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AUTOMATION IN DEVELOPING COUNTRIES

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An Exploratory Study

International Labour Office
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I - INTRODUCTION

The increasing use of "automation" in a variety of economic sectors in countries throughout the world has been accompanied by both concern and anticipation. On the one hand there are those who point to the dislocations which seem to be associated with this modern technology - displaced workers and unemployment of the work force, the obsolescence of traditional skills, and the problems of the individual forced to adapt to new working conditions and even a new way of life. On the other hand, there are observers who maintain that unemployment does not necessarily follow from automation and that the problems of adjustment are relatively minor in comparison with the tremendous productive possibilities of the new equipment - possibilities which open up the opportunity to achieve adequate food, clothing, and shelter for the entire world, even to produce consumer goods to meet the huge world deficiencies.

Interest in the problems and potential of advanced technology has not been confined to industrialised countries where the modern equipment has already been introduced in varying degrees. In developing countries also, there has been a growing interest in this question and there is a general feeling that automation will have a significant impact on the development of these nations.

In recognition of this interest, the I.L.O. organised a field survey in a limited number of developing countries during the first half of 1965 to determine the extent of automation in such countries and the kind of social and economic issues which had developed. The results of that investigation are reported in this paper.

Definition of "Automation"

To avoid ambiguity over the meaning of the word "automation", a limited definition was adopted, encompassing four types of technology, as follows :

1. Electronic data-processing equipment (computers).
2. Numerically controlled (or tape controlled) machine tools and other machinery.
3. Equipment for continuous-flow operations utilising devices which inspect the output and automatically operate the production processes in accordance with a programme of instructions previously fed into the machinery.
4. Machines equipped with devices which automatically transfer the material being processed from one processing stage to another, position it, activate the processing mechanism and then move the material on again to the next stage. (This form of automation is often called "Detroit automation".)

Objectives of the Study

One objective of the investigation was to determine the extent of automation, as defined above, in each country studied.

A second purpose was to determine, within the context of selected developing countries, whether the social and economic difficulties associated with automation differ from those connected with new technology in general.

A third goal of this report is to indicate the similarities and differences between the problems encountered in a developing country and those which are to be found in an industrialised country. Such an analysis will provide valuable guidance concerning the need and applicability of programmes adopted in industrialised countries to the difficulties which may arise in developing areas.

Choice of countries and Procedure

In planning the field study, developing countries with a substantial industrial base were selected since automation was more likely to be utilised in such countries and comparisons could be drawn between the new technology and the older forms in use. Furthermore, other developing countries would presumably be moving through similar conditions in the future. These criteria led to the choice of India, Mexico, Chile and Argentina, and visits were organised to these countries after appropriate arrangements had been completed. The procedure used in each country, with modifications, was to arrange for contacts with persons who had been directly associated with the introduction of automation - either from the employer or trade union side. Interviews were also arranged with knowledgeable persons from government, industry and union circles.

In addition reference has been made to the limited literature on automation in developing countries¹.

¹ While the concept of "automation" is frequently extended to cover "technological change", the following articles have been of value :

Adhemar Byl, "Automation and the Less Developed Parts of the World", Economisch en Sociaal Tijdschrift, 16e Jaargang, Nr. 3, July 1962.

Julius Rezler, The Nut and Bolt Division of Company X : A Case Study in Automation, (Ranchi, Jamshedpur Productivity Council and Xavier Labour Relations Institute, 1962).

Walter P. Krause, "Aspectos Econômicos e Sociais da Automatização - o Problema do Brasil" (Economic and Social Aspects of Automation - The Problem of Brazil), in Revista de Estudos Socio-Econômicos, Ano 1, No. 5, 1962.

Gabriel Ardant, "Automation in Developing Countries", in International Labour Review, Vol. XC, No. 5, November 1964.

The study may be described as exploratory, in the sense that it was designed to explore the kinds of problems connected with the spread of automation in developing countries, rather than to draw general conclusions. Such conclusions would demand a much wider range of observations, and even then the diversity of conditions in the developing countries makes it difficult to generalise except in terms so wide as to be platitudinous. It has been necessary to reject the alternative procedure of describing specific situations in detail, since some persons who supplied information wished their remarks to be kept confidential and the companies and installations studied must remain anonymous. The results of the study thus provide a sample of the types of problems observed in the countries studied, and their relevance to other developing countries must vary according to circumstances.

Extent of Automation

In the course of the study many instances of "automation" were reported but upon evaluation, it was determined that most examples did not fall within the definition. Modern technology is in use in many old and new plants in the four countries, but few cases of the industrial application of "automation" came to light. On the other hand, the study showed that a number of computers were in use in the four countries for office operations.

In India, approximately two dozen units had been installed by the end of 1964 and another dozen were scheduled for installation during 1965¹. In both Mexico and Argentina, approximately 70 computers were reported in use in early 1965 while approximately 20 were reported for Chile².

While the use of computers in a country will depend on a variety of factors other than its level of industrial development (for example, the extent of operations controlled from a central headquarters within the country), some indication of the relative extent of computer utilisation can be gained by noting their use in relation to the economically active population of the country. Rough calculations show the following relationships :

¹ Computer Society of India and statements to the I.L.O.

² Information for Argentina was provided by a computer supplier. Figures for Mexico were estimated by the Centro Nacional de Cálculo of the Instituto Politécnico Nacional. The estimate for Chile was made by an I.L.O. expert familiar with the economy.

<u>Country</u>	<u>Ratio between No. of Computers and Economically Active Population¹</u>
United States	1 : 4,000
Western Europe	1 : 25,000
Argentina	1 : 100,000
Chile	1 : 120,000
Mexico	1 : 160,000
India	1 : 10,000,000

Of the computers in use in the four countries reviewed, a substantial proportion are employed in government offices concerned with the armed forces, tax collection, social security, etc. /It is likely that additional computers are being utilised by segments of the armed forces in some of these countries but figures are not publicly available/. Computers are also being used in research establishments, universities, banks, insurance firms, a newspaper plant (for type-setting) and other sectors which do not fall within the scope of "industrialisation".

On the other hand, computer installations were reported in firms manufacturing textiles, footwear, steel, metal products, petroleum, food-stuffs, tobacco and chemicals. While in almost all cases they were being used for processing office data, instances were also noted of their use for the purpose of production scheduling and machine utilisation.

In addition, all countries provided instances of computer service centers catering to a number of clients, some of whom were engaged in manufacturing activity. Service centers operated by suppliers of electronic computers were characteristic of this form of activity.

¹ For the United States, computer figures were taken from "Computer Census - February 1965" published in Business Automation, February 1965, pp. 48-9. For Western Europe, figures were published in "Automatisierung und Rationalisierung" by Dr. Günter Friedrichs and Albert Räuber, in Der Gewerkschaften Monatschrift für die Funktionäre der I.G. Metall, No. 3. Figures of economically active population were taken from I.L.O. Yearbook of Labour Statistics 1964.

Numerically controlled machine tools, the second type of automation under consideration, were reported in use in a few establishments in the steel and metal products industries. From all indications, there were no such tools in India, and only in Mexico, was reliable evidence obtained of their use.

The third type of automation covered in the definition represents a highly advanced technique, usually associated with a large volume of output. In the countries studied, this form of automation was reported for only a very few establishments, all in the petroleum or chemical industries.

The fourth or "transfer machine" type of automation (sometimes called "Detroit Automation") was not reported to be in use in the heavy metal industries or in the automobile industries of the countries reviewed. On the other hand, instances were cited of individual machines (such as cigarette rolling and packaging units, bottling machines, etc.), which transport material through an automatic sequence of several operations without human intervention. This type of equipment is frequently called "automation" although it does not strictly fall within the definition used for this study. Thus, although the four countries supplied no instances of intricate multiple station transfer mechanisms (now used in the metal and electronics industries of some countries), they do have numerous plants utilising modern, highly automatic machines.

In sum, industrial applications of "automation", as rigorously defined, were few in number, although a fair number of firms used computers for office operations. Modern machinery, however, either in a portion of an establishment or throughout the plant, was not uncommon.

With this very limited degree of automation as a base, particularly in the industrial sector, it is difficult to answer the question: "Are the problems associated with automation in developing countries different from the problems arising from the introduction of new technology?". What did emerge from the interviewing, however, was the general conclusion that if not altogether "different", automation problems are likely to be more intense and even broader in scope.

Outline of the Report

With particular reference to the industrial sector, although drawing on the full range of information obtained from the respondents, the following three sections will review the economic, labour and institutional factors associated with technological change, and especially automation. The special problems arising from modernisation - using automation or other technology, - will be reserved for a separate section. In the final part, the matter of comparability between problems in developing and industrialised countries will be reviewed.

II - ECONOMIC CONSIDERATIONS

An exhaustive account of the economic factors associated with technological change would be beyond the scope of this paper. Certain economic considerations are, however, so basic that they were frequently emphasised during the interviews. These factors are in some cases national in scope, independent of any action which might be taken by an individual establishment, while other factors are operative at the plant level. These will be examined in turn, with references to factors both favoring and impeding the new technology.

Shortage of capital

While it can be fairly assumed that a major economic handicap in most developing countries is a shortage of capital, there is some capital available in countries similar to those studied, and so the issue is essentially one of allocating limited capital between alternative opportunities. Automation equipment, being more expensive than other equipment, suffers a disadvantage because it requires such a large block of capital.

As a corollary to this fact of capital shortage, interest rates are likely to be relatively high. This restricts the use of advanced technology in two ways : first, since the cost of such equipment is higher than for more conventional machinery, the advantages from its use must be greater in order to cover the interest charges on the additional capital. Various respondents pointed to this difficulty and noted a second, related, problem : because of these high rates, the private capital which is available in the economy is easily able to command a high return, virtually risk-free, and there is consequently little pressure to use it for entrepreneurial ventures (industrial projects) with their attendant risk.

When capital is treated as the scarce commodity, the pressure to use capital saving technology is complementary to the effort to provide new job opportunities for the unemployed and under-employed work force. Several government officials suggested that employment opportunities should occupy first priority in decisions on types of technology to install - but other officials emphasised the need to introduce the most economical equipment and argued that only modern technology¹ would enable the country's products to compete in world markets¹. When labour-intensive considerations receive priority, the labour-saving features of automation equipment will preclude its adoption.

¹ In this connection see :

Walter P. Krause, op. cit.

A. Goldberg, "The role of heavy chemicals in industrial development", in United Nations Conference on the Application of Science and Technology for the Benefit of the less developed areas, Geneva, 4 to 20 Feb. 1963.

Capital shortages have yet another dimension - an associated scarcity of foreign exchange. Except in rare instances, modern, complex equipment will not be manufactured within the developing country but must be purchased from an industrialised country. Older, more standard types of equipment on the other hand, may be produced in the developing country. Thus for countries with a shortage of foreign exchange, there will be pressure to forego the modern equipment and to purchase items produced within the economy. A specific instance was reported in India where machine tools are manufactured and where numerically controlled machine tools would have to be imported by use of extremely scarce foreign exchange. Potential buyers had so far turned to domestically produced equipment.

Large-Scale Production

It was frequently argued that the scale of production was not sufficiently great in the particular country for automation equipment to be economically feasible. This observation would apply to mass-production industries, usually of consumer goods. It points to the advantages of large and expanding markets and implies that the use of automation will increase as national economies grow and as regional economic units become established. It also suggests the advantages of computer service centers which can make computers available to a number of companies which wish to use the most efficient equipment but haven't the need for such machinery on a full time basis.

Numerically controlled machine tools provide an exception to this generalisation. These tools have proven economically sound for producing a small number of units, and may prove to have a special advantage in developing countries suffering from a lack of skilled manpower. This topic will be further reviewed in the following section.

Level of industrialisation

The lack of industrial development in associated fields will pose a further handicap to automation. In one of the countries it was reported that the locally purchased paper supplies used with a computer installation had proven unsatisfactory, and import restrictions prevented purchases abroad. In another country, plans to introduce a computer to control a railway system could not be implemented because the communication lines were inadequate and could not supply the required information to a central computer location.

Costs and Benefits

Plant level decisions on the use of automation were generally based on the technological advantage of the equipment (it could provide information not otherwise available, or produce better quality output or yield results more quickly) or on expected cost reductions. In essence these factors are identical to those influencing business firms in industrialised countries¹. However, in calculating costs and benefits, different factor prices must be used, often leading to different conclusions. Capital costs, for example, are likely to be higher : not only the price of the equipment, but also the interest charges on borrowed funds. With hourly wage rates lower than in industrialised countries, the reduction in manpower requirements stemming from automation will yield a smaller total saving. A piece of equipment may therefore² be economically justifiable in one country and not in another².

There was evidence from the field reports that establishments associated with a firm in an industrialised country have certain advantages in making economic evaluations. Technicians and managers who are familiar with the new technology provide advice on costs and benefits, thus reducing the risk element. And an association of this sort also opens up new sources of capital, particularly "hard currency".

In planning for a new establishment, a full appraisal of the plant's advantages requires that the costs and benefits for both the plant and the community be taken into account.

¹ See for example : Richard S. Roberts, Management Decisions to Automate, (Stanford Research Institute, Stanford University, Menlo Park, 1964).

² For a detailed discussion of this point see : Seymour Helman, "Aspects of the design of Machinery Production During Economic Development", in Industrialization and Productivity, Bulletin No. 8, United Nations, New York, 1964, pp. 62-70.

Government training costs may be involved, and these can be quantified with relative accuracy. But national employment objectives, less easily measurable in money terms, must also be considered. When the difference in plant costs is relatively small, employment objectives may be given priority¹. In effect, government policies on industrialisation and employment will not necessarily run parallel and they may require judicious balancing in particular cases.

III - LABOUR ASPECTS

Labour questions associated with the use of advanced technology in new establishments will be reviewed in this section, first in terms of the actual state of affairs existing in the four countries, and secondly in consideration of how these issues may promote or hinder the spread of advanced technology.

Selecting and Training Staff

For employers introducing computer installations, the manufacturers provided extensive assistance in meeting staffing problems. This assistance included guidance concerning job specifications and worker qualifications required for the new jobs and even extended to arrangements to administer aptitude tests to assist in the selection process. Programmers, systems analysts and computer operators were typically trained by the equipment supplier, although a number of universities and technological institutes in the four countries also provided training for such personnel.

Most training courses were organised at the local office of the supplier although it was not unusual for some trainees, systems analysts particularly, to be sent to a training programme at the home office. In Mexico, besides training facilities for computer staff, one large computer manufacturer maintained special facilities for company executives desiring to learn of the advantages of data processing.

¹ See for example the hypothetical but realistic calculation of costs for alternative production techniques for cotton weaving in : International Labour Organisation, "Production Techniques and Employment Creation in Underdeveloped Economies", in International Labour Review, Vol. LXXVIII, No. 2, August 1958.

For maintenance work, however, the equipment manufacturer undertook to provide any required servicing, thus relieving the computer user of a difficult staff selection and training responsibility.

Employment Opportunities

From a nation-wide perspective, the major labour issue associated with automation is the question of whether less advanced technology might not be preferable since it would provide more job opportunities. There are economic considerations involved in this question which have already been reviewed (Section II). But decisions are not usually made on economic grounds alone and government policy may call for some adjustment to social considerations¹.

Union spokesmen in particular emphasised the need for an industrial development programme which would put a high priority on job opportunities. In line with this approach, some opposed modern technology for both new and established plants. But others expressed an acceptance of advanced technology for new plants on the grounds of competitive requirements while opposing the modernisation of existing plants because of the employment effects.

Management and Maintenance Staff

The relationship between industrial growth and shortages of high-level manpower has been extensively examined². It is sufficient here to note that advanced technology such as automation places additional demands upon the management structure and its potential utilisation is therefore hampered.

Most respondents indicated that little difficulty had been encountered in establishing new manufacturing plants. By bringing in a cadre of workers - from another plant or from an associated company in another country, or even from the equipment supplier - it had usually been possible in a short time to develop a reasonably trained work-force for the production process. More difficulty had been encountered in developing a satisfactory maintenance staff.

¹ I.L.O., "Production Techniques and Employment Creation in Underdeveloped Economies", op. cit.

International Labour Organisation, "Employment Objectives in Economic Development", in International Labour Review, Vol. LXXXIV, No. 5, November 1961.

² See for example : Frederick Harbison and Charles A. Myers, Manpower and Education, (New York, McGraw-Hill, Inc., 1965).

There developed an indication that the educational system in at least one of the four countries was not adequately preparing young people for the demands of modern technology. Some management officials who indicated dissatisfaction with the quality of the maintenance work related this to the education system which they claimed emphasised memory-learning instead of an analytical, problem-solving approach¹. These observations were usually applied equally to persons trained for actual repair work and to engineering college graduates who would have supervisory responsibilities.

One respondent added further that when trainees are sent to study an installation at the home plant of an international company, they did not necessarily gain a broader outlook since they were likely to see a smooth-running operation. In his view, it would be advisable to utilise, in developing countries, only those forms of technology which had been thoroughly tested in an industrialised country and for which experienced staff had already developed repair procedures for different types of breakdowns.

For most employers, the problem of securing capable maintenance staff far outweighed difficulties in selecting and training operatives. It was noted that large companies

¹ Studies in Puerto Rico have indicated a need to provide broader training for technicians than is required in the U.S. William H. Knowles, "Manpower and Education in Puerto Rico", in Manpower and Education, by Frederick Harbison and Charles A. Myers, (New York, McGraw-Hill, Inc., 1965), pp. 108-139.

See also : East Africa Royal Commission 1953-1955 Report, (London, HMSO, Cmd 9475), p. 152.

Pue Rochanapurananda, "Social and Cultural Factors in Management Development in Thailand", Meeting of Experts on Social and Cultural Factors in Management Development, MAN.DEV/S.C./9, (Geneva, 22 Nov. - 4 Dec. 1965, International Labour Office, Management Development Branch, Human Resources Department).

had often established their own training facilities for skilled workers, thus gaining an advantage over the small and medium-sized firms. This advantage may well increase as automation and other complex equipment is introduced and the shortage of qualified maintenance men intensifies.

While the complexity of the training required for maintenance work on advanced technology was seen as an obstacle to the use of such technology, training requirements for operating numerically controlled machine tools were reported to favor the use of such equipment. Several respondents noted that the operators of these machines did not require the high order of skill which was needed by a regular machinist - the skill was built into the machine. It was suggested that the total training required for operators of a battery of such tools would be less than the training required to develop traditionally skilled machinists to produce an equivalent output.

Such savings in the total training time may also occur when a few workers on modern equipment are required to have a high skill and others relatively little skill, as compared with a middle level skill for more workers on conventional equipment¹.

For the four countries reviewed, future introduction of advanced technology for new establishments is likely to be hampered by difficulties in arranging for proper management and maintenance. These problems are related to the cultural, institutional and educational systems of the countries which will be considered further in the following section.

¹ Dr. Thomas Vietorisz, "The potential of the computer and high-speed information processing techniques for industrial development", in United Nations Conference on the Application of Science and Technology for the Benefit of the less developed areas, Geneva, 4 to 20 February 1963.

IV - CULTURAL AND INSTITUTIONAL CONSIDERATIONS

Although each of the four countries studied is basically a "market economy", the central governments exercise varying degrees of control over economic affairs. Legislation in force and government policy both have a bearing on decisions to introduce automation - either in the private or public sectors.

The discussions with government officials and representatives of employer and worker organisations provided divergent viewpoints on the advisability of automation for the country concerned. These differences occurred among respondents of a single group, as well as between persons from different groups.

Government views

Government officials pointed particularly to the need for modern technology to enable the country to progress, and frequently maintained that existing legislation would protect workers whose jobs might be eliminated by the new machines. In Mexico, for example, the discharge of a worker is severely restricted and in India, the operation of the Labour Courts is reported to provide a means for securing protection against arbitrary company decisions, particularly when large groups are involved.

Other government officials expressed concern for the employment implications of modern technology and indicated the additional job opportunities stemming from the use of older technology was a factor that outweighed the efficiency argument. While no official suggested that the economy should be built on rudimentary technology as represented by cottage workshops, neither was it generally accepted that there should be an uncontrolled expansion of modern plants which in effect would eliminate such operations.

Management attitudes

Several respondents indicated that businessmen in the particular country were generally unwilling to engage in ventures carrying a risk element. Entrepreneurs, it was reported, sought both a high rate of return and quick results and these observations are in accord with various studies of entrepreneurial attitudes.¹ Such viewpoints on investment naturally restrict the pace of economic development, and the effect on the use of automation is even greater because of the large capital investment required for such advanced technology.

¹ See, for example: Albert Lauterbach, "Government and Development: Managerial Attitudes in Latin America", in Journal of Inter-American Studies, Vol. VII, No. 2, April 1965.

There is a question too, whether demands for quality products are sufficiently strong to force manufacturers to improve their methods of production. With imports of luxury goods available, with factories accepting mediocre products from suppliers, the innovating pressures present in industrialised countries are often lacking. Older forms of technology can be utilised.

But an even more serious impediment to the use of automation undoubtedly lies in the geographical and psychological separation between businessmen of the developing countries and the major world centres of technological research and development. Knowledge of the uses and advantages of automation is consequently less diffused in those countries than in the more industrialised countries. With some business connection in the industrialised countries, this gap may be decreased, although seldom fully bridged.

The social and cultural factors which affect managerial attitudes are likely to pose particular handicaps to the introduction of advanced technology which demands greater technological skill, new organisational structures and large capital investments.¹

V - MODERNISATION

Whereas sections II-IV have viewed automation questions in connection with new plants, this section will consider those issues which are associated with modernising an operating establishment.

Use of attrition

Several respondents reported on the introduction of modern technology - computers in offices and machinery in the factory - with a minimum of difficulty. They spoke of the use of

¹ For some further discussion of this point see:

United Nations, "Management of Industrial Enterprises in Underdeveloped Countries", (New York, 1958).

I.L.O. Technical Meeting on Problems of Productivity Improvements in Certain Countries (Bangalore, February 1959).

I.L.O. Meeting of Experts on Social and Cultural Factors in Management Development (Geneva, 22 November - 4 December 1965).

attrition to avoid labour dismissals and providing the existing staff with opportunities for qualifying for the new occupations. This approach was not universally satisfactory however. One notable case was reported of strong opposition from the staff of an insurance company and their union organisation to the introduction of a computer which would have meant the relocation of some employees, although assurances had been given that no employee would be terminated. The opposition centred on the need to provide employment opportunities in the country and extended to the organisation by the union of a "Convention against Automation" which received the support of other trade union bodies. Only one of the two planned computers has already been installed and this case seems therefore to be still in a state of flux.

Wage questions

In another case, a company found that it could not recruit satisfactory trainees (in spite of the labour surplus in the country) at the wage levels it considered appropriate. This had led to an examination of the company's wage structure and a realisation that some upward revision was necessary. There was other evidence also which indicated that the new technology had in several cases forced upward wage adjustments in a plant. Computer operators, for example, could not be considered "machine operators" and paid according to that job category.

Some respondents reported that trained computer personnel had been hired away by other firms offering higher salaries. Numerous new installations will intensify pressure for the scarce personnel and may force adjustments in wage and training policies. More than one firm reported that arrangements had been developed with computer staff which in effect obligated the employees to a five-year contract of employment.

In other situations, wage rates for jobs associated with the new technology did not pose any difficulty. During the training period, management continued to pay trainees the rates they had previously received, even though this resulted in a spread between the pay of different members of the trainee group. There was even some indication that these differentials might not be eliminated when the trainees were later assigned to operational tasks with the same work requirements in the computer unit.

It is fear of the labour-saving characteristics of advanced technology which leads to opposition to its introduction. Similar difficulties arise from modernisation or rationalisation programmes in both developing and industrialised countries. There may be occasions when advanced technology is by-passed because of such opposition and concern over potential conflict situations. Such decisions to avoid the new technology are not necessarily uneconomic within the context of the total economy,

however, since the social costs of displaced labour or reduced job opportunities may represent real monetary costs to the government and outweigh economic gains at the plant level. When value judgements concerning social questions are also considered, the decision-making becomes yet more difficult. In effect, this balancing of costs and benefits can only be done in the context of a particular situation, with consideration for future developments. It requires political evaluations as well as economic.¹

VI - EXPERIENCE IN INDUSTRIALISED COUNTRIES

In spite of extensive research in the United States, Canada and other industrialised countries on the labour problems associated with automation, there is a noticeable lack of agreement concerning its effects. For some experts, automation has been the main cause of the high unemployment experienced in North America in recent years, and therefore threatens to make it impossible to achieve and maintain a "full employment" economy.² Other analysts point to the sharp decline in unemployment in those countries during the past two years as disproving any causal relationship. For some, the major effect of automation is to raise skill requirements, thus creating obstacles to the employment of unskilled workers and requiring changes in occupational training programmes.³

In Western Europe, advanced technology has been welcomed just because it is "labour-saving" - in many countries there exists a labour shortage concurrently with a heavy demand for increased production. Automation technology manned by the same number of workers, enables output to increase more rapidly than otherwise. Consequently, there are active efforts in several of these countries to speed up the pace of introduction of such modern technology.

¹ For a further discussion of this point, see: W. Philips, "Technological Levels and Labor Resistance to Change in the Course of Industrialisation", in Economic Development and Cultural Change, Vol. XI, No. 3, Part I, April 1963.

² See, for example: Donald Michael, Cybernation - The Silent Conquest (Santa Barbara, Calif. Center for the Study of Democratic Institutions, 1962).

³ See, for example: Charles Killingsworth, "The Automation Story: Machines, Manpower and Jobs", in Jobs, Men and Machines: Problems of Automation, edited by Charles Markham, (New York, Frederick A. Praeger, Inc., 1964).

Developing countries can appropriately conclude that many factors apart from technology will influence an economy's health and growth. In most cases, each new establishment in these countries represents an increase in productive capacity and, whether using automation or not, provides more jobs than were previously available.

It is only within the framework of national conditions and policies that decisions can be reached, in specific instances, on the advisability of exchanging some economic advantages of advanced technology for greater employment opportunities with other technology. The experience of industrialised countries highlights these national differences and shows furthermore that modern technology is itself neutral - its effects may be good or bad depending on the circumstances and policies accompanying its introduction.

Improved Manpower Programmes

But apart from these quantitative aspects of the new technology, there are qualitative issues which demand consideration. In several industrialised countries, steps have been taken recently to expand and improve manpower programmes. Training and retraining courses are being established, job placement services and counselling programmes are being improved, and special programmes are being organised for young workers, poorly educated, older workers, etc. These national efforts are designed to improve the operation of the labour market so that persons with the required skills are available, in sufficient numbers, in the places where needed. In many developing countries, efforts have been undertaken to meet this same objective. With the introduction of advanced technology, the demand for qualified staff will intensify and the training techniques and curriculum content developed in the industrialised countries may prove particularly helpful.

Worker displacement

When the focus shifts from new establishments to modernisation of existing establishments, then automation, as a type of labour-saving technology, leads to other considerations. While nation-wide unemployment cannot be charged to automation, it is nevertheless true that displacement of workers at the plant level can frequently be traced to the introduction of new technology. Such displacement may also occur at supplier plants when the automating plant takes over certain operations previously performed by other companies, and displacement may sometimes be noted at competing establishments which lose business to the modern factory. To meet the labour problems of such displacement, a variety of government and private programmes have been formulated. Advance planning,

for example, permits an early evaluation of the probable manpower effects of new technology. If this is followed by a policy of reducing the workforce through attrition (replacing workers who resign or retire with temporary employees or not replacing them at all), labour saving machinery can frequently be introduced without severing anyone from his employment. For those developing countries which have adopted legislation restricting company efforts to terminate employees, such programmes are particularly important. The law provides security of employment ; the attrition policy permits the workforce to be reduced with a consequent gain in efficiency.

Aid for Redundant Workers

For workers whose employment is terminated, both government and private programmes are available in industrialised countries to provide income while they search for a new job - unemployment insurance benefits (usually provided under government auspices, although sometimes financed wholly or partly by the workers), supplements to such benefits (provided in collective bargaining agreements in the U.S. and Canada), and lump-sum severance awards (in agreements in the U.S. and Canada and provided by legislation in Great Britain). In most countries, government employment bureaus assist in finding new employment and workers are encouraged to undertake training for other occupations or for improving their current occupational skills¹.

An important policy decision concerns the extent to which these economic aids are to be provided under government auspices or by private arrangements. Further, government programmes may be financed by general tax revenues, or by taxes levied on employers and/or workers. The general economic philosophy of a developing country will influence decisions on these questions, and the extent of any benefit programme will be largely determined by the country's economic development.

¹ See : International Labour Office, Unemployment and Structural Change, Studies and Reports, New Series, No. 65, (Geneva, 1962).

D. Bok and Max D. Kossoris, Methods of Adjusting to Automation and Technological Change : A Review of Selected methods prepared for the President's Committee on Labor-Management Policy, [Washington/ Department of Labor, /1964/].

In specific instances involving the redundancy of large numbers of workers, special arrangements have been developed to assist in the adjustment process ; this has been the case in the coal industry in Great Britain and France, and in the railroad industry in the United States, to name a few examples. Similar special measures were adopted during the modernisation of the textile industries in India and Mexico and this ad hoc approach will undoubtedly prove useful when major changes are being introduced for an entire industry.

It has frequently been charged that automation leads to "silent firings" since the "automated" plant will provide fewer job opportunities for persons seeking work than would a more conventional establishment. This argument is similar to the charge that automation causes unemployment - i.e. that with automation, there will not be enough jobs for all persons who want to work. If the economy is expanding rapidly enough, however, there will be job opportunities in other parts of the economy even after modern equipment reduces the labour requirements at particular plants.

While manpower programmes in industrialised countries can be useful as a guide for developing countries, there is at least one inconsistency that requires clarification. With automation has come a trend toward broad training for workers and an emphasis on the need for labour mobility - between occupations and localities. This approach runs counter to the emphasis in developing countries on building worker interest in his occupation and skill, and responsibility towards his work. A reconciliation of these view points will become more challenging as new technology is introduced and, in the not too distant future, replaced by even more modern forms of technology.

