1964

A contemporary analysis of the growth, effects, and adjustments to automation

James G. Frazer

A CONTEMPORARY ANALYSIS OF

THE GROWTH, EFFECTS, AND ADJUSTMENTS TO AUTOMATION

A THESIS

Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science in Business Administration, Graduate School of the University of Richmond.

By

James G. Frazer, B. A.

1964

Preface

The objective of this thesis is to compile and analyze information on automation, beginning with its background and origin and continuing through various contemporary issues, directly or indirectly related to its development; namely, the need for automation in advancing our present-day society, socially and economically; the present-day uses and future expectations; factors standing in the way of automatic development; effects, both good and bad, attributed to automation by management, labor, and business; beliefs of management, labor and business as to the methods of adjusting these effects for the benefit of all mankind; and the question concerning automation's being the prime cause of unemployment, reported in many communities today.

In studying automation we should remember that although we are living in an advanced technological society, automation is still in its infancy and the benefits to be derived from its future development are as unbelievable and remote as was the airplane in the time of Leonardo da Vinci. In the future development of automation, almost everyone in the world will encounter problems and reap blessings from this automation. It is to our advantage to learn all we can about the phenomenon

so we can cope with various problems, present and future, which will surely arise as automation plays a more prominent part in our economy.

The author is indebted to many whose friendly criticisms and suggestions have contributed to the improvement of this paper. Among those who have been good enough to help are Dr. T. Berry, of the University of Richmond School of Business Administration and Mrs. C. E. Bullard of Richmond, Virginia.

The author assumes responsibility, however, for the points of view expressed and for possible deficiencies and errors.

James G. Frazer

CONTENTS

Page

Chapter IV

FACTORS TO BE CONSIDERED BY MANAGEMENT

Chapter V

THE EFFECTS OF AUTOMATION

Page

Chapter VI

ALLEVIATING THE ADVERSE EFFECTS OF AUTOMATION

Chapter I

ORIGIN AND DEFINITIONS OF AUTOMATION

Automation - what is it? From what source or sources did it come? What can society expect from its future growth and application? These are questions being asked by businessmen, union leaders, politicians, and academicians the world over.

The answers to these questions are as numerous as the people who wish to delve into, analyze, and discuss this new phenomenon.

The Beginning of Automation

The technological developments of which we are very much aware had their origin in the 18th century at the beginning of the Industrial Revolution. Automatic devices during this period took the form of some of the world's most significant inventions, significant from the point of view that this was the birth of a new era, the Industrial Revolution. John Kay's flying shuttle, James Hargreaves' spinning jenny, Richard Arkwright's roller spinning frame, and Watt's steam engine are only a few of the significant inventions which opened the way to our present society of automation.

The feed-back system, which is characteristic of all automatic systems, is not altogether new. Before automation was a passing thought, windmills were constructed with small vanes perpendicular to the main shaft; and as

the wind shifted, these small vanes turned the arms of the windmill to head into the wind. Another example of a simple feedback system is a thermostat's reaction to changes in temperature so as to regulate the burner in a heating system.

Now through a more intensive application of this principle called feedback, machines can be made which are self-sufficient, so that production processes do not have to be designed to take into account the human limitations of employees.

Is Automation A New Process?

In analyzing the definitions and writings of authors we become aware of the various schools of thought encouraged by this new term. There are several questions still unanswered. Is automation really something new? Is it different from previous methods in kind, or degree?

The closed-loop or feedback system seems to be the main point of disagreement on the part of many experts. Does this feedback create a new system in kind, or is it just a greater degree of control over a much improved automatic system? Many experts believe a windmill without its small turning vanes is just another automatic device, and these vanes do not exemplify automation as it should be defined in the terms of today's technology. At what point does a system cease to be automatic and become automated? May we settle for a definition whereby an automated system is one in which the mechanical integration of the mental

and physical factors is inherent in the continuous production of certain goods and services - a system in which continuity is dependent on self-operation and correction measures, requiring a minimum of human surveillance?

As already suggested it is not easy to make a hard and fast distinction between automatic machinery on the one hand and an automated group of machines on the other. At a certain degree of automatic control there is a change from separate automatic production to a more intensified control of two or more parts of these original, separate automatic functions. Experts are devided as to their appraisal of this increased control. Some experts believe that automation is something completely new, a change in kind. Other experts believe it is just a continuation of the degree to which more intensive production control is used bringing about the use of automated processes; therefore, automation is a change in degree of certain automatic processes, and not a change in kind.

Definitions of Automation

The definition of automation will probably continue to change as we learn more about its application.

The following accounts from recorded discussions define automation in the light of present day developments.

Most authorities seem to agree that the word "Automation" was coined by S. D. Harder of the Ford Motor Company to refer to "the automatic handling of discrete parts

between progressive processing operations". Automation, in this sense, is now applied in the machining of engine blocks, pistons, ring gears, etc. Like the assembly lines of the 1920's, the methods used in handling materials in the automobile industry are being introduced by other metal working plants which produce large volumes of standard and non-standard goods.[1]

On the other hand, D. J. Davis, Vice-President of Manufacturing for Ford Motor Company, believes the word Automation is very much misused and misunderstood. Davis says Automation is exemplified by a simple change he made in a milling operation at General Motors which enabled the machine to clamp various parts automatically. Davis thinks this is automation in the "true" sense of the word.[2]

A third authority, John Diebold, President of John Diebold Associates says that eight or ten years ago the thought of the definition of automation in relation to machines and the manner in which automation could contribute to increased productivity. But now he is convinced the fundamental importance of automation is not so much the converting of machines as it is the ability to create automatic information and control systems.[3]

Diebold defines "automation" in these words: "One way of defining automation is to say that it is a means of organizing or controlling production processes to achieve optimum uses of all production resources -

material, mechanical, and human. There are two basic steps that industry follows in the approach toward automation. The first of these is the organization of each of several steps of the production process into a fully integrated system. The oil refineries pioneered in this step; the chemical industry, the processing industries, and nuclear production have since followed in going through the first step of automation. They have changed what had formerly been batch processes into integrated systems."[4] Emphasizing control, Diebold further states: "The second step of automation is to take the system and to control it in such a way that it operates at optimum all the time.... People who are not familiar with the process industries will point to oil industries and say 'this is automation; other industries are going to develop in the same way.' Actually, by the introduction of control systems into oil refineries and other processing industries - paper manufacturing, sugar refining, chemical manufacturing, etc. - a second stage of automation is being achieved. Here it is not a case of replacing hand labor by machines, but rather of operating the machines at optimum efficiency all the time."[5]

In testimony before the 86th Congressional Sub-Committee on Automation and Energy Resources, Diebold stated that if automation means anything at all, it means something more than just the extension of mechanization.

Diebold believes that new technological developments are a break with past trends because it is no longer necessary to think of only one machine, or even in terms of a group of machines; instead it is practical to look at the whole process as an integrated system and not as a series of individual steps.[6]

The reader must note that Diebold has a concept altogether different from Davis. Davis describes automation as an evolutionary process. Diebold is more explicit in his definition. His explanation of automation seems to lie more in the complete self-sufficiency of a production system than in just one individual facet of that process.

Labor leader Walter Reuther defines automation as "a techniquo by which whole batteries of machines, in some cases, almost whole factories and offices can be operated according to predetermined automatic controls. The raw material is automatically fed in the machine, automatically taken away, often to be fed automatically into still another machine that carries it automatically through a further process."[7]

Reuther is quick to take issue with people such as Davis of the Ford Motor Company when the latter explains automation as just the "extension of the normal technological evolutionary process". Reuther believes that automation is the beginning of the second phase of the

Industrial Revolution which started in the 18th Century. His reasoning on this point is as follows: automation is an entirely new development because, in addition to substituting mechanical power for human power, it substitutes mechanical thinking for human thinking. Some machines have the ability to store vast amounts of information and to call upon these services quickly to adjust machinery for a necessary process. This means that the machine is capable of replacing not only the human being, but also the thinking process of the human being. With the idea in mind that automation is more than an evolutionary process, it is wishful thinking to assume there will be no social repercussions if these problems are not quickly met. 8

Reuther believes that the growth of automation will be revolutionary. If we do not recognise the seriousness of our present situation, we face a repetition of the '29 crash, possibly resulting in a tremendous rate of unemployment.

Another union leader, James B. Cary, President of the International Union of Electrical Workers, has this to say about automation: "When I speak of automation, I am referring to the use of mechanical and electronic devices, rather than human workers to regulate and control the operation of machines. In that sense, automation represents something radically different from the

mere extension of mechanization. Of course, it is not a sudden full blown appearance. It rests upon previous developments, especially upon government-sponsored research and development in electronics and radar. But it is a new departure from the older method of machine operations, since it represents the automatic operation of machines and the entire industrial and clerical processes."[9] We see from Cary's definition that he and Reuther tend to agree, and that both are in direct disagreement with Davis. Cary shares Reuther's idea that automation is a new process rather than the extension or improvement of processes already known.

David O. Woodbury is another student of automation who thinks there is a distinction between automatic machinery and automation. In his book "Let Erma Do It", he remarks that the word "automation" has a confusing connotation because it has no generic meaning. Each person confronted by this new phenomenon has his own definition. The difference between automatic machinery and automation, says Woodbury, is comparable to the difference between the mechanical responsibility of the truly "automatic" machine and the machines previously thought to be automatic.[10]

CHAPTER I FOOTNOTES

[1] E. Weinberg, "A Review of Automatic Technology", United States Department of Labor, Impact of Automation, Bulletin No. 1287 (Washington: Government Printing Office, 1960), p. 5.

[2] 84th Cong., 1st Sess., Joint Committee, Hearings Before the Subcommittee on Economic Stabilization: Automation and Technological Change (Washington: Government Printing Office, 1955), p. 65.

[3] Morris Philipson, "Automation: Implications For the Future", Bringing Automation Up To Date (New York: Vintage Books), p. 27.

[4] 84th Cong. Hearings, p. 8.

[5] Ibid., p. 8.

[6] Philipson, op. cit., p. 25.

[7] 84th Cong. Hearings, p. 98.

[8] Ibid., p. 121.

[9] Ibid., p. 220.

[10] D. Woodbury, "Sixty-Four Billion Dollar Word", Let Erma Do It, (First edition; New York: Harcourt, Brac and Company, 1956), p. 5.

CHAPTER II

THE CONTINUED GROWTH OF AUTOMATION

Is Automation Necessary?

Do we really need to further the cause of automation? After World War II the development of automation was accelerated to help meet the increasing consumer demand. The demand for superior products and lower prices carried automation into many industries. Within each industry there have been many applications of automation. Progressive companies in all these industries are still looking for the best way in which automatic machinery can decrease their costs. Will automation and automatic processes be necessary in the future to increase industrial productivity and to keep American industry abreast of the times? Is this new "phenomenon" something we must learn to live with, not because we have unnecessarily forced it upon ourselves, but because it is necessary to our present and future way of life.

Management's Reasons For Making Expenditures On Automation

What reasons are given for such expenditures on automation? Manufacturers, when asked why they believe it necessary to allocate funds to automation, give these answers:

1. Sagging Sales. Declines in sales volume and share of the market are often traced to production inefficiencies. A company may have an excellent market potential, but because of production inefficiencies, it finds itself unable to produce the necessary goods fast enough and cheaply enough to compete in the markets of its choice.

2. Soaring Costs. Any increasing cost places a company in a precarious position because of the need for either raising the price or accepting a lower profit. This situation, of course, weakens a company's market position, and may prove disastrous if not checked in time.

3. Labor Shortage. Companies which move to new areas experiencing a labor shortage or to areas lacking available skilled labor find that automation is the only way to operate their plants satisfactorily.

4. Poor Working Conditions. Through automation, many operations, hazardous and unhealthy, are eliminated. In this category fall the steel and chemical industries.

5. Lagging Output. If back-orders pile up, customers will not receive the delivery they desire, and manufacturers will lose reorders. This situation also adversely affects new order receipts.

6. High Rejects. Rejects necessitate the reworking of material, this situation possibly resulting in much customer dissatisfaction. Both of these factors are respon-

sible for increased costs and decreased profits; furthermore, rejects may adversely affect the cooperation and attitude of production workers. People on piecework are extremely irritated with machinery which continually has a high percentage of rejects. This general attitude may make a poor showing in other departments.

7. Competitive Markets. Competitors are always trying to improve their market position by the use of the latest technological advances. In order to keep abreast of the current market, companies must meet this challenge with their own technological improvements.[1]

Corporate Expenditures For Automatic Equipment

In reference to the future of automation in the United States one notes with interest the expenditures anticipated for new technological advancements.

Clifford E. Evanson, President, TAB Engineers, Incorporated, says: "Certainly automation is no passing fancy. It has passed like wild fire through industry. By the end of 1962 annual installations of automated equipment will reach $6.8 billion; that is up 80 per cent in six years. It is expected that by 1970 total expenditures for such systems will reach $15 billion."[2] Evanson adds that in the paper industry a number of plants have organized special automation groups. His report from a survey shows

a 17 per cent increase in the number of paper plants using such groups. In the same survey of 18,065 plants it was noted that large manufacturers planned to spend $3.7-billion on automation in 1961, or an average of $619,000 per plant; medium-sized producers, to spend a total of $1.5-billion on automation, an average of $237,000 per plant; and small producers made plans to spend $780-million in 1961, an average of $202,000 per plant.[3] Many other companies representing various industries have similar groups; for example steel, automobile, and electric power. These groups complement the functions carried on by companies such as International Business Machines and are always alert to the possibilities of using new methods of improving production and controlling costs.

Increasing Research And Development

Forces are continually at work to increase the efficiency and broaden the application of automated processes. C. C. Hurd, International Business Machines' manager of industrial control system projects, states that for two years International Business Machines has been building a staff to deal with production control problems. Mr. Hurd says that several hundred people at International Business Machines are working on these projects and related matters. I.B.M. has exerted every

effort to make sure that it tackles the most complicated problems available. A large amount of International Business Machines' work has been directed toward developing computers which can control not only whole plants but also groups of such plants at one time.[4]

International Business Machines is not alone in the computer field by any means. Several other companies are doing similar research in order to keep abreast of the market. Competition within the computer field has become intense, calling for extensive research and development expenditures for companies wishing to survive.

Man-Hour Output

One of the main factors in the long-term increase of output per man-hour has been the growth of automation, the introduction of which, along with other innovations, has given our economy its dynamic characteristics. During World War II there was a retardation in the improvement of plant and equipment, which could have been installed to serve our consumer market immediately after the war. This is not to deny that a number of breakthroughs occurred in the field of automatic production and automatic systems.

As a result of these cumulative technological developments, advances in output per man-hour in the field of manufacturing almost doubled between 1919 and 1947. After World War II, many of the new technological ideas used

directly in war production, were converted to civilian production. The following statistics give some indication of the extent of technological changes which took place between 1939 and 1958.

	1939	1958
Diesel locomotives as a per cent of total	1.4	93.4
Dial telephones as a per cent of all Bell telephones	55.7	93.8
Catalytic cracking as a per cent of total	5.1	45.4
Per cent of underground coal loaded mechanically	31.0	84.9[5]

Without technological change none of these increases would have been possible.

Table I, page 16, exhibits the tremendous increase in output per man-hour in the private economy, agricultural and non-agricultural sections between 1909 and 1958.

Competition From Abroad

One factor supporting the present trend in technological growth is the United States' wish to remain competitive in world markets. It is deemed necessary for American industry to increase man-hour output at a faster rate than the increase in unit costs. At the present time, even with all its productivity, the United States finds it difficult to compete in some world markets. The growth of the Common Market in Europe is a great factor in the increasing competi-

TABLE I [6]

(1947-49 = 100)

Year	BLS* Total Private	BLS* Agriculture	BLS* Non-agriculture	Census** Total Private	Census** Agriculture	Census** Non-agriculture
1909	47.6	58.2	51.6	47.8	58.6	52.0
1945	98.5	89.2	101.3	99.0	89.3	101.9
1946	96.0	93.8	97.5	96.6	94.4	98.2
1947	96.7	90.5	97.5	97.4	90.6	98.4
1948	100.2	107.1	99.4	100.3	107.5	99.4
1949	103.1	102.2	103.3	102.2	101.6	102.4
1950	110.4	116.2	108.8	110.3	116.1	108.5
1951	113.2	114.5	110.6	115.2	114.1	112.8
1952	115.7	124.5	112.0	118.9	124.0	115.5
1953	120.4	138.6	115.1	123.9	138.0	119.0
1954	122.6	148.3	116.9	127.0	147.9	121.8
1955	128.0	153.5	121.9	133.1	152.9	127.5
1956	128.3	156.4	121.5	133.6	155.8	127.2
1957	132.8	166.7	124.9	137.9	167.0	130.1
1958	135.4	188.6	126.3	139.1	189.2	130.1

* Output per man-hour series based on real product data from the Office of Business Economics, U. S. Department of Commerce, and unpublished man-hours data prepared by John W. Kendrick linked in 1947 to BLS man-hours.

** Output per man-hour series based on real product data from the Office of Business Economics, U. S. Department of Commerce, and unpublished man-hours data prepared by John W. Kendrick linked in 1947 to Census man-hours.[6]

tion. The idea of a United Europe is not so fantastic as many thought it would be. As the tariff walls are lowered among these common market countries America will need all the low-cost productivity it can muster to sell in these markets. Another thing to remember in conjunction with the growing competition from abroad is that most of these countries, including those in the Far East, are still in the rebuilding stage. Therefore, the mass of technological information developed here and elsewhere may prove to be advantageous to them. With their own aggressive attitudes, lower wage scales, and in some instances foreign aid, these countries may make greater inroads on American markets. All this has the result of placing upon the United States a real necessity for increasing its competitive ability.

Views of Labor Leaders

Joseph A. Beirne, President of the Communication Workers of America, has this to say: "We should like to state quite clearly and emphatically that we have never resisted mechanization for the sole purpose of maintaining jobs for workers we represent."[7]

"We welcome technological improvements. We think they will make a better life."[8] Mr. Beirne's big question is: what profit is there in having a quicker telephone connection made if it is at the price of human suffering?[9]

Mr. Beirne's feelings on the growth of automation seem to be focused on the point of view that since automation in the telephone industry has reached a very advanced stage, there should be a leveling-off process in technological innovations. This would allow normal attrition to reduce the communication work force.

A second labor leader, James B. Cary, President of the International Union of Electrical Workers, seems to feel that automation is a good thing as long as it raises individual standards of living, but in no way decreases or displaces the work force.[10] Both Cary and Beirne agree, however, that the growth in automation has been too rapid, and that there has not been enough planning to cope with the hardships which will result from automation. In other words, these men believe that until unemployment problems have been alleviated, there is no real necessity for increasing automation beyond its present level.

A view apparently quite different from these is that held by W. P. Kennedy, President of the Brotherhood of Railroad Trainmen, who states: "Automation, together with atomic energy, offers mankind its first real opportunity to eliminate poverty. No rational person would be opposed to scientific advances which offer such a great promise for people everywhere.

No responsible trade-union representative appears to be opposed to automation as such. The fact is that our

national security depends upon an increase in the rate of scientific advance in this country."[11]

Another view is that of Walter Reuther, who says: "I believe that this developing technology is going to put in the hands of freemen the tools with which they can prove the Communists are wrong."[12] Reuther further believes that it is necessary to increase our use of new technological methods if we are to remain a world power. He insists that as we increase our technological skill, we must also increase our expertness in the social sciences so that we can handle more efficiently the social problems arising from automation.[13]

Views of Management Leaders

General Electric's Ralph J. Cordiner believes that most of the industry in the United States has a long way to go before it begins to realize the full benefits of automation. He sees many wasteful and burdensome hand operations still used in manufacturing today. It is necessary, accordingly, that all the facets and functions of automation, from manufacturer to customer and consumer, be used in increasing productivity, reducing costs, and increasing the overall welfare of the American citizen. Automation is necessary because it eliminates much of the danger and drudgery from industry, and at the same time increases the pay of more highly skilled workers.

In another reference to the future necessity of automation Cordiner relates that processes will change to such a degree that 90 per cent of the changes will be in the familiar processes of mechanization and electrification. Included in these operations will be manufacturing, layout, product design, material selection, data processing, marketing, management methods, and a host of other techniques, all these making work more productive.

Cordiner gives his reasons for believing automation essential to our way of life.

1. By technological advancements our national security will be increased. We must accelerate our rate of progress if we wish to see Americans' standard of living rise at rates comparable to that of the past decade.

2. Automation strengthens competition at home and abroad.

3. Through automation everyone receives the best service: customers, stockholders, employees, suppliers, and the public in general.

4. A gradual technological change decreases unemployment while exerting a stimulating influence on the economy.[14]

D. J. Davis of the Ford Motor Company, acknowledging that our country is blessed with an abundance of natural resources, holds that technological progress has enabled

the United States to remain a world power. Davis conceives automation to be another technological step forward, bringing about many good changes. Automation opens unlimited fields for industrial diversification and the introduction of many new products. Davis feels that we owe a duty to ourselves and our country to take the greatest possible advantage of automation.[15] Davis seems to be in complete agreement with Cordiner and the labor leaders cited above in believing that automation will bring a better way of life to the United States.

The conclusion is irresistible that the movement towards further automation is not only almost certain to continue but is hailed in several different quarters as an indispensable adjunct to the furtherance of present trends in production and consumption.

CHAPTER II FOOTNOTES

1 C. E. Evanson, "Are You Ready For Automation?", The Iron Age (May 10, 1962), p. 87.

2 Ibid.

3. C. Evanson, "Plain Talk About Automation", The Paper Industry (March 1962), p. 772.

4 "Computers Start Running Plants", Special Report On Major Business Problems, New York: McGraw-Hill Publishing Co., Inc.; No Page Numbers. Available only to subscribers to Business Week.

5 "Factors Affecting Output Per Man-Hour", United States Department of Labor, Trends In Output Per Man-Hour In The Private Economy 1909-1958, Bulletin No. 1249 (Washington: Government Printing Office, 1959), pp. 13 ff.

6 Trends In Output Per Man-Hour In The Private Economy 1909-1958, Ibid., pp. 17 ff.

7 84th Cong. Hearings, P. 337.

8 Ibid., p. 347.

9 Ibid., p. 348.

10 Ibid., p. 28.

11 Ibid., p. 455.

[12] Ibid., p. 117.

[13] Ibid., p. 117.

[14] Ibid., pp. 425 ff.

[15] Ibid., pp. 58 ff.

CHAPTER III

CONTEMPORARY APPLICATIONS OF AUTOMATION

Automatic machinery was available before World War II, and consequently was a great part of the tremendous mobilization effort required during this period. Automatic control systems and electronic computers were, for the most part, developed from innovations introduced during World War II. Today most of the manufacturing industries operate automatic machinery, that is, labor-saving devices in the mass production of standard items such as filling bottles, inspecting materials, and testing operations.[1]

Computers: Digital and Analogue

Present-day computers may be divided into two categories, digital and analogue. The digital computer acts on the same principle as an extremely fast adding machine, turning out its results by means of arithmetical calculations. The analogue computer operates by means of electrical impulses and is set up in such a manner that it handles measurements, some being currents, voltages, etc. Analogue computers can provide direct control signals since actuators respond to this type of signal. When digital computers are used for control, converters are needed. Computers have been used to a great extent in helping

management make decisions pertaining to production, construction, markets, and new products. Variables are introduced into these computer systems. Several different actions registered by the machine are appraised as to results. These findings are helpful in the solution of everyday management problems.

Industrial Automation

Automatic equipment has played a major role in the development of several industries, and in all probability will continue to play an important part in America's industrial development. In applying this new technique, the electric power, oil, and steel industries are the leaders.

The Louisiana Power and Light Company has a closed-loop system at its Little Gypsy station, which is located fifteen miles north of New Orleans. This system, constructed by Daystrom Systems, not only controls the plant but also starts the station producing power and closes it down.

In the oil industry, Texaco's polymerization unit at Port Arthur, Texas, is the first computer-controlled plant in the world to turn out a commercial product. Although computers enjoyed a fast start in this industry, the industry has not purchased automatic systems as rapidly as manufacturers expected. The oil recession of the last few years has curtailed the capital expenditure for new oil plants, where the computer manufacturers hope to install

their equipment, since old plants in the oil industry are not usually converted to new processes.[3]

The steel industry is especially well suited to automated supervision. The problems faced by steel mills are many and varied, and differ from complex mechanical assembly jobs in that the steel products are different items which must be combined in the right quantities, and at the right time. Furthermore, processes in the steel industry are easily adapted to computer control. Punch cards can be made to control the rolling of an ingot from the time it reaches the rolling mill until it leaves. During the process electrical controls can check the heat content of the steel and also detect and prevent deviations from specifications.

The Jones and Laughlin Steel Company has an automatic installation in which a continuous steel strip passes through an annealing furnace at the rate of 2,000 feet per minute. As different temperature steel is welded to existing coils, the temperature in the annealing furnace is automatically adjusted so as to yield a uniformly tempered metal. This machine also collects quality control records, supplies various payroll calculations, and punches out inventory data on tape.[4]

Linde Company, a division of Union Carbide Corporation, has a simulated experiment of a blast furnace opera-

tion on a large computer which promises to be highly successful. There are a few variables, and the computer has proved that it is capable of coping with the problems. The three minutes taken by the computer to run a series of simulations represents a twenty-four year period of testing a real furnace in the conventional manner.[5]

Automatic machinery is also helping manufacturers to recapture markets lost because of faulty delivery schedules. Carl J. Rieser, writing in Fortune describes the International Business Machines 1401 computer used by Westinghouse Electric Corporation as "a little machine with a fabulous memory." This machine, able to hold 20 million bits of information, not only knows various facts about 15,000 Westinghouse customers and stores data on 60,000 finished products, but also handles an average of 1,800 orders a day.[6] Business offices have been using automation more and more extensively. They find computers so very valuable in analyzing sales for establishing the optimum inventory to sales ratio. In other companies the computers record sales information, automatically calculate and print out invoices, and tabulate the commission checks for salesmen.

In West Virginia the Internal Revenue Service is relying on its computers to help expose people not reporting all their taxable income. On electromagnetic tape the complete history of the taxpayer, in a matter of seconds,

can be made ready for study by the tax authorities.

In 1955 John Diebold stated before the subcommittee on Economic Stabilization that most of America's industry depends upon short runs to produce various products. Diebold further stated that about 90 per cent of all production in the United States is in lots of less than 25 pieces. Since products are forever changing, it is impossible at this time to build machines flexible enough to handle the varied products.[7]

Future Developments

Even without the knowledge of servomechanisms and automatic processes, there is no limit to the possibilities of automation which the mind of one wishing to think about the matter may conjure up.

Take, for example, a new experimental device which receives a message and repeats it in three languages, and at the same time types the message in as many as four languages. At present this machine is limited to 100 one-syllable words, but its inventors predict there will come a more efficient device which can break down whole speeches and type them. This kind of machine could be an aid in relieving the critical secretarial shortage prevalent in many industries, and in translating and recording meetings among foreign powers.[8]

Another innovation in computer operations is the thin

film computer. These circuits, minute compared with either vacuum tubes or transistors, have the capacity for storing 2,500 bits of information within a square inch. The memory of such a unit depends on a superconductive metal which loses electrical resistance completely at very low temperatures. Within the apparatus information is stored on minute areas of thin film. Currents read and write from superimposed zigzag lines of thin film lead. By 1980 the market for this type of computer is expected to reach 20 billion dollars a year. The main advantage of such a system is the elimination of numerous parts which are largely responsible for computer construction costs. The new microminiature circuits can be made in units containing hundreds of parts which are completely interconnected. With a minimum amount of effort these parts can be assembled into a more complex system. The speed of the new thin film computers will be higher than that of present machines.[9]

The uses to which man may put his new automatic machines and technological advances seem limitless, yet with almost each new use come the problems which limit the carrying out of the new way of doing an old job. As man seeks to gain greater prosperity for everyone through automation he must overcome many deterrents before this dream can become a reality.

CHAPTER III FOOTNOTES

1 E. Weinberg, "A Review of Automatic Technology", United States Department of Labor, Impact Of Automation, Bulletin No. 1287 (Washington: Government Printing Office, 1960), p. 4.

2 "Computers Start Running Plants", Special Report On Major Business Problems, New York: McGraw-Hill Publishing Co., Inc.; No Page Numbers. Available only to subscribers to Business Week.

3 Ibid.

4 Ibid.

5 Ibid.

6 C. Rieser, "The Short-Order Economy", Fortune: Vol. LXVI, No. 2 (August, 1962), pp. 90 ff.

7 84th Cong. Hearings, p. 9.

8 "Talk To The Machine - It Types", Changing Times: Vol. 16, No. 8 (August, 1962), p. 5.

9 G. Boehm, "Electronics Go Microminiature", Fortune: Vol. LXVI, No. 2 (August, 1962), p. 99.

CHAPTER IV

FACTORS TO BE CONSIDERED BY MANAGEMENT

The High Cost of Installation

The high cost of automatic equipment is the principal factor retarding its introduction into many production situations. Some of the computers and automatic devices are so elaborate that they cost millions of dollars or are leased at rents equally prohibitive. It is no wonder that executives in many industries think long before investing in such equipment. Mr. Clifford E. Evanson, President of T A B Engineers, Inc., believes one can handle some of these situations, where the cost is relatively high, by using partial automation. That is, partial automation is probably the best solution for a company whose processes are adapted to automation but which does not have the needed funds for complete automation. In such a case a step-by-step process may later be coordinated into a completely automated system.[1]

According to Evanson, automation is not always highly expensive to install. In some instances the existing equipment can be used as is or it can be modified or coupled with newer equipment to achieve automation.[2]

Rates of Depreciation

To some extent the federal government is attempting at the present time to amend the tax laws so as to allow business to retain more earnings for the development of new, more flexible processes. Thus a new rule has been issued to allow higher rates of depreciation on new equipment. The increased depreciation should bring a greater cash flow (net earnings plus depreciation) to companies who can take advantage of the new rule. In other words an expensive outlay such as that involved in purchasing a piece of large automatic equipment can be recouped more quickly than has been the case in the past. Another consideration is that the more quickly a company can depreciate its equipment, the less chance it stands to lose money because of obsolescence arising from changes in consumer preference and technological change.

It is interesting to note the opinion of the Prentice-Hall Tax Service on new depreciation methods. It sees that new assets can be written off at a more rapid rate and that tax payers who take advantage of such a rate will tend to benefit from larger current deductions for depreciation. However, the tax advantage of a fast write-off plus capital gain at sale is largely offset by the "recapture" of depreciation (for most depreciable property other than buildings) as ordinary income at sale.[3] [With the increase of infla-

tionary pressures, companies are still unable to regain the total cost of their equipment.]

United States producers, by using highly automatic machinery, may in many instances find it possible to compete in the world market without having to operate foreign subsidiaries. Although the tremendous flow of capital out of the United States in recent years has been offset to some extent by imports of equipment from American plants overseas a great amount of capital has on balance been invested abroad. Lower unit costs in American plants could be expected to result in more exports of products rather than capital to make them.

Failure of Management to Understand

Management's lack of interest and understanding are named as factors which may prove to be deterrents to the advance of automation. Lethargy, traditional thinking, and a lack of factual information probably have as much (or more) bearing on management's decision not to install new automatic equipment as any technological and economic consideration. In many instances management seems to have the idea that what has been adequate in the past will be adequate in the future. This attitude has always been a salient factor in the retardation of growth and in some cases has hailed the demise of concerns which at one time

were among the leaders in their respective industries. One factor underlying this attitude is the fear of antagonizing labor. Some businessmen state they "just don't want to rock the boat." There are many small businesses in the United States which could take large or small advantages from advanced technology. These include companies which are still riding the "crest" of the early 'fifties. Management teams and other enterprises with such apathy tend to look back rather than ahead. Few people will disagree that it is very difficult to go forward while looking over one's shoulder. In view of these circumstances there seems to be a definite need for the strengthening of management for the new technological advancements which may soon be an important part of our everyday lives.

Technical Personnel

Another interesting and important question concerning automation is: who will run the new machinery? Management must seek the right answer if its new production methods are to be a success. Training programs must be set up to retrain eligible workers to handle new machinery. Management may find this to be a deterrent to which it has not given due consideration. A tremendous amount of expense is likely to go into training capable technicians.

In his book Automation Servant To Man, Frank Ross, Jr. writes that the human element may provide a temporary

barrier to the further expansion of and development of automation. Fear is even now being felt that too few workers with the required training will be available to operate and maintain automated systems. Computer manufacturers are conducting schools. The federal government is also considering the sponsorship of training programs in automation. These would be set up to help workers displaced by automation and also to train new workers entering the field.[4]

An example of the results of a human error in the use of automatic machinery can be found in the Venus space craft launching during July, 1962. The omission of a hyphen in the data fed to the automatic control equipment caused the Venus rocket to veer off course. Since the rocket had to be destroyed, the experiment failed at a cost of $18,500,000.[5]

Patterson-Emerson-Cornstock has described a situation where a plant was highly departmentalized until the ingress of automation. Thereafter each of the plant facilities lost its individuality and became a part of an integrated whole. Several other companies have organized groups known as "automation engineers." Management must use great care in choosing such men according to their ability to analyze data. Men appear to be more

successful if they can design, procure, and install machinery in such jobs.[6]

A regrouping and recasting of engineers and technicians is only one of the facets of business which will probably undergo change. Management must definitely believe in and carry through any program which it has seen fit to introduce. Although the "follow-up" is an old management axiom which will never become obsolete, it is often the phase of a program to which organized thought is given too late or too sparingly.

Management's Inability to Interpret Data

Testifying before the Joint Economic Committee of the 85th Congress, Roger W. Bolz, Editor of Automation, expressed the opinion that one of the greatest deterrents to the development of automation is the inability of companies to obtain information enabling them to forecast costs. Bolz believes nevertheless that many of management's decisions are based on hearsay.[7]

It is quite possible that the statistical data now being made available to management are sufficiently and correctly prepared but are none the less incorrectly interpreted. In a rapidly moving technological society, management risks heavy losses whenever it makes a decision concerning investment in new technological equipment. It may not be so much the need for better information as for

managers better trained to interpret it. Such men are prone to introduce programs yielding better data on which to base an investment decision.

Distribution

Today some people believe that too great emphasis is being placed on production at the expense of distribution. The thought is that distribution bottlenecks are being formed as production becomes more automated and a greater number of items are turned out in a shorter time. We are said to have inadequate channels through which to market the greater volume of products.[8]

The solution to this problem may be in the continued growth of discount houses, cheaper air-freight, and mergers The small distributors and wholesalers have their work "cut out" for themselves, if they wish to be a part of the new automated society and not deterrents which have to be eliminated to make merchandise move more freely to the consumer.

There is a need for improvement in the efficiency of distribution if customers are to be satisfied on the basis of better service and quicker delivery. In the next decade the distribution system within the United States will probably be so intensively developed that one-day delivery will be the fule rather than the ex-

ception. The increased use of automatic machinery will help to bring about and sustain such an improvement.

Make or Buy

Should management decide that new or increased automation is the course to be taken consideration must be given to whether or not the equipment will be made or bought.

Firms tend to undertake the development - building jobs themselves:

1. When secrecy is desirable because of competition.
2. When an unusual material or process will be used.
3. When machinery requirements are likely to keep changing.
4. When a new principle of manufacturing is involved.
5. When delivery will be faster.

Firms tend to go outside for the development of automatic machinery:

1. When the vendor is a specialist in the particular equipment needed.
2. When standard equipment is used.
3. When user lacks the necessary engineering skills.
4. When vendor has special development equipment.

After the decision to make or buy is made the user must install, man, and coordinate the new system.[9]

CHAPTER IV FOOTNOTES

1 C. E. Evanson, "Are You Ready For Automation?", Iron Age (May 10, 1962), pp. 87 ff.

2 Ibid., p. 88.

3 Deductions - Depreciation, Amortization, Depletion, New Jersey: Prentice-Hall, Inc., 1963, pp. 14130 ff.

4 Frank Ross, Jr., Automation Servant To Man, New York: Lothrop, Lee, and Shepard Co., Inc., 1958, p. 210.

5 Richmond Times-Dispatch (July 28, 1962), p. 1.

6 85th Cong., 1st Sess., Joint Committee, Hearings Before the Subcommittee on Economic Stabilization: Automation and Recent Trends (Washington: Government Printing Office, 1957), p. 27.

7 85th Cong., Hearings, p. 28.

8 L. A. DuBridge, "Educational and Social Consequences", Automation and Technological Change, Edited by John T. Dunlop, (New Jersey: Prentice-Hall, Inc., 1962), p. 36.

9 J. R. Bright, "Procurement", Automation and Management, (Mass: Plimpton Press, 1958), p. 107.

CHAPTER V

THE EFFECTS OF AUTOMATION

Unemployment: Is Automation the Prime Cause?

What has been the state of our civilian labor market with regard to unemployment? Table II gives a comparison from 1947 through 1962 which shows that unemployment has been comparatively high since 1957 and is not declining.

Table III gives rates of unemployment since 1951 according to the color, occupation, and age of the worker. It is interesting to note that the rate for non-white workers has been much higher than that for the white and that the rates have generally been inverse to the degree of skill. The unskilled area is the very one where one can expect to find handicaps in education and training.

There are divergent views on the general question of automation and employment. A few of them are presented here to show the ragge of opinion in different quarters.

One view, expounded by James B. Cary of the International Union of Electrical Workers, holds that the rate of growth of consumer purchasing power must be comparable to that of output per man-hour; Cary

TABLE II[1]

CIVILIAN LABOR FORCE

EMPLOYMENT, & UNEMPLOYMENT

(in 000's)

Year	Annual Average	Thousands Unemployment	% of Civilian Labor Force
1947	60,168	2,356	3.9
1948	61,442	2,325	3.8
1949	62,105	3,682	5.9
1950	63,099	3,351	5.3
1951	62,884	2,099	3.3
1952	62,966	1,931	3.1
1953	63,815	1,870	2.9
1954	64,468	3,578	5.6
1955	65,847	2,903	4.4
1956	67,530	2,822	4.2
1957	67,946	2,936	4.3
1958	68,647	4,681	6.8
1959	69,394	3,813	5.5
1960	70,612	3,931	5.6
1961	71,603	4,806	6.7
1962	71,854	4,007	5.6

TABLE III[2]

UNEMPLOYMENT RATES

	1951-53 Average	1955-57 Average	1960-62 Average
Total	2.7%	4.0%	6.3%
White	2.5	3.6	5.3
Non-white	4.5	7.8	11.2
By Occupation			
Professional, technical	1.1	1.1	1.8
Craftsmen, foremen	2.5	3.7	5.6
Operatives	3.8	5.8	8.4
Laborers, except farm & mine	5.8	9.3	13.1
All Males	2.5	3.8	5.7
18 and 19	6.7	10.7	15.0
20-24	3.9	7.0	9.5
35-44	1.7	2.6	4.0

adds that high levels of employment may be attained by increasing the buying power of workers to enable them to purchase more goods. The purchase of goods necessitates the purchase of more automatic equipment to meet the production demand. Employment will also rise because there is a need for more skilled workers to operate the new automatic machinery. In other words Cary reasons that American industry gets the most benefit out of automatic equipment if wages are increased at the same or even a higher rate than the rate of the increase in productivity. He believes that the only alternative is depression brought on by increasing production without increasing the purchasing power of workers.[3]

George Meany, President of AFL-CIO, presents a discouraging picture of unemployment resulting from automation. Since unemployment feeds upon itself a downward spiral dumps the national economy into a recession. Our country has now suffered from a continuous succession of recessions, one after another about every 3 years, and each time it becomes harder to climb out. The receding tide leaves a higher plateau of unemployment than the last. According to Meany automation and other new production methods have drastically cut manpower needs and will undoubtedly eliminate jobs at the rate of about a million a year for the next few years. In retrospect total manufacturing output has in-

creased almost 25 per cent in the last decade but employment of production and maintenance workers has decreased by 12 per cent at the same time.

In order to remain static our national economy must in the next 10 years create at least 3 million new jobs a year.[4] Mr. Meany not only sees very little advantage in automation but seems to believe that it is threatening to become a curse.

In regard to railroad unemployment W. P. Kennedy, President of the Brotherhood of Railroad Trainmen, believes that no other group of employees has suffered so much as the railroad workers. Automation and railroad mergers have been responsible for this, says Kennedy, who also states that technological job losses have been much greater than work losses because of business conditions. Kennedy states that the working man is not at all convinced that management wants to share profits equitably. The Union, he points out, feels that, on occasion, management is using the threat of automation as a "club" with which it gets its way during bargaining sessions. Kennedy admits however that such an attitude on the part of management is the exception, and not the rule.[5]

Railroad management, on the other hand, has been saying that operations cannot continue profitably, or will not become profitable until there is a greater consolidation of railroad interest and costs. Costs are

to be reduced through the combining of job functions, in some instances, and through the automation of functions, in other instances.

The Southern Railway, for instance, is introducing automation into its offices. Computers are said to have saved the railroad about $850,000 in one year. In the period between 1946 and 1956 the annual profit of the Southern rose from $19.5 to $40.5 million but employment dropped from 40,000 to 22,000. Total employment in the railroad industry as a whole has decreased only 15 per cent whereas the Southern's employment has gone down 45 per cent.[6]

It is interesting to note railroad management's plans for the latter part of 1962: to eliminate 13,000 firemen on freight and diesel engines within a year, lay off excess workers, who fall into a category approved by union and arbitrators, and to adjust wages to a more realistic work scale.[7]

It seems quite clear that at least part of this situation has been brought about by the increase in automatic technology. Railroad executives have tried to anticipate the reaction from the union at the introduction of such a plan. They have also worked with a Presidential Fact-Finding Board set up especially to determine how much effect "featherbedding" is having on the railroad industry. This Board has issued a report confirming what railroad

executives have been saying for many years: there is too much "featherbedding" in the railroad industry.

The telephone industry is another one to encounter unemployment problems. In his book Automation: Its Impact on Business and People, Walter Buckingham remarks that overall employment in the Bell System since 1920 has increased from 200,000 to about 600,000 employees. Recognizing that there has been a tremendous growth during this period, he nevertheless presents the data to support a thesis that automation creates employment opportunities rather than reducing them.[8]

On the other hand Frederick R. Kappel, Chairman of the Bell System, stated in May, 1962, that he expected the facilities of the Bell System to continue growing at a more rapid rate than in 1960 and 1961 but that total employment in the System would decline in the future. He noted that since 1957 total employment had already fallen nearly 67,000, to some 726,000. He also remarked that total payroll had increased during the same interval.[9] The contrasting statements of Buckingham and Kappel show how opinions differ when it comes to analyzing the effects of automation. Buckingham is looking at overall employment within the Bell System over the past 40 years whereas Kappel is interested in recent trends in employment which may be expected to continue. The figures presented by

Kappel show not only a definite decrease in employment since 1957 but also that the Bell System can handle much more traffic with fewer people.

In regard to solutions of the employment problem in the Bell System, Joseph A. Beirne, President of the Communication Workers of America, has voiced the Union's feeling that the Bell management has not cooperated by releasing its future plans on replacing workers by automatic equipment. Beirne has also admitted that his organization's estimates and evaluations have been made without management cooperation even though no thorough analysis is possible without such cooperation. Even without what Beirne terms the "necessary information" he has predicted an ever decreasing work force in the telephone industry in spite of continuing expansion. Thus, it is estimated by the Communication Workers of America that by 1965 there will be any where from 100,000 to 115,000 fewer employees in the Bell System as compared with the number employed in 1954.[10] If such a decrease in employment does take place, which appears very likely, it will almost certainly place a heavy strain upon management - union relations.

In reference to the increasing working force in America, Ewan Clague, Commissioner of Labor Statistics, and Leon Greenberg, Chief of the Bureau of Labor Statistics, make interesting statements concerning the challenge of unemployment. They report it probable that

in the next decade our country's technological advancements will make it possible to abolish at least 200,000 jobs each year (compared with Meany's 1,000,000 a year). Estimations in this report have been based on a study of the 1953-1959 period, when automation apparently displaced about 200,000 workers a year. During the 1947-1957 period automation displaced about 883,000 workers in manufacturing plants alone -- less than 100,000 a year. Many statistical computations have led Clague and Greenberg to the opinion that automation will have a very adverse effect on employment in the future.[11]

Clague and Greenberg found that the correlation between changes in output per man-hour and employment appears to be low. To be sure there appeared to be a slight tendency for large gains in output per man-hour to be associated with declines or relatively small increases in employment, and for smaller gains in output per man-hour to be associated with larger than average gains in employment.

From their analysis Clague and Greenberg concluded that not all disemployed workers stay unemployed - some quit, retire, or die. On the other hand their studies do not reflect the disemployment that may arise between plants within an industry, or the replacement and reshuffling that may occur within plants where technological changes are taking place. Furthermore, they do not reflect the dis-

employment arising out of technological competition - where plants may decrease employment or even shut down because they transfer activities to another modern plant -- nor do they tell the impact of technological change on plants or industries which lose markets to technologically progressive competitors, to new products, and to new materials.

Clague and Greenberg indicate that technological change has implications not only in terms of displacement and adjustment of the present labor force but also for new workers who are or will be preparing for different vocations and looking for jobs sometime in the future.[12]

John Bright has stated in his comprehensive study of automation in 13 plants that the intense and often biased interest in the labor aspects of automation has occasionally distorted the picture. Bright's study comprehends only the labor aspects of automation which management has encountered or noticed. Bright admits that it will take a much broader study to test the applicability of his findings.

The leading findings reported by Bright are as follows:

1. Twelve of the thirteen firms adopted automation partly to reduce labor costs. There were tremendous increases in productivity but surprisingly little changes

in overall employment. The final employment record was a combination of the effects of many factors such as increased demand, consolidation of facilities, changes in product labor content, and the like (employment figures are given in Table IV). In this study three plants showed a net gain, three a net reduction, and seven no change in employment. Bright readily admits that another sample could have shown a different experience.[14]

It is interesting to note that Clague and Greenberg intimate that unemployment may increase above their estimates because of disemployment arising among plants within the same industry, or that replacement and reshuffling may occur within such plants. Bright is quick to point out that his final employment data result from a combination of the effects of several factors such as continued expansion, new capacity, and absorption in other operations, factors which tend to offset unemployment. Bright appears to agree with Clague and Greenberg that large increases in productivity are frequently accompanied by little change in overall employment.

In his study Bright has emphasized that it is inaccurate to attribute net employment changes solely to developments in automation. There are simply too many other factors affecting employment. For example, each of the following tends to reduce employment: increased

TABLE IV

TOTAL EMPLOYMENT AFTER AUTOMATION INSTALLATION IN THIRTEEN FIRMS

Company	In the Mfg. Sequence Involving the Automation		In the Firms Total Employment at This Location		Source or Disposition of Jobs
	Jobs Gained	Jobs Lost	Jobs Gained	Jobs Lost	
Ford	4,700		4,700		New addition to capacity.
Blue Motors		350	no change		Absorbed by expanded car-building operations.
Autoparts					Automatic workfeeder was not adopted to change labor content, but to control inventory.
Electromech	38	420	no change		Absorbed by expansion of business.
Burton		10% reduction in direct labor hours	no change		Absorbed in other job shop operations.
Queen Motors	2		no change		Absorbed in other operations.
Duke Motors		33	no change		Absorbed in other operations.
Ovenflow		250 - 300		250 - 300	Con't. expansion of the business has resulted in gradual addition of about 100 employees. In the 4 years following the original reduction.
Sunshine	20		20		Additional new operation made possibly only by the automation concept.
Northland Oil	165		165		Addition of a production facility.
Growmore		3 minimum 17 maximum		3 minimum 17 maximum	Min. & max. operations caused by seasonal extremes in demand.
Elkhart		5		3	Partially absorbed in other operations.
Rubberfoam		18	no change		Absorbed by expansion of another dept. in the same plant.

productivity of automation, consolidation of production facilities, more efficient layout and workplace arrangement, substitution of new equipment for old, product redesign for simplicity, shift from departmental to line production, and mechanization of formerly manual operations. On the other hand, there are as many factors which tend to increase employment: increase in demand, addition of new production facilities, addition of new products, introduction of more complex products, union regulations on working conditions, increased need for maintenance and other services to support automation, and a new policy to provide better housekeeping, maintenance, and working conditions. Bright's conclusion is that consideration must be given to all factors involved before and after automation. Otherwise the employment changes due to progress in automation cannot be measured accurately.[15]

2. Bright takes issue with those who think that automation always brings the following results:

a. Higher degrees of skill for all those assigned to the automated lines;

b. A higher proportion of skilled jobs; and

c. A shift from operating to maintenance jobs, thus increasing the proportion of skilled jobs.

The results of Bright's study, as shown in Table V,

TABLE V

SUGGESTING THE CHANGING CONTRIBUTION REQUIRED

OF THE OPERATORS WITH ADVANCES IN LEVELS OF MECHANIZATION

WORKERS CONTRIBUTION	MECHANIZATION LEVELS			
	1 - 4 (Hand control)	5 - 8 (Mechanical control)	9 - 11 (variable control signal response)	12 - 17 (variable control action response)
Skill (knowledge of art)	increasing	increasing	increasing - decreasing	decreasing - nil
Skill (dexterity)	increasing	decreasing	decreasing	nil
Education (knowledge of the theory)	increasing	increasing	increasing - decreasing	decreasing - nil
Experience (practice awareness, comprehension)	increasing	increasing - decreasing	increasing - decreasing	decreasing - nil
Physical Effort	increasing - decreasing	decreasing	decreasing	decreasing - nil
Mental Effort	increasing	increasing - decreasing	decreasing	decreasing - nil
Influence on Productivity	increasing	increasing - decreasing	mostly decreasing	nil
Exposure to Hazards	increasing	decreasing	decreasing	nil
Acceptance of Undesirable Job Conditions	increasing	decreasing	decreasing	nil
Responsibility ++	increasing	increasing	increasing - decreasing	increasing - decreasing - nil
Seniority	not affected	not affected	not affected	not affected
Decision-Making (significant judgments)	increasing	increasing - decreasing	decreasing	decreasing - nil

++ Safety of equipment, the product of other people

throw considerable doubt on the certainty of such results. To be sure Bright found that comparable data on the composition of the work force in terms of "skilled jobs" were usually not available. That is, it appeared impossible to determine whether automation has been altering the job mix so that skilled jobs rose and unskilled jobs fell in percentage of total employment.[17]

3. Bright found that automation has not forced management to take drastic measures because of an increase in operator skill requirements. There have been some such increases but none beyond the capacity of average employees. The plants employing the highest degree of automation have had little or no trouble teaching current operating employees to master the new equipment. Over all there is little evidence to show that superior skills are required.[18] These ideas expressed by Bright are for the most part in direct contrast to the ideas expressed by most other students of automation. Of course one must remember that Bright's conclusions are drawn from a study of only 13 manufacturing concerns. The situation may be quite different in other areas.

New Job Classification and Industrial Relations

Shortly after World War II the Ford Motor Company

started a tremendous expansion program. New processes, entirely different from the old, were introduced. The United Auto Workers were very much concerned about manpower problems and related issues such as the following: (1) job classifications and rate changes for "automated" jobs; (2) changes in the skills needed to operate the new machinery; (3) retraining; (4) seniority; and (5) effects on skilled workers' classifications.

A new operation at the Cleveland plant paid eleven cents an hour less than a similar operation in the Dearborn plant. The Dearborn operation was in existence before Ford started installing automated machinery. The union noted this discrepancy in wages and contended that new job rates and classifications were in order in Cleveland. After a strike the company reached a compromise with the union whereby automation was recognized in job classifications it affected and changed work was recognized on particular jobs done by certain operators on major lines and by other workers with different classifications.

It was also known that automation would effect a great change in the required skills of certain workers. In other words workers having the capacity were retrained for new jobs. The agreement on seniority placed a burden on the Company to consider Ford workers laid off at other Ford plants before hiring new personnel.

The United Auto Workers maintained that skilled workers have a specific classification which places them above apprentice and journeyman standards.[19]

The coming of automation in the Ford plants gave the Union an excellent opportunity to tighten its hold on old members as well as to obtain new members.

Growth of the Service Industries

Throughout the years technological change has affected man in many ways - some good, some bad. In the days of the Industrial Revolution many men were working as much as 72 hours a week. Today the average work-week is approximately 40 hours and workers in some industries are on a 35-hour work-week. The amazing thing about this remarkable decrease in working hours is that it has been accompanied by tremendous increases in both wages and the standard of living. Moreover, various company plans have given working people substantial non-wage benefits such as hoppitalization, retirement, sick pay, vacation, etc. Many people are able to retire today on company-financed pensions as early as age 62.

The home life of individuals is reaping the benefits of technological change. The average family income in the United States (Table VI) is approximately $7,000 and, as it has been stated, people are now spending less time in the office or plant. The extra leisure can be used in many ways, ways in which the expenditure of money

TABLE VI [20]

PERSONAL INCOME RECEIVED BY EACH FIFTH AND TOP FIVE PER CENT OF FAMILIES AND UNATTACHED INDIVIDUALS

	average income in current dollars			
	1935 1936	1947	1955	1960
Total	$1,631	$ 4,126	$ 5,540	$ 6,845
Lowest Fifth	337	1,023	1,355	1,576
Second Fifth	749	2,275	3,200	3,758
Third Fifth	1,146	3,308	4,634	5,581
Fourth Fifth	1,708	4,542	6,290	7,721
Highest Fifth	4,216	9,483	12,722	15,588
Top 5 Per Cent	8,654	17,226	22,893	27,368

is needed if people are to fulfill their everyday desires. The additional free time people now have, coupled with a greater expendable income, has given a marked stimulus to the so-called service industries. People with extra time and money are able for instance, to travel more often and spend more money on services they formerly could not afford. These expenditures, of course, have a stimulating effect on the economy and to a certain extent help keep our unemployment figures at a lower level.

- Some believe that the extra time and money in the hands of workers has an adverse effect on employment. The theory is that workers do many jobs around the house in their off-time which would otherwise have required paid professionals. The "do-it-yourself" idea has spread at a tremendous rate during the past decade. In their spare time "do-it-yourself" enthusiasts spend much time in house painting, sewing, building, gardening, and doing general repair work. Such workers are amateurs to whom the work furnishes not only recreation but also an opportunity to save money. But it should be remembered that the industries supplying these amateur carpenters need more employees to serve the enlarged market. We may also speculate that home repair men create considerable work by bungling jobs, which offsets to some extent the work they take from professionals.

Incidentally there are those who disagree with the statement that automation can bring much more leisure time to workers. One of these, Sebastian de Grazia, a political science teacher at Rutgers University, says that the leisure time of man is "just a myth". He bases his argument on the following: the Bureau of Labor Statistics excludes part-time jobs in its estimate of the average work-week. If such jobs were included the average work-week would figure at 46 or 47 hours. Workers "moonlight", which makes for additional hours of labor. The combination of all the time spent in commuting to and from work, along with that used in do-it-yourself "chores" actually leaves the workers very little time properly termed leisure.[21]

In his book Of Time, Work And Leisure de Grazia brings out the point that the word "leisure" has always referred to something personal, a state of mind, or a quality of feeling. It seems to Mr. deGGrazia when one changes from "leisure time" to "free time" one has gone from a qualitative to a quantitative concept. De Grazia believes that free time is very different from leisure time. Much of a man's "leisure time" turns out to be "free time" during which he does not have a chance to do what he really wants to do.[22]

Retirement

The number of people facing retirement in the near future will probably continue to grow. Such an increase will have an important effect on social and economic conditions in the United States. These retired workers need diversions to occupy their spare time, but they must also have money to pay for the necessities of life and for various desired activities. Many of these old people do not have adequate incomes even with Social Security.

Table VII indicates that by 1980 we can expect to have 9 to 11 per cent of the United States population in the over-65-category.

Table VIII shows the change in money incomes of the aged by class and sex, 1949 - 1959. Table VIII indicates that about 55 per cent of the senior citizens had money incomes in 1959 from all public and private sources of less than $1,000. Yet in 1949 even more (about 74 per cent) had incomes of less than $1,000 and only 13 per cent received $2,000 or more. The gain in money income between 1949 and 1959 has been offset to some extent by the 20 per cent decrease in purchasing power of the dollar

With an increase in automation there is a good chance that people near retirement age will elect early retirement, where it is available, instead of retraining.

We can expect Social Security coverage to grow to

TABLE VII[23]

AGE COMPOSITION OF THE U.S. POPULATION
AT TWENTY-YEAR INTERVALS, 1900 - 80

	Per Cent of Population in Each Age Group		
Year	Under 20	20-64	65 and over
1900	44	52	4
1920	40	55	5
1940	34	59	7
1960	38	53	9
1980	44-34	47-55	9-11

TABLE VIII[24]

Money Income Class	Total		Men		Women	
	1959	1949	1959	1949	1959	1949
No income	15.1	30.7	3.2	12.0	24.9	47.5
$1 - 499	13.1	24.2	7.2	22.6	18.0	25.7
$500 - 999	26.9	19.4	19.6	21.0	32.9	17.9
$1,000 - 1,999	23.3	12.5	32.8	19.8	15.5	6.1
$2,000 - 2,999	8.9	4.8	14.3	10.9	4.4	1.9
$3,000 - 4,999	6.7	4.8	11.6	9.5	2.6	.6
$5,000 or more	6.1	2.1	11.4	4.2	1.6	.3

help alleviate these social and economic problems.

Meeting Foreign Competition

Professor Robert L. Raimon of Cornell University analyses the problem of foreign competition in this way. The spread among wage levels by industry has widened in the postwar period; high wages have become higher faster than low wages have risen. A fall in prices, particularly in things we export, might have increased our exports. Such an increase would have increased employment and eased our balance of payment problems. A fall in prices might also have better prepared us to accommodate the rise in prices that may come to attend the recovery period we are now in. Why did prices not fall? Wages rose faster than did productivity and the increased labor costs were reflected in price increases.

From 1953 to 1959 the prices of manufactured exports were rising faster than those of our chief competitors. For example:

5 per cent faster than England's
10 per cent faster than Germany's
20 per cent faster than France's

Our share of the world market for manufactures fell from 26 per cent in 1953 to 21 per cent in 1959.

Raimon States further in relation to foreign com-

petition that wages in western Europe and in Japan have been rising much more rapidly than in the U. S. Two additional items of importance are: (1) the wage increases abroad clearly have been of the demand-pull variety, in view of the previously indicated labor shortage; that is, employers have been getting maximum production from their labor resources, and (2) until recently, their rate of increase in wages has been exceeded by the rate of increase in output per man-hour. This productivity performance thus helps to explain the increase in the ability of foreign producers to compete with American goods.[25]

Another interesting view similar to Raimon's is that of Mr. Frank Flick, President of Flick-Ready. He has this to say about automation and unemployment: by virtue of automation a corporation's productivity may increase, say 4 per cent. The union maintains that increases in productivity belong to the laborer. If all this increase is given to the employee in the form of added compensations, taking into account the cost of added automatic equipment, the company will simply have to sell the additional product at higher prices. The pre-raise "money in the bank" of these same workers has actually lost some of its purchasing power in buying these products because the products have risen

in price. Likewise - in respect to the same products - the purchasing power of widows, orphans, retired people, and all others living on fixed incomes has similarly lost some of its purchasing power.

Before the price increase the corporation in our example was selling to foreign markets and was just meeting competition - now the increased selling price will almost surely lessen foreign demand.[26] Mr. Flick also sees uncontrolled wage increases by unions as the prime cause in the unemployment controversy.

How can the United States best place itself in a position to compete with foreign countries? One answer to this question is that we should begin immediately taking advantage of the automation which has been, and will be introduced to many of our industries. Savings in many industries have been unrealized because of the rising costs in the form of excessive wage demands. Industries need more money for carrying out their research and development programs. To alleviate this problem it may be well to accelerate depreciation allowances and lower corporate taxes. Such a move would have to be offset by a decline in government expenditures at home; and, probably a cut in foreign aid. We must remember however, that a large part of our foreign aid is channeled through American companies to supply these countries. Cutting

out this expenditure entirely, then, could adversely affect our economy. The effect of making extra capital available to United States corporations would be allowing them to invest more in automatic equipment. The increased efficiency brought about by such investment would enable many American corporations to compete more extensively in world markets.

Summary

As with technology in general, the relationship between automation and employment (or unemployment) is highly complicated. Nobody denies that pockets of unemployment can and do result directly from the introduction of new methods into a given operation. However, there are almost always other factors which tend to exert an offsetting or compensating effect.

In general the pattern appears to be that older and semi-skilled and unskilled workers have suffered to a greater extent than younger and skilled workers. More studies are needed to verify this, and to discover other aspects of the relationship between automation and employment.

As man-hour output develops (partly through the introduction of automatic equipment) people may have (a) a higher standard of living or (b) more leisure time or (c) a combination of the two. Employment in

general will be influenced considerably by whether we choose more free time, and if so, how we choose to use it.

One looks for a further growth in the demand for more aid to the superannuated, a group which can be expected to grow both in absolute numbers and in relative size compared with the active work force.

As for foreign competition, the lowering of barriers to trade and the movement of capital should encourage the introduction of new methods in various areas, some of which have been handicapped from a technological point of view. It follows that American industries which adopt cost-cutting methods will fare better in world markets than those which fail to do so. At the same time, all peoples should benefit more or less from the general lowering of unit cost and extension of trade.

CHAPTER V FOOTNOTES

1
United States Department of Commerce, Employment And Earnings Statistics, 1909-60, Bulletin No. 1312, Vol. 43, No. 12 (Washington: Government Printing Office, 1960). pp. 5 ff.

2
M. S. Folsom, "Where Unemployment Hits Hardest", Saturday Review: Vol. XLVII, No. 2 (January 11, 1964), p. 23.

3
84th Cong. Hearings, p. 221.

4
G. Meany, "The Unemployment Problem", Vital Speeches Of The Day: Vol. XXVIII, No. 24 (September 3, 1962), pp. 763 ff.

5
84th Cong. Hearings, pp. 460 ff.

6
Jacobson and Roucek (Eds.), Automation And Society, Philosophical Library, New York, 1959, pp. 117 ff.

7
"Is There Going To Be A Railroad Strike?", United States News And World Report: Vol. LIII, No. 5 (July 30, 1962), p. 84.

8
W. Buckingham, "The Great Employment Controversy", Automation: It's Impact On Business And People (New York: Harper and Brothers, 1961), p. 110.

9
"Arithmetic Of Automation", Forbes Business And Finance (May 15, 1962), p. 22.

10
84th Cong. Hearings, pp. 337 ff.

11 S. Porter, "Automation Will Wipe Out Two Million Jobs In a Decade", Richmond Times-Dispatch, (May 22, 1962), p. 10.

12 E. Clague and L. Greenberg, "Employment", Automation And Technological Change, (New Jersey: Prentice-Hall, Inc., 1962), pp. 118 ff.

13 J. R. Bright, "The Impact Of Automation On The Work Force", Automation And Management, (Boston: The Plimpton Press, 1958), p. 175.

14 Op. cit., pp. 170 ff.

15 Op. cit., pp. 175 ff.

16 Op. cit., p. 186.

17 Op. cit., p. 176.

18 Op. cit., p. 195.

19 K. Bannon and N. Samp, "Impact Of Automation On Ford - UAW Relationship", United States Department of Labor, Impact Of Automation, Bulletin No. 1287 (Washington: Government Printing Office, 1960), pp. 58 ff.

20 Statistical Abstract Of The United States And Survey Of Current Business, "An American Economy", College Of The Air Television Study Guide, (New York: McGraw-Hill Book Company, Inc.), p. 138.

21 "Same Old Hours", Newsweek: Vol. LIX, No. 26 (June 25, 1962), p. 56.

22 S. De Grazia, Of Time, Work, & Leisure, (New York: Twentieth Century Fund, 1962), p. 65.

23 J. G. Turnbull, C. A. Williams, and E. F. Cheit, "Age Composition Of The Total Population", Economic And Social Security (New York: The Ronald Press Company, 1962) p. 47.

24 J. G. Turnbull, C. A. Williams, and E. F. Cheit, "Money Income Of The Aged", Economic And Social Security (New York: The Ronald Press Company, 1962) p. 59.

25 R. L. Raimon, "Automation And International Competition", Vital Speeches Of The Day: Vol. XXVIII, No. 15 (April 6, 1962), pp. 476 ff.

26 F. Flick, "Does Automation Cause Unemployment?", Vital Speeches Of The Day: Vol. XXVIII, No. 9 (October 26, 1961) pp. 280 ff.

CHAPTER VI

ALLEVIATING THE ADVERSE EFFECTS OF AUTOMATION

Education

Education is perhaps the leading factor in alleviating any adverse effects of automation. Most businessmen, union leaders, and government officials regard education as the most important facet of any long-term program proposed to stem the tide of unemployment brought about by automation. Increased and more comprehensive basic teaching is needed if the United States is to remain a world leader. America needs to look forward and to give our children a firm foundation of instruction in their early years of school; furthermmove, it should set up higher standards to be maintained even through graduate school. This does not mean retraining programs are not necessary; they are, but only through long term planning can we cope with the situation now facing us.

In regard to retraining programs, it is interesting to note that on March 15, 1962, President Kennedy's signature made the Manpower Development and Training Act a public law. This act provides mainly for the appropriation of funds to help in retraining the necessary manpower needed to operate a fast advancing technological

society. It further provides training for those individuals, being now unable to secure jobs because of a lack of certain skills. This instruction will be imparted through vocational educational institutions, authorized by the Federal Government, and under the direction of the Department of Health, Education, and Welfare. Possibly private educational and training institutions will be used. The Federal Government will pay the total costs for the vocational training of the unemployed through June 30, 1964, after which time states wishing to continue participating will have to bear half the expense. Federal and state governments will share equally in bearing costs of training other persons. Workers unemployed at the present time will receive priority in training. Also to be considered for the program are part-time employees and those full-time employees wishing to up-grade or up-date their job skills. Potential trainees will apply through their local public employment office, and the selection of eligible workers to be retrained will be left to these offices. The amount paid trainees will depend on hours worked, and will include allowances for transportation and subsistence. In the fiscal year 1963, $100,000,000 was appropriated for these programs; in 1964, $165,000,000, and the same amount in fiscal year 1965. The sum of $5,000,000 was authorized

for fiscal year 1962 to help plan and initiate the programs under the Act.[1]

The question arises: what prompted the decision to make appropriations for training workers? In April of 1962 the President's Advisory Committee on Labor-Management presented to President Kennedy a report on automation which showed that the postwar population increase had been responsible for a great influx of workers into the labor market. The last decade has also seen a great change in the nature of jobs, this change often leaving a gap between job requirements and the qualifications of applicants. The report further stated that during the 1950's the total number of skilled technical and professional workers had increased some 58 per cent. This increase had an adverse effect on young workers who were trying to find opportunities for work. In connection with this problem the Department of Labor estimated that unless something were done to check high school withdrawals, some seven and one-half million new workers joining the labor market in 1960 would not have completed high school and over two and one-half million would not have finished grade school.[2] Assuming that these figures were approximate the reader can readily see that a retraining program was certainly indicated. Of course, this report was not the only one advocating the necessity of a training program: subcommittees of Congress, management groups, and labor organizations have held many meetings

in reference to the matter. There is still, however, a great need for further study of the subject.

Revision of Federal Wage-Hour Law

Walter Reuther, United Auto Workers' President believes that a change in the federal wage-hour law so as to require double pay for overtime would greatly alleviate the adverse effects of automation. In conjunction with this proposal Reuther and other labor leaders believe that all employees should have a 35-hour workweek, the same principle of double overtime being applied. The theory is that employers will hire more employees rather than pay double overtime rates. The proposal also entails the payment of the same wages to those working a shorter workweek.[3] If such be the case the unions may be intensifying the adverse effects of automation on employment and possibly working towards a decline in job opportunities for their members. If employees receive the same pay for a shorter workweek productivity must rise sufficiently to finance such wage increases. In other words if industry cuts its workweek 14 per cent it will have to increase output by at least 14 per cent per hour to reach the same level of total production. It is highly doubtful whether production can be increased enough at present to warrant such a decrease in working hours. If demand and technology do not increase

as the workweek decreases, then greatly reduced productivity must follow. This in turn will affect industry profits adversely, as well as employment and the standard of living. Since demand for products is a very important phase of this theory, it is found more economical in many production situations today to follow the plan of paying overtime rather than running a new shift. The market for many products may not be sufficiently large to run 2 seven-hour shifts. If an additional shift works only part time, there is a strong possibility that the union will demand full wages. So far, as unit costs are increased, management will tend to raise selling prices in order to maintain profits. The effect of such an increase in prices will discount the hope of any rise in the standard of living because of an inflationary wage price spiral. Unions will contend that higher wages will increase production demand because of the greater amount of money brought into the economy. Undoubtedly, productivity cannot increase without sufficient investment capital to support it; therefore this plan would probably leave industry without the necessary capital.

Probably a more sensible plan would be to leave the workweek and wages at their present levels. Any productivity increases would then increase corporate profits. Thus corporations would have more money for research and

development expenditures, an increase in these resulting in lower prices and a better competitive position for American corporations.

Management Outlook

Some economic circles believe that management must change its methods of handling new responsibilities. In reference to this Peter Drucker, a noted management consultant, has stated that management is now expected to meet public demands in many areas, which until recently were not considered its responsibility. In attempting to adjust American business to automation with the least possible effects, management has a tremendous problem. Additional responsibilities are these:

1. Keeping America competitive in world markets and, wherever necessary, changing wage and job policies so deeply rooted in American business;

2. Seeking new innovations which will help in advancing both technology and management policy;

3. Remembering that today big business faces the problem of being not only a single economic entity operated for profit, but also a servant of the public as well as of its stockholders; and

4. Classifying businessmen as professional persons rather than just businessmen.[4]

These responsibilities, if handled properly, will certainly have an excellent effect on all business relations.

Plans of Action: Management, Labor, and Government

Management, in carrying out any plan of action, must consider the factors listed by Drucker. In some instances both management and labor seem to be taking his advice by cooperating to alleviate some of the adverse effects of automation.

The West Coast shipping industry showed such a spirit of cooperation in signing a five-year pact with its longshoremen. New mechanization and modernization were being introduced with two objectives: (1) the employers' desire to cut costs and cargo handling time, and thereby attract more cargo to Pacific Coast ports; and (2) the union's hope of preserving the longshoremen work force and giving workers of long service a greater interest in the industry. The agreement gave management a free hand to introduce any labor saving device deemed necessary so long as employees were protected against technological unemployment. A minimum weekly wage was guaranteed, and older employees were given financial incentives to retire early. This working plan appears to be reaching both objectives. In May, 1962, management stated that there had been a 20 per cent productivity

increase since January, 1959. The greatest disadvantage in this program has been that members have not been completely indoctrinated as to the workings of the plan.[5] That is the unions seem to be unable to cope with the problem of educating their own members.

Another plan has been introduced by Armour and Company which has received more publicity than the West Coast shipping agreement but has proved less successful. Armour and Company has agreed to contribute as much as $500,000 toward an "automation fund". These contributions will be made on the basis of one-cent for every hundred pounds of meat shipped. The fund is to be used for a study of problems arising from automation, retraining programs, and to promote employment opportunities within the Armour organization.[6]

Still another plan was introduced by the United Auto Workers at its convention in May, 1962, which placed greater responsibility on employers to care for workers displaced by automation. This program includes the rehiring of production workers to fill white collar jobs, more severance pay for workers who lose their jobs, and provisions for retraining. The United Auto Workers believe that this program, by means of organized planning, should be developed as a formal company policy within the whole industry.[7] The unions must cooperate with management and

try, through objective thinking, to formulate a plan which is logical and non-inflationary.

According to government sources a retraining plan introduced by the U.S. Air Force has been one of the most successful projects in this area. In carrying out the program the Air Force has retrained thousands for its new programs, many of which require highly technical skills. The Air Force Logistics Command, because of its ever changing weapons system, figures on retraining as many as 15,000 employees a year, many of whom require rudimentary instruction. The time needed for such training ranges from a few months to three years.[8] In analyzing this case one must not forget that the Air Force is a government agency. Millions have been spent on this program, some of which are corporations' contributions through tax payments. If corporations are not careful they may lose the opportunity of setting up their own programs. That is, the federal government may some day require business concerns to retrain their workers, including those who are displaced permanently. Regardless of what happens in this situation it behooves management to think more seriously about its retaining problems.

Use of Time

Still another factor, most important in solving the adverse effects of automation, is the use of leisure

time. Time itself is most resourceful; and only when man fails to use it to greatest advantage, does it seem otherwise. Many people consume time in complaining instead of working to overcome the cause of their complaints. Benjamin Franklin, in his powerful maxims, emphasized the importance of using this valuable possession wisely. Asked he: "Dost thou love life? Then do not squander time, for that is the stuff life is made of." Time is ours, but what to do with it is the question.

A man whose enjoyment of life requires costly activities is not helping either himself or the economy. By using his spare time to improve his education, man will find his regards in things costing little; in fact he may well come to realize that the things in life that really count are those that money does not buy.

Conclusion

The solution to the problems resulting from automation, must lie in a broad program involving management, labor, and government. The main objectives of this program should be the encouragement of economic and productive growth, and the spread of benefits to all the labor force. This will mean the introduction of a program which in turn will accelerate demand and spread the increase in productivity. Carrying out such a plan

will require a complete examination of our present tax structure. Assessments should be made just so far as they will neither discourage investment nor hinder production; this undoubtedly means a decrease in taxes. The Federal Government, in conjunction with a tax cut, should closely evaluate our foreign policy to insure America's receiving full value for the expenditure of its tax dollars. Money thrown away on countries not trying to help themselves should be rechanneled through our economic system in the form of tax cuts. America must also educate, train, and retrain our population to increase its flexibility and mobility. America must stand supreme in her conquest of space. She must be a deterrent to aggressive forces, and at the same time a leader in the race to conquer space.

America has the wherewithal to meet the challenge of automation. Only time will tell whether or not she has the workers, business leaders, and statesmen willing to cooperate, and ultimately enjoy its multitudinous benefits.

CHAPTER VI FOOTNOTES

1 S. Wolfin (Director), The Manpower Development and Training Act of 1962, United States Department of Labor (Washington: Government Printing Office, April, 1962), passive.

2 The President's Advisory Committee On Labor-Management Policy: Automation (Washington: Government Printing Office, 1962), pp. 2 ff.

3 "Reuther Proposes More Overtime Pay To Open New Jobs", National Observer, (May 7, 1962).

4 P. Drucker, "Big Business And The National Purpose", Harvard Business Review: Vol. 40, No. 2, (March and April, 1962), p. 49.

5 "Peaceful Automation Pays Off", Business Week, Vol. 1708 (May 26, 1962), p. 136.

6 A. C. Lasher, "When You Automate; How To Avoid Labor Woes", Dun's Review And Modern Industry (April, 1960), pp. 42 ff.

7 "In Labor", Business Week, (May 5, 1962), p. 64.

8 "Where Job Training Works", Business Week, Vol. 1712 (June 23, 1962), p. 49.

BIBLIOGRAPHY

Books

American Management Association, STRENGTHENING MANAGEMENT FOR THE NEW TECHNOLOGY. 64p.

Bright, J. R., AUTOMATION AND MANAGEMENT (Mass: Plimpton Press, 1958). 262p.

Buckingham, W., "The Great Employment Controversy", AUTOMATION: IT'S IMPACT ON BUSINESS AND PEOPLE (New York: Harper and Brothers, 1961). 190p.

De Grazia, S., OF WORK, TIME, AND LEISURE, (New York: Twentieth Century Fund, 1962) 559p.

Diebold, J., AUTOMATION (New York: D. Van Norstrand Company, Inc., 1952). 175p.

Dunlop, J. T., AUTOMATION AND TECHNOLOGICAL CHANGE (New Jersey: Prentice-Hall, Inc.,1962). 173p.

Hugh-Jones and (editors), THE PUSH BUTTON WORLD: AUTOMATION TODAY (Norman: University of Oklahoma Press, 1956). 158p.

Macmillan, R. H., AUTOMATION FRIEND OR FOE? (London: Novello and Company, Limited, 1956). 96p.

Philipson, Morris, AUTOMATION IMPLICATIONS FOR THE FUTURE (New York: Alfred A. Knopf, Inc., and Random House, Inc., 1962). 456p.

Rusinoff, S. E., AUTOMATION IN PRACTICE (Chicago: American Technical Society, 1957). 261p.

Soule, G. H., TIME FOR LIVING (New York: Viking Press, 1955). 184p.

Woodbury, D., LET ERMA DO IT (First edition; New York: Harcourt, Brace and Company, 1956). 300p.

Documents

Bannon, K., and Samp, N., "Impact of Automation on

Ford-UAW Relationship," United States Department of Labor, Impact of Automation, Bulletin No. 1287 (Washington: Government Printing Office, 1960). 114p.

* "Company Policies Regarding Workers Displaced by Automation," Encyclopaedia Britannica Library Research Service (March, 1962).
* Service available only to owners of Encyclopaedia Britannica.

84th Cong., 1st. Sess., Joint Committee, Hearings Before The Subcommittee on Economic Stabilization: Automation And Technological Change (Washington: Government Printing Office, 1955). 644p.

85th Cong., 1st Sess., Joint Committee, Hearings Before The Subcommittee on Economic Stabilization: Automation And Recent Trends (Washington: Government Printing Office, 1957).

"Factors Affecting Output Per Man-Hour," United States Department of Labor, Trends in Output Per Man-Hour In The Private Economy, 1909-1958, Bulletin No. 1249 (Washington: Government Printing Office, 1959). 47p.

The President's Advisory Committee On Labor-Management Policy: Automation (Washington: Government Printing Office 1962).

United States Department of Labor, Population and Labor Force Projections For The United States, 1960 to 1975, Bulletin No. 1242 (Washington: Government Printing Office, 1960). 56p.

Weinberg, E., "A Review of Automatic Technology," United States Department of Labor, Impact of Automation, Bulletin No. 1287 (Washington: Government Printing Office, 1960). 114.

Weinberg, E., "Summary and Conclusions," Adjustments To The Introduction of Office Automation, United States Department of Labor, Bulletin No. 1276 (Washington: Government Printing Office, May, 1960). 64p.

Wolfbein, S. (Director), The Man Power Development And Training Act of 1962, United States Department of Labor (Washington: Government Printing Office, April, 1962).

Periodicals

"Arithmetic of Automation," Forbes Business And Finance (May 15, 1962).

Beirne, J. A., "A Union Looks At Automation and Its Implications For Education," Looking Ahead: National Planning Association, Vol. 10, No. 3 (April, 1962).

Boehm, G., "Electronics Go Microminature," Fortune Magazine, Vol. LXVI, No. 2 (August, 1962).

Brown, H., "The Human Spirit Needs Space," Saturday Review, Vol. XLV, No. 7 (February 17, 1962).

Changing Times (August, 1962)

Drucker, P., "Big Business And The National Purpose," Harvard Business Review, Vol. 40, No. 2 (March and April, 1962).

Evanson, C., "Are You Ready For Automation?" The Iron Age (May 10, 1962).

Evanson, C., "Plain Talk About Automation," The Paper Industry (March, 1962).

"How To Succeed In Business By Really Trying," Forbes Business and Finance, Vol. 90, No. 1 (July1, 1962).

"Is There Going To Be A Railroad Strike?" United States News And World Report, Vol. LIII, No. 5 (July 30, 1962).

Jacobson and Roucek (eds.), Automation And Society (New York: Philosophical Library, 1959).

Lasher, A. C., "When You Automate, How To Avoid Labor Woes," Dun's Review and Modern Industry (April, 1960).

National Observer (July 23, 1962).

"Peaceful Automation Pays Off," Business Week, Vol. 1708 (May 26, 1962).

Porter, S., "Automation Will Wipe Out Two Million Jobs In A Decade," Richmond Times-Dispatch (May 22, 1962).

"Prospects Of More Food," The Population Bomb (New York: Hugh Moore Fund, 1944). 21p.

Richmond Times-Dispatch (July 28, 1962).

Rieser, C., "The Short-Order Economy," Fortune Magazine, Vol. LXVI, No. 2 (August, 1962).

"Same Old Hours," Newsweek, Vol. LIX, No. 26 (June 25, 1962).

* Special Report On Major Business Problems (New York: McGraw-Hill Publishing Company, Inc.), no page numbers.
* This report available only to subscribers of Business Week.

"The Other Side of Automation," Dun's Review And Modern Industry (May, 1962).

The World Almanac (New edition, New York: New York World-Telegram and Sun, 1962). 896p.

"Under Fire: Government Buying of Foreign Steel," United States News and World Report, Vol. LIII, No. 1 (June 25, 1962).

"Where Job Training Works," Business Week, Vol. 1712 (June 23, 1962).