are the fastest means of getting from one place to another, commercial air carriers transport their passengers at the rather leisurely speed of around 500 miles per hour. In contrast, digitized information travels at the speed of light. The rapid movement of information through electronic media is a key component of globalization, and it, too, represents the latest phase of a process that started long ago. The first great breakthrough came in the middle of the 19th century, when the telegraph made communication almost instantaneous.[43] Once the wires were strung up, a message could be sent and received as fast as telegraph operators could convert texts to dots and dashes, and vice versa.

Today, digital technologies make long-distance communication faster, cheaper, and more accurate than could have been imagined a generation ago. Computers and their associated networks greatly expand the ability to communicate because anything that can be digitized—numbers, letters, and sound and light frequencies—can be transmitted electronically and then reconstituted as music, texts, images, and much else.[44] Electronic communication technologies propel globalization when investors buy and sell shares in foreign firms and government-issued bonds, fans of Afropop tune in to the latest releases, and scientists share experimental data with colleagues on other continents.

Not all the technologies that have moved globalization forward are based on digitization and electronics, or even embody state-of-the-art technologies. One of the most significant commercial technologies of recent decades has been a plain metal box: the shipping container. A common sight at ports and on railroads and highways, standard-sized containers are the building blocks of intermodal transportation. *Intermodal* simply means that containers can be transported on many different types of carriers, including ships, railroad flatcars, and flatbed trucks. The use of containers has made global transportation cheaper, safer, and much more efficient. Before the widespread use of containers, the long-distance haulage of cargo usually entailed several episodes of "breaking bulk," as when crates of merchandise were loaded into trucks, taken out of the trucks and stowed in a ship's hold, unloaded after a sea voyage and transferred to railroad boxcars, and then finally moved from the boxcars to delivery trucks. Each of these transfers required gangs of workers to unload and load cargo every time it was transferred to a new mode of transportation, incurring substantial labor costs and likelihood of damage during each phase. Further increasing costs, cargo spent a lot of time just sitting around in a holding area, where it was vulnerable to more damage, the effects of the weather, and pilferage. These problems are avoided through the use of containers, as the merchandise stays securely in the same container from when it leaves the factory to the time it is unloaded at a warehouse or retail establishment. Due to all its advantages, containerized intermodal transportation now accounts for the vast majority of international transportation, and in 2008, the world's intermodal facilities handled the equivalent of 152 million standard, 20-foot-long containers.[45]

The shipping container, along with all the other technologies that make globalization possible, has contributed to an interconnected world. To some extent, globalization represents a new stage in human affairs, but it also has many historical precedents. For its supporters, globalization has increased incomes and improved workplace conditions. For its critics, it has had the opposite effect. Most serious students of globalization would agree, however, that it has been a multidimensional process containing many contradictions. The next chapter will take a look at this complex phenomenon and its consequences for work in the 21st century.

Photo 5.1 Shipping containers



SOURCE: ©Olivier Lantzendorffer/iStockphoto.

FOR DISCUSSION

1. Why are technological fixes so appealing? To what extent can new technologies substitute for other changes? Can you think of some examples of effective technological fixes, as well as some that have not lived up to expectations? What accounts for the differences between the two?

2. Technological change has produced many benefits, but it also has done a fair amount of damage to particular regions, industries, occupations, and individuals. Should governments develop policies and programs to alleviate problems caused by technological change? What might these be?

3. Do you agree that the owners and managers of business firms have deliberately tried to deskill their employees? What sort of evidence can be used to support or reject this idea?

4. Can you think of any jobs that have required increased levels of skill as a result of technological change? Have some jobs required *less* skill due to technological change?

5. Would you like to be a teleworker? How would telecommuting ease some problems of combining work with other roles? What sorts of new problems might it create for you?

Notes

1. One early statement of this thesis is Daniel Bell, *The Coming of Post-Industrial Society: A Venture in Social Forecasting* (New York: Basic, 1973).

2. Calculated from *Statistical Abstract of the United States 1920,* "Table 192: Population 10 Years and Upward Engaged in Gainful Occupations, Census Year 1910," http://www2.census.gov/prod2/statcomp/documents/1920-01.pdf (accessed July 19, 2006).

3. This is the definition I use in *Society and Technological Change,* 6th ed. (New York: Worth, 2008), 6.

4. John D. Verhoeven, "The Mystery of Damascus Blades," *Scientific American* 284, no. 1 (January 2001): 74–9.

5. See, for example, Walter Vincenti, "Technological Knowledge Without Science: The Innovation of Flush Riveting in American Airplanes, ca. 1930–ca. 1950," *Technology and Culture* 25 (July 1984): 540–76.

6. F. M. Scherer, *New Perspectives on Economic Growth and Technological Innovation* (Washington, DC: Brookings Institution Press, 1999), 25–48.

7. Malcolm I. Thomis, *The Luddites: Machine-Smashing in Regency England* (New York: Schocken, 1972), 14–5.

8. Allan Jalon, "Synthesizers: Sour Sound to Musicians," *Los Angeles Times,* December 6, 1985.

9. Neal Templin, "A Decisive Response to Crisis Brought Ford Enhanced Productivity," *Wall Street Journal,* December 15, 1992.

10. Melvin Kranzberg and Joseph Gies, *By the Sweat of Thy Brow: Work in the Western World* (New York: G. P. Putnam's Sons, 1975), 177.

11. Thomis, *The Luddites,* 14–5.

12. Amy Sue Bix, *Inventing Ourselves Out of Jobs? America's Debate Over Technological Unemployment, 1929–1981* (Baltimore: Johns Hopkins University Press, 2000).

13. Ibid., 76–8.

14. Marietta L. Baba, "Work and Technology in Modern Industry: The Creative Frontier," in *Meanings of Work: Considerations for the Twenty-First Century,* ed. Frederick C. Gamst (Albany: State University of New York Press, 1995), 139.

15. Emily Thornton, "Japan Lays Off Its Robots," *World Press Review* 43, no. 7 (July 1996): 31–2.

16. Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy* (1942; repr., New York: Harper, 1975), 82–5.

17. Sara J. Czaja and Joseph Sharit, *Aging and Work: Issues and Implications* (Baltimore: Johns Hopkins University Press, 2009), 259.

18. T. E. Rizzuto and S. Mohammed, *Workplace Technology and the Myth About Older Workers.* Paper presented at the Annual Conference of the Society for Industrial and Organizational Psychology, Los Angeles, CA, 2005. Cited in Ron P. Githens, "Older Adults and E-learning: Opportunities and Barriers," http://www.rodgithens.com/papers/older_adults_elearning_2007.pdf (accessed August 26, 2010).

19. Leora Friedberg, "The Impact of Technological Change on Older Workers: Evidence From Data on Computers," (Department of Economics, University of California, San Diego, 1999), http://www.escholarship.org/uc/item/1s97n77x#page-2 (accessed August 26, 2010).

20. Horace L. Arnold and Fay M. Faurote, *Ford Methods and Ford Shops* (New York, 1915), 41–2. Quoted in David Montgomery, *Workers Control in America: Studies in the History of Work, Technology, and Labor Struggles* (Cambridge, UK: Cambridge University Press, 1979), 119.

21. Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974).

22. Quoted in Alfred D. Chandler, *Giant Enterprise: Ford, General Motors, and the Automobile Industry* (New York: Harcourt, Brace, & World, 1964), 39–40.

23. David Hounshell, *From the American System to Mass Production, 1800–1932: The Development of Manufacturing Technology in the United States* (Baltimore: Johns Hopkins University Press, 1984), 216–301. For a more recent account of life as an assembly line worker, see Ben Hamper, *Rivethead: Tales From the Assembly Line* (New York: Warner, 1991).

24. Quoted in Hounshell, *From the American System,* 259.

25. David F. Noble, "Social Choice in Machine Design: The Case of Automatically Controlled Machine Tools," in *Case Studies in the Labor Process,* ed. Andrew Zimbalist (New York: Monthly Review Press, 1979), 34.

26. Cathy Trost, "The Price of Progress," *Wall Street Journal,* September 16, 1985.

27. J. Patrick Wright, *On a Clear Day You Can See General Motors* (New York: Avon, 1979), 94.

28. Shoshana Zuboff, *In The Age of the Smart Machine: The Future of Work and Power* (New York: Basic, 1988), 250.

29. Larry Hirschhorn, *Beyond Mechanization: Work and Technology in a Post-Industrial Age* (Cambridge: MIT Press, 1984), 62–86.

30. Kenneth I. Spenner, "Deciphering Prometheus: Temporal Change in the Skill Level of Work," *American Sociological Review* 48, no. 6 (December 1983): 824–37.

31. David R. Howell and Edward N. Wolff, "Trends in the Growth and Distribution of Skills in the U.S. Workplace, 1960–1985," *Industrial and Labor Relations Review* 44 (1991): 486–502. Cited in Chris Tilly and Charles Tilly, *Work Under Capitalism* (Boulder, CO: Westview, 1998), 159.

32. Ruth Milkman and Cydney Pullman, "Technological Change in an Automobile Assembly Plant: The Impact on Workers' Tasks and Skills," *Work and Occupations* 18, no. 2 (May 1991): 123–47.

33. Robert Reich has labeled information workers as "symbolic analysts," and he has viewed the growth of their activities as one of the fundamental forces reshaping the workplace. See *The Next American Frontier* (New York: Times Books, 1983).

34. Cindy Krischer Goodman, "Balancing Act: Telecommuting Is On The Rise," *Pittsburgh Post-Gazette,* June 7, 2010, http://www.post-gazette.com/pg/10158/1063247–407.stm (accessed January 7, 2011).

35. Diane E. Bailey and Nancy B. Kurland, "A Review of Telework Research: Findings, New Directions, and Lessons for the Study of Modern Work," *Journal of Organizational Behavior* 23 (2002): 384.

36. Phyllis Moen and Patricia Roehling, *The Career Mystique: Cracks in the American Dream* (Lanham, MD: Rowman & Littlefield, 2005), 179.

37. Ibid.

38. *Federal Daily,* "Telework Unlocks Workplace Flexibility, Union Leader Says," April 6, 2010, http://fcw.com/articles/2010/04/06/telework-key-to-workplace-flexibility.aspx (accessed August 31, 2010).

39. Bailey and Kurland, "A Review of Telework Research," 383–400.

40. Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton, NJ: Princeton University Press, 2002), 160.

41. Ibid., 155.

42. Carlo M. Cipolla, *Guns, Sails, and Empire: Technological Innovation and the Early Phases of European Expansion* (New York: Pantheon, 1966); William H. McNeill, *Plagues and People* (New York: Anchor Books, 1976).

43. Tom Standage, *The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's On-Line Pioneers* (New York: Walker, 1998).

44. Darin Barney, *Prometheus Wired: The Hope for Democracy in the Age of Network Technology* (Chicago: University of Chicago Press, 2000), 62–4.

45. Jean-Paul Rodrigue, Claude Comtois, and Brian Slack, *The Geography of Transport Systems,* 2nd ed. (New York: Routledge, 2009), http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/worldcontainertraffic.html (accessed January 10, 2011). For a discussion of intermodal transportation and its implications for labor, see Edna Bonacich and Jake B. Wilson, *Getting the Goods: Ports, Labor, and the Logistics Revolution* (Ithaca, NY: Cornell University Press, 2008).