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Technology and Labor in Five Industries

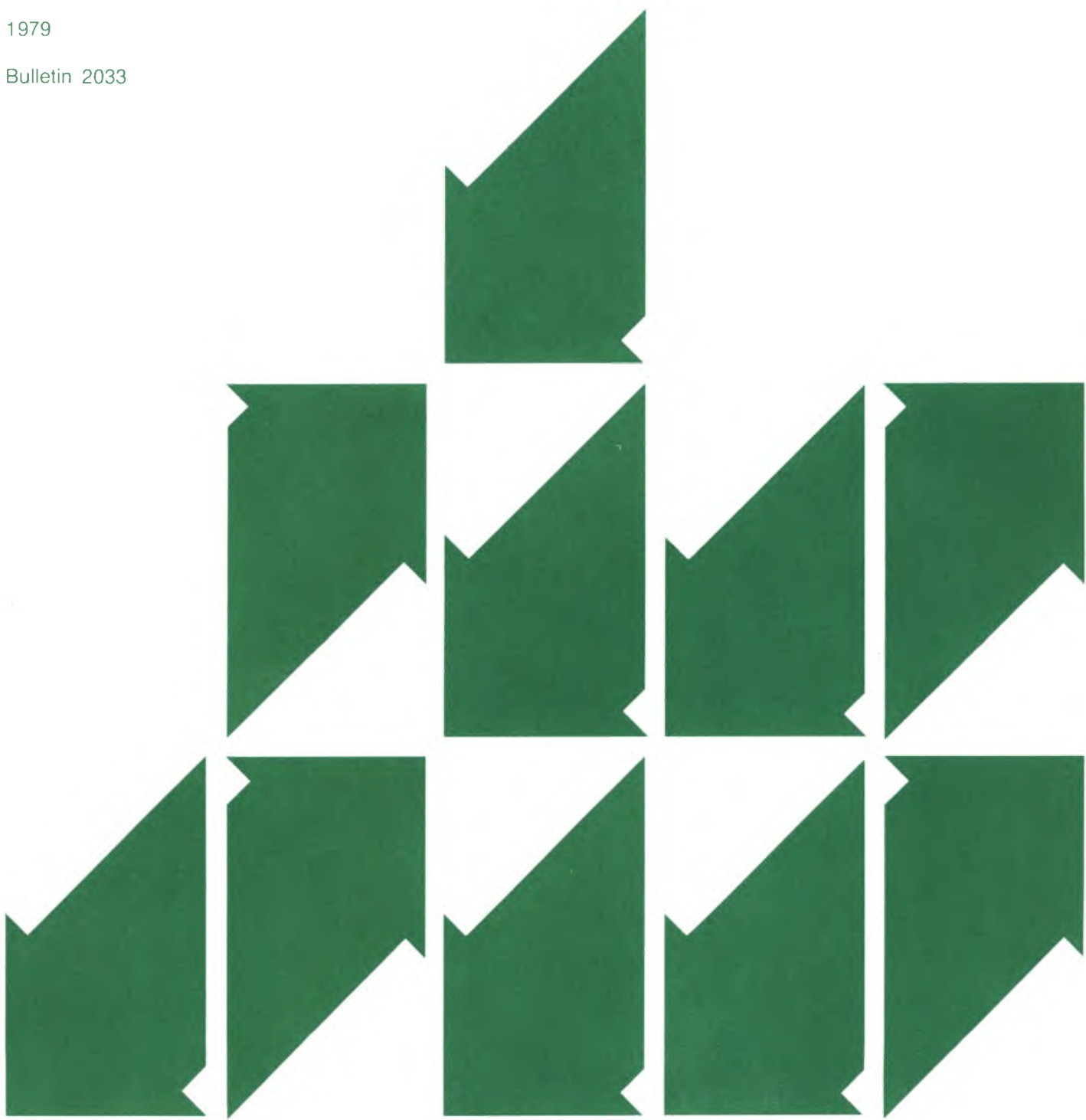


Bakery products/Concrete/Air transportation
Telephone communication/Insurance

U.S. Department of Labor
Bureau of Labor Statistics

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Preface

This bulletin appraises some of the major technological changes emerging among selected American industries and discusses the impact of these changes on productivity and occupations over the next 5 to 10 years. It contains separate reports on the following five industries: Bakery products (SIC 205), concrete (SIC's 3271,2,3), air transportation (SIC 45), telephone communication (SIC 481), and insurance (SIC 63).

This publication is the fifth of a series which updates and expands BLS Bulletin 1474, *Technological Trends in Major American Industries*, published in 1966, as a part of the Bureau's continuing research program on productivity and technological developments. Preceding bulletins in this series are included in the list of BLS publications on technological change at the end of this bulletin.

The bulletin was prepared in the Office of Productivity and Technology under the direction of John J. Macut,

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Chapter 1. Bakery Products

Summary

The technology of the baking industry has not changed substantially in the last two decades, and significant advances are not anticipated. In general, the changes have been largely confined to improvements to existing machinery rather than changes in design concepts or functions. In breadbaking, important innovations were introduced in the 1950's, but acceptance and diffusion have been limited. In the long run, however, the trend toward larger plants and the possibility of higher labor costs will tend to make advanced mechanized systems economically feasible for more breadbaking plants. In the cookie and cracker segment of the industry, advanced technologies are already widely established.

Productivity growth in baking was moderate from 1960 to 1977; the average annual rate of 2.5 percent was roughly comparable to the average growth rate of all manufacturing for the period. However, in the last 10 years of the period, 1967-77, the rate was only 1.5 percent, while the growth rate of all manufacturing was 2.3 percent. Because of the industry's prospects for relatively small increases in output, productivity growth is expected to be very moderate in the 1980's.

Despite the fact that dollar outlays for plant and equipment more than tripled from 1960 to 1977 peak levels, real dollar outlays peaked in 1966 and then turned down. This was associated with the underutilization of existing capacity and expectations of slow industry growth.

Industry employment has shown an almost steady decline for the last 20 years. From its highest level in 1956, employment decreased almost 25 percent, to 228,400 workers in 1978. Decreases were most concentrated in the years from 1967 to 1978, when the rate of decline averaged 2.1 percent annually. The long-term outlook is for a decline of less than 1 percent annually from 1978 to 1990, or roughly half the 1960-78 rate.

Industry Structure

The bakery products industry (SIC 205) is composed of two major groups: Establishments engaged in manufacturing bread, cakes, and other perishable bakery products

(SIC 2051), and establishments engaged in manufacturing biscuits, cookies, crackers, and similar "dry" bakery products (SIC 2052) (called the cookie and cracker sector in this chapter). The bread sector is by far the larger, with almost 5 times the number of employees and 3 times the value of shipments of the cookie and cracker sector in 1977.

The cookie and cracker sector of the industry is dominated by a few firms that operate a relatively small number of large-capacity plants. The four largest companies accounted for almost 60 percent of the sector's shipments in 1972, as they did in 1958. Almost 70 percent of shipments came from plants with 500 or more employees. In this sector of the industry, advanced technologies have been widely adopted.

Unlike the cookie and cracker sector, however, the perishable nature of bread and cake products has limited the geographic market of bakery plants. Inventory buildup is not possible and the very frequent deliveries are costly. Transportation costs have both effectively prohibited their expansion and insulated them from the competition of more economical producing units. Consequently, large-capacity plants have been restricted to areas of high population density.

To some extent, the structure of the breadbaking sector is changing to allow increased capacity utilization and economies of scale. The number of breadbaking plants is declining, and the larger plants are becoming relatively more important. By 1977, for example, the number of breadbaking plants had declined to half the number in 1958. Plants with more than 100 employees accounted for more than 18 percent of all bread plants in 1972 compared with less than 12 percent in 1958, and their proportion of shipments increased from 69 percent to 80 percent in this period.

Technology

There have been no major technological innovations in the last several decades in either sector.

Since the largest proportion of cookie and cracker shipments comes from high-capacity plants, the economies resulting from the installation of mechanized

or automated equipment in this sector have long been recognized. Bulk handling of material, high-capacity mixing, mechanized processing, and automated packaging are now commonplace in the industry. The amount of labor required to operate production lines has been minimized. Future equipment developments will attempt to offer more efficient operations by reducing break-downs or reducing "cripples" (imperfect products), but the manufacturing process will probably be altered very little. The impact of new technology on labor in this sector is expected to be relatively low in the 1980's.

In baking bread, radical technologies were introduced in the 1950's. For larger plants, a more automated processing system was developed which included liquid fermentation and continuous mixing, discussed in detail below. However, continuous mixing has not been accepted, and liquid fermentation is used almost exclusively with conventional processing rather than with a continuous system. For smaller batches, technology modifications such as high-speed dough mixing significantly reduced fermentation time and facilitated conventional processing, but these affect specialty products primarily.

Since the introduction of liquid fermentation and

continuous mix processing, there has been no significant change in the technology of the breadbaking industry. New equipment has been introduced, but the changes have been in capacity, reliability, or efficiency rather than in concept or function. Even in the larger breadbaking plants where advanced mechanization is most feasible, no significant new techniques are available to the manufacturer.

In general, conventional breadbaking equipment has been improved to reduce manual processing and handling. Pneumatic conveyors transfer bulk materials to storage and mixing operations. Automatic batching and weighing equipment delivers ingredients to mixers quickly and with a high degree of accuracy. Bulk dough is divided, rounded into balls, molded into loaves, and panned by specialized machinery. Products pass through the final fermentation, baking, and cooling stages, and between processing stations, on conveyor systems. Slicing, wrapping, packaging, palletizing, and tray stacking can be accomplished by machine.

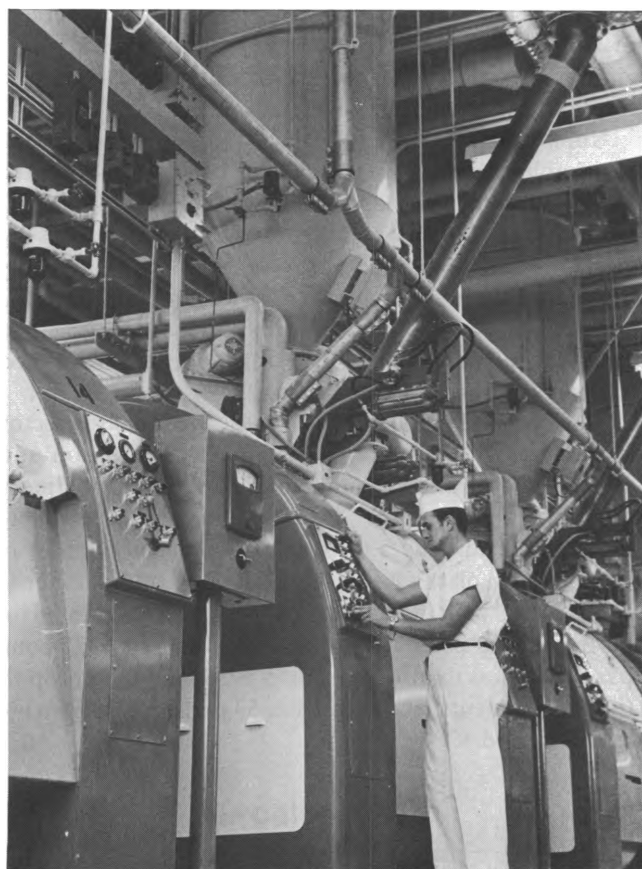
The major impact on unit labor is likely to come from improvements to conventional machinery and from structural changes, such as larger establishments which permit better capacity utilization, rather than from development or diffusion of innovative, higher capacity machinery. It is also possible that, in the long run, increasing labor costs may make the adoption of more automated machinery feasible even in medium- and small-sized plants.

Continuous mixing

Continuous mix processing substantially reduces the labor required for dough mixing and makeup in bread manufacture. Instead of the two-step mixing of the conventional sponge and dough method, continuous mix processing subjects a steady flow of liquid ferment to high-speed mixing. The developed dough is extruded and panned without further processing by conventional degassing, dividing, rounding, and molding equipment.

Because several separate processing stages are eliminated, makeup time and labor requirements are greatly decreased. The semiskilled workers who transfer dough between the mixer and the fermentation room are no longer needed, and the number of bakers who oversee the mixing and makeup operations is reduced. Also, because continuous mixing operates in a closed system, cleanup is easier. Consequently, one or two operators produce the same hourly dough volume as six or seven workers in conventional processing.

Despite significant savings of labor costs, continuous mixing has not gained acceptance since its introduction in the 1950's. Because high levels of output are necessary to achieve a significant reduction in average unit cost, continuous mixing is economically practical only for larger plants. Also, to some extent, there appears to be a problem with consumer acceptance of the texture of



Baker controlling flow of ingredients from overhead conveyor system to mixer.

bread produced by continuous mixing. Moreover, operating problems have also limited its diffusion.

Liquid fermentation

Liquid fermentation gained acceptance in American bakeries in the early 1950's and is currently widely used. An important step in the automation of the breadbaking process, it was developed to replace the sponge stage of the conventional sponge and dough method in order to reduce total processing time and labor requirements.

The liquid ferment can be advanced through several processing stages by pumps instead of by manual transfer of the mixed sponge, a procedure that is required in conventional processing. Bulk fermentation time is shortened, less plant space is required, and processing and maintenance time is reduced.

In contrast to the conventional sponges which require immediate processing, the fermenting liquid can be cooled and stored for a short time, which makes a more flexible production schedule possible. Besides its impact on conventional mixing, the introduction of a pumpable ferment that could be processed in a closed system made possible the concurrent development of a continuous mixing process.

The impact of liquid fermentation on labor requirements is significant. Skilled workers responsible for sponge remixing in conventional processing—often among the highest paid in the plant—are no longer needed. Also, the work done by unskilled mixers' helpers in transferring dough between the mixer and the fermentation room is eliminated.

Because liquid fermentation can be utilized in both conventional and continuous mixing, its diffusion has been great. It has been estimated that liquid ferments are currently used in 40 percent of bread and 75 percent of bun and roll production. Because widespread use has already been achieved, it is expected that further diffusion will be minimal.

High-speed mixing

High-speed mixing eliminates the extended fermentation time required in conventional breadmaking. It is suited primarily to the manufacture of nonwhite breads which constitute about 10 percent of current bread output. With high-speed mixing, separate sponge and dough mixing and fermentation are replaced by the rapid mixing of all ingredients of the batch in a single step. In 5 minutes of high-speed mixing, the concentrated input of mechanical energy is sufficient to accomplish the same dough development that results from 4 to 5 hours of fermentation and conventional mixing.

As in the case of liquid fermentation, significant labor savings can be achieved because several stages of conventional processing are eliminated. Skilled mixers responsible for sponge remixing in conventional processing are no longer needed. Also, the work done by unskilled mixers' helpers used to transfer dough between mixer and fermentation room is reduced.

At present, high-speed mixing accounts for less than 5 percent of bread production in the United States, or less than half of the output for which it is suitable. The expense of replacing conventional mixers with ones capable of the necessary energy output may not be economically justified and has been the primary factor limiting diffusion.

Output and Productivity Outlook

Output

From 1960 to 1977, output of all bakery products rose at the relatively slow rate of 0.7 percent annually. However, this reflected a much stronger rate during the first part of the period than during the last. From 1960 to 1967, the growth rate was 1.5 percent; this followed the pattern of the 1950–60 decade. During 1960–67, output increased in every year except 1961, when a small decline occurred in conjunction with the 1960–61 recession. In contrast, the rate from 1967 to 1977 slowed to only 0.4 percent annually, which reflected a sharp decline during the 1969–71 recession. (See chart 1.)

In general, the slower rate of output growth in the last 10 years is associated with a decline in per capita consumption and slower population growth. Per capita consumption patterns may relate to changes in diet or in income levels. A BLS study of consumer spending habits in 1972–74 shows that for the United States as a whole, expenditures for bakery products increased with family income.¹ Outlays for bread alone, however, stabilized at family incomes of \$15,000 and above. Since slower population growth is projected for the 1980's and no significant increases in per capita consumption are expected, it is likely that bakery product output growth will slow down.

Productivity

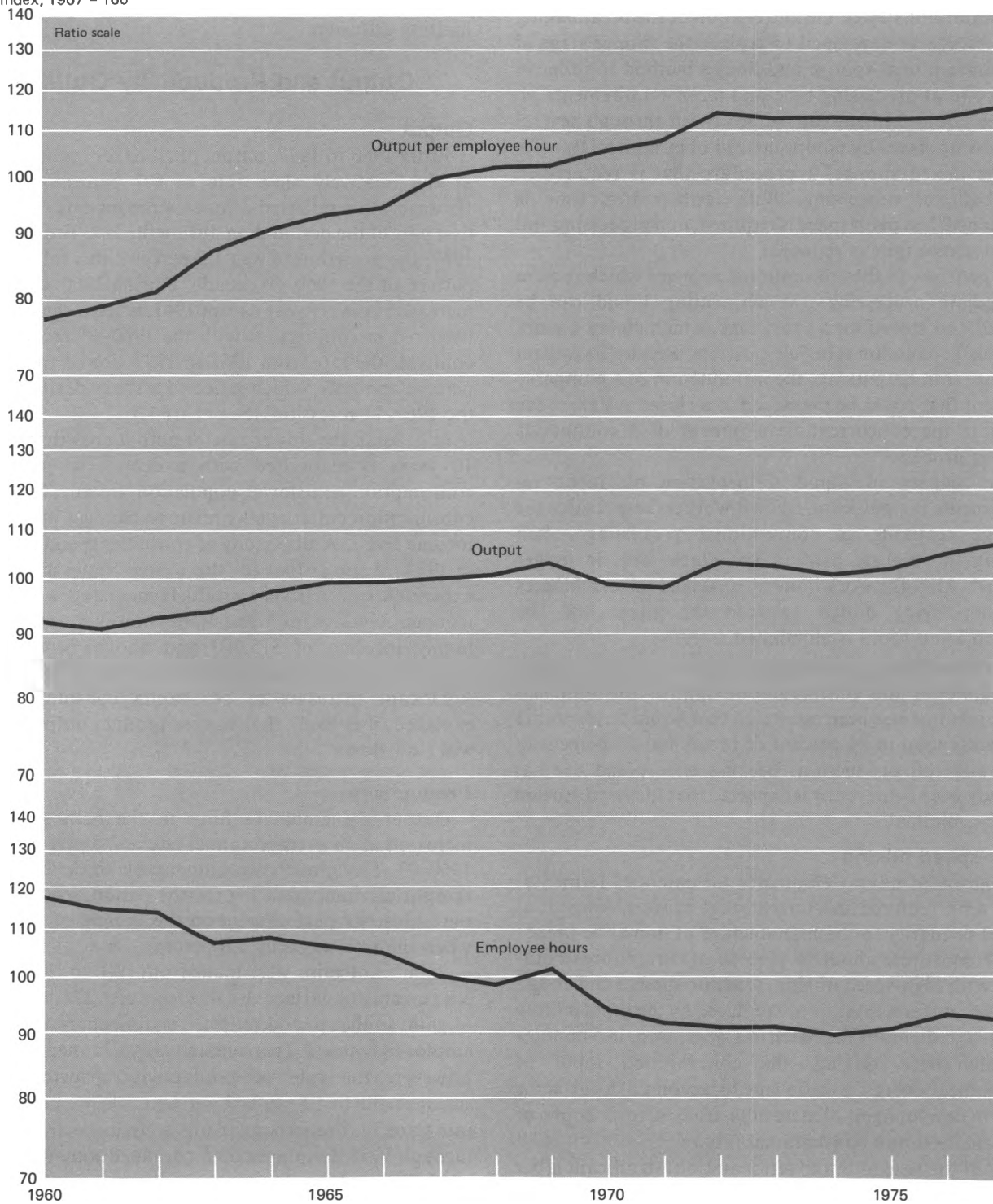
Output per employee hour in the baking industry increased at an average annual rate of 2.5 percent during 1960–77. This growth was comparable to the 2.6 percent rate for all manufacturing for the period and surpassed the industry's performance in the decade of the 1950's when the rate was only 1.8 percent.

Significant gains were made from 1960 to 1967 when a 3.8 percent annual increase was recorded. The productivity gains in that period reflected significant reductions of employee hours (2.2 percent annually). In the last decade however, the rate of productivity growth fell off substantially to 1.5 percent per year. The modest growth rate since 1967 reflects small productivity declines in 1973 through 1975. Employee hours declined somewhat in the 1967–77 decade, and output growth was negligible. In the 1980's, productivity growth is expected to be very moderate because of the industry's prospects for relatively small increases in output.

¹ *Consumer Expenditure Survey: Diary Survey, July 1972–June 1974*, Bulletin 1959 (Bureau of Labor Statistics, 1977).

**Chart 1. Output per employee hour and related data,
bakery products, 1960-77**

Index, 1967 = 100



Source: Bureau of Labor Statistics.

Investment

Capital expenditures

Real outlays for new plant and equipment hit a peak in 1966 and have been declining almost steadily since then. This may be associated with the underutilization of existing facilities and the projected slow growth of demand for the industry's products.

In current dollars, capital expenditures in the baking industry rose to \$363 million in 1977, a threefold increase from 1960. In the 1960's, expenditures for plant and equipment fluctuated cyclically, rising moderately overall; but from 1969 to 1977, they rose very sharply and without interruption to peak levels. More than 80 percent of the industry's outlays were those of the bread and cake sector. Outlays by the cookie and cracker sector followed the general pattern of the bread and cake sector, but the cyclical swings were more pronounced.

These data reflect costs unadjusted for price changes. Because equipment prices rose very significantly during this period, comparisons of current dollar outlays over time are not necessarily indicative of change in the stock of capital equipment. Adjusting current-dollar expenditures by the BLS index of bakery machinery prices shows that real capital outlays probably declined in the 1970's compared with the 1960's. The peak in real expenditures occurred in 1966; since then, the overall trend has been down. Measured in 1967 dollars, real annual outlays for 1961-69 (1960 price data unavailable) averaged \$153 million and in 1977, only \$142 million.

Between 1960 and 1977, capital expenditures per production worker, expressed in current dollars, quadrupled as these outlays rose for both sectors of the industry. However, after adjustment for bakery machinery price increases, annual real expenditures per production worker in 1977 (\$1,083) were 15 percent greater than in the 1960's (\$939). In bread and cake establishments, real outlays per production worker averaged about 15 percent higher in 1977 than in the 1960's, while they rose 25 percent for cookie and cracker establishments.

Employment and Occupational Trends

Employment

Approximately 228,400 workers were employed in the baking industry in 1978—almost 25 percent below the number employed in the peak year of 1956. With the exception of only 4 years, employment declined steadily as the industry moved toward greater concentration and the utilization of mechanized, laborsaving production techniques. From 1960 to 1967, employment fell at an average annual rate of 1.0 percent; for the years 1967-78, the rate of decline more than doubled. Overall, from 1960 to 1978, employment fell 1.6 percent annually or a total of 24.1 percent.

The outlook is for a decline in employment by 1990. According to BLS projections,² the rate of decline from 1978 to 1990 will be roughly half the 1960-78 rate (chart 2).

Production workers accounted for about 58 percent of all employees in 1978, and their share of the total has not changed significantly since 1960. In all manufacturing, production workers accounted for about 75 percent of all employees. Extensive use of driver-salesworkers—a practice not common to other industries—contributed to the high proportion of nonproduction personnel.

In 1978, women accounted for almost 27 percent of industry employees (having increased gradually from about 24 percent in 1960) compared with 30 percent in all manufacturing. But the two sectors of the industry differed significantly. In cookie and cracker establishments, the proportion of women was relatively high, 47 percent of all employees, and had not changed substantially since 1960. In bread and cake plants, however, women constituted only 22 percent of the total but had increased significantly from their 1960 proportion of 18 percent. Historically, jobs held by women in both segments of the baking industry have been in the assembly or packaging operations. In cookie and cracker manufacture, these operations require proportionately more plant labor than they do in bread and cake baking. Because improved breadbaking techniques since 1960 have reduced the unit labor requirements in the stages of production in which jobs are typically held by men, the share of jobs held by women has increased.

Occupational trends

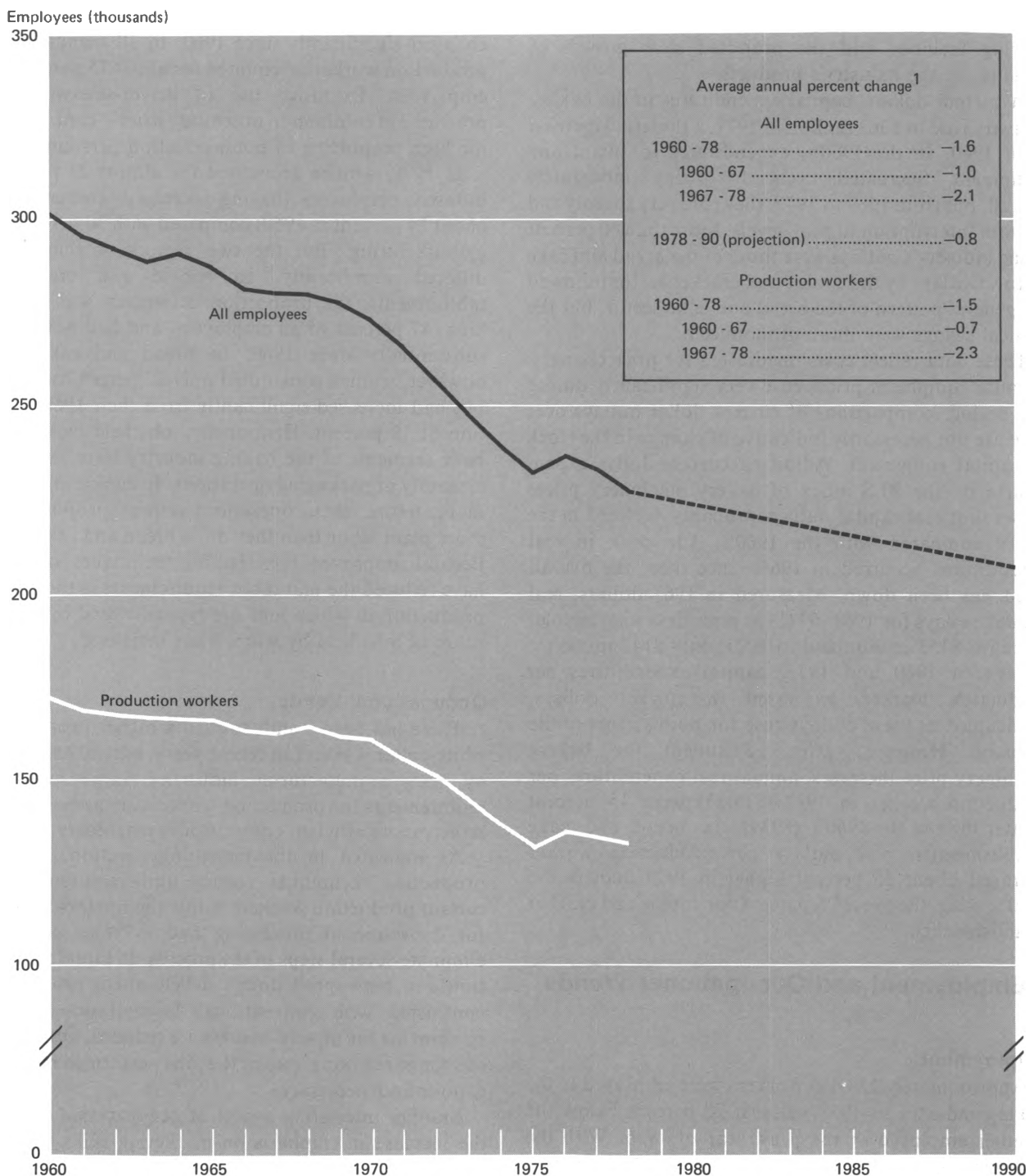
There has been a shift toward a higher proportion of white-collar workers in recent years, a trend experienced by many manufacturing industries. Lower unit labor requirements for production workers are associated with larger, more efficient conventional machinery.

As indicated in the technology section, advanced production techniques reduce unit requirements for certain production workers below the number necessary for conventional processing and in some cases may eliminate several steps in the process. In liquid fermentation and high-speed dough development processes, as contrasted with conventional fermentation, unit requirements for mixers' helpers are reduced, but the work of sponge remixing, one of the jobs performed by mixers, is no longer necessary.

Another interesting aspect of occupational change is the increase in emphasis on marketing skills. This will contribute to the growth in administrative personnel, as shown in chart 3, particularly in the breadbaking sector. Because differences in cookie and cracker products are more easily recognized, nonprice competition and

²The projected data are BLS estimates of what the economy might look like in 1990, given certain assumptions, for example, a full-employment economy (4.5-percent unemployment). For details, see *Monthly Labor Review*, April 1979, pp. 3-14.

Chart 2. Employment in the bakery products industry, 1960-78, and projection for 1978-90



¹Least squares trend method for historical data; compound interest method for projection.

Source: Bureau of Labor Statistics.

advertising have always been more important than in bread products, where the emphasis traditionally has been on gaining production advantages to permit price competition.

Job content for production workers has changed very little in recent years. Technical changes in past decades have already eliminated most of the manual processing of materials in bakery plants. Even where continuous mixing has been introduced, the duties and responsibilities of the mixers, for example, have not changed significantly. In general, no additional skills are required by the more advanced technology for production workers.

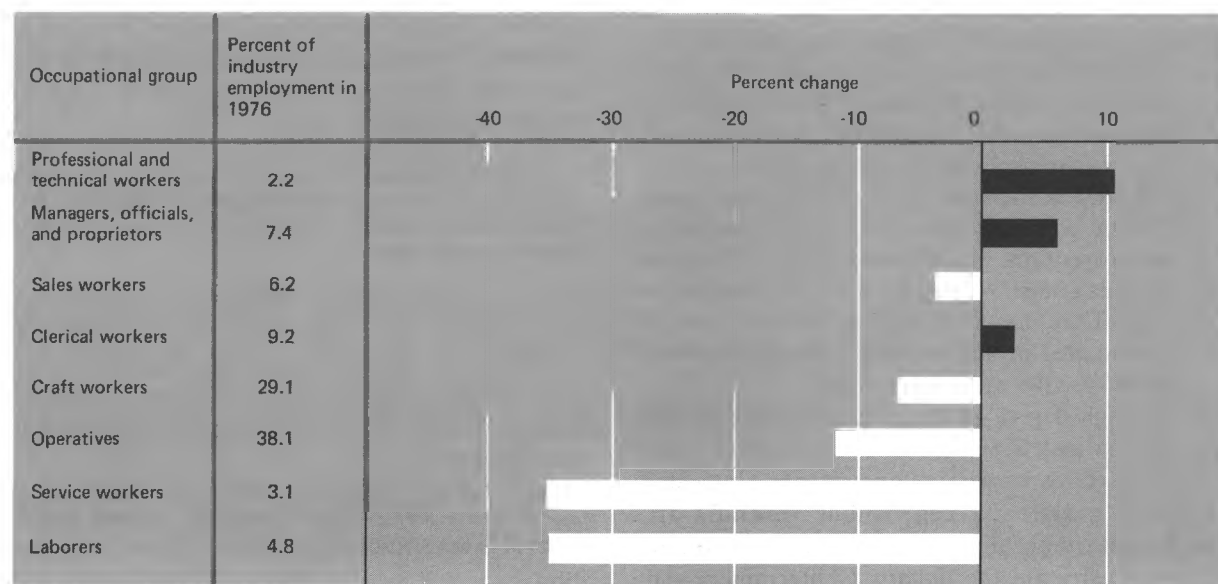
Currently, in most plants, production variables are decided in advance by supervisory personnel. The bulk of production employees in breadbaking plants are semi-skilled operatives assigned to feed materials into machines mechanically or automatically, conduct quality checks, make minor adjustments to the machinery, and monitor the machines' operation, in some cases for emergencies only. In most bakeries, unskilled beginners are known as helpers (e.g. mixer helper or oven tender helper) and may be part of an apprenticeship program. In small bakeries, all-round bakers assisted by helpers may handle all the work.

Maintenance workers and mechanics are the most skilled workers in the bakery plant, and generally the

highest paid. They make the necessary machine repairs and adjustments on plant equipment and delivery trucks. Mixers and oven operators are among the highest paid production workers. In broad terms, mixers combine the ingredients needed to make dough and oven operators monitor the ovens, adjusting temperature and timing. Mixers' duties include monitoring the flow of predetermined quantities of ingredients into the blending machines. In breadbaking, divider operators run machines that divide, round, and shape dough into loaf-size balls. Moulder operators, somewhat down the skill and pay scale, monitor machines that degas the proofed dough and form it into loaves. After baked goods cool, slicing and wrapping machine operators feed loaves of bread into the conveyers which lead to slicing and wrapping machines, or where equipment is more automated, the operators monitor the process for problems. For every occupation, the duties vary with the automaticity of the equipment.

One occupation in the breadbaking sector not common to other industries is the driver-salesworker or route driver. Because of the perishable nature of bread and cake products, store deliveries and stock rotation have to be made frequently. Historically, when retail outlets for bread were small grocery stores, the duties of the route worker included selling and promoting new items, making collections, servicing display space, and removing

Chart 3. Projected changes in employment in the bakery products industry, by occupational group, 1976-85



Source: Bureau of Labor Statistics.

stale products. However, since retail grocery sales have become concentrated in large supermarkets, the job of the route driver has changed in many areas. Product marketing and sales contracts are now usually arranged by administrative personnel. Also, the servicing of shelf space and stock rotation have increasingly become the responsibilities of store employees. Generally, the route driver is paid a base wage plus a commission for products sold. According to BLS data, route drivers made up 8 percent of the industry work force in 1976; employment projections indicate a decline in both number and proportion by 1985.

As a result of the changes in the industry, the proportion of white-collar workers has been increasing. White-collar occupations—professional and technical workers; managers, officials, and proprietors; sales workers; and clerical workers—constituted 25 percent of bakery products employment in 1976 or a rise from 22 percent in 1970. Conversely, blue-collar occupations—craft workers, operatives, laborers, and service workers—declined over this period. As is evident from chart 3, this trend will continue into the 1980's, according to the BLS projections. The workers chiefly responsible for production—craft workers and operatives—are expected to decrease in number from 1976 to 1985 but will continue to account for two-thirds of the total work force. Although laborers and service workers now constitute only 8 percent of employees in the industry, they will probably decline sharply in number and proportion by 1985.

Adjustment of workers to technological change

Programs to protect employees from the adverse effects of changes in machinery and methods of production may be incorporated into contracts or they may be informal arrangements between labor and management. In general, such programs are more prevalent and more detailed in industries and companies which negotiate formal labor-management agreements. Such contract provisions to assist workers in their adjustment to technological and associated changes may cover new wage rates, new job assignments, retraining, transfer rights, layoff procedures, and advance notice of changes planned by management, including machine changes or plant closings. They may also include various types of income maintenance programs such as supplementary unemployment benefits or severance pay.

There is a high degree of unionization in the baking industry; approximately 80 percent of the employees are covered by collective bargaining agreements. Contracts usually run 3 years, and negotiations generally are conducted on an establishment basis. The major unions in the baking industry are the Bakery, Confectionery and

Tobacco Workers International Union, the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America, the International Association of Machinists and Aerospace Workers, and the International Union of Operating Engineers.

Shielding the worker from the impact of technological change is not a central issue of the collective bargaining agreements in the baking industry. Specific reference in union contracts to new technology or changing production methods is infrequent. Provisions requiring advance notification of production changes or transfer rights for workers displaced by new machinery are present in only a few agreements. Provisions which allow renegotiations of pay rates for workers expected to absorb increased workloads because of a change in production methods are found in some union contracts—usually those covering larger plants. Of nine major contracts covering 1,000 or more workers studied by BLS, two had provisions related to increased workloads.³ One contract provided that union officials would be informed of changes in methods of manufacturing or increases in production being considered by the company. If the union claims that any change will result in more than a fair day's work for the employees involved, representatives of the union and management would be designated to confer in an effort to reach an agreement on the issue. Every contract examined contained grievance and arbitration procedures to facilitate the enforcement of contract rights.

Although unrelated to the impact of technology, one of the major issues of collective bargaining in this industry involves the hours of the workweek or temporary layoffs. As protection from marketing priorities that require sharp fluctuations in daily production, most union contracts contain provisions that govern production schedules. For example, guarantees of a full day's pay for employees reporting to work are common. The following provision is typical:

Employees required to report for work and who report for work at a regular starting time and place shall be given not less than eight (8) hours pay except where work is discontinued by mutual agreement.

Although provisions for advance notification of temporary layoffs are common, the time required for notification can vary from as long as 7 days to only a few hours. Of the nine contracts examined by BLS, two required 7 days' notice and two only notification in the previous shift.⁴

³Unpublished data. For general subject matter, see *Characteristics of Major Collective Bargaining Agreements, July 1, 1976*, Bulletin 2013 (Bureau of Labor Statistics, 1979).

⁴Ibid.

SELECTED REFERENCES

- Federal Trade Commission. *Economic Report on the Baking Industry*, 1968.
- Matz, Samuel A. *Cookie and Cracker Technology*. Westport, Conn., Avi Publishing Co., 1968.
- O'Connell, Desmond H. *Aim for a Job in the Baking Industry*. New York, Arco Publishing Co., 1971.
- Opportunities for New Machines in the Baking Industry*. New York, Frost & Sullivan, 1976.
- Pylar, Ernst John. *Baking Science and Technology*, 2d ed. Chicago, Siebel Publishing Co., 1973.
- U.S. Congress, Select Senate Committee on Nutrition and Human Needs. *Economic Organization of the Milling and Baking Industry*, 1975.
- Whiteley, Peter R. *Biscuit Manufacture: Fundamentals of In-Line Production*. London, Elsevier Publishing Co., 1971.

Chapter 2. Concrete

Technological developments in the concrete industry will only slowly reduce labor requirements and change job content through the 1980's. Diffusion of new machinery and equipment will be very slow, largely because local market areas and seasonal demand limit the need for volume output. Although some structural changes are occurring, automated, high-volume technologies will continue to be uneconomic for all but the largest manufacturers.

For purposes of analysis, the industry is divided into two parts: Concrete products (SIC 3271 and 3272) and ready-mixed concrete (SIC 3273).¹ In the concrete products sector, some technologies such as transfer systems and automatic cubers may reduce labor requirements, particularly for material handlers. In the ready-mixed sector, the changes may be primarily in job content, such as the shift in the batch operator's duties from controlling to monitoring.

Between 1960 and 1977, productivity in concrete products and ready-mixed concrete rose at an average annual rate of 3.1 percent and 1.6 percent, respectively. The more rapid productivity rate in the concrete products sector was associated with greater volume resulting from new markets, and the demise of smaller, more inefficient block plants. Productivity growth slowed in the last decade in both sectors compared with the first half of the 1960's, when construction was particularly strong.

Capital expenditures in current dollars increased more than fourfold from 1960 to 1977, at an average annual rate of 7.9 percent. Real expenditures—after adjustment for changes in the price of concrete-producing machinery and general purpose machinery—rose very sharply from 1960 to 1967 (price increases were minimal), but from 1967 to 1977 real outlays did not rise significantly as prices moved up rapidly.

Employment in the concrete industry increased from

¹The concrete industry includes establishments producing concrete products and ready-mixed concrete and excludes concrete which is produced on-site by the contractor. The industry includes SIC 3271, concrete block and brick; SIC 3272, concrete products other than block and brick (major products are precast and prestressed concrete and concrete pipe); and SIC 3273, ready-mixed concrete. In ready-mixed production, cement and aggregates are either mixed in the plant and delivered to the job site (centrally mixed) or funnelled into the truck and mixed on the way to the site (transit-mixed).

137,300 in 1960 to 159,000 in 1976 or at a rate of 1.3 percent annually. The peak year was 1973, at 180,000; a sharp drop in 1974 and 1975 reflected the very sizable decline in new construction activity. Block and brick employment declined over those 16 years, but the decline in this sector was offset by gains in employment in precasting, prestressing, and ready-mixed concrete. In 1977 and 1978, employment rose sharply to a near-record level, as construction activity recovered from the mid-decade slump.

Technology in the 1980's

Technological developments will only slowly reduce labor requirements and change job content in the concrete industry because diffusion will be slow. Several factors account for the slow diffusion, including seasonal demand for concrete and small, local markets which tend to limit volume output. Consequently, the average plant is small, and complex, high-capacity equipment is generally uneconomic.

The average plant had 16 employees in 1977. Three-quarters of the more than 10,000 establishments in the industry employed fewer than 20 workers. They accounted for about 30 percent of both employment and output in 1972 (latest data). The other, larger plants accounted for the bulk of employment and output, but, even in these plants, employment averaged only 48 workers.

Some progress has been made toward bringing about conditions which would promote the use of newer technologies, for example, the extension of construction activity and concrete manufacture to longer periods of the year and the greater standardization of building equipment.² While changes in the construction industry are basic to technological progress in the concrete industry, other problems exist such as the difficulty of transporting concrete long distances. Consequently, although the trend to larger plants may accelerate in the long run, automated, high-volume technologies will continue to be uneconomic for all but the largest manufacturers. The average plant will continue to use less complex ma-

²"Prestressed Concrete: A 20-Year Success Story Without an End," *Engineering News-Record*, Sept. 28, 1972, p. 33.

Table 1. Major technology changes in the concrete industry

Technology	Description	Labor implications	Diffusion
Improved material handling equipment	Transfer cars, conveyors, or platforms move blocks or pipes inside plant; cuber stacks blocks without manual assistance.	Eliminates need for forklift operators inside plant and a worker to operate the cuber.	In use in about 25 percent of plants in industry; use increasing.
Improved casting methods	Use of higher capacity block machines, specialty precasting machines, improved extruders and mobile casting beds for prestressed concrete.	Reduces unit requirements for block and prestressed concrete workers; specialty precasting machine eliminates need for hand casters.	Diffusion dependent on strength of demand but limited to larger plants.
Hot concrete, hot oil, and autoclave methods of curing	Hot concrete process is the preheating of concrete so that forms can be stripped more quickly; hot oil method replaces conventional steam curing; autoclaving uses high-temperature, high-pressure steam.	No need for fireman to attend hot water boiler when hot oil is used; other methods save unit labor by reducing curing time.	Hot oil becoming widespread; hot concrete in limited use in United States; autoclaving used for about 25 percent of all blocks. Slow diffusion expected.
Automatic batchers	Electronically select, weigh, and proportion aggregates and cement for different mix designs. Quality of concrete is improved.	Operator's duties change from control to monitoring.	Used by about 10 percent of plants in industry. Diffusion to smaller plants unlikely.
Larger mixing-truck capacity	Larger capacity allows truck to carry more concrete to job site.	Jobs can be completed more quickly with fewer driver hours.	Many trucks at maximum permitted by law, but older, smaller trucks will be replaced.

chinery such as semiautomatic methods of batching and cubing.

This study analyzes the most recent technological changes in the industry. Their diffusion and their impact on labor are presented in the following pages and are summarized in table 1.

Material handling equipment

Technological change will improve material handling, a major part of concrete products manufacture. The most highly mechanized plants in the industry are using transfer systems to move newly cast concrete through a number of different operations inside the plant. Transfer systems range from simple conveyor belts to more sophisticated rack transfer cars or mobile platforms. They are used most often for the production of blocks, but they are also used in pipe manufacture and in the production of smaller precast concrete products.

These material handling techniques reduce requirements for forklift operators who move concrete products from one operation to another inside the plant. The plant's machine operator can control the transfer system in addition to his other duties since only minimal control is necessary.

In conjunction with transfer systems, automatic cubers are also used by the largest block plants in place of manual or semiautomatic methods. The automatic cuber has a pair of arms which arranges blocks in the proper pattern and then stacks them. This is an improvement over the semiautomatic cubing process which requires a worker to arrange the blocks before the machine stacks them. The automatic cuber requires only periodic supervision, in place of one full-time semiskilled employee for a semiautomatic cuber and four unskilled employees for the manual process.³ The automatic cuber is periodically

³Special Concretes, Mortars and Products, (Skokie, Ill., Portland Cement Association, 1975), p. 26.

supervised by the plant's machine operator.

While only a few employees are affected by the use of transfer systems and automatic cubers, the relative labor reduction can be very substantial. In one case, for example, the use of a block transfer system and an automatic cuber reduced the labor force inside the plant by half. About 25 percent of all block plants utilized transfer systems and automatic cubers in 1974.⁴ Since the remaining 75 percent are relatively smaller plants, diffusion is likely to be limited. The impact of these systems on industry productivity will increase, however, if smaller plants continue to leave the industry, as one industry expert expects.⁵

Improved casting methods

Casting methods are being improved for blocks, specially designed precast shapes, concrete panels, and for more standard prestressed products such as hollow-core slab. The industry is adopting some of these new methods when it is economically feasible to do so.

Larger capacity block casting machines will increase productivity in concrete products manufacturing. The new machines can produce 1,200–1,600 standard 8-inch units per hour⁶ compared with about 1,000 units per hour with average machinery in the 1960's. Unit labor requirements decrease with the use of a high-capacity block machine since it does not require a larger crew than does a smaller machine. But, as would be expected, the use of high-capacity block machines is limited to large producers of block.

⁴Gordon F. Jensen, *Industrial Energy Study of the Concrete, Gypsum and Plaster Products Industry* (Palo Alto, Stanford Research Institute, 1974), p. 2.

⁵J. Bell, *From the Carriage Age to the Space Age*, (Arlington, Va., National Concrete Masonry Association, 1970), p. 166.

Concrete Industries Yearbook 1975/76 (Chicago, Pit and Quarry Publisher), p. 106.

On the other hand, machines which produce specially designed precast shapes are expected to be used more widely.⁷ The use of these machines in place of the manual process eliminates the need for casters. One producer of concrete curb units, for example, changed from a manual process to the use of a new molding machine and doubled production using only half the labor formerly required.⁸

The casting of prestressed concrete is also being improved. (Prestressed concrete is concrete in which steel strands, tensioned by hydraulic jacks, are embedded to increase tensile strength.) The casting of hollow-cored slab, one of the most common prestressed concrete products, has been accelerated by the replacement of electric motors with hydraulic drives in some extruding machines. According to one manufacturer of extruding equipment, hollow-cored slab can be extruded at speeds of about 12 feet per minute compared with about 8 feet per minute in the 1960's.

Hollow-cored slab can also be made on mobile beds which move under stationary equipment, just the reverse of the extrusion process. This system, which has been used in Europe for a number of years, has recently been introduced to American industry and is reportedly very productive. One manufacturer of mobile beds, for example, claims that production can be increased more than 50 percent above the more conventional extrusion process.⁹

When a mobile casting bed system is used, there is no need for an extruding machine operator, but the system must be controlled by a skilled worker from a control panel. Some plants which use mobile casting beds do not need an overhead crane and operator which are required for other methods of manufacturing hollow-cored slab.

The diffusion of mobile casting beds in the United States has been very slow. Only four plants had adopted the system by 1975 largely because of the high cost of the equipment and the fact that many producers do not have a large enough market area to need such a system.¹⁰ This is an example, not uncommon in this industry, of a very productive technology which cannot be used economically.

Curing technologies

Changes in curing methods (heating the concrete after it is cast so it will harden and become stable in volume) will also affect productivity in concrete products manufacture. However, some of the more productive methods are not being widely adopted because the seasonal demand for concrete permits the use of slower curing methods in slack periods. High energy costs will also

restrict the use of fast but energy-intensive curing systems.

Hot oil is one of the more important methods of curing in many prestressing operations. With this type of system, hot oil is pumped under the length of the casting bed, providing heat by conduction. Hot oil systems are replacing hot water and steam systems because hot oil is easier to control than steam and is capable of retaining the heat longer than a hot water system. Moreover, there is no need for a tending fireman.¹¹

For blocks and other small precast products, high pressure steam (autoclave curing) is the most technologically advanced system. When this system is used, blocks are either placed directly in the autoclave for high-pressure, high-temperature curing (one-stage curing) or are permitted to harden for a short time and then are placed in the autoclave (two-stage curing). One-stage autoclave curing can be completed in 12 hours and two-stage curing can be completed in 8 hours.¹² This compares with curing times of between 24 and 48 hours for more conventional low-pressure steam systems.¹³

"Hot concrete" is a new process which speeds the curing of precast products. This method, used much more widely in Europe, consists of preheating the concrete in the mixer. This permits the concrete to harden much more quickly after it is cast than concrete produced conventionally. In some applications, curing is completed in one half of the normal time, saving labor per unit of output.

In spite of the advantages of these systems, autoclave curing is used for only about 25 percent of all blocks and the use of "hot concrete" is even more limited. Because of the extensive slack period each year, the process of curing blocks with older, less productive methods and allowing them to "yard cure" (the blocks finish curing in the storage yard during the slack months) is widespread.

Automatic batchers

A major technological advance in the concrete industry is the completely automatic batcher. It can be used by any concrete manufacturer but is used most often for the manufacture of ready-mixed concrete, where different mixes are usually demanded on a daily basis. Its major advantages are improved quality control and greater flexibility. Nevertheless, less than 10 percent of the plants in the ready-mixed concrete sector have completely automatic batchers, and about 50 percent still batch manually. Because of the limited market area that a manufacturer supplies, the use of an automatic batcher may not be economically justifiable. The radius of shipment averages about 50 miles, and volume output tends to be limited.

When the automatic batcher is used, labor requirements do not change, but the function of the operator is simplified. Automatic batchers electronically select, weigh, and proportion required amounts of

⁷Ibid., p. 108.

⁸"Rhode Island Precaster Automates Curb Production with New Molding Machine," *Modern Concrete*, Feb. 1973, p. 32.

⁹Ralph Ironman, "Movable-Mold System Offers Big Advantages," *Concrete Products*, Oct. 1975, p. 37.

¹⁰William J. Blaha, "Stresscon 'Rolls' in Central Florida," *Concrete Products*, Aug. 1976, p. 15.

¹¹*Concrete Industries Yearbook*, p. 191.

¹²Ibid.

¹³*Special Concretes, Mortars and Products*, p. 285.

aggregates and cement for a particular mix of concrete. The operator simply activates the batcher and supervises its operation. The process is terminated without manual assistance. In addition, manual data-logging to record raw materials, batching time, and truck identification is greatly reduced.

The automatic batcher is a significant improvement over the manual system in which the operator must weigh each ingredient separately and cut the operation off when the proper amounts have been added. It is also an improvement over the semiautomatic batching system, which is self-terminating but which must be activated by the operator for the weighing of each ingredient.

The most recent improvements to batchers include the incorporation of a computer and, in some cases, a teletype printer into the system. Computers can store thousands of mix designs, and teletype printers keep accurate records of inventory. These types of systems, however, are only used by the largest plants.

Larger mixing-truck capacity

The increased capacity of ready-mixed concrete trucks—in which mixing takes place on the way to the site—has been the major source of productivity gains in this component of the industry. Larger capacity has

allowed ready-mixed concrete manufacturers to carry more concrete in each truck and complete a job with fewer driver hours. According to the National Ready-Mixed Concrete Association (NRMCA), the average volume of a mixer in the early 1960's was 7 cubic yards. By the early 1970's, this had increased to 8.5 cubic yards.¹⁴

Larger truck-mixer capacity will be less significant in bringing about future productivity gains, however. The average size may continue to move up slightly as smaller, older trucks are retired, but most trucks have reached maximum weight restrictions permitted by State law. Since truck-mixing concrete accounts for about three-fourths of total ready-mixed production, the smaller potential for productivity growth in this area is significant.

Production and Productivity Outlook

Output

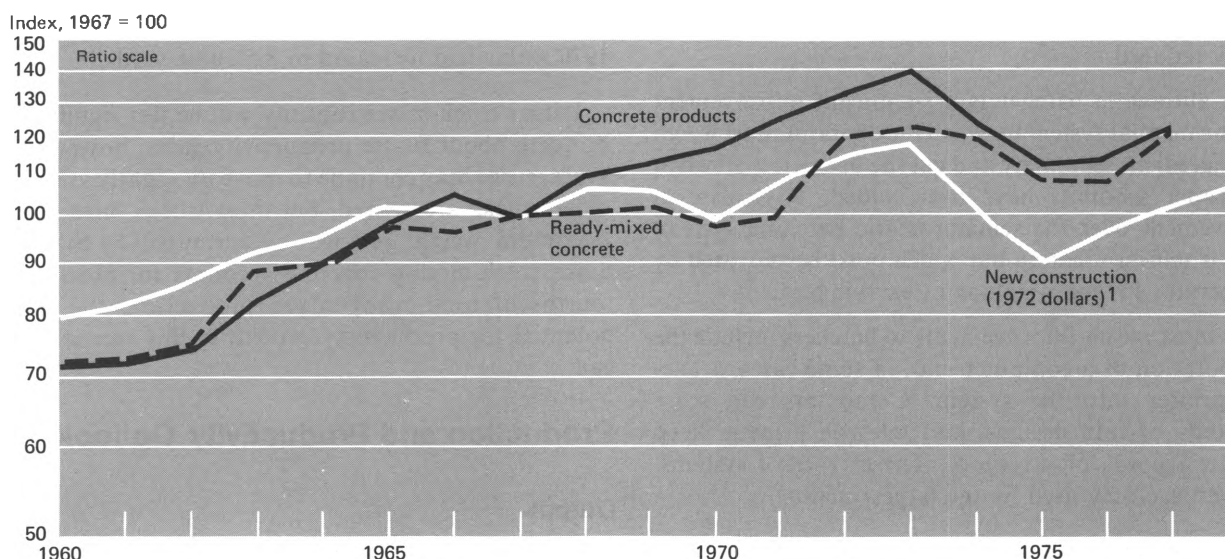
Output of concrete products and ready-mixed concrete

¹⁴Robert S. Robinowitz and Martha Farnsworth Riche, "Productivity in the Ready-Mixed Concrete Industry," *Monthly Labor Review*, May 1973, p. 13.



Automatic batching in which aggregates and cement are automatically selected and weighed to meet required specification.

Chart 4. Concrete industry output and construction activity, 1960-78



increased at an average annual rate of 3.5 percent and 2.8 percent, respectively, from 1960 to 1977 compared with 3.5 percent for all manufacturing.¹⁵ In the products sector, output grew rapidly through most of that period with the exception of some decline in 1967 and a very sharp drop in 1974-75. While demand for ready-mixed was as strong as for concrete products until the mid-1960's, it has not risen as rapidly through most of the 1970's. On the other hand, ready-mixed output declined more moderately in 1974-75 (chart 4).

Although more recent output data are not available, concrete production trends can be estimated from the pattern of construction activity, as shown in chart 4. As is evident from the chart, concrete output in general reflects construction activity. Judging from the construction recovery in recent years, concrete output appears to have increased to the levels of the early 1970's. The outlook is for continued high output through the mid-1980's.

The association of construction activity with output of concrete products was particularly close through the late

1960's. However, from 1969 to 1973, the rise in concrete products output far outdistanced the increase in construction activity. During that time, precast and prestressed concrete replaced alternative building materials such as structural steel and timber. The increase in use of precast and prestressed concrete in the late 1960's was dramatic.

Prestressed and precast concrete offer certain advantages over other building materials. Buildings made with prestressed concrete do not require a structural steel frame, and buildings made with precast concrete do not require extensive onsite fabrication. As a result, assembly time is rapid and great quantities of onsite labor are not needed.

Productivity

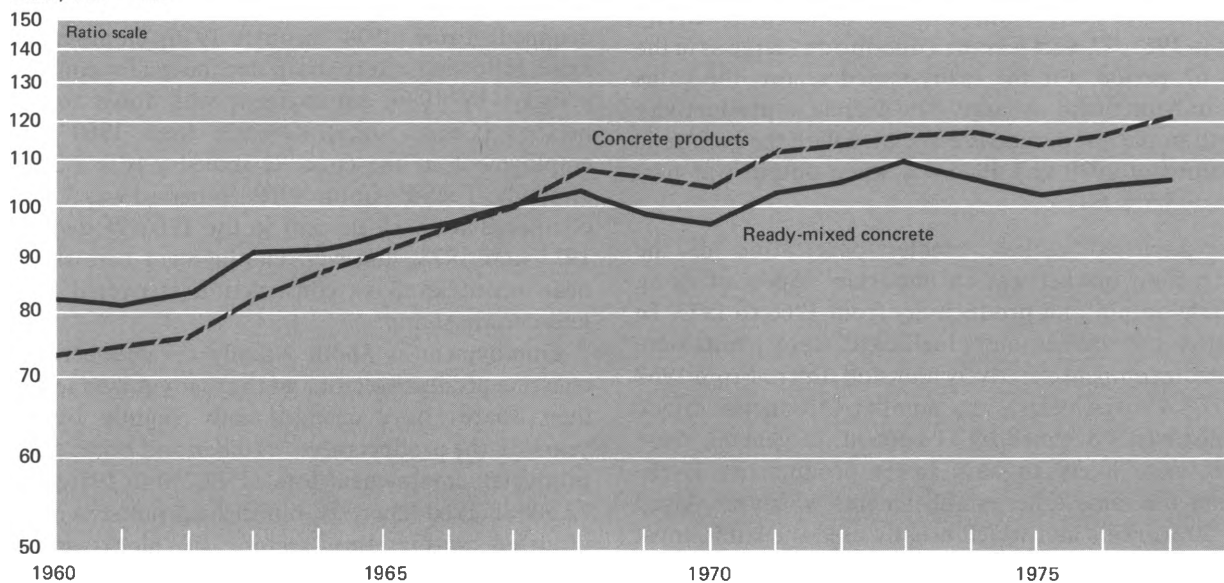
Productivity in the concrete products and ready-mixed concrete sectors increased at average annual rates of 3.1 percent and 1.6 percent, respectively, from 1960 to 1977 compared with 2.6 percent for all manufacturing.¹⁶ The higher productivity growth rate of products compared

¹⁵BLS output data which exclude onsite production by contractors are based on Census value of shipments and BLS industry price data.

¹⁶For information on productivity measurement, see *BLS Handbook of Methods*, Bulletin 1910 (Bureau of Labor Statistics, 1976), ch. 31.

Chart 5. Output per employee hour in the concrete industry, 1960-77

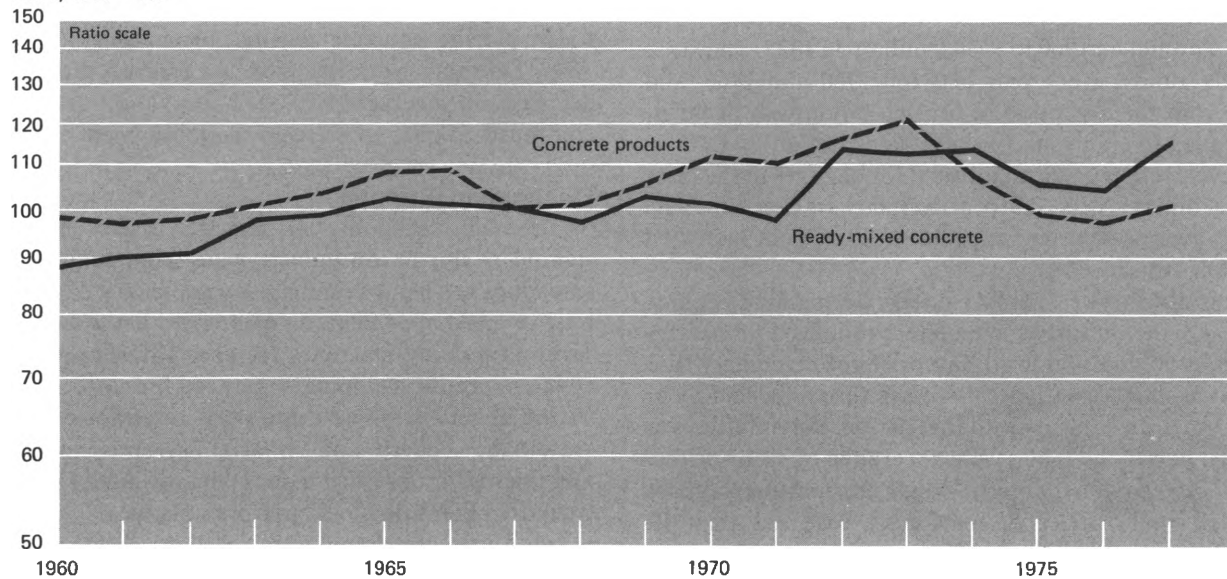
Index, 1967 = 100



Source: Bureau of Labor Statistics.

Chart 6. Employee hours in the concrete industry, 1960-77

Index, 1967 = 100



Source: Bureau of Labor Statistics.

with ready-mixed was associated with a more rapid output growth and a comparatively slower hours growth in the former sector than in the latter, particularly in the 1960–66 period (charts 4–6).

For the products sector, average annual productivity gains in 1967–77 were less than one-third as large as in the 1960–67 period; for the ready-mixed sector, the gains were only one-fifth as large. The decline in productivity growth in the last decade is associated with the economic recessions of 1970 and 1974–75, when output was particularly hard hit.

As discussed earlier, greater penetration of the construction market was an important aspect of rising concrete output and productivity from 1966 to 1973. In addition, the smaller, more inefficient block plants were unable to compete effectively and shut down. From 1967 to 1977 (census years), the number of concrete block establishments declined by 21 percent. In general, these plants were likely to have lower productivity levels. During the same time, establishments which employed over 20 workers and which usually used the latest, most efficient equipment increased from just under 22 percent to about 27 percent of the total.

Capital expenditures

In general, capital outlays in the concrete industry are limited because firms are small. This applies particularly to outlays for research and development. As is common in many such industries, the manufacturers rely heavily on equipment manufacturers for information on technological developments.

Nevertheless, dollar outlays for new plant and equipment increased more than fourfold from 1960 to 1977, at an average annual rate of 7.9 percent, from \$127.4 million in 1960 to \$554.9 million in 1977. They rose rapidly almost every year between 1960 and 1966, and then, with the exception of four recession-year declines, continued to climb sharply. These current-dollar figures, however, reflect costs unadjusted for changes in the price of machinery. Very sharp price increases since the late 1960's suggest that real expenditures have not increased significantly since then.

From 1967 to 1977, dollar outlays for plant and equipment by the industry, concrete products and ready-mixed, more than doubled, but prices of machinery rose almost as much, so that real outlays rose only slightly in those years. In contrast with that period, dollar outlays in the first half of the 1960's were not eroded by rising prices. From 1960 to 1967, current-dollar expenditures almost doubled while prices of machinery rose less than 10 percent.

Employment and Occupational Trends

Employment trends

In line with the expansion of new construction, concrete industry employment (block, brick, and other

products and ready-mixed concrete) increased sharply from 1960, when 137,300 persons were employed, to 1973, when employment peaked at 180,000. The only significant exception in employment growth in that period occurred in 1967, when construction activity dropped. From 1974 through 1976, employment fell again following a very sharp decline in new construction activity; by 1976, employment was down to 159,000 persons (Census data). Overall, from 1960 to 1976, employment in the concrete industry rose 1.3 percent annually. The rate in the 1960–66 period was 3.1 percent compared with 0.9 percent in the 1966–76 decade.¹⁷ In 1977 and 1978, however, employment rose sharply to near-record levels as construction recovered from the mid-decade slump.

Employment is about equally divided between the concrete products sector and the ready-mixed sector, and their shares have changed only slightly over those years. In the products sector, (block and brick, and other products), employment totaled 77,200 in 1976, up from 72,500 in 1960 (chart 7), but distinct patterns of growth occurred within this sector. In block and brick manufacture, employment declined in 10 of the 16 years—averaging a drop of more than one-half of 1 percent annually—while in products other than block and brick (primarily precast and prestressed), employment rose every year except in periods of recession; the increase averaged 1.7 percent in those 16 years.

Similarly, employment in the ready-mixed concrete sector grew at a 1.7-percent rate, from 64,800 in 1960 to 81,800 in 1976. In part this resulted from a change in construction industry work practices in the late 1960's and early 1970's.¹⁸ Contractors required concrete to be delivered early enough in the day so that employees could finish placing concrete during normal working hours. Also, Saturday work declined. As a result, there was a decrease in average weekly hours and, as demand continued to rise, an increase in employment.

Occupational trends

Although technological change is not having a significant impact on industrywide labor requirements, some jobs are being eliminated, some reduced, and some only changed in content. As mentioned in the technology section, molding machines for specially shaped precast concrete products eliminate the need for casters. Hot oil curing systems eliminate the need for trained firemen. Automatic cubers and transfer systems reduce requirements for unskilled material handlers and industrial truckdrivers inside block and pipe plants.

Job duties are changing in mechanized block plants. Where the job of material handlers has been eliminated, responsibility for the mechanized operations is being assumed by the operator of more basic machinery. In

¹⁷Census data for SIC's 3271, 2, and 3; BLS data are not available for the concrete industry.

¹⁸Robinowitz and Riche, p. 13.

Chart 7. Employment in the concrete industry, 1960-77

Employees (thousands)
200

175 —

150 —

125 —

100 —

75 —

50 —

25 —

0
1960

1965

1970

1975

Total employees

Ready-mixed concrete

Concrete products

Average annual percent change¹

Concrete products

1960-77 0.8

1960-67 2.2

1967-77 0.2

Ready-mixed concrete

1960-77 1.7

1960-67 2.5

1967-77 1.7

¹Least squares trend method.

Source: Bureau of the Census.

small plants, there may be only one operator, excluding the supervisor and outside yard workers. That operator will be responsible for overseeing all major operations performed inside the plant. These include batching, mixing, blockmaking, curing, cubing, and other handling operations.

Duties and skill requirements of the batching operator are also changing, particularly in ready-mixed plants using automatic batching equipment. As described in the technology section, the operator simply activates the machine and supervises its operation. The process is terminated without manual assistance. In addition, manual data-logging is greatly reduced. In the manual system, the operator must weigh each ingredient separately, terminate the process, and keep records.

On the other hand, skill requirements for maintenance workers are increasing in ready-mixed and concrete products plants where new technology is used. Maintenance workers become responsible for maintenance of control panels and instruments as well as machinery. However, since diffusion of new technology is expected to be slow, such changing skill requirements on an industrywide basis will be gradual.

In the ready-mixed sector of the industry, technological change is not expected to affect labor requirements significantly. Truckdrivers should be less affected by the increased payloads of ready-mixed trucks than they were in the 1960's because, as explained earlier, most trucks have reached maximum weight restrictions permitted by law. Changes in the other major occupation, batching, will also be minimal. Although the batch operator's duties change from control to monitoring with the use of the automatic batching system, the use of the automatic system is not expected to increase significantly above its current 10-percent level.

By and large, plant production workers are semiskilled and maintenance workers are skilled. However, the central batch plant operator is the most skilled worker in the plant and concrete pipe makers and blockmaking machine operators are also skilled workers.

In many concrete plants, the unskilled and semiskilled workers perform several jobs rather than being assigned just one. This is necessitated by seasonal production patterns, the nature of the work, and the characteristics of the small plant. In one plant visited by BLS, the president of the company explained that he arranges for workers to alternate jobs. One worker, for example, may be able to operate a semiautomatic cuber and a forklift. This practice becomes particularly important in the absence of a worker, in slow periods, or when new machinery reduces labor requirements for a specific job in the plant.

The BLS occupational employment survey of the concrete, gypsum, and plaster products industry (concrete accounts for 90 percent of employment) showed the following occupational distribution for the major groups in the industry in 1977: Managers and officials, 9 percent; professional and technical workers, 2 percent; produc-

tion workers, 76 percent. The other groups (sales, clerical, and service workers) accounted for relatively small shares of the total.¹⁹

The largest occupations in 1977 were truckdrivers, with 26 percent of the employment total; industrial truck operators, 37 percent; and automotive mechanics, 3 percent.

Adjustment of workers to technological change

Assistance to workers in their adjustment to technological change varies depending on the industry and the union. Programs to protect the worker from the adverse affects of changes in machinery and methods may be incorporated into union contracts or they may be informal arrangements between labor and management. Adjustments to new technologies may relate to the workers' involvement through advance notice or knowledge of workload changes, with possibilities of retraining or transfer based on seniority rights. Where severance is a possibility, seniority may be particularly important. Aid in adjustment to layoff may include various types of income maintenance such as supplementary unemployment benefits or severance pay. In general, these provisions are more prevalent and more detailed in formal labor-management contracts.

The extent of unionization differs in the two major sectors of the concrete industry. While a majority of workers are unionized in the ready-mixed sector, substantially less than 50 percent of the workers engaged in the production of concrete products are unionized. The two major unions (agreements cover 1,000 employees or more) are the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America, which covers the ready-mixed sector, and the Laborers' International Union of North America, which represents employees in the concrete products sector. To a lesser degree, about 12 other unions represent workers in the concrete products sector. Unionization is not more widespread in part because the industry is made up of small firms which are difficult to organize. In addition, prestressed concrete manufacturing is a relatively new part of the industry in which labor organization is still developing.

The contract provisions which help the worker adjust to change are not specifically tied to technology. These provisions include seniority and advance notice. In general, seniority provisions are standard in nature, but the length of time required for advance notice in most cases is minimal. In several Teamsters' contracts, severance pay is provided.

Provisions related specifically to technology are not common in these contracts. For example, workload

¹⁹Unpublished preliminary data from the BLS Occupational Employment Statistics survey of the manufacturing sector conducted in May 1977. For earlier data, collected in 1971, see *Occupational Employment: Concrete, Gypsum, and Plaster Products Industry, April 1971*, Report 430-39 (Bureau of Labor Statistics, September 1974).

adjustments, transfer rights, retraining, and similar measures are relatively few. Nevertheless, unwritten agreements between management and labor may exist,

either in unionized or nonunionized plants, and the formal provisions discussed above are not assumed to be the only agreements.

SELECTED REFERENCES

Concrete Industries Yearbook. Chicago, Pit and Quarry Publisher, annual.

Jensen, Gordon F. *Industrial Energy Study of the Concrete, Gypsum and Plaster Products Industry*. Palo Alto, Stanford Research Institute, August 1974.

"Prestressed Concrete: A 20-Year Success Story Without an End," *Engineering News-Record*, September 28, 1972, pp. 28-58.

Robinowitz, Robert S., and Martha Farnsworth Riche. "Productivity in the Ready-Mixed Concrete Industry," *Monthly Labor Review*, May 1973, pp. 12-15.

Chapter 3. Air Transportation

Summary

Air transportation,¹ one of the Nation's fastest growing industries in the last several decades, has also been among the most advanced in the adoption of technological innovations. Because of the rapid growth which accompanied these changes, technological progress took place without reduction in total employment. Over the next decade, technological development will be evolutionary, rather than revolutionary, and aimed primarily at lowering maintenance and fuel costs, meeting environmental requirements, and improving reliability.

At the same time, the Cargo and Airline Deregulation Acts of 1977 and 1978 have ushered in an era of intense competition requiring the highest productivity performance. Consequent emphasis on laborsaving technologies and processes is expected. Reappraisal by airlines of their competitive strengths could alter industry structure and traffic patterns and substantially affect productivity and labor. Although opinions differ on long-term implications for productivity and employment, it is generally believed that expanding airline traffic will offset reductions in unit labor requirements. The new legislation will end the Civil Aeronautics Board's power over routes and fares by 1983 and abolish the agency by 1985, ending 40 years of Federal regulation.

This study will deal primarily with the private sector air transportation industry; data on output and productivity cover certificated air carriers only. The following are not included in this study: General aviation; government sectors involved in air transport regulation or research such as the National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA); and industries manufacturing air transports, engines, or other equipment.

Productivity for certificated carriers (as measured by revenue passenger-miles, freight ton-miles, express ton-miles and U.S. and foreign mail ton-miles per employee),

showed a rapid growth of 6.5 percent annually between 1960 and 1977 compared with 2.6 percent in all transportation and 1.4 percent in the private nonfarm sector. If air traffic, spurred by deregulation, continues to climb, it is likely that productivity growth will be strong in the 1980's.

Employment in air transportation, which includes terminal services, rose to a high of 396,000 in 1978, having increased at an average annual rate of 4.7 percent from 1960. Except for three recession years, employment climbed upward as passenger and cargo traffic outpaced productivity growth. In the 10-year period 1967-77, however, the annual rate was only 1.9 percent. The outlook is for a more rapid rise, according to BLS projections, with a growth rate of 2.2 percent annually from 1977 to 1990.

Technology in the 1980's

Current developments in air transport technology are directed toward improving reliability and fuel efficiency and reducing pollution levels. In particular, special effort will be concentrated in the next decade in developing a more sophisticated air control system. Containerization, the principal technological innovation in air freight handling, is widespread among major carriers, but smaller carriers do not find the system economically feasible.

Productivity gains will be achieved through the use of larger than average planes with low-maintenance turbofan engines; expansion of more efficient passenger processing; and digital electronic systems to assist in traffic control. The application or extension of many of these technologies could reduce unit labor requirements for maintenance personnel, controllers, and reservation and ticket agents. However, anticipated traffic growth in the 1980's is expected to more than offset the effects of laborsaving technologies. The effect of deregulation on technology application or utilization is not yet clear, however, particularly in the long run, and will not be addressed directly in this section.

Technological research, development, and implementation in the air transportation industry are products of private and public organizations. In particular, NASA and the FAA play basic roles in these processes.

The FAA, with authority to regulate in the interest of

¹Standard Industrial Classification (SIC) 45, the Transportation by Air Industry, includes establishments engaged in furnishing domestic and foreign transportation by certificated and noncertificated air carriers and also those operating airports and flying fields and furnishing terminal services. The technology, employment, and occupations sections of this chapter cover SIC 45, while output and productivity measures are for certificated air carriers only (SIC 451).

aviation safety, employs two mechanisms, regulatory and operational, to achieve this goal. In regulatory provisions, the FAA establishes standards for the design, performance, and maintenance of aircraft, aircraft engines, equipment, and instruments, and for certification of aircraft and air personnel. Their operational functions relevant to the impact of technology include procurement, installation, operation and maintenance of air navigation, communication, and surveillance facilities; installation, operation, and maintenance of the air traffic control system; and a research, engineering, and development program to assure a safe and efficient system.

This study analyzes the major technological changes in the industry. Their diffusion and impact on labor are presented in the following pages and in table 2.

Airframes and engines

Deregulation and the anticipated traffic pattern changes have spurred interest in small and medium-sized planes. Small planes seating 50 are expected to fill the gap between smaller commuter lines and the larger jets. Carrying sophisticated navigational equipment, such planes could be used efficiently for short trips between small cities or between small cities and major airports. This could increase industry employment.

The biggest thrust is currently in the medium-sized plane carrying 180–220 passengers. This new generation of wide-bodied, medium-range jets with improved turbofan engines will be placed in service in the early 1980's. Incorporating technology developed over the last decade such as advanced wing designs, specialized composite material structures, and high-bypass-ratio engines, these planes are reported to be more reliable, more energy efficient, quieter, and less polluting.

This medium-sized plane is expected to increase productivity for the middle-range flights, and it is likely that unit requirements for flight and maintenance personnel will be reduced. Productivity increases may also be associated with the competitive climate of deregulation—more efficient route structure and load management.

At the same time, redesign of engines is being undertaken. In anticipation of high capacity requirements in the 1980's and FAA's time schedule on reducing noise levels, the industry is working with manufacturers to retrofit older planes with new quieter, fuel-efficient engines.

The supersonic transport (SST), which in 1965 was expected to revolutionize air transportation in the 1970's, has not had the expected impact. Nor is it likely to play an important role in the near future. The first



Mechanics doing maintenance on engine of wide-body jet. These engines produce more thrust with lower fuel consumption per pound of thrust by using new powerplant technology.

generation of SSTs—only 10 are in operation—has problems of payload capacity, range, and, above all, noise and pollution. At 1,400 miles per hour, these planes can travel 3,500 miles without refueling. But they carry only about 125 passengers and consume about three times as much fuel per passenger mile as the fastest subsonic transports, which can carry several times as many passengers for up to 6,000 miles.

Fuel efficiency will be of growing concern as fuel costs rise. Already, considerable savings have been realized. Between 1973 and 1978, the number of passengers flown per gallon increased nearly 40 percent. According to the Air Transport Association, this was due to more efficient aircraft and reduction in jet cruising speed.

Advances in navigation

Sophisticated navigational aids to increase productivity and safety are being developed, implemented, and evaluated. Since the most critical phase of flight is probably the approach and landing operation (about 40 percent of accidents occur at that time), high priority is being given to this area.

The Microwave Landing System (MLS) was selected in 1978 as the international standard for eventual replacement of the Instrument Landing System (ILS). Utilizing advanced electronics, the MLS requires a coordinated program of airborne equipment and ground station installation. Although the MLS will make possible more reliable landing guidance, is more efficient, and is easier to install and maintain, the transition to MLS will be gradual. ILS will remain the dominant landing system for several years as new ILS's with solid-state systems replace older tube-type ILS's in locations which do not justify the use of the MLS. The FAA expects that conversion to MLS will be "well on its way by the mid-1980's."²

Improved surveillance and separation assurance

As part of the overall air traffic control system, the FAA is developing and testing DABS, the Discrete Address Beacon System for improved surveillance, and the DABS data link for improved air-ground communications. Since the voice system currently in use is not adequate in many situations, the DABS data link system is being considered to assure improved surveillance and to be part of a collision avoidance system (CAS) called Automatic Traffic Advisory and Resolution Service (ATARS). The ATARS under development will provide information via the DABS data link on traffic within its coverage, and will, if needed, automatically transmit conflict resolution instructions, as a check on the basic air traffic control system. The Beacon (CAS) would provide information on collision avoidance, principally outside

the surveillance system, and act as a backup within surveillance areas.

Also, the data link system would be useful in transferring information on weather automatically by digital, visual, or aural means (inadequate weather information is one of the major causes of air accidents), and for more routine communications to the pilot of aircraft with digital equipment. These digital systems are considered by the FAA to be critical to the evolution of a more efficient automated traffic control system. To accomplish this objective, it is expected that the current computer system will require enhancement or replacement in the late 1980's.

In view of expected traffic growth by 1990 and the subsequent heavy demand on controllers, such automatic systems are believed to be essential for safety. If implemented, the reduction in unit requirements for controllers would be more than offset by increased traffic.

Developments in traffic flow

The traffic control system is now manual, i.e., controllers monitor and guide pilots by voice from control centers and terminals. If traffic continues to grow as expected, however, twice as many controllers will be required in the 1990's, and the subsequent complications in air traffic control could greatly decrease safety. To increase productivity and safety, it is believed that automated systems will have to be used.

Improvements in traffic flow are being developed which will probably be implemented in the 1980's. Examples of such improvements to the system are ETABS (Enroute Tabular Display System) and TIPS (Terminal Information Processing System). These are designed to increase controller productivity and overall flight productivity by reducing or automating some of the controller's functions and increasing airspace and airport capacity utilization. TIPS, for example, will accept, process, distribute, and display flight and other data in terminal control facilities and towers.

In addition, several important advances are still in the design stage and would follow the implementation of DABS. These include continuous control systems such as AERA (Automated Enroute Air Traffic Control), and cockpit display systems which will give the pilot more control. Such systems, which are expected to be implemented in the 1990's, would also increase controller productivity and overall flight productivity.

These automation aids are, however, still controversial. Questions remain in regard to the function of the controller in this system, the impersonal aspect of visual compared to voice information, and the tie-in of these aids to future air traffic control systems in view of anticipated traffic growth and limited airspace.

Automating airport terminal services

The speed and efficiency of passenger processing will become particularly important in the 1980's, in view of the

²Statement of Langhorne Bond, Administrator of the Federal Aviation Administration, before the House Committee on Science and Technology, Subcommittee on Transportation, Aviation and Weather, Sept. 12, 1978, p. 4.

Table 2. Major technology changes in air transportation

Technology	Description	Labor implications	Diffusion
Developments in fuel-efficient airframes and engines	New generation fuel-efficient, medium-size, medium-range jets with improved turbofan engines.	Reduce unit requirements for maintenance.	Will be in use in the early 1980's; expected to be widely adopted.
Advances in navigation aids	Microwave Landing System (MLS) utilizing advanced electronics; makes possible more reliable landing guidance.	Increases airport capacity-utilization; improves flight productivity.	Gradual implementation through the 1980's.
Developments in surveillance and separation assurance systems	Development by the FAA of Discrete Address Beacon System (DABS) surveillance and data link system providing improved surveillance, air traffic control communications, and collision avoidance. Beacon Collision Avoidance System (BCAS) would provide information on collision avoidance outside surveillance areas, and a backup within.	Provides basis for automating controller functions; possible increase in pilot control with subsequent reduction in involvement of controller.	Currently in development and testing by FAA; expected to be implemented in the 1980's.
Developments in traffic flow	Automated aids to pilot and controller to increase efficiency of traffic flow.	Increase controller efficiency.	Should be implemented in the 1980's.
Automated airport terminal services	Several systems designed to reduce ticketing time, e.g., scanning machines at terminal confirm reservations and issue tickets; can be operated by credit card.	Reduce unit requirements for reservation and ticket agents.	Diffusion limited; expected to increase in the 1980's.

expected travel growth and the limited capacity of airports. Of more immediate importance is the necessity to adopt cost-cutting procedures in the new competitive climate. With this in mind, innovative automated passenger processing procedures are being instituted which could greatly reduce unit labor requirements for terminal services, even as traffic increases. Currently, persons working in airports and terminal services constitute about 10 percent of all air transportation employment.

Computerized systems for reservation information are in general use, even for multicity itineraries involving several airlines. However, a large proportion of tickets are still issued by hand. Now, the major airlines have an automated reservation and ticketing system which greatly reduces time involved in manually issuing tickets. When the passenger arrives for the flight, the ticket agent verifies the reservation on the cathode ray tube and generates the ticket on the printer. Also, two major airlines have a more automated system which does not require a ticketing agent. The passenger can insert certain major credit cards into a scanner at the terminal which will issue the ticket automatically. At least one airline is utilizing an established "ticketron" system to expedite reservations and billing.

For baggage handling, a system is in use by at least one airline in which an encoded sticker is placed on each piece of baggage at the checking point. A laser beam scanner then reads the stickers, separates the bags, and directs them to the proper flights. More automated systems may be instituted in the next few years. For example, the passenger could deposit baggage at an unmanned check-in position where an electronic device would encode the identification number on each bag and on the boarding pass.

Although still in limited use, these and other newer systems will become more widespread in the 1980's.

Production and Productivity Outlook

Output

Industry measures for air transportation, as published by BLS, are available for certificated carriers only.³ The output index (based on data from the CAB) covers most of the certificated air transportation industry's operations, which are measured by revenue passenger-miles, freight ton-miles, express ton-miles, and U.S. and foreign mail ton-miles. Only excess baggage, subsidy, and miscellaneous sources of revenue are excluded from the computation of the index.

Continuing the pattern of the 1950's, air transportation of passengers and cargo in certificated airlines rose very sharply in the early 1960's; from 1960 to 1966, the annual growth rate averaged 15.4 percent (chart 8). After 1966, however, demand started edging off and hit a low point in the 1974-75 recession when air transportation declined for the first time in the post-World War II period. As the economy recovered in 1976, air transportation rose more than 10 percent from the year before. Because of the sharp dips in the recession years, however, air transportation

³The certificated domestic airlines account for over 90 percent of the air passengers and cargo transported annually within the United States, and over 80 percent of the employment. The certificated route air carriers hold a Certificate of Public Convenience and Necessity issued by the Civil Aeronautics Board (CAB) to conduct scheduled services over specified routes. Certificated carriers also are permitted to conduct certain nonscheduled (i.e., charter) operations. Not covered in this study are the noncertificated carriers (SIC 452), which are mostly in limited charter and air taxi service, or fixed facilities and services related to air transportation (SIC 458), i.e., airports and flying fields and airport terminal services.

growth in the decade ending in 1976 averaged only 6.4 percent annually. Overall, in the 16-year period 1960–76, the growth rate for air transportation was 11.5 percent.

Many factors will affect traffic growth in the next decade. While route and rate deregulation is stimulating demand in the short run, opinions differ as to whether competitive pressures to keep rates low will continue and whether the consumer response will remain as strong. Moreover, confidence in air safety is probably an important determinant of miles flown for optional travel. In addition, saturation in supporting air and ground facilities can limit the industry's growth in some major metropolitan areas. The cost to carriers from aircraft delays due to airport congestion is already very high.

But the major factors affecting demand—growing population, rising income, and ever-increasing interest in travel—will continue to be strong in the next decade. Moreover, the limiting factors mentioned above are being addressed by the industry by developing and implementing technologies which increase productivity and reliability. Consequently, the outlook for air transportation in the 1980's is very good. According to the Department of Transportation, passenger travel will continue to increase at a faster rate than the general economy in the 1980's. Assuming the economy remains stable, the outlook for cargo traffic should also be favorable.

Productivity

Productivity for this industry, as measured by output per employee, rose very rapidly from 1960 to 1977, roughly continuing the growth pattern of the 1950's.⁴ At the average rate of 6.5 percent annually in the 17-year period, productivity growth compared very favorably with all transportation industries (2.6 percent). The sharpest rise occurred in the 1960–66 period (following the introduction of the turbojet) when the average annual increase was over 10 percent. Even in the last decade, however, when productivity growth slowed to the lower rate of 4.4 percent, it was nevertheless more than double the rate for all manufacturing or for all transportation.

The sharp productivity growth rate in the early sixties was associated with technological changes such as the jet, which greatly increased output with only minimal employment growth. Then, starting in the late 1960's through most of the 1970's, the economy slowdown significantly reduced air transportation, and productivity growth declined markedly.

The outlook is good for strong productivity growth in the 1980's. The impetus may come from deregulation, which will probably result in route rationalization and more efficient scheduling. Also the new medium-size planes may improve load ratios in cities where the traffic

does not justify jumbo jets but has outgrown smaller planes. In the long run, deregulation may stimulate changes in demand or in the industry structure with yet unknown productivity implications.⁵

Employment and Occupational Trends

Employment in air transportation rose to a high of 396,000 in 1978, at an average annual rate of 4.7 percent from 1960. Except for three years associated with recession, 1970, 1971, and 1975, employment climbed as passenger and cargo traffic outpaced productivity growth. Reflecting the declines of those three years, the average rate of employment growth in the last decade was considerably below that of the first half of the 1960's; employment grew at 5.9 percent annually in the 1960–67 period and averaged 1.9 percent in the decade 1967–77. The 1967 high growth rate of 20 percent—the largest 1-year jump—followed the 43-day strike a year earlier of employees of the International Association of Machinists.

Of the total working in air transportation, about 90 percent are employed by air carriers. The remaining 10 percent are employed in airport and terminal services.

Women account for a relatively large proportion of employees in the air transportation industry, and their share has been increasing. In 1960 women held slightly over 20 percent of the jobs; by 1978, their share had risen to 31 percent as women workers increased more rapidly than men. A large majority of the women are flight attendants, and nearly all flight attendants are women. Most of the other women in this industry are communication, ticket, and reservation clerks. Few women are pilots, copilots, flight engineers, dispatchers, or in jobs related to maintenance, baggage handling, or cargo operations.

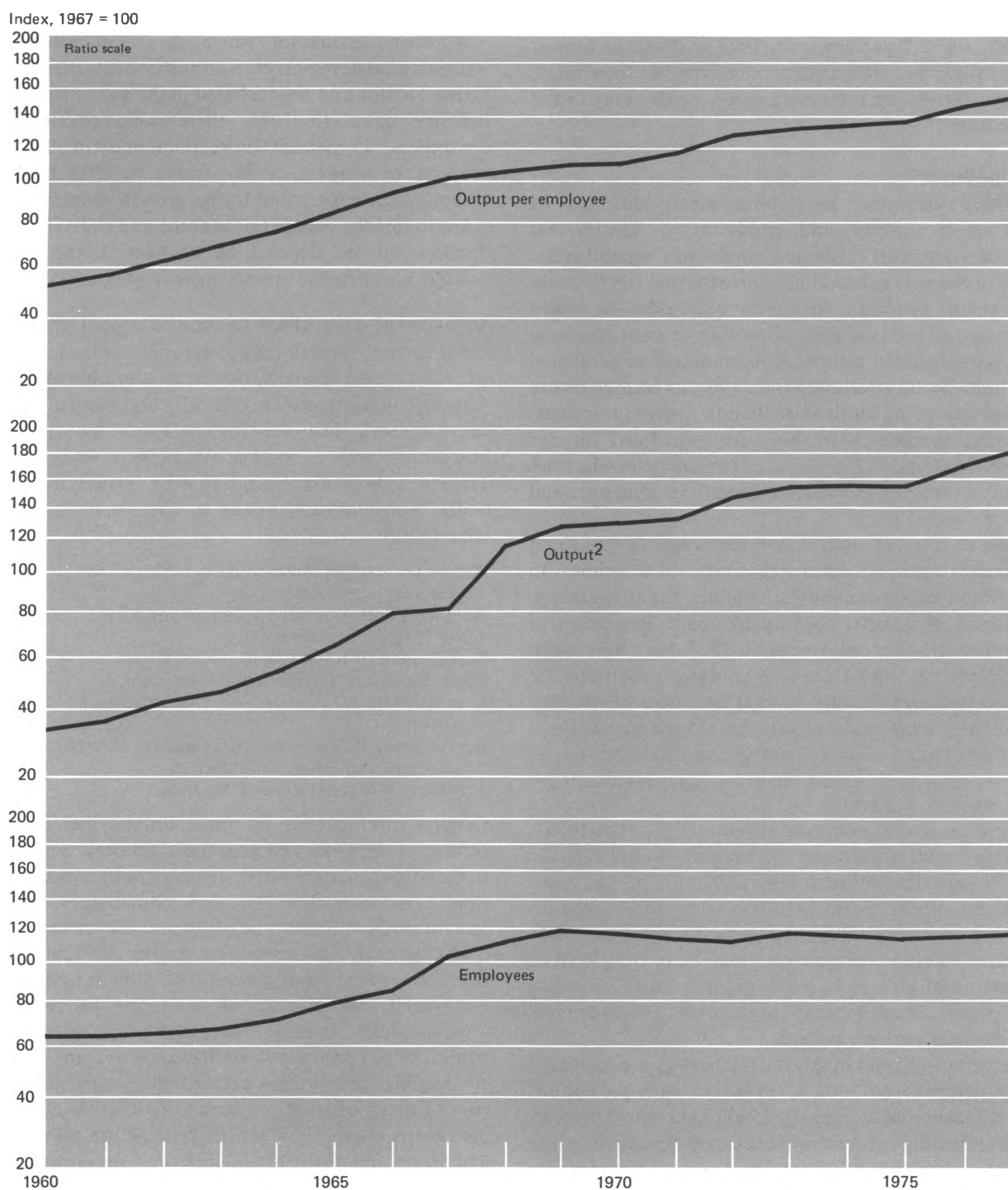
Because the industry cannot stockpile its product, employment is particularly sensitive to fluctuations in demand. Moreover, labor constitutes about 40 percent of total costs. A pronounced business recession may, as it did in 1970–71, cause up to 10 percent of the work force to be furloughed in some airlines, although such furloughs are mostly of short duration.

The effect of deregulation on employment in the 1980's is not clear. Deregulation may continue to stimulate extra traffic, which could require more labor. Employment could increase as regional carriers using smaller planes move in to replace or supplement long haul, major carrier service. But, in the view of one union official, the likelihood is that, in the long run, people will get used to lower fares or that rates will rise and people will no longer respond with extra travel. Other unknowns include

⁵It should be noted that several of the technological developments discussed earlier which could reduce requirements for controllers would not be reflected directly in airline productivity data. The labor productivity data cited do not include hours of controllers since controllers are Federal and not airline employees. Nevertheless, their greater efficiency could increase airspace and airport capacity utilization and thereby overall flight productivity.

⁴The index of output per employee for the air transportation industry (SIC 4511) was developed in accordance with concepts and procedures described in chapter 31, "Output Per Employee-Hour Measures: Industries and the Federal Government," *BLS Handbook of Methods*, Bulletin 1910, 1976.

**Chart 8. Output per employee and related data,
air transportation,¹ 1960-77**



¹Covers SIC 4511, which includes domestic and international/territorial operations, both scheduled and nonscheduled.

²Measured by revenue/passenger-miles, freight ton-miles, express ton-miles, and U.S. and foreign mail ton-miles.

Source: Bureau of Labor Statistics.

mergers and cost cutting automated systems which could reduce employment whether or not traffic increases.

According to the most recent BLS projections,⁶ the outlook for employment in air transportation is expected to be about 464,000 in 1985 and 511,000 in 1990. This would mean an annual increase of 2.4 percent from 1977 to 1985, and 2.2 percent from 1977 to 1990, as output moves up more rapidly than productivity. At these rates, employment will be increasing more rapidly than in the last decade.

Occupations

Ground personnel have been greatly affected by changing technology and productivity. The sizable productivity growth discussed earlier has permitted air traffic to rise very substantially since the mid-1960's, with only small increases, or even decreases, in many occupations. For example, according to data from the CAB for scheduled airlines, communications personnel have been steadily declining since 1968, as computers are increasingly being utilized to handle growing volume. Similarly, mechanics working for scheduled airlines totaled 45,000 in 1977, or about 15 percent below the peak in 1969, in spite of tremendous growth in passenger and cargo volume.

These changes are reflected in the proportion of flight personnel to ground personnel in scheduled airlines. In 1967, flight personnel (pilots, copilots, flight engineers, and flight attendants) constituted about 20 percent of scheduled airline employment; in 1977, they were more than 25 percent. Pilots, copilots, and flight engineers did not increase significantly in that decade and declined slightly as a proportion of total employment, but flight attendants (stewardesses, stewards, and pursers) rose 78 percent. FAA regulations require 1 flight attendant for every 50 seats available.

Flight personnel increased substantially in the 1970's, and this trend is expected to continue, as indicated in chart 9. For the entire industry group SIC 45, pilots numbered almost 45,000 and flight attendants more than 41,000 in 1976. By 1985, their numbers are expected to increase 18 and 81 percent, respectively, over 1976. As a proportion of all employees, flight personnel (including flight engineers) are expected to increase from 24 percent in 1976 to 29 percent in 1985.

Aircraft mechanics in this full industry group increased only 8 percent from 1970 to 1976, but BLS projections show a substantial increase by 1985 of almost 40 percent. While technological developments are expected to reduce unit labor requirements for maintenance on newer planes and engines, older equipment, increased traffic, and greater emphasis on safety will result in greater demand for mechanics. As for airport services, the number of reservation, ticket, and passenger agents declined from

1970 to 1976. But, as shown in chart 9, an increase of 27 percent in these occupations is expected by 1985. Although newer mechanized and automated servicing procedures will be instituted, the increase in traffic could greatly increase passenger and baggage service employment.

Another occupation which is greatly affected by technological developments, air traffic controller, is in the Federal sector and not included in the air transportation industry data. In 1976, there were about 32,000 controllers, 25 percent more than in 1970. The BLS projects an increase of 30 percent by 1985 to 42,000 assuming the anticipated traffic growth develops.

Undoubtedly, occupational needs and skills in the next decades will be affected by changes in the industry brought about by the competitive climate of deregulation.

Adjustment of workers to technological change

Air carriers typically negotiate agreements nationwide on an individual company basis with a number of unions.⁷ Although these unions are generally organized along craft lines, several, like the International Association of Machinists and Aerospace Workers (IAM) and the Transport Workers Union (TWU), represent various crafts. Some of the unions in the air transportation industry are:

Airline Dispatchers Association
Airline Employees Association
Air Line Pilots Association, International
Allied Pilots Association
Brotherhood of Railway and Airline Clerks
Flight Engineers' International Association
International Association of Machinists and Aerospace Workers
International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America
Transport Workers Union of America

Occupations covered by these unions include clerks (office, store, fleet, and passenger service), dispatchers, flight attendants (pursers, stewards, and stewardesses), flight engineers, kitchen and commissary workers, meteorologists, pilots, and radio and teletype operators.

In general, seniority provisions in the labor-management contracts govern reduction in force, layoff, and recall, which may or may not be related to technological change. In addition, technological severance pay provisions are included in many contracts to eligible employees permanently separated from employment because of technological change. Such provisions cover about one-fourth of the pilots, flight engineers, and flight attendants, and two-thirds of the customer service agents, office clerical employees, and maintenance and related workers.⁸

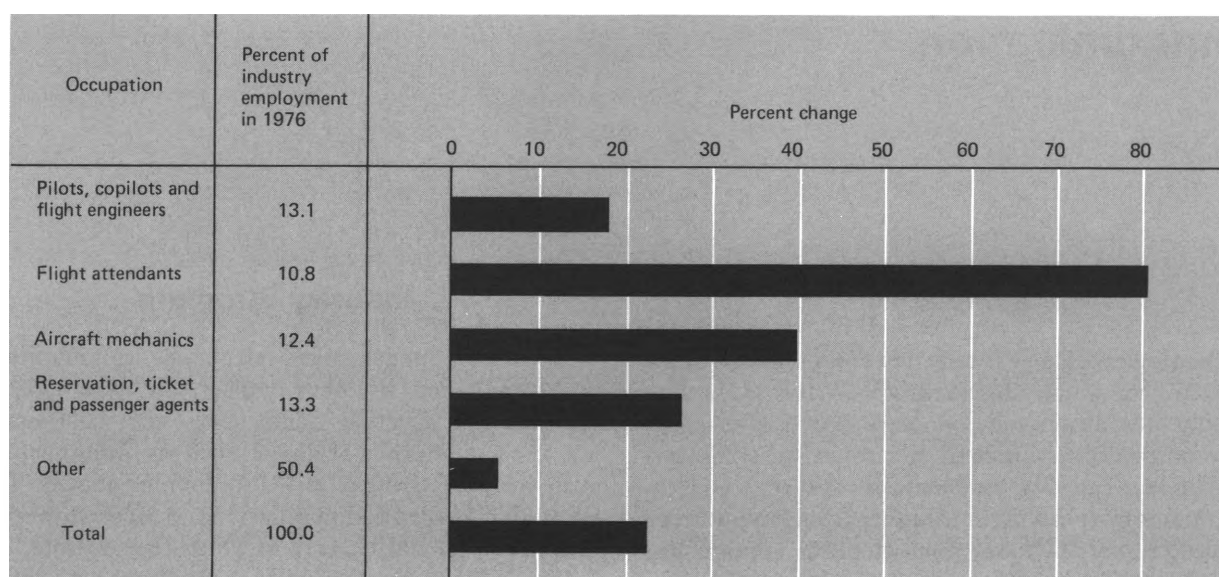
In addition, the Deregulation Act provides financial protection for employees, under certain conditions, who are laid off as a result of the act. If at least 7½ percent of

⁶The projected data for SIC 45 are BLS estimates of what the economy might look like in 1985 and 1990, given certain assumptions, for example, a full-employment economy (4.5-percent unemployment). For further details, see *Monthly Labor Review*, April 1979, pp. 3-14.

⁷*Industry Wage Survey: Scheduled Airlines, August-November 1975*, Bulletin 151 (Bureau of Labor Statistics, 1977), pp. 1-5.

⁸*Industry Wage Survey*, p. 21, table 16.

Chart 9. Projected changes in employment in air transportation, selected occupations, 1976-85



Source: Bureau of Labor Statistics.

the company's full-time employees are laid off within a 12-month period due to deregulation, employees in the company with 4 years' seniority are guaranteed 60 percent of their wages for 6 years by the Federal Government or until the laid-off employee finds comparable work.⁹

One of the major labor issues related to technology is the question of two- or three-member flight crews. According to a report by an FAA-sponsored task force, safety is not diminished by a two-member crew instead of

three-member flight crew in the planes at issue. It pointed out that manufacturers have controlled the workload in two-men aircraft by automating and simplifying systems to lessen required pilot actions. On the other side of the controversy, the Air Line Pilots Association states that the task force ignored conditions outside the cockpit, namely the amount of traffic and the increasing load of the air traffic control system.

⁹Airline Deregulation Act of 1978, Section 43.

SELECTED REFERENCES

Air Transport Association of America. *Air Transport*, 1978. Washington, D.C., 1978.

Aviation Week and Space Technology. Weekly issues, 1975-78.

Haggerty, James J. "Air Transports: The New Generation," *Aerospace*, Fall 1978, pp. 2-7.

Loving, Rush, Jr. "How the Airlines Will Cope with Deregulation," *Fortune*, Nov. 20, 1978, pp. 38-41.

Schneider, Lewis M. *The Future of the U.S. Air Freight Industry*. Boston, Harvard Business School, Division of Research, 1973.

U.S. Department of Labor, Bureau of Labor Statistics. *Industry Wage Survey: Scheduled Airlines, August-November 1975*, Bulletin 1551, 1977.

U.S. Department of Transportation, Federal Aviation Administration. *Consultative Planning Conference, New Engineering and Development Initiatives — Policy and Technology Choices, Progress Report*, Sept. 6, 1978. Summary.

_____, _____. *Systems Research and Development Service. Progress Report*, Aug. 8-9, 1978, 350 pages.

_____, _____. Statements before the House Committee on Science and Technology, Subcommittee on Transportation, Aviation and Weather. *Concerning the FAA R, E & D Program*, Sept. 21, 1978.

_____, _____. Statement of Quentin S. Taylor, Deputy Administrator of the Federal Aviation Administration, before the House Committee on Science and Technology, Subcommittee on Transportation, Aviation and Weather, *Concerning the FAA R, E & D Program*, Feb. 20, 1979.

Chapter 4. Telephone Communication

Summary

Technological change is affecting every segment of the telephone communication industry (SIC 481), considerably altering the job content and skill levels of industry occupations. Efficient electronic switching systems, higher capacity transmission systems, and increasing automation will contribute to rising output levels while decreasing the labor content of the communications process. In addition, alternate methods (domestic satellites) and forms (computer data traffic) of communication are in active use.

Due primarily to technological change, productivity growth averaged 5.5 percent annually from 1960 to 1977, well above the average for the total private economy. The growth rate was 5.8 percent for both 1960–67 and 1967–77. Current growth trends of output and employee hours indicate continued high productivity in coming years associated with expanding use of the newest technological developments.

Expenditures for telephone plant and equipment more than quadrupled to \$14.4 billion between 1960 and 1977. After accounting for the very substantial construction cost increases over this period, real expenditures roughly doubled. Although sensitive to general economic conditions, expenditures will likely be maintained to provide sufficient system growth to meet continually increasing demands.

Employment totalled 992,400 in 1978, having increased by an average of 2.5 percent annually from 1960. This rate reflected periods of strong growth combined with sharp employment declines in the early 1960's, when technological changes were at a peak, and in the 1974–75 recession when total employment dropped almost 50,000 by 1976. The BLS projection for employment in 1990 is for a moderate growth rate of 1.0 percent annually between 1978 and 1990, indicating that continued output growth will offset productivity growth despite the effects of technological change. Changes in occupational distribution and skill levels were perhaps greatest in the late 1950's and early 1960's, but they will continue to be significant as newer technologies and operating procedures are more widely implemented.

Industry Structure

To fully understand telephone communication technology and its labor impact, an explanation of the industry structure would be useful. The telephone industry is comprised of almost 1,600 operating telephone companies servicing over 162 million telephones. These companies, called common carriers, must serve everyone within the geographic area in which they operate.

The Bell System dominates the industry with roughly 82 percent of total telephones and 84 percent of total operating revenues. The Bell System is headed by the American Telephone and Telegraph Company (AT&T), which is a holding company with total or majority ownership of 21 operating telephone companies and minority ownership of 2 additional companies. Through these companies, Bell serves about half of the geographic area of the United States, an area which includes the more densely populated urban centers. In addition to the telephone operating companies, the Bell System includes the Western Electric Company—the manufacturing subsidiary; Bell Telephone Laboratories—the research and development subsidiary; and AT&T Long Lines, which provides long-distance service between individual operating companies.

The remaining common carriers, known as independents, primarily serve rural and suburban areas and small towns. The independents are also dominated by holding companies, the largest being the General Telephone and Electronics Corporation (GT&E), which controls over 50 percent of independent telephones. Like AT&T, GT&E also controls manufacturing subsidiaries and research laboratories. While independent companies provide long-distance service within their own territories, AT&T Long Lines provides long-distance links between territories.

In addition to the common carriers, several specialized communications carriers are now providing private-line data and voice transmission services in some high-demand areas as a result of recent Federal Communications Commission (FCC) rulings. Equipment manufacture and supply have also been opened to competition. The effect of these changes on the telecom-

munications industry has thus far been small (about 2 percent of revenues), but the long-run effects remain uncertain.

A major area of competition is in high-volume, long-distance service. The rates charged for service by the common carriers are based on averages of the costs of local and long-distance calling, with less costly, long-distance service, in effect, subsidizing more costly local service. Since the specialized carriers operate under different rate structures than those required of the common carriers, they are able to provide specific services to the less costly, high-volume, long-distance users at rates that more accurately reflect the lower costs of these services. As a result, the common carriers are losing revenues from this market segment. In response to this challenge to their traditional regulated monopoly standing, the common carriers have proposed changing rate structures to permit them to compete more effectively in this lower cost area. However, according to the common carriers, this would mean that to meet FCC

regulated rates of return, prices in other areas of service might increase. In the area of equipment manufacture and supply, the long-standing practice has been to use only carrier-supplied equipment. In contrast, the law now permits the use of any communications equipment which is registered with the FCC as compatible with the existing network. Responding to this area of competition, the common carriers are trying a new method of telephone distribution—directly to customers for self-installation.

Technology in the 1980's

Telephone communication is in essence a combination of two processes, call switching and signal transmission. In call switching, the major development in technology is the electronic switching system (ESS), in fairly wide use now but continually evolving. In signal transmission, optical instead of electrical transmission is most important, with significant commercial use expected by the early 1980's. Basic to almost all segments of the industry is the pervasive use of computers to automate equipment

Table 3. Major technology changes in telephone communication

Technology	Description	Labor implications	Diffusion
Electronic switching systems (ESS)	High-speed, computer-based switching equipment monitors its own performance and provides advanced dialing capabilities. Call-handling capacities greatly increased over previous equipment—threefold for local ESS, fourfold for long-distance ESS.	Reduces unit labor requirements for central office equipment installers and repairers. Modular design, self-maintenance features reduce mechanical skills needed for routine maintenance; knowledge of computer-based systems and programming concepts necessary for operation and control.	Local ESS introduced in 1965; serviced nearly 25 percent of phones by 1978; nearly complete conversion projected by 2000. Long-distance ESS introduced in 1976; 50 percent coverage projected for 1985.
Transmission innovations	Millimeter waveguide: Long-distance transmission medium consisting of an underground tube through which signal-carrying radio waves are transmitted. Call-handling capacity is more than double that of most advanced existing cables. Fiber optic cables: Glass fiber cables combined with semiconductor light sources for very high capacity transmission. Cables are compact, resist electrical interference, and interface well with digital switching and transmission techniques. Use is feasible on long-distance and local interexchange routes.	Unit labor requirements for installation and repair personnel will be reduced, affecting long-run employment growth. Similarity to microwave relay transmission should not require major skill changes. Long-run employment growth of installation and repair workers will be affected by reduced unit labor requirements. Skill requirements may be lessened due to highly preengineered equipment.	Undergoing field tests. Future diffusion will depend on growth in call volume on high density communication routes and optical system development. In trial stages; application to commercial communications systems expected in 1980.
Satellite communications	Satellites serve as relay points between distant earth stations, transmitting voice, data, and television signals. Satellite systems add versatility and security to existing ground network.	Modest growth in R&D and implementation employment should result from greater utilization. Use as supplemental capacity should not affect employment on ground-based facilities.	First domestic satellite system installed in 1974, second in 1975, and third in 1976. Third system ties into nationwide telephone network; others are leased, private-line service only. International satellites linked 100 countries in 1977.
Digital transmission	Transmission of electrical pulses instead of continuous signals greatly increases capacity with minimal investment and facilitates transmission of data. Compatible with future technologies.	Reduces unit labor requirements for maintenance craft workers in the long run. Short-run growth of installation personnel may occur during changeover. Skill requirements not expected to change.	Digital links between 100 cities on microwave relay now in operation. Evolution of a primarily digital transmission network planned for late in this century.
Computer applications	New uses of stored program control facilitate switching and billing operator-assisted toll calls, answering intercept calls, maintenance and testing functions, and management information processing.	Unit labor requirements reduced in all cases; however, actual effects on employment depend on growth in service demand. Equipment operation and repair are simplified, in most cases resulting in less employee specialization but greater variety in job duties.	Operator functions converted in some high demand areas. Maintenance systems, some now in limited use, are expected to be in operation throughout the network by 1980. Management information systems expanded considerably since 1970.

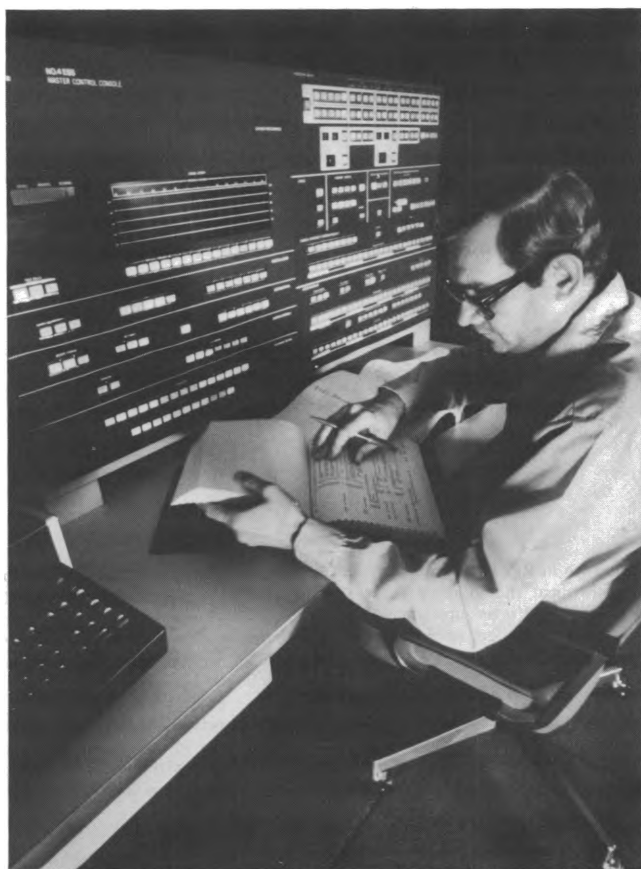
through stored program control. In general, major advances in technology substantially increase the system's capacity while requiring little, if any, additional labor.

These aspects of technological change in the telephone communications industry, their labor impact, and their diffusion are discussed in the following sections and are summarized in table 3.

Electronic switching systems

Electronic switching systems (ESS) adapt the technology of stored program control to the central office function of switching telephone calls. ESS utilizes solid-state designs with the inherent advantages of high-speed operation, high reliability, ease of maintenance, and physical compactness. This technology, first introduced to local call switching in 1965, was used for roughly 25 percent of U.S. telephones in 1978. Coverage is expected to be almost complete by the year 2000¹ as new central offices are established and as older crossbar and step-by-step switching equipment is phased out. ESS was also adapted to long-distance call switching in 1976, with

¹Stanley Johnston, Herbert Kettler, Alan Tedesco, "Planning Local Switching Replacement with ESS: When and How?" *Bell Laboratories Record*, March 1977, p. 59.



Employee monitors the master control console of a long-distance electronic switching system.

conversion expected to be about 50 percent complete by 1985.²

Call-handling capacities are greatly increased compared to previous equipment—threefold for local and fourfold for long-distance ESS. In addition, automatic maintenance monitors locate and diagnose circuitry problems, notify operating personnel of necessary repairs, and route connections around faulty components until such repairs are made. Most ESS circuitry consists of plug-in modules that can be rapidly changed. In areas where ESS has been widely installed, central control centers may link each switching office and perform remote monitoring and maintenance functions. Moreover, ESS provides automatic dialing functions, which may be individualized simply by changing the software controlling the operation of each switching machine.

The workers mainly affected by this technology are the central office installation and maintenance craft workers. The installation of electromechanical switching equipment involved complex wiring assignments to integrate a standardized machine into varied central office operations. The tasks are greatly simplified with ESS because its software is preprogrammed to meet the specific requirements of each installation. Thus, unit labor requirements for installation are decreased as more of this function is incorporated into the manufacturing process.

Similarly, maintenance requirements with ESS are being reduced—up to two-thirds in the case of long-distance switching systems.³ Electromechanical switching equipment requires extensive mechanical abilities and a basic knowledge of electrical circuitry. With no moving parts, however, ESS eliminates the need for mechanical skills but requires a working knowledge of electronic computer-based systems and programming concepts and greater responsibilities in job duties. Thus, the technical skills of personnel are increasing as are the educational requirements for this type of work. However, no changes in occupational classifications are anticipated.

ESS will also affect network administration clerical personnel, whose jobs involve the translation and analysis of network operating data. As this type of information becomes more sophisticated and complex with ESS, the skills of this occupational group will increase.

Since ESS and its support systems sharply increase capacity and reduce unit labor requirements, their impact on employment growth could be adverse. However, sharply increasing call volume may offset the reduced unit labor requirements of electronic switching technologies, resulting in slight increases in central office craft worker employment.

²Information provided by American Telephone and Telegraph Co. officials, October 1977.

³"Illinois Bell Using Long-Distance Switch," *Electronics News*, January 19, 1976, p. 8.

Transmission Innovations

Increases in long-distance call volume, averaging 9 percent annually during the last decade,⁴ have prompted the development of two innovative transmission systems—the millimeter waveguide and fiber optic cables. Using totally different technologies, both can achieve call-handling capacities far greater than existing coaxial cables and microwave relays.

The millimeter waveguide is essentially an underground tube through which signal-carrying radio waves are transmitted. It was developed as an adjunct to the video telephone, which required much more capacity than normal voice communication for its video signals. Although interest in video communication has waned, the waveguide remains a viable, long-distance transmission medium that can provide additional capacity, as call volume increases. In view of its extremely high capacity, waveguide would be installed only on high density communication routes, such as between major cities, and its diffusion would depend on call volume growth in such areas.

Optical transmission systems employ a light source (light-emitting diode) modulated by a voice or data signal, and an optical “cable” (a bundle of hair-thin glass fibers) in place of the electrical signal/copper wire concept of conventional cable systems. An optical system, in sharp contrast to existing transmission methods, has the potential for extremely high capacity, very compact size, resistance to common electrical interference, and a high degree of compatibility with proliferating digital voice and data transmissions. In addition to usage on long-distance routes, the space savings achievable with fiber optic cables make them ideally suited to connections between central switching offices in urban areas. One such system was first tested early in 1976, and another underwent field trials in 1977 during which it actually carried commercial traffic. It is in this capacity that optical systems are first expected to be used for telephone communications starting in 1980,⁵ although limited, specialized applications may occur even sooner.

Although technological problems still exist, recent breakthroughs have advanced optical systems into consideration as one of the primary transmission media of the future. Industry specialists believe that by the time substantially higher capacity is needed on the long-distance network, optical systems will have proven sufficiently reliable and cost competitive with other systems in high-density, long-distance transmission applications. During the transition period to these high capacity transmission systems, a different type of radio transmission will be used. Called single side-band (SSB), it will more than triple the capacity of the microwave network with only minor equipment modifications at transmission end points.

⁴American Telephone and Telegraph Co., *Annual Report 1973*, p. 6; *Annual Report 1978*, p. 6.

⁵American Telephone and Telegraph Co., *Annual Report 1978*, p. 7.

Significant employment changes may occur. The installation and maintenance of facilities associated with transmission systems fall in part to line and cable craft workers, a relatively small occupational group constituting roughly 5 percent of the industry work force. As is the case with ESS, the transmission innovations mentioned (waveguide, optics, and SSB) greatly increase capacity, with a corresponding decrease in unit labor requirements. These technologies, in combination with others described in following sections, may reduce employment in this occupational group. The increasing volume of calls, however, will at least moderate, if not offset, any employment declines. As transmission capacity becomes more dependent on the electronic equipment at the end points of transmission systems instead of the cable itself, a shift in emphasis from the cable crafts to the central office crafts may occur. Equipment modifications and new equipment installations may spur short-run employment increases in the central office installation crafts.

The two innovative systems are not expected to radically alter skill requirements. The millimeter waveguide is not likely to require many new skills of craft employees due to basic similarities with microwave relay transmission technology. Well established cable-laying procedures will continue to be used with only a few new techniques of aligning and joining sections of waveguide “pipe.” Optical transmission systems are likely to be highly preengineered so that cable splicing may be reduced to plugging together two connectors, simplifying the skills needed for this task. In addition, transmission end point equipment will remain principally electronic in nature and not require central office skills beyond those already needed for digital transmission equipment.

Satellite communication

Communication via satellite began in 1965 between the United States and Europe (satellites linked about 100 countries in 1977), providing an alternative to undersea cables for international signal transmission. In operation, satellites in synchronous orbits serve as relay points for transmissions between distant earth stations, which in turn connect to the ground telephone network. Advances in semiconductor technology and microminiaturization of circuitry have increased the call-handling capability of satellites to 25 times that of the original system and increased the satellite life-span from 18 months to over 7 years.

Westar, the first domestic satellite system providing communication between points within the United States, was placed in operation in 1974 by the Western Union Telegraph Company. Consisting of two satellites and seven earth stations, it can relay 28,800 voice channels, data traffic, and color television transmission on a leased, private-line basis. Another domestic system, Comstar, a joint venture of AT&T and GT&E, began operation in 1976. It has capabilities similar to the Western Union

System but ties into the nationwide telephone network. One other system is currently in use, and several more are planned.

Aside from providing additional capacity, satellite systems increase network versatility with a third transmission medium, which, in contrast to ground-based systems, has transmission costs independent of transmission distance. In addition, satellite service capacity can be shifted to reduce the load on ground facilities as peak calling demand shifts between time zones, obviating concentrations of capacity that are fully used only at certain times of day. Data traffic, video, and other types of one-way transmission will be the most important uses of satellites; voice traffic is expected to be of secondary importance due to time delays involved with transmission over such great distances (nearly 50,000 miles in the case of orbiting synchronous satellites).

The labor involved in satellite communication is primarily in the field of research and development and ranges from electrical engineers and physicists to psychologists. In addition, personnel are needed in the construction, operation, and maintenance of earth stations. Modest employment growth can be expected in these and associated occupations as satellite use becomes more extensive. Since satellites provide only supplemental capacity, their use does not greatly affect the personnel associated with ground-based transmission facilities.

Digital transmission

The major factor underlying the growing interest in digital transmission is the basic need for increased transmission capacity at minimal cost.

In allowing up to 24 simultaneous calls on a single communication channel, digital transmission was developed in the 1940's as a method of increasing the capacities of existing transmission systems at minimal cost. While conventional transmission is in analog form—continuous signals each occupying a single communication channel—digital transmission converts analog signals into electronic pulses, combines them with others for transmission, then decodes and reconverts them to analog form upon reception. Industry plans call for the evolution of a primarily digital transmission network by the end of this century with the utilization of long-distance ESS, millimeter waveguide, and fiber optic cables. Aiding in the transition is a relatively new technique that transmits digital data and normal voice traffic simultaneously on the nationwide microwave relay network, making the construction of separate digital facilities unnecessary. This system now links nearly 100 cities and could be expanded to the entire microwave network.

Computer data traffic, although minimal at present, is expected to increase at an annual rate of 35 percent

through 1985.⁶ And, although growth in the absolute volume of voice traffic is expected to exceed that of data traffic for the foreseeable future, the impact of data communications on the industry cannot be discounted.

The conversion to a telephone network based on digital transmission will affect employment as the other, previously mentioned transmission technologies will, except that the impact will be much more immediate. This technology is likely to reduce employment in line and cable crafts. However, employment may increase in the central office installation crafts. Skill levels for both groups are expected to remain unchanged.

Computer applications

The impact of computer technology in the form of stored program control on the telephone industry will be far-reaching, changing some segments not previously affected and increasing efficiency in other areas. Office administrative tasks were the first to undergo automation in the late 1950's, and various refinements in full-scale data processing systems are still being made. Numerous management information systems have evolved that automate the processing of customer records, keep inventory records, assign plant facilities, and perform various analyses on pertinent data. Clerical personnel will continue to be affected by these systems.

Currently, stored program control is being applied to more operating aspects of telephone communications than ever before. Undergoing automation are operations such as switching and billing toll calls, interception of calls to nonworking numbers, and maintenance testing systems.

The operator's duties are being changed by an electronic console which automates most of the switching and billing tasks on operator-assisted long-distance calls. This equipment can increase operator efficiency by about 25 percent and has altered the toll operator's routine job to a more varied one which requires less physical effort, somewhat more imagination and responsibility, and different, but not necessarily more complex skills. About 75 percent of telephones, in primarily urban areas, are presently serviced by this equipment. Its diffusion will increase as new methods are developed allowing remote centralized coverage of large rural areas.

An innovation which eliminates the need for one group of operators is a device which automatically answers intercept calls (vacant, changed, or disconnected numbers) with a computer-assembled voice response explaining the reason for interception and giving new number information. Although intercept operators constitute a small proportion of all operators, this equipment completely eliminates their function. Automatic intercept is currently in use only in large metropolitan areas where demand is greatest; however, systemwide implementation is expected. In addition, a system to automate coin telephones will be put into effect shortly that will monitor and compute charges on coin phone calls without

⁶Frederick G. Withington, "Beyond 1984: A Technology Forecast," *Datamation*, January 1975, p. 73.

operator contact, thus eliminating another operator function.

Perhaps most significant are the computerized maintenance, quality-control systems now in various stages of development. One system, expected to be in use nationwide by 1980, tests trunk lines, analyzing problems of signal loss and noise. Affecting line and cable repairers, this system can increase by a factor of 25 the number of lines tested in a typical time period.⁷ Central office craft workers are being similarly affected by computerized systems. One such system, now in use, tests crossbar switching networks, locating and analyzing problems that limit switching capacity. Another system, called computerized line assignment, designates wiring attachments on central office main distributing frames to ensure proper load-balancing conditions and reduce wiring congestion.

Another important maintenance, quality-control system is now being installed. It is a computerized line status verifier which is expected to eliminate one of the top plant craft positions—the test desk operator. Under the conventional testing system, this central office job requires experience in both inside and outside plant crafts and involves testing lines and switching equipment to find customer-reported problems. The computerized line status verifier performs most of these tests automatically, reducing the work of the test desk operator by roughly 60 percent,⁸ and is operated by someone of clerical status.

“No end in sight” has been said to describe expectations for future computer use in the telephone industry. Minicomputers and microprocessors integrated directly into equipment will be commonplace. An example of this is a proposed revenue accounting system based on computer circuits built into individual telephones to provide immediate revenue information. Another built-in system would allow customers to perform certain quality tests on their own telephones, decreasing the involvement of telephone repairers in the maintenance process. A step in this direction will be taken soon with the introduction of the electronic telephone set that replaces most of the mechanical parts of the older telephone sets with integrated circuits, and provides higher quality at lower cost.

As is evident from the foregoing, increased computer use will significantly affect labor since it acts to reduce unit labor requirements in almost all its applications. However, the actual effects on employment will depend greatly on changes in demand.

Production and Productivity Outlook

Output

Output in the telephone communication industry,

⁷“Accentuate the Practical,” *Bell Telephone Magazine*, March–April 1974, p. 30.

⁸“Data Processing—Burning Through the Bog,” *Bell Telephone Magazine*, March–April 1976, p. 16.

measured in terms of real operating revenue⁹ (chart 10), more than tripled between 1960 and 1977. The rate of increase was relatively steady at 8.1 percent annually, continuing the upward growth pattern of the 1950's. Output advanced at 8.2 percent per year during 1960–67 and at an annual rate of 7.6 percent during 1967–77. The lower rate in the later period was due primarily to the 1970–71 and 1974–75 economic recessions when output growth dropped somewhat to the still relatively high rates of 5.1 percent and 3.1 percent, respectively.

The rapid output growth rate since 1960 resulted from the more than doubling of the number of telephones in service to over 162 million and a substantial increase in usage per telephone. Various social and demographic factors have been primary causes of both these increases. Among these are the trend toward single-member households as children leave home at an earlier age; rising income levels; increasing population mobility; and an increasing reliance on communications by business and government.

The outlook is for continued strong output growth as residential and business demand increases. Although the slower population growth rate could moderate growth in demand in the long run, it is expected to be offset by continuing societal changes leading to increases in the number of households. Other factors will also contribute to output growth, such as rising income levels, proportionately larger increases in long-distance calls compared to local calls, and growth in data communications. Unknown at this point, however, is what effects competition will have on industry prices and output growth.

In addition to normal demand growth, new markets for communication services are expected to develop very rapidly in the next decade. Electronic funds transfer systems, an electronic postal service, and home data processing are important examples of future, non-traditional uses of the telephone network.

Productivity growth

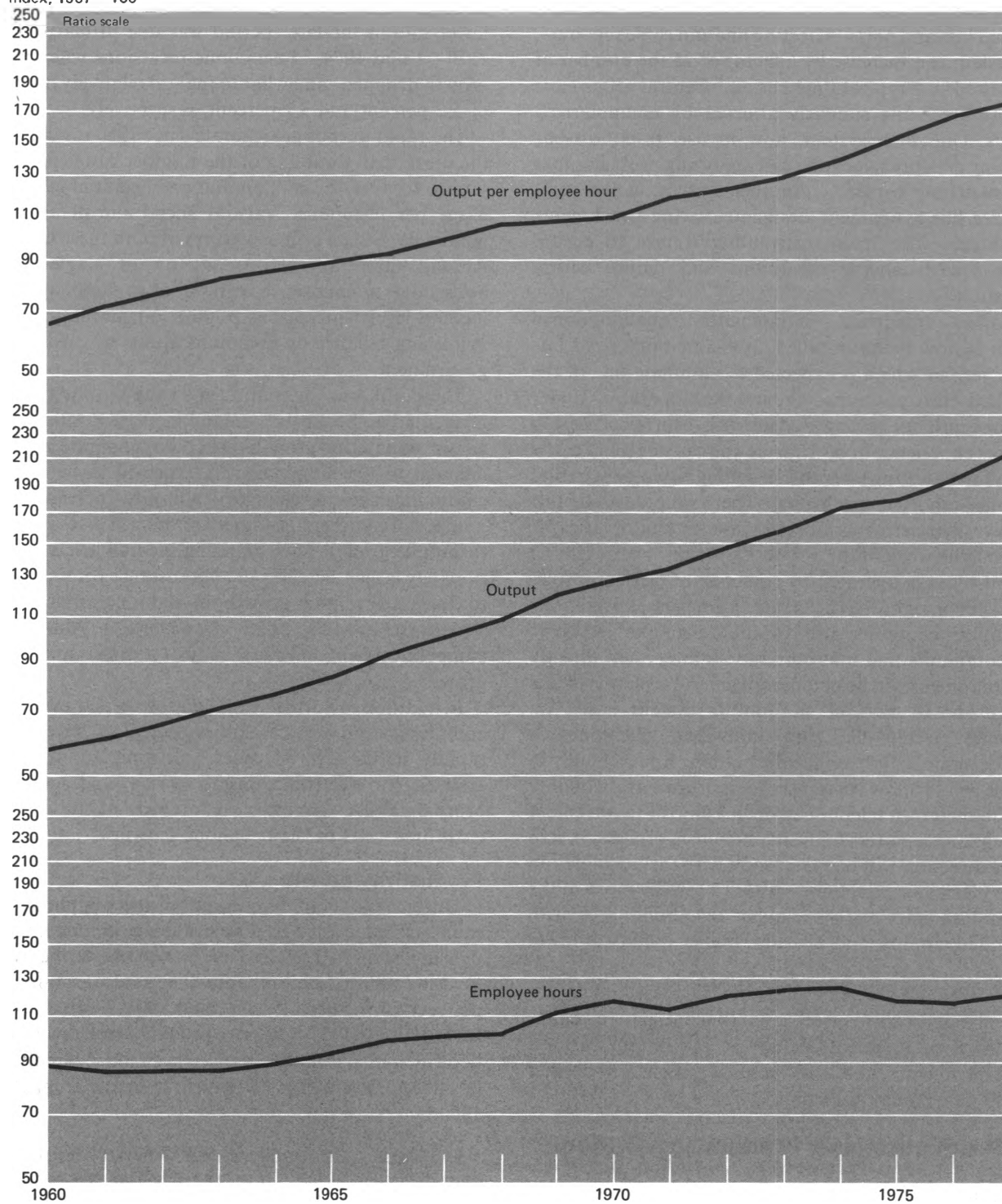
Output per employee hour in the telephone communication industry grew at an average annual rate of 5.5 percent between 1960 and 1977, well above the average for the total private economy. The rate was 5.8 percent per year during both 1960–67 and 1967–77. In the 7 years from 1970 to 1977 however, productivity grew at a 7.1-percent annual rate. It advanced even more rapidly in the late 1950's, averaging 9.2 percent annually from 1955 to 1960.¹⁰

⁹The output of the industry is defined as the real value of operating revenues of all telephone carriers with \$1 million or more in annual revenue reporting each year to the Federal Communications Commission (FCC); and of selected large carriers, not subject to reporting requirements, for which the FCC reports the data. The real value of operating revenue is derived by appropriate deflation procedures.

¹⁰*Productivity Indexes for Selected Industries, 1978 Edition*, Bulletin 2002 (Bureau of Labor Statistics, 1978), p. 106. Rates are derived by the linear least squares trend method using annual indexes.

Chart 10. Output per employee hour and related data in telephone communication, 1960-77

Index, 1967 = 100



Source: Bureau of Labor Statistics.

Changes in the rate of productivity growth have been largely associated with changes in employee hours, since output, as previously indicated, moved up relatively steadily. In the late 1950's, for example, the peak growth in productivity resulted mainly from reduced employee hours due to changeovers to automatic dial systems and electronic data processing. Hours remained fairly constant through the first half of the 1960's but were erratic in subsequent years. They began rising in the mid-1960's as employment expanded in the relatively labor-intensive occupations of installation and repair, necessary to the maintenance of the growing system. (See chart 10.)

On the other hand, employee hour growth slowed in the early 1970's as a result of reduced labor requirements realized from newer technologies and in response to tightening economic conditions. During the economic recession of the mid-1970's, hours declined more sharply than at any time since 1958, while output continued to rise at a relatively steady rate. In summary, following a decline of 0.5 percent annually from 1960 to 1963, hours increased at 4.1 percent per year during 1963-70 but then dropped to 0.3 percent annually from 1970 to 1977.

Investment

Capital expenditures

Current-dollar expenditures for telephone plant and equipment increased from \$3.2 billion in 1960 to \$14.4 billion in 1977 at an average annual rate of 10.3 percent. Similarly, the book value of total plant in service increased fourfold, nearing \$130 billion at the end of 1977.¹¹ Of yearly expenditures, a major portion generally goes toward system growth—new telephone services for new and existing customers. Plant replacement, modernization, and customer movement account for the remainder.¹²

These data, however, reflect costs unadjusted for changes in prices. Real dollar outlays (outlays after adjustment by an implicit price deflator combining communication equipment and structures) also rose sharply from 1960 to 1977, 5.8 percent annually, more than doubling over the period. Although sensitive to general economic conditions in the short run, it is likely that real expenditures will at least maintain their current level over the next decade in order to accommodate continued industry growth in response to competitive pressure.

Between 1960 and 1976, expenditures per employee (an indication of capital intensity) averaged about \$8,500 in the telephone industry, compared to about \$1,200 in all manufacturing industries combined (Bureau of the Census data). The annual rates of growth of expenditures

per employee however, were roughly similar—7.6 percent and 8.0 percent per year, respectively.

Funds for research and development

Research and development (R&D) activities have been instrumental in raising industry productivity and assuring the most technologically advanced telephone communication system. Although R&D data are not available for the industry as a whole, data for AT&T (which alone performed nearly 85 percent of the industry's 1977 R&D) indicate the magnitude of the research effort in this industry.

A recent survey showed that, based on expenditures, AT&T ranked as the fourth largest performer (behind major automotive and computer manufacturers) of corporate R&D in the United States in 1977, spending nearly \$718 million.¹³ Of annual expenditures, basic research and fundamental development generally account for roughly one-third and are performed by the Bell Telephone Laboratories for the Bell System. In addition, more specific product development and design work is done by Bell Labs for the Western Electric Company, accounting for the remaining annual R&D expenditures.

Employment and Occupational Trends

Employment trends

Employment in the telephone industry has undergone severe fluctuations in the post-World War II period due to both changing technologies and varying economic conditions. Through most of the 1950's, employment grew strongly, increasing 24 percent between 1950 and 1957. Later in the decade, the near complete diffusion of direct dialing and increasing use of electronic data processing combined with the effects of two recessions to decrease employment almost 11 percent between 1957 and 1963.

Employment rose sharply after 1963 as increasing demand for telephone service offset the effects of technological change. In the period 1960-67, employment rose an average of 2.1 percent per year in spite of the sharp decline in the early part of the period. (See chart 11.) From 1967 to 1970, employment growth averaged 5.5 percent annually, reflecting expansion in the labor-intensive craft occupations that were gaining in relative importance at that time.

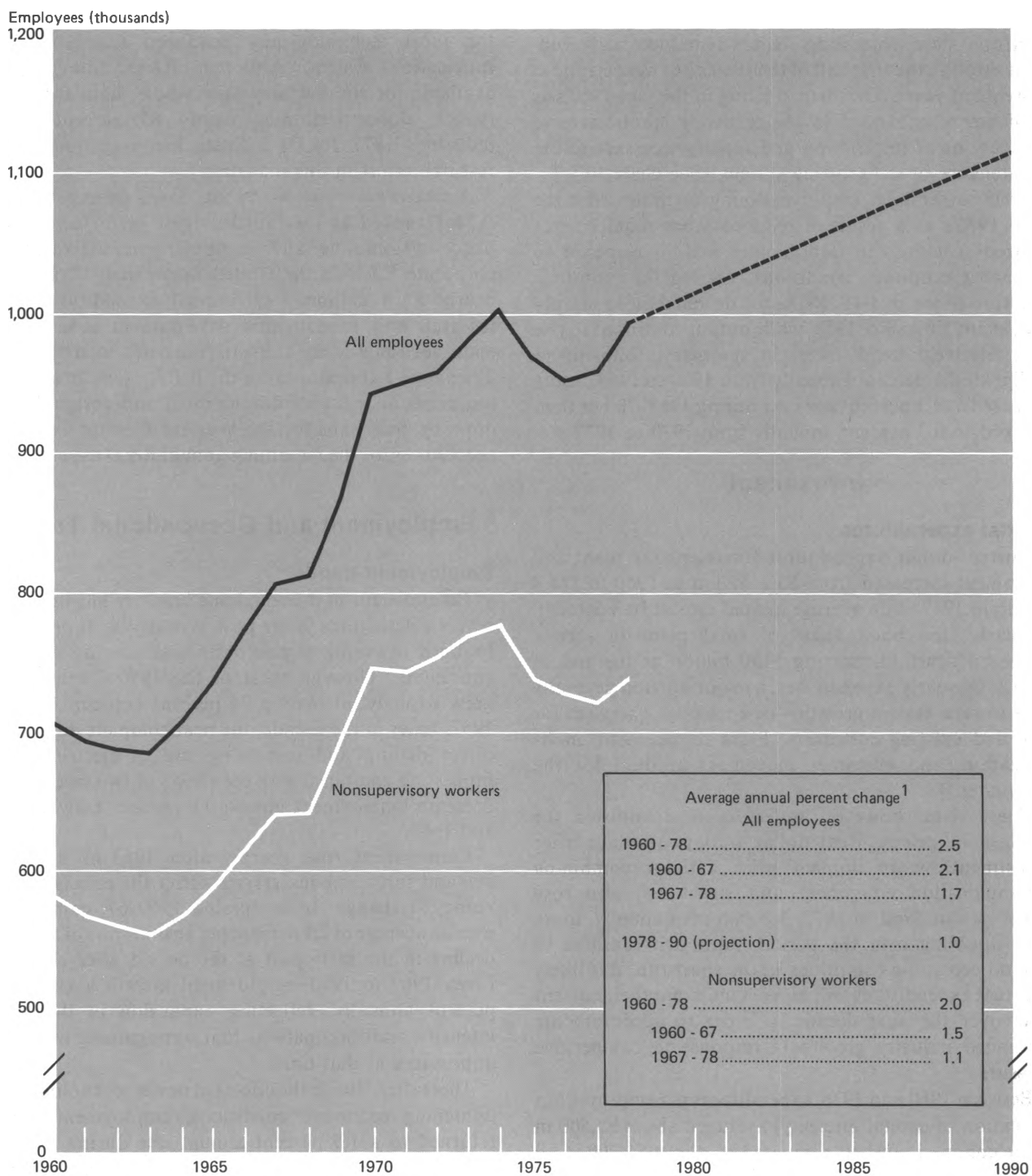
Thereafter, due to the effects of newer technologies and tightening economic conditions, employment growth returned to a 1.5 percent annual rate during 1970-74. However, when these factors combined with the economic recession, employment fell 2.4 percent annually between 1974 and 1976. Employment then increased slightly in 1977 and more sharply in 1978. Thus, overall in the period 1960 to 1978, total employment rose

¹¹American Telephone and Telegraph Company, *Annual Reports*, various years; United States Independent Telephone Association, *Independent Telephone Statistics*, various years.

¹²John G. Reynolds, "Telcos Plan \$12.3 Billion Construction," *Telephone Engineer and Management*, Apr. 15, 1974, p. 77.

¹³"R&D Spending Patterns for 600 Companies," *Business Week*, July 3, 1978, p. 77.

Chart 11. Employment in telephone communication, 1960-78, and projection for 1978-90



¹ Linear least squares trend method for historical data; compound interest method for projection.

Source: Bureau of Labor Statistics.

from 706,000 to 992,400 at an average annual rate of 2.5 percent.

The outlook for employment as projected by BLS¹⁴ is for a continuation of this upward trend at a moderate rate of 1.0 percent annually between 1978 and 1990. Underlying this projection are the expectations that, relative to the 1970's, the rates of growth of output and productivity will decrease, with productivity growth slowing slightly more than output growth.

However, some within the industry feel that, due to a changed economic climate and impending competition, reductions in labor intensity will have to continue. Thus, the peak employment levels of the 1970's may not be achieved in the 1980's, although additional labor requirements in the middle of the decade may cause employment to again start slowly rising at that time.

Nonsupervisory worker employment rose from 581,900 in 1960 to 738,800 in 1978 at an average annual rate of 2.0 percent. As in many other industries, non-supervisory workers decreased relative to supervisory workers, declining from 82.4 percent of total employment in 1960 to 74.5 percent in 1978.

Women workers, primarily in operator and clerical positions, have historically constituted a major portion of telephone industry employment. However, technological changes in the last two decades have adversely affected the labor-intensive occupations held by women, such as telephone operators. Jobs generally held by men in such occupations as construction, installation, and maintenance were not affected nearly as much. Thus, although the number of women workers increased almost 23 percent from 1960 to 1978, their share of total employment fell from 57.2 percent in 1960 to 50.0 percent in 1978. However, if operator employment does not decrease significantly through the 1980's, and if greater numbers of craft jobs open to women, their share of total employment may stay near 50 percent.

The employment of outside labor on contract is becoming more widespread, but its use has extended almost exclusively to the provision of secondary services such as cafeteria operation and janitorial work in telephone office buildings. Most collective bargaining agreements covering major industry occupational groups make reference to subcontracting, prohibiting its use if it provides services that can be performed by covered workers or if it would cause layoffs or part-timing of permanent employees.

Occupational trends

As previously mentioned, telephone communication has become a highly complex and automated process. Although the impact of technological change on labor may have been more severe in the past (particularly in the

late 1950's), it continues to alter job content, skill levels, and occupational distribution.

In general, technological change has been very effective in reducing labor intensity in all segments of the industry, and particularly in operator and clerical occupations. But, while technological development has made the U.S. telephone system the most advanced in the world, the ability of technology to make significant additional contributions to efficiency may be reaching a peak in some operations. Nevertheless, labor intensity continues to be reduced by relegating more of the communication process to the customer. Just as the dial telephone and direct long-distance dialing removed the task of call switching from the operator to the customer, other similar changes are now taking place.

Present examples include the toll operator's electronic switching console, which allows the customer to dial special calls (collect, credit card, etc.) with only a relatively short intervention by the operator for call completion. Although not related to technology, some reductions in operator service are being accomplished in areas where charging for directory assistance has been initiated.

Similarly, telephone installation and repair are becoming less labor intensive. Changes began in this area with the prewiring of buildings for telephone service during construction. Although performed by telephone industry employees, this task is much simpler during construction than after. As a result of prewiring, a concept of customer do-it-yourself developed to take advantage of possible labor savings. The customer chooses the telephone in a retail-type establishment, takes it home, and plugs it in—effectively eliminating the functions of the telephone installer.

As for maintenance, the modular assembly of telephones, where components plug in and out, is reducing the time and skills needed for telephone repair. And, carrying the concept a step further, the technology is being developed for customer participation in the maintenance of the telephone, as mentioned in the technology section of this report. This will also alter the job content of the telephone repairer's tasks. In coming years, meeting competition in equipment supply is expected to be the primary force behind employment and occupational changes in telephone installation and repair.

Important changes will also be faced by the central office crafts, i.e., installation and repair of switching and transmission equipment, in the next decade. As discussed earlier, ESS installations, due to smaller size and increased prefabrication, are considerably less labor intensive than previous equipment, but the accelerated pace of installations could increase labor requirements. Once installed, ESS and its support systems, particularly the facility for centralized remote maintenance and control, will greatly affect the skills and labor requirements of repair personnel. On the other hand, increased modifications and installations of new types of

¹⁴The projected data are BLS estimates of what the economy might look like in 1990, given certain assumptions, for example, a full-employment economy (4.5-percent unemployment). For further details, see *Monthly Labor Review*, Apr. 1979, pp. 3-14.

transmission end-point equipment may increase the requirements for craft workers in this area.

Line and cable craft workers, at one time the most highly skilled craft group, are being affected adversely by technological improvements in the local distribution plant, i.e., the lines between central offices and local subscribers. Changes such as dedicated plant (permanently installed lines and connectors in commercial and residential buildings), buried cable, and quick-connect terminals, although not as spectacular as some new technologies, will nevertheless continue to reduce both the labor requirements and skill levels of this occupational group.

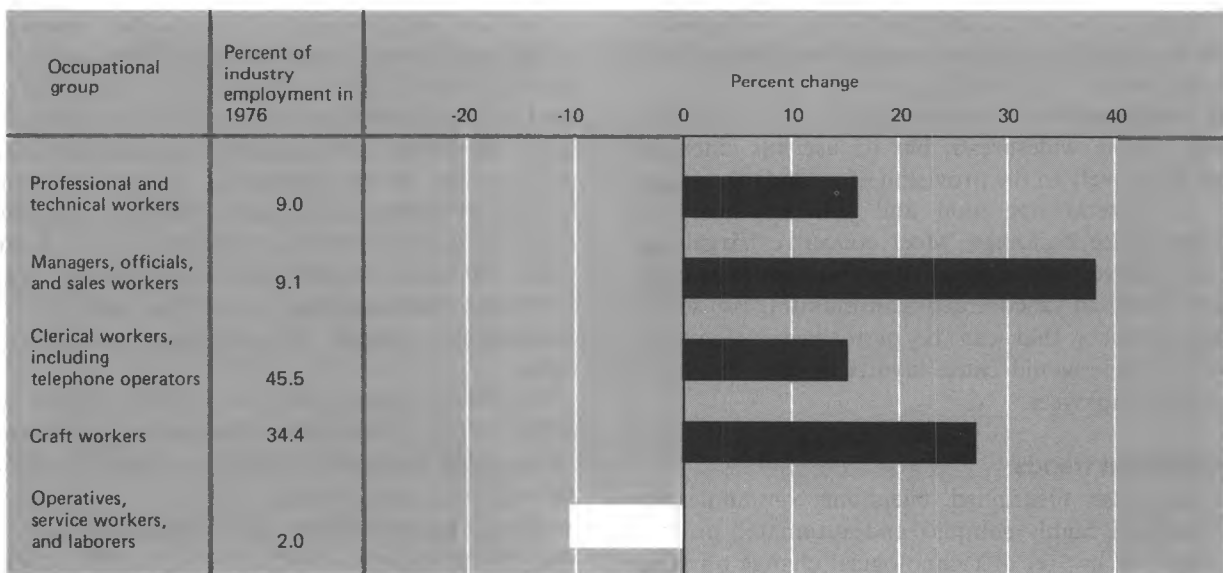
In summary, as service demand continues to grow, it is generally expected that many craft occupations will increase in number through the 1980's, although only moderately due to the widespread diffusion of new technologies. According to the BLS, craft and kindred workers in the telephone industry are projected to increase 27 percent from the 1976 level by 1985. (See chart 12.) Clerical employment, although affected by many new computerized management information systems, is also expected to increase in response to industry growth—15 percent between 1976 and 1985. Telephone operators, once the largest single occupational group, have been declining in number since the mid-1950's. The decline however, may not continue in the 1980's if reduced labor

requirements are offset by increasing service demand. Some in the industry feel that unless a new technology is discovered soon, operator employment may even increase. While clearly unit labor requirements for almost all these occupations are declining, the employment outlook will depend on the growth in demand for services.

As for the professional and technical occupations, the BLS projection is for an increase of 16 percent over the 1976 level by 1985. In this case, the continuing importance of technological advancement is expected to lead to strong growth of scientific and technical employment.

Managers and sales workers are also expected to increase by 1985. Attempting to ensure service demand growth and mindful of the newly competitive environment, the industry is at present in transition from a technology-based organization to one of greater market orientation. Increased emphasis on diversified customer services is the major goal for the coming years. Versatility will take the form of new customer equipment, already apparent in the new varieties of telephones now available, and the new types of services for both business and residential customers that were described earlier. Business and sales occupational groups will be primarily affected by expansion along these lines, and these groups are projected to achieve substantial gains in the 1980's. As shown in chart 12, the BLS projects a 38-percent gain over the 1976 level by 1985.

Chart 12. Projected changes in employment in telephone communication, by occupational group, 1976-85



Source: Bureau of Labor Statistics.

Adjustment of workers to technological change

Programs to protect the worker from the adverse effects of changes in equipment and methods may be incorporated into union contracts or they may be informal arrangements between labor and management. Adjustments to new technologies may relate to the worker's involvement through advance notice or knowledge of workload changes, with possibilities of retraining or transfer based on seniority rights. Where reduction in force is a possibility, seniority may be particularly important. Aid in adjustment to layoff may include various types of income maintenance such as supplementary unemployment benefits or severance pay. In general, these provisions are more prevalent and more detailed in formal contracts.

In the telephone communication industry, coverage of nonsupervisory workers by formal labor-management contracts is estimated to be essentially complete. Covering by far the largest number of workers is the Communications Workers of America (AFL-CIO); the rest are covered by smaller unions, independent or AFL-CIO affiliated. The Communications Workers estimate their coverage of telephone operators and plant craft workers to be roughly 80 percent and 60 percent, respectively.

General provisions, such as a seniority basis for layoff and recall, part-timing during slack work periods, advance notice of layoffs, and severance pay, are found in most contracts and afford some protection against the effects of technological change. Other protective provisions are also quite common. For example, in a recent BLS study of 77 telephone industry contracts covering 665,050 workers, provisions for interplant transfers and on-the-job training applied to 88 percent and 56 percent, respectively, of the workers. The most recent contract negotiations also provided a supplementary income protection plan and a reassignment pay protection plan. These provisions act to minimize employee displacement due to technological change and other causes of force reduction.

Some contracts contain provisions specifically geared to the problems of technological change. Advance notice of technological change, for example, covered about 15

percent of the workers in the aforementioned BLS study.

One agreement provided that, "... the Company will notify the ... Union ... ninety calendar days in advance of a force surplus brought about by technological change."¹⁵ Another agreement states, "Advance estimates shall be made of employee requirements as of the date the technological change is to be made so as to determine the number of employees to be retained and to be displaced, and to permit the working out of an orderly plan of force reduction."¹⁶ The contract then goes on to provide either transfer, leave of absence, or termination allowance to displaced employees.

Labor-management cooperation in assessing employment needs has been notably successful in the telephone industry. In one collective bargaining agreement,¹⁷ a joint committee on technological change—formed by the company—dealt with the problems created by new technologies. Solutions to these problems included transfers, on-the-job training for other assignments, and the possibility of pensioning employees.

In general, since technological changes affected occupations with high turnover rates, such as telephone operators and clerical workers, the planned use of attrition became a major factor in successfully reducing employment. As employment begins to decline in the more stable craft groups, however, increased emphasis will be placed on retraining employees for new technologies or different types of jobs, while slowly decreasing the size of the work force through attrition.

One union official commented that, while jobs are lost, people seldom are. Thus, since worker displacements are minimized, technological change as a means of raising productivity is generally accepted by telephone industry employees.¹⁸

¹⁵Agreement between the Michigan Bell Telephone Co. and the Communications Workers of America, Aug. 4, 1974, p. 12.

¹⁶Agreement between the Southern Bell Telephone and Telegraph Company and the Communications Workers of America, July 18, 1974, p. 40.

¹⁷Agreement between the Bell Telephone Company of Pennsylvania and the Pennsylvania Telephone Guild, July 21, 1974, "Letter Agreements", p. 4.

¹⁸*Improving Productivity: Labor and Management Approaches*, Bulletin 1715 (Bureau of Labor Statistics, 1971), p. 17.

SELECTED REFERENCES

- Brand, Horst. "Productivity in Telephone Communications," *Monthly Labor Review*, November 1973, pp. 3-9.
- Capron, William M., ed. *Technological Change in Regulated Industries*. Washington, D.C., The Brookings Institution, 1971.
- Diebold Group. *Automation: Impact and Implication; Focus on Developments in the Communications Industry*. Washington, D.C., April 1965.
- "Independent Phone Companies: The Best-Kept Growth Secret," *Business Week*, May 5, 1973, pp. 84-91.
- Loewenberg, J. Joseph. *Effects of Change on Employee Relations in the Telephone Industry*. Harvard University Graduate School of Business Administration, unpublished doctoral dissertation, June 1962.
- McKinsey and Co. *A Study of Western Electric's Performance*. New York, American Telephone and Telegraph Co., 1969.
- "Telephone Industry Forecast," *Telephone Engineer and Management*, Jan. 15, 1975, p. 6.
- U.S. Department of Labor, Bureau of Labor Statistics. *Manpower Planning for Technological Change: Case Studies of Telephone Operators*, Bulletin 1574, 1968.
- U.S. Department of Labor, Bureau of Labor Statistics. *Improving Productivity: Labor and Management Approaches*, Bulletin 1715, September 1971, pp. 17-18.
- U.S. Department of Labor, Bureau of Labor Statistics. *Technological Trends in Major American Industries*, Bulletin 1474, 1966.
- U.S. Department of Labor, Manpower Administration. *Technology and Manpower in the Telephone Industry 1965-75*, Manpower Research Bulletin 13, November 1966.
- U.S. Federal Communications Commission, Common Carrier Bureau. *Statistics of Communications Common Carriers*, annual.
- United States Independent Telephone Association. *Independent Telephone Statistics*, annual.
- "The Changing Network," *Bell Telephone Magazine*, January-February 1975, pp. 3-7.

Chapter 5. Insurance

Summary

Insurance carriers (SIC 63) were the first industry to apply computers to business office procedures on a wide scale with the advent of electronic data processing (EDP) in the early 1950's.¹ Since then, the industry's substantial accounting and statistical requirements, its vast data storage and retrieval operations, and the mass of paperwork it produces have pushed it to the forefront of EDP utilization. Practically every function of an insurance carrier has been computerized, and almost all firms have applied EDP and related technology to at least part of their operations. By 1985, the industry may employ more than 30,000 persons in computer positions.²

The spread of EDP and the growth of the industry have been mutually supporting. A rising population in a growing economy, with concomitant increases in personal income and expenditures for insurance, have made it nearly impossible for firms to function without EDP. Moreover, computers have made it easier for carriers to take advantage of statutes allowing the underwriting of different lines of insurance by the same company. The main problems created by this rapid growth have been gigantic and cumbersome files, interminable transcription of the same data from one form to another, and a myriad of tedious and repetitive operations; for all of these, EDP and related technology is ideally suited.

New technology has brought about substantial improvements in productivity in a wide range of labor-intensive insurance processing operations. The more widespread use of computers, along with optical character recognition equipment, remote computer terminals, microfilm technology, and related innovations, has reduced unit labor requirements in data storage and retrieval, computations, billing functions, and processing of claims, bids, and proposals.

Employment in the insurance industry increased at an annual rate of 2.0 percent during 1960-78 as personal consumption expenditures for insurance reached higher

¹Standard Industrial Classification 63 comprises stock and mutual enterprises which underwrite all types of insurance, primarily life, accident and health, property, casualty, surety (financial responsibility), and title insurance. This study does not include independent agents and brokers (SIC 64) who sell insurance underwritten by others or who render services to insurance carriers or policyholders.

²Unpublished BLS data which include both insurance carriers (SIC 63) and insurance agents and brokers (SIC 64).

levels. A total of 1.2 million persons were employed in the industry in 1978. The number of persons working in clerical occupations is expected to rise at a slower rate than total employment during the period 1978-85 as computers and related technologies increasingly reduce labor requirements in data processing tasks.

Technology in the 1980's

Technological developments in the insurance industry have centered on the application of EDP to an increasing number of the industry's functions, particularly to the management of information. A summary of the major technological changes is presented in table 4.

To cope with the huge volume of paperwork, calculations, and records generated by rapid industry growth, an increasing number of firms are using EDP. Computer programs have been developed for a wide range of insurance industry functions, ranging from actuarial research to claims processing. In addition, EDP is used extensively by the industry to perform basic office tasks such as word processing (typing, copying, printing), mail handling, and check writing.

Technological advances in the industry have led to the merger of a vast electronic data base and computation capability with on-line communications networks, output devices, and office operations equipment. Utilizing this technology, many of the major operating functions for all insurance lines may be performed by a central computer on demand from a terminal in the home office or in any field office (including overseas offices), with the results made available either through visual display devices or on hard copy. More complex operations are constantly being devised, and worldwide electronic communications and operations networks are being created. In addition to EDP, more extensive use of equipment such as closed-circuit TV and other audiovisual equipment for training, new and improved copying devices, text-management equipment, and electronic calculators also have improved efficiency in insurance industry operations.

Planning and implementing EDP applications are preceded by intensive analysis of existing procedures and practices in order to develop the appropriate program, and conversion to EDP (including personnel retraining) is accomplished gradually to avoid disrupting current operations. With the advent of the new generation of



Modern information display system including control unit and printer.

small computers and the corollary drop in computer system operating costs, EDP and integrated systems will be widely applied in the industry during the 1980's.

EDP applications

The number of insurance industry functions which are being converted from manual to EDP operation is growing. Computers are being applied to a wide range of major activities including billing and collection, actuarial research, underwriting, and claims. The industry consensus is that during the balance of the decade and through the 1980's computer technology will be extended to other areas, with unit labor requirements in clerical operations expected to continue to decline. Employment of computer programmers, systems analysts, and other computer specialists is expected to continue to increase as computer use grows.

The further introduction of minicomputers is expected to bring about additional changes in insurance industry operations. Until recently, the insurance industry installed increasingly larger and more complex EDP hardware. This compelled the user to attempt to process through a large computer a growing number of minor operations (as for example, the management of office supplies). The minicomputer will be used more extensive-

ly to perform such tasks as payment of policy dividends and claims and, through a terminal, to edit and process data prior to input into the central system. A minicomputer programmed for an increasing number of insurance applications ultimately may replace the desktop calculator in an insurance firm's head office and branches.³

Billing and collection. A common EDP application is premium billing and collection. Although some carriers prefer to collect premiums through their agencies, the trend is toward home office collection, often through the "turnaround" billing system.

In turnaround billing, a machine readable notice of premium due produced by the computer is returned by the policyholder with the remittance. The computer puts the payment data on a magnetic tape or disk for the accounting department, calculates the agent's commission on each premium, and credits the appropriate account. These systems are currently operating at the rate

³At present, branch offices have little or no processing equipment and often no EDP systems whatever. Most branch equipment consists of key-entry devices for input to home office computers. This is particularly the case among property and liability insurance carriers. Current technology permits the home office to transmit computer programs from the central EDP installation, thereby eliminating the need for programmers in field offices.

Table 4. Major technological changes in the insurance industry

Technology	Description	Labor implications	Diffusion
Electronic data processing (EDP)	EDP is being applied to an increasing number of insurance industry functions including billing and collection, actuarial research, underwriting, and claims processing. Minicomputers are being introduced more widely in various departments within an insurance firm and in some instances are being joined with a central computer. These small computers edit, correct, and preprocess data at the department level before the data are transmitted to the main computer installation. They also retrieve and manipulate data already stored in integrated electronic data base/data communications systems and carry out other functions.	EDP technology has reduced unit labor requirements for file clerks, typists, and other clerical staff. Employment of programmers, computer operators, and related staff has increased along with the number of installations.	EDP technology will be diffused more widely over the next decade as new, less costly, and technologically improved small computers become available.
Integrated electronic data base/data communication systems	All data are recorded on magnetic tape, discs, or drums and processed through a central computer installation. Information can be retrieved instantly at base or remote locations anywhere in the country and displayed on video screens or in printed form. The data may be updated, deleted, or segmented for specific functions. The central processing unit can activate various electronic devices which will utilize the stored data to perform functions such as accounting, billing, internal and statutory reports and statistical tables, correspondence, and promotional brochures.	Reduces the number of file clerks required.	The number of systems in use is increasing. Most of the major carriers have already accomplished the conversion to the system; others are using the building block approach, computerizing their files and operations systems function by function, with a view to eventual integration.
Data input devices: Optical character recognition	Photoelectric devices are being used to scan encoded documents, interpret them, and produce a magnetic tape which triggers operating systems and also constitutes a permanent record of each transaction. They can produce output as disks or video display devices.	Reduces the number of key-punchers and mechanical systems required for EDP.	Widespread, particularly in premium billing and collection operations, promotional campaigns, and data bank input.
Mark sense input system	Special writing tools which trace symbols (lines, dots, or curves) on ordinary paper are being used to produce information readable by computers.	Reduces the number of key-punchers required for EDP.	Not widely used as yet. Expected to gain acceptance in the near future.
Portable computer terminal	Microcomputers in briefcases, complete with keyboard, video display unit and line printer, are being joined to integrated electronic data base/data communications systems by ordinary telephone.	As yet minimal.	Expected to be used more extensively by salespersons.

of about 5,000 remittances an hour, but equipment already available is capable of handling over 40,000 remittances an hour.

Actuarial research. Computers also are reducing unit labor requirements in actuarial tasks. In life insurance, actuarial research yields studies and projections based on mortality and morbidity (the proportion of disease cases to population) rates as well as on records of premium earnings and of policy lapses and maturity. An actuarial department calculates each carrier's premium and dividend rates and provides risk selection guidelines, among other things. Actuarial work is well suited for EDP since it requires the quick retrieval of large amounts of statistical data, the performance of sophisticated mathematical analyses and complex computations, and the production of statistical tables to meet the company's reporting requirements.

Underwriting. Underwriters review all policy applications, pass upon endorsements (changes to policy conditions), and determine the amount and type of reinsurance required. Although the decision to accept or reject each risk must still be made by a trained underwriter, EDP experts and underwriters are working together to expand the computer's participation in underwriting. Operations already performed electronically include logging for transaction control, file search for

possible related material, and coding, rating, and policy issuance.⁴ Electronic processing can control and monitor a policy application through the entire underwriting and policy issuance cycle, producing daily reports on case status at each work station, thereby saving time and labor—an important factor since 10,000 new and renewal applications may be processed daily in the underwriting department of a major carrier. One property and liability company, for example, reduced the personnel in its policy-issuing operation alone by one-third after conversion to EDP.⁵

Claims. The application of EDP to claims processing varies widely with the type of insurance involved; even within the same line, the time frame over which a claim must be serviced greatly affects the automated processes

⁴Insurance policies usually consist of three parts: (1) A jacket, or printed section, which contains only constants applicable to a given carrier or kind of policy; (2) the declarations—a printed form bearing a typed description of the variables involved, such as premium or particular risks; and (3) endorsements, which usually are extensions of either the jacket or the declarations. (Both the printing and typing of policies have been computerized.) Surveys in the property and liability lines have shown that electronic processing of the declarations eliminates an error factor of approximately 8 percent which plagues the manual operation.

⁵LOMA Resource, Life Office Management Association, March/April, 1976.

involved. The widest variation in claims procedures occurs within the life and health insurance companies. Claims that call only for death benefit payments require only eligibility verification and check issuance. In integrated electronic systems, the search capability of the system identifies all policies for a given claimant, and the data base will show the current status of the policies, compute the amounts payable, activate the check-issuing devices, make the appropriate entries into the general ledger, and block any other transaction from occurring.

Health and disability insurance claims involve more intricate processes which require complex EDP programs. These policies provide for payments for services as well as income protection and indemnity. Health and disability claims require large numbers of examiners, file clerks, and typists. In an EDP system, the examiner can view the claim history file on a video screen, determine coverage, adjudicate the claim, calculate the benefits, issue payment checks, and generate the required correspondence.

In the property and liability field, the growing complexity of the coverage has placed a strain on claims processing and encouraged more extensive application of EDP. For example, no-fault automobile insurance in many cases sets a time limit for the insurer to respond to the claim. To achieve growth with a stable work force will require improvements attainable only through electronic automation—a significant challenge in light of the substantial manual processing of claims that occurs in many property and liability companies. The potential of EDP to improve efficiency in claim processing is illustrated by the following example of a system in operation. An appraiser involved in an auto damage claim first checks eligibility and coverage through the home office computer, assesses the damage, and then writes a check to settle the claim. A form filled out at settlement is fed into a transceiver which sends an image by telephone line to the home office (usually at night) for accounting and central files. At the receiving end, the unattended device produces a photograph of the forms and turns itself off when the transmission is completed.

Integrated communication systems

Electronic data base/data communication systems are being applied to the substantial data handling requirements associated with the insurance industry. These data generally must be maintained in current form for several decades and are periodically required for immediate use at various locations in the home office and in the field. As many as 12 separate records are maintained on a given policy, spread among various departments and often duplicated in field offices. In most instances, these functional files include duplicate information. The data overlap often results in one file being current while its duplicates remain static and become outdated.

Integrated electronic data base/data communication systems have several advantages, including the capability

to consolidate all data related to a single policy in the company's central computer installation. The systems search capability permits instant identification of all policies connected with one name and of all names connected with one policy; review of all documents which meet a given specification; and browsing through entire files by flashing their contents on a video screen document by document. In advanced installations, the information is stored on magnetic tape or in disk packs which can hold up to about 30,000 pages of data. The files may be updated or deleted at will, and may easily be segmented for specific purposes and the various segments protected from unauthorized use. To protect the data from accidental destruction, duplicate disks or tapes are kept, usually off premises. Through advances in communication technology, data are accessible rapidly at all stations—immediate and remote—at terminals equipped with video display devices and line printers. Each system is linked by a communication and teleprocessing network of ordinary telephone circuits and leased telephone or telegraph lines. The integrated electronic data base/data communication system produces internal statistical statements on demand as well as the periodic reports required by regulatory agencies. Because of their capability to improve data handling, electronic data base/data communication systems will be used more extensively over the next decade.

Data input devices

Electronic devices which feed into a computer directly from documents are increasing accuracy and displacing keypunch operators. Optical character recognition technology is expected to assist the industry to cope with the massive increase in paperwork to accompany future growth. Without such devices it would already be impossible for the large carriers to handle expeditiously the huge number of inquiries, applications, remittances, and claims they receive every day.

Optical character recognition (OCR) is the instant interpretation and transmission of the symbols and alphanumeric characters which constitute a coded entry, by a photoelectric device known as an optical scanner. In the insurance industry, the optical scanner is used primarily for premium billing and collection. Additional uses are being developed in the processing of other documents which can be preprinted or encoded in machine readable form, such as policy applications, surrender notices, and reinstatement requests, as well as loan applications in life insurance and loss statements in property and casualty claims.

Coded machine readable documents can be produced by the computer or independently by special purpose typewriters and by the "Mark Sense" system, which involves the use of graphic input devices. These consist of a form listing a number of specific pieces of information, a writing tool for touching the items to be entered, and a photoelectric device which converts the data to digital

form for the computer. Data from graphic input devices can be fed onto magnetic tape through a multiplex unit which can support up to 15 stations, each capable of carrying the data stream for a different insurance operation—such as underwriting, claims, or investments. These devices generally cut data entry time by 30 percent. In one instance, a carrier which processed about 400 bids and proposals a month with a staff of 11 was able to process nearly twice as many with a staff of 9 after switching from keypunch to an electronic pen.

Increasing utilization also is seen for the portable input-output device, or “briefcase terminal.” The latest of these devices, which weighs under 15 pounds, is equipped with a keyboard, a microprocessor, a small video screen, and a compact line printer. Connected to an ordinary telephone (by placing the telephone receiver on a cradle in the device) and plugged into an electrical outlet, this device links an agent anywhere in the world with the company’s central EDP installation. Hard copy is produced at the rate of 1,800 characters per minute. With instant access to the company’s central computer 24 hours a day the year round, the agent can make a presentation and place the order for a policy.

Microfilm technology

Advances in microfilm technology are resulting in space savings in records storage, faster retrieval of policy-holder information, and lower labor requirements for file clerks, typists, and other clerical staff. Microfilm processes are particularly advantageous to the insurance industry since large quantities of records are produced, such as policy and loan applications, paid drafts, and Medicare reports, that cannot be stored in the computer in digital form because of their format or statutory requirements.

The original microfilming process (which insurance companies pioneered in the 1940’s) is giving way to microfiche, in which the roll film is replaced by 4”×6” cards each holding about 100 frames (microphotographs) of legal size documents. (Already under development is a high-reduction technique known as ultrafiche, which will increase the capacity of the card substantially.) Microfiche expedites handling of hard copy documents and practically eliminates the storage space required for these items: The contents of about 140 file cabinet drawers can be stored in an 18-inch card tray. When microfiche is coupled with computer-output-micrographic (COM) devices, data are transferred directly from the computer to microfiche without need for intermediate hard copy. Multiple hard copies can be produced rapidly from the microfiche through a nonimpact printer.⁶ Thus, the COM system can produce in a few seconds, from data in the computer, a microfiche frame for the record, available for instant viewing on a screen, and a number of hard copies for distribution. One life insurance carrier made two hard copies each of 230,000 documents from computer tape through microfiche in 15 hours—an operation that would

have required 200 hours with an impact printer. Another carrier, which produced nearly 300 million microfiche frames in 1974, has plans to double this volume within the decade. The COM process is particularly advantageous for use in property and casualty underwriting where there are frequent changes in policy data (as when an automobile is traded in) many of which require transferring or reprogramming data needed for historical purposes.

Industry Outlook

The outlook is for continued expansion in the three major segments of the insurance industry—life, health, and property/liability. About two-thirds of the Nation’s total population are covered by life insurance policies issued by the 1,750 life insurance companies with headquarters in the United States.⁷ The face value of policies in force totaled \$586 billion in 1960, \$2,583 billion in 1977, and was projected by the U.S. Department of Commerce to reach \$3,097 billion in 1979. The number of life insurance policies in force totaled 390 million in 1977, 38 percent more than in 1960. Purchase of new life insurance totaled \$367.3 billion in 1977, compared to \$74.4 billion in 1960, with the average amount of life insurance in force per insured family rising steadily and amounting to \$36,900 in 1977.

Group life insurance, in particular, is gaining rapidly as life insurance benefits increasingly are being included in employee benefit programs, with coverage extended to dependents of group insurance certificate holders. Over 89 percent of all group life insurance contracts covered employer-employee groups in 1973 (most recent year for which data are available), and the average coverage per employee for these contracts was about \$12,000. In addition, millions of employed and retired people are participants in retirement plans operated by life insurance companies. Even greater growth is anticipated in individual retirement plans under the Employee Retirement Income Security Act of 1974, which permits persons employed in firms with no private retirement plan to purchase an individual plan of their own.

Health insurance has expanded substantially. Expansion has been accelerated by the increasing inclusion of health benefits in labor contracts and by insurance

⁶Several printing techniques are available which do not involve striking paper with a mechanical hammer, but use photographic, chemical, or magnetic ink processes and specially treated paper. In one of the most sophisticated of these, the Ink-jet Printer, a stream of magnetic ink droplets is shot towards the paper and deflected by electrostatic plates to form the desired character. Speeds in excess of 75,000 lines per minute are possible with the Ink-jet Printer, although such speeds are not yet available in commercial versions.

⁷The sources of statistics on amounts of insurance in force, number of policies in force, premiums written, number of persons covered, and related data included in this section for these three segments of the insurance industry are as follows: Life insurance, American Council of Life Insurance; health insurance, Health Insurance Institute; and property and liability insurance, Insurance Information Institute.

company participation in the Medicare program enacted in 1966. At the end of 1976 (latest year for which data are available), 177 million persons were covered under provisions of one or more forms of private health insurance. Individuals under age 65 accounted for 93 percent of the total. The older groups were insured under private plans to supplement Medicare benefits. Premiums received by the industry for health insurance coverage rose to \$24.3 billion in 1976, nearly double the premium income received in 1971.

The property and liability segment of the insurance industry also has recorded substantial growth. Between 1960 and 1977, net premiums written for property and liability insurance increased by almost 400 percent, from \$15 billion to \$74 billion. Auto insurance in 1977 accounted for about 42 percent of total property/liability premiums.

Accompanying the premium growth in the major categories of insurance, as discussed above, has been increasing diversification in the types of insurance underwritten by insurance carriers. Insurance companies also are merchandising mutual fund shares and other investment plans, and giant department store chains have formed insurance subsidiaries and are selling policies through in-store booths at their hundreds of outlets. Already many carriers have formed holding companies encompassing estate planning and equity investment, real estate, and data processing.

Employment and Occupational Trends

Employment

Insurance is a major industry that employed 1.2 million persons in 1978, or about 1 out of every 4 persons working in the finance, insurance, and real estate sector. Employment in insurance has been rising steadily as gains in personal consumption expenditures for insurance resulted in a steady rise in policies issued, premiums written, and insurance in force per insured family.

Total employment in insurance increased at an average annual rate of 2.0 percent during 1960-78 (See chart 13.) The annual employment growth rate was 1.8 percent during 1967-78 and 1.7 percent during the earlier 1960-67 period. Employment in the three largest components of the insurance industry—which combined account for about 94 percent of the total industry work force—fluctuated over the period 1967-78. Establishments primarily engaged in underwriting life insurance (SIC 631) continued to employ the largest number of employees, 522,500 in 1978, but their share of total employment declined from over 50 percent in 1967 to about 44 percent in 1978.

Second in size of work force is the fire, marine, and casualty insurance segment of the industry (SIC 633) which employed 460,600 people in 1978, a gain of 44 percent since 1966. Its share of total employment in the insurance industry rose slowly, reaching 39 percent in 1978.

The accident and health segment of the industry (SIC 632) is third in terms of employment, but it is the fastest growing and accounted for about 12 percent of the work force in 1978. Employment in establishments which underwrite accident and health insurance reached 138,900 persons in 1978, more than double their 1966 employment.

The rise in total employment in the industry has been accompanied by increased use of computer and related technology. Despite the fact that in many applications unit labor requirements have declined substantially, with the computer doing in a few hours the work dozens of employees formerly turned out in one day, the adverse effect on employment has been mitigated by several factors. The high rate of attrition which prevailed among the clerical work force required to perform the industry's massive, repetitive data processing tasks has facilitated conversion with minimum dislocation. Moreover, rapid business expansion and advance planning of work force changes appear to have obviated the need for any significant layoffs, and conversion has been carried out mainly by retraining and relocating personnel. Some companies however, have imposed a total freeze on the hiring of clerical workers for protracted periods after computerization to facilitate reassignment of existing staff.

Occupations

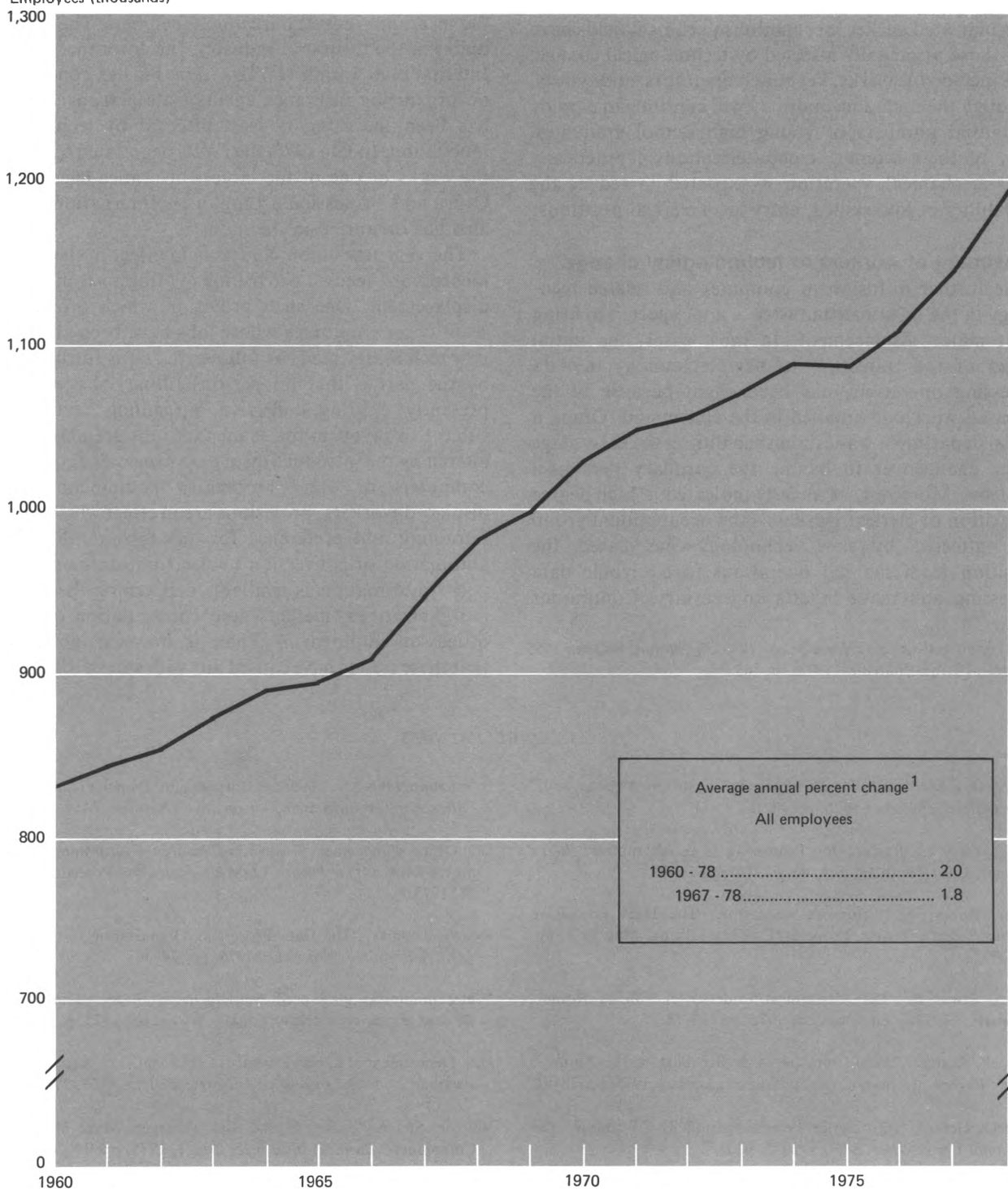
A wide range of occupations in the insurance industry has been affected by the application of EDP and related technologies. Because of these innovations, employment in clerical occupations is expected to increase at a slower rate than that envisioned for all employment in the industry. Consequently, clerical workers, who constitute nearly half of the insurance carrier work force, will make up an increasingly smaller proportion of total insurance industry employment by 1985. The demand for and relative importance of a number of clerical positions, including secretaries and typists, keypunch and other office machine operators, bookkeepers, and file clerks, is expected to decline.

However, employment in managerial and technical positions including those related to the planning, installation, and operation of electronic computer systems is expected to increase. Demand will rise for executives and other officials to determine EDP policy, manage data base and teleprocessing networks, and supervise program development and the recruiting and training of computer applications personnel. Employment of systems analysts, programmers, and computer console operators and related computer operating staff is expected to continue to increase. The insurance industry will continue to be receptive to further application of technology to insurance operations since the industry ranks second only to commercial banks in the proportion of its work force engaged in data processing activities.

Employment of persons engaged full time in selling all lines of insurance directly for the carriers (excluding

Chart 13. Employment in the insurance industry, 1960-78

Employees (thousands)



¹Least squares trend method.

Source: Bureau of Labor Statistics.

general agents and brokers) is not expected to keep pace with the rapidly expanding volume of sales, primarily because of the increasing number of policies sold to groups and the increasing sales of policies which cover several perils previously covered by separate policies.⁸

As indicated earlier, occupations in clerical fields have been those principally affected by technological change; these include file clerks, keypunch operators, and typists. Although the insurance industry will continue to employ substantial numbers of young high school graduates, many of them women, computerization of practically every mechanical operation is expected to reduce the availability of low-skilled, entry-level clerical positions.

Adjustment of workers to technological change

The further diffusion of computer and related technology in the insurance industry is not expected to bring about major displacement. In most cases, the initial impact of the transition to new technology in data processing operations has been slight because of the increased workload entailed in the conversion. Often, a special department was established during the early stage of the changeover to handle the corollary personnel problems. Moreover, as already indicated, a high degree of attrition of clerical workers—the occupational group most affected by new technology—has eased the transition from manual operations to electronic data processing and made layoffs unnecessary. Continuous

⁸*Occupational Outlook Handbook, 1978-79 Edition*, Bulletin 1955 (Bureau of Labor Statistics, 1978), p. 763.

industry growth has permitted absorption of displaced personnel in all categories, and coordinated retraining and relocation by the employers have reduced dislocations to a minimum.

Relatively few employees affected by new technology in the insurance industry are union members. The principal union in the insurance industry, the Insurance Workers International Union (IWIU), thus far has concentrated on organizing insurance agents (salespersons), and this has been the category least affected by technological innovation. In late 1976, the IWIU negotiated to organize the clerks of one of the largest insurance carriers. The Office and Professional Employees International Union also has organized in the industry.

The very few union contracts in effect in the industry incorporate specific provisions relating to technological displacement. One such provision which provides job security for employees whose jobs have been affected by new technology reads as follows: "... It is further agreed by the parties that no persons filling jobs within the presently existing collective bargaining unit will be subject to layoff in the event that jobs are abolished or altered by the introduction of data processing equipment, computers or other automated equipment..." For displaced workers, provisions are in effect which provide retraining and preference for any jobs resulting from automation or conversion to electronic data processing.

No information is available concerning the effect of reorganizations, mergers, and consolidation of branch offices on employment. There is, however, no evidence that these trends have caused any widespread dislocation.

SELECTED REFERENCES

- | | |
|---|---|
| Bowers, Dan M. "Intelligent Terminals and Distributed Processing," <i>The Office</i> , September 1976, pp. 86 ff. | International Business Machines Corporation. <i>Property/Liability Field Office Application Systems—Executive Overview</i> , May 1975. |
| Cantrell, Gary L. "Remote Job Processing as an Alternative," <i>Best's Review</i> , Life/Health Edition, July 1976, pp. 68-70. | Life Office Management Association. <i>Insurance Information Processing: A Look at Our Future</i> , LOMA Systems and Procedures Report 28, 1975. |
| Fischer, Robert A. "Insurance Tomorrow: The Data Processing Picture," <i>Best's Review</i> , Property/Liability Edition, May 1975, pp. 104-09. | Roach, Thomas. "The Data Processing Organization of the 1980's," <i>LOMA Resource</i> , November 1975, pp. 29-30. |
| Fromm, Erwin F. "The Mechanical Underwriter," <i>Best's Review</i> , Property/Liability Edition, June 1975, pp. 16-18. | "Telecommunications Speed Settlement of Auto Claims," <i>Best's Review</i> , Property/Liability Edition, November 1975, p. 102. |
| Goldbeck, George. "Mini-Computers—A Big Part of the Future," <i>Best's Review</i> , Property/Liability Edition, January 1975, pp. 78-81. | U.S. Department of Labor, Bureau of Labor Statistics. <i>Impact of Office Automation in the Insurance Industry</i> , Bulletin 1468, 1966. |
| Goldbeck, George. "Information Processing in the P/C Business," <i>The National Underwriter</i> , Sept. 5, 1975, p. 2. | Valovic, Stefan. "Survey Shows Risk Managers Make More Use of Computers," <i>Business Insurance</i> , Dec. 1, 1975, pp. 19-20. |
| International Business Machines Corporation. <i>Group Insurance—Application Description and System Planning Guide</i> . White Plains, N.Y., May 1975. | Vanderbeek, Robert E., and H. Thomas Verdonk. "Computer System Offers Personalized Customer Service," <i>Best's Review</i> , Life/Health Edition, February 1976, pp. 66-67. |
| International Business Machines Corporation. <i>Individual Life Insurance: DB/DC Information Systems Design Concepts</i> , January 1975. | Wray, Theodore S. "Field Office Video Units Improve Policyholder Service," <i>Best's Review</i> , Life/Health Edition, June 1975, pp. 81-84. |

General References

- National Science Foundation. *Funds for Research and Development*. Annual.
- U.S. Department of Commerce, Industry and Trade Administration. 1979 *U.S. Industrial Outlook*, January 1979.
- U.S. Department of Commerce, Bureau of the Census. *Annual Survey of Manufactures, 1976*, December 1977.
- U.S. Department of Commerce, Bureau of the Census. 1972 *Census of Manufactures, General Summary*, November 1975.
- U.S. Department of Labor, Bureau of Labor Statistics. *Productivity Indexes for Selected Industries, 1978 Edition*, Bulletin 2002, 1978.
- U.S. Department of Labor, Bureau of Labor Statistics. *Characteristics of Major Collective Bargaining Agreements, July 1, 1976*, Bulletin 2013, 1979.
- U.S. Department of Labor, Bureau of Labor Statistics. *Employment and Earnings, United States, 1909-75*, Bulletin 1312-10, 1976.
- U.S. Department of Labor, Bureau of Labor Statistics. *Occupational Outlook Handbook, 1978-79 Edition*, Bulletin 1955, 1978.

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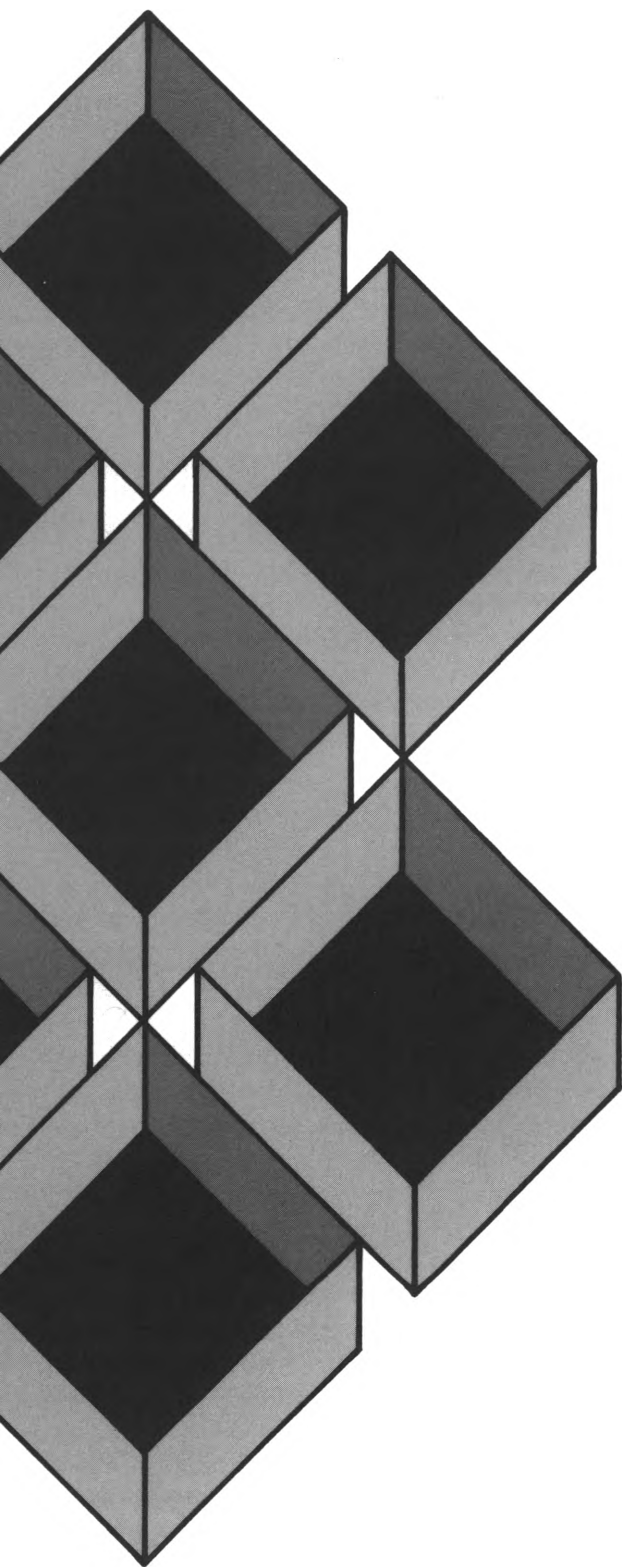
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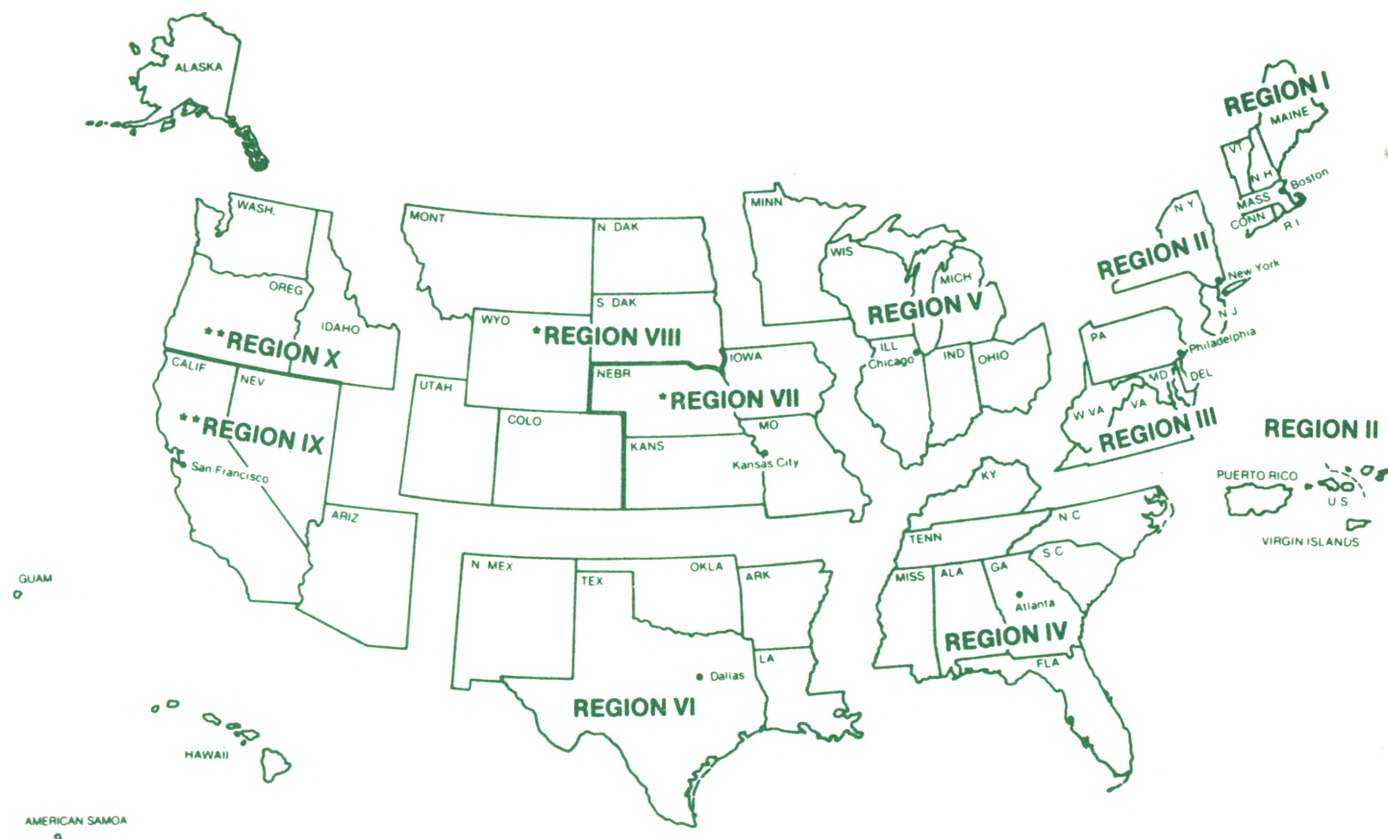
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