Chapter 12

Work and the Amenity Networks

CONTENTS

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While chapters 10 and 11 chronicled massive changes taking place in the working life of most Americans, many of the changes proved difficult to explain. The present chapter attempts to explain some of these changes by examining the way the structural shifts described in chapter 6 affect the nature of work in each amenity network.[1]

It proves to be easier to document the kinds of jobs that are disappearing than the kinds being created by economic change. The number of jobs in traditional occupations like machine operators, farmers, and secretaries is declining while there has been rapid growth in jobs classified as "other." The problem of tracking shifts in occupations is made all the more difficult by the fact that many careers have become serial specialties. Few people can expect to begin a career with a long apprenticeship and end it with a gold watch. Employers are likely to find that the most valuable employees are those with protean characteristics—people capable of shifting rapidly to new tasks and teaching themselves what needs to be known. Typically, this requires an ability to work as a part of a group that often combines disparate backgrounds and capabilities. The right kind of education can provide employees with considerable scope. Given no other information, it is often difficult to determine whether a person staring at a computer screen is operating a nuclear power plant or answering a consumer's inquiry about a credit card charge.

[1] As with chapter 6, the amenity discussions in the present chapter are drawn largely from a set of working papers conducted in support of this document; since the papers were cited in the appropriate sections of chapter 6, citations are not reproduced here. Also in keeping with the form set by the earlier chapter, this discussion concludes with a look at the U.S. manufacturing sector as a whole, though many manufacturing activities are addressed by the individual amenity discussions.

FOOD

Over 17 million people owe their jobs directly or indirectly to food production, processing, preparation, and sales. This is roughly 16 percent of all U.S. jobs. Of this total, one out of five work preparing foods, largely in restaurants (see figure 12-1). Food production provides nearly as many jobs for data entry employees as for farmers.

Productivity growth in this network has been uneven. Rapid growth in on-farm productivity and steady advances in food manufacturing technology have resulted in declining employment in these areas. Comparatively slow productivity growth among grocery stores, restaurants, and wholesale facilities, coupled with rising demand, has resulted in rapid job growth. There is a real danger that structural changes underway in food production will result in an industry sharply divided by skills and wages.

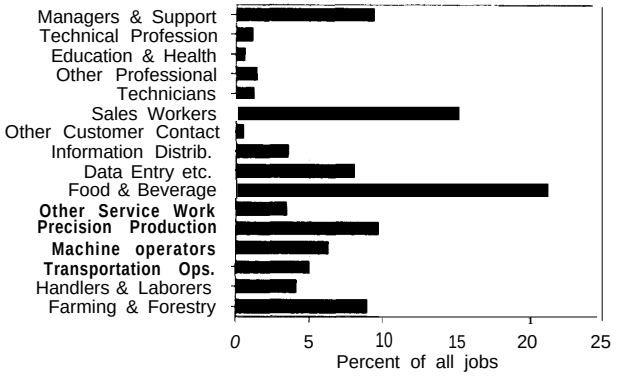
Farming

Although farms employed one-third of the U.S. work force at the end of the 19th century, there were only about 3 million people working on farms in the United States in 1986. The farm jobs that remain are likely to fall into two categories: (i) jobs for managers and skilled equipment operators whose wages and skills will more closely resemble those in advanced manufacturing firms than those in traditional farming; and (ii) poorly paid, temporary and often dangerous jobs for unskilled farm labor.

The fate of the much celebrated "family farm" remains clouded. Some, of course, can and will grow to become major production operations. Others will be maintained even at very low rates of return on assets by farm families willing to sacrifice income for the independence and dignity of farm life. Increasingly, this independence is available only for those able to supplement farm income with income from other sources. Of roughly 2.2 million farms operating in 1982, only 860,000 were operated by individuals who reported no off-farm income. More than one-third of the operators worked more than 200 days a year in off-farm occupations.[2] Taken as a

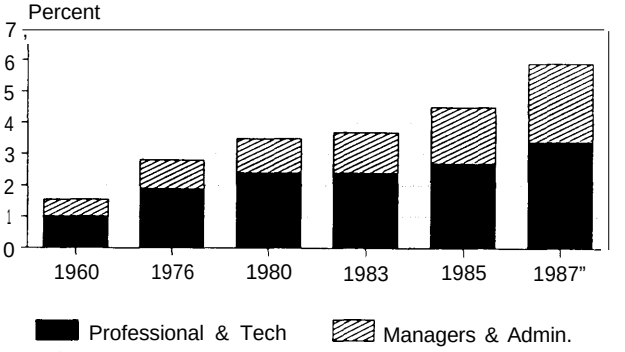
[2] U.S. **Bureau** of Census, 1982 *Census of Agriculture,* Washington, DC, October 1983.

Figure 12-1.-Jobs Needed To Produce Food in 1984 (percent of 17.5 million jobs)



SOURCE: See table 10-6 of chapter 10.

Figure 12-2.-Professional, Technical, and Managerial Positions in Agriculture as a Percent of all Jobs in Agriculture



'November 1967,

SOURCE' U.S. Department of Labor, Bureau of Labor Statistics, matrices for Employment by Occupation and Industry, Washington, DC, various years,

whole, farms with annual sales below $40,000 (71 percent of all farms operating) failed to make any net income in 1985.[3] Farming enterprises with annual sales above $500,000 (1.2 percent of all farms) were responsible for 55.3 percent of all net farm income in 1985, and are expected to provide more than 80 percent of all farm output by the turn of the century.[4] These large farms are typically managed like modern production facilities (see figure 12-2).

While growing farm productivity will eliminate many jobs, it appears that there will be continuing need for the services of farm laborers. There are presently 2.6 million hired farm workers, of whom 740,000 work more than 150 days a year,[5] New technologies may substitute for some stoop labor in areas such as fruit harvesting, but reliable estimates are difficult to obtain. It does appear that these workers are the most glaring exception to cheerful estimates showing how machinery has substituted for difficult and dangerous work. In 1985, employees in agriculture, forestry, and fishing enterprises were nearly five times more likely to suffer a death on the job than the average U.S. employee.[6] The continued availability of individuals willing to work seasonally for very low wages, and the alternative of inexpensive produce from abroad, diminishes incentives to introduce technology and capital equipment as a substitute for migrant farm labor.

Food Manufacturing

The food manufacturing work force has been decreasing in absolute numbers because labor productivity has grown faster than demand for the output of food in domestic facilities. Total employment in food and kindred product manufacturing fell from 1.83 million in 1955 to 1.65 at the end of 1987.[7] The beef and pork industries, which have labor costs that exceed the average for all food manufacturers, have made major efforts to reduce such expenses. Productivity gains made possible in part by centralized processing of boxed beef described in chapter 6 caused the number of meat cutters and butchers to decline an average of 1.2 percent annually between 1970 and 1982.[8] Partial automation in centralized facilities has had the effect of narrowing tasks and reducing skills.

Mechanization has also eliminated some of the heavy lifting and other hazards of cutting, though meat cutting remains a highly dangerous occupation. Food processing is still one of America's most dangerous industries, with the second highest rate

3 U.S. Bureau of the Census *Statistical Abstract* 01 *the United States: 1987* (107th edition.), Washington, DC, 1986, table 1114.

41985 statistics from Census Bureau, cited in footnote 3. Forecasts from Office of Technology Assessment, Technology, *Public Policy, and the Changing Structure of American Agriculture, OTA-F-285* (Washington DC: U.S. Government Printing Office, March 1986).

5U.S Department of Agriculture, Economic Research Service, "The Hired Farm Working Force, 1983" AER-554, Washington, DC, June 1986.

6*Statistical Abstract of the United States: 1987,* op. cit., footnote 3, Table 696,

7 U.S. Department of Labor, Bureau of Labor Statistics, Employment *and Earnings,* various issues.

8 U.S. Department of Labor, Bureau of Labor statistics, Employment *Projections for 1995* Bulletin 2197, Washington, DC, March 1984, p. 48.

of occupational injuries and illnesses per full-time worker.[9]

Retailing and Wholesaling

Retail and wholesale food stores (primarily groceries and their suppliers) provide at least as many jobs as farming. In 1985, retail groceries employed 2.6 million persons and wholesalers 670,000. Some of the best paid employees in the American food production and delivery system work in grocery stores; high levels of unionization have held wages considerably above retail averages. This situation is changing rapidly as employers attempt to drive down labor costs.[10]

The impact of new information technologies on employment will be more indirect. While they will increase the productivity of cashiers somewhat, much check-out work will remain labor-intensive. Technology will have its greatest effect on the clerical jobs associated with taking orders, processing invoices, preparing announcements, handling promotional coupons, making sales calls, and correcting errors in all of these processes.

The negotiating status of grocery employees has been undermined by declining employment in beef preparation—a job requiring a unique and specialized skill. Chicken and pork preparation has been almost completely removed from retail grocery firms—replaced with centralized processing and brand-name products. Beef preparation may follow. Continued movement of meat cutting into factory settings, however, is by no means certain. Some upmarket stores have rehired butchers primarily for promotional reasons (see p. 209).

Management has taken advantage of soft labor markets to be much more aggressive in opposing unions. In a widely reported case, Kroger, the Nation's second largest retailer, closed a large number of operations in Pennsylvania because it claimed that union wages made it uncompetitive. [11]

These strategies have had a striking effect on wages and work hours. Grocery wages are now declining and retail labor's share of the food dollar actually decreased 3.5 percent in 1985.[12] Part-time workers are replacing full-time workers; hours per week in grocery stores fell from 32.5 in 1977 to 30.6 in 1983. At the end of 1983, average weekly earnings in grocery stores were nearly equal to the average weekly earnings of all private workers and were 37 percent higher than the earnings of average retail workers. By the end of 1987, average weekly earnings in groceries had fallen to 78 percent of the average for all private workers and were only 15 percent higher than average retail wages. Jobs in grocery stores may increasingly resemble conventional retail jobs in both the skills they require and the wages that are paid.[13]

Food Services

Restaurants and other food service businesses have been a major source of new jobs in the United States. Most of these jobs pay very low wages, and provide only part-time work. In October 1987, the average worker in an eating and drinking place worked 25.9 hours a week (down from 35.5 hours in 1960) and earned $4.44 an hour (a wage less than half the national average).[14] The difference between restaurant employment and jobs elsewhere in the economy may become even more exaggerated as automated equipment substitutes for routine skills in many facilities, and the management of a fast food franchise is made much easier by the introduction of sophisticated computer-based inventories and accounting information that can be derived directly from check-out registers.

Food service employees not only work part-time, but typically work hours that would not be attractive if alternatives were available. Restaurant employees often work in the evenings and on weekends. Low wages make the jobs unattractive to anyone forced to commute any significant distance. A commute costing $5 could reduce take-home pay by 20 percent.

[9] U.S. Bureau of Labor Statistics, *Occupational Injuries and Illnesses in the United States* cited in *Statistical Abstract of the United States*: 1987, op. cit., footnote 3, table 697.

[10] Charles R. Handy, "Food Retailing," in *Food Marketing Review, 1986, AER-565,* U.S. Department of Agriculture, Economic Research Service, Washington, DC, February 1987,

11 P.R. Kaufman, "Food Retailing, " in *Food Marketing Review, **1985,*** U.S. Department of Agriculture, Economic Research Service, Washington, DC, 1986.

[12] R. Parlett and D, Dunham, "Food Prices Post Small Rise, " in *National Food Review,* Report No. 32, U.S. Department of Agriculture, Economic Research Service, Washington, DC, 1986, p. 17.

[13] U.S. Department of Labor, **Bureau of Labor** Statistics, *Employment and Earnings,* various issues.

[14] U.S. Department of Labor, **Bureau of Labor** Statistics, *Employment and Earnings, vol. 34, No. 12,* December 1987, p. 95.

Fast-food service was made possible in part by the fact that many young people were willing to work irregular hours for low wages. The industry may face difficulties as the number of entry-level workers declines for demographic reasons (see ch. 11). Retired workers may be a new source of labor for the industry. Food chains such as McDonald's and Wendy's have already started to hire senior citizens to compensate for a shortage of teenagers.[15]

[15] Terry Stephenson Supple, "The Coming Labor Shortage," *American Demographics*, vol. 8, No. 9, September 1986, p. 34.

HEALTH

Bringing the Health amenity to Americans requires the efforts of about 14 million people. The range of talents required is enormous. Health enterprises employ large numbers of professional personnel, technicians, as well as semi-skilled personnel (see figure 12-3). The extraordinary amount of paperwork associated with health care in today's economy is evident from the fact that Health spending produces nearly as many jobs for data entry personnel as it does for education and health professionals.

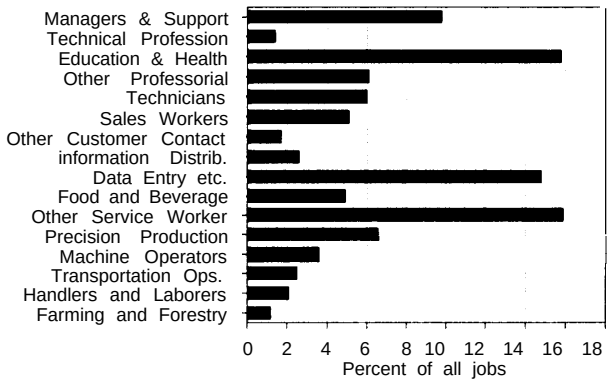
The Future of Health Care Employment

Factors Affecting Supply and Demand

As recently as 1983, estimates provided by the U.S. Bureau of Labor Statistics (BLS) suggested an overall increase of 3 million new health care jobs between 1982 and 1995—almost 12 percent of all new jobs created.[16] Although these numbers suggested a slight slowing of the growth in health care employment that was experienced during the 1970s, they did not fully reflect the profound changes that were beginning to occur in the early 1980s. Table 12-1 shows an uneven pattern of growth. There has been a rapid and continuing rise in the more highly skilled medical professions, but comparatively slow growth among licensed practical nurses and other "health technicians." The number of these technicians actually declined in 1987. The table, of course, does not include many people indirectly employed by health enterprises.

[16] G.T. Silvestri, J.M. Lukasiewicz, and M.E. Einstein, "Occupational Employment Projections Through 1995," Monthly *Labor Review, vol. 106, No. 11,* November 1983, pp. 37-49; and U.S. Department of Labor, Bureau of Labor Statistics, "Employment Projections for 1995," Bulletin 2197, Washington, DC, 1984.

Figure 12-3.-Jobs Needed To Produce Health in 1984 (percent of 13.9 million jobs)



SOURCE: See table 10-6 of chapter 10.

Significant changes underway in the structure of the Nation's health care network will have profound effects on the nature and number of jobs created in this system. Employment in health services will shift away from the hospital. New jobs will be created primarily in smaller, ambulatory care facilities, nursing homes, and home health agencies. Jobs within the hospital setting will also change in response to new technologies and management strategies. The following themes will dominate:

- The combination of an increase in the supply of physicians[17] and growth in the number of investor-ownership of hospitals and ambulatory facilities may result in a greater proportion of physicians and other health practitioners becoming salaried employees of health care corporations.[18] As a result, physicians' wages may decline or stabilize.
- Conflicting forces will affect growth in occupations sometimes known as physician "extenders" —such as physician assistants, nurse practi-

[17] In 1981, on average, only 36.9 percent of physicians were over 50 and 41.4 percent were under 40. See American Medical Association, "Profile of Medical Practice, 1981," Chicago, IL, 1981.

[18] D. Neuhauser, "Twenty-First century Medical Education: Economic, Social, Political and Technological Implications for Change," presented at the 94th Annual Meeting of the Association of American Medical Colleges, Washington, DC, 1983.

Table 12-1.—Health Related Occupations

	Number of jobs (in thousands)		Percent women	Annual percentage growth rate in numbers	
	11/83	11/87	11/87	11/83-11/87	11/86-11/87
Health diagnosing	706	826	18.1	4.00	9.0
Health assessment	1,909	2,118	85.1	2.63	7.6
Health technologists	1,113	1,173	83.7	1.32	–0.6
All occupations (for reference)			45.1	2.52	2.8

	Average hourly earnings (percent above/below national average)	
	1983	10/87
Offices of physicians	–10.2	–7.3
Hospitals	1.7	9.7
Nursing homes and personal care	–35.3	–33.5

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Employment *and Earnings,* **Tables A-22 and C-2, various** issues

tioners, mid-wives, and nurse anesthesiologists. Pressures to contain costs would seem to favor the substitution of low-wage personnel to perform certain physician tasks. However, the growing surplus of physicians may make it harder for physician extenders to gain entry into the field.

- Although hospital utilization is declining, demand for registered nurses is increasing, in part because many of the people admitted to hospitals require more care. A real nursing shortage has resulted in some regions. There are a variety of explanations, the most compelling being comparatively low wages and irregular working hours offered nurses coupled with the growing number of attractive alternative employment opportunities for women with comparable education and training.[19] More nurses are likely to obtain BAs, MAs, and even doctorates.[20] The nursing profession may become increasingly polarized between highly skilled jobs in acute care hospitals and general duty nursing jobs in ambulatory and convalescent care facilities and home care settings.
- Hospital-based employment for licensed practical nurses is also likely to shift towards convalescent and home health care.
- The number of positions for health care managers and administrators will continue to grow.[21] Traditionally these workers were doctors or nurses, but today the vast majority are graduates of health care administration, public health, or business programs.
- Demand for medical technicians with different specialties is sensitive to the nature of the equipment used in health care. Demand also depends on where the technology is used (much equipment is now used away from the hospital).[22] Demands for comparatively high levels of training are likely to increase since it is very likely that new equipment will be the rule rather than the exception. Technicians and assistants unable to keep abreast of fast moving changes in technology may find employment opportunities shrinking because of automation.
- Health care workers with comparatively few formal skills, such as nurses' aides, orderlies, and attendants, constitute about 40 percent of the health work force. These jobs are likely to shift from hospitals to convalescent and home care settings.
- Increasing application of information and communications technologies to health care delivery can have significant effects on the nature

19 L. H. Aiken and C.F. Mullinix, "The Nurse Shortage: Myth or Reality," The New *England Journal of Medicine,* vol. 317, No. 10, 1987, pp. 641-646; J.K. Inglehart, "Problems Facing the Nursing Profession," *New England Journal of Medicine,* vol. 317, No. 10, 1987, pp. 646-652.

20 U.S. Department of Health and Human Services, Health Resources Administration, "Source Book—Nursing Personnel," DHHS Publication No. HRA81-21, Washington, DC, September 1981.

21 From 1980 to 1982, the number of health administrators grew from 213,000 to 228,000. See U.S. Department of Labor, *Handbook of Labor Statistics 1983*, Bulletin 2175, (Washington, DC: U.S. Government Printing Office, 1983).

22 U.S. Department of Labor, Bureau of Labor Statistics, "Medical Technology of the 1980s: Giving Birth to New Health Careers," Occupational *Outlook Quarterly, vol. 27, No. 1,* winter 1983, pp. 3-14.

of work in health profession. For nurses, computer technologies can reduce the time spent performing clerical duties and increase the time available for direct patient care. Complex medical care technologies can create nursing specialties, as is now seen in intensive care units. Home health care employment may be more highly skilled, due to earlier hospital discharge and new telemedicine capabilities. Computer-aided diagnosis and treatment technologies could result in greater job responsibilities for non-physician providers, and in perceived deskilling of physicians. At the same time, however, consumer use of these technologies could reduce the need for health care providers of any kind.

- Since 13 percent of health care workers are minorities, as compared to 10 percent in the rest of the labor force, and since the overwhelming majority of health care employees are female, reductions in hospital employment due to layoffs or closures will significantly affect these groups—particularly in depressed urban centers. In addition, many current health workers may also be displaced if jobs that remain in the hospital require an upgrading of skills through tougher requirements or longer training periods (e.g., a BA for RN licensing).

Wages in Health Services Delivery

The earnings of wage and salary workers in the many health service occupations are below average (again see table 12-1). Some increase has occurred in the past few years, but progress has been comparatively slow.[23] There are at least three reasons for estimating continued low average wages in the sector:

1. The proportion of women in the health services delivery sector is high, and will remain so in the future. While women constituted 45.1 percent of the national labor force in December 1987, table 12-1 shows that they accounted for 85 percent of all employment in health assessing occupations and 84 percent of all health technologists. Women typically are paid only 70 percent of men's earnings (see discussion in ch. 11).
2. The growth of largely non-unionized proprietary health care chains, and the growth of contracting out for health services-as evidenced by temporary nursing agencies and laundry services—may circumvent unions and benefit provisions and result in lower wages. Historically, unions have been able to win wage and benefit increases from hospitals for the 15 to 20 percent of the health labor force that is unionized, most of whom are lower-skilled workers. The union pay advantage typically amounts to approximately 5 percent for nurses and 10 percent for lower-skill workers.[24]
3. The shift in employment from the hospital to ambulatory care facilities may also result in a lowering of wages, particularly for nurses. In 1980, nurses in hospitals earned approximately $4,500 more than nurses employed in physicians' offices.[25] Employees in the rapidly growing home health care business are often paid extremely low wages.

[23] E. Sekscenski, "The Health Services Industry: A Decade of Expansion," *Monthly Labor* Review, vol. 104, 1981, pp. 9-16.

[24] F. A. Sloan and B. Steinwald, *Hospital Labor Markets: Analysis of Wages and Work Force Composition* (Lexington, MA: Lexington Books, 1980); R. Feldman and R. Scheffler, "The Union Impact on Hospital Wages and Fringe Benefits." *Industrial and Labor Relations Review.* vol. 35, 1982, pp. 196-206; and U.S. Department of Labor, Bureau of Labor Statistics, "Industry Wage Survey: Hospitals," Bulletin 2204, Washington, DC, 1984.

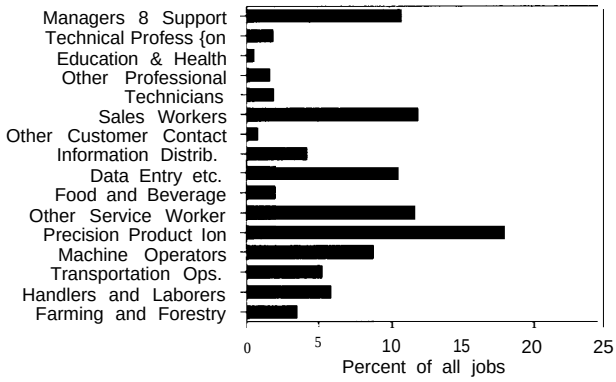
[25] U s Department of Health and Human Services, Health Resources Administration, "The Registered Nurse Population: An Overview," DHHS Publication HRS-P-OD-83-1, Washington, DC, November 1982.

HOUSING

The jobs produced to supply Americans with housing and to provide construction services of all kinds are most heavily concentrated in "precision production," a category that includes most building trades (see figure 12-4). The large financing costs of housing described in chapter 6 do not produce a correspondingly large number of jobs in the financial or real estate industries.

The use of labor in the construction industry provides a good example of the ways diverse, multidisciplinary teams can be assembled on short no-

Figure 12-4.-Jobs Needed To Produce Housing in 1984 (percent of 15.8 million jobs)



SOURCE" See table 10-6 of chapter 10

tice for a variety of projects.[26] Adapting itself to a long history of uncertain demand, the industry has achieved enormous flexibility. Unfortunately, much of this flexibility has been achieved by avoiding long-term commitments in the form of either capital investment or permanent staffs. Most single-family home construction is undertaken by small independent builders with no permanent payroll. Even major projects, such as the construction of a nuclear power plant, typically involve a unique combination of contractors, subcontractors, and temporary personnel.

The price of flexibility appears to have grown in recent years. Labor productivity in construction has actually declined, construction wages have fallen in comparison to national averages, and uncertainty surrounding employment in construction has risen. Capital-to-labor ratios increased 2.6 percent per year from 1947 to 1968, but declined by 3 percent per year from 1968 to 1981. After a jump of 4 percent in 1982, the rate has continued to decline.[27]

New manufacturing technology used in construction could increase capital investment and encourage greater commitment to a trained permanent staff. This could radically transform the employment demands of the industry. A significant amount of work on home construction is already done in factory settings (pipe trees, roof trusses, pre-hung doors, and entire wall panels). This has the effect of moving jobs from the construction site into more manufacturing and designing settings.

Labor Productivity

Real productivity in the construction industry has fallen steadily since 1968, with the exception of certain years. Overall, only mining appears to have suffered a worse decline, but in mining the decline is largely due to increased investment in workplace safety. The decline in construction productivity is particularly perplexing since it is obvious that many new technologies (plastic piping, pre-hung windows, factory-made roof trusses, etc.) have made some parts of the construction process—particularly in the residential sector–more productive (see p. 226).

There is no consensus about why new technologies have not led to higher measured productivity in the construction industry. A variety of explanations have been offered.[28] It is possible that productivity has declined because a highly fragmented industry that has never invested heavily either in research or capital equipment has simply failed to keep pace with technology available in other parts of the economy .[29]

Poor management practices and craft traditions may also contribute. One recent review of major construction practices (both residential and non-residential) estimated that only about 40 percent of a worker's time is spent in productive activity; of the rest, more than half is lost because of administrative delays, poor selection of methods, or jurisdictional delays.[30] Administrative delays result from poor coordination, late deliveries, confusion at the site, and inadequate planning. Many new commercial buildings, for example, use poured concrete; the price of building form-work for the concrete represents half the total cost. Yet architectural drawings seldom indicate how these forms should be designed,

[26] See Michael Piore and Charles Sable, *The Second Industrial Divide* (New York, NY: Basic Books, 1984).

[27] U.S. Department of Labor, Bureau of Labor Statistics, cited in Building Research Board, National Research Council, Construction *Productivity* (Washington, DC: National Academy Press, 1986).

[28] U.S. Congress Office of Technology Assessment, *Technology, Trade, and the U.S. Residential Construction Industry-Special Report,* OTA-TET-315 (Washington, DC: U.S. Government Printing Office, September 1986), pp. 31-32.

[29] J.E. Cremeans, "Productivity in the Construction Industry," *Construction Review, vol. 27,* May/June 1981.

[30] Richard L. Tucker, "Construction Technologies," in *Technology and the Future of the U.S. Construction Industry* (Washington DC: The AIA Press, 1986).

and take no account of the complications introduced by imbeds needed for items such as electrical boxes. As one analyst has noted: "Architects love to put a lot of imbeds . . . and you depend on the workers in the field to somehow hold it in exact position while you place the concrete around it and push it around."[31]

Jurisdictional problems are not necessarily the result of union work rules, but stem from longstanding craft traditions: "Carpenters don't put in conduit, for example, even though they're quite capable . . . Operators can't unload the truck. It takes a particular craft that has the stuff on the truck to unload their stuff."[32] Estimates of productivity gains made possible through better communication and management practices with *no* new technology range from a few percent for processes such as installing insulation, to 130 percent for structural work in commercial buildings or installing piping in heavy industrial structures.

New technology clearly has the potential to increase productivity throughout the construction industry. Many of the most basic problems in field erection, primarily affecting heavy construction, have received virtually no help from contemporary technology. Making field connections of pipes, beams, electrical wire or other elements is extremely inefficient in the field. The current process "leaves a lot of standing around."[33]

Wall elements, and even entire building modules, have been successfully manufactured in factories to improve overall productivity, particularly in the residential sectors of Sweden and Japan. Much of this improvement has resulted from greater use of factory production techniques based on robotics and computer-assisted design/production systems. The Japanese firm of Sekisui Heim claims to have reduced the labor hours for a residence from 400 person-days for a conventional site-built house to 125 person-days for a manufactured house, and to have an experimental system capable of reducing construction time to 20 person-days. The Swedes, estimate that they can reduce labor from 175 to 75 person-days using factory construction; of the 75, nearly two-thirds are taken up by site preparation and erection.[34]

Productivity in residential construction is also discussed in the Housing section of chapter 6.

Job Skills and Job Quality

Compared with jobs elsewhere in the economy, jobs in construction are traditionally well paid but are relatively dangerous and insecure.[35] A shift toward more factory-based construction could change this picture. The Swedes chose to encourage factory-based construction as a matter of national policy in part *because* it could create better and more stable jobs in the industry.

Wages

While jobs in construction still pay more than the average U.S. wage, construction wages fell from 28 percent above the median annual U.S. private sector wage in 1971 to less than 9 percent above the median in 1986—when the ratio of median annual construction wages to the national average median wage reached a post-war low.[36]

Skills and Work Quality

The Swedes emphasize that their homes are "factory crafted," not mass produced, and that automated equipment is used by skilled teams that have often worked together for years.[37] They do not use "mass production" lines. In Japan, where factory production is projected to serve 50 percent of the domestic market in the mid 1990s, "housing companies apparently enjoy a high level of worker loyalty and productivity."[38]

U.S. factory construction of housing is often little more than site construction under a roof. Assembly

31 Alton S. Bradford, "Computers and Construction, in Technology and *the Future of the U.S. Construction Industry,* op. cit., footnote 30.

32 Ibid.

33 Ibid.

34 Paul Kando, "perspectives on Swedish and Japanese Factory Built Housing" contract report prepared for the National Institute of Building Sciences, Washington, DC, Nov. 5, 1986.

35 John Tschetter and John Lukasiewicz, "Employment Trends in the Building Trades," *Occupational Outlook Quarterly, vol. 27, No. 2,* spring 1983, p. 8.

36 U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.8b.

37 Lee Schipper, Stephen Meyers, and Henry Kelly, *Coming in From the Cold: Energy Efficient Housing in Sweden* (Cabin John, MD: Seven Locks Press, 1985).

38 James G. Sackett, "Japan's Manufactured Housing Capability," contract report for the U.S. Department of Energy, Washington, DC, May 1986.

of mobile homes ("manufactured housing") is typically more heavily automated, using an assembly line approach resulting in less skilled and more routine jobs. There is often a considerable amount of turnover, particularly during periods of slack demand for housing. Some firms have used manufacturing facilities to replace skilled craft workers with low-wage employees who enjoy little job security. Two-thirds of all jobs in U.S. home manufacturing facilities require less than one year of training; 33 to 40 percent require less than a month.[39]

Technology also promises to change the use of labor in design and engineering firms. Computer-based designs can radically reduce routine architectural jobs. Each designer is typically supported by 3.8 draftsmen and 0.2 persons engaged in writing specifications and documentation. Most of the individuals calling themselves architects are, in fact, engaged in such support activities.[40] At least one in four jobs in architecture is therefore threatened by new technology. Computer-based designs will also affect engineering draftsmen, who are generally not trained engineers.

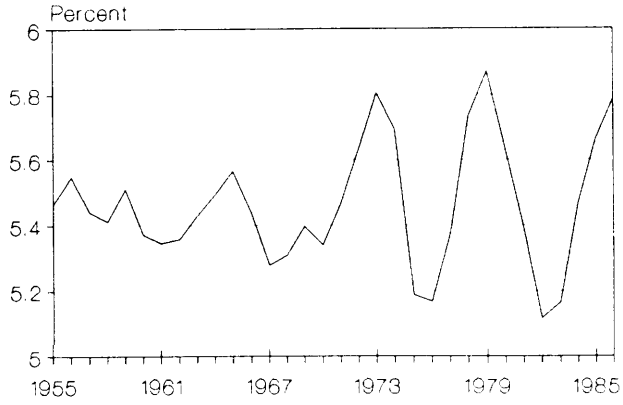
Jobs in design and engineering may also change with the introduction of computer-based design systems. Manual tasks can largely be replaced. The staff remaining are likely to be members of interdisciplinary teams consisting of designers, builders, and individuals familiar with the specific needs of a client. Interpersonal skills, and a basic grasp of all parts of the construction process—from design to engineering analysis to site construction—will be needed for members of such teams.[41]

[39] *Technology, Trade, and the U.S. Residential Construction Industry—Special Report,* op. cit., footnote 28, table 5.

[40] Harry Mileaf, "Computers and Constructlon," in *Technology and the Future of the U.S. Construction Industry* op. cit., footnote 30.

41 A. Bradford, in Technology *and the Future of the U.S. Construction Industry* op. **cit., footnote 30.**

Figure 12-5.-Construction Jobs as a Percent of all Jobs



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts, " historical diskettes, table 67

Job Security

Employment in construction varies with the weather, with the seasons, and with the business cycle. An average annual construction work force of some 4 million varies by as much as one-quarter between winter and summer; this is especially acute in the northern areas of the United States. Approximately 40 percent of U.S. construction workers found themselves without employment at least once during 1981, as opposed to 18 percent of all U.S. nonagricultural workers.[42] The industry has always been very sensitive to changes in the business cycle (see figure 12-5), and this sensitivity appears to have increased during the past few decades.[43]

[42] Ibid., p. 7.

43 Tschetter and Lukasiewicz, op. Cit., footnote 35, P. 5

TRANSPORTATION

The U.S. transportation system provides starkly contrasting employment opportunities. Some firms, such as major railroads, rely on well-paid management and labor. Skilled operators of large, complex equipment (such as ships, aircraft, and trains) have large responsibilities and are well rewarded. Unions have helped maintain wages. Many transportation firms, however, such as owner-operator truckers and cab drivers, might actually be earning less than the minimum wage if they accounted properly for their hours.

Providing the Transportation amenity produces more jobs in manufacturing and other professions

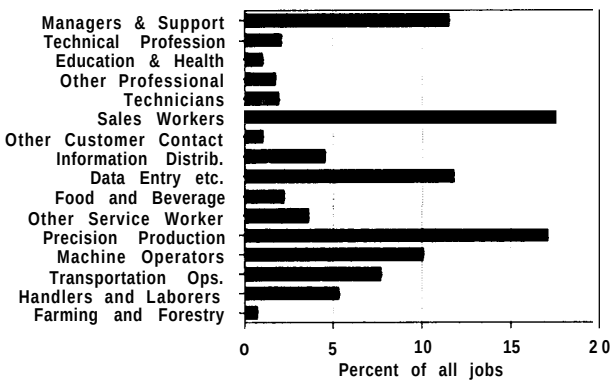
than it does for equipment operators (see figure 12-6). Automobile production results in a large number of well paying positions. The operation of automobiles produces a varying assortment of jobs, including a large number of sales workers ranging from automobile sales personnel to sales workers in gasoline stations paid hourly wages 40 percent below average 1987 wages.

Employment in the industry is strongly affected by changes in demand, production recipes, and trade described in earlier chapters. The decline in highway and airport construction obviously translates into a loss of comparatively well paid construction jobs. Deregulation of trucking and aircraft has created fierce competition, making union organization more difficult.

Technologically sophisticated equipment has created demands for higher skill levels in many transportation occupations. Advanced computers and communications equipment are becoming standard in airport control towers. Modern aircraft have become machines of staggering complexity. Railroads, trucking firms, and urban delivery vehicles are keeping close touch with their vehicles using a variety of communication devices. All of this equipment must be designed and maintained, and operators must develop skills to use them properly.

The administrative complexity of transportation is rising as the value and diversity of freight shipments increase. Investments in careful identification of loads within trucks, careful routing and tracking of deliveries, increased insurance, greater use of partload shipments, and the rapid shift to more complex air transport equipment and facilities all contribute to this diversity. At the same time, new strategies for inventory control are partly responsible for the complexity of transportation information. All of this creates growing demand for clerical, analytical, and technical employees in transportation firms.

Figure 12-6.-Jobs Needed To Produce Transportation in 1984 (percent **of** 8.1 million **jobs)**



SOURCE: See table 10-6 of chapter 10.

While technology helps optimize the flow of traffic, individual operators of aircraft, trucks, and other vehicles maintain enormous independence and individual responsibilities. They must not only perform their required tasks competently, but they are the transportation firm's representatives in dealing with customers. This sense of independence and responsibility can make transportation an attractive occupation. While technology can help managers keep closer tabs on the location of vehicles and operator performance, thereby reducing the perception of freedom to some extent, the responsibility for the vehicle's safety and performance remains clear. The skills and responsibility entailed should continue to command comparatively high wages.

Workers in many parts of the transportation industry benefited from public regulation. Public transport workers, railroad workers, and airline employees were particularly advantaged, though trucking regulation sheltered the wages of many drivers in that industry as well.

In a newly deregulated environment, airlines struggling to compete with non-union lines are obtaining concessions from their employees. Truckers are forced to compete with independent, non-union operators who often work long hours and average 30 percent lower wages.[44] Railroads, struggling to meet competition from trucking, have broken some long-standing union work rules, doing such things as running trains with two-man crews. The system is in such flux that industry-wide patterns of employment are extremely difficult to trace.

Employment in most transportation industries has grown more slowly that private employment. Employment in automobile manufacturing is virtually the same as it was in 1955. Transit operators have

[44]See U.S. Small Business Administration, *The State of Small Business 1987* (Washington, DC: U.S. Government Printing Office, 1987), pp. 185-206.

declined. On the other hand, there has been sharp growth in the airline industries and in service industries that support personal and business transportation. Trucking, warehousing, and wholesale trade have grown modestly faster than overall employment. Many changes are occurring in the kinds of jobs offered by these businesses, however. Employment in regular route common carrier truck firms has not grown, even though overall employment in trucking has increased.

Personal Transport

Table 12-2 shows sharp declines in jobs in most mass transportation occupations. Only air travel posted significant gains. Jobs in both inter- and intracity rail and bus transport have remained virtually unchanged. Most local and inter-urban transport facilities are located in older metropolitan areas, such as New York, Philadelphia, Boston, and Chicago. They are heavily unionized, and work rules provide them with relatively stable 8-hour jobs and no split schedules despite the fact that urban commuting requires working two peaks. Moreover, the jobs provide good incomes for employees, many of whom are members of minority groups who might otherwise face bleak job markets in central cities.

In many regions, the provision of attractive employment opportunities in public transport has resulted in high labor costs and increased transit fares. As a result, transit workers in some areas are under pressure to accept part-time or split schedules and lower wages. Many new "paratransit" services benefit from the fact that they can use operators willing to work erratic hours at comparatively low wages in competitive labor markets.

Freight Transport

Two major movements are underway in freight transportation. First, rail lines, operating under increasingly competitive conditions, have placed unprecedented pressures on rail unions to accept greater flexibility in work rules. The results of this development have been mixed. It is clear, however, that unless the work rules are revised in a way that permits rail lines greater flexibility, rail freight will be limited to an extremely narrow set of commodities—typically bulk coal and grain deliveries,

The second movement resulted from the nearly complete deregulation of trucking during the late 1970s, which increased competition between regular route common carriers, independent owner operators, and railroads (particularly in long hauls). These operators may be unaware of their real costs. Many compensate for poor earnings by forcing themselves to drive extraordinary hours. Erratic working hours have, of course, long been necessary adjuncts of truck operation; however, both fatigue and parsimonious maintenance may have contributed to the growing number of trucking accidents (see discussion below),

Table 12-2.—Employment and Employment Growth in Selected Transportation Industries

Industry	Full-time-equivalent employment (in thousands) 1955	1965	1975	1986	Average annual growth rate (o/o) 1955-86
All private industries. 53,530		57,864	67,443	87,653	1.7
Motor vehicles and equipment	876	831	777	870	0.6
Other transportation equipment	991	1,005	909	1,152	0.1
Railroad transportation.	1,196	730	541	311	–3.6
Local and interurban passenger	332	290	282	322	–0.1
Transportation by air.	128	221	351	533	4.2
Water transportation	235	218	187	178	–0.8
Pipelines, except natural gas	26	19	17	18	–0.8
Trucking and warehousing.	883	1,073	1,249	1,571	1.8
Wholesale trade.	3,164	3,648	4,521	5,849	2.1
Transportation services	82	92	137	288	4.3
Auto repair, services, and garages . .	311	450	638	1,129	4.0

NOTE: Full-time-equivalent employment includes part-time workers converted to a full time schedule using the ratio of the number of average weekly hours worked to the weekly hours typically worked by a full-time employee in the industry. The total also includes self-employed persons. The percentage growth rate is computed using a simple regression.

SOURCE: U S Department of Commerce, National Income and Product Accounts, historical diskettes

If, as chapter 6 suggests, independent truckers eventually lose market share to major companies capable of managing sophisticated marketing, sales, communication, and dispatch systems, many truck drivers may be increasingly treated primarily as paid employees of major firms. Such a development would represent a reversal of the present trend toward small-scale trucking activities brought about largely by deregulation—since 1980, the number of motor carriers with annual sales under $1 million has more than doubled, while those in larger sales classes have held steady or decreased (see ch. 5).

Safety

Transportation jobs are among the most dangerous in the Nation. Death rates are nearly three times the national average. Trucking and warehousing businesses reported losing 208 workdays per 100 full-time-equivalent workers in 1984, up from 188 in 1980. The average for all private businesses in 1984 was 63 workdays lost per 100 full-time workers (a 3 percent decline from 1980). Local passenger transit, railroads, and air transport all reported work losses 40 percent over national averages.[45] While accidents involving passenger cars, motorcycles, and even medium trucks all fell by at least 10 percent between 1980 and 1984, accidents involving light and heavy trucks rose to historically high levels by 1985—even after a significant decrease in such accidents during 1982.[46] Indeed, between 1981 and 1985, the annual rate of truck accidents increased roughly 40 percent faster than the increase in total truck miles traveled.[47]

Transportation jobs can also be extremely stressful. Stress-related illness is seldom reported as an occupational injury, but it is well known that bus drivers have higher rates of hypertension, and of diseases of the gastrointestinal tract and the musculoskeletal system, than other workers. While some of this may be traceable to noise, vibration, and carbon monoxide fumes, some studies suggest that the illnesses are related to the need to keep schedules that are extremely difficult to meet in any but ideal conditions.[48]

45 *Statistical Abstract of the United States. 1987,* **op. cit., footnote 3,** table 697.

46 Ibid., table 1028.

47 Statement of Edith B. Page, Office of Technology Assessment, to the Committee on Public Works and Transportation, Subcommittee on Surface Transportation, U.S. House of Representatives, Washington, DC, Sept. 16, 1987.

48 S.L. Symne "Social Determinants of Health," in *Social Determinants of Health and Disease,* paper provided to OTA by the Centers for Disease Control, Atlanta, GA, p. 65.

CLOTHING AND PERSONAL CARE[49]

The network of fiber, textile, apparel, transportation, wholesaling, and retail businesses that combine to bring the amenity of Clothing and Personal Care to Americans dominates the pattern of jobs shown in figure 12-7. Retailing and machine operators represent 40 percent of all jobs in the network. This may soon change.

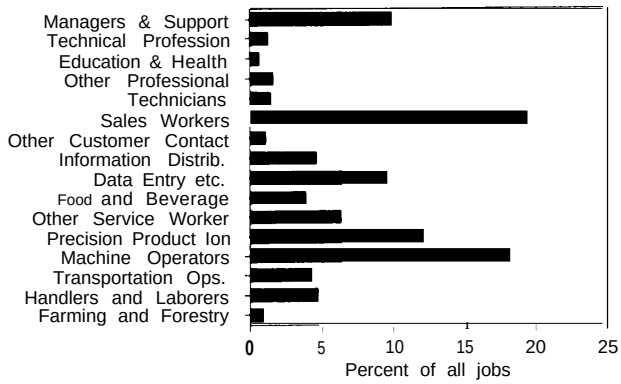
The network of businesses that produce fiber, textiles, and apparel combine to be the Nation's largest nondurable goods manufacturer, employing one out of every every nine manufacturing workers. Apparel is the largest employer, with 1.1 million employees at the end of 1987. Textile mills provide 713,000 jobs and organic fiber producers employ 61,000. The textile machinery industry, a durable goods sector, employs 21,000 people. Retail apparel and accessory stores provide jobs for nearly 1 million people. General merchandise stores (which also sell apparel) employ over 2.5 million people.[50]

Growth in domestic demand has partially offset employment losses resulting from increases in imports and productivity. Between 1977 and the end of 1987, employment in the apparel industry fell 15 percent and textile employment fell 19 percent. Total employment fell by 370,000. It is important to note, though, that many of the jobs eliminated by automation were dangerous and unpleasant. The threat of "brown lung" that haunted the industry for

49 The following section is drawn largely from U.S. Congress, Office of Technology Assessment, *The U.S. Textile and Apparel industry: A Revolution in Progress-Special Report,* OTA-TET-332 (Washington, DC: U.S. Government Printing Office, April 1987).

50 U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings, vol. 34, No. 12,* December 1987, table B-2.

Figure 12-7.-Jobs Needed To Produce Clothing & Personal Care in 1984 (percent of 7.5 million jobs)



SOURCE: See table 10-6 of chapter 10.

years has been reduced significantly through the use of machines for tasks that would pose health and safety threats to human operators.

In apparel, labor-intensive operations still predominate in the industry, and job declines are largely due to import penetration. Women account for 81 percent of apparel employment. The ratio of production workers to total employees was 84 percent at the end of 1987, in comparison to 68 percent for all manufacturing. Job loss has been particularly severe in the apparel industry, which provides large numbers of low wage production jobs for women and minorities.[51]

In textile mill products, adoption of new, capital-intensive technology has resulted in sharply increased productivity. This has led to both job losses and a major redesigning of jobs that remain. Burlington Mills, for example, began a major modernization program in 1978 and has since reduced its work force by at least 10,000. Stevens has spent more than $480 million on its capital program since 1978, and, like Burlington, has trimmed 10,000 people from its payroll. Modernization, of course, does not always lead to job loss—especially if new plant and equipment can be used to expand markets.[52] Indeed, modernization is a crucial element in maintaining any domestic production industry.

The only industry sector claiming new job creation was retail trade. Employment in apparel retailing increased 26 percent between 1977 and the end of 1987, adding 225,000 jobs.[53]

Apparel jobs have traditionally paid lower wages than textile manufacturing jobs—themselves low-paying by U.S. industrial standards. The wages are, of course, much higher than those paid by many of America's competitors. Average 1987 hourly earnings in apparel retail trade were $5.69, in contrast to $6.01 for apparel manufacturing, $7.23 for textile mill products manufacturing, and $8.75 for textile machinery manufacturing, In the newer man-made fiber industry, however, wage rates are significantly higher, with average hourly wages at $12.20.[54] These compare to an average hourly rate for all manufacturing of $10.00.

It is important to note that the United States is not alone in suffering employment losses in the textile and apparel industry. Job loss has occurred throughout the developed world—for example, 53 percent in the Netherlands and 37 percent in the United Kingdom within the last decade. At the same time, employment in developing nations is gaining significantly—111 percent in South Korea and 194 percent in Mauritius, for example.[55]

Domestically, textile employment is geographically concentrated, particularly in the Southeast where plant closings and job loss can mean economic devastation to an entire town or region. In North Carolina, South Carolina, Georgia, Tennessee, Alabama, Florida, Kentucky, and Mississippi, 33,400 jobs were lost in 1985, bringing textile employment 17 percent below its 1951 level. According to the Bureau of Labor Statistics, 32.2 percent of the region's total manufacturing employment in 1951 was in the textile industry. By 1985, this figure had shrunk to only 13.5 percent.[56] The absolute decline in employment has been the greatest in North Carolina, South Carolina, New York, and Pennsylvania.

51 The U.S. Textile and *Apparel Industry: A Revolution in Progress—Special Report,* op. cit., footnote 49.

52 *Textile Week,* Aug. 10, 1981, p. 6.

53 U.S. Department of Labor, Bureau of Labor Statistics *Employment and Earnings,* various issues.

54 U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings, vol. 34, No. 12,* December 1987, table C2, pp. 91-93. September 1987 figures used.

55 International Labor organization, *Social and Labor Practices of Multinational Enterprises in the Textile Clothing and Footwear Industries,* cited in Bureau of National Affairs, *Daily Labor Report,* Jan. 3, 1985, p. A-6.

56 U.S. Department of Labor, Bureau of Labor Statistics, cited in AFL-CIO News, July 19, 1986, p. 3.

The technology described in chapter 6 has the potential to reshape the jobs offered by the system in very basic ways. Automated equipment—much of it imported—has already revolutionized textile mills and replaced many low-skill, dangerous jobs. Productivity in textile production grew at twice the rate of manufacturing industries during the past decade. Equipment that combines automated inventory control, reordering, design, layout, and other features could lead to a new pattern of work organization, making it possible to substitute highly trained and well paid workers for those now forced into narrow production tasks. Flexibility could be achieved through teams capable of moving quickly to fill new orders and adapt designs to changing markets.

EDUCATION

Productivity

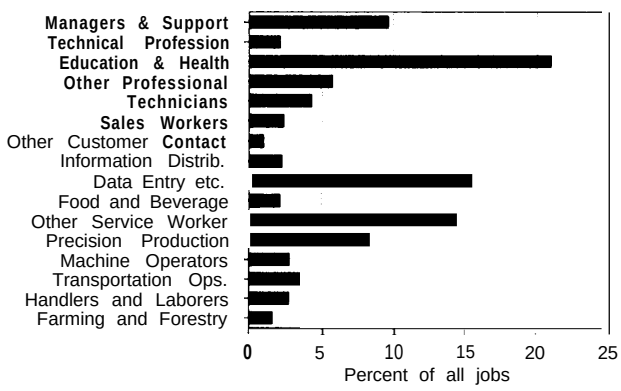
Education is responsible for at least 9 percent of U.S. jobs. This estimate, based on official reports, may underestimate the number of individuals working as teachers or trainers by as much as 50 percent. U.S. corporations obviously make heavy investments in teaching and training, but because people labeled "teachers" are paid relatively low wages, many instructors in a business setting have more expensive sounding titles like "productivity engineer." Earlier discussions also demonstrated that learning and teaching tasks are becoming routine parts of many jobs.

The business of delivering the Education amenity also generates a significant amount of work for clerical and other service occupations (see figure 12-8).

While the productivity of teaching is notoriously difficult to measure, there is little to suggest that it has increased in several generations. Indeed, growth in staff-to-student ratios, coupled with declines in average test scores, suggests that real productivity has fallen. In Japan and Taiwan, it appears that school systems with staff-to-student ratios lower than those in the United States may provide better basic instruction.

Many excuses can be offered for a decline in measured U.S. school productivity .57 Much of the growth in U.S. staff-to-student ratios resulted from more administrative positions, rather than instructors. Some of the increased overhead costs–but probably not all—result from the need to administer more complex government programs.

Figure 12-8.-Jobs Needed To Produce Education in 1984 (percent of 9.2 million jobs)



SOURCE: See table 10-6 of chapter 10.

Skills and Work Quality

The Work Environment

The occupation "teacher" is one of the largest undifferentiated categories maintained by the Bureau of Labor Statistics. The underlying assumption here is that teachers are largely interchangeable—to some extent the assumption is correct.[58]

The essential difference between teaching and another form of mass delivery, of course, is that there

[57] It must be recognized that productivity measurements in education attempt to quantify what is difficult to view in objective terms: the quality of teaching. For example, if two teachers provide a far better learning experience for the same amount of students than one teacher, is their productivity still lower because of the ratio? Are standardized test scores, which may be biased against certain demographic groups, a true measure of the productivity of teaching? Is productivity low because more attention is being paid to students with special physical, mental, or emotional problems?

58 There are differences in the skills of individual instructors, but Virtually no distinctions are made in either job descriptions or pay except for distinctions based on credentials and seniority. Often the only way to advance in status as a teacher is to become an administrator, which may in part explain the growth in the relative size of school administration activities during the past decade.

is always something new and exciting about a group of students. The thrill of watching a student discover for the first time a new idea or a great work of art is a reward that cannot be measured by conventional accounts.

On the other hand, many teachers in the United States are expected to cure a growing number of social problems—brought on, in part, by the shrinking proportion of traditional families. Different interest groups expect schools to indoctrinate students in everything from religious beliefs to sexual hygiene. Teachers have been sued for exercising both too much and too little discipline. Such pressures can lead not only to frustration, but in some cases to real physical danger.

Specialization and Differentiation of Occupations

Most educational institutions are managed in a way that gives individual instructors almost unlimited freedom in the conduct of instruction within their own domains. Yet, as in so many other cases throughout the economy, unlimited freedom does not necessarily translate into diversity or innovation. Observers have noted that instruction in high schools is astonishingly uniform throughout the country. A system that appears to be highly labor-intensive, thereby permitting much individual attention and flexibility, is in fact often impersonal and inflexible.

An educational work environment making heavy use of new instructional technologies, such as the one described in chapters ***3*** and 6, could be significantly different from the current system. Schools have already seen some growth in the use of instructors working on specialized problems: teaching the physically or mentally handicapped is one such example. This specialization can be expected to grow enormously with use of new technology. At a minimum, teaching staffs could be divided into the following kinds of specialties:

- tutors trained in professional areas such as chemistry or English literature, who would work with individuals on a daily basis, coach them as they work through problems, monitor their progress in the programmed instructional systems, and challenge them to debate;
- specialized consultants, who would work with students over a wide geographic area, handling questions or problems that individual tutors felt incompetent to address;
- people specializing in the preparation of software that would include computer programming, and in the preparation of visual and audio materials for presentation (which could include animation, simulations, or even complete reenactments of historical events);
- system monitors, paid to maintain order when students are working with information-based systems and to handle routine problems; and
- specialists in the production and maintenance of hardware in the schools, and central distribution and communication modes.

This greater differentiation would plainly lead to differentiation in training and pay. Individuals designing and maintaining the software would necessarily be peers of software design teams working elsewhere in the economy. Teachers would have to make the transition to the more demanding task of tutors, which would require them to spend virtually all of their time handling unique and difficult questions. But teachers exasperated by routine assignments would find themselves much freer to experiment with new ideas and enjoy the company of their students. Any attempt to introduce differentiation in job descriptions may, however, be resisted by unions interested in maintaining a uniform professional position on issues such as pay, seniority, and working conditions.

Wages and Part-Time Work

Teachers are among the best educated class of workers in the market, but are paid significantly less than the average wage. And while there are exceptions, most teacher salaries have not kept pace with inflation.

Measured in constant 1983-84 dollars, the salaries of teachers actually fell from a high of $24,194 in the 1972-73 school year to $20,733 in 1980-81; recent interest in educational reform raised average teaching salaries to $22,019 in the 1983-84 school year.[59] In 1981, about 30 percent of all public school

59 National Education Association, "Estimates of Shool Statistics 1983-1984," Washington, DC, 1985.

teachers received pay for some form of employment other than teaching to supplement their income.[60]

There is also little opportunity for advancement. Few teachers are able to enjoy significant increases in pay after their first 10 to 12 years on the job.[61] This is all the more difficult to accept since they receive a starting salary that is far below those offered in many other professions requiring college training. The result is that comparatively little difference in the wages paid teachers: 61 percent of all teachers receive between $15,000 and $25,000 in pay.[62]

Teachers, of course, are seldom paid for year-round work, and are left to their own devices to find employment during summer months. Comparatively few teachers can find work during these months in anything but temporary clerical or sales jobs. Many do not work, but spend the time in leisure activities or, in the case of university faculty, doing research needed for promotion or tenure. Teachers are seldom provided office space or significant clerical support services in their schools and, as a result, spend an average of 4 to 5 hours a week working at home.[63]

The Nation's primary and secondary school systems have always been subsidized by women willing to work for low wages because they could find no alternative employment commensurate with their intellectual skills. This, of course, is changing with the dramatic increase in the participation of women in all parts of the labor force.

Educational Demand and the Desire to Teach

The combination of new job opportunities for women, relatively stagnant pay, and deteriorating work conditions in many school systems has resulted in a dramatic decline in the percentage of women choosing to get degrees in education. While roughly 38 percent of women in their first year of college intended to go into education in 1968, this percentage fell to only about 10 percent in 1985.[64] The fraction of males obtaining bachelor's degrees in education fell from 9.5 percent to 6.5 percent between 1971 and 1980.[65] In 1966, when teachers were asked "suppose you could go back to your college days and start over again; in view of your present knowledge, would you become a teacher?, " 53 percent said that they certainly would. By 1983, only 24 percent gave a positive response.[66]

There seems little question that developments such as these are likely to lower the quality of teaching in the public school system. Indeed, there is evidence of a critical juncture in the teaching market—in a break from the past, there are likely to be more jobs than prospective teachers over the next 10 years.[67] Moreover, the fraction of education graduates with backgrounds in science or mathematics choosing to enter teaching has fallen. In 1971, 59 percent of all graduates from science teaching programs, and 63 percent of all graduates from mathematics teaching programs, entered teaching. By 1980, the fraction had fallen to between 54 and 55 percent, respectively.[68]

The disparity between teacher salaries in science and mathematics and salaries offered individuals with equivalent education levels is particularly high. The National Science Foundation estimates that 300,000 new mathematics and science teachers will be needed during the next 10 years, a number larger than the total of those now teaching. The problem is aggravated by the fact that the average age of the Nation's science and math teachers is 42.[69]

Overall, as many as 1.3 million new teachers will be needed between 1986 and 1992.[70] Assuming that the demand for new teachers would be met from existing colleges and universities, this would mean that 23 percent of people graduating from college

60 National Education Association, "Status of the American Public School Teacher, 1980-1981," Washington, DC, 1982.

61 Carnegie Forum on Education and the Economy, *A Nation prepared: Teachers for the 21st Century,* report of the Task Force on Teaching as a Profession, Washington, DC, May 1986, p. 98.

62 U.S. Department of Labor, Bureau of Labor Statistics, and Louis Harris and Associates Inc., cited in Carnegie Forum, op. cit., footnote 61, p. 97.

63 Francis W. Horvath, "Work at Home: New Findings from the Current Population Survey, " Monthly *Labor Review,* vol. 109, No. 11, November 1986, pp.31-35.

64 Alexander W. Austin, et. al., *The American Freshman: National Forums for Fall, 1968-1985,* Cooperative Institutional Research Institute.

65 U.S. Department of Education, National Center for Educational Statistics, *The Condition of Education, 1982* Edition (Washington, DC: U.S. Government Printing Office), p. 96.

66 National Education Association, "Status of the American Public School Teacher, 1980-81," 1982; and unpublished tabulations, July 1983, in *The Condition of Education,* op. cit., *1985* edition, footnote 65.

67 See Carnegie Forum, op. cit., footnote 61.

68 Betty M. Vetter, "Supply and Demand for Science and Math Teachers," National Institute of Education, Conference on Teacher Shortage in Science and Mathematics, Washington, DC, Feb. 8-10, 1983.

69 U.S. Congress, Office of Technology Assessment, "Education, " Sector study, Washington, DC, 1987.

70 Carnegie Forum, op. cit., footnote 61.

would need to enter the teaching profession during the early 1990s—a fraction far higher than is likely to be attracted to the profession, given recent history.[71] The potential shortage of teachers with adequate training may contribute to demand for technology in the classroom that can make the best possible use of the time of trained teachers.

71 Ibid., p. 31.

PERSONAL BUSINESS AND COMMUNICATION

Recent Trends

The skills required to provide the amenity of Personal Business and Communication are dominated by managers and clerical personnel (see figure 12-9). Information technology is likely to have a particularly dramatic impact on jobs in this sector.

Of the industries that contribute the most jobs in this sector, only the heavily capitalized communications industry has achieved productivity growth rivaling that of manufacturing; productivity in this sector has been spectacular, rising 750 percent between 1954 and 1984.[72] Productivity gains were far lower in banking (where reported productivity actually fell during the 1970s), insurance, law, and real estate.

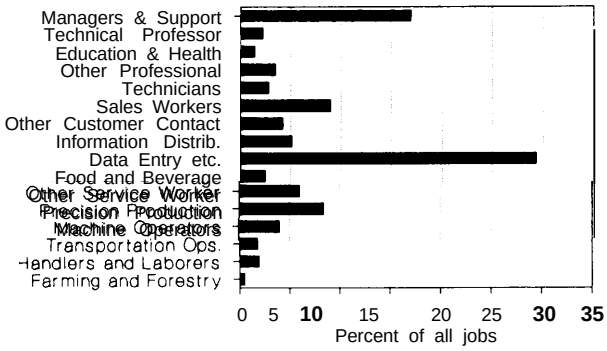
New technology has the potential to change the mix of skills in the transactional businesses that are the principal deliverers of Personal Business and Communication, but the changes have been extremely difficult to measure. In fact, technical changes may reverse recent trends slowing productivity growth in communications, where complex and highly differentiated services requiring more personalized attention may lead to lower measured productivity while they result in higher productivity growth rates among office-based operations.

The discussion of chapter 11 showed how the choices management must make about the use of technologies translate into stark differences in the number and quality of jobs in transactional businesses. Because of the sharply contrasting possibilities, and the near impossibility of using objective measures such as reported job descriptions to understand trends, analysts are constantly forced to fall back on anecdotes. Unfortunately, there are two opposing classes of anecdotes, with radically different pictures of the direction of office employment; both descriptions are true.[73]

Possible employment scenarios include a situation in which most skill has been built into equipment—in this case, computer and communications equip-

[72] U.S. Department of Labor, Bureau of Labor Statistics, "Productivity Measures for Selected Industries," Washington, DC, various years.

Figure 12-9.-Jobs Needed To Produce Personal Business and Communication in 1984 (percent of 5.8 million jobs)



SOURCE: See table 10-6 of chapter 10.

[73] See, for example, L. Cummings, *The* Rationalization and *Automation of Clerical Work,* Master's Thesis, Brooklyn College, 1977; Maarten DeKadt, "Insurance: A Clerical Work Factory," in Andrew Zimbalist, cd., Case *Studies in the Labor Process (New* York: Monthly Review Press, 1979); E. N. Glenn and R. Feldberg, "Degraded and Deskilled: The Proletarianization of Clerical Work," *Social Problems, vol.* 25, October 1977; E.N. Glenn and R. Feldberg, '(Technology and Work Degradation: Effects of Office Automation on Women Clerical Workers," in Joan Rothschild, cd., *Machina Ex* Dea (Elmsford, NY: Pergamon Press, 1983); Joan M. Greenbaum, *in the Name of Efficiency* (Philadelphia: Temple University Press, 1979); Ida Hoos, *Automation in the Office* (Washington, DC: Public Affairs Press, 1961); K. Nussbaum and J. Gregory, "Race Against Time: Automation of the Office" (Cleveland: Working Women Education Fund, April 1980); and U.S. Congress, Office of Technology Assessment, *Automation of America Offices, OTA-CIT-287* (Washington, DC: U.S. Government Printing Office, December 1985); H. Hartman, R.E. Kraut, and L.A. Tilly, eds., *Computer Chips and Paper Clips* (Washington, DC: National Academy Press, 1986); K.S. Koziara, M.H. Moskow, and L.D. Tanner, eds., *Working Women* (Washington, DC: The Bureau of National Affairs, Inc., 1987).

ment instead of advanced production machinery—leaving operators to perform highly routine but stressful occupations. Telephone information operators, assisted and monitored by computer equipment, are an extreme example. At the other extreme, highly differentiated products in commercial insurance or financial services can require close cooperation of teams composed of managers and paraprofessionals.

Available data provide a poor guide to much of what is happening in this sector. Productivity gains among transactional businesses require major changes in management and organization. These changes affect not only clerical employees, but managers, professionals, and technical support staffs as well. In many cases, the distinctions between clerical and managerial jobs have become almost impossibly blurred. One-third of all the job growth in finance, insurance, and real estate businesses between 1983 and 1986 resulted from new positions for executives, administrators, and managers, even though these occupations represented only 22 percent of all jobs in these businesses in 1983 (see table 12-3). Administrative support jobs, on the other hand, were responsible for only about 30 percent of job growth, even though these clerical positions represented 43 percent of the 1983 work force.

The distribution of work within the clerical work force is also changing. Table 12-4 provides a bewildering picture. Why did the number of supervisors grow rapidly and then fall? Why did the number of mail delivery jobs increase nearly as rapidly as jobs for computer operators? Exactly what are these "computer operators" doing? A careful examination of an important industry in this sector can provide some clues but no completely satisfactory answers.

Table 12-3.–Changes in the Occupation Mix of Finance, insurance, and Reai Estate, 1983-1986

Occupation	Share of 1983-86 job gain	Share of 1983 jobs
Executive, administrative, and managerial	33.2	22,3
Professional specialty	0.9	2.4
Technicians and related support	0.6	1.8
Sales	28.5	23.2
Administrative support (including clerical)	31.3	42.8
Service occupations	3.6	4,3
Precision production, craft, and repair	**2.6**	1.8
All other	**–0.7**	1.6
Total	100.0	100.0

NOTE: Numbers may not add to 100 due to rounding.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Employment *and Earnings,* **table A-25, various issues. Data for 1986 are from November, and have not been seasonally adjusted.**

The Insurance Industry: A Case Study of Automation on Employment[74]

The insurance industry provides a good example of the kinds of changes underway in many businesses providing transactional services. Automation can radically reshape the organization of work in an insurance company, changing the definition of clerical, professional, and management jobs. Clerical jobs can be upgraded and responsibilities expanded, as the tasks of data entry and analysis are combined using computers and communication networks. Professional jobs can become increasingly demanding while routine tasks are eliminated.

74 This material draws heavily on Barbara Baran, "Technological Innovation and Regulation: The Transformation of the Labor Process in the Insurance Industry," contract report for the Office of Technology Assessment, Washington, DC, January 1985.

Table 12-4.–Growth in Administrative Support Occupations, 1983-1987

Occupation	Number (in thousands) 11/83	11/87	Annual percentage growth rate 11/83-11/87	11/86-11/87
All administrative support	16,628	18,539	2.76	3.4
Supervisors	667	767	3.55	–3.9
Computer equipment operators	696	901	6.67	7.5
Secretaries, stenographers, typists	4,942	5,078	0.68	4.0
Financial records processing	2,470	2,403	–0.69	–0.7
Mail and message distributing	832	991	4.47	7.4
Other administrative support	7,021	8,399	4.58	4.2

SOURCE: **U.S. Department of Labor, Bureau of Labor Statistics,** *Employment and Earnings,* **Table A-22, various issues.**

Individuals are now given a variety of different titles (such as "paraprofessional," "skilled clerical," "paratechnical," or "professional clerical"), and often use computer terminals to process highly standardized information on applications and payments. These new positions combine tasks once done by data entry clerks, raters, and underwriters. In effect, skilled clericals, "(limited by *the decision parameters built into the machines)* are responsible for the soundness and accuracy of the millions of routine risks their companies write."[75] This pattern of work organization already dominates directly marketed insurance products, where customer service representatives are essentially sales people, underwriters, raters, data entry clerks, and claims personnel.

There is considerable potential for productivity increases. Between 1970 and 1980, for example, the number of life insurance policies written increased 49 percent, while the labor force expanded by 10 percent. Property/casualty insurance, not as heavily automated, did not show equivalent gains. Nevertheless, some firms indicated that they enjoyed a 70 to 85 percent increase in output per operator when cathode ray tubes (CRTs) replaced older data processing equipment. Turnaround time was cut dramatically, while storage space was reduced by 50 percent or more.[76] Quality was also improved.

This system can either result in widening the division separating clerical from professional work or make the division smaller to the point where there is no clear distinction between a skilled clerical and middle manager. The difference depends on the extent to which the market demands relatively routine, standardized products that lend themselves to high levels of automation, and on the management strategies of the companies involved. One estimate indicates that approximately 70 percent of the policies in life insurance, and 50 percent in the property/casualty area, are extremely routine and can be automated.[77]

Changes in occupation patterns illustrate the net effect of the developments just described most clearly. Between 1978 and 1981, when overall insurance employment grew by 8 percent, professional and technical jobs grew nearly 40 percent faster than the average, and managers and officers grew nearly 60 percent faster (see table 12-5). Total clerical employment grew far more slowly than average job growth, as did growth of specialized sales workers. Computer-based positions increased (computer programmers increased by 41 percent), while jobs in traditional areas such as bookkeeping were lost—presumably, these titles were redefined, or jobs were replaced by systems analysts. There was virtually no growth of specialized underwriters, since their tasks were increasingly handled by skilled clericals; significant growth was seen among clerical life/health claims examiners, clerical office machine operators, secretaries, and clerical supervisors. Other clerical categories registered little change, although file clerks seem to be on the decline due to the ability of automation to assume such tasks.

Table 12-5.—Percent Change in Selected Occupations in the Insurance Industry, 1978.1981

Occupation	Change
Professional/technical	11.4°/0
Accountant/auditor	11.4
Systems analyst, EDP	44.4
Claims examiner, property/casualty	10.1
Special agent	86.3
Underwriter	0.8
Computer programmer	41.1
Managers/officers	13.4
Sales workers	7.0
Clerical	6.6
Accounting clerks	4.7
Hand bookkeeping	– 1.1
Claims clerk .,	3.1
Claims adjuster	2.2
Claims examiner, life/health	26.2
Clerical supervisor	9.4
File clerk	–9.6
General office clerk	–0.3
Office machine operator	17.9
Rater	3.2
Secretary	12.9
Typist	–0.1
Total	8.3

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Survey, Washington, DC, 1978 and 1981.

Changes in job classifications must be treated with some caution. The survey conducted for this analysis discovered cases where managers were locked into compensation schemes that did not adequately adjust for inflation. As a result, the only way to increase a person's pay was to increase his or her rank. In other cases, jobs were redefined and reclassified

[75] Ibid.

76 LOMA, Word *Processing Survey, 1979.*

77 The U.S. Bureau of Labor Statistics classifies property/casualty claims examiners as "professional and technical" jobs, while life/health claims examiners are classified as "clerical."

in response to successful affirmative action suits. Indeed:

> Not only were women moved into managerial positions to meet company quotas, but men were at the same time often also promoted from professional to managerial categories to maintain their seniority. The company where we conducted our case study, for example, had been hit by a successful affirmative action suit. Between 1973 and 1979, supervisory personnel in their underwriting departments grew by 202 percent.[78]

Automation of Insurance: The Mass Production Approach

The new skilled clerical jobs, while routine, are more demanding than the ones they replaced. It is not obvious, however, that they offer better job opportunities. To begin with, these new positions pay little more, and in some cases no more, than clerical jobs. Yet the new jobs carry considerably greater responsibility, only without much sense of control—a situation that can increase stress. In the older pattern of clerical work, employees were often able to do routine tasks nearly automatically and could enjoy the sociability of an office environment; the new systems require far greater concentration and fewer opportunities for casual conversation.[79] The new work involves a "curious combination of abstraction and routinization" and, since there is little tangible evidence of work completed, a reduced sense of accomplishment[80] (see p. 371).

While these changes have had a significant impact on the productivity of clerical workers, their effect on middle management positions maybe even greater. Standardization and computerization eliminate a number of tasks once reserved for professional underwriters and claims examiners. Those that remain often have significantly changed jobs. In the newer systems, much less of a professional's time is spent reviewing routine matters that can or have been automated; more time is spent "living by one's wits. " Underwriters devote more time wrestling with exceptions and difficulties, developing new products, selling products to customers, or—in the case of property/casualty insurance—working in the field.

This pattern of organization has affected not only the insurance companies themselves but staffing in insurance agencies. Automation forces agencies to increase emphasis on sales, since much of their service functions have been moved to other parts of the insurance system. This is significant because between 1970 and 1981, agencies and brokerage houses generated 45 to 50 percent of all new insurance jobs and 61 percent of all new clerical jobs. The agencies, particularly the captive agents of a large insurance firm, are becoming more closely integrated with the parent company.

Productivity improvements in agencies resulted from a vast decrease in routine paper work and record keeping. Routine policy renewal or endorsement is the most time-consuming operation for personal lines, and the second most time-consuming process for commercial insurance lines. Nearly 40 percent of the document handling for these operations involves rehandling or correcting of previously handled documents, A survey of agency productivity increases occurring within 2 years of automation showed that revenues per employee increased by an average of 70 percent, with agency gains ranging between 50 and 125 percent.[81]

Automation of standardized products can also affect the location of work and the sexual composition of the work force. The new processing centers are typically located in suburban facilities, which are physically separated from the corporate headquarters of the company (see ch. 5.) One industry survey found that 75 percent of industry firms had made major changes in the location of their facilities in the past 5 years; 94 percent of these, or 71 percent of all firms, had shifted the bulk of their work to suburban locations. Of the remaining 29 percent, most had either made small-scale transfers of work to suburbs or small towns or were actively considering such moves.[82]

Personnel managers often search for regions with large numbers of white housewives with high school educations. It was felt that such people are less likely

[78] Baran, op. cit., footnote 74, p. 106"

[79] P. Adler, "Rethinking the Skill Requirements of the New Technologies," Harvard Business School, working paper, Cambridge, MA, October 1983.

[80] S. Zuboff, "Some Implications of Information Systems Power for the Role of the Middle Manager," Harvard Business School, working paper, May 1983.

[81] Temple, Barker, and Sloane survey, in *National Underwriter*, May 13, 1983, pp. 18-22.

[82] B. Baran, op. cit., footnote 74.

to demand high wages, more likely to accept part-time work, and more willing to be flexible in adjusting to newly automated systems.[83]

Approximately 88 percent of all new jobs added in insurance between 1960 and 1982 were filled by Women.[84] Most of these jobs were clerical—92 percent of clerical employees and two-thirds of technical employees in insurance are female—but women moved increasingly into management positions during the 1970s. The proportion of females in management positions grew from 11 to 24 percent between 1970 and 1979; women professionals grew from 17 to 38 percent, and women technicians from 38 to 65 percent.[85]

Part of this increase resulted directly from successful affirmative action suits in the 1970s, but some evidence suggests that automation is associated with a shift to a heavily female work force. The records of one large property/casualty insurer indicated that women comprised 70 percent of the work force of the highly automated personal lines of insurance, but only 56 percent of the less automated commercial lines. Similarly, women held 82 percent of the grade 7 underwriter jobs in personal lines but less than 60 percent of the jobs in commercial lines.

Even the physical environment of the newer administrative settings reflects the changes in occupations brought by automation. The walls of many private offices have been torn down, and middle managers and professionals now work side by side with clericals in shoulder-high cubicles.[86]

Automation of Insurance: The Team Approach

While automation can produce relatively routine and unpleasant jobs for skilled clericals, it can also create situations where routine clerical work is absorbed into jobs that are interesting, varied, and rewarding. This is particularly true in such areas as commercial insurance, where products are complex and difficult to standardize. It may also be true in areas where overall volume is comparatively low, but local customer services are desirable. Such local offices are staffed by multi-disciplinary teams working closely together, in which skilled clericals work directly with agents—something once the exclusive province of underwriters-and are given considerable amounts of responsibility.

Over 70 percent of the life insurance companies interviewed said that they had introduced some type of team arrangement, emphasizing geographic areas where work volume is comparatively low.[87] They are tied to extremely sophisticated computers and data retrieval systems through telecommunications networks (such as IVANS, or insurance value-added networks). Between 1973 and 1983, the ratio of claims handled by an office staff to claims handled by field offices increased from 0.5 to 3.5.

Carriers and agencies that can expand their operations to provide a variety of financial services require a new mix of talents and a flexible work staff. Increased use of training programs and new licenses in this area indicate that agency employees are expanding their scope.

Looking to the Future

The complex changes in the organization of production in the insurance industry have led to a number of conflicting theses about the future of employment in all industries associated with providing Personal Business and Communication. Clearly, there is significant room for network-wide productivity growth, since many transactional businesses can benefit from the introduction of existing technology and the power of integrated information and communications systems is growing (see discussion in ch. 6).

A detailed survey of industry specialists conducted by Georgia Institute of Technology suggested that, given optimistic assumptions about the capacity and utilization of new information technology, output per clerical worker could grow at an annual average rate of 7 percent during the next two decades, with the bulk of the increase coming between 1990 and 2000.[88] The labor reduction coefficients calculated by the same survey (the ratio of the hours needed

83 Ibid.
84 U.S. Department of Labor, Bureau of Labor Statistics, Employment *and Earnings,* various issues.
85 Eileen Applebaum, "Alternative Work Schedules of Women," paper presented to the Economics Department of Temple University, Philadelphia, PA, July 1985.
86 Based on interviews reported in Baran, op. cit., f00tnote 74.
871bid.
88 D.J. Roessner et al., *Impact of Office Automation on Office Workers,* Georgia Institute of Technology, April 1984.

to complete a task in the year 1980 to the number of hours needed to complete the same task in the year 2000) averaged 0.42, with the productivity gains being greatest for data processing and database management, and least for communications and monitoring. Similar projections for 1990 and 2000 appear in table 12-6, first for the insurance industry and then for selected industries within the Transactional Activities sector.

If clerical work can be automated to the extent suggested by the Georgia study, the distribution of jobs in the insurance industry would no longer be a pyramid, with a small number of top managers, a larger number of professionals and technicians, and a still larger number of clerks. Rather, it would be shaped more like a diamond, with a small number of top managers and clerks and a large number of quasi-professionals in the middle.

Table 12=6.—Labor Coefficients for the insurance industry

	1990		2000	
Occupation	S2	S3	S2	S3
Managers	0.99	0.84	0.88	0.50
Sales workers	0.98	0.94	0.96	0.89
Clerical	0.84	0.84	0.70	0.53

NOTE: S2 and S3 refer to different scenarios used in the study. The coefficient for clerical workers is a weighted average.

SOURCE: Wassily Leontief and Faye Duchin, The *Impacts of Automation on Employment, 1963-2000,* **Institute for Economic Analysis, April 1984.**

Labor Coefficients for 1990 in Selected Transactional Industries

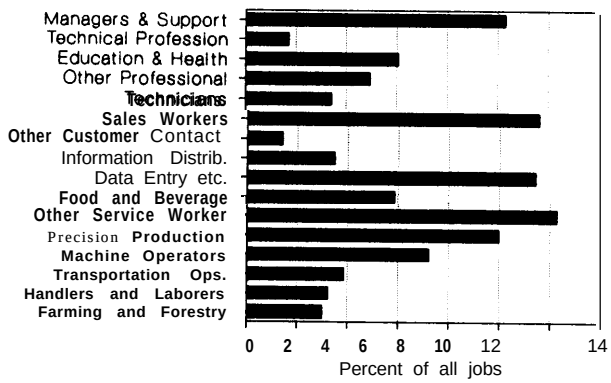
Occupations	Banks	Credit agencies	Securities	Insurance	Business services	Miscellaneous services
Professional/technical	1.27	0.96	0.85	0.86	1.11	1,02
Manager ... ,	1.13	0.87	0.90	0.84	1.08	1.11
Sales.	1.05	0.76	0.68	0.95	0.93	0.96
Clerical	1,10	0.83	0.72	0.71	1.01	0,95

SOURCE: M.P. **Drennan, "Implications of Computer and Communications Technology for Less Skilled Service Employment Opportunities,"** report **for the U.S. Department of Labor, USDL-21-36-80-31, 1984.**

RECREATION AND LEISURE

The rapidly growing demand for the Recreation and Leisure amenity has made this an increasingly important source of employment in the American economy. According to the U.S. Travel Data Center's definition of the travel industry, the industry employed some ***4.5*** million people in 1972 (a little over 6 percent of the work force).[89] Using the somewhat different definition of the industry employed in this analysis, by 1984, it was directly and indirectly employing 8.5 million people, or 8 percent of American jobs. Providing this amenity creates significant numbers of jobs for virtually every occupation category (see figure 12-10). While comparatively few technical jobs are created, recreational spending ripples into both service and production occupations.

Figure 12-10.-JobsNeeded To Produce Recreation & Leisure in 1984 (percent of 8.5 million jobs)



SOURCE: See table 10-8 of chapter 10.

Will employment in the Recreation and Leisure network continue to expand at the same rate? The evidence is mixed. The service and retail jobs that make up the vast majority of the sector's work force

'Albert J. Comes, *Hospitality in Transition: A Retrospective and Prospective Look at the U.S. Lodging Industry,* American Hotel and Motel Association, 1985, based on data from the U.S. Department of Labor, Bureau of Labor Statistics, "Supplement to Employment and Earnings, United States 1909-1978," Washington, DC, July 1984.

are not easily replaced by labor-saving technology. This implies that recreation employment will continue to be labor-intensive. In fact, a recent analysis of the lodging industry suggests that hotel industry is becoming even more labor-intensive: in 1933, there was one employee for every 5 hotel rooms; in 1982, there was one for every two rooms.[90]

On the other hand, if there is a slowdown in the rate of growth of recreation demand, then demand for labor may drop as well. Coupled with downward pressure on work force levels because of decreasing numbers of young people who have traditionally worked in leisure industries, this could limit job creation in the sector.

While the sector has clearly generated a significant amount of employment, many of the jobs created by restaurants, hotels, and amusements do not offer high wages or significant opportunities for advancement. In 1987, these industries respectively paid roughly half, two-thirds, and three-quarters of the average hourly wage.[91]

But these figures focus on only the direct services provided by the away-from-home recreational businesses, neglecting the significant number of jobs resulting from the production of products for recreation and leisure. Outdoor recreation means purchases of everything from tennis rackets and hiking shoes to recreation vehicles. The businesses themselves purchase manufactured products ranging from french-fry slicers to jet aircraft. Travel generates employment for travel agencies and the people who make and maintain the complex communication and data processing systems on which that these businesses now depend. New hotel and motel construction was responsible for 11 percent of all new 1986 nonresidential construction.[92]

Figure 12-10 indicates that 10 percent of the jobs associated with this amenity fall into the relatively good paying managerial and precision production occupations. When indirect effects are included, the Recreation and Leisure amenity generates more jobs for precision production manufacturing jobs than it does food and beverage workers.

90 Albert J. Gornes, op. cit., footnote 89.

91 U.S. Department of Labor, Bureau of Labor Statistics, Employment *and Earnings, vol. 34, No. 12,* December 1987, table C2, pp. 83-97. Wages are for September 1987, reflect money payments only, and do not include tips.

92 Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 5.4.

GOVERNMENT

Federal defense and government activities like fire, police, and administration activities that could not be allocated to other amenity groups produce about 13.1 million jobs. Managers, education and health professionals, and data entry workers represent over 40 percent of all of these jobs (see figure 12-1 1).

A large share of the government workers not easily traceable to an amenity network like Education or Health work at the Federal level. The Department of Defense, the Postal Service, and the Veterans Administration employ over two-thirds of all Federal workers, and have been responsible for nearly all growth in the Federal work force since 1977.[93] Federal employment has grown at only one-third the rate of private employment since 1977, resulting in a decreasing share of the overall labor force[94] (see figure 12-12). Outside the Department of Defense, Federal employment growth was slowed by the hiring freeze imposed in 1981, reduced employment ceilings for many agencies, and cutbacks of approximately 14 percent and 17 percent at two large Federal agencies: the Department of Health and Human Services and the Department of Agriculture.[95] By 1986, the Federal work force was less than half that of State and local governments.

In part because of the growing complexity of government administration, and in part because some clerical activities are handled under contract, the Federal work force is increasingly composed of skilled professional and administrative jobs. Jobs in these categories were 35 percent of all Federal jobs in 1976 and 42 percent in 1986.[96] The educational attain-

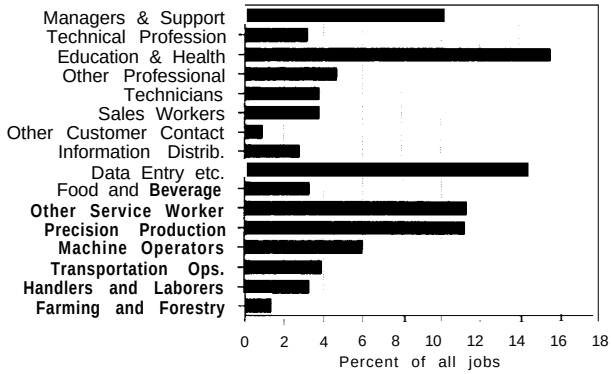
93 U.S. Congress, Congressional Budget Office, Federal *Civilian Employment* (Washington, DC: U.S. Government Printing Office, December 1987), p. x.

94 Ibid., p. ix.

95 Ibid., p. xii.

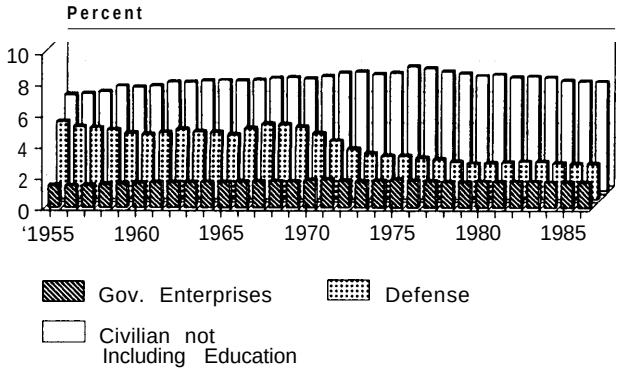
96 Ibid,, p. xiii. Statistics refer to non-postal employees.

Figure 12-11.-Jobs Needed for Defense and Other Government in 1984 (percent of 13.1 million jobs)



SOURCE: See **table 10-6 of chapter 10,**

Figure 12-12.-Government Employees Not Directly Involved in Education (as a percent of all employed persons)



How To **Read This Figure:** Civilian **employment** in Federal, State, and local government (not including State education employees) peaked in the mid 1970s and has subsequently declined as a fraction of all employed persons. Federal defense employment (a category that includes the Coast Guard) fell sharply at the end of Viet Nam War. Federal, State and Local Enterprises (e.g., power authorities) have accounted for a nearly constant share of employed persons since 1955. Employed persons include full-time employees, self-employed persons, and part-time employees and converted to full-time equivalents.

Notice that the employment in this figure are NOT the same as that shown in figure 12-11. Figure 12-11 shows both direct and indirect employment and excludes government employees who can be traced directly to an amenity network like Food.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts," historical diskettes, table 6.10.

ment of Federal workers have also increased—31 percent of all non-postal employees held a bachelor's degree or better in 1986, up from 25 percent in 1976. The 1986 national average was 22 percent.[97]

Although the Federal government is often depicted as inefficient and overstaffed (it apparently takes 55 employees to answer a letter received by the Secretary of Health and Human Services[98]), the productivity of the Federal government has increased at an annual rate of 1.6 percent from 1979 to 1986—significantly higher than other service sector industries such as finance, insurance, and real estate (–.8 percent); legal services (– 1.9 percent); and business services (– 1.8 percent).[99]

Measured productivity in government has slowed since 1982. The decline can be attributed in part to a negative measured rate of productivity growth in the Department of Defense.[100] Productivity in the non-postal, civilian portion of the Federal government grew at an annual rate of 2.2 percent between 1982 and 1986, rivaling some of the productivity increases occurring in the manufacturing sector.

The source of productivity gains in non-defense areas can be tied to the widespread implementation of computers into the workplace, suggesting that significant future employment growth in this sector is unlikely. Introduction of computers in the Social Security Administration, for example, resulted in a reduction of employment.[101] When the Department of Commerce implemented a new electronic system for issuing export licenses, the approval time for overseas sales was cut from from 13 days to 3.[102] The Internal Revenue Service is experimenting with a new electronic tax filing system that promises to cut processing time by a factor of two, reduce filing errors by a factor of ten, and deposit a refund check in the taxpayer's bank account three weeks after the

97 Ibid p. xiii; and U.S. Department of Labor, Bureau of **Labor Statistics,** "Table 13: Occupation of employed persons by age and years of school completed," unpublished.

98 "'The Grace Commission Report," 1983, cited in Lewis Lapham, Michael Pollan, and Eric Etheridge, *The Harper's Index Book (New* York, NY: Henry Holt and Co., 1987), p. 43.

99 U.S. Department of Labor, Bureau of Labor Statistics, "Time Series Data for Input-Output Industries," June 1987, unpublished.

100 Ibid., p. 22.

101 Ibid., p. 20.

102 Lee Mercer, Acting Deputy Undersecretary for Export Administration, U.S. Department of Commerce, "'Elain' Joins 'Stela' to Cut Processing Time," *Business America, vol. 109, No. 5* Feb. 29, 1988, pp. 7-10.

return is filed.[103] This new system should not only hold down labor costs in the IRS, but should also have a large indirect effect on the Postal Service as the more than one billion pieces of yearly tax correspondence are reduced.

This document was typed by professional staff using the same desktop personal computers that were used to perform all of the OTA calculations presented here and to create all of the graphics. The hardware and software costs averaged about $2,500 per station. In most cases, the data used in the analysis was received from Federal agencies over the telephone line or on floppy disks that could be inserted directly into the desktop equipment. The staff that once performed largely clerical work have become specialists in perfecting graphics or formatting digital text files.

[103] Judy Rosenfeld, "The Electronic Taxman," *PC World*, April 1987, pp. 184-191.

MANUFACTURING

Manufacturing employment is the paradigm of work in U.S. society. The vocabulary of labor analysis and statistics, and much of the scholarly debate over changes in work force skills, is built around production work.

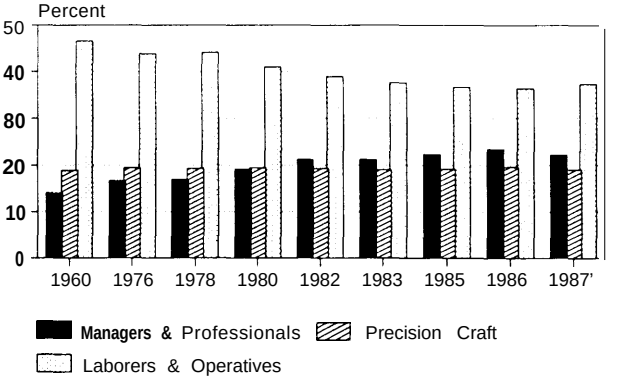
These paradigms change slowly even though classic manufacturing jobs—craftsmen, laborers, and machine operators—are likely to be only 10 to 15 percent of the labor force by the end of the century. Even in manufacturing the mix of skills needed may increasingly resemble the mix of skills needed by businesses like banking and insurance.

The productivity gains achieved with new manufacturing technology have not uniformly reduced the need for all kinds of occupations. For the most part, they have resulted in sharp declines among manual workers (operators and laborers) rather than among management staff (see figure 12-1 3). Workers classified as "precision production, craft, and repair" have held a roughly constant share of jobs.

As in the case of insurance (discussed in the previous section), there is considerable uncertainty over the way new manufacturing technology can or should be used. Fragmentation of markets, and the inherent characteristics of robotic and other production equipment, seem to point away from mass production runs and toward the production of smaller batches (see ch. 5). Using the technology installed in most major metal shaping facilities today, producing batches of 10 or less requires ten times as many people per piece produced as a production line making 1,000 or more identical parts. [104] Advanced "flexible manufacturing systems" (FMS) can result in a radical change in the economics of mass as opposed to batch production. The Japanese, who are being forced away from mass production by the need to serve smaller local markets as well as export markets, are making heavy use of FMS to increase the productivity of small batch production dramatically. [105] A flexible manufacturing system (FMS) used in small batch production runs may require only one-fifth the number of employees needed with conventional systems (see table 12-7).

Even more importantly, the FMS systems change the nature of jobs created in manufacturing. For example, FMS creates nearly twice as many engineering jobs per part produced as a conventional sys-

Figure 12-13.-Occupations in Manufacturing (as a percent of all manufacturing jobs)



● November 1987.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, matrices for Employment by Occupation and Industry, Washington, DC, various years,

[104] Hiroyuki Yoshikawa, K. Rathmill, and J. Hatuany, *Computer-Aided Manufacturing: An International* Comparison (Washington, DC: National Academy Press, 1981).

105 Ramchandran Jaikumar, "Postindustrial Manufacturing," Harvard *Business Review, vol. 64, No. 6,* November/December 1986, pp. *69-76.*

Table 12-7.—Manpower Requirements for Meta-=Cutting Operations: Fiexibie v. Conventional Manufacturing (workers need to produce the same number of identicai parts)

	Number of workers	
Type of activity	Conventional U.S. system	Japanese FMS
Engineering	34	16
Manufacturing overhead	64	5
Fabrication	52	6
Assembly	44	16
Total	194	43

NOTE: There is no column for a U.S. FMS because as of the end of 1986, no U.S. machine tool producer had an FMS on line.

SOURCE: Ramchandran Jaikumar, "Postindustrial Manufacturing," Harvard Business Revlew, November/December 1988, p. 73.

Flexible Manufacturing Systems (FMS) Used for Machining Metal Collars

	Before FMS	After FMS
Number of machine tools	8	4
Number of processes	3	1
Number of workers	10	2
Machine utilization	50%	75%
Factory availability per day	16 hours	24 hours
Necessary lead time	6 days	1 day

SOURCE: Okuma Machinery Works Ltd., reported in B. Stokes, "The 21st-Century Factory," National Journal, Feb. 13, 1986, p. 383.

tern (again see table 12-7). Successful use of FMS to achieve high degrees of flexibility in rapidly moving markets requires close cooperation between design engineering and production. Products and production techniques must be designed simultaneously. The Japanese find, for example, that the productivity of software development (usually considered a "service" occupation) is critical in the overall cost of products made from FMS; for example, Yukio Hasegawa, an expert on robotics at Waseda University, estimates that the cost of FMS production could be cut by 25 percent given advances in the productivity of software development. [106] Teamwork, a mixture of skills, and a high degree of intellectual flexibility appear necessary to make FMS work.

The discussion in chapter 6 explained that the jobs created by new manufacturing strategies depend heavily on management choice. There is some evidence that the Japanese have moved more rapidly to exploit the flexibility inherent in FMS while U.S. firms have opted to use the equipment more as a direct substitute for mass production. A recent survey found that U.S. manufacturers used FMS systems to make an average of 10 different parts while the Japanese averaged 93 parts per FMS system.[107]

Production Workers

The debate over whether new production equipment will lead to a net increase or decline in the skills of manufacturing workers is impossible to resolve given the uncertain future of new production technology. Chapter 11 summarized some of the debate. It is clearly possible that new production equipment would lower skills on the shop floor but create many highly skilled support jobs, both in manufacturing enterprises and in the businesses that supply them.

Even the comparatively narrow question of whether new manufacturing technology will make production work more interesting and challenging or more mundane proves difficult to resolve. While there are no convincing data on the subject, anecdotes suggest that management has a wide range of choice in the kinds of jobs that are created in new production systems.[108] Since experience is limited, it is difficult to prove which choice is preferred. There are reasons to believe that attempts to achieve productivity without actively involving workers in the design and operation of a plant can prove disastrous—particularly in dynamic situations where products change rapidly.[109]

Obviously not all managers are convinced of the advantages of designing systems around a skilled production force. Computer-controlled equipment has been introduced in a way that, as one manager put it the " . . . operator can be just short of an idiot''[110] (see box 12-A). In fact, a majority of the operators interviewed in one survey believed that the use of numerically controlled machine tools made their jobs less interesting and less rewarding. As one operative put it, "you get to be, in my opinion on a NC [numerically controlled machine tool], a little

106 Bruce Stokes, "The 21st-Century Factory, "National Journal, Feb. 13, 1988, vol. 20, No. 7, p. 386.

107 Ibid.

108 Carol Parsons et al., "The Development of Programmable Automation Systems in Discreet Parts Manufacturing Industries," contract report prepared for the Office of Technology Assessment, Washington, DC, 1984.

109 Ray Marshall, "Economic Performance and Work Force Quality," Testimony before the Joint Economic Committee, U.S. Congress, Oct. 21, 1987.

110 Parsons, op. cit., footnote 108.

Box 12-A.–Does Technology De-Skill Production Workers?

"In most companies the programmer is paid as a grade 9 while the operator is paid as a grade 6. But in our company there aren't any up-in-the-front-office type programmers. So the CNC operators are paid as a grade 8. This was OK with the operators but some of the other employees were angry because operators spend a lot of time just sitting reading a book."

—A vice president for manufacturing of a firm in Iowa

"Yes and no. Operators now have new skills. With the old machines they had to have a feeling for tool nudging and continuous adjustments. Now they need to understand the cycle of a program. We also need more competent electronic technicians and troubleshooters. There are poor diagnostics on the [CNC] machines."

–A **vice president** for manufacturing in an independent producer of manifold and other engine parts that has used CNC for 3 years.

SOURCE Carol Parsons et al., "The Development of Programmable Automation Systems in Discreet Parts Manufacturing Industries," contract report prepared for the Office of Technology Assessment, Washington DC, 1984.

weak-minded."[111] In such cases, a job once held by a trained machinist is replaced by one inwhich an individual performs simple loading operations and spends more time waiting for something to go wrong. Programming of the equipment is removed from the shop floor, and placed in the hands of specialists. When something does go wrong, the worker on the floor can do little more than call a repair team. The result is generally boredom, as well as frustration over loss of autonomy; moreover, responsibility without control can create enormous stress. The feeling of helplessness can be increased when workers loose incentive bonuses because of equipment failures over which they have no control.

On the other hand, there are examples of shops where teams of designers and operators have collaborated in a way that benefits the entire work force. An examination of textile machinery manufacturing in West Germany found that "firms concentrate their expertise in coordinating the design and assembling the full product."[112] operators in such facilities may take delight in reprogramming equipment to reduce the processing time by a few seconds and beat the record of the previous shift. In one Japanese firm employing an FMS, for example, "systems engineers with a thorough knowledge of several disciplines. . . [rotate] through all manufacturing departments,"[113] so that each would be able to gain the kind of competitive expertise that may be unobtainable without a coordinated approach to design and assembly.

The Japanese seem to have faith that new production technology will lead to much higher demands on the skills of their workers. An increasing fraction of their production jobs are held by college graduates, or by high-school graduates whose knowledge of mathematics and science rivals that of college juniors or sophomores in the United States. Nissan Motors recruits high school graduates with a rigorous nationwide test that places particular emphasis on mathematics and science.[114]

Equipment Maintenance

One undisputed trend is the increasing need for highly skilled individuals capable of designing, installing, and maintaining new automated equipment. An overwhelming majority of firms interviewed indicated that they had difficulty finding qualified personnel; most had instituted in-house training programs. These training programs are not trivial. The equipment involved is highly complex and cannot be understood with a few brief lessons. A survey of 48 British engineering plants in 1981 indicated that firms with numerically controlled tools thought they needed maintenance personnel with higher skills, while those that had not automated indicated that they hoped to simplify equipment so that the skills of maintenance personnel could be reduced.[115]

Several of the automated firms indicated that they were concerned about raiding by other firms of trained personnel, and were nervous about their training investments. Many of the advanced systems

[111] Ibid., p. 201.

[112] Charles Sabel et al., "How To Keep Mature Industries innovative," Technology *Review, vol.* 90, No. 3, April 1987, p. 30.

[113] Jaikumar, op. cit., footnote 105, p. 75.

[114] B. Stokes, op. cit., footnote 106.

[115] P. J. Senker and T. M. Brady, "Skills for Automation: The Maintenance Training Gap," paper prepared for the 2nd International Conference on Human Factors in Manufacturing, West Germany, June 11-13, 1985.

require people familiar with a number of fields: hydraulics, electronics, and mechanical equipment.[116] These jobs plainly demand a flexible intellect and can be quite challenging. They can also be extremely stressful, since a single problem in a highly connected factory system can shut down a large and expensive facility. Such problems are often difficult to diagnose under pressure.

116 Parsons, op. cit., footnote 108