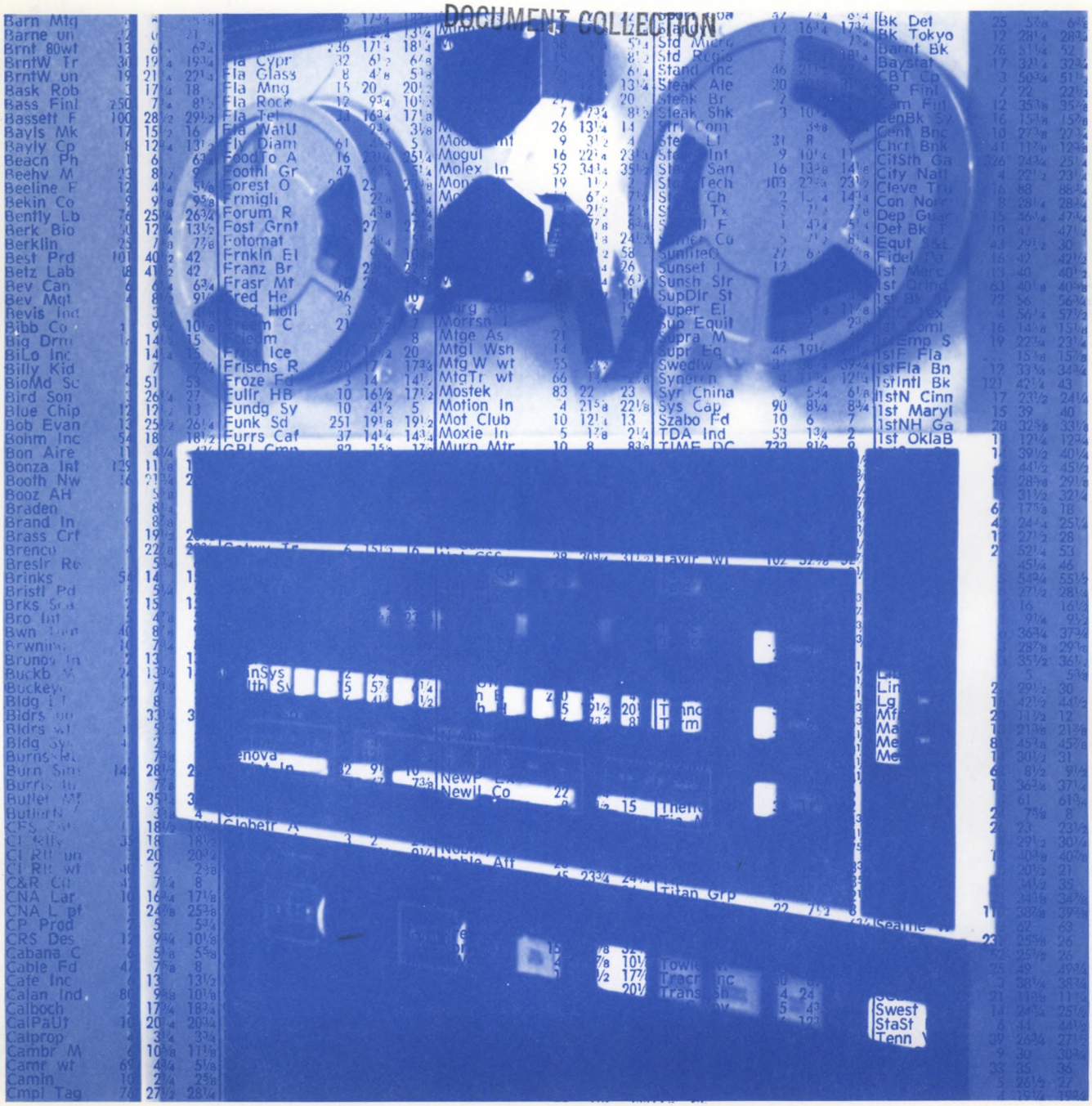
Outlook for Technology and Manpower in Printing and Publishing

Bulletin 1774

U.S. DEPARTMENT OF LABOR
Bureau of Labor Statistics
1973



Outlook for Technology and Manpower in Printing and Publishing

Bulletin 1774

U.S. DEPARTMENT OF LABOR
Peter J. Brennan, Secretary
BUREAU OF LABOR STATISTICS
Ben Burdetsky, Deputy Commissioner

1973

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, GPO Bookstores, or BLS Regional Offices listed on inside back cover. Price 75 cents domestic postpaid or 50 cents over-the-counter. Make checks payable to Superintendent of Documents.

Microfiche edition available from National Technical Information Service, Springfield, Va. 22151, at 95 cents a set. Make checks for microfiche payable to NTIS.

Preface

This bulletin describes changes in technology in the printing and publishing industry, a major industry employing over 1 million workers. The study focuses on the impact of new technology on productivity, employment, and occupational requirements, and describes methods of adjustment. It is one of a series of reports prepared to meet the requirements of the Manpower Development and Training Act of 1962, which directs the Secretary of Labor to establish techniques and methods for detecting in advance the potential manpower effect of automation, technological change, and other innovations that may result in changes in the structure of production. This type of advance information could be of great assistance to management and union leaders, educators, government officials, economists, and others in planning policies to cushion the effects of change.

Information for the study was obtained by members of the BLS staff during field visits to newspapers and commercial printing establishments where new technology was introduced and from experts in industry, labor, and government. Information also was obtained from secondary source materials, particularly trade and technical journals.

The study includes firsthand information on the impact on production and manpower of electronic computers, phototypesetting equipment, web-offset printing, and other innovations at the nine printing firms which participated in the study. The report also discusses the outlook for future diffusion of new printing technology and describes measures undertaken to maintain job security at survey plants and elsewhere.

The Bureau of Labor Statistics is grateful to the many individuals who provided useful information and reviewed the draft of the report. We also wish to thank the Harris-Intertype Corporation for providing us with photographs.

The bulletin was prepared in the Division of Technological Studies, Office of Productivity and Technology, by Robert V. Critchlow and Arthur S. Herman, under the direct supervision of Richard W. Riche and the general direction of John J. Macut, Division Chief.

Contents

Contents—Continued

Introduction

Although the printing and publishing industry has a history of slow technological change, the pace of change has quickened considerably in all the major production steps during the past several decades. Typesetting, for example, was performed by hand for several centuries, until the first commercial typesetting machines became available in the 1880's. The next important innovation, the teletypesetter, was developed 50 years later. Two decades later, in the 1950's, photographic typesetting machines were commercially available. Technological innovation has been much faster in the last 10 years; computerized typesetting, cathode ray tube typesetters, optical character reading equipment, and high speed data transmission are among the major advances. Considerable information describing these recent technologies is available, but much less is known about their effects on workers in plants where the innovations are being used.

In an effort to assess the manpower implications of these emerging technologies, this study undertakes to provide answers to the following questions: How extensively are the various innovations being used, and what is the trend of their use for the future? What factors, such as costs and benefits, govern the future trend of adoption? How has employment been affected by these innovations? What changes in occupational requirements are brought about? What are the training needs for the various innovations? What industrial relations problems arise?

This bulletin presents general information for the entire printing and publishing industry (SIC 27), but focuses on two of the most important divisions of this industry: newspaper publishing and printing (SIC 271) and commercial printing (SIC 275). These two major industry groups employ about two-thirds of the total industry work force of more than 1 million and are utilizing almost all of the major technological changes available to the industry.

To better understand the implications of the new technologies in printing, it is important to realize that all of the sectors of the printing industry have common production operations. These include composition, platemaking, printing press operations, and various finishing operations. These production operations, in turn, are common to the three major printing processes—letterpress, gravure, and lithography (offset). For a more comprehensive description of major printing processes and production operations, see appendix A.

Highlights

New technology is being introduced in nearly all phases of the printing industry. These innovations frequently involve the application of electronic techniques in place of mechanical equipment. In the composing room, typesetting computers, high speed electronic phototypesetting, new techniques to prepare camera-ready copy, and optical character recognition equipment are among innovations having an impact on productivity and manpower. The electronic computer can undertake several key composing room functions traditionally carried out by composing room craftsmen, including word hyphenation and margin determination.

Phototypesetting is another major innovation affecting composing room operations and involves typesetting by photographic processes which are significantly faster than the conventional "hot metal" method. Phototypesetting systems will be introduced more widely in medium- and large-sized newspapers and book and periodical printers. Other innovations affecting manpower and productivity in printing firms that are expected to be diffused more widely include new platemaking methods and materials, automatic plate processors, electronic methods to separate color in color printing, automatic equipment to process films in making negatives, automatic electronic controls and higher speeds on printing presses, and automatic mailroom equipment.

Implementing new printing technology did not require a substantial amount of technical manpower and generally did not take a long time. Planning for new equipment at most survey plants was undertaken by a small group of high level management employees, including shop foremen in some instances. Most of the engineering and installation effort was performed by staff provided by the supplier of the new technology, the size and composition of the team depending upon the type of equipment purchased and the complexity of the installation. General-purpose computers were among the most complicated new technologies to implement since they required a large amount of programing effort and specialized peripheral equipment.

Adoption of new printing technologies is encouraged by lowered production costs, higher quality, and faster output. The cost of new technology varied widely at survey plants, depending upon the type of equipment installed, the nature and complexity of the application, and the type and size of the user firm. Costs of computers, for example, ranged from $22,000 for a small special-purpose computer at a local newspaper to $610,000 for an advanced model, general-purpose computer at a commercial printer.

Some of the more important objectives for introducing new technologies at the survey plants were to increase the quality of product, expand output, reduce labor costs, increase operating capabilities, and reduce waste.

All the plants achieved most of the gains they anticipated and benefits were substantial in some cases. Gains were achieved by increasing output per worker, decreasing typographical errors, reducing paper costs and makeready time, decreasing labor costs, and increasing output.

Total employment at survey printing firms generally had increased, although occupations and skills of employees working with new technology had been altered. In departments where new technology had been introduced, however, the employment situation was mixed: in some units employment was higher; in others, lower levels were reported. Significant reductions in unit labor requirements in some instances followed introduction of technology, with the largest productivity gains occurring in newspaper mailroom operations. Only six full-time employees were involuntarily separated (and later reinstated) and none were down graded at the nine firms included in the study.

Occupations and skills in all of the major production steps of composition platemeking, presswork, and newspaper mailroom operations are undergoing change. In survey printing firms, linecasting machine operator positions were being eliminated; computer programer and related jobs were being added; and composing room employees were being retrained in photographic methods, in typing skills to prepare tapes used to operate computers and phototypesetters, and in maintenance procedures for electronic equipment. The use of computers has simplified keypunch operations in tape preparation, reduced errors, and improved productivity In platemaking and press operations, new equipment and methods require more technical skill and less of the traditional craft skills. In the mailroom, manual tasks

associated with counting, handling, and tying newspapers are being drastically decreased through the growing use of automatic equipment.

Training workers to function with new printing technology was essential and has been the foremost method of manpower adjustment. Training was provided by major unions, industry associations, vocational schools, equipment manufacturers, and printing firms. In the shift from hot metal composition to computers and phototypesetters, many employees received on-the-job instruction, lasting from 1 week to 15 months; some attended classes at the computer manufacturer's school.

New printing technology has focused attention on techniques to maintain job security. Printing unions generally favor technological change, provided measures are undertaken to protect members from displacement and other adverse effects. Collective bargaining agreements at unionized survey plants and in the industry generally contain provisions applicable when new technology is introduced, including those relating to jurisdiction, advance notice, training, selecting employees for new jobs, layoffs, and severance pay. At the nine firms surveyed, substantial advance manpower planning was undertaken, including providing notice up to 3 years prior to the installation of new printing equipment, selecting employees to staff new computer and related positions, determining wage rates for new and modified positions, and providing training to employees whose job duties were modified.

The outlook for new technology in the printing industry is for significant growth. By 1980, industry experts optimistically forecast that nearly all newspapers in the United States will be using computers for composing room and various business data processing operations. The diffusion of computers in commercial printing is expected to be slower.

New printing technology will continue to affect employment and job skills during the decade of the 1970's. Total employment in printing is expected to increase over the next decade. In the newspaper segment, however, employment is projected to be lower by 1980 because of the impact of new technology. As technology becomes more sophisticated, more professional managers, engineers, technicians, and computer personnel will be needed, and composing room employees increasingly will need to acquire skills in keypunching, photography, and electronics. Although limited displacement of compositors, typesetters, electrotypers and stereotypers, and others is expected, the impact may be eased as demand for printed products increases and attrition and training facilitate manpower adjustments.

Chapter 1. The Printing Industry's Importance in the Economy

The printing and publishing industry is a major U.S. industry, employing over 1 million workers. It is characterized by the predominance of small firms and the presence of strong craft unions. Economic trends in the industry are towards increasing employment, rising productivity, growing capital investment, and intensified research and development. This chapter contains a definition of the industry, a description of the importance of the printing industry in the Nation's economy, and a discussion of the major economic trends. It provides the background for subsequent chapters on changes in technology and their manpower implications.

Definition of the industry

According to the Bureau of the Census, the printing and publishing industry consists of approximately 38,000 establishments, of which about 4 out of 5 employ fewer than 20 workers.

The U.S. Government's Standard Industrial Classification (SIC) designates nine industry subgroups. These include establishments engaged in printing newspapers, books, periodicals, and business forms; lithographic and nonlithographic commercial printing; and establishments that perform services for the printing trade, such as bookbinding, typesetting, photoengraving, and electrotyping.

This report focuses on two of the most important of these industry divisions: newspaper publishing and printing (SIC 271) and commercial printing (SIC 275). Each of these two divisions employs about one-third of the total industry's work force, and both are undergoing significant technological change.

Employment

In 1971, there were nearly 1.1 million employees in the printing and publishing industry—approximately 367,000 more than in 1947. This constituted a 51 percent growth in printing industry employment, in contrast to a 20 percent growth in employment in manufacturing as a whole, and a 12 percent gain in employment in nondurable goods.

As shown in table 1, employment in the industry grew at an annual rate of 1.8 percent from 1947 to 1971. Employment in newspapers grew by a slightly lower rate—1.5 percent a year. The greatest difference in growth rates was between the two major sectors of commercial printing—nonlithographic and lithographic. Employment in nonlithographic commercial printing grew at an annual rate of less than 1 percent, while in lithographic commercial printing, although smaller in absolute terms, employment maintained a growth rate of 4.4 percent a year.

About 22 percent of all printing employees work in printing craft occupations; the remaining 78 percent are employed in positions such as clerks, salesmen, general office workers, reporters and editors, and managers.

Table 1. Employment in printing and publishing, selected subgroups and periods, 1947-71

Period	Total printing and publishing	Newspapers	Commercial printing	
			Except lithographic	Lithographic
NUMBER OF EMPLOYEES (thousands)				
1947	721.0	248.5	179.8	49.5
1958	872.6	314.1	194.0	73.7
1971	1,087.7	370.0	209.1	128.2
PERCENT CHANGE				
1947-71	50.9	48.9	16.3	159.0
1947-58	21.0	26.4	7.9	48.9
1958-71	24.7	17.8	7.8	73.9
ANNUAL RATE OF CHANGE				
1947-71	1.8	1.5	0.7	4.4
1947-58	1.9	1.9	1.1	4.1
1958-71	2.0	1.4	0.8	4.7

SOURCE: Bureau of Labor Statistics.

Production and productivity

An index of productivity for printing and publishing is not published by the Bureau of Labor Statistics, primarily because output data for the industry are limited. Physical output data are poor or nonexistent and, although value of shipments data exist, appropriate deflators are not available.

The Federal Reserve Board (FRB) publishes an index of production which, while not reliable enough to be used in the construction of productivity indexes, nonetheless can be useful as an approximation of the magnitude of change in production. From 1954 to 1971, production (FRB index) in total printing and publishing nearly doubled–an increase of 91 percent, or an average of 4.2 percent per year–as demand for printed materials rose with expansion of population, business activity, income levels, and leisure time. In contrast, the increase in total employment (BLS data) over this period was 34 percent or 1.8 percent per year, substantially below the rate of growth of production. (See table 2.) Although definitive measurements of productivity for the industry are not available, these figures do suggest an improvement in manpower utilization during the 1954–71 period as new and more productive equipment was introduced into printing establishments.

Capital spending

Printing firms spent $982 million for new plant and equipment in 1971.[1] Average capital expenditures per employee–one indicator of the pace of technological change– have been rising. (See table 3.) Data on value of capital stock in place–considered a more valid indicator of technological change than annual capital expenditures–are not available for printing and publishing.

In 1947, the three industry subgroups of newspapers, nonlithographic commercial printing, and lithographic commercial printing had greater capital expenditures per employee than the industry as a whole.

By 1971, this situation had changed considerably. Expenditures for newspapers and nonlithographic commercial printing fell below the $903 per employee industry average. Expenditures in lithographic commercial printing, however, rose to a figure in excess of $1,500 per employee–well above the industry average. Moreover, total capital expenditures in lithographic commercial printing in 1971 ($197 million) reversed the past pattern and exceeded the total for nonlithographic printing ($154 million).

The relatively large gain in capital expenditures per employee in commercial lithographic printing between 1947 and 1963 (an increase of 144 percent) probably reflected the introduction of such new technologies as phototypesetting and web-offset presses into commercial lithographic printing during the 1950's and early 1960's.

The wave of new technology that caused the large growth in commercial lithographic printing spread to newspapers in the early 1960's. Average expenditures for new plant and equipment per newspaper employee increased from $411 in 1963 to $742 in 1971 Total capital expenditures more than doubled while employment increased by 12 percent.

[1] Bureau of the Census.

Table 2. Production and employment in printing and publishing, 1954-71

Period	Production	Employment (all employees)
INDEX, 1967=100		
1954	53.6	77.7
1955	59.0	79.7
1956	62.7	82.3
1957	64.9	83.0
1958	63.3	83.3
1959	67.6	84.8
1960	70.4	87.0
1961	70.7	87.5
1962	73.3	88.4
1963	77.1	88.8
1964	83.6	90.8
1965	89.5	93.5
1966	98.1	97.1
1967	100.0	100.0
1968	103.0	101.7
1969	105.7	104.3
1970	104.1	105.6
1971	102.5	103.8
PERCENT CHANGE		
1954-71	91.2	33.6
1954-63	43.8	14.3
1963-71	32.9	16.9
ANNUAL RATE OF CHANGE		
1954-71	4.2	1.8
1954-63	3.5	1.5
1963-71	3.7	2.3

SOURCE: Federal Reserve Board and Bureau of Labor Statistics.

Research and development

Research and development (R&D) activities are increasing, although it is estimated that for the total

Table 3. Expenditures for new plant and equipment in printing and publishing, selected subgroups and periods, 1947-71

Period	Total printing and publishing	Newspapers	Commercial printing	
			Except lithographic	Lithographic
DOLLARS PER EMPLOYEE				
1947	$313.96	$328.30	$337.47	$ 351.25
1963	498.50	411.07	505.35	858.26
1971[1]	903.19	742.16	734.10	1,539.00
PERCENT CHANGE				
1947-71	187.7	126.1	117.5	338.1
1947-63	58.8	25.2	49.7	144.3
1963-71[1]	81.2	80.5	45.3	79.3

[1] Preliminary.

SOURCE: Bureau of the Census and Bureau of Labor Statistics.

printing industry only 1 percent or less of each sales dollar goes into R&D. In commercial printing, the proportion spent for R&D is reportedly well below the 1 percent industry average.[2]

Most R&D is carried out by equipment and material manufacturers, trade associations, industry and independent research organizations, and a rather small number of medium to large-sized printing firms with the capital and willingness to experiment. The number of printing and publishing firms with in-plant research departments increased during the 1960's and this trend is expected to continue.[3]

Traditional manufacturers of printing equipment and printing materials have hastened their development of new products, and firms not generally associated with the printing industry—such as computer manufacturers—are developing new products for the industry. Possibly the entry of new firms into the manufacture of printing equipment prodded the traditional manufacturers to greater development activity than would have occurred otherwise.

Other sources of R&D are trade associations, such as the National Association of Printing Ink Manufacturers, the Technical Association of the Pulp and Paper Industry, the Institute of Paper Chemistry, and the American Newspaper Publishers Association, which have sponsored research and, in the case of the ANPA Research Institute, have performed research.

Research organizations—both industry-supported and independent—are very important sources of R&D. Among the industry-supported organizations are the Graphic Arts Technical Foundation, Gravure Research, Inc., The Book Manufacturer's Institute, and the Photoengraver's Research Institute. Independent research institutes that conduct research on a contract basis include the Battelle Memorial Institute, involved in printing industry research since 1934 and the developer of the process of xerography; the Massachusetts Institute of Technology, which performed some of the basic research on the Photon phototypesetter; the Stanford Research Institute, presently conducting research on electrostatic printing; and the Rochester Institute of Technology, which has a comprehensive graphic arts training and research program.

[2] *U.S. Industrial Outlook—1970*, p. 71.

[3] J. Homer Winkler, "How Research and Development Spark the Printing Industry," *Inland Printer/American Lithographer*, November 1968, p. 27. Also see Winkler, "Research: The Key to Graphic Arts Vitality," *Inland Printer/American Lithographer*, May 1969, pp. 41–44.

Chapter 2. Key Technological Changes

New technology is being introduced in all major phases of printing including composing room, platemaking, pressroom, and mailroom operations. This chapter describes some key innovations underway in the industry and provides examples of their use at survey plants. Table 4 lists the innovations installed at the nine newspapers and printing plants included in the study.

Composing room

As indicated in appendix A, the printing process begins in a composing room where manuscript copy is set in type and checked for errors. Some of the most dramatic technological changes are occurring in the composing room where approximately half of all printing craftsmen are employed. Important among the innovations being introduced are (1) typesetting computers, (2) high speed electronic phototypesetting, (3) strike-on typesetting, and (4) optical character recognition.

Computers for typesetting. Computers can perform several important composing room operations that traditionally have been performed by highly skilled composing room employees. The most common applications are automatic margin setting (justification) and word hyphenation.

The diffusion of typesetting computers has been proceeding at a rapid pace. According to Composition Information Services, Inc., typesetting computer installations in the United States increased from 98 in 1964 to 663 in 1968—a gain of nearly 600 percent.[4] As demand for new printing technology grows, major computer manufacturers increasingly are entering the printing industry market which previously had been supplied primarily by two large printing machinery firms.

Newspapers are the largest users of typesetting computers, accounting for nearly two-thirds of total installations.

Generally, composing room computers are divided into two classes: special-purpose and general-purpose machines. Special-purpose computers are small, simple machines designed to justify copy. Some special-purpose computers also can hyphenate words, but the inclusion of this capability adds to the complexity and expense of the machine. The more expensive general-purpose computers can perform, in addition to justification and hyphenation, many noncomposition operations, such as accounting, payroll preparation, and customer billing. Thus, one general-purpose computer can be used for a variety of business data processing and production needs.

In composing room operations, computer input is either magnetic or punched paper tape. Punched paper tape is more widely used, primarily because it was commonly used to operate conventional typesetting machinery. Tape is punched on teletypesetter equipment or on the newer tape-punching machines that utilize a typewriter keyboard. The latter are probably somewhat faster and easier for new employees to operate since anyone who can use a typewriter can learn to use the relatively simple extra keys and controls. In contrast, the teletypesetter keyboard is entirely different, requiring operators to be specially trained.

In preparing copy for computer justification and hyphenation, the operator first types instruction codes, such as line length and spacing, and then types the manuscript without regard to line length and hyphenation. The result is a reel of "unfinished" tape that is ready for computer processing. The computer performs all the necessary typesetting functions and puts out "finished" tape that can operate automatic hot metal or photographic typesetting machines.

A secretary with average typing skills—with only a small amount of training—can type unfinished tape on an electric typewriter and feed the tape into a computer for processing. Consequently, skilled composing room craftsmen who have traditionally set type can be bypassed and the work can be completed faster and reportedly at lower cost.

Computers were being used for composing room operations at seven of the nine printing firms contacted for information. The two large metropolitan dailies were using advanced general-purpose computers to perform hyphenation and justification as well as general business tasks. One of these newspapers also was using its

[4] *CIS Survey of Computerized Typesetting*, Composition Information Services, Los Angeles, October 15, 1968.

Table 4. Advanced equipment and techniques in use at newspapers and printing plants visited

Type of plant	Computerized typesetting	Phototype-setting	Optical character recognition	Automatic stereotype platemaking machines	Plastic printing plates
Newspaper:					
Large metropolitan daily	x	x		x	
Small local daily	x	x	x		
Large metropolitan daily	x	x		x	[1] x
Small local daily					
Small local daily	x				
Commercial printing plant:					
Publications printer (books, magazines, pamphlets)					
Typesetting plant for books (mainly textbooks)	x	x			
Typesetting plant for directories, catalogs, etc.	x	x			
Publications printer (mainly magazines)	x				x

Type of plant	Automatic film processing	Web-offset press	Advanced press controls	Automatic mailroom equipment
Newspaper:				
Large metropolitan daily			x	x
Small local daily		x		
Large metropolitan daily			x	x
Small local daily	x	x		x
Small local daily				x
Commercial printing plant:				
Publications printer (books, magazines, pamphlets)	x	x	x	
Typesetting plant for books (mainly textbooks)				
Typesetting plant for directories, catalogs, etc.				
Publications printer (mainly magazines)				

[1] Experimental.

SOURCE: Plant visits.

computer system for press control and mailroom operations.

A local newspaper visited was using a small special-purpose computer for justification only; another local paper in the survey, an innovator in the industry, was using a highly sophisticated computer system in connection with data transmission. The latter newspaper, then the headquarters of a statewide chain of local newspapers, installed a large general-purpose computer for typesetting and set up a data transmission network linking the computer to a number of its other papers. The newspapers in the system transmitted "unfinished"

copy directly to the computer, which performed hyphenation and justification, and sent "finished" copy back to the originator's terminal where tape was punched for use in automatic typesetting machines.

Two commercial printers contacted were using special-purpose computers: a book typesetting plant for hyphenation and justification, and a publications printer for justification only. A directory typesetter, on the other hand, had installed a powerful third-generation general-purpose computer to be used with an advanced third-generation phototypesetter.

Phototypography. Another important innovation in the printing industry is typesetting by photographic processes (phototypesetting), a much faster technique than hot metal typesetting which it is displacing. The most advanced automatic hot metal typesetting machines can set 7 to 10 type characters a second, compared with computerized phototypesetters which operate at speeds up to 1,000 characters a second.

In phototypesetting, type is set on photographic film or paper rather than in metal. The brass molds used in hot metal typesetting are replaced, in all but the new cathode ray tube models, by photographic negatives called "matrices." Depending upon the machine used, a matrice may be small and contain only one character, or larger, containing one or more complete alphabets. The desired character is alined between a light source and a lens, and its image is exposed through the lens, onto film or paper. By changing the position of the lens, or using different lenses, the character can be exposed in a variety of different sizes. When the film or paper is exposed, it is developed and used to make printing plates.

Three generations of phototypesetters currently are in use. The earliest are mechanical, keyboard-operated machines that select and expose one character at a time at speeds up to 10 characters a second. Second-generation phototypesetters are electro-mechanical machines that usually are tape-operated, rather than manually controlled. These machines use matrices that contain one or more complete alphabets (sometimes referred to as "grids"), rather than single-character matrices, and expose 10 to 30 characters a second.

The recently developed third-generation machines operate by more advanced electronic principles. These machines generate characters from matrices or digital information stored in a computer and display them on a cathode ray tube (CRT) similar to a TV picture tube. The characters, as they appear on the face of the tube, are picked up by the lens and are exposed onto photographic film or paper. These machines can turn out 1,000 characters a second, and compose entire pages instead of a line at a time. Because of their speed and complexity, CRT typesetters regularly use computers to "input" data, institute commands, and generate type characters.

In the mid-1960's, an estimated 1,000 phototypesetting machines, performing about 2 percent of total typesetting, were in use; by early 1973, however, installations had risen substantially, with an estimated 10,000 phototypesetting machines performing about 35 percent of all typesetting.[5]

Phototypesetting offers several major economic advantages which make the process highly attractive for use by newspapers. It operates at a typesetting speed unattainable by hot metal processes, especially when phototypesetting equipment is linked to a computer. The machine error rate for computerized phototypesetting is generally lower than for hot metal typesetting. Manpower requirements in the composing room can also be reduced with computers and phototypesetters. Some of these economic advantages, however, can be realized without shifting completely to a computerized phototypesetting system by using computers to drive hot metal typesetting machines or using phototypesetting without a computer in applications such as setting advertisements.

Three of the newspaper and two of the commercial printers in the study were using phototypesetting equipment at the time of visit. Three newspapers were using second-generation phototypesetters. In addition, one of the newspapers was experimenting with a third-generation (cathode ray tube) unit, although it was not fully operational at the time of visit.

Among the commercial printers, a book typesetter was using both first- and second-generation units and found them suitable to its operations. A directory typesetter had just replaced a second-generation computerized phototypesetter system with an advanced system incorporating a large computer and a cathode ray tube phototypesetter. This firm was changing and updating catalogs, directories, and price lists, jobs which lend themselves to processing by a high speed third-generation computerized phototypesetting system.

Strike-on. This composing system utilizes typewriter-like typesetting equipment which produces justified text composition in a limited range of styles and sizes. Text copy is produced by impacting the image through a carbon ribbon onto proofing paper (in the same way that a letter is typed on a typewriter). The proofing paper is then ready for assembly with headliner and artwork, after which it is photographed and made into a printing plate.

[5] *Kodak Highlights,* February 1973, p. 9. Published by the Eastman Kodak Company, Rochester, New York.

High speed phototypesetting machine

Strike-on, or "cold type" composition, is a popular means of producing composition where cost is a more important factor than quality. The system has the potential for bypassing many of the traditional composing room operations by allowing a typist, with some additional training and using fairly simple typesetting equipment, to prepare text copy. Because of its low cost, and the ease with which copy can be produced, the strike-on method has found increased acceptance in typographic firms, the composing rooms of some commercial printers, and in-house composing departments.

Optical character recognition. Optical character recognition (OCR) equipment is a composing room innovation that may become more important in the future. This equipment consists of electro-optical devices using photoelectric cells to compare characters on the copy to characters programed into the computer memory of the scanners. Each character is identified and translated into an electronic signal that operates the tape-punching equipment. OCR equipment is designed to "read" copy at rates of 75 to 3,200 characters a second and translate it into unjustified tape which can be fed into a computer for justification.

This innovation is an attempt to bypass the worst bottleneck in composing room operations, the manual manipulation of a keyboard to prepare punched paper tape for computer and typesetter input. Eventually, OCR equipment may be able to read any style of type set before it, even handwritten copy. At present, however, scanners are in limited use since they have many operational limitations and are very expensive.

One local newspaper, the headquarters of a highly innovative chain, was using two optical scanners in conjunction with its computerized typesetting system. This was a pioneer installation of this technology in the newspaper industry. Originally only one scanner was installed; however, when it proved unreliable, a backup unit was added. Because of the high speed operation and great cost of the scanners, utilizing their full capabilities economically was difficult. The scanning system could handle much more copy than the newspaper was able to generate.

Platemaking

Platemaking technology is undergoing significant change. Most of the innovations involve photographic

forms of platemaking used by all three major printing processes–lithography, letterpress, and gravure.

Lithographic platemaking has increased in the past decade because lithographic printing–especially web-offset–has grown so rapidly. Most of the growth has been in commercial printing, but some of it is due to the adaptation of web-offset by small- and medium-sized newspapers.

To make a conventional offset plate, a thin metal sheet (usually aluminum) is coated with light-sensitive chemicals, and the copy negative exposed onto it by use of a strong arc light. The light-sensitive chemical is hardened in the image area, becoming insoluble to water, and the plate is coated with a special ink–receptive lacquer that adheres to the hardened chemical. The plate is washed in water to clean the lacquer and nonhardened water-soluble chemical from all parts of the plate not carrying the image. Thus, only the image area retains the lacquer and remains receptive to ink.

Precoated plates are available which reduce plate preparation work. The most advanced plate comes with a presensitized, water-receptive coating. This plate can be unpackaged and exposed to a film negative for about 2 minutes, and is ready for the press–no addition of chemicals or washing or drying is needed. This method of platemaking contrasts greatly with the more complicated and time-consuming techniques needed to make the heavy lead stereotype plates for conventional letterpress printing.

Letterpress printing with plastic printing plates. The introduction of plastic printing plates for letterpress printing is another development that may prove to be of major importance in the printing industry. Although a large amount of letterpress equipment is presently in use, competition from web-offset printing presses used in conjunction with phototypesetting has made major inroads into letterpress printing. With the significant amount of capital invested in existing letterpress equipment, much research and development effort has been undertaken to upgrade and modernize the letterpress process; the plastic plate is the most important result of that effort.

The first widely used plastic printing plate was introduced in the early 1950's. It can be used for black and white or color printing, electrolytically plated for long press runs, and used on rotary presses. Plastic printing plates offer excellent ink transfer characteristics (using slightly less ink than conventional metal plates), and reduce makeready time in some applications. Although the plate has received considerable acceptance in most of the printing industry, thus far most newspapers have found them uneconomical because they are expensive and time-consuming to make.

The key criteria for letterpress newspaper plates are that they must be prepared quickly and inexpensively. However, the quality need not be comparable to commercial printing plates because, with the possible exception of some advertisements, they are used for one edition only.

The recent introduction of two new printing plates made of thin, flexible plastic may fulfill these criteria and result in their future application in newspaper printing. One type of plate is made by photographic processes, and this capacity is being developed for the other plate system, allowing phototypesetting, with its laborsaving potential, to be combined with existing letterpress printing presses. The cost and the time required to prepare the newer plastic printing plates are about the same as for stereotype plates, but printing quality of the plastic plates is superior, press life is longer, ink transfer characteristics are better, and handling and storing are easier due to their light weight.

One of the large metropolitan daily newspapers visited was experimenting with the newer plastic plate system. Although the platemaking equipment was operational at the time of visit, results on the press were not yet satisfactory. Company officials, however, were optimistic about the eventual success of this system for newspaper letterpress printing.

Letterpress printing with stereotype platemaking. Several advances also have been introduced in conventional stereotype platemaking for letterpress printing. These include more highly automated platemaking machines which produce original and duplicate plates quickly and inexpensively, and automatic routing equipment to remove irregularities in non-image areas much faster than hand methods. This type of equipment was in use at the two large daily newspapers visited. Despite these advances, stereotyping is expected to decline in use because of the growing competition from lithographic printing and the potential competition from plastic plates.

Gravure printing. Gravure is a specialized form of photoengraving used mainly for high quality magazines and books and for packaging. The gravure printing plate is a hollow cylinder, usually made of steel or cast iron, and is electrolytically plated with copper. Large gravure cylinders are over 100 inches long and can weigh almost a ton. Press life for the cylinder can extend into the millions of impressions, and operating speed for web-fed (rotogravure) presses can exceed 2,000 feet a minute.

The main advantage of gravure printing is long run production with high quality printing. This is especially

true for color printing, because gravure puts a thicker layer of ink on the paper than any other process that operates at a comparable speed. Disadvantages include the relatively high cost and the large amount of time and handwork needed to prepare cylinders. Due to their size and weight, the cylinders are difficult to handle, plate changes cannot be made easily, and cylinder storage can be a problem.

Gravure may be on the edge of rapid growth. Demand is strong for the high quality color printing that gravure can provide. All of the advances in film processing such as color separation, automatic developing, and electronic etching apply to gravure. Research on new gravure techniques is underway with laser etching of gravure cylinders a major innovation under study.

Electronic color separation. In color printing, the colors must be separated from each other photographically and a printing plate made for each color. Each plate, therefore, contains a segment of the total image to be printed. Color separation, until recently, has remained essentially a hand process—time-consuming, fairly costly because of high labor input, and requiring highly skilled craftsmen. Color separation has long been a bottleneck in color printing and the problem has become particularly acute in recent years because the demand for color printing has increased greatly.

A solution to this problem has been the introduction of electronic color separation (or color scanning) equipment. These machines convert light from color copy into electronic signals that can be used to expose the separation films. Color scanners do not eliminate all of the time-consuming handwork involved in color separation, and they do not greatly reduce color preparation costs. But, when used as part of a color separation and correction system, scanners can reduce substantially the amount of manual preparation work and skill required. They are faster than conventional procedures; color separations that require several hours of work by conventional camera methods, for example, can be accomplished in considerably less time with a scanner. Moreover, their output is more uniform and predictable than conventional hand processes and at least equal in quality.

Automatic film processing systems. As with color separation, conventional film developing to make negatives used for platemaking has involved a considerable amount of manual work. Automatically controlled film processing systems, becoming widely used, provide high quality developing with less manual work and lower processing costs. Their major advantage, however, is in the uniformity of output. They standardize and control quality but require no special skills. Automatic film processing units are operating satisfactorily at a local newspaper and a publications printer visited as part of the survey.

Other innovations. Electronic engraving equipment—primarily for making gravure cylinders—scans copy in a fashion similar to electronic color separators, but uses the electronic signals to operate a sharp stylus that automatically engraves printing plates at very high speeds. These systems are being used extensively in Europe, and their use is growing rapidly in the United States. Several copy-to-plate camera systems exist that automatically photograph copy and make plates. Although copy-to-plate systems are not yet completely perfected, they do eliminate negatives and developing and stripping operations.

Press operations

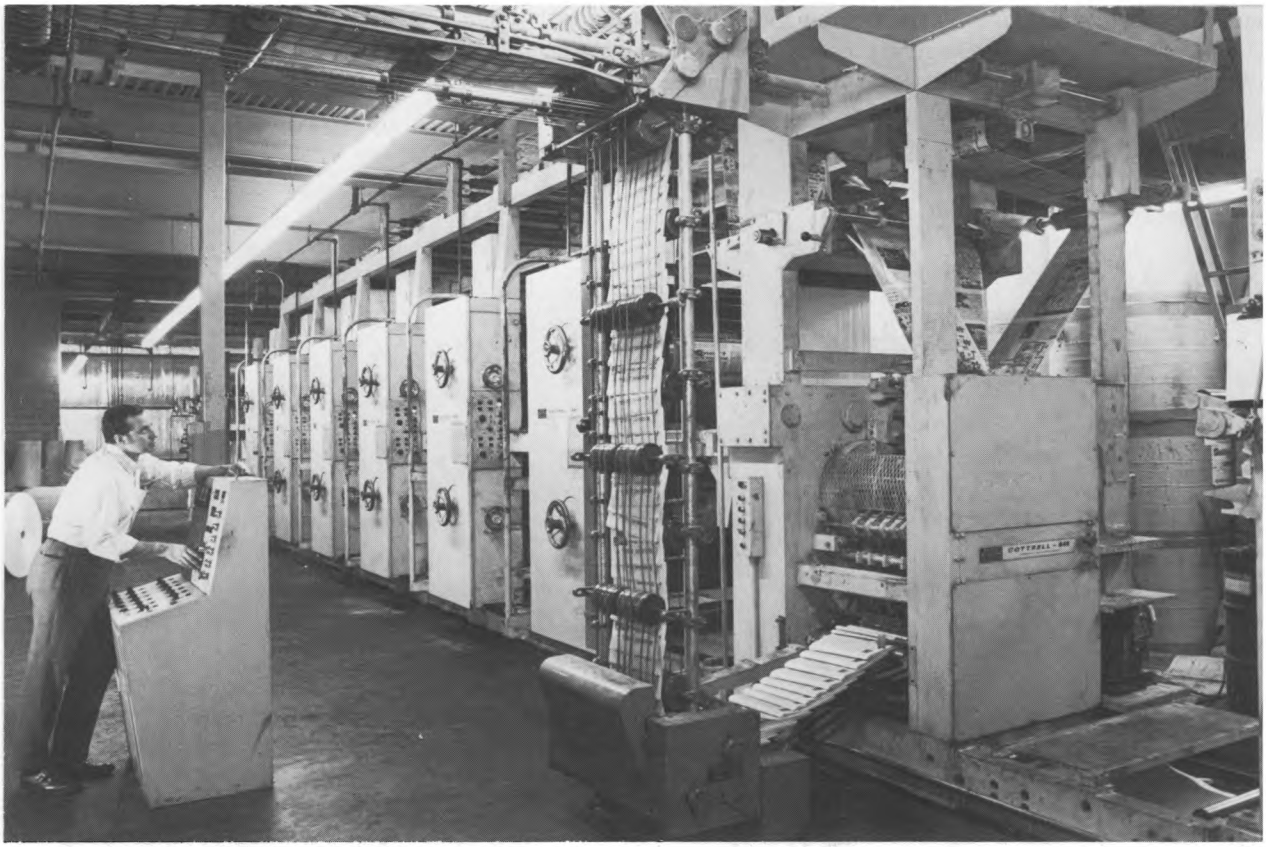
The two most significant changes in press operations in the past two decades have been the shift from web-letterpress and sheet-offset to web-offset presses, and the application of advanced electronic systems to make the controls of presses more automatic.

Web-offset presses. Web-fed printing presses have been used for many years in letterpress and gravure printing, but web-fed offset presses did not come into use until the early 1940's, when they were developed specifically for printing business forms. In the 1950's, web-offset expanded into commercial printing and book and magazine publishing. Small weekly and daily newspapers began to convert to web-offset in the early 1960's. By 1970, 47 percent of the 1,400 daily newspaper printing plants and 41 percent of the 6,165 weekly newspaper printing plants were using web-offset presses.[6] This trend is expected to continue until about 90 percent of all newspapers in the country are printed by lithography.

For newspapers, web-offset offers several advantages over web-letterpress. Web-offset provides a much higher quality of newspaper printing than does letterpress—especially in printing photographs for both editorial and advertising purposes. Also, makeready time for web-offset is lower and operating speeds are higher than for letterpress. Manufacturers have developed a number of web-offset presses to meet the specific needs of small- to medium-sized newspapers.

Sheet-fed lithography, never an important factor in newspaper printing, has importance in other sectors of the industry. In commercial printing, the sheet-fed

[6] *American Press,* March 1970.



Modern web-offset newspaper press

method reached its peak in the early 1960's, then declined under the impact of the web-fed method, which has the advantages of faster press speeds and less paper handling.

The two small local newspapers included in the study switched from web-letterpress to web-offset presses to gain printing quality. One of these newspapers changed over when it moved to a new building and found that a new web-offset press cost very little more than a reconditioned web-letterpress. The other newspaper switched as part of a general shift to a computerized phototypesetting system which is more compatible with offset printing than with letterpress printing.

A publications printer contacted for information was a pioneer in the use of web-offset presses for commercial color printing. This firm felt that the quality of web-offset printing was as good as that from the sheet-fed offset presses that it had been using; therefore, when it needed additional capacity, it installed web-offset presses.

Other press operations. Improved instrumentation and highly automatic electronic control and monitoring equipment for printing presses are being introduced. New ultraviolet inks and ultraviolet ink-curing systems and hardware are being adopted increasingly, particularly for web-offset printing. Ink/water balance controls (for offset presses) are the most automated to date, and improvements are progressing on web-tension, register, and color controls, and in peripheral equipment such as microwave dryers, automatic folders, and flying pasters. The complete operation of a printing press by remote control computers is foreseeable, but only at such a great cost that there would probably be no economic justification for such an installation. One of the large newspapers visited, however, uses its computer system to control press speed. Another large newspaper surveyed has an automatic system for counting the number of papers printed and shutting down the presses at the proper time to reduce overruns.

Mailroom

A number of innovations in newspaper mailrooms are providing significant laborsavings. One of the more important advances is the counter-stacker, which counts finished newspapers, stacks them in piles of a specified

number, and ties them into bundles automatically. This equipment is used by three newspapers visited. High speed conveyor systems, in some cases computer-controlled, are used by many newspapers to send the correct number of bundles to trucks for distribution. Mechanized inserting machines have reduced much of the manual labor required to assemble large newspaper editions.

Chapter 3. Introducing New Technology at Survey Plants

Introducing new printing technology generally involves arriving at the decision to undertake the change, forming a management team to implement the conversion, and undertaking the technical and manpower planning required to ensure an orderly change. In this chapter, some techniques used by survey plants to plan and implement new printing technology are highlighted. The cost of new printing equipment installed at survey plants also is presented along with some examples of operating improvements and cost savings.

Planning

Planning for new equipment at most survey plants was undertaken by a small group of high level managerial employees. In a large newspaper, for example, the decision to purchase new equipment is made by a management team which considers any new technology that will make possible cheaper or faster output. The potential equipment is evaluated on a financial basis and purchased only if sufficient dollar return is anticipated. Therefore, no experimental equipment is considered. On the other hand, a small newspaper, the headquarters of a highly innovative chain, installed some of the most advanced experimental equipment available to the industry. While this firm expected the equipment to be profitable, the key criteria were improved volume and quality of product. In another small newspaper, when the publisher decides that new equipment is needed, the general manager and the foreman of the affected department visit other newspapers already using the equipment to evaluate different types of installations. They report back to the publisher who makes the final decision. At a book typesetting firm, the director of research performs evaluation studies on new equipment based on factors such as capacity, cost, and return on investment. Management bases the decision to purchase on these studies.

Installation

Once a printing firm decides to acquire the equipment, most of the engineering and installation effort is provided by the supplier, who sends in a team to accomplish the installation. The size and composition of this team depend upon the type of equipment purchased and the complexity of the installation. Installing new web-offset presses in a survey publications printing plant averaged about 2 months per press and required a four-man crew supplied by the manufacturer. The production manager or his assistant spent the 2 months on a full-time basis supervising the installation and testing the operation of the new press and was involved, on a part-time basis, for about 6 months after installation to assure successful operation. When press operations began, the manufacturer assigned about five mechanics and instructors to the plant for several weeks to answer questions and correct minor problems. If serious difficulties arose, an engineer was made available by the equipment supplier to assist the team.

Installing special-purpose computers at survey plants generally was a simple operation. At one plant, for example, the computer was delivered, installed, and made operational in 1 day. At another plant, however, where an installation of a special-purpose computer was undertaken, six vendor employees spent about 3 months trying to de-bug a system. Programing was supplied by the computer vendor for all three special-purpose computer installations at survey plants. In only one case were programing modifications undertaken by the user.

General-purpose computer installations were more complicated since many more data processing functions were involved and specialized peripheral equipment was needed. These systems required a large amount of programing effort. While some of the programing was supplied by the vendor, a significant amount was provided by user staff. All four survey firms using general-purpose computers, for example, had programing departments for their computer systems. The staffs of these departments worked with the vendor's programers and systems analysts in preparing programs for the computer. They continued to work on programs for day-to-day operations and special applications after the vendor team left.

Costs and benefits

Introducing new printing technology at survey plants generally involved a substantial investment which was

undertaken only after careful consideration of costs and anticipated benefits. Nearly all of the equipment was purchased rather than rented from the equipment manufacturers. The exception was a large metropolitan daily newspaper which chose to rent rather than buy its general-purpose computers.

The cost of new technology varied widely at survey plants, with the volume of investment depending upon the type of equipment installed, the nature and complexity of the application, and the type and size of the user firm. Costs of computers, for example, ranged from $22,000 for a small special-purpose computer at a local newspaper to $610,000 for an advanced model, general-purpose computer at a commercial printer. A small web-offset press for a local newspaper cost $191,000, while a commercial printer paid over $1 million for a large web-offset press. As another example, a large metropolitan daily newspaper paid $39,000 per unit for second-generation phototypesetters, while a commercial printer paid $370,000 for one of the more advanced models. (See table 5 for additional information about the costs of new equipment at survey plants.)

Some of the more important objectives for introducing new technologies at survey plants were to increase output, reduce labor costs, and increase product quality. These objectives were met in varying degrees in all of the installations. Examples of the benefits at survey plants are presented below. The nature and extent of these improvements were influenced by factors such as level of output, type of innovation, and efficiency of the preexisting technology. These examples therefore should be considered as illustrative only, since

Table 5. Costs of new equipment at selected survey plants

Plant	Type of equipment	Cost
Large metropolitan daily newspaper	2 general-purpose computers	$5,000 rental per month each
	2 second-generation phototypesetters	$39,000 each
Small local daily newspaper	Web-offset press	$191,000
	Camera and platemaking equipment for the press	$9,300
	Automatic film processing system	$15,000
Small local daily newspaper	Small special-purpose computer	$32,500
	Small special-purpose computer (back-up unit)	$22,000
	Mailroom counter-stacker and conveyor system	$65,000
Publications printer	Large color web-offset press	$653,000
	Large color web-offset press	$1,003,800
	Large color web-offset press	$720,900
	Large color web-offset press	$969,200
	Large color web-offset press	$956,500
	Automatic film developing system	$12-15,000
	Automatic platemaking equipment	$30,000
Book typesetter	Special-purpose computer	$50,000
	2 second-generation phototypesetters with 6 keyboards	$ 56,000–$60,000, depending upon how equipped
Directory and catalog typesetter	General-purpose computer	$610,000
	Third-generation phototypesetter	$370,000
Publications printer	Special-purpose computer	$ 59,200 (includes $1,200 for programs)

SOURCE: Plant visits.

they could be significantly different in plants not surveyed or in survey plants at different times.

At *a large metropolitan daily newspaper* automatic stereotype casting and centralized remelt equipment led to a decline in the number of stereotypers from 44 to 33. Automatic press controls and sensing equipment reduced press overruns and unaccounted-for-newspapers from about 3,000–3,500 papers to 200–300 per day. Automatic inserting, stacking, and handling equipment reduced mailroom employment from 105 workers to 32. All of these changes occurred during a period when output was increasing.

At *a small local daily newspaper* the shift from hot metal letterpress printing to phototypesetting and web-offset led to better quality printing, fewer errors, and greater speed. A typesetting computer led to faster, more accurate tape-punching. These changes allowed a decrease of four employees in the composing room despite growing printing volume.

At *a large metropolitan daily* automatic mailroom equipment led to a reduction in part-time employment equivalent to five to six full-time workers. Computers and phototypesetting provided an increase of 11 percent in columns produced per employee over a 9-year period.

A small local daily gained greater speed, higher product quality, and capabilities for job printing because of the substitution of a web-offset press for letterpress equipment.

At *a small local daily* the introduction of a special-purpose computer and a tape-driven hot metal typesetter led to a reduction in composition time, allowing the newspaper to reach the stands 1½ hours earlier. Part of this gain was attributed to a decline of 35 percent in typographical errors. Savings in the composing room were estimated to be almost $12,000 per year. In the mailroom, automatic equipment led to a reduction of 50 percent in employment, down from eight to four men on the line, with savings estimated at about $30,000 per year.

A large commercial publications printer shifted to web-offset from sheet-fed offset and gained increased speed with equal quality, and a reduction in makeready time and paper costs.

A book typesetter gained increased speed and capacity, higher type quality, and a reduction in keyboarding costs of about 20 percent with the introduction of a special-purpose computer and first- and second-generation phototypesetters.

At *a directory and catalog typesetter* the advanced computerized phototypesetting system was too new to determine specific gains.

At *a publications printer* the installation of a special-purpose computer allowed typists to be used instead of skilled linotypers and led to a reduction in the cost of composition of about 12 to 15 percent below that of manual operations.

Chapter 4. Employment Trends and Occupational Changes

Increasing employment in the printing industry has been accompanied by major changes in occupations and skills. In this chapter, employment trends in the major printing industry sectors are examined in the context of the impact of new technology on occupations and skills in the major production steps of composition, platemaking, presswork, and mailroom operations.

Employment trends

As indicated earlier, nearly 1.1 million people were employed in the printing and publishing industry in 1971. The two most important industry subgroups were newspapers, with 370,000 employees, and commercial printers, with 349,000. Within commercial printing, the two most important groups were "commercial printing, except lithography" and "commercial printing, lithographic." The nonlithographic sector accounted for 209,000 employees in 1971 and the lithographic sector for 128,000. (See table 1.)

Printing industry employment has grown steadily since 1947. Between 1947 and 1971, it increased by 50.9 percent, compared to an increase of 19.7 percent in manufacturing employment. On an annual basis, as shown in table 1, printing and publishing employment increased at an average rate of 2.0 percent per year during the period 1958–71 compared to an average rate of 1.9 percent per year during 1947–58.

Employment growth rates varied considerably within individual sectors of the printing industry. The number of jobs in newspapers grew from 248,500 in 1947 to 370,000 in 1971–an increase of 48.9 percent. No data are available for total commercial printing over the 1947–71 period because this sector underwent a change in SIC definition that left the 1947 figures incompatible with those for 1958 and 1971. Figures are available, however, for the lithographic and nonlithographic groups, which accounted for over 96 percent of commercial printing employment in both 1958 and 1971. In both groups, employment increased, but at very different rates. Nonlithographic employment increased from 179,800 in 1947 to 209,100 in 1971–an increase of 16.3 percent. During the same period, lithographic employment rose from 49,500 to 128,200–an increase of 159.0 percent. Lithography ranks as the fastest growing part of the printing industry.

Several sectors of the industry do not receive major attention in this study, including book and periodical printing and publishing, bookbinding, and packaging printing. In all of these sectors, employment increased from 1947 and 1971, although in no case was the increase as marked as in commercial lithographic printing.

Production workers make up a significantly smaller proportion of total employment in this industry than in manufacturing as a whole—61 percent of total industry employment in 1971 compared with 72 percent for all manufacturing. Within the major printing and publishing industry subgroups, production workers in newspapers were a relatively low 49 percent of all employees; in commercial printing, except lithography, 78 percent; and in lithographic commercial printing, 75 percent. In 1947, production workers constituted a larger share of the work force in both printing and publishing (68 percent) and all manufacturing (84 percent).

Employment of women in the industry increased from 250,200 in 1959 to 353,100 in 1971, a gain of 41 percent (compared with a 25 percent increase in total employment over this period). Women also increased as a percentage of all employees–from 28 percent in 1959 to 32 percent in 1971. Part of the increased employment of women can probably be attributed to the increase of keyboard operations that are associated with computer and tape-operated phototypesetters.

Impact on occupations and skills

New technology is changing the duties and skills of production workers who perform composition and typesetting operations, prepare printing plates (including camera and film processing), operate printing presses, and carry out mailroom tasks. One major development is the creation of new occupations–systems analysts, programers, and console operators–to plan, program, and operate electronic computers and related equipment. Information on the nature of these and other changes, based on plant visits and secondary sources, is presented in the following text and in tables 6 and 7.

Table 6. Technological changes in the composing room at selected survey plants

Firm	Innovation	Impact on employment	Impact on skills
Large metropolitan daily newspaper	Computers for justification and hyphenation, and photocomposition equipment used for setting advertising copy.	Production worker employment in 1962 (before installation of computers and presently used photocomposition machines) was 217. By 1968, it had increased to 268, a gain of 23.5 percent. Throughout the 6-year period, production workers accounted for 88-90 percent of total composing room employment. Jobs eliminated: By 1968, only four linecasting machine operators remained—men who were so close to retirement that they were not willing to be retrained. No new linecasting machine operators were to be hired. Jobs created: Computer programer and console operator positions were filled by retraining company employees. Systems analysts were hired from outside the company, as their skills are based on a considerable amount of computer experience. The company did not consider it practical to train its own people in these skills until the computers had been operational for some time.	There was a major skill shift from linecasting machine operators to keypunch operators. The keypunching staff consisted of production typists trained in computer codes and retrained linecasting machine operators. Journeyman typesetters were retrained in photocomposition skills such as paste makeup, monitoring tape-driven photocomposition machines, and photographic film processing.
Small local daily newspaper (central newspaper in a chain of newspapers)	Computers for justification and hyphenation, leased telephone lines for data transmission between other newspapers in the chain, photocomposition equipment, optical scanning equipment.	The change to computerized photocomposition reduced employment by four people. At the time of the BLS visit, composing room employment (excluding computer personnel but including working supervisors) was 114. Jobs created: Computer programer and console operator positions were filled by retraining employees from within the company. The programer staff was headed by a former linecasting machine operator. Five systems analysts were hired at different times from outside the company. However, their lack of familiarity with the printing industry made them unsatisfactory for the newspaper's purposes.	Most of the teletypesetter (TTS) typists were retrained to type input copy for the optical scanner. Probably, little retraining was required, as the scanner has reduced skill and training requirements—copy that is typed for the scanner can be read by the typist. In contrast, the TTS machines produce punched paper tape, requiring the operators to learn TTS code, then "read" the holes in the tape. Typesetters were retrained for photocomposition machine monitoring, paste makeup, and film processing operations.
Book typesetting firm	Computer for justification. First-generation phototypesetting machine. Second-generation (tape-driven) phototypesetting machines and tape-perforating (keypunch) units.	Work force increased from 35 people in 1961 to 166 by 1969. Jobs created: The computer console operator had previously been a keypunch operator. She was trained to handle computer input and output tape and to operate the computer controls. As a secondary duty, this employee also did some keypunch work involving hyphenation of a sort that cannot be done by the computer.	Required new typing skills to operate phototypesetting machines. Required skills to operate computer console.

Table 6. Technological changes in the composing room at selected survey plants— Continued

Firm	Innovation	Impact on employment	Impact on skills
Book typesetting firm— Continued		Programing was initially provided by an outside programing service. Later, the firm switched to a freelance programer and one of the firm's own electronics maintenance employees who had learned programing techniques on his own. In addition to his programing work, the employee operated as an electronic trouble-shooter, which was less demanding of his time than straight maintenance work. Nine keypunch operators with typing experience were hired to punch tape for the computer. It was for one of these positions that the computer console operator was originally hired. One of the first-generation phototypesetting machine operators with a good background in typography was trained to operate the new phototypesetting machines. This employee, in turn, trained 12 keypunch operators and four technicians who were hired to operate the new phototypesetting machines.	
Directory and catalog typesetter	This firm had gone through a complete change of printing technologies and, at the time of the BLS visit, was undergoing a second change. The first change was from strike-on techniques to use of a computer and a second-generation phototypesetter. The second change consisted of the installation of a more advanced computer and (at the time of the BLS visit) a soon-to-be-installed CRT phototypesetter.	At the time of the BLS visit the firm employed 12 people (including the manager). All of these were, in a sense, new jobs resulting from the firm's conversion from strike-on typesetting to computerized phototypesetting. All but two employees had some knowledge of programing, even though it might not have been their primary job. Five employees were full-time programers. Six were in "operations" work (as distinguished from programing) consisting of preparing tape, machine operation and maintenance, and the necessary peripheral work. The latter group was composed of one keyboard operator, one combination keyboard operator/programer, one machinist, one paste makeup artist, one operator/programer trainee, and one person who handled corrections, small typesetting jobs, and occasional programing assignments. The hiring of 10 additional employees was planned within several months following the BLS visit. This group was to be in the "operations" section: six as keyboard operators and four as equipment operators. Jobs created: The CRT machine, when installed, would create a new job opening—CRT machine operator—for someone with an electronics background. Jobs eliminated: The conversion from strike-on typesetting to computerized phototypesetting had eliminated all of the strike-on typist positions.	The CRT phototypesetter, when installed, would substantially affect one job: the operator of the presently used phototypesetter was to become supervisor for both that machine and the CRT machine. This person had also received training in programing, and was to assume greater programing responsibilities. The programer staff had to learn programing techniques for the new computer.

Table 6. Technological changes in the composing room at selected survey plants– Continued

Firm	Innovation	Impact on employment	Impact on skills
Publications printer	Computer for justification and hyphenation.	Total composing room employment, excluding salaried employees, declined from 97 in 1965 to 78 in 1969, but employment in certain occupations increased. The number of keyboard operators grew from two to seven after the computer was installed and three to four proofreaders were added.	The change in keyboard operator skills wrought by computers is illustrated in this company by the use of manually operated linecasting machines and automatic linecasters driven by computer-prepared tape. An operator who must do his own justification and hyphenation is expected to set 3,000 "ems" an hour. An operator punching "raw" tape that serves as computer input is expected to set 6,000 "ems" an hour.
		Jobs created: One of the keyboard operators was trained to operate the computer console and was promoted to supervise the other keyboard operators. The computer was run for 2 or 3 hours a day, so console operation duties were only part time. The balance of this employee's duties included training new keypunch operators and operating a keypunch machine.	The firm has introduced automatic (tape-driven) linecasting machines in addition to the manually operated linecasters already in use. Several linecasting machine operators were trained to operate and monitor the automatic units. The composing room maintenance employee received some computer maintenance training from the computer manufacturer.
Large metropolitan daily newspaper	Computers for justification and hyphenation. Second-generation, tape-driven phototypesetter. Third-generation CRT phototypesetter.	In 1958 there were approximately 280 full-time composing room employees (334, including part-time employees). By 1968, full-time employment had increased to 312 (354, including part-time employees). The number of makeup employees (both hot metal and photographic) increased for two reasons: more makeup work was necessary because of the increased amount of material being printed; and the newspaper was operating with shorter deadlines, allowing less time for correcting errors. The number of composing room machinists increased due to an increase in the number of machines used, and to more intensive use of those machines. Jobs created: Seventy people were hired or trained to punch tape for the computers (keypunch operators). Some were linecasting machine operators who were retrained in 1963-64, when the linecasting machines were converted to computer operation. By 1967 the phototypesetting machines had also been converted to computer operation, and about 80 percent of the phototypesetter operators decided to retrain for TTS operations, with the balance being retrained for makeup or paste makeup operations. Among the 70 keypunch operators, 40 were retrained printers (linecasting and phototypesetting machine operators) who had no previous experience with keyboards. Most of the remaining keypunch operators were hired for that specific ability, and needed no training.	Most of the composing room jobs have been modified by the introduction of the computerized phototypesetting system. Some had to be modified to make use of the new equipment; in addition, the newpaper's management decided to develop, among the composing room employees, a large reservoir of skills in handling various facets of the new technologies. A half-dozen training courses were set up and employees were given the opportunity to take as many of the courses as they wished. Out of 315 composing room employees, 275 received at least some training in new or modified job skills. The phototypesetting machines, used for setting advertising copy, modified the jobs of "makeup" employees, who had previously set up advertisements and laid out newspaper page formats in three-dimensional metal type. Makeup employees (now classified as paste makeup) were retrained to use sheets of film and paper to produce the same result in two-dimensional form from which photographic negatives are made. Between 35 and 40 people were involved in paste makeup work. Composing room machinists who maintained the phototypesetting machines received training in electronics.

Table 6. Technological changes in the composing room at selected survey plants— Continued

Firm	Innovation	Impact on employment	Impact on skills
Large metropolitan daily newspaper— Continued		The conversion to linecasting and phototypesetting machines that are operated entirely by computer-generated tape necessitated training a crew of machine monitors. While not a new occupation for the industry, it was new to this newspaper. Approximately 15 people were trained to monitor linecasting machines and five were trained to monitor phototypesetting machines. Four programer positions and one systems analyst position were filled by retraining journeyman typesetters. The systems analyst was previously a composing room supervisor, and was trained first as a programer.	
Small local daily newspaper	Special-purpose computer for justification.	Work force increased from 61 men at the time the computers were installed to 66 at the time of the BLS visit. Five composing room employees were added because of the increased output of the computer: two for handling corrections, one machine monitor, one on the collection bank, and one electrician. A retiring machinist was replaced by a machinist with training in electronics.	With the exception of employees who set type for advertising, all composing room employees are trained to punch tape (including learning to justify copy, although this skill is not often needed), operate the computers (which are relatively simple), and monitor automatic linecasting machines. Computer justification has simplified keypunch work and has reduced typographical errors by 35 percent—the latter because keypunch operators, no longer required to do justifying, can pay more attention to keypunch accuracy.

Composition and typesetting. Computerized typesetting and phototypesetting can have a considerable impact on the occupational structure of the composing room, where almost one-half of the industry's craftsmen are employed. The introduction of computers into the typesetting process requires several new skills. New job functions of computer console operator and programer are being created, and can often be filled by retraining composing room employees who might otherwise be displaced. A large newspaper that installed computers, for example, staffed four programer positions with journeyman typesetters who were retrained in a 12-week course of programing classes. A relatively small number of systems analysts will be needed (only one was required by the newspaper mentioned above) and industry practice thus far generally has been to hire from outside the firm to fill these positions. One firm surveyed hired systems analysts from outside the company because it did not consider training its own staff a practical alternative during the early stages of computer installation.

The laborsaving potential of computers in producing tape to run automatic machines is illustrated at a survey firm that uses both computer-prepared tape and manually prepared tape. In the computerized method, justification and word hyphenation decisions are carried out automatically at high speeds to produce "finished" tape. Operators preparing computer input tape are expected to set 6,000 'ems" an hour. Operators who must do their own justification and hyphenation are expected to prepare tape at a rate of 3,000 'ems" an hour.

An increasingly necessary, but perhaps not so obvious, skill is the ability to use a typewriter keyboard, in which the keys are arranged in a manner different from the widely used Linotype and Teletypesetter (TTS) keyboards. Typewriter keyboard arrangements are becoming standard on the more recent tape-punching machines that prepare input tape for computers and automatic typesetting machines.

Several new skills are necessary in photocomposition. Cold type and graphic displays must be assembled and

pasted onto layout sheets (paste makeup). A knowledge of photographic processes is necessary for both setting copy onto film and developing the film for platemaking. The developed film must then be assembled and arranged into pages (stripping). Journeyman typesetters at survey plants are being retained in photocomposition skills such as paste makeup, monitoring tape-driven phototypesetting machines, and film processing.

Much of the new equipment is electronic or electromechanical in operation, rather than primarily mechanical. Thus, machinists who maintain new equipment generally need a good background in electronics. At a large metropolitan daily included in the survey, for example, 12 machinists primarily involved in mechanical maintenance activities passed a qualifying test and were given electronics maintenance training to provide new skills needed to service phototypesetting equipment.

Platemaking. Several changes are occurring in the making of printing plates that are having an impact on employment and job skills. Some are applicable to all printing processes, some only to particular processes.

Many printing plates are made by a photographic-chemical finish process that has traditionally involved a great deal of handwork. Such platemaking is time-consuming, and the quality of the final product is unpredictable, as it is highly dependent upon a craftsman's skill–which is not completely consistent from job to job.

New technologies such as automatic film developing systems, electronic color separation equipment, and electronic engraving equipment considerably reduce the handwork involved in platemaking. Employees operating the equipment utilize less craft skill, but must learn new technical skills. Generally, the new equipment requires less time to produce a given amount of work than did the hand methods, but the demand for artwork and photographs in printing is increasing so rapidly that employment should not suffer. Traditionally trained craftsmen can be retrained to operate these new technologies, which can affect all three major printing processes–letterpress, gravure, and lithography.

The several letterpress plastic printing plates that are being developed–if successful–can cause some skill changes. These platemaking systems rely more heavily on technical skill than the traditional craft-oriented processes. Traditionally trained craftsmen, however, can be retrained to operate this equipment.

Employment in most platemaking occupations is expected to increase over the next 5 years. The new platemaking technology is more productive than its predecessors, and this will set some limit on employment growth.

Lithography, as the fastest growing printing process, will be responsible for most of the growth in platemaking occupations. As all lithographic printing plates are made from photographs, new technologies such as automatic film developing systems, electronic color separation equipment, and automatic plate processors will modify skill requirements for lithographic platemakers.

The employment of photoengravers (not including gravure), most of whom work in commercial printing shops, will remain fairly constant in spite of an increase in output. This will result from a combination of laborsaving technology and increased competition from lithography. Some photoengravers are retraining for lithographic occupations–a trend that is expected to continue. The skill requirements for both occupations are similar–printing plates made from a photographic-chemical process. Certain of the new technologies are equally applicable to both processes.

Employment in electrotyping and stereotyping–duplicate platemaking processes for letterpress printing–is being adversely affected by technological change. New, more durable materials have increased the printing life of electrotype plates, thereby reducing the number of duplicate plates needed for a given printing job. Automatic platecasting equipment for stereotype plates (used primarily in newspapers) has reduced manpower requirements for stereotypers, and the potential effects of the plastic plate systems now being developed could reduce manpower requirements even further. At one newspaper surveyed, for example, the installation of an automatic stereotype platecasting system reduced employment of stereotypers by 25 percent over a period of approximately 6 years. Moreover, competition from lithographic printing has pulled business away from letterpress printing, including those facets of letterpress that use stereotype and electrotype plates. As a consequence, the employment of electrotypers and stereotypers is declining.

The effects of technological change on gravure printing employment are, at the moment, unclear. As a form of photoengraving, gravure printing is subject to most of the changes in skill requirements and to the laborsaving effects of new technology, which could limit employment opportunities. But the gravure process can produce a very high quality of printing and, if methods of engraving gravure cylinders more quickly and less expensively can be developed, the demand for gravure printing–and, consequently, for gravure employees–could increase dramatically.

Press work. The increasing automation of printing press controls is changing the skill requirements of pressmen.

Table 7. Technological changes in platemaking, presswork, and mailrooms at selected survey plants

Firm	Innovation	Impact on employment	Impact on skills
Large daily metropolitan newspaper	Automatic stereotype plate-casting system.	Manpower requirements for stereotypers reduced from 44 men in the early 1960's to 33 men in 1968.	Required shift from hot metal typesetting techniques to phototypesetting skills.
		Production workers in the press room increased from 85 in 1962 to 137 in 1968.	Required new programer and related computer occupations.
	Automatic inserting, stacking, and bundling system in mailroom.	Mailroom production worker employment declined considerably, from 98 in 1961, to 27 in 1968.	Required familiarity with new mailroom equipment.
Small local daily newspaper	Conversion from letterpress platemaking and printing press to lithographic platemaking and printing press.	Employment increased after the conversion because the lithographic press—at least initially—required a larger operating crew (2 additional men per shift). The newspaper was in the midst of retraining over 50 percent of its press operators, and hoped that when all operators were sufficiently trained, a reduction in the size of the press crew might be possible.	This newspaper's conversion from letterpress printing to lithographic printing caused a considerable change in job structures and skill requirements. Before conversion, the newspaper maintained a small lithographic section, so there were a few employees trained in lithographic platemaking and press operations. The conversion resulted in a substantial enlargement of the lithographic department and the virtual disappearance of the letterpress department.
		Jobs created: Flying paster operator. The previously used press had not been equipped with flying pasters, as was the new lithographic press. Several custodian employees were trained to operate the flying paster units. Jobs eliminated: Seven letterpress operators were separated becaused they refused to be retrained for lithographic presswork.	A part of the conversion was the creation of an "offset-engraving" section to perform all lithographic platemaking and printing press operations. Each "offset-engraving" operator is trained in all of the skills necessary to photograph camera-ready copy, develop the film, expose it onto printing plates, etch the plates, mount the plates on the press, and operate the press. During his training, an "offset-engraving" employee generally finds that he prefers either the platemaking operations or the press operations—a preference that usually determines his major work assignments. Most of the journeyman employees in the "offset-engraving" department had been (or, at the time of the BLS visit, were being) retrained from letterpress operators. Included were former press operators, stereotypers, engravers, and some typesetters.
Publications printer	Advanced model of developing room camera. Automatic printing plate machine. Tape-operated photocomposing machine. Web-offset presses added to pressroom previously using sheet-fed lithographic presses only.	Platemaking employment had not changed. The same employees who had operated the older equipment had been retrained to operate the new equipment. Jobs created: Due to the substantial differences in skill requirements for operating sheet-fed presses and web-offset presses, and to the general unwillingness of sheet-offset pressmen to retrain for web-offset work (less than 10 percent of the firm's sheet-offset pressmen were willing to retrain), new press crews had been hired to operate the web-offset presses.	The new platemaking equipment had caused some changes in skill requirements. Craft skills were not as important as they had been with the older equipment, but greater technical skill was required to operate the new machines. Generally, more work is performed with less physical effort by the employees operating the new machines.

Table 7. Technological changes in platemaking, presswork, and mailrooms at selected survey plants— Continued

Firm	Innovation	Impact on employment	Impact on skills
Publications printer—Continued		The greater complexity of web-offset necessitated an increase in the size of the press crew. A four-color sheet-offset press requires a four-man press crew: head pressman, assistant pressman, feeder operator, and tender. A four-color web-offset perfecting press requires a five-man crew: head pressman, assistant pressman, paster operator (counterpart of feeder operator on sheet-offset), tender, and console operator. The console operator monitors web and color register, and adjusts the printing cylinders as needed.	
Small local daily newspaper	Conversion from web-letterpress to web-offset printing.	Size of the press and maintenance crews increased as a result of the conversion. One man was added to the press crew to set and maintain the ink/water balance and to watch tension on the paper roll.	The entire web-letterpress crew was retrained to operate the web-offset press.
	Automatic film processing machine.		The cameraman was retrained to work with lithographic equipment. When the firm installed an automatic film processing machine, the cameraman was trained to operate it in replacement of the less automated (and more craft-oriented) method he had previously used.
	Automatic counting and stacking equipment installed in mailroom.	The newspaper originally operated with an 8-man crew in the mailroom and nine delivery truck drivers. Installing the counter-stacker allowed use of a 3- to 5-man mailroom crew (depending on the speed at which the presses were being run). There was a need to increase the number of delivery truck drivers during this period, however, because of increased circulation.	All mailroom employees (including drivers) were trained to operate the counter-stacker equipment and to drive delivery trucks. They could perform either of the two types of duties, depending upon the newspaper's needs.
Large daily metropolitan newspaper	Automatic counting and stacking machine.	Total full-time mailroom employment increased slightly from 1959 to 1969, but this increase was due to the newspaper's increased circulation. The new equipment decreased overall manpower requirements and decreased the day-to-day fluctuations in crew size that result from printing newspapers of varying sizes. In 1959, there were 34 full-time mailroom employees. An average working-shift crew on the conveyor and tying machines was 18 men, and could go as high as 24 men. By 1969, 47 men were employed full-time. An average shift—working with the increased output of an additional printing press—was 15 men, and never exceeded 18 men. Before the use of automatic inserting equipment, all separately printed sections of the Sunday newspaper were inserted by hand—part in the newspaper's mailroom and part by the delivery boys. The in-plant work was performed by approximately 100 part-time employees working shifts during Saturdays and Saturday nights. The productivity of the inserting machines was so much greater that, in spite of a large increase in Sunday inserts, manpower requirements were reduced to about 35 part-time employees on Saturday nights.	The counter-stacker brought about considerable change in skill requirements. Before its introduction, the work procedure was as follows: Newspapers came off the presses and were carried to the mailroom via a conveyor. Employees manually counted out groups of 25 or 50 newspapers and put them on another conveyor which led to a tying machine. One man operated the machine, which wrapped wire around the bundle of papers. Now, the counter-stacker automatically counts the newspapers as they come off the presses. The stacks are then manually transferred to the second conveyor, where they activate a switch that turns on the tying machine which automatically ties the stack of papers. Skill requirements changed from work that was primarily manual to the operation of complex machinery. Considerable training and a rudimentary preventive maintenance program were needed. At first, the newspaper's machinist and electrician did equipment maintenance. Later, as the mailroom employees became more experienced, they took over some of the equipment maintenance.

Electronic monitors and controls can perform many press operations faster and more accurately than the press crew. This frees the crew from many machine operations, allowing them to spend more time on quality control, but in the process traditional craft skills become less important, and technical knowledge and ability become more critical.

Web-offset (lithographic) printing presses have affected manpower in several ways. Printing companies changing from sheet-fed lithographic presses to web-fed presses have to retrain their existing press crews or train entirely new press crews because the skill requirements for the two types of presses are very different. Web-offset presses, with their faster operating speeds, require faster decisionmaking, monitoring of more variables, and greater physical effort. If a problem occurs while running a sheet-fed press, there is more time to study it and make a decision on correcting it before paper wastage becomes excessive. Because of these differences in skill requirements, only some sheet-fed pressmen are willing to retrain for web-offset work.

Companies converting from web-letterpress to web-offset (most frequently, this involves newpapers) retrain their original press crews and often enlarge them. The skill requirements for web-offset and web-letterpress are, in some respects, similar. There is, however, at least one very important difference: the ink/water balance used in the lithographic process. Letterpress crews generally are unfamiliar with this complex process and must be retrained in this stage of press operations. The entire web-letterpress crew at a small local daily newspaper included in the study were retrained for web-offset operations by sending one man at a time to work with the crew at another newspaper using the same type of press. Web-offset is a more complex process because of the ink/water balance that must be maintained in lithographic printing and this extra complexity generally means that an additional man must be put on the press crew.

Employment is expected to increase moderately for press operators and assistants. This is attributable to an anticipated increase in printing output, and should be very noticeable in that part of the industry using web-offset printing presses.

Mailroom. Newspaper mailrooms have been dramatically affected by the introduction of two technological developments: automatic counter-stacker equipment and automatic inserting machinery. Prior to the introduction of these two innovations, mailroom operations involved semiskilled manual work. Employees manually counted and stacked newspapers as they came off the presses, inserted separately printed sections (such as the Sunday comics), ran machines that tied the paper into bundles, and distributed the bundles to trucks for delivery. In addition to being labor intensive, the operation called for a work crew varying with the size of each day's newspaper, the Sunday paper requiring the largest crew.

The automating of many of these operations—counting, stacking, bundle tying, and, to an extent, inserting—has substantially reduced labor requirements, changed skill requirements, and, in some instances, reduced fluctuations in work-crew size. One survey newspaper which introduced automatic equipment to insert sections in the Sunday edition reduced employment in this operation by 65 percent. Moreover, skill requirements also were significantly affected, shifting from primarily manual tasks to duties involving the operation of fairly sophisticated mechanical equipment. A training program for operators was initiated.

This evidence indicates a strong impact on manpower resulting from present and expected technological change. Employment in most occupations is changing—increasing in some instances, decreasing in others. Skill requirements for all production jobs studied (with the possible exception of proofreaders, who are among the composing room employees) are changing in various degrees. In some cases, technical skills are being required in addition to the traditional craft skills. Certain skills are becoming obsolete, although many smaller printing plants will continue to use the older methods for some time to come. Some entirely new skills are being created. Finally, most of the new technologies require less time and/or lower skill requirements to perform a given job than do the older printing methods.

Training programs are necessary to avoid job displacement and to build staffs of people capable of operating new equipment. Training programs at survey plants are discussed in detail in the following chapter. However, it should be clear from the data presented in this chapter that considerable training has been carried out at the survey plants—training that has varied from teaching craftsmen to do the same job in new ways to taking people who have been displaced from one job and training them to perform different jobs.

Chapter 5. Training for New Technology

Training workers to operate new equipment and work with new processes is one of the most important techniques used to adjust to technological change in the printing industry. Training is provided by the major unions (on both the national and local level), industry associations, vocational schools, equipment manufacturers, and printing firms. In this chapter, examples of training programs are provided.

Union training

The International Typographical Union has set up a highly advanced training center in Colorado, offering courses covering all of the modern graphic arts methods, including such topics as paste makeup, camera use, darkroom techniques, keyboard operation, phototypesetter operation and maintenance, and computer programing and operation. Classes are small and instruction techniques consist mainly of working directly with equipment. Most courses last 3 weeks and can be taken by union members on their vacation. All ITU members are eligible for this training, which is provided without cost, although they, or their employers, must pay for travel and living expenses. Many union members return to their locals after taking courses at the Center and instruct other local members in the new techniques.

The International Printing Pressmen and Assistants' Union of North America has a program consisting of decentralized on-the-job training. This program replaced a union printing school when the union found it impractical to install the many new models of presses appearing on the market. Members now receive training on the presses used in the plants at which they are employed. The union provides textbooks, visual aid materials, and manufacturer-trained union instructors to assist workers.

The Graphic Arts International Union also has a large-scale training program. Union policy is that training provisions should be a part of local collective bargaining agreements, and about 95 percent of the local unions have contracts in which employers contribute to training programs. A total of 54 regional training centers have been established by the union, financed by employer and union member payments. These centers provide training in lithographic and photoengraving skills such as stripping, camera work, darkroom techniques, paste makeup, platemaking, and presswork to journeymen and apprentice union members. The union also has initiated a Technological Developments and Education Committee, whose members visit equipment manufacturers to learn about the latest machines and processes and study the impact of technology on members.

Industry trade associations

A number of printing industry trade associations are involved in training programs affecting both management and production workers. The American Newspaper Publishers Association Research Institute, for example, provides training in new processes to production employees of member firms, with special emphasis on web-offset printing. The Graphic Arts Technical Foundation has an education service which consists of publishing books and technical manuals for use in schools and apprentice programs and providing advanced training sessions for industry, management, and union personnel, ranging from formally organized programs to crash in-plant programs.

Manufacturer and user training

Manufacturers of printing equipment and other suppliers to the industry generally provide instruction in the operation of their new equipment and processes. Some firms set up classroom sessions at their plants or in special schools for user employees, while other firms send instructors into user plants to provide training. User firms also have utilized extensive internal training programs to introduce new processes, as indicated by the experience at some of the plants visited for this study.

Entry level training

Apprenticeship training under union contract is the most common method of entry into the printing industry for production workers. Approximately 11,000 apprentices were registered in printing trades in 1971. Training lasts from 4 to 6 years and generally consists of on-the-job, classroom, and correspondence school in-

struction incorporating modern printing techniques. In addition, there are about 4,000 vocational schools, high schools, technical institutions, and colleges that provide courses in printing for entry level jobs in the industry.

Training at survey plants

All of the newspapers and commercial printers visited provided training to affected employees when new equipment and processes were introduced. Examples of training programs at plants are presented in the following sections.

Large metropolitan daily. The shift from hot metal composition to computers and phototypesetting required training for almost all the composing room employees. Computer programer positions were staffed by four composing room journeymen who were provided with about 12 weeks of training at a computer manufacturer's school and at classes held at the newspaper. About 275 of the remaining composing room journeymen received training in new skills. A total of seven categories of instruction were offered. Six were designed for composing room employees and consisted of courses in paste makeup, markup, darkroom operation, automatic linecaster monitoring, proof press operation, and keypunching. The seventh category was for machinists and involved maintenance of electronic equipment. Employees selected for maintenance training had to pass a test in electronics, which required prior home study and attendance at night school. Twelve machinists passed the test and received the training.

Company policy was to train every journeyman in the composing room in any one or more of the categories that they were interested in, with the exception of the TTS course, for which the employee had to pass a typing test. Over 60 workers were trained in all six categories, over 200 received training in more than one category, and 275 were trained in at least one new skill. A total of 40 journeymen learned how to operate keyboards. The length and content of the courses were determined jointly by management and a two-man union committee, with the exception of the keypunch course which was already covered by the union contract. Darkroom and machine monitoring were 1-week courses, proof press was 2 weeks, paste makeup was 4 weeks, markup was 6 weeks, and keypunch was 15 months.

All instruction was on the job. In most cases, one man at a time worked with an instructor, and in some cases, after initial instruction was given, the employee gained proficiency in the new techniques by working with equipment by himself Instructors were journeymen who were already proficient in the new processes; some of them had gone to manufacturers' schools. All employees were paid at a journeyman's rate while taking training. Approximately 25 older employees, mostly proofreaders whose jobs were relatively unaffected by the shift, chose not to take training.

There was an unusual training problem at this newspaper. A total of 45 deaf mutes were working in the composing room at the time of the changeover. These employees were graduates of a printing course given by a local college for the deaf and had received journeyman union cards under a special union program. A unique type of training had to be devised for these workers since they functioned by feel and sight, rather than by hearing. As Linotype operators, for example, they could feel the operation of the machine; however, as monitors they would not have their hands on the keyboard. The problem was solved by designating two employees who were mutes but not deaf as the initial trainees for the group. These two employees then became instructors for the rest of the group and developed the techniques required for the deaf mutes to operate the new equipment.

A publications printer shifted its major printing capacity from sheet-fed to web-fed offset presses by adding new web-fed presses, although it still continued to operate sheet-fed units. The company trained almost all of its press crews internally. Only about 10 percent of its 121 pressroom employees were hired as skilled workers from the outside. Crews for new presses were staffed by moving skilled workers from existing press crews and training lower level employees. When a new web-offset press was planned, for example, a skilled pressman was designated to be the head operator of the new press, and other skilled workers were moved from other presses. Vacancies in existing press crews were filled by promoting and training lower level workers, who were provided with 3 to 4 months of on-the-job training in their new skills. Entry level workers were hired from the outside. The line of progression in a web-press crew in this plant is from floorman (general helper) into a press crew as a fly boy, paster, console operator, successively, to assistant pressman, to pressman, which is the highest level job in the crew. This plant uses a console operator, which is a new job function, on web-fed presses. Duties of this job involve adjusting press operations using the press console. Workers in these functions were provided on-the-job training by the pressman in their crew. The line of progression in this plant may not be representative of the industry.

At *a small local daily newspaper* the introduction of a special-purpose computer required a minimal amount of training. The computer manufacturer instructed some of the compositors in the operation of the equipment in

one afternoon of on-the-job training. Almost all the rest of the compositors learned how to operate the computer later on. Two machinists received 3 weeks of training in electronics and computer maintenance at the computer manufacturer's school. Training for the other advanced composing room equipment, such as the automatic linecasters, was provided by the typographical union, at a local school and on the job, as covered by the contract. As part of its apprenticeship program, the union trained compositors to operate teletypesetter machines, and, when computers were installed, retrained the men to punch tape for the computer. This newspaper has an agreement with the typographical union allowing union members to use any of the equipment in the composing room on their own time in order to learn new skills or brush up on previously learned techniques.

Table 8 provides the highlights of training programs at other survey plants.

Table 8. Training programs for technological change at selected survey plants

Plant	Innovation	Type of training
Large metropolitan daily newspaper	Computer and phototypesetting system.	Programers and other computer-related jobs were filled from within by testing and retraining employees using both on-the-job training and computer manufacturer courses. Linotype operators were retrained to be keypunch operators. This plant was almost completely nonunion and had a formal entry level training program, equivalent to the union apprenticeship program, which allowed employees to advance faster if they had the ability and included instruction in the new processes in use in the plant.
Small local daily	Computer, phototypesetting system, and web-offset press.	Computer programers were trained internally, progressing from tape handlers to console operators and then to programers. Compositors were retrained from hot metal operations to computerized phototypesetting techniques. Letterpress printers and stereotypers were retrained for lithographic platemaking and press operations using on-the-job training and a buddy system in which a trainee works alongside an experienced worker. Two janitors were retrained for the new job of flying paster operator.
Small local daily	Web-offset press.	The press crew was retrained from letterpress to web-offset by sending one man at a time to work with the crew at another newspaper using the same type of press. The head pressman and cameraman received a 2-week course at a lithography school. All wages and training expenses were paid by the firm.
Book typesetter	Computer and phototypesetting system.	Twelve keypunchers and three technicians were retrained in phototypesetter operation. Training for keypunchers was on the job, included the use of books, and was provided by the foreman. Training for technicians was based on prior electronics background and consisted of on-the-job instruction in repairing minor breakdowns. A keypunch operator was provided on-the-job training 1 day a week for 4 months to become a computer console operator. A phototypesetter technician with an electronics background received on-the-job training in computer technology and maintenance.
Directory and catalog typesetter	Advanced computerized phototypesetting system.	Five or six employees took a typesetting computer language course and a 5-day phototypesetter orientation course. Four employees took a 2-week computer assembly language course.
Publications printer	Computer.	The computer manufacturer trained some employees to operate and trouble-shoot the computer during the month that they were involved in installation. A Linotype machinist also was trained to maintain the computer during the same period.

Chapter 6. Adjustment of Workers to Technological Change

Collective bargaining contracts in the printing industry contain provisions to facilitate adjustment of workers to new technology. In this chapter, the attitude of major unions toward changing technology and examples of provisions relating to advance notice, training, jurisdiction, maintenance of job security, and related measures are presented. Training programs, the major method of preparing employees for new work, were described in detail in the previous chapter.

The influx of new technology has been a source of considerable concern to unions. All of the unions generally favor technological change. Underlying this attitude, however, is a fear for the job security of their members if they cannot establish some control over the introduction of new processes, for not only do many of the new processes decrease the amount of manpower necessary for a given job, but they also cross traditional craft jurisdiction lines or perform work in such a way that no one union has clear jurisdiction over the operation of the process. This leads to the potential threat of a loss of jobs and members (sometimes to other unions), and to jurisdictional problems between unions.

Several unions have stated a philosophy toward technological change. The International Typographical Union, for instance, favors technological change as long as member interests are not disregarded. In keeping with this philosophy, the ITU demands a voice in determining the conditions under which new equipment or processes are introduced, and a share of the benefits resulting from their use.

Another part of ITU's philosophy is the long-held belief that its interests can best be served by supplying industry with the most skilled workers available. Consequently, ITU places considerable importance on training and retraining programs for its members, and has maintained a training school to this end for many years.

ITU is opposed to the concept of attrition as a means of handling job displacement resulting from new labor-saving machinery. Rather, ITU proposes that industry increase its output enough to maintain the present work force.

The Graphic Arts International Union (GAIU) expressed increasing concern over the threats to job security resulting from technological change in its 1965 biennial convention. It was predicted that virtually every worker would have to be retrained at least three times during his productive career, and an opinion was expressed that the training facilities then existing were so limited that the majority of union members were denied the opportunity to adapt and adjust to the demands of a rapidly changing industry.

During the convention, a Committee on Technological Developments was established for the purpose of studying the employment impact and the cost savings effects of technological changes. The Committee formulates plans for the use of locals in their negotiations with employers that can assist them in acquiring a fair share of the benefits occurring from the technological changes.

The International Printing Pressmen and Assistants' Union has long had a reputation for encouraging and supporting technological change. The union's answers to problems caused by change are to establish retraining programs for members whose skills have become obsolete and to urge an industry rate of growth that will produce new jobs to balance those lost. Six specific steps have been advocated by the union: advance planning, advance information to employees, use of attrition as a means of reducing excess work force, simultaneous planning of new jobs with preparations for the elimination of old jobs, and, where layoffs are inescapable, ample warning to minimize the hardships involved.

Contract provisions relating to technological change

The concern of labor unions about the introduction of new equipment and processes is reflected by the large number of provisions in labor-management agreements designed to protect members against potential adverse effects. The most common union position is to accept technological change as long as members are not thrown out of work. In general, when new equipment is introduced, unions attempt to gain jurisdiction for their members over the operation of the equipment, and to have this jurisdiction made part of their labor-management agreement. Jurisdictional provisions in printing industry contracts, therefore, are very specific, with the type of equipment, in some cases even brand names, clearly spelled out. Other common contract provisions

relating to technological change include advance notice, training, employee selection, layoffs and severance pay clauses. Examples of some of these provisions are presented in table 9.

Manpower planning in survey plants

Although only six full-time employees were involuntarily separated (and later reinstated) and no one was downgraded when new printing technology was introduced at the nine firms visited by BLS staff, substantial advance manpower planning and labor-management adjustments generally were required. Six of the nine survey plants were unionized and the collective bargaining agreements provided the mechanism for providing advance notice of change, undertaking special negotiations to handle disputes, selecting employees for new jobs, determining skill levels and wage rates, and providing training for new skills.

Advance notice of technological change. Information about new equipment and processes was provided in advance of installation at all of the printing firms visited. At unionized plants, company officials notified the chapel chairman or local union officers of the impending changes. At nonunion plants, the procedure generally involved informal meetings between foremen and supervisors and affected employee groups. The timing of advance notice ranged from 3 months to 3 years prior to installation of new printing technology. At a small nonunion plant visited, the policy was to notify employees immediately upon deciding to acquire new equipment.

Selecting employees for new jobs. In most of the unionized plants visited, procedures for selecting production workers for new jobs were spelled out by labor-management agreements. The majority of the new jobs in survey plants involved operating and programing computers and were filled by training employees from the affected units. At a large daily newspaper, for example, programer positions were staffed by composing room and mailroom employees who had passed a programing test and were given training. Even at nonunion plants most computer and related jobs were filled by upgrading employees who already had printing skills. Systems analysts, however, generally were hired from outside the firm. Most of the other new positions were filled from within. Two janitors at a small newspaper were trained to operate the flying pasters on a new press, while a commercial printer trained existing employees to be console operators and flying paster operators on new web-offset presses.

Determining skill levels and wage rates. Unions in the printing industry usually have a formalized system of skill levels and wage rates in their labor-management agreements. Printing craftsmen are generally divided into two skill levels: journeymen, who are the skilled workers; and apprentices, who are learning the trade. Wage systems differ between unions, however. The ITU has a two-scale system, for example. All composing room journeymen in any one contract, regardless of job title, receive the same minimum wage rate, with adjustments for various shifts and holidays. Apprentices receive a proportion of journeymen's rates that increases as their experience increases. Mailroom workers who are affiliated with the ITU generally are covered under a separate contract at lower rates. The GAIU, on the other hand, while still operating under the apprentice-journeyman skill system, negotiates different minimum wage rates for different jobs. Journeyman photographers, platemakers, and pressmen and feeders, for example, all have different hourly wage rates in the same contract.

In general, the minimum negotiated wage rate at survey plants tended to become the actual wage rate for all union workers, including those affected by technological change. However, at a few survey plants, workers who were trained in new technologies were paid bonuses above union scale. The most common explanation was that the increases were paid so that these workers would not leave for jobs with other firms. When a large daily newspaper installed a computer and phototypesetting equipment, for example, wages for all the composing room employees were increased from $10 to $15 per week above scale. A small local daily newspaper paid a composing room machinist $5 per week over scale for maintenance work on typesetting computers. Among the nonunion plants, with the exception of a large daily newspaper which increased wage rates for some employees, there were no wage rate changes that could be directly attributed to the introduction of specific innovations.

Special negotiations and labor-management disputes. At a large metropolitan daily, the contract with the ITU local was modified because of the introduction of computers. This newspaper was among the earliest to install computers for typesetting. Originally, the ITU local had no jurisdiction over computers. When the decision to install computers for typesetting was announced, however, management and the union worked out an agreement dealing with jurisdiction over the computers which was made a formal part of the contract and is included in table 9.

Union jurisdictional demands shaped a decision about the type of computer to purchase at a small local daily

Table 9. Provisions relating to technological change from selected collective bargaining agreements

Subject of provision	Source	Content of provision
General technological change	Agreement between a local of the Graphic Arts International Union (GAIU) and commercial printers.	The parties recognize that technological developments, if they are to further the continued growth of the graphic arts industry, place responsibility upon companies to explore and promote new markets and require the cooperation of the company and union in the development of new skills. In order to insure the orderly and most advantageous introduction of new types of equipment and new processes, the parties agree to meet upon request of either party to consider and develop programs for the retraining or rehabilitation of employees in new skills so that there shall be adequate availability of new skills required and no layoffs as a result of the introduction of new types of equipment or new processes. It is understood that pending the institution of such programs, there shall be no layoffs by reason of the introduction of new types of equipment or processes.
Jurisdiction over equipment and processes	Agreement between a local of the International Typographical Union (ITU) and the Newspaper Publishers Association.	Jurisdiction of the union and the appropriate unit for collective bargaining is defined as including all composing room work and includes classifications such as: hand compositors, operators and machinists for all typesetting machines, tape perforating devices, tape reading devices, . . . and recutter units for use in composing or producing type; proportional spacing typewriters, . . . and proofreading and/or scanning devices; and any and all phototypesetter machines. . . . For performance of work recognized as being within the jurisdiction of the union in a computer operation, employees covered by this agreement shall perform all computer operations (except systems analysis . . .) such as: detailed flow charting, coding or preparing programs from detailed flow charts in language acceptable to the computer, testing and debugging the program, operation of the computer and all input and output devices, the preparation and handling of all material to be processed and the maintenance of all equipment and devices. . . . This agreement goes on to exempt programing and maintenance normally provided by the computer manufacturer under contract and indicates that single purpose composing room computers must be manned wholly by union members while general purpose computers used partially for composing room operations must have a proportional number of union members on the data processing staff.
Advance notice	Agreement between a local of the GAIU and commercial printers.	The company agrees that it will not change its present methods of lithographic production before giving thirty (30) days' notice of such proposed change to the union in order that the parties may meet to consider whatever other related changes are required. This clause relates only to changes of methods within the plant.
Training for new equipment and processes	Agreement between a local of the ITU and the Newspaper Publishers Association.	For the purpose of providing retraining necessary for new processes, a Joint Training Committee will plan and prepare training programs for situation holders who have held their current situations continuously for at least six (6) months. However, the 6 months requirement may be waived by mutual agreement. This committee will provide an equitable opportunity to train on the new processes in each office to the extent that an adequate number of journeymen will be available to satisfy the needs of the office to operate the new equipment. . . . This contract goes on to state that the Joint Training Committee will consist of four members, two from the union and two from management, machinists will be given preference to train to maintain the new machines, and equipment and instructors for training will be provided by management.
Layoffs	Agreement between a local of the ITU and commercial printers.	The union agrees that if an employee covered by this agreement, who is employed in a composing room covered by this agreement, is competent to operate such new machinery, new equipment and/or new processes, he may be assigned to such new machinery, new equipment and/or new processes. However, if a layoff occurs, such layoff must be made in strict priority order. Employees with higher priority than a person working on aforementioned new machinery, new equipment and/or new processes, who have established an aptitude for such retraining as prescribed herein, and who have not previously been given the opportunity for retraining in that office, shall be given such opportunity before being laid off.

Table 9. Provisions relating to technological change from selected collective bargaining agreement- Continued

Subject of provision	Source	Content of provision
Severance pay	Agreement between a local of the ITU and commercial printers.	When an employee covered by this agreement is discharged or laid off otherwise than as a result of his own willful and persistent breach of duty or gross misconduct which a joint committee. . . has acknowledged, such employee shall be paid, in addition to sums otherwise due him, the following at such individual employee's straight-time rate of pay, not including overtime, for the past previous week of employment: One year but less than 2 years service with the employer . . . 1-week's pay; 2 years or more of service with the employer . . . 2-weeks' pay.

newspaper. This paper had placed an order for a general-purpose computer to be used for business and typesetting functions. When the unions were notified, both the ITU and the Newspaper Guild locals indicated that they wanted to have a union member assigned to the computer staff. Management felt that, when the computer was working on business problems, the two union members on the computer staff would be nonproductive. Therefore, they cancelled the order for the general-purpose computer and purchased a special-purpose computer for the composing room only.

There was a strike related to the introduction of computers at a small local daily newspaper visited for the study. The union went on strike when management discharged six union members and attempted to reclassify jobs so that union craftsmen would not be allowed to work on the computer. Wage rates for remaining printing jobs were deemed unsatisfactory by the union. Management hired nonunion workers and continued printing. An NLRB trial examiner ruled in the union's favor, ordering that striking employees be rehired, strikers be awarded back pay, and the union craftsmen discharged be rehired. Management appealed the decision to the NLRB, and lost.

Chapter 7. Outlook for Technology and Manpower

Innovations in printing technology during the decade of the 1970's will continue to have significant implications for printing methods and manpower. In this chapter, prospects for specific technologies are discussed along with their potential impact on employment, job skills, and training.

Outlook for technology

Computers. Continued growth in the number of computers and applications is anticipated. Computer-assisted typesetting (line justification, and, to some extent, hyphenation) will probably continue to be the most important application. This is especially true for small newspapers that cannot afford the expensive general-purpose computers that can be applied to several different jobs. These newspapers will probably restrict themselves to the smaller, much less expensive computers that are designed primarily for typesetting uses.

The rate at which computerized typesetting will grow is difficult to predict. Two estimates were given by people in the industry who talked with BLS staff members. One estimate is that by 1980, 90 percent of all newspapers will be using computers with phototypesetting equipment. The other is that by 1983 all newspapers will be using such equipment.

Newspaper classified advertisements offer considerable potential for computer application. One large newspaper plans to install a computer photocomposition system in the following manner: Computer data entry terminals which display, visually, information entered into the system will be located in the classified phone room and connected directly to the computer. Typists will enter information on ads into the system at these terminals and accounting data and text material will be recorded immediately in the memory unit of the computer system. Running ads may be stopped, corrected, and extended by classified sales personnel using the terminals. At the close of the classified business day, the computer will include new classified ads with any ads running from the previous day, format these ads into page layouts, and drive high speed phototypesetting units to set full pages of classified ad text.

Computers also can be applied to production scheduling, pressroom control, and newsprint inventory control. Data collection points can be installed throughout a newspaper's production department. Data on output from the composing room, page makeup, and printing platemaking can be entered into the information system. Printing press operation, including measures of rolls of newsprint used, web breaks and paster losses, and the number of newspapers being produced, can be logged into the computer system. Data collection points can provide information on quantities of newsprint received, stored, and issued.

As a result of this information system, the computer will have data concerning all production operations of the newspaper. Display terminals can be used to provide management and supervisors with current information on the production schedule status. The computer also will be able to detect problem areas, schedule manpower, and provide complete production statistics.

Predicting the rate of computer growth for commercial printers is more difficult than for newspapers due to the much greater diversity of firm size and jobs performed. Firms concentrating on printing books, periodicals, directories, and catalogs are finding computerized typesetting advantageous. Those firms performing large amounts of varied work, however, will probably find computers to be of limited use.

Newspaper mailrooms provide another potential application area for computers. Computer printout can be used to address copies of newspapers going to mail subscribers.

The printing industry generally uses punched paper tape for computer input and output. This is due to the industry's long use of paper tape for much of its automated typesetting equipment and the resulting large investment in tape-punching and tape-reading equipment. Over time, magnetic tape will be used more widely since it can be run at faster speeds and carry more information than paper tape.

Phototypesetting. The use of phototypesetting will increase in both newspapers and commercial printing. According to one forecast, about 50,000 phototypesetting machines may be carrying out about 75 percent of all typesetting by 1980.[7] Over the next few years,

[7] *Kodak Highlights,* February 1973. p. 9.

Electronic editing and proofreading display terminal

most of the increase will be in second-generation equipment. The third-generation (cathode ray tube) equipment, although very fast, is still limited primarily to printing directories and catalogs. The third-generation equipment presently is too expensive to be within the financial range of many printing establishments.

By 1980, most small- to medium-sized newspapers will be using phototypesetting. Most of these newspapers will be using web-offset, with which phototypesetting is very compatible. The larger newspapers will probably convert to computerized phototypesetting if the plastic printing plate works out successfully.

In commercial printing, book and periodical printers will increase their use of phototypesetting. Small job shops, however, will probably find phototypesetting of more limited usefulness.

CRT terminals. Cathode ray tube (CRT) terminals, a relatively new innovation presently in limited use, will be adopted more widely in the printing industry over the next few years, primarily in editorial and classified operations in large newspapers and in book and periodical printers. The terminals consist of a CRT display panel and a keyboard and/or light pencil. Copy can be typed into the terminal, or already prepared copy can be displayed on it. Editing, makeup and formating, and corrections can be completed on the terminal prior to typesetting. In newspaper applications, the terminal can serve as the first step in a very high speed computerized phototypesetting system that results in fully made-up pages. Terminals will generally be tied in with a computer, although some self-contained units with their own memory banks will be available.

Optical character recognition equipment. OCR equipment is available, but its dispersion will probably remain limited. One reason is that the equipment is too expensive, considering operational limitations, for many firms. The operational restrictions may greatly retard dispersion since copy must be typed in a format that the OCR equipment can "read." Hence, printing firms that set their own type—especially newspapers—will probably not find much use for the scanner since the typed material they must prepare can serve directly as computer input, thereby bypassing the need for the scanner. OCR equipment will be most useful to those printing firms that receive copy already typed by customers.

Electronic color separation. As the demand for color separation is growing more rapidly than the supply of skilled craftsmen, the use of color scanners is expected to increase. The amount of growth is uncertain due to two limiting factors: color scanners are expensive, requiring a high volume of work to justify their installation; and conventional color separation materials and procedures are improving enough to make conventional processes competitive with color scanners in some instances.

Plastic letterpress plate. If the plastic letterpress printing plate that is now under development becomes successful, it will probably be used by most of the large newspapers. As this plate is made from a photocomposition process, newspapers will be able to take advantage of the benefits of phototypesetting without having to sacrifice their substantial investment in letterpress printing presses. Since a considerable amount of research and development is being devoted to this plate, it will probably become commercially successful within the next few years.

Printing presses. The outlook is for continued technological improvement in printing presses. In general, presses will become more sophisticated and efficient and operate with less waste of materials and more effective use of manpower.

Lithographic presses will be used more widely, especially in newspapers. By 1978, an estimated 88 percent of all newspapers—primarily those of medium and small size—may be using web-offset presses. Improvements can be expected in ink-drying equipment, electronic control devices, and, possibly, in the development of more durable printing plates. If the plastic printing plate does not turn out to be successful, even the large newspapers will eventually convert from letterpress to lithography. Sheet-fed lithographic presses, primarily used in commercial printing, also will increase in number, although press size probably will not increase. Their operating speeds will increase, however, and they will be equipped with more sophisticated instruments and automatic controls.

The outlook for diffusion of letterpress equipment is less favorable. Installations of flat-bed letterpress equipment are declining and may eventually disappear. The number of rotary letterpress units (including web-letterpress used in newspapers) is expected to remain unchanged. If the plastic printing plate made from photocomposition is successful, installations of web-letterpress equipment could begin to increase. Such printing presses would be different from those presently in use (which have been designed to accommodate the comparatively larger and heavier stereotype and electrotype plates). However, it is also possible that web-offset presses could be modified to use the plastic plates with even greater success than modified web-letterpress units.

Outlook for manpower

Total employment in the printing and publishing industry is expected to increase slightly between 1970 and 1980 as employment increases generated by a rising demand for printed products more than offset employment declines resulting from technological change (see table 10). In the newspaper segment of the industry, however, employment is projected to decline from 372,000 in 1970, to an estimated 365,000 in 1980. In commercial printing the level of employment is projected to be higher—rising from 356,000 in 1970 to an estimated 390,000 in 1980.

Employment of nonproduction workers is likely to grow at a faster rate than that of production workers. This is anticipated because the productivity of production workers, using new technology, is expected to increase more than that of nonproduction workers, to whom most of the new technology is not applicable. It has also been predicted that, due to the use of new technology, there will be a growing need for more professional managers, engineers, and technically trained employees.

Both management and union officials who met with the BLS staff stated that much of the new technology will reduce, as well as change, the skill requirements of many traditional occupations. There was also general agreement that composing room employees increasingly will need to acquire skills in keypunching, photography, and electronics to operate and maintain new printing equipment.

Table 10. Employment in printing and publishing, 1960 and 1970, and projections for 1980

[Numbers in thousands]

Industry subgroup	1960	1970	1980	Average annual percent change	
				1960-70	1970-80
Total printing and publishing	911.3	1,106.8	1,240.0	2.0	1.1
Newspapers	325.2	371.9	365.0	1.4	−0.2
Commercial printers	290.7	356.1	390.0	2.0	0.9

SOURCE: Bureau of Labor Statistics. A detailed discussion of the methodology used to develop 1980 projections may be found in *Tomorrow's Manpower Needs: Volume IV, Revised 1971,* BLS Bulletin 1737 (1972).

Table 11. Employment in craft occupations in printing and publishing, 1960 and 1970, and projections for 1980

[Numbers in thousands]

Occupation	1960	1970	1980	Average annual percent change	
				1960-70	1970-80
Total printing trade craftsmen	254.3	255.9	258.5	.1	.1
Compositors and typesetters	153.4	141.5	121.2	−0.8	−1.6
Electrotypers and stereotypers	8.7	4.7	2.9	−6.0	−4.7
Engravers, except photoengravers	4.6	5.8	8.1	2.3	3.4
Photoengravers and lithographers	21.2	30.3	46.0	3.6	4.3
Pressmen and platemakers	66.4	73.6	80.2	1.0	0.9

SOURCE: Bureau of Labor Statistics. A detailed discussion of the methodology used to develop 1980 projections may be found in *Tomorrow's Manpower Needs: Volume IV, Revised 1971,* BLS Bulletin 1737 (1972).

NOTE: Sums of individual items may not equal totals because of rounding.

It is important to keep in mind that technological change has raised the threat of job displacement in the printing industry on several occasions in the past, although on a more restricted basis. It occurred with the introduction of linecasting machines in the late 19th century and with improvements in printing presses (especially in the development of automatic press feeders) in the early 20th century. In both instances, considerable retraining was necessary, and in the latter instance, one group—manual press feeders—experienced considerable displacement.[8] But in both cases, demand increased sufficiently to lessen the impact. In the current situation, technological change is so widespread that it affects all facets of the printing process. Displacement will probably occur in certain occupations such as compositors, typesetters, electrotypers, and stereotypers, as indicated in table 11, but the combination of an increased demand for printing products, a somewhat slow rate of diffusion of technological change, attrition, and extensive retraining will ease the impact of new technology on manpower.

[8]Elizabeth F. Baker, *Displacement of Men by Machines* (New York, Columbia University Press, 1933).

Appendix A. Three Major Printing Methods and the Printing Process

The three major printing methods include letterpress, gravure, and lithography (offset). Letterpress, the oldest and most widely used printing method, employs a printing plate upon which the printing surface is raised above the nonprinting surface. (See illustration.) Printing is achieved by covering the printing surface with ink and pressing it directly against paper, thus transferring the image onto the paper. Type is set for letterpress by both "hot metal" and photographic processes.

Platemaking techniques include photoengraving (etching plates made from photographic processes), stereotyping and electrotyping (for making duplicate metal plates from hot-metal or photoengraved originals), and flexography (the use of flexible rubber plates and quick-drying inks). There are three types of letterpress printing presses: platen, flat-bed cylinder, and rotary presses, both sheet-fed and web-fed.

Gravure printing is the reverse of letterpress. The gravure printing plate is a hollow metal cylinder and has an image area that is etched into—or below—the nonprinting surface of the plate. Printing is achieved by filling the etched areas with ink, scraping excess ink from the non-image areas with a "doctor" blade, and pressing the plate cylinder directly against paper. The plate cylinders are made by a form of photoengraving. Gravure printing presses are of the rotary type, and can be either sheet-fed or web-fed (rotogravure). The gravure process can produce very fine quality printing, but preparing the cylinders is expensive and somewhat slow.

Letterpress and gravure share two printing techniques: both use a three-dimensional printing plate, and in each method ink is transferred directly from the printing plate to paper.

The third major printing method, lithography (offset), differs significantly from the two other major methods. Lithography uses a smooth, flat, two-dimensional printing plate, the operation of which is based on the principle that grease and water will not mix. The plate is made by a photographic process and chemically treated in such a way that ink will adhere to the printing areas but water will not. On the printing press, the plate is moistened with water over all but the image areas (which repel water), then inked. The ink will not adhere to the nonprinting areas because it will not mix with the water already on the plate, but it will adhere to the chemically treated image areas. The second difference, to which the word "offset" applies, is that the printing process is indirect. The printing plate prints onto a rubber "blanket" cylinder, which in turn prints onto paper. Lithographic printing presses are of the rotary type, and may be either sheet-fed or web-fed. Lithography is the fastest growing of the three major printing methods.

There are four basic production steps involved in the three major printing processes just described. These include composition, platemaking, press operations, and finishing.

Composition. The first production step takes place in the composing room where manuscript copy is set in type. Typesetting, or composition, involves selecting a style and size of type face, determining format and margins, and the actual setting of type. Copy can be set in metal type (hot metal), on photographic film or light-sensitive paper (phototypesetting), or by direct impression from special typewriters or similar machines (strike-on).

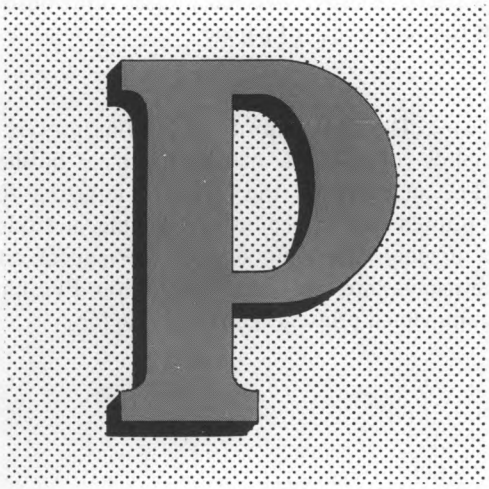
Platemaking. Once type has been set, the next step is to convert it into printing plates that can be mounted onto printing presses. At this point, artwork (photographs, graphic displays, etc.) is merged with the type.

Type that has been set in metal can sometimes be mounted onto a press without the use of a printing plate. This, however, is rarely done. Instead, metal type is generally used to make a mold from which duplicate printing plates are produced. Film used in photocomposition—and in artwork—is reproduced onto metal printing plates, which are etched to give the effect necessary for printing. These plates can also be used to make duplicates.

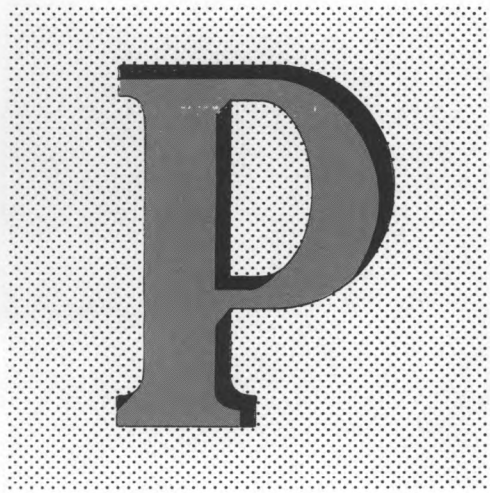
Printing plates are made from metal, various alloys, plastic, or rubber. They can range from plastic plates weighing a few ounces to gravure cylinders weighing up to a ton.

Press operations. The step just before starting up the presses is "makeready", during which printing plates receive a final adjustment to insure uniform and distinct printing impressions. Makeready can vary from being

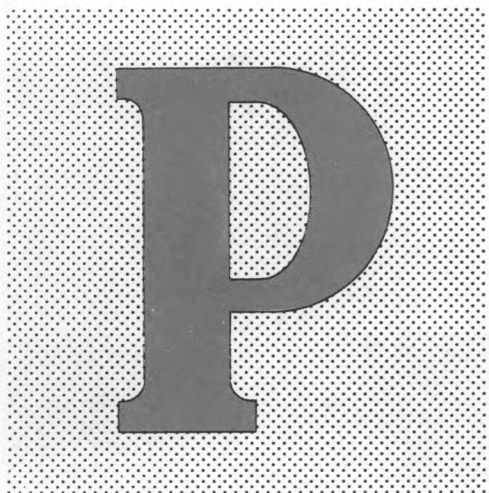
Three Major Printing Methods



LETTERPRESS
Printing area is raised above nonprinting area.



GRAVURE
Printing area is below nonprinting area. Depressed area is filled with ink.



LITHOGRAPHY (OFFSET)
Printing area is on same plane as nonprinting area.

relatively simple to being very difficult and delicate, depending on the printing process and therefore on the type of printing plate and press being used.

Printing presses come in a wide variety of sizes and are designed to operate by one of several printing processes. All share a common principle: ink is dispersed over the printing areas of the plates, from which it is transferred, directly or indirectly, to paper or other material.

This study focuses on the rotary press, which uses one or more curved printing plates that are mounted onto a cylinder. As the cylinder rotates, it prints onto paper moving past it. Rotary presses are fast and efficient, and can be used in every major form of printing except screen process printing (not included in this study).

Basically, there are two types of rotary presses: sheet-fed and web-fed. These terms pertain to the manner in which paper is "fed" into the press. Sheet-fed presses print on individual sheets of paper that have been precut to a particular size. Web-fed presses print onto a continuous roll, or "web," of paper.

Finishing work. The final step of the printing process is the assembling of printed material into a finished product. For newspapers, this involves inserting the separately printed sections; counting, stacking, and tying together a predetermined amount of newspapers; and loading the papers into trucks for distribution. Finishing work for commercial printers varies with the job.

Appendix B. Selected Annotated Bibliography

A. Periodicals, books, and articles

"Automatic Litho Plate Processing." *Book Production Industry,* December 1968, pp. 46–49.

Description of automatic wipe-on, presensitized, and bimetal plate systems, with conclusion that these plate systems allow improved uniformity and continuity between plates.

Bock, Ralph F. "Novel Methods for Drying Inks." Graphic Arts Technical Foundation, *Research Progress Report,* Number 86, December 1970.

A review of the literature on prospective ink-drying systems for sheet-fed presses.

Bruno, Michael H. "Printing Technology 1971." *Inland Printer/American Lithographer,* February 1971, pp. 42–45.

"Computer Controls High Speed Mailroom Line." *Printing Production*, Newspaper Industry Edition, October 1968, pp. 32F – 32H.

Pressroom, mailroom, and dispatch area all tied into computer system that regulates speed and number of newspapers printed, automatically bundles them into standard and odd sizes, and dispatches them for most efficient delivery.

Cosden, Thomas B. "CRT Editing Terminals." *Book Production Industry*, June 1970, pp. 44–50.

Description of operations and applications of CRT editing terminals.

Cosden, Thomas B. "Facsimile Transmission: Publisher's Link to the Future." *Book Production Industry*, November 1969, pp. 65–70.

Rapid growth expected for facsimile transmission due to advantages of rapid communication between central editing offices and satellite printing plants.

Cosden, Thomas B. "Publisher Keyboarding: Today's Input To Tomorrow." *Book Production Industry*, January 1971, pp. 36–40.

Keyboarding expected to change from a production operation to an editorial-production system. Problems involved include type of equipment and training, alternatives to use of keyboards, and union-management problems.

Eggleston, David. "Today's Printing Plates: Tomorrow's Antiques." *Inland Printer/American Lithographer*, July 1970, pp. 38–41.

Faster press speeds, labor shortages, and pollution requirements are factors that will change printing plate technology in the 1970's.

"Electronic Control Arrives for Sheetfed Litho." *Book Production Industry*, November 1967, pp. 48–51.

Description of recent developments in automatic controls, effects on output, and skill changes necessitated.

Farrell, Guy. "The Larger Meaning of Comprint 90." *Book Production Industry*, January 1971, pp. 30–35.

Communications technology will completely change the nature of the printing industry over the next 20 years. Much of the printing done will not be performed by printers as they are known today, but by businesses that offer a wide range of products and services, including printed materials.

Farrell, Guy. "Litho Platemaking Automation Grows." *Book Production Industry*, March 1970, pp. 48–51.

Automated film processors ease labor shortage problems, and sometimes provide an improvement in quality and speed.

"Gravure: How Will It Fit Into the Future of Publishing Production?" *Book Production Industry,* April 1970, pp. 42–45.

Description of technological improvements in gravure and economic factors affecting the application of gravure in various areas.

"Ink Drying: Electronics Promise Basic Changes." *Book Production Industry*, April 1969, pp. 48–50.

The use of electron beams and radio wave energy with specially formulated ink may allow faster drying, under safer conditions than is presently possible with heat-drying systems.

Impact of Web Offset. New York, Lithographers and Photoengravers International Union, 1964.

Description of web-offset operation, statistical data on growth of web-offset, and analysis of web-offset's impact on manpower.

Johnson, Gordon O. F. "Revolution in the Darkroom: Automatic Film Processors." *Inland Printer/American Lithographer*, May 1969, pp. 45–47.

Automatic film processing equipment becoming widely used because of such advantages as greater quality control and time and cost savings.

Kelber, Harry and Schlesinger, Carl, *Union Printers and Controlled Automation*. New York, The Free Press, 1967.

A study of composing room automation, with emphasis on computers, and of the response to automation by the International Typographical Union.

"Keyboards: Growing Sophistication in Their Design and Use." *Book Production Industry,* February 1969, pp. 60–64.

Description of four basic types of keyboards, and three major problem areas of coding structure, human factors, and the value of hard copy.

"Lack of Understanding Slows Computer Typesetting." *Book Production Industry*, January 1968, pp. 50–52.

Lack of knowledge about each other's problems prevents computer people and printing people from using computers to best advantage in printing industry. Several suggestions offered to printers contemplating computer installations.

"New Plate Upholds Power of Letterpress." *Business Week*, February 8, 1969, pp. 68, 70.

Description of a plastic printing plate made from photocomposition techniques that is applicable to newspaper production.

Olerich, Richard B. and Anderson, Bruce D., "Webb Printing – Automatic Control Almost Within Reach." *Book Production Industry,* October 1967, pp. 58–61.

Complete automation for web-offset presses should be available within several years, and should offer such advantages as higher press speeds and much less waste.

Printing Production. June 1968, pp. 70–121.

Seven articles dealing with technological change and its effect on the printing industry during the 1970's.

Safran, Hyman. "Putting Color Scanners in Perspective." *Inland Printer/American Lithographer*, September 1968, p. 98.

Summary of advantages and limitations of color scanners. Fast, consistent, less need for handwork.

"Space Age Electronics Fights Traditional Methods in the Pressroom." *Inland Printer/American Lithographer*, January 1971, pp. 51–53.

Description of new developments in drying techniques, ink-jet printing and xerography.

"Stereotyping of Plastic Plates Achieved by RI." *Editor and Publisher*, June 5, 1971, p. 16.

Refinement of plastic plate technology that allows lead stereotype plates to be produced from plastic original.

"Union Carbide, Sta-Hi Announce Hylox Plastic Platemaking System." *Book Production Industry*, May 1969, p. 78.

Description of a plastic printing plate applicable to newspaper production.

"Web Press Design – Where Is it Going?" *Book Production Industry*, March 1968, pp. 54–60.

Summary of recent developments in printing presses. Includes variable cutoff folders, split-plate cylinders, microwave drying, press drives, and web tension control.

B. Government publications

U.S. Government

U.S. Department of Commerce, National Bureau of Standards. *Automatic Typographic-Quality Typesetting Techniques: A State of the Art Review.* Monograph 99. By Mary E. Stevens and John L. Little. 1967. 98 pp.

A comprehensive survey of typesetting techniques, including hot metal, cold type, phototypography, computer usage, key punch operations, and graphic arts.

U.S. Department of Commerce, National Bureau of Standards. *Electronic Composition in Printing: Proceedings of a Symposium.* Special Publication 295. Edited by Richard W. Lee and Roy W. Worral. February 1968. 128 pp.

Twenty-three papers describing several advanced composition systems, and government and nongovernment research in and application of such systems.

U.S. Department of Labor, Bureau of Labor Statistics. *Union Wages and Hours: Printing Industry, July 1, 1971.* BLS Bulletin 1744. 1972. 62 pp.

Latest in an annual series providing statistics on union wage rates and hours in 69 cities.

Foreign

Australia, Department of Labor and National Service. *Technological Change in the Printing Industry–Four Case Studies.* Employment and Technology, No. 3. Melbourne, 1969. 42 pp.

Discusses nature of change in the four firms, effects on skills, preparations for changes, training requirements, extent of job displacement.

Great Britain, Department of Employment and Productivity. *Manpower Studies No. 9: Printing and Publishing.* London, 1970. 115 pp.

A study of the effects of technological change on production and manpower in the British printing and publishing industry.

Other BLS Publications on Technological Change

Railroad Technology and Manpower in the 1970's (Bulletin 1717, 1972), 90 pp., $1.00.

Describes changes in technology in the railroad industry and projects their impact on productivity, employment, occupational requirements, and methods of adjustment.

Outlook for Computer Process Control (Bulletin 1658, 1970), 70 pp., 70 cents.

Describes the impact of computer process control on employment, occupations, skills, training, production and productivity, and labor-management relations.

Technology and Manpower in the Textile Industry of the 1970's (Bulletin 1578, 1968), 79 pp., 60 cents.

Describes changes in technology and their impact on productivity, employment, occupational requirements, and labor-management relations.

Manpower Planning for Technological Change: Case Studies of Telephone Operators (Bulletin 1574, 1968), 34 pp. Out of print.

Policies and experiences of four offices in adjusting to technological change.

Job Redesign for Older Workers: Ten Case Studies (Bulletin 1523, 1966), 63 pp. Out of print.

Examples of redesign of jobs to retain older workers in employment.

Technological Trends in Major American Industries (Bulletin 1474, 1966), 269 pp., $1.50.

Appraises technological developments in 40 industries and the effects on output, productivity, and employment.

Impact of Office Automation in the Insurance Industry (Bulletin 1468, 1965), 71 pp. Out of print.

Survey of extent and future directions of electronic data processing (EDP), manpower impact, and implications.

Manpower Planning to Adapt to New Technology at an Electric and Gas Utility (Report 293, 1965), 25 pp. Out of print.

Describes personnel procedures and practices used to minimize hardships on employees.

Outlook for Numerical Control of Machine Tools (Bulletin 1437, 1965), 63 pp. Out of print.

Outlook for this key technological innovation in the metalworking industry and implications for productivity, occupational requirements, training programs, employment, and industrial relations.

Publications for sale may be purchased from the Superintendent of Documents, Washington, D.C. 20402, or from regional offices of the Bureau of Labor Statistics at the addresses shown on the inside back cover. Out of print publications are available at many public and school libraries and at Government depository libraries.

Periodicals from the Bureau of Labor Statistics

For current, timely, authoritative data on the economy

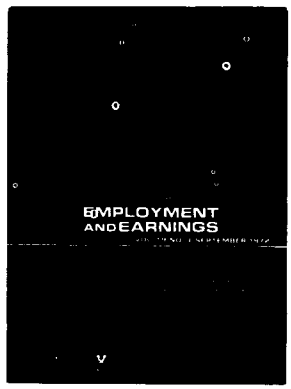
For sale by regional offices of the Bureau of Labor Statistics, U.S. Department of Labor, or by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402. Make all checks payable to: Superintendent of Documents. Prices are subject to change by the Government Printing Office.

Monthly Labor Review,

the authoritative research journal in economics and the social sciences, publishes analytical articles and current data on prices, wages, and productivity; employment and unemployment; and hours and earnings. Each month, the *Review* also reports on important developments in industrial relations, significant court decisions, union conventions, labor developments abroad, and includes an extensive section of book reviews and listings.

Subscription price: $9 per year
(add $2.25 if mailed to a foreign address).

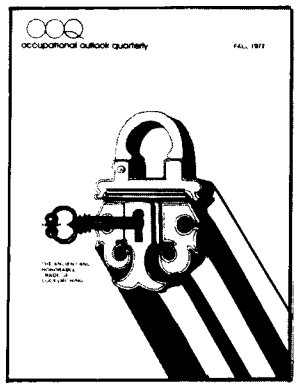
Single copy price: 75 cents.



Employment and Earnings,

a monthly report presenting charts and detailed tables on the labor force, employment, unemployment, hours, earnings, job vacancies, and labor turnover. It is compiled from data based on household interviews, nonagricultural establishment records, and administrative records of unemployment insurance systems.

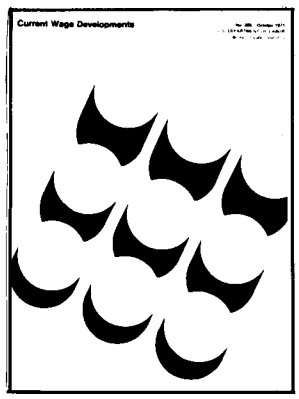
Subscription price: $10 per year
(add $2.50 if mailed to a foreign address).



Occupational Outlook Quarterly

is today's guide to tomorrow's jobs. Illustrated in color and written in nontechnical language, the *Quarterly* reports on emerging jobs, educational and training opportunities, salary trends, and the effects of changing technology on jobs. Sources of free or inexpensive career and manpower publications are also listed.

Subscription price: $1.50 per year
(add 50¢ if mailed to a foreign address).



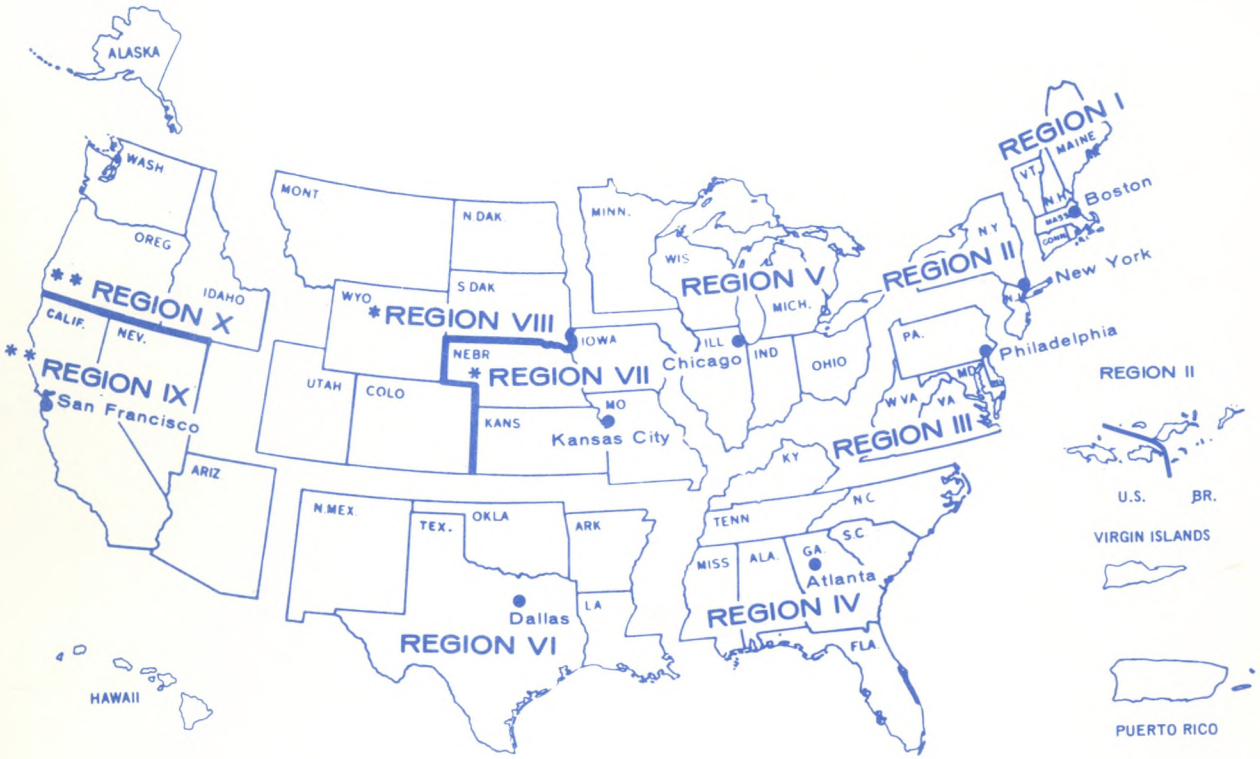
Current Wage Developments

reports in detail on major collective bargaining agreements, presents statistical tables on compensation changes, and features special reports on wage and salary trends in both the private and public sectors. Published monthly.

Subscription price: $4.50
(add $1.25 if mailed to a foreign address)

BUREAU OF LABOR STATISTICS

REGIONAL OFFICES



Region I
1603 JFK Federal Building
Government Center
Boston, Mass. 02203
Phone: 223-6762 (Area Code 617)

Region II
1515 Broadway
New York, N.Y. 10036
Phone: 971-5405 (Area Code 212)

Region III
P. O. Box 13309
Philadelphia, Pa. 19101
Phone: 597-1154 (Area Code 215)

Region IV
Suite 540
1371 Peachtree St., NE.
Atlanta, Ga. 30309
Phone: 526-5418 (Area Code 404)

Region V
8th Floor, 300 South Wacker Drive
Chicago, Ill. 60606
Phone: 353-1880 (Area Code 312)

Region VI
1100 Commerce St., Rm. 6B7
Dallas, Tex. 75202
Phone: 749-3516 (Area Code 214)

Regions VII and VIII *
Federal Office Building
911 Walnut St., 15th Floor
Kansas City, Mo. 64106
Phone: 374-2481 (Area Code 816)

Regions IX and X **
450 Golden Gate Ave.
Box 36017
San Francisco, Calif. 94102
Phone: 556-4678 (Area Code 415)

* Regions VII and VIII are serviced by Kansas City.
** Regions IX and X are serviced by San Francisco.

U.S. DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
WASHINGTON, D. C. 20212

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

THIRD CLASS MAIL

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF LABOR

LAB - 441