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Automation's Impact on Industrial Safety

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AUTOMATION HAS BEEN VARIOUSLY DESCRIBED as a diabolical scheme of management, as a second industrial revolution, and as merely the next step in the slow evolution away from the "sweat shops" of the past. None of these definitions is completely wrong and none is completely right. As with most concepts that threaten to change existing social and economic patterns, its appraisal depends largely on how it will affect the one making the appraisal. Its importance in law lies chiefly in its impact on safety standards.

Definition

The word "automation" apparently was coined about ten years ago by D. S. Harder of the Ford Motor Company. Harder applied the word to the special engineering task force assigned to study better methods in heavy press operations. This particular effort was directed at the study of engine manufacturing, and in fact resulted in the construction of the Cleveland Engine Plant of the Ford Motor Company.[1]

The word appeared in print for the first time in *The American Machinist Magazine of Metalworking.*[2] There, "automation" was described as "The art of applying mechanical devices to manipulate work pieces into and out of equipment, turn parts between operations, remove scrap, and to perform these tasks in timed sequence with the production equipment, so that the line can be wholly or partially under pushbutton control at strategic stations." [3]

Other companies had been making similar investigations, corresponding to this broad definition, but would not accept the word because it conjured up visions of automotive mass-production in a Detroit-style operation. Some automobile manufacturers probably would not use the word because it was a competitor's concept.

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1 Article, Amer. Machinist, 135 (Mar. 17, 1952; McGraw-Hill).

2 LeGrand, Ford Handles Automation, Amer. Machinist 107 (Oct. 21, 1948).

3 Ibid.

Labor unions pounced on it as evidence of a diabolical management scheme; ministers and social planners assailed it as another big business attempt to degrade the dignity of the individual. Aggressive salesmen used the word to sell everything from soft-drink dispensers to multi-spindle drill presses. All this furor culminated in a Congressional hearing on "Automation and Technological Change" in 1955. (see n. 7.)

Automation now has taken on a larger connotation and is considered by some people to be no less than a philosophy of manufacturing. In its broadest sense, it now includes such manufacturing techniques as parts design, manufacturing methods, tool control and production control systems, and the applications of data processing.

The viewpoint which engineers accept as correct is much narrower and easier to understand. The average engineer will define automation as two basic elements of a process: (1) it must be continuous and automatic, and (2) it includes mechanized handling and control. What this means is that you can start with a simple machine and, by improving its design and performance, make it completely automatic. This actually is not *automation,* but increased mechanization. *Automation* itself begins only when you combine several similar operations mechanically and add the necessary controls to provide continuous automatic production until the product is completed.

Importance (Statistics)

The following table shows the top ten industries in the country using some automation, ranked according to the percent of companies using automation within that industry.

TOP TEN BY COMPANY[4]

Rank	*Industry*	*% of Companies with Some Automation*
1	Office & Store Machines	46%
2	Motor Vehicles & Parts	34%
3	Electrical Equipment	34%
4	Fabricated Metal Products	29%
5	Precision Mechanisms	26%
6	Miscellaneous Machine Parts	22%
7	Railroad, Shipbuilding, etc.	17%
8	Domestic & Service Equipment	15%
9	Agricultural Machinery	12%
10	Aircraft & Parts	11%

[4] Ibid., The Impact of Automation 166 (Oct. 21, 1957; McGraw-Hill).

Many of the individual companies within these various industries are not aware of the fact that they are using automation. Still others believe that they are working with automation, though as far as the writer is concerned they actually only have a high degree of mechanization.

Far more important in relation to industrial safety is the table which shows the statistical picture of the top ten industries in employment.

TOP TEN BY EMPLOYMENT[5]

Rank	*Industry*	*% of Workers in Companies with Some Automation*
1	Motor Vehicles & Parts	99%
2	Office & Store Machines	98%
3	Electrical Equipment	91%
4	Precision Mechanism	85%
5	Miscellaneous Machine Parts	76%
6	Fabricated Metal Products	75%
7	Domestic & Service Equipment	62%
8	General Industrial Equipment	51%
9	Aircraft & Parts	49%
10	Special Industrial Machinery	46%

Of special interest is the fact that four out of five people in metal working are employed in plants that have some degree of automation.[6]

Principal Types of Equipment

As to the types of automation employed in these industries, for the sake of brevity we will consider the five most common as being representative of the top ten industries. They are:

1. Machine tools with automatic loading and unloading
2. Transfer devices between machine tools
3. Transfer machines
4. Transfer devices between presses
5. In process automatic gauging.

Reasons For and Against Automation

The lawyer (as to safety), the doctor (as to stress), and the social scientist (as to social effects) all ask the same question about automation. If automation, in all of its various concepts,

[5] Ibid., p. 167.

[6] Ibid.

is causing such an uproar from Congress, labor leaders, and small businessmen, why does large industry insist on using its applications?

According to a nine-year survey by the *American Machinist Magazine* (see n. 1), large industry saw in automation a new tool to accomplish four major objectives: reduce direct labor costs, increase output, improve product quality, and meet labor shortages of skilled and semi-skilled manpower. At the beginning, the most important reason for installing automation was to reduce direct labor costs. By 1957 the main reason for installing automation had abruptly changed to improvement of product quality.

Besides the problems that arise from the discontent of labor unions, automation brings certain problems of its own to the management conference table. Quality improvement has become the major benefit to be derived from automation, by building the quality into the machines rather than depending on the skill of the operator. Combine this with larger output per man hour, and the picture looks rosy. But with larger output and better quality in a shorter space of time, the necessity for in process and inventory control becomes greater. Then expensive IBM equipment and electronic data processing become necessary.

One of the biggest disappointments, from industry's point of view, is that automation involves too many electronic problems and not enough experienced mechanics. Although the skill required by the direct labor force is diminishing, the amount and type of training required of the maintenance force is rapidly increasing. Another problem is that equipment must be designed on the basis of little or no existing precedents, so that mechanical bugs are the inherent diseases of automated equipment.

Small manufacturers charge that large companies which can carry the expense of automating are squeezing them out of the competitive picture. This is unrealistic. The president of the Carnegie Institute of Washington sees in automation new opportunities for small business: "If large manufacturing companies turn to automation in extreme form, they increase their own rigidity and render it more possible for the small individual unit to prosper by reason of its inherent flexibility." [7]

[7] Cited in automation and technological change hearings before the Subcommittee on Economic Stabilization of the (Congressional) Joint Committee on the Economic Report, 84th Congress, 1st Session, Washington, 1955 (p. 615).

Safety Engineering

A most important result of automation has been the elevation of the safety engineer in recent years. Prior to automation and the rapid increase in mechanization, the safety man usually held only the status of a personnel trainee. After a suitable probationary period, if he performed his limited duties without offending shop stewards, foremen and the personnel manager, he was elevated to the position of interviewing job applicants. Due to the awe-inspiring mass and complexity of automated and mechanized equipment, the safety engineer now is coming of age in a specialized field. Large industry in the future will have to hire far more full-time safety engineers. The implications of this fact, to a lawyer, are obvious.

Unions are already pressing management for more safety engineers and better safety campaigns. Management apparently must, and intends to, accept the challenge, in sheer self-defense, if only to keep compensation payments at a reasonable level. "As new processes and materials are developed, new hazards will arise. It will be management's job to find the solution to those safety problems before workers get hurt." [8]

Safety Statistics

To determine how well industries with automation are handling their safety problems, it is necessary to define two categories or methods of reporting injuries. The *frequency rate* is described as the number of disabling injuries per one million man hours of work. The *severity rate* is the total number of days lost per one million man hours of work.

By checking the 1957 edition of the Major Industry Accident Rates, published by the National Safety Council, it is interesting to find that, both in frequency rate and severity rate, all of the top ten automated industries are well below the average injury rates for all industry. In fact, three out of the top four, Aircraft, Electrical Equipment and Motor Vehicle, are the safest industries in frequency rate.

Safety Programs

The good safety statistics can be attributed to several factors. One is the recognition of the need for greater safety measures, as evidenced by the trend towards upgrading of the safety

[8] Note, 19 Occupational Hazards (2) (Dec. 1956; Industrial Publ. Corp.).

engineer and union pressure for safety precautions, and full management participation. Another is the safety legislation adopted by Federal, State and local bodies; still another is the value of a sound preventive maintenance program in management's own interest.

Preventive maintenance is a two-pronged tool. The discovery of trouble through regularly scheduled inspections and the accumulation of data on all breakdowns aid industry by minimizing scrap and scrap repair and provide a useful tool for a more realistic allocation of costs. In addition to increasing productivity, it also extends machinery life and lessens costly tooling replacement. This type of system provides two major benefits—increased product quality and, most important, increased employee safety.

An illustration will demonstrate the effects of a preventive maintenance system on industrial safety. First of all, for scheduling purposes, the year is divided into twelve months of four weeks each. In order to use the facilities of electronic data processing, the standard practice for the operation to be performed on each particular type of equipment is coded.

For this illustration, the piece of machinery is a semi-automatic lathe made by manufacturer "M." We assign a code to this type of equipment for a periodic mechanical check by a qualified machine repair craftsman. By means of manufacturers' recommendations, safety council recommendations, or past practices developed in the plant, a frequency for inspection in various categories is assigned.

A standard practice for mechanical checking of automatic lathe "M" on a scheduled basis is written from this information. Once a week, for example, the following would be checked:

1. Gibs and slides adjusted
2. Clutch and brake adjusted
3. All seals checked for leaks.

On a monthly basis, the complete hydraulic system would be checked on the following points:

1. Set unloading valve at 200 PSI
2. Charge accumulator at 200 to 250 PSI
3. Set safety valve to open at 900 PSI
4. Set safety valve to close at 750 PSI
5. Set relief valve to open at 350 PSI
6. Inspect all cables for wear
7. Check bearings and lead screw
8. Check all drive belts for scraping or looseness.

All instructions for all safety checks are carried in a manual with a detailed explanation on the maintenance of each type of equipment. It must be remembered that the above is only an abbreviated description of the check points for the machine repair craftsman. There are other standard check points for the pipefitter, electrician, electrical instrument repairman, machine cleaner and millwright. Each coded operation number has a routing which describes the exact work to be done on the equipment by each trade.

After the tradesmen check the equipment, any major discrepancies that need correction or any pertinent facts concerning the piece of equipment is noted by the craftsman and sent to the workorder section for immediate attention. The condition is speedily corrected by the proper maintenance trade.

The coded card is signed by the craftsman and he records the time on the card in pencil. The card is sent to the tabulating section, where a machine translates the time into punched holes. The holes are translated into printed data when the card is processed to accumulate the costs.[9] It is then transfer-posted to individual machinery cost records.

This gives you a rough idea how a preventive maintenance program operates. All are not operated alike[10] but all have the same basic features and results. Plant applications, size of maintenance force, and the data-processing equipment available, all help to determine the vehicle chosen, but all reach the same destination—(1) Increased product quality and (2) greater employee safety.

It is not strange that of our three major automated industries—Aircraft and Parts, Electrical Equipment and Motor Vehicles—all have adopted some form of a scheduled preventive program. Thompson Products, an aircraft parts manufacturer, has an extensive preventive maintenance program under the direction of its Manager of Plant General Services. All machine

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[9] For a more detailed account of the cost accumulation aspect of preventive maintenance and other useful byproducts of the system (other than employee safety), see the excellent article by Collier, Mechanized Maintenance Control in 114 Factory Management and Maintenance Magazine (3) (March 1956).

[10] Several good systems are described by R. T. Morgan, in a Note, Sure-Fire Maintenance Control, in the Plant Operation and Maintenance Section of Power Magazine, Sept. 1956. In this article, a detailed explanation of the McBee system is given. A General Electric Preventive Maintenance system in operation at Fort Wayne, Indiana is outlined by George E. Wralstad, in "Engineered Maintenance is Better, 10 Ways" in Plant Engineering Magazine, January 1957.

lubrication, wiring, cleaning and coolant systems are checked on a regularly scheduled basis by the use of IBM pre-punched cards. Pratt-Whitney and General Electric plants have similar means for keeping equipment in safe operating order. This not only cuts down accidents but increases equipment life.

Psychological and Social Effects

There are other, more subtle effects of automation that can not be as readily measured as safety statistics can be. There are mental injuries to individuals temporarily displaced by automation to be considered. If the displaced worker is in the younger age group, he can be retained and upgraded to one of the higher skilled jobs that automation creates. If on the other hand, he is in one of the older age brackets, industry is not too prone to retain the older worker except in times of extreme labor shortage.

Employers' tendencies to place women or housewives in automated jobs previously held by semi-skilled or skilled men cause family disorganization. In plants where production workers earn incentive wages in addition to the hourly wage, the increased skill demanded of maintenance forces must be compensated. The maintenance worker has seen his position as the major breadwinner deteriorate when his young son just out of school almost from the beginning brings home a pay check larger than his.[11]

Some psychologists think that fatigue in automated jobs (which require little or no physical effort) is mental in essence, and represents an attempt on the part of the worker to retreat or escape from a situation against which he can not fight. As can be expected, the alcoholic in industry is becoming a growing problem.[12]

In an extensive study, not long ago, it was said that "assembly line pacing is responsible for a considerably larger portion of the psychological unrest and discontent in industry, than most would have us think."[13]

On the other hand, some authorities rule out the psychological and social effects of automation as a normal "resistance

[11] Harry T. Schwan, Vice President, Methods Engineering Council, in a talk presented before the April 17, 1956, IMS meeting.

[12] Pfiffer & Feldman, A Treatment Program For the Alcoholic in Industry, 161 J. A. M. A. 827 (June 30, 1956).

[13] Walker & Guest, The Man On The Assembly Line (1952, Harv. Univ. Press).

to change" during a transition period.[14] In some plants this "resistance to change" can be broken down by investing in such improvements as increased lighting. Plants that have done this have found it has resulted in increased worker efficiency and lower accident rates.[15]

An agency of the United Nations, The International Labor Organization, produced a report on the social implications of automation and technological developments. In its report, the agency found that industrial disturbances and social unrest are not necessary consequences of technological changeovers.[16]

Conclusion

"The fact that Congress continues to be interested in automation and will doubtless hold more or less periodic hearings on the subject must not be misunderstood. The government's interest in automation is primarily that of making certain that the individual, human costs of widespread material progress are kept at a minimum. We want to be sure that the private enterprise system . . . is not building up pressures or frictions that may mean trouble in the future." [17]

It is unfair to blame all mental discontent and anxiety in industry on automation and increased mechanization. Other segments of our society are equally responsible. The measures necessary in order to curb abuses naturally will depend on the rate of introduction and the pace of progress. One should not, and can not, realistically blame technology. It is expected that changes in outmoded personnel policies will cure and prevent many of the apparent deficiencies. Personnel policy improvements, as well as safety engineering and adaptation of law, must keep pace with technological changes.

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14 Cowan, The Human Side of Automation, Electrical Engineering Magazine (Sept. 1957).

15 Phillips and Woods, What Will Good Lighting Cost You?, Engineering and Management Section, Power Magazine (June, 1957).

16 Bolz, Automation Grows in Stature, Automation Magazine (Jan., 1958).

17 Representative Wright Patman (Texas), Chairman of the Joint Economic Committee of Congress, at 2nd Annual Automation Conference sponsored by Purdue University (1957).