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ABSTRACT

Does management in newly established factories using highly advanced technology meet special problems in recruitment and training of their workers? Are the traditional training systems supplying the skilled manpower required for running highly sophisticated plants? These were the basic questions asked when the present study was started in seven European countries. Information was gathered by questionnaire enquiries made through direct interview with senior management staff, foremen, and workers in 29 factories. The monograph provides an analytical study of the opinions expressed about the impact on recruitment and training practices of the introduction of new technology. It describes in some detail the observations made during visits in the seven countries as to how recruitment and training have been carried out when new factories using advanced technology have been put into operation. It concludes with a discussion of the methods used in the inquiry and of the results obtained. A select bibliography of recent literature on the subject is included. (Author/PT)

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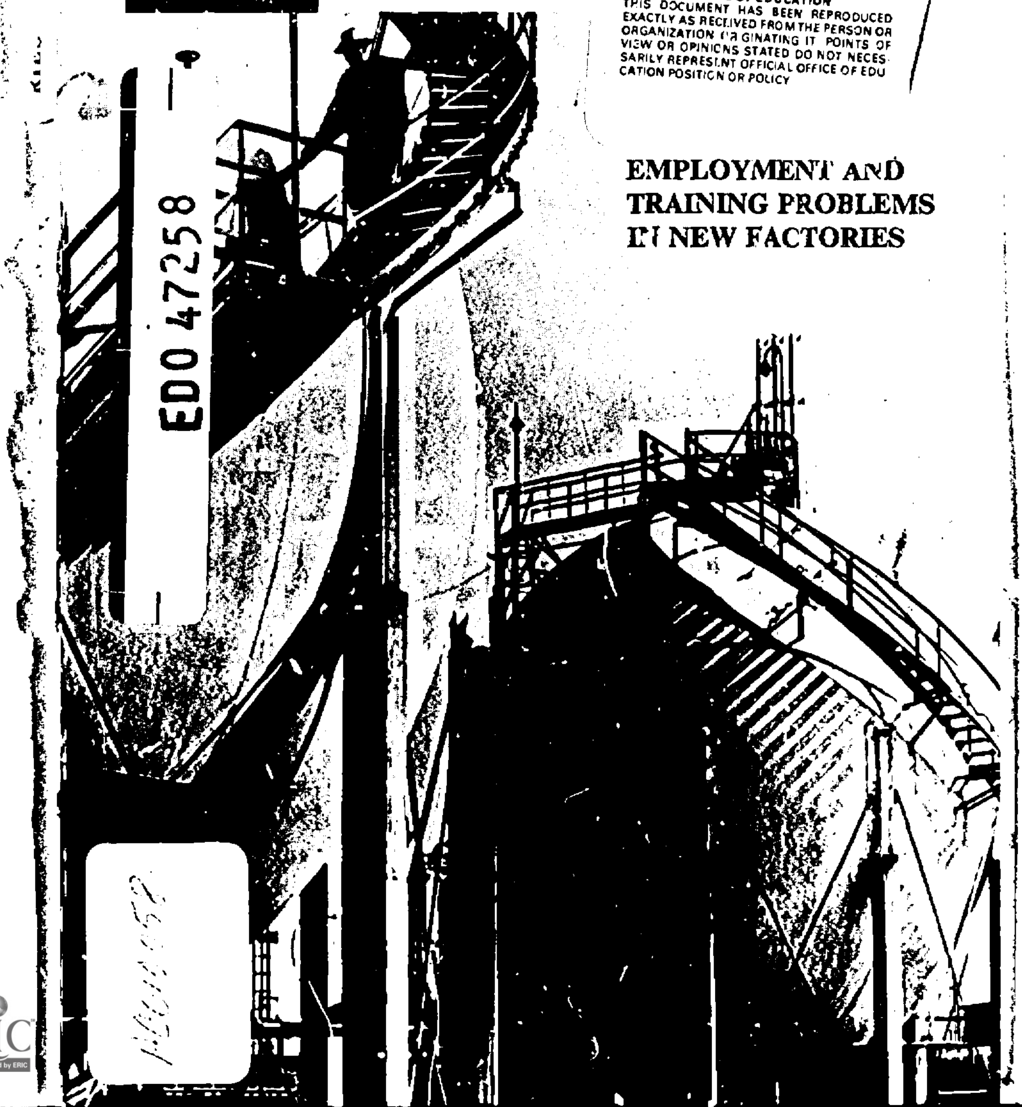

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Employment and training problems in new factories

Does management in newly established factories using highly advanced technology meet special problems in the recruitment and training of their workers? Are the traditional training systems supplying the skilled manpower required for running highly sophisticated plants? These were the basic questions asked when the present study was started in seven countries: Belgium, Czechoslovakia, Germany (Federal Republic), Luxembourg, Poland, United Kingdom and Union of Soviet Socialist Republics.
The study was carried out by a team of research workers of the Human Resources Department and the Automation Unit of the International Labour Office. Questionnaire inquiries were made through direct interviews with senior management staff, foremen and workers in 29 factories.

Contents of this monograph

This monograph provides an analytical study of the opinions expressed in various countries about the impact on recruitment and training practices of the introduction of new technology. It describes in some considerable detail the observations made during plant visits in the seven countries as to how recruitment and training have been carried out when new factories using advanced technology have been put into operation. It concludes with a discussion of the methods used in the inquiry and of the results obtained, and is supplemented by a selected bibliography on recent literature on the subject.

EMPLOYMENT AND TRAINING PROBLEMS IN NEW FACTORIES

A study on the recruitment and training of labour in newly established plants using advanced technology

CIRF Publications
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PREFACE

This study on the recruitment and training of labour in newly established plants using advanced technology is the third to be published in the series of CIRF Monographs. It is the result of a project initiated and developed by the Automation Unit of the Research and Planning Department of the International Labour Office, and carried out by research staff of the Automation Unit in conjunction with the Studies and Reports Section of the Vocational Training Branch of the ILO.

The report is based on the findings of field research at plant level to determine the action taken and the difficulties encountered, if any, by plant managements in assembling and training the labour force required for a new industry, for instituting a new production process or for changing over to highly mechanised or automated installations.

The study relates to undertakings in seven countries — Belgium, Czechoslovakia, the Federal Republic of Germany, Luxembourg, Poland, the United Kingdom and the USSR — and covers a sample of plants representing both light and heavy industry and processes ranging from batch production to continuous flow. It also analyses situations described in current literature dealing with similar questions. It is an attempt to test the validity of statements to be found in such literature and the fears generally expressed regarding the impact of technical innovation on manpower recruitment and training policies.

At every stage of the research project, but in particular during the field work, the research team benefited from the whole-hearted co-operation of the firms and plants in which the case studies were carried out. The managements gave time and staff, made available all relevant facts and

figures, were prepared to discuss problems encountered during the plant establishment or modernisation process. In return for such free and frank discussion some of them requested the research team to respect their desire for anonymity. This condition has been willingly accepted and consequently no list of the participating undertakings has been included in the final text of the study. At most there are from time to time references which situate a given undertaking within its national frontiers when this is necessary in order to understand a specific point.

The research team also wish to acknowledge the co-operation of a number of individual persons and specialised institutions. Among them are the following:

Belgium	National Employment Agency, Bruxelles Federation of Belgian Industries, Bruxelles
Czechoslovakia	State Commission for Finance, Prices and Wages, Praha Ministry of Foreign Affairs, Department of Economic Organisations, Praha State Commission for Technology, Committee for Technical Development, Praha State Commission for Planning and Organisation, Praha
Federal Republic of Germany	IFO Institut, München
Poland	Institute of Labour, Warszawa
United Kingdom	The Manager, King's Lynn Employment Exchange, King's Lynn
USSR	Council of Ministers, State Committee for Labour and Wages, Moskva Ministry for Food, Moskva Ministry for the Chemical Industries, Moskva Ministry for the Electrotechnical Industry, Moskva.

This short list is by no means an exhaustive enumeration of the persons and bodies which helped the research team during the course of the project. To each of them and to many others — including the ILO Branch Offices and correspondents in the countries concerned — we take this opportunity of expressing our most sincere thanks.

The ILO official in charge of initial planning and preparation of the project was Leonid Pisarik, under the general guidance of Ralph Bergmann, the Chief of the ILO Automation Unit. The field work and case studies were carried out by R. Bergmann and L. Pisarik, and by Armin Gretler and Jacques Monat, both of the Studies and Reports Section of the Vocational Training Branch of the ILO.

The first draft of the synthesis of the findings was prepared by Leonid Pisarik. The final text was produced within CIRF Publications, which has assumed responsibility for editing and publishing the study.

CHAPTER I - DESCRIPTION OF THE PROJECT

Following the general trend of economic expansion, numbers of new enterprises are started every year in most countries. Setting up a new plant involves many problems of major importance for the national economy. This project has deliberately left aside the problems associated with choosing the site of a plant and determining the nature of its products, to concentrate on the problems connected with establishing the workforce for new industrial enterprises. And it is concerned exclusively with the experience of industrially developed countries.

Lack of sufficiently qualified manpower is generally assumed to have grave consequences for a newly established undertaking. Specifically, it may cause undue delay between starting up the new plant and operating it at full capacity, which in turn may entail considerable financial losses.

For this reason advance planning is held to be essential. One author postulates that, just as there are precise methods enabling a plant to be constructed with the greatest possible efficiency, so there are specific ways of simultaneously building up or "constructing" its workforce so as to have, on the day set for the start up, competent men already trained for the posts they are to occupy. No one could be surprised at two years or more being needed for the physical construction of an industrial plant. Everybody ought to regard it equally normal that a comparable amount of time is needed for building up the corresponding hierarchical pyramid.[1]

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[1] Didier Manheimer: "Industrialisation et formation. Essai de bilan méthodologique", in "Promotions", No. 76, 1er trimestre 1966, pp. 32-33.

One of the considerations in choosing this subject for study was that theoretical statements such as the passages just quoted often have little or no support in the form of related studies made at plant level. For this reason field work was seen as the most important part of the present study.

It is known that changes in technology considerably affect manpower requirements. Various studies have indicated that occupations associated with automation require workers with higher skill levels. If this is so, it could be expected to affect the processes of recruiting and training labour for new undertakings where modern or automated equipment is to be used. Do the managements of such factories really employ any special methods to recruit workers for operating modern machines? How different are such methods from "classic" methods for the recruitment and training of a workforce for plants based on conventional,"old" technology? What difficulties and problems are encountered in securing adequately qualified staff?

This research project was intended both to clarify these questions and, at the same time, to investigate changes in skill requirements caused by automation and advanced technology in general.

The sample

The ideal conditions for examining and if possible answering these questions would be a situation where an entirely new plant has been started in a locality where no other similar plant is already in operation. This is the type of situation which will most clearly demonstrate both the need for special measures to recruit and train workers, as well as the accompanying problems. It was therefore considered important to visit plants which had been built recently but not so recently as to preclude seeing the various recruitment and training measures in proper perspective), were using modern production techniques and were established in localities where no similar plants previously existed.

Ideally, too, the technology applied in the plant should fall within the definition of "automation". But as relatively few plants are actually using automation, in the normally accepted sense of the word, it was decided the study should also take into consideration plants using other types of advanced technology. As the project developed, it was found that even this broadened approach did not permit an adequate sample of plants to be taken. Consequently, some plants using modern technology not differing radically from earlier technologies were included in the sample.

As finally evolved, the sample comprised 29 plants in 7 European countries: 5 selected in Belgium, 6 in Czechoslovakia, 5 in the Federal Republic of Germany, one in Luxembourg, 5 in Poland, 3 in the United Kingdom and 4 in the USSR.

The range of production represented by these 29 industrial concerns was wide, including both light and heavy industry:

Branch of Industry	Plant No.
- aluminium	16
- cardboard articles	15
- cement manufacture and brickmaking	19, 25
- chemicals	21, 22, 24, 27
- electric lamps	29
- electronic components and computers	1, 12
- food industries	9, 10, 11, 28
- machine tools	5
- motor accessories	4, 14
- motor cars	6
- nail and wiremaking	8
- oil refining and petroleum products	7, 20

- plastics	13, 17
- plate glass	18
- steel rolling	3
- textiles, including synthetic fibres	2, 23, 26

In the course of plant visits, it was sometimes found that not all the conditions taken as a basis for a plant's inclusion could be observed. Although most of the plants chosen for the study and approved by national authorities had been built recently, a substantial number of them were simply new units within older enterprises. In market economies, they were part of a large corporation, often multi-national in scope; in the centrally planned economies, many of the plants were part of a complex of establishments under centralised direction. In some cases, the new plants had been set up close to similar older ones which were being phased out, and from which the new plant had been able to draw the major part of its workforce. In other cases, the new plants had close ties to a parent enterprise which was able to provide training facilit' . 'nd sometimes even labour.

A further problem encountered by the research team related to the level of automation employed. This varied considerably among the different plants visited and in some it was found difficult to focus on automated jobs. Where instances of this kind occurred during field work, an effort was made to distinguish between personnel specifically recruited for the new technology and those engaged for work in the long-established departments using more conventional production processes.

Age of the plants and degree of automation

To describe each of the factories visited would be to make a mere catalogue of the plants and their installations. There is, however, a case for mentioning 'efly here their age and degree of automation. Both factors have a bearing on the action taken and problems encountered by the plants in recruiting and training their respective workforces, and constitute an aid to understanding the implications of the findings described in chapters III and IV.

All four plants visited in the USSR went into production between 1965 and 1967. Three of them were using the most advanced technology in the particular sections to which the study was directed. Production in these sections was organised on the principle of a continuous flow process with the use of transfer lines and control panels. In the fourth plant, of which only one of seven buildings was completed at the time of the visit, the production process was only partially automated. There was widespread use of manual work in the production of bulbs for signal lamps and torches and in the assembly shop. Most of the automatic equipment was in the filament and electrode shop. Ninety per cent of the workers and auxiliary workers in the main shops were in the lowest pay grades.

In Czechoslovakia, the scene was somewhat similar, but five of the new units dated from 1964 and the sixth from the beginning of 1966. All, no doubt, incorporated the most modern production techniques in practice at the time of their construction; the installations in one plant, for example, were specified as follows:

	%
Automatic equipment and single purpose machine tools	40
Semi-automatic equipment	30
Universal machine tools	30

On the whole, however, the equipment in use did not seem to be as advanced as that encountered in some other countries.

Of the group of plants in Belgium and Luxembourg, four came into operation during 1965-1966 while one was slightly older, having begun operations in 1961 in an old factory building pending erection of a new one which was completed in the period 1964-1966. Much of the machinery and equipment seen in this group of plants was among the most advanced in the world, in the particular industries concerned — chemicals, electronic components, steel products, motor accessories and textiles.

Two of the plants in the Federal Republic of Germany started up in 1966; two others started production 1963 and 1964 respectively, while the fifth unit was of older origin. In the two plants with mainly assembly production processes the level of automation was not high. One plant used the largest and most up-to-date machinery of its kind in Europe; both the remaining factories had very modern and complex installations.

Two of the United Kingdom plants also were among the most advanced in their field (chemicals and textiles), one of them having the first fully automated spinning unit in Europe. The third was engaged in a rather conservatively traditional manufacturing sector and was partly automated, partly mechanised and partly manual. Although all three companies were long-established, the departments studied were of very recent origin.

The Polish sample included three highly automated plants in chemicals and in a related industrial sector; two of the three were new units in old companies, and the third had been set up in 1964. The remaining plants were even newer (1965-1966). Their main production shops were equipped with automated machinery, while the other shops used manual labour.

None of the plants visited used on-line or central computers to control production processes.

Scope of the project and research method

The study concentrates on production and maintenance workers, supervisors and technicians. Management and administrative, commercial and clerical staff were deemed to be outside its scope. In a sense, the project is a companion work to another study carried out by the International Labour Office and concerned with the recruitment, training and adaptation of maintenance workers for highly mechanised or automated units in industries other than mechanical and electrical engineering.[1] The two studies are somewhat similar in approach, in that each is based essentially on plant studies carried out in various European countries and data drawn from discussions with national authorities, employers' organisations and plant officials. They differ, however, as regards purpose.

The main objective of the earlier study was to determine the principal trends and requirements of in-plant training for specific categories of skilled workers engaged on maintenance operations in certain branches of industry where production methods had undergone substantial changes during the preceding ten years.

The present study is concerned not with any special group or groups of workers, but with a workforce in general. It seeks to examine the whole process of establishing a total workforce for new plants, and to do so using two different lines of approach. Firstly, it inquires into the measures taken by the undertakings to locate, attract, and finally select and hire their staffs. Secondly, it attempts to discover, and to describe in broad outline, the special problems connected with ensuring

[1] ILO, Automation Programme: Training of Maintenance Workers. Genève, International Labour Office, 1967: AUT/DOC/6, 38 p. (processed).

that the personnel so recruited either possess or are given the opportunity to acquire the range and levels of skill required for performing their new functions. The questions covered in the chapter on training therefore relate both to the employees' education and training prior to employment as well as to the training provided after hiring.

These two chapters — recruitment and training — constitute the bulk of the report. The field work on which they are based was preceded by a study of the literature on the subject. Published material concerned specifically with skill requirements, recruitment procedures and training measures adapted to jobs associated with new technology is relatively scarce. Nevertheless the survey has assembled a bibliography of some fifty titles — both books and articles — on the subject, all of which throw light on different aspects of the problems examined and analysed in the body of the report. An analysis of the main lines of thought and action derived from a study of this literature is given in chapter II. The titles are listed in Appendix I.

Material arrangements

Arrangements for plant visits were made through governmental bodies in Czechoslovakia, Poland and the USSR; in Belgium, the Federal Republic of Germany, Luxembourg and the United Kingdom they were made directly with the individual companies and their managers. Before making plant visits, a description of the project was sent to the undertakings selected. Where relevant, material for the study was prepared in advance.

Plant visits normally lasted two days. They included meetings with the plant manager or one of his deputies, as well as with personnel and training officers, and an examination of production processes in the shops. To ensure a reasonable measure of standardisation, discussions with plant officials were based on a questionnaire prepared for the guidance of the ILO staff members conducting the interviews.[1] Emphasis was on the situation and problems obtaining when the plant or department first started operation.

In some countries, in addition to plant visits, meetings were arranged with officials of the various ministries concerned. Information obtained during such discussions is also included in this report.

[1] Reproduced in Appendix II.

CHAPTER II - SURVEY OF RELEVANT LITERATURE

In order to understand more clearly what kinds of adaptation may have to be made in conventional procedures if recruitment and training are to meet the needs of automation and advanced technology, it is desirable first to review some of the reports, studies and articles written on changes in skill requirements and the corresponding employee qualifications needed for new jobs. Even a brief examination, however, of the literature on manpower requirements of plants using advanced technology, and on the measures taken to meet them, reveals that relatively few studies have concentrated on the experience of newly established plants. It would, in fact, be almost impossible to compile a meaningful bibliography limited to the ideal situation envisaged when this study was planned.

This survey of current literature therefore reviews not only studies conforming to the ideal conditions laid down but also studies relating to older, long-established enterprises now employing advanced technology. It does not lay claim to being exhaustive but it does nevertheless constitute a fairly complete round-up of opinions and ideas — many of them contradictory — to be found in published material on the implications of advanced technology for manpower planning and utilisation.

Job content and skill requirements

Almost all the literature dealing with the probable and the actual effects of the introduction of advanced technology stresses the importance of the changes in skill requirements brought about by a new technology. In general, the effects are apparent mainly in two forms: changes in the skill content of jobs or the creation of new jobs, and changes in levels of skill.

An empirical "before and after" study of changes which took place in a large bakery setting up and transferring production to a new plant and, at the same time, introducing advanced technology, was carried out by a research group of the University of Colorado during 1958-1962. The published report contains some conclusions of interest, particularly as regards where the changes tend to lie [1].*

The basic and most important changes in the production process in the new plant as compared with the old one were "... in the greater use of bulk handling of raw materials, larger and faster processing machinery of the semi-automation and automatic order, and further extension of conveyors and mechanical handling of materials".

The relevant changes in skill requirements are described as follows:

(a) automation reduces many skilled jobs to rather easily learnt ones while responsibility levels increase for many employees;

(b) automation requires higher technical skills from the supervisors.

An article by Lundgren and Sagaser, published in a fairly recent issue of "Personnel Journal", deals with a major metalworking development of the second half of this century — numerical control of machine tools — which has brought in the new profession of the part programmer and has changed both the nature of the machine-tool operator's job and the division of the duties between workers and staff: "... control over manufacturing activities is shifting away from the machine operator and supervisor to the staff level. As a result, changes will most likely have to be made in the training of both operators and supervisory personnel as the nature of their duties change ... It is probable that the use of semi-skilled operators will prevail in the long run" [2].

* For this and subsequent references in this chapter, cf. Appendix I: List of selected bibliographical references.

Completely new jobs arising as a result of advanced technology seem to be relatively rare, however. Much more frequent are references to changes in the levels of skill required and in the decision making factor. In December 1964 a North American Joint Conference on the requirements of automated jobs was convened by the Organisation for Economic Co-operation and Development (OECD) at Washington, D. C. Some of the conclusions of the conference emphasised that "the skill levels required for many occupations have increased...but technological change has not increased skill requirements in all occupations". In connection with the net effect of technological change on the skill level it was noted, however, that "...technology...is operating to raise skill levels generally" [3]. Support for this conclusion was given two years later by a participant in another OECD meeting held at Zurich, the European Conference on Manpower Aspects of Automation and Technical Change: "It is sometimes argued that automation destroys skill and lowers the dignity of jobs. Such a view seems exaggerated and indeed wrong-headed..." [4].

There is ample evidence to support both views: the skill content of some jobs is increasing, of others, decreasing. In a study prepared for the National Commission for Technology, Automation and Economic Progress and published in the USA in October 1965, Walker noted that: "Minor decisions on work allocation and quality of product formerly made over a period of time and on the factory floor must now be made by a sophisticated staff at a higher level..." and "the cost of errors made in planning is far greater than on conventional equipment". [5]

A study carried out in a large motor car factory in Belgium indicated that in some cases new technology lowers the level of skills. Such a lowering took place, for instance, when cold forging was replaced by hot forging, or when machine casting was introduced in a foundry [6].

In an article based on a thirteen-industry study, Bright noted a similar tendency: "...there was more evidence that automation had reduced the skill requirements of the operating work force and occasionally of the entire factory force including the maintenance organisation..." [7].

On the other hand, the Belgian study [6] pointed out that in the mechanical, electrical and electronic maintenance sectors there was a growing need for highly skilled workers to meet new demands. As far as maintenance workers in general are concerned, in fact, most studies on skill requirements stress the necessity for these workers to have more sound technical knowledge of the equipment and processes they handle than they have ever needed before. Such a view was expressed some years ago by Naville in a report published by the National Research Centre (Paris) in 1961 [8], and in an article on new metalworking technology in the USA published in "Occupational Outlook Quarterly" in 1965 [9]. The same observation is to be found in Soviet literature [10, 11], in a report on twenty-five case studies carried out by the IFO Institute in the Federal Republic of Germany [12] and in a CIRF study carried out for the High Authority of the European Coal and Steel Community [13].

There are also references to an increasing need for a wider range as well as a sounder grasp of knowledge related to new technologies. In 1965 Hardebeck, writing about the mechanical and electrical engineering industries in the Netherlands, stated that for some posts there was a need for a combination of knowledge not only of mechanical and electrical engineering but of electronics and hydraulics as well [14]. This view is supported by the findings of the CIRF study just referred to [13] and in an earlier one also dealing with the basic metal industries [15]: this combination of knowledge was considered an essential feature of both the new occupation of control technician in the blast furnace departments and the electricians and mechanics in the steel-making departments of steelworks.

In the USSR various books and articles indicate the same trend towards the development of multi-skilled workers in plants using advanced technology [16, 17]. As pointed out by Belkin in an article published in May 1967, "The main feature of such a worker is his ability to carry out all the operations of a complete production process at a given workplace." [18].

The situation described in an ILO report on structural changes in the textile industry can be taken as fairly typical of any rapidly and radically modernising industrial sector. The report, which was submitted to the Eighth Session of the Textiles Committee in 1968, lists four possible immediate consequences of technological change as regards jobs and skills in this field:

"(a) need for more intensive specialisation, an occupation being subdivided into two or more specialised activities that have narrower limits but often call for more thorough study and a wider knowledge;

(b) replacement of an activity requiring skilled manpower by a simpler activity that can be entrusted to less skilled persons;

(c) simplification of work resulting mainly from the introduction of new machines that virtually reduce a skilled trade to the level of a general activity;

(d) need to carry on new and highly skilled activities." [19].

Skilled, semi-skilled, unskilled

The changes in job content and skill levels are accompanied by changes in the proportions of skilled, semi-skilled and unskilled workers making up the labour force of modern industrial concerns. In 1964-1965 the

Manpower Research Unit of the British Ministry of Labour studied occupational trends in the metal manufacturing and metal using industries. It was found that "a majority of firms expected a gradual reduction in the proportion (though not in the numbers) of skilled operatives, mainly as a result of technological change, with some of the more demanding work being taken over by technicians and some, broken down into simple operations, by semi-skilled workers. It was a general view that skilled operatives on maintenance were likely to gain in relative importance compared with those in production and that both would need to be better trained". [20]

Statistics published in the USSR [18], in the USA and in some other countries also [21] show similar tendencies together with a relative decrease in the proportion of unskilled workers in total industrial employment during the last decades. A researcher of the IFO institute, Julius Kruse, described the change in occupational structure then taking place as a result of technical development in the textile, stoneware and road building sectors. In all three the proportion of unskilled workers in relation to total employment had on the whole decreased, while the semi-skilled workers in relation to total employment had gained in importance, both as regards the quantity and quality of their work. "In contrast, however," he went on, "skilled work is losing ground in directly productive tasks – the building trades constituting an exception from this general tendency. The skilled worker trades typical of particular branches are losing out to mechanisation" [22].

Assembling the workforce

A great deal has been written on the theme that modern technology requires a new type of worker with quite other qualities than have been looked for in the past, and there is a wealth of published material providing examples of recruitment procedures and selection methods. It is fairly generally felt that, as Clay Smith pointed out in his book "Psychology of Industrial Behaviour": "The difficulties of making good selections are rising. Fewer and fewer workers are needed for simple jobs with obvious requirements, more and more are needed for complex jobs with requirements that are hard to specify and harder to measure... As the difficulties of making good selections mount, companies use more sophisticated methods of selection. Interview procedures are modified... aptitude, achievement, interest and personality tests are given with increasing frequency" [23]. There is a growing belief that there is a need to develop more effective tests and recruitment methods for use in selecting workers for new production processes. "Testing" Egan points out, "is no longer a question of belief but a question of evidence" [24].

Perhaps one reason why more elaborate selection methods are being experimented with is that the qualities and abilities sought in the workers are in fact increasingly difficult to assess. The following are extracts from two ILO studies in which criteria are listed for recruitment to very new types of job in two different industries. Signallers (or apparatus operators in blast-furnace control stations), according to one of the reports, must certainly have "a detailed knowledge of the duties of a blast furnace helper and a stove attendant", but they must also have "above-average intelligence, an alert mind and quick reactions; in addition, they must be vigilant, active and capable of sound judgment... gas controllers must be able to pay attention to several factors at once, be immune to boredom, have a gift for diplomacy" [15]. In the choice of operators for numerically controlled machine tools, says the other ILO report, formal skill qualifications play a smaller role than character, responsibility and reliability [25]. Some writers, such as Ottieri in his book "The Men at the Gate", put their faith in psychotechnical testing:

"If one has to allocate particular men to particular work,... psychotechnical methods offer a reliable means of selection and of discovering individual aptitudes: this much has been proved" [26].

Selection criteria

The application of sophisticated selection tests in recruiting new employees is not a common trend. The CIRF blast-furnace study already referred to [15] noted few changes in the procedures of recruitment for new processes: "In the production departments recruitment and training have so far changed very little from the traditional forms. Production department personnel are still for the most part operatives who have been trained on the job. Selection for the various jobs normally takes place after a probation period and on the recommendation of the supervisory staff". Two of the firms visited in the course of the blast-furnace research project gave preference to operatives who had had any kind of systematic training, even if it had no direct bearing on the particular job in view. The important thing was that the workers should already have had some mental training enabling them to learn and carry out new types of work more quickly. Efforts were generally made to recruit intelligent young people for working with the modern equipment. (In the blast-furnace maintenance services, however, there was a strong trend towards recruiting only skilled workers who had completed their training.)

The accent on recruiting young workers would appear to be a common preference. As observed in the CIRF steelworks study, "in all the steelworks where there have been important technical changes (in particular when oxygen processes have been introduced), in so far as is possible they select young workers for working with the new equipment. Older workers sometimes have difficulty in adapting to new processes". [13]

Recruitment for a big firm in the Paris area began with a survey to assess the standard of technical knowledge of that section of the population who could be expected to answer advertisements put out by the firm. Taking into account results of the survey as well as some basic information supplied by the Ministry of Labour's regional department of industrial psychology, the company's management laid down the selection standards and the level and duration of training. In the selection process certificates and diplomas were not the only criteria. In certain cases priority was given to the results of the intelligence tests rather than to the knowledge acquired. [27]

Systematic planning

According to most of the studies and reports analysed, the key to successful recruitment for the new plant lay in early and systematic planning. Experience of the Dillinger Hüttenwerke (Federal Republic of Germany) in recruiting workers for a modernised steel plant is described as follows: "We have streamlined our recruitment procedures and introduced stiffer requirements for entry into apprentice training. Recruitment begins well before the end of the school year. A list of the number and type of apprentices we require is sent to the vocational guidance office of the public employment service. It is this office which, by means of aptitude tests, interviews and counselling sessions, does the first screening of possible recruits among the school leavers." [28].

An interesting account of systematic and early planning of staffing for a new factory in France is to be found in an OECD study published in 1967 [29]. The factory was a pilot plant in a new industry and "... the installation required a large qualified staff, of a sort that was practically non-existent at the time". The factory took a considerable time to build, therefore "forecasting and programming could be carried out in favourable circumstances... The departments concerned had six months to plan the jobs, define qualifications, arrange training programmes, provide the school equipment, carry out selection and provide participants with accommodation, etc.".

Estimating manpower requirements was carried out in three steps:

(1) laying down the necessary qualifications;

(2) predicting the standard of recruits who could be obtained;

(3) determining the amount and duration of training required.

As to the qualifications required, it was considered, after they had been laid down, that "in this type of industry, where technical development can be very fast, it would have been a mistake to lay down strictly defined professional qualifications. The individual's knowledge must be able to keep pace with technical development".

Another example of a very early start of the recruitment and training programme for a new plant is described in an account of experience gained in the United Kingdom by Richard Thomas and Baldwins Limited in converting its Spencer Works to the LD steelmaking process. The new plant began to produce steel in July 1962, but planning the training of the workforce was started early in 1960, some key appointments being made already in the summer of 1959. "By the spring of 1962, the recruitment of managers, supervisors and staff grades was almost complete and the recruitment of worker grades was well under way. At the end of the initial recruitment phase, nearly 60,000 applications had been considered and over 6,000 appointments made, some 2,250 to management and staff grades and 4,000 to worker grades. The intention that managers should have the opportunity to participate in the selection of their subordinates was observed at all levels throughout the recruitment phase, and foremen took a part in the selection of their operatives". [30]

Action at national level

Not all firms or undertakings may be equipped to embark on such highly systematic and scientific methods of planning the staffing of their new plant or production unit. In several countries there are examples of government departments or semi-governmental agencies providing services at national level to help firms in the recruitment and selection of qualified personnel, including skilled operatives. As was seen above, the French factory in the Paris area had recourse to the research services of the University of Paris and to data supplied by the regional department of industrial psychology of the Ministry of Labour [27].

In the United States of America, the Employment Service has developed a special programme of placement services for professional workers (i.e. those with university training, or the equivalent). This programme — the Professional Office Network — provides a quick and direct means of communication among local offices in the inter-area recruitment and placement of scarce professional personnel. It uses the most up-to-date information techniques. As indicated in the Manpower Report of the President (1965), electronic data processing and telecommunications systems were being developed for the storage, retrieval and communication of job and worker information. The electronic data processing system was in an advanced development stage and plans were going ahead to expand the computer system to serve ultimately all stages. [31]

Action with much the same sort of purpose in view was the establishment in the USSR in 1966 of committees for the utilisation of manpower resources at the Republic level. These committees operate through special services at the regional and local levels. One of their tasks is to perfect the procedure of matching workers and jobs by collecting and disseminating information on the labour force which is required and available in the area and by developing the necessary measures to maintain the balance. [32]

Training the work-force

One of the characteristics of the past twenty years has been a substantial increase in the demand for education — a world-wide phenomenon — which has been paralleled by, or may even be said to have in some measure generated an equally marked increase in the demand for training. In discussing trends in vocational training over this period, an ILO report on the manpower aspects of economic developments in Europe [33] points out that it "is now commonly recognised that an advanced stage of industrial development demands more and more persons with a good education and training background and fewer and fewer with only limited knowledge and skills". Moreover, as transfers from one occupational field to another are becoming increasingly necessary, the individual must be given a greater versatility potential through broad-based initial training which will facilitate subsequent specialisation and/or retraining.

The consequences of these general trends in the field of education and training are to be seen in two parallel movements — expansion and rationalisation — each of which is as applicable to the training providing basic skills for youth as to that which is intended to give adults additional skills or to raise the level of the skills they already possess. But because of the urgency of the need to expand all types and levels of training and the limitations imposed by national budget provisions, the chief aims of education and training planners have been to ensure the most effective use possible of available funds, training staff and facilities. This implies, the report goes on, an organisational approach and a methodological approach, a systematic "search for new or improved structures and training methods better suited to current and probable future requirements". Planners, researchers in industry and in the academic world, government departments and international agencies have therefore been focussing their efforts on a methodical assessment of training facilities, aims and needs. To do so they have first set out to discover present input of training and education systems — the people and the operational institutions — to assess their capacity or output, to determine desirable output and then to draw up a balance sheet with a view to determining the action needed to achieve, or restore equilibrium.

Planning ahead

This common wave of assessment and planning for the future is symptomatic of the new approach being adopted by national, regional and local authorities, by institutions and by plant managements alike in the planning and organisation of training. Most of the resultant reforms have been designed to ensure equality of access to training and generally to raise its quality — both being requirements necessitated, as has been seen above, by the demands of advanced and constantly changing technologies. To achieve these purposes it is increasingly recognised that the only sure solution lies in systematic planning and its corollary, advance planning. Much of the success reported by the Paris manufacturing firm in recruiting personnel and getting them adequately trained was attributed to the time which was available for preparation between making the decision and opening the factory: there was time enough to study the structure of the trade, to plan the training and to prepare the ground [27].

Long-term preparation seems generally to be held essential. In the USSR, Šlionskij, writing in "Ėkonomičeskaja Gazeta" at the end of 1968, holds that a three-months training period, considered adequate by some officials in the Ministry of Ferrous Metal Industry, is not sufficient. When establishing a new plant, the training required would have to be spread over a much longer period. [34]

Advance planning of training is a recurring theme in the studies dealing with the manpower implications of setting up new plants. The study on the conversion of Richard, Thomas and Baldwin Limited, already referred to above, bears this out. "The clear general lesson from the experience gained from the building of Spencer works is the value of training being planned. It must be planned early; well in advance...". It is considered vital that training should be accepted as an integral part of starting a new works, and not as something distinct and separate from the other aspects of developing a new site. "Ideally, the training of work people should end just as the plant begins to operate." [30]

The experience of Brown Boveri, a Swiss firm manufacturing electronic equipment and of VOEST, an Austrian steel-making firm, tell the same tale.

"Planning training [at VOEST] begins at the contract discussion stage. Together, client and supplier check the skills and knowledge which the production, maintenance and other technical staff going into the new mill have acquired in their previous work. Together, they assess the buyer's need for additional staff training, and provisions concerning the training job to be undertaken by the supplier are written into the contract or made the subject of a special agreement... Training begins about six months before the new plant is scheduled to go into production... The timing of the training must allow the newly-trained personnel to participate in setting up their home plant... Like VOEST, Brown Boveri stresses the importance of timing the training. Courses which are started too early often lead to wastage of the acquired skills; the trainees forget the skills and routines learnt or, tired of waiting, they take other jobs before the plant they were trained for is finished." [35]

When the equipment to be installed in a new plant is much more sophisticated than that in use in similar production units of the company, some concerns initiate training of workers for a new plant long before its actual start-up. For instance, to meet the skill needs for its new 80-inch automated hot strip mill, the Indiana Harbour Works of the Inland Steel Company of the USA started training the workers for the mill between one and two years before it was completed. "Working closely with the plant training department staff, first line supervisors scheduled for transfer to the 80-inch steel mill began preparing training manuals and conducting on-the-job training for affected workers. Maintenance workers were encouraged to up-grade their skills by enrolling in the company's various training programmes conducted both at the plant and at Purdue University. Key supervisors and technicians were briefed on operation and maintenance of the new mill by the equipment installers' and manufacturers' engineering representatives... Purdue University professors visited the Indiana Harbour Works plant to train electrical maintenance crews. Lower-skilled workers in the 44-inch mill were being similarly prepared to replace higher-skilled men transferring to the new facility. And whenever possible, workers were moved into the new 80-inch mill even before operations began." [36]

Organisational principles

The report to the ILO Textiles Committee already referred to above states categorically that a first necessity deriving from the modernisation of industry, and increasingly recognised in most countries, is that of organising systematic training for all workers at every level [19]. This, as many writers have noted, implies not only the longer-term and advance planning discussed in the preceding section but also consideration of what should be taught and at what level, the organisation of the instruction, the place where the training is being given and the actual methods used.

Lantier and Mandon, describing recruitment and training practices in the metal trades in the Lyon area, emphasise the need for higher level and also broader training for modern technology. Neither the skilled worker, narrowly specialised and lacking the essential theoretical bases, nor the specialised technician who encounters difficulties in applying his knowledge to concrete projects, they say, can meet industry's current requirements [37]. In view of increasing automation, some researchers in the USSR consider it urgently necessary that in vocational-technical schools the training of skilled workers (for instance in the chemical industries) should begin at the same level as regards skills and knowledge as the training of technicians [38].

An ILO study on the training of maintenance workers [39], which covered sixteen undertakings in Belgium, France, the Federal Republic of Germany and Sweden, has shown that companies attach great importance to "trouble shooting" and the techniques of detecting causes of faulty functioning. They consider that most training courses neglect these aspects of maintenance work. A factory making films and photographic paper was experimenting with the introduction of a course in logic. The maintenance engineer was convinced that difficulties encountered in maintenance work, particularly in fault detection often originated from a lack of ability in many maintenance men to reason logically. He was systematically seeking ways of "de-mystifying" the maintenance of automatic equipment.

Where the training should be given remains a controversial point. At an international seminar on vocational training and further training (Berlin, 23-25 November 1967), a delegate from Czechoslovakia reported that it was intended to abolish specialisation in secondary vocational, technical and higher education. Such training would instead be given at the place of work, in factory schools, in short-term and long-term courses, etc. Various forms of training at plant and industry level would in future play a very important part in the whole system of training of engineers and technicians. By means of these measures, it was expected to solve the problem of training people for the future. [40]

School-based training remains the principal system in Poland subject to sufficient guarantees that the schools take adequate account of the requirements of industry. Within the Polish chemical industry as many as 50 vocational schools, with a total of some 12,000 pupils, and 38 technical schools (6,500 pupils) had been organised by the end of 1967. The schools operate in conjunction with large undertakings. The necessity of having large vocational and technical training centres in industry has been seen in the ever-higher level of basic knowledge required from the workers in the chemical industry which is being modernised, mechanised and automated more rapidly than any other industry. [40]

A Soviet publication shows that workers for new plants are often trained in similar enterprises which may be located very far from their home plant. For a new tyre plant in Krasnojarsk, for example, 891 workers were trained in similar plants in Moscow, Omsk and Jaroslavl [41]. Belkin, writing in "Sočialističeskij trud" in 1967, proposed establishing vocational schools for big industrial concerns before constructing the undertakings themselves, averring that such schools "... could be used for training the construction workers and then the skilled workers for the new plant" [42].

The reasons most frequently given in support of removing basic skill training from the shop floor, according to the CIRF study on apprenticeship in Europe, are as follows:

"the training workshop, which is separated from the dangers and pressures of regular production or maintenance work, makes it easier for the apprentice to transfer from school life to the active working life of the adult;

"certain basic skills can be better and more systematically taught under the close supervision of experienced instructors who apply modern didactical methods and use efficient teaching aids;

"good working habits are learnt more easily in a training workshop than under the pressures of production;

"the production process in highly organised larger undertakings (piecework and assembly production lines) leaves journeymen and foremen little time for taking care of the apprentice and teaching him'. [43]

A Soviet study comparing in-plant training and training in vocational schools concluded that the training of workers in schools has many advantages and especially pays off in new and complicated occupations [44]. According to statistics, approximately two-thirds of the new workers required for industry in the USSR need to be trained in vocational and trade schools to satisfy the skill demand [45].

Experience at the Fiat School, Torino (Italy) in teaching new trades has been described in an article written by the head of the school. First they tried to train production workers and maintenance personnel on the shop floor. It was soon found, however, that this training was insufficient. The most important reason was that "repair and maintenance of automated machinery, even running it, required much more knowledge and insight into electronic processes than could ever be conveyed to trainees working on production jobs" [46]. This observation has since been confirmed repeatedly, and in many ways: it is better to train both production and maintenance staff away from the production lines provided always that the courses are constantly kept in tune with the latest developments from the methods lahoratory.

In contrast, however, some writers consider that on-the-job training provided hy supervisors will continue to play an important role. But for complete success to be obtained in such training the following elements are essential:

- adequate supervisory training with emphasis on training techniques;
- formal and informal appraisal programmes which provide a two-way communication channel and a means of ascertaining training needs;
- the provision of training aids — particularly manuals. [47]

Other writers, for example, Bourdeau (France), have pointed out the importance for supervisors, specialists and key production personnel of a plant of being on the site during the final weeks of construction [48]. The ILO report on the training of maintenance workers [39] suggested that these categories of workers, too, should he given initial training during the installation of the new plant "in order to learn from the supplier's assemhly men how the new equipment should be run and serviced". On-the-job training for them is essential.

The article on planning training at Brown Boveri and at VOEST makes another point: "manufacturers and suppliers of equipment render invaluable service in training the workers and technical staff required to handle new installations". [35]

The need for plant training to he a joint effort is also apparent in the current expansion of its organisation in inter-plant training centres. Group training has been gaining ground in many countries — France, the Federal Republic of Germany, Switzerland and the United Kingdom among them. One of the principal recommendations for further action made by the Committee of the Employers' Federation for the Chemical Industry (Federal Republic of Germany) was that smaller undertakings should be encouraged to take an active part in the industry's training effort by inter-plant arrangements [39]. Similar developments are found in Sweden. The Federation of the Swedish Pulp and Paper Industry, for instance, has set up its own residential school for the training of maintenance and production personnel for its member firms. It is also organising shorter, specialised courses in co-operation with various vocational schools. [39]

Psychological effects of the introduction of advanced technology

Much has been written on the various psychological problems raised by the introduction of new technology. The Colorado University research group report cited above [1] says that "... automation makes psychological adjustment training for workers as necessary as technical training for new automatic work". Another writer, Warren Gorman, puts it this way: "The present psychological trend is one which swings between fear of automation and excessive expectations of it. Less well-informed people or those who are incompletely trained, show a manifest fear of automation... Just as the witches and sorcerers of old were accredited with abnormal and mystical powers, many of us today somehow feel that the computer, and thus the automatic machine, contains a moiety of sorcery in its inner recesses and that a machine which is operated by the computer may possibly brew up something of the supernatural". [49]

In 1958 an international group of experts was convened by the World Health Organization to consider the mental health problems associated with the introduction of automation. In its report the study group noted that the introduction had r[illegible] in psychological repercussions on those involved, and that in some cases these might set off reactions affecting mental health. The report went on: "Two types of reaction can be distinguished: first, emotional reaction to the introduction of an essentially new technological method and in particular to the anticipation of possible consequences of the innovation; second, the reaction of the person who, confronted by new working and living conditions, is exposed to physiological and psychological strain". [50]

Some specific consequences of the introduction of automation were reported by an American participant at an automation seminar organised by the Australian Council of Trade Unions: "It was found that in the Ford Motor Company, automation had almost eliminated hernia, eye troubles, foot accidents, etc., in its Cleveland Engineering Plant. However, the reduction in physical risk seems to be accompanied by an increase in emotional hazards. The highest incidence of gastric ulcers in the hourly-paid group in America is now among the skilled machinists who exert less physical effort nowadays than previously. And also we find that these kinds of psycho-somatic disorders, as we call them, are increasing among the workers in the automated plants and the numbers of physical illnesses decreasing". [51]

Another study pointed out two major problems in applied psychology in the present stage of partial automation: the problems of vigilance and variability in work load. Dealing with the "human factors in automation" the writer indicated that "it is difficult for man to remain effectively vigilant when there is very little going on". [52]

Many writers have paid considerable attention to another aspect of automation — the monotony of the work on, for instance, assembly lines. In his book on "Modern technology and civilisation" Walker describes a variety of methods which have been tried within industry for the relief of monotony in highly simplified repetitive operations. Included among them are frequent transfers between jobs, introduction of rest pauses, music in the workshop, the grouping of workers into competitive teams and so forth. [53] Such measures may be indicative of the increasing importance being attached by managements to the psychological and mental health aspects of introducing advanced technology or automated production methods into their plant. They may also be merely symptomatic of a general unease, on the part of management and employee alike, concerning the mental adjustment effort that might be required of them.

CHAPTER III - RECRUITMENT

It was assumed in preparing the project that the location of the plants visited would be among the major factors influencing the recruitment of their labour force. It was felt that their siting would have helped determine plant recruitment policies as well as the relative ease with which the respective managements had been able to find and attract the personnel required for their new production process or department.

Broadly, the undertakings visited could be said to fall into two groups: those located in the heart of their own industries and those set up in more isolated areas.

One example of the first group was a new plant set up by a foreign combine and producing strip steel (No. 3)[1], which was established in the heart of the country's steel industry. This afforded it an abundance of raw material, a large and experienced pool of labour and excellent transport facilities — three factors which may be considered to constitute an ideal combination. Similarly, a motor car plant studied (No. 6) was a subsidiary of a big firm manufacturing various products in the same and related industries. The plant had recently been modernised but older production methods were still used in some departments. It was located in an industrial region and could take advantage of the parent company's vocational school. This plant therefore experienced little difficulty in getting the skilled labour it required.

[1] The number in brackets is the code number of the plant referred to.

In other plants in this category it was either a matter of having been long-established in the locality and merely embarking on new ventures (Nos. 13 and 22), or a case of a new factory built to replace smaller, old ones (Nos. 9, 10 and 28). In none of these cases was the recruitment of an adequate labour force a problem except, perhaps, in the sugar refinery (No. 28), which suffered from a lack of skilled maintenance men and from the seasonal character both of sugar production and of local employment.

The isolated or unique undertaking

The case of concerns set up in isolated areas or away from their own line of industry might present a different picture. One such plant was a plastics factory (No. 17), a branch of one of the largest chemical companies in the USA. The area was not isolated but its production was unique in the country. Partly for this reason and partly because there was no local unemployment, its location caused some initial recruitment difficulties, but certain economic advantages outweighed this drawback in deciding on the site. Another example was a new plant (No. 16) turning out aluminium plates, strips and profiles. Lack of an industrial tradition in the locality gave rise to some recruitment and training difficulties during the first period of production. This was also the case of one of the motor accessories plants (No. 14) which was located in the same country and quite near the aluminium plant.

In another country a factory manufacturing wire, nails and cables (No. 8) had been set up in an area where no similar plant existed. However, since the State also operated other plants manufacturing the same line of product, it was possible to transfer some of the skilled workers required and to recruit others from within the industry. The undertaking provided housing for key personnel coming from other areas.

Other plants falling within this category were a chemical company (No. 24), two of the textile undertakings (Nos. 2 and 26) and the electric lamp factory (No. 29), all located in fairly isolated areas in different countries. In none of these cases did isolation from their own particular industry or the fact that the areas did not have an industrial tradition give rise to any real recruitment difficulty. Much of the work required only semi-skilled labour, which was obtainable locally. In one or two instances unfamiliarity with factory work created some initial psychological problems, which will be referred to later.

There were also plants in this category which had been set up by, were affiliated to or had close ties with foreign companies. Some of these plants suffered initial recruitment problems, but the latter were due more to an insufficient appreciation of local conditions of work, language problems and the seasonal character of the local employment situation, than to the absence of a potential labour force or to the level of technology introduced. This group of plants manufactured a variety of products: thin film plastics (No. 17), electronic components (No. 1), aluminium (No. 16), machine tools (No. 5), motor accessories (Nos. 4 and 14) and computers (No. 12).

The over-all impression was that the siting of a factory was not influenced to any extent by the availability in the locality of persons technically qualified to work on modern machinery and equipment, so long as there was available for recruitment a sufficient supply of manpower which could be trained.

Establishing recruitment requirements

Preparation of manning tables

Manning tables were variously prepared either by the state authorities, by the plant management or the parent companies, with the equipment manufacturers or suppliers sometimes playing a major advisory role. In the USSR, Czechoslovakia and Poland, for example, the manning tables for the plants visited had been prepared by central authorities, such as the Central Project Institute for the Nitrogen Industry, the relevant department of the Ministry of Food or the institute of technology for the industry in question. In the USSR they were based on the experience of setting up similar plants in other regions of the country. When new machinery was obtained from abroad, the views of the suppliers were sought on the draft manning tables and taken into account. This was the case in a synthetic fibres plant (No. 26). After consultation with the equipment suppliers, the manning tables were passed for action to the new plant management which did not appear to have taken part in their preparation. As a rule, the technological plan was prepared in similar fashion and at the same time.

In Czechoslovakia there was one case of the manning tables being prepared by the equipment suppliers; in all the other plants studied they had been established by the competent institute of technology for the industry concerned. In Poland, prospective administrative staff in some of the plants had participated in making up manning tables which were basically being prepared by project institutes. The skill requirements were specified in the course of the running-in period.

In Belgium, Luxembourg, the Federal Republic of Germany and the United Kingdom it was the managements of the new plants or of their parent company who assumed this responsibility. Since in almost all cases they either formed part of an associated group of companies or were new plants established by concerns with world-wide interests, the preparation of the tables did not present any problem. In the case of the automatic spinning unit (No. 23), however, it was the manufacturers of the machinery who established the first manning table on the basis of their design of the equipment since the plant itself was in the nature of a pilot project.

In general, it appeared that very few changes had subsequently had to be made in the tables established. In the cardboard articles plant (No. 15), because of unforeseen operational problems encountered when a particular machine functioned fully automatically, two workers had to be allocated to it instead of just the one planned for in the manning tables. The skill requirements determined for some pieces of automatic machinery in the motor car plant (No. 6) were subsequently found to be too low, and additional training had to be organised for the workers assigned to these machines. In one exceptional case (No. 28), where substantial changes were necessary, the manning table had become available only three months before start-up. This period proved too short. It created recruitment difficulties, fewer employees being recruited than were later found to be required.

In other cases the project figures were found to be below those actually required. In one project the manning table provided for 32 workers, but after the running-in period 46 were found to be necessary. On the other hand, there were also one or two cases where the effective workforce was reduced by as much as 10 per cent after running-in. It is sometimes difficult to foresee the extent to which automation and mechanisation will be accepted by the workers or the speed with which they will become accustomed to the new conditions after the initial running-in period. Some firms initially recruit more personnel than they require in order to allow for the early staffing troubles inherent in starting up an entirely new unit. One concern with a highly automated production process (No. 22) had a 10 per cent reserve of the workforce on stand-by in case of illness, holidays and the like.

Staffing and skill levels

The type of workforce data available in the plants differed to such an extent that strict comparisons for a number of plants were not feasible. In particular the classifications "skilled" and "semi-skilled" worker proved to vary between both plants and countries so that any attempt at comparison would be meaningless.

The following skill level structures are given as merely indicative of general trends identified during the visits.

In the automatic spinning unit of one of the textile plants (No. 23) it was possible to make a comparison with the personnel required for a conventional production unit of the same size. The normal manning table for the latter provided for a total of 43 staff working three shifts: 10 production workers per shift and respectively 4, 5 and 4 supervisory and ancillary staff. With the new automatic spinning unit, however, it proved possible to amalgamate the jobs of scutcher, tender, card tender and draw-frame tender into an entirely new job — "prep tender" — thus saving 3 tenders per shift and bringing down the total number of direct production workers from 30 to 21. On the other hand, while 4 setter/mechanics for three shifts were sufficient for the conventional unit, the automatic spinning unit needed 6. The indirectly productive and highly skilled workforce had therefore increased in proportion to total employment. Moreover there was an increase in the skills expected of operatives: the "prep tenders" became key men in the automatic unit and required some six months of upgrading training in order to reach full production standard.

In a chemical factory (No. 24), there were 5 to 6 supervisors and foremen for each unit employing a total of between 8 and 12 operatives. In addition, there were 17 maintenance men for a total of about 40 operators. The management of the undertaking indicated that this was a high proportion of skilled and managerial personnel compared with the requirements of conventional methods of manufacturing similar products. It should be noted also that a good deal of the maintenance work was contracted out and that, consequently, the maintenance men had more limited functions in the automated plant than they would have had in a conventional one.

The personnel required and their levels and types of skill seemed to differ according to the degree of mechanisation or automation in use. Plant No. 4, for example, had highly automated equipment involving little manual work and producing many different types of motor accessories for cars, marine engines, mowing machines, etc. Fifty per cent of the production workers were women, employed on semi-skilled work in such occupations as automatic machine operating, wire welding, inspection and, in one instance, in instructing. Among the machines in use was a completely automatic assembling machine whose operation turned out to be a key post, although originally not so envisaged in the manning table. Mastery of this machine required some six months' training and the management had subsequently found itself obliged to pay the workers a higher wage in order to keep them with the firm.

In the petroleum products unit of the oil refinery (No. 7), operating on continuous flow process with a central control panel, there were four shifts of some eight workers, each composed as follows: a foreman with specialised secondary education followed by four to five years of work experience, one chief operator with the same qualifications, four operators having apprentice-school training and three years' work experience, and one or two maintenance workers similarly qualified. All were on the two top steps of an eight-step wage scale.[1]

A modern dairy (No. 9), processing up to 300,000 litres of milk per day and using automatic bottling and pasteurisation machinery, had a work-force of 360 employees. These comprised 179 production workers, 15 foremen in the production units, 31 maintenance personnel, 100 transport workers, 21 workers in the storage department and 14 employed in the canteen and in administrative and clerical jobs in the production department.

In the cement plant, which produces 210,000 tons of burnt lime per year, 104 people were employed in the production of lime. Among them there were 10 control panel operators, 6 electricians, 12 fitters, 12 quality control and laboratory workers, 16 loaders and 30 conveyor-belt workers. Of the 104 workers engaged in lime production about 17 per cent had had a secondary technical education, 20 per cent had completed vocational school (3 years) and 63 per cent had been trained under various kinds of apprenticeship.

In a large synthetic fibres plant using almost entirely automatic equipment (No. 26), a breakdown of the workforce showed the following distribution by level of qualification and sex:

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[1] In Czechoslovakia, Poland and the USSR workers are classified in different wage categories (usually from I to VI) with category I being the lowest. The categories are closely tied to the level of education and training, the skilled worker categories normally starting with category III.

	Chemical shop	Spinning shop	Textile shop	Total
Workers	151	114	517	782
Technicians	11	10	18	39
Apprentices	1	3	17	21
Others	1	2	5	8
TOTAL	164	129	557	850
- Men	144	79	90	313
- Women	20	50	467	537

Of the total strength of 782 workers, 15 per cent were employed in the two highest wage categories (VI and VII), 45 per cent in category V, and 20 per cent in categories IV and III respectively. The category of employment obviously had an impact on ease of recruitment.

The brickworks with a production capacity of 550,000 bricks a week, employed a small number of workers in two teams: 23 unskilled workers, 14 semi-skilled production workers, 5 skilled management staff (including supervisors and charge-hands), and a team of 6 maintenance staff (5 skilled and semi-skilled mechanical and electrical fitters and one unskilled worker).

In Belgium, where vocational and technical education is provided almost exclusively on a full-time basis in schools, vocational and technical schools classified as A4 train their pupils up to semi-skilled level, those as A3 to skilled worker level and those in the A2 and A1 categories to technician and higher technician levels respectively. In a factory producing electronic components for use in radio, television and assimilated apparatus, a breakdown of the staff by level of employment and level of training provides the following picture:

Senior management (university trained)	10
Higher technicians (A1)	25
Technicians (A2)	30
Technicians (originally trained to A3 level, recruited as skilled workers and subsequently promoted)	20
Skilled workers (A3)	110
Semi-skilled (or specialised) female workers	635
Semi-skilled (or specialised) male workers	100

About 40 of the 110 skilled workers were employed on first-level supervisory duties, for instance as team leaders, while the remainder were employed on maintenance work or were attached to the mechanisation service.

Maintenance work in this factory occupied 49 people among whom were 32 mechanics, 9 electricians covering both electrical and electronic maintenance, one technician, 2 higher technicians and 2 team leaders. For everything connected with the installation of machines, overhaul of electric motors, etc., maintenance was entrusted to a "building service" which had 11 workers (almost equally distributed among electricians and mechanics), an assistant foreman and a junior technician.

New jobs and changing functions

On the whole, the field studies brought to light few cases of jobs which either had actually been created as a result of technical innovations or had disappeared because of them. There were, however, examples of changes in specific functions or in degree of responsibility. These were most noticeable in maintenance work and in supervisory categories of employment, but the trends of the changes were not uniform. In some cases greater versatility was required and in others there might be a diminution of responsibility or a docking of specific tasks resulting in lower status or reduced technical content. It was not the purpose of this project to consider the impact of automation and advanced technology on the skill content of specific jobs, but the following data are indicative of these trends and have a general bearing on the firms' recruitment and training problems and policies.

Mention has already been made of one entirely new post which came into being as the result of new technology. This was the "prep tender" in the automatic spinning unit. In the course of project field work another such post was noted: that of "programmer" in a plant producing numerically controlled machine tools (No. 5). By means of the coded instructions on punched cards, magnetic or paper tapes, many duties formerly carried out by workers have been eliminated, e.g. selection of proper tools, speed and feed, flow of coolant, machine positioning and sequence of operations.

The operators of such machines tend to become merely machine minders or watchers, and their status to be thus reduced to that of a semi-skilled worker. But the job of the programmer demands high-level qualifications, since errors in programming will have serious financial consequences. It should be noted that with the introduction of numerically controlled machine tools the ability to organise and lay out jobs becomes of more importance for production than the personal skills of the worker.

Complex modern machinery in a synthetic fibres plant (No. 26) has led to the development of a split in the foreman's functions and the creation of a post of assistant foreman in textile production, who has been made responsible for the technical side of the foreman's job. The new assistant foremen play an important part in the production process, assuming the responsibility for current trouble shooting.

With advances in technology, some jobs in the textile field have grown in responsibility and importance and in the process have created other jobs, many of them requiring little skill. Two of the more far-reaching changes concern the occupations of spinner and weaver. From the conventional spinner's job at the textile mill referred to above (No. 23), the following functions have been split off: cleaning, brushing (blowing and sucking are now done by machine), oiling and doffing. This has resulted in the creation of the posts of doffer, frame cleaner, roving layer, conveyer man, roller picker, roller buffer, traveller changer, oiler and spindle cleaner. (Data concerning the type and duration of training required for some of these new jobs are given in Chapter IV.) In general, the weaver on automatic looms, who may be in charge of as many as 90 looms, cannot devote much time to each loom. For jobs that take more than a minute or two he calls on the helper weaver. In the job of weaver more emphasis is therefore now being laid on qualities of responsibility, supervision and work organisation.

Characteristics of the workforces recruited

In view of the sometimes rather fluid situation as regards skill requirements for working with the new processes or running the ultra-modern production and production process among the undertakings studied, it might be supposed that there would be a similar diversity in the characteristics and qualifications of the men and women actually engaged to fill the posts in the manning tables. The firms tended, however, to seek not so much specific qualifications in their new employees as abilities and aptitudes which could be made to grow with the job.

The basic requirements sought at both operator and foreman levels, for instance, by one of the chemical plants (No. 24) were described as follows: reasonable physique, basic intelligence (without any prescribed minimum requirements of educational background), a certain amount of enthusiasm, an inquiring mind and a flexible approach to the job, an ability to solve simple problems independently, the honesty and courage to admit mistakes, some leadership and management potential (with a knack of getting along with people), safety consciousness and a certain degree of self-discipline. Maturity and stability were also demanded, and the firm preferred to select young married people, on the assumption that they would be more reliable in their work and stable employees. One of the food processing plants (No. 11) gave preference to young people with a sound general education, considering them to be more adaptable to new and changing technology.

Despite the broadness of such criteria, it was nevertheless possible in the course of the study to detect some common trends and tendencies in the labour force intake as regards age, distribution between male and female workers and level of skill.

Age

There is a definite tendency to employ young workers on new, automatic equipment. In the chemical plants the average age of production workers was 27-28 years, sometimes (e.g. in plant No. 22) as low as 24-25 years. As has just been seen, in another of the chemical plants (No. 24), where no average age was quoted, the management preferred to employ young married workers. The same tendency was found in the motor car plant. Exceptionally, kiln attendants in the brickmaking firm were between 40 and 50 years of age because of the impact of shift work on family life: elsewhere at the plant the workers were young. In most of the other firms the average age of their workforce was in the middle twenties: e.g. 28 years in the computer plant 25 in the electric lamp plant. In the plant manufacturing machine tools, persons recruited as operators of numerically-controlled lathes were 17 to 18 years of age and the new post of programmer was filled by a man of 23.

The tendency towards employing relatively young people on new and sophisticated equipment might be general but it was by no means uniform. In several instances, for example in factories Nos. 3 and 5, it was considered preferable to build up a team comprising older, experienced people as well as young workers. Supervisory grades tended to be between 35 and 40 years of age.

From talks with plant managements it was evident that age and qualifications were considered to go together, and that for the operation of machines based on advanced technology, such as those involving numerical control, preference was given to people with open minds who had not had time to become accustomed to a routine. In one plant in Czechoslovakia even foremen were selected from among young men with secondary technical education. But this was an exception to the general rule.

Women in the workforce

All the plants visited were equipped to a very large extent with modern and sometimes unique automatic and mechanised equipment. But the advanced technology in use, while calling for some workers with the highest technical qualifications, left a considerable employment field for production workers without technical qualifications at all. For these jobs the qualities needed were resistance to monotony, care and attention to work, and manual dexterity — qualities which many women workers tend to possess. Although the heavy machinery in the plants was operated by men, therefore, much of the other equipment called for these qualities and was operated by women.

The proportion of women doing production work varied from as high as 75 per cent in the electric lamp factory down to zero in the brickworks. Between these two extremes other proportions were:

70 per cent - in an industrial-type bakery (No. 10),

50 per cent - in a motor accessories plant (No. 4),

40 per cent - in the motor car plant (No. 6),

30 per cent - in a nitro-chemical plant (No. 27),

20 per cent - in the computer plant (No. 12), principally engaged on manual work in the assembly section,

12 per cent - in another nitro-chemical plant (No. 22).

The textile industry has traditionally provided a large field for the employment of women workers. The proportions noted in two synthetic fibres plants were 40 per cent (No. 2), mostly in the spinning shop, and 65 per cent (No. 26) respectively.

In the assembly shop of the computer plant (employing about 100 women among a total of some 350 production workers), the main tools used were screwdrivers and pliers and highly specialised soldering and welding equipment, all comparatively simple for semi-skilled workers to use. This particular factory was engaged in the assembly and testing of various parts received from plants belonging to the same enterprise. In the motor accessories plant (No. 4), some of the women were working as inspectors on semi-skilled and specialised work, the others were mainly employed on assembly work, but also on welding and other machine operations (except for work on the automatic lathes).

Skilled versus semi-skilled workers

The skill levels specified in the manning tables give some indication of what might be considered the ideal ratio of skilled to semi-skilled workers. The survey revealed a wide variation in these proportions from plant to plant and even between departments within a plant. One company (No. 8) in which there was more mechanisation than automation, considered that in the wire production department between 70 and 80 per cent of the workers were skilled against about 35 per cent in another production department. In the motor car plant, which replaced another older one in the same industry, the average wage category step of the worker was 4.5 against 4.0 in the old plant.

In one plant of a chemical concern with a high degree of automation (No. 27), the distribution of production workers in the various pay scales showed a high proportion of skilled workers. The wage table for this plant may be considered typical for the whole concern.

Wage level steps	1	2	3	4	5	6	7 (the highest)	Total
Number of workers	-	16	13	58	124	90	73	374
Percentage	-	4.3	3.5	15.5	33.2	24.0	19.5	100

Another chemical concern showed a similar picture for its petroleum products unit except that all its members were in the top three wage steps. In the sugar factory roughly two-thirds of the production workers were in the top three steps.

At the modern bakery (No. 10) there was a large proportion of personnel with a low level of skill. Previously, a high degree of skill was required of a baker, but in a modern industrial type bakery the emphasis is on greater technical knowledge of monitor technical processes which are machine-controlled. An oven operator (in the highest step wage level) was required to have completed a three-year apprenticeship, acquired seven years' work experience and completed the "school for foremen" course. In one bread production unit of 8 workers, 3 operators (dough production, oven and mixer) were assisted by 5 semi-skilled women workers, all of whom were in the lower wage steps.

A textile firm spinning nylon-type fibres (No. 26) showed that of 824 workers, 40 per cent were in the lower half of the wage scale, 45 per cent on the first step in the upper half and only 15 per cent in the two top levels. Another synthetic fibres plant (No. 2), in recruiting operators for the plant's most advanced equipment, demanded no previous theoretical knowledge of its new recruits — practical common sense was considered sufficient. This was not the case for the maintenance men, however, who were required to have both theoretical and practical knowledge as well as experience.

Two firms (Nos. 7 and 27) considered that automatic machine operators required special abilities. One of them recruited only persons with technician level qualifications as operators. On the other hand, another firm considered that under normal conditions an automatic lathe operator would be of approximately semi-skilled level; at the time of the enquiry, however, such a machine was a novelty in the district and it had proved necessary to take on highly qualified lathe maintenance men as operators.

Of some 550 directly productive workers in the computer plant, 350 semi-skilled workers were employed on final and group assembly work which did not call for any special qualifications; 150 were engaged on testing which required mechanics and technicians with either full training as skilled workers, or full technical education to technician level; 30 to 40 were employed on maintenance. The maintenance crews were composed of skilled workers and technicians with completed apprenticeship or a technical secondary school education. During the first 18 months that this firm was in operation the percentage of workers with only primary school education dropped from 16.1 per cent to 9.6 per cent. The percentage of those with just a completed apprenticeship or industrial or commercial school education also dropped (from 61.2 to 55.9 per cent), while the proportion belonging to higher categories — graduate engineers and higher technicians, graduates of other university faculties with a good knowledge of general mechanics — rose from 9.4 to 14.8 per cent. Of 12 so recruited originally, 4 became tool designers.

In the lamp factory, employing approximately 1,000 production workers, over 60 per cent were in the semi-skilled or specialised bracket. A production unit at the brickworks was composed of 5 skilled workers (supervisors and charge hands), 7 semi-skilled and 13 unskilled. The maintenance team, on the other hand, was made up of 2 skilled, 3 semi-skilled and one unskilled worker; the management considered that it would be preferable, however, to have a team consisting entirely of skilled fitters with one highly skilled electrical technician in charge.

One of the motor accessories factories (No. 14), had a relatively high proportion of specialised or semi-skilled machine operators. The production process was described as semi-automatic. Production and maintenance personnel totalled 422, of whom roughly 120 were skilled metal-trades workers, 280 semi-skilled and specialised (50 per cent of whom were women) and 22 apprentices. A job breakdown of these two groups showed roughly the following distribution.

Skilled workers — metal trades	
Assistant foremen	11
Plant maintenance (machine fitters and electricians)	18
Toolmakers and grinders	17
Mechanics in the experimental workshop	12
Machine setters	25
Quality controllers	20
Various skilled workers	17
	120

Semi-skilled or specialised	
Machine setters	5
Quality controllers	25
Machine operators	160
Various helpers, storeroom and despatch workers, etc.	90
	280

Sources from which the personnel were recruited

Where had the new recruits come from? What were their previous education and work experience? In some cases the plant managements were able to supply details regarding the sources from which their workers had been recruited. The three examples below, each relating to a different country, may be taken as typical. They concern the sugar factory, one of the synthetic fibres plants and the plate-glass factory.

Sugar (No. 28)

Source of recruitment	Number recruited	Percentage of workforce
Farms and non-sugar-beet firms	134	30
Construction workers who remained with the sugar factory	100	22
Workers and technicians drawn from other sugar plants	70	15
On temporary loan from the Regional Sugar Trust	40	9
Staff from an older sugar plant closing down	30	6
General school leavers	45	10
Vocational school graduates	35	8

This factory can be described as 25 per cent fully automatic, 55 per cent semi-automatic and 20 per cent mechanised. A great many of the workers with low-level skills came from farms. About 25 per cent of the workforce did not require any training, and the majority fell into the three lower grades of a six-grade wage scale.

Textiles (No. 2)

Source of recruitment	Men		Women	
	No.	%	No.	%
Other textile firms	13	22.4	5	12.5
Building trades	16	27.5	-	-
Metal trades	6	10.3	-	-
Hotel industry	-	-	12	30.0
Garment industry	-	-	3	7.5
Other industries	9	15.5	2	5.0
Agriculture	4	6.8	-	-
Self-employed workers	5	8.6	-	-
General school leavers	5	8.6	2	5.0
Domestic workers			3	7.5
Housewives	-	-	11	27.5
Miscellaneous	-	-	2	5.0

Plate-glass (No. 18)

Source of recruitment	Percentage of workforce
Agriculture	60
Plants in various industries	16
Plants in the glass industry	2
Vocational school graduates	6
Unemployed women	4
Migrants from various regions of the country	2
Other sources	10

Within-plant transfers

Some of the firms relied heavily on recruitment from within the plant. The computer company transferred some 400 to 500 workers from another of its plants, thereby covering all its management staff requirements, 50 per cent of its specialists and 33 per cent of its highly skilled workers. The car factory brought 11,000 of its total strength of 14,000 workers from an old plant within the firm; some 1,200 were apprentices and the balance came from elsewhere.

All the workers for the automatic spinning unit (No. 23) were recruited within the existing plant. This was true also of one of the chemical plants (No. 22), since the workforce was already there and only required retraining, and, on the whole, of the plant producing machine tools. Another of the four chemical plants studied drew the bulk of its manpower from another unit within the plant, but the others recruited elsewhere. One of them had staffed the first of its new processes by in-plant transfers, but for the later units, it recruited from outside.

Within-plant transfers were also the main source in the petroleum products unit (No. 20). The latter started up with 32 workers in four shifts of eight. Each shift consisted of:

1 foreman 1 chief operator	- on the highest wage step, with specialised secondary education and 4 to 5 years' practical experience;
4 operators	- one wage step lower; completed apprenticeship and 3 years' experience;
1-2 maintenance workers	- with similar training and wages.

Later, the unit was increased to 46 workers.

Recruitment from other plants

The steel rolling mill drew 95 per cent of its workforce from a neighbouring steelworks which was reducing staff, the remaining 5 per cent being recruited from among employees of the building constructors (chiefly electricians and maintenance mechanics), or from other works in the locality, or among acquaintances of workers in the plant. Several firms claimed that the last procedure had a favourable psychological effect. The nail and wire drawing factory recruited its technicians and foremen from similar plants in the country, and 50 per cent of its skilled workers (electricians and maintenance men) from factories in other types of production. Skilled workers represented about 80 per cent of the production workers in wire production, 35 per cent in the manufacture of nails. Unskilled workers were recruited from agriculture. Other instances of considerable recruitment from competitors or other industrial concerns included one of the chemical plants (No. 27) and the bakery. The breakdown of the recruitment source of the workforce in a dairy was: 63 per cent recruited from other dairies, 15 per cent from various apprentice training centres, and 22 per cent from the general public as the result of outside advertisement.

For its first unit of 25 workers, the brickworks drew 22 men from other, non-brickmaking concerns in the locality and from the transport, construction and service industries. Only three employees came from other brickworks.

A concern producing electronic components, nearly 75 per cent of whose workers were female, recruited its employees mainly from textile and garment-making firms. Very few came directly from schools and none at all from agriculture or from among the unemployed. One of the motor accessories plants (No. 4), in which women workers accounted for

chemical plants, one (No. 27), employing some 2,000 persons, had drawn 12 per cent from technical schools, the other (No. 24) had obtained its laboratory technicians for quality control from the chemical section of the local technical college.

Vocational schools run by the undertakings were predominant sources of skilled labour in two instances in Poland. Both were in the chemical industry: one of them had obtained most of its personnel from this source, the other, 50 per cent.

Special recruitment situations

A substantial number of the plants recruited much of their unskilled labour from agriculture, horticulture and viticulture. The cement plant and the sugar factory are cases in point. The same sources of recruitment had been tapped where plants were being established in areas not previously zoned for industrial development and where there was a substantial labour reserve of seasonal workers. In two instances (Nos. 6 and 26) men released from military service were said to be an important source of skilled workers with good sound knowledge of mechanics and electronics and with a sense of responsibility in their work.

In the western European countries, foreign workers had sometimes been engaged, but never in any great numbers. In one of the plastics plants (No. 13) approximately 25 per cent of the workforce were foreign nationals. Another instance was the brickworks, where 20 per cent of the workers were Italians.

On the whole it appeared that these new plants had a lower percentage of foreign workers than was common in other factories in the same country. These observations do not take account, however, of firms located close to national frontiers. Technically such firms were employing foreign workers but their situation must be assimilated to that of firms able to recruit in their immediate neighbourhood. It is interesting to note in this connection that the only case of a language problem reported during the field studies related precisely to such a recruitment source situation: French-speaking border workers taking up employment in a Flemish-speaking area of Belgium.

Methods of recruitment

Among the methods of recruitment employed in newly-established plants using advanced technology can be found all the traditional methods adopted in factories using conventional equipment and procedures. Used with varying degrees of success, these include advertisements, requisitions to national employment offices, transfers from affiliated plants and from plants outside the company group, approaches to vocational and technical schools, word of mouth propaganda, personal relationships, notices in public places, recruitment offices on the site and in the local town hall, approaches to construction workers, representatives of equipment suppliers and so forth. While the plant visits did not bring to light any radically new methods arising from the use of advanced technology, they did show up two examples of the use of "starting-up teams". The action of these teams considerably facilitated the commencement of "running in" and eased the problem of recruiting for this stage, without eliminating it.

In one concern (No. 7) composed of a number of plants producing different substances, each plant consisted of several units. The concern had formed a special organising group which was responsible for all preparatory work and for the start-up of a new unit. The group was composed of four to ten people from the main departments — e.g.

technical, maintenance and management. More than half the group usually consisted of persons who had already participated in the start-up of a new unit at least once. They were specially trained and were sometimes sent to the equipment manufacturers for further instruction. In the USSR a similar system has been instituted by the Ministry for the Chemical Industry, in the form of a special section which is concerned with the start-up and running in of new plants. A group of highly qualified specialists is formed and sent to the new plant to help the management. In both these examples, the system had not only eased the running-in period but had reduced its duration as well.

Advertisements

Almost all the plants visited used this method of recruitment, but to varying degrees. Advertising by one of the Belgian firms concentrated chiefly on press publicity for foremen and assistant foremen, as it was particularly short of personnel at these levels. Five concerns in four different countries (Nos. 10, 12, 14, 17 and 24) used the national press mainly for obtaining skilled workers and high level staff; the local press was used for recruiting unskilled workers who would normally be drawn from the immediate neighbourhood of the plant. In the USSR advertisements for skilled workers were inserted in local newspapers circulating in the areas where similar plants existed. One concern, the first of its kind in Byelorussia, obtained almost all its skilled workers for its first unit from such areas as Siberia, the Urals, the Ukraine and Central Russia. Advertisements posted in nearby collective farms employing large numbers of farm hands were used by another concern (No. 28) to obtain a large part of its low-skilled workers. One plant (No. 9) obtained only 22 per cent of its workers through advertisements, whereas another (No. 29) found 85 per cent in this way. A plant set up in the

Federal Republic of Germany advertised in the national and local press at a time of high level employment, yet these advertisements produced more than 600 applicants. It was the firm's most successful method.

Another concern (No. 2) first obtained a 3-page write-up in the local newspaper which was followed up with a full page advertisement running for three weeks. The procedure attracted six times as many candidates as there were vacancies.

Employment agencies

All the firms visited used the employment agencies extensively, chiefly for filling vacancies in the lower echelons. Foreign concerns with plants located in Belgium, for example, normally first approach the National Employment Office (ONEM) when recruiting employees. The ONEM, in addition to the more usual services rendered by an employment agency such as keeping firms posted on job seekers and the state of the employment market, has instituted a special programme to assist newly established undertakings. Among other things it runs a psycho-technical testing service, which is placed freely at the disposal of recruiting employers, and offers financial assistance towards the cost of training undertaken by the firm.

The cardboard articles factory (No. 15) recruited the largest part of its employees through the local employment office. In the United Kingdom the employment exchanges were considered to be most useful for recruitment at unskilled and semi-skilled levels; firms preferred advertising in the press for filling jobs at skilled craftsman and technician levels. Individual employment exchanges frequently communicate information about job vacancies to other employment exchanges in the country, thus giving wide coverage to an employer's requirements.

In the United Kingdom use is made of Youth Employment Offices, whose functions include providing young applicants with vocational guidance and introductions to employers. Through them, schools can be contacted and likely trainees discovered for apprenticeships leading to skilled and supervisory jobs. Personal contacts, however, also played an important role.

In Czechoslovakia, city councils operate employment agencies which collect information on job vacancies and make it available to job seekers. All undertakings within their jurisdiction must report their vacancies monthly, and usually recruit their unskilled workers through this channel.

In two instances (Nos. 19 and 27) the local planning authorities had made surveys of available manpower in the areas before decisions to build the plants there were taken.

Transfers

As has been seen, one of the principal sources of the highly skilled personnel demanded by the use of advanced technology was by transfer, whether effected within the company or from another concern. In many cases it was the only way a plant could be started up at all, for such skilled personnel could not be found either among the unemployed or through employment offices. They could be reached through advertisement and thus "poached" either from rival firms or from other firms using similar equipment.

Transfers from within the same company were used more particularly in cases of very large concerns operating similar manufacturing plants in many different countries in the world, and sometimes operating more than one plant within the same country. Trained staff might be seconded from the parent company for the construction and start-up periods, and for helping to train qualified workers recruited locally.

Miscellaneous recruitment methods

While the above constitute the main and the more conventional methods encountered during the field work, some of the firms resorted to more personal and original approaches. Among the latter were visits to villages within a radius of 40-50 kilometres by groups of company officials who put up posters in the villages and gave talks in the cafés. Word of mouth propaganda gradually produced a marked effect as it made the name of the concern and its working conditions widely known. Another method was to organise special film showings about the plant in local cinemas, community halls etc., with selection tests offered on the spot to any one who chose to present himself as a candidate for employment. Distribution of folders; visits to local dignitaries, such as the Mayor, the local priest, trade union leaders and directors of youth movements; recruitment sessions in parish halls; advertisements in local buses; posters on factory walls; and even personal letters addressed to young people thought to be interested in factory work, were all tried with varying success. Pl nt visiting days were an attraction to the families of young prospective ecruits. Encouragement given to existing employees to bring along to the plant any relatives, or acquaintances whom they considered suitable for and likely to seek engagement also produced quite good results.

Incentives

About half of the concerns visited offered various types of incentive in order to make their recruitment campaign more effective. But there was no evidence that such incentives were required by reason purely of the advanced technology employed in the plant: they were such as would also be offered by a company using conventional methods of manufacture. As a rule, a firm which had a reputation for paying good wages and offering reasonable working conditions had little recruitment difficulty. Problems did arise where available manpower was largely rural or accustomed mainly to seasonal work, but even in such cases the incentive of good wages — sometimes higher than the average payable locally — proved sufficient attraction.

Technicians, foremen and skilled workers in some countries, e.g. the USSR, were offered housing facilities and generous travel expenses, as well as installation allowances. The same incentives were offered to all recruits coming from distant places. They were particularly effective when there were housing shortages in the area of the proposed work place.

Payment on a monthly basis for all staff, and full wages during initial periods of sickness, were features in one or two plants (e.g. Nos. 12 and 24). High overtime rates (No. 17), substantial holiday periods for all employees, pension schemes, free issue of work clothing and shoes, monetary rewards for suggestions on safety measures and production methods, and factory buses to transport workers to and from their work were among the features noted. Some firms in Poland offered their employees both housing facilities and financial credits on favourable terms for building private houses. These facilities belong, however, to general employment conditions or fringe benefits rather than to incentives designed to attract specially skilled workers for advanced technology.

One concern (No. 12) made a recruitment feature of its good working conditions. It offered a suggestions-award scheme, covering proposals for improvements in machines, work methods, work organisation, quality of product, safety or the use of materials. It also offered cheap canteen meals, medical care at the factory, and insurance for all employees (survivors' benefits and invalidity benefits). Other advantages were study stipends and paid leave for study purposes, a library for the staff and a social club. Moreover, as a matter of policy, distinctions between "staff" and "workers" were being gradually eliminated; all persons on the pay-roll were regarded as employees and paid monthly salaries. Many of the employment conditions were the same for all employees. They used common kitchens and cafeterias, had the same working hours, enjoyed the same indemnities for absence from work for medical consultations, marriages, births, deaths, and the like. Holiday entitlement was based on the number of years of service, but regardless of rank. Periods of notice were the same for all, as were social security arrangements in the case of illness.

Most companies offered promotion prospects to their employees as part of their recruitment campaigns. It was common practice, for instance, for jobs at foreman level to be filled by promoting suitable workers. Some firms, however, preferred to recruit foremen from similar plants in the country, or even from plants outside their sector altogether (Nos. 8, 9 and 10). One of the firms making motor accessories (No. 4) made a policy of recruiting its foremen from the metal trades.

Posts as quality-control inspector were not always on the promotion ladder and were occasionally filled from outside the company. This work requires strict impartiality, complete authority and, in a sense, a certain aloofness from the workers. It is not easy for a former fellow worker, male or female, to develop such qualities when suddenly charged with responsibility for controlling the quality of output of former workmates. Knowing "all the tricks of the trade", they may be tempted to pass minor defects in the products in order to maintain friendly relations. Inspectors were therefore in some instances recruited from outsiders trained in full-time technical school courses.

Checking qualifications

When employees were transferred from other plants belonging to the same concern, or from other sections within the same plant, their credentials were already known. Applicants from outside were normally screened by interview, sometimes accompanied by additional checks such as selection tests. This was standard procedure; it had no special relation to the use of advanced technology by the firms, except in the nature of the questions which might be asked of the candidate. The basic qualities looked for at operator and shift foreman levels by a chemical firm (No. 24) have already been referred to: there was some evidence that the questions put to candidates had been specially designed to reveal the reasons why they had applied for a job — an attempt to foresee whether they were likely to stay with the firm.

Some interviews were conducted by the personnel department, assisted by representatives of the sections or services for which the recruits were destined. Skilled workers were usually interviewed by a foreman qualified in the speciality concerned to assess the applicants' technical competence.

Previous experience was sometimes treated as of little account, the emphasis was more likely to be on the recruit's ability to learn. For certain technical duties, only persons with a general secondary school education were recruited for training. In one chemical concern, 43 per cent of the workforce had had no previous industrial experience (No. 27), and in another firm (No. 15) persons without previous experience in the industry were considered more suitable than experienced workers for operating modern machinery.

In another company 50 per cent of the workforce had not been previously employed (No. 29). The management of the company manufacturing electronic components indicated that on the whole, even for the most advanced machinery, neither previous theoretical knowledge nor prior practical experience was the first consideration to be taken into account in selecting operators. Common sense, technical aptitude, maturity and ability to assume responsibility were sought, together with, in the case of maintenance personnel, an aptitude for teamwork. Preference was nevertheless given to persons who had previously worked in jobs of a technical character. Only one instance (No. 3) was noted of a specific and rather unusual qualification — a need for acute hearing — being required because of the very special process involved.

One or two of the plants visited had adopted the practice of recruiting at a higher level of attainment than that called for by the job initially offered. This was thought to provide an incentive to the worker to gain promotion to more exacting work.

Selection tests

The incidence of the use of selection tests as a means of checking qualifications varied widely from country to country. In eastern and central European countries tests are either not employed at all or are still in the early stages of development. None was used in any of the plants visited in the USSR, and in Czechoslovakia only one of the six concerns surveyed used them. In this instance the plant had given one of its officials special responsibilities for the psychological aspects of selection. Talks with government officials in Czechoslovakia revealed that in some concerns with a high degree of automation, psychological tests were used to select workers for certain jobs. This was done in collaboration with and under the supervision of the Czechoslovak Academy of Science. The Academy has developed a series of psychological tests for operators of automatic production lines in the chemical industry. The plant also administered other tests such as an intelligence test (Raven test), a memory test, a psycho-motor test, etc. So far, the volume of experience gained with such tests is small. There has been some reaction against them by the workers, perhaps occasioned at least in part by their novelty and insufficient explanation before administering them.

One of the five plants visited in Poland had already been using psychological tests to select workers for certain jobs for at least two years prior to the visit. In the other plants, the use of psychological tests was at an experimental stage. None of the plants had any statistics which could indicate the effectiveness of the tests, but the general opinion was favourable. It should be noted that tests were not used exclusively for jobs related to new technology; a large group of the workers who underwent testing in one Polish plant using tests, for instance. were lorry drivers.

In western Europe, selection tests are in general use and well developed. Examples included tests for dexterity and co-ordination of movement, the N-tool test, Purdue pegboard, Piorkowski rings, Bennett paper tests and tests designed for specific jobs, e.g. electricians and quality controllers. I.Q. tests and, for maintenance personnel, tests of theoretical and practical knowledge relating to the materials used, were among those employed by the firms visited in western Europe.

Of the eleven concerns visited in Belgium, Luxembourg and the Federal Republic of Germany, eight used selection tests. One of the companies employed a specialised private firm to carry out the testing which was applied only with respect to employees at higher technician level and above. Sometimes, the tests were designed to check knowledge of arithmetic and mechanical aptitude. In several instances the battery of tests had been designed by a parent firm in the USA. In the aluminium plant specific tests had been developed by the undertaking itself. In another firm tests were applied for mechanics and technician posts, chiefly to test the applicant's aptitude for logical and analytical thinking. Of the three concerns which had not used tests at all, two were plants in the Federal Republic of Germany. One of them considered that a four-week probation period was a more reliable test as a means of selecting workers for the jobs. For the other the question had not arisen as a very high proportion of the staff had been taken over from an associated company.

In Belgium, as previously indicated, the National Employment Office has its own selection test service, which is placed at the disposal of recruiting companies, free of charge. Selection tests were a special feature in one company which used recruitment for one of its new plants as the occasion for trying out new methods of selection and training. It was hoped that the results of this experience would be of value in its other factories. Particular attention was paid to psycho-technical tests and to colour tests since colour vision deficiences could have harmful repercussions on its production processes. Maintenance and quality control personnel in one of the motor accessories firms (No. 4) were required to pass proficiency tests that lasted a full day and included assessment of competence in electricity or electronics. In this company it was not the practice to check up on any diplomas claimed by recruits but each candidate was subjected to a theoretical examination of his level of scholastic achievement. The examination had been prepared by the personnel department in collaboration with the technical director or a foreman. One firm (No. 1) used psychotechnical tests at all levels of recruitment; where technical knowledge was required, a theoretical examination was given and sometimes a practical test also.

In the United Kingdom selection tests are by no means universally employed. Their use is tending to become more common, however, partly as a result of the Industrial Training Act of 1964 which has done much to make management more training conscious and anxious to improve selection procedures and skill standards generally. Among the permissive functions of an industrial training board established under the Act, for instance, is the application of selection and other tests for ascertaining the degree to which standards recommended by the board have been attained.

Of the three plants studied in the United Kingdom, none employed selection tests. In the textile industry attempts made by the Cotton Board to introduce testing had had mixed results; it had been found difficult to correlate test results and job performance. The Cotton and Allied Textiles Industry Training Board (established in July 1966) is currently carrying out research aimed at validating selection tests for the industry.

The value of selection tests is still a matter of much debate, and some concern was expressed during the interviews as to whether tests originally carried out in one situation and with a specific technology in view could still be considered valid when applied to another technology and to a different set of circumstances. The data collected during the course of this project do not permit suggesting even a tentative answer to this question.

Recruitment difficulties

The fact that a new plant is operating with the most up-to-date machinery and equipment does not seem to cause much difficulty in establishing a satisfactory workforce. Recruitment difficulties brought up in the course of the field studies did not generally arise directly from this fact. Only two instances were reported of initial mistrust of new machinery. In both the bakery and the brickworks some workers looked askance at electronic aids in automatic machinery, preferring to use manual devices. They chose to stay on in the old conventional type of plant where there was no automation, instead of moving to a modern factory. These psychological problems associated with working on new machines did not as a rule last for more than a few months.

The need for multi-purpose training in the operation of new plants occasionally produced a psychological, negative reaction. In textile plants, the operator generally works at the same machine, and becomes to some extent attached to it. There was a reluctance to accept transfer to a different machine in another department in the interests of flexibility. Sometimes there was reluctance to work on modern machinery in a new textile mill, as it meant some isolation at the work place since only a few people worked in a large space filled with many machines. Moreover discipline tended to be stricter than in a conventional mill. Even for the prospect of substantially higher wages, the worker did not want to give up the companionship and less rigid discipline found in the old-type mills.

wages attaching to it which were the chief deterrents. Monotony was recognised as a problem in many cases, though by no means a new one. A study of monotonous jobs at the motor car plant (No. 6) showed conclusively that in some positions on the assembly line high productivity could only be attained if the duration of the work period did not exceed four hours. One solution was to introduce a job rotation scheme in such positions. Training for greater versatility and as a general preparation for such jobs was also a means of combating the problem.

CHAPTER IV - TRAINING

In so far as possible the data on training action collected in response to part III of the field study questionnaire have been analysed and classified in order of time: action taken before start-up, training provided during the start-up and running-in periods, supplementary training found necessary after the minimum start-up training, long-term training schemes embarked on or planned. This is an arbitrary structure, one which inevitably gives rise to some overlapping. It is also, however, the one which seems most easily to point up similarities and dissimilarities. The firms and plants visited were too few in number, the products manufactured too varied and their individual backgrounds too diverse to adopt a scale of comparison other than the one common timetable of events through which each will have had to pass — construction, start-up, running-in, full production.

Before embarking on a discussion of the specific arrangements made for training staff for the new plant or process, it may be useful to restate the limits of the survey as regards the subject of this chapter. Firstly, it is concerned exclusively with the training organised for or taken by production workers and maintenance staff — unskilled, semi-skilled or specialised, and skilled workers — supervisors and technicians. Such categories as higher management and administrative, commercial and clerical personnel are therefore excluded. Secondly, while many firms and undertakings have instituted very comprehensive training schemes or have set up their own vocational schools and training centres, a tremendous amount of training is done much more informally in day-to-day work on the job. Each type has its place and is used effectively in the modern plant. Wherever possible both have been covered by the study but in most instances the figures given relate only to the former, more formal and more easily quantifiable type of training.

<u>The impact of the recruitment basis</u>

Given the recruitment methods and sources described in chapter III, and the resultant characteristics of the workforces assembled, it might be expected that a number of assumptions could be made regarding their impact on training requirements and subsequent training policy, at least as regards broad lines. Common trends in training action might be revealed not merely among modern firms or production units in the same or a related industrial sector, using similar production processes or installations, but also among those having been able to recruit their labour force largely from among the same broad categories of manpower or by the same methods.

More than half of the plants investigated had relied heavily on transfers from the same or an associated concern or, if from outside the concern, then from within the industry. Four had been able virtually to take over the personnel of a similar plant which was either closing down or reducing its staff. The rolling mill had recruited almost all of its staff in this manner, so had the dairy and the bakery. About 78 per cent of the employees in the motor car plant were brought in from an old plant within the firm, the remainder being made up of 1,200 apprentices and some 1,800 persons recruited from other sources. Transfer was the predominant system used by the oil refinery, followed closely in order of importance by recruitment from similar industrial concerns. In one of the textile firms (No. 23) all the staff for the new automated unit came from within the company; in another — a synthetic fibres plant (No. 26) — recruitment was reported as being "mainly" through the medium of transfer.

As a group, the chemical industries showed a fairly common recruitment pattern: one firm manufacturing petroleum products (No. 20) reported that all personnel came from other plants and units of the combine; another plant (No. 21) obtained all key operators and maintenance staff from within the firm and indicated, furthermore, that every third person in the area was employed in the chemical industry; a third (No. 22) informed the researcher that about 50 per cent of the new staff came from the "old" ammonia plant, with the key personnel being hand-picked as its best workers. The fourth chemical plant (No. 27) draws a large proportion of its new staff from similar plants in other — often far distant — parts of the country. Only one of the chemical plants (No. 24) followed a different pattern: most of the operators were recruited locally and had an agricultural background, or sometimes an engineering background as machinists, although in 1964 some 15 chemical process workers were taken over from a plant which was closing down.

Of the two plastics manufacturing plants, one (No. 13) had brought all its initial essential workforce from another plant not very far away whereas the other (No. 17) had had to recruit not only from outside the plant but from outside industry altogether and to a large extent chiefly from among agricultural workers. Five others among the 29 undertakings studied had had a largely rural if not a wholly agricultural labour supply as their recruitment basis. The aluminium plant had got most of its production workers from agricultural labour, the cement works 95 per cent and the plate-glass factory 60 per cent (with, as has already been seen in the previous chapter, only 2 per cent coming from the industry itself and another 16 per cent coming from other industries). One of the two motor accessories firms (No. 14), although able to recruit mainly from a related field — the metal trades — had drawn what was termed a large contingent from agriculture, as had the sugar refinery. Only about 6 per cent of the latter's workforce had been acquired through transfer and a very small number from other sugar processing plants.

To get a full picture of the possible repercussions of the recruitment basis on subsequent training action, mention should be made of two other concerns: the brickworks staff had been recruited almost exclusively locally and (except for the maintenance personnel) came from mixed occupational backgrounds; the electric lamp factory had recruited 85 per cent of its labour force right in the town where it was located and from among workers with a low level of skill. For about 60 per cent of them the new job was their first work experience.

To deduce parallels in training requirements from similarities in recruitment basis, however, would be incorrect. The transferees in the dairy foods concern and the computer plant were reported to have required no additional training and those in a synthetic fibres factory (No. 26) hardly any. But all the bakery employees taken over by the modern bakery had needed at least three months' adaptation and training, as had the personnel of one of the textile firms (No. 23) which had recruited all its employees from within the old plant. It would seem virtually impossible, therefore, to draw hard and fast rules associating this or that recruitment method or source of manpower with given amounts, types or levels of training, or with the timing of the training. The data assembled in the course of the field studies and summarised in this chapter tend to underscore the complexity of the operation and the number of factors — among them the average level of education and the systems of education and vocational training obtaining in the countries concerned, national or local attitudes towards employment and towards change, and prevailing economic and social structures and policies — which managements have to take into account in planning and organising for an efficient workforce.

If any single, common conclusion is to be drawn, applicable to all the concerns studied, it can only be that in each case the managements had relied heavily on skills and competencies already available in the labour force of the undertaking itself or within the immediate vicinity.

Training before start-up

If training was begun too early considerable wastage of manpower could result. In one case (No. 8) some 400 workers had been trained at the parent plant and in other similar plants during the early period of construction. Under pressure from the trained workers, anxious to start their new work, the plant started up before the installations were complete. But the delays resulted in a loss of workers and in other difficulties. In another case — a chemical firm (No. 24) — training for a new unit began in September when the start-up had been planned for November. This proved to be too long in advance and when a new unit was subsequently built the training before start-up was cut by about one month.

Another general comment to be made here concerns the level of education and experience which the firms sought in their new labour force. Some of them had recruited principally among people already trained. Others, located in countries where industrial training is carried on within the education system and not in industry, had recruited as usual among vocational or technical school graduates. In one or two cases — e.g. the oil refinery and one of the chemical plants (No. 27) — management had consciously recruited at a skill level higher than was strictly necessary. In all these cases the concerns might be said to have demanded, but have not themselves seen about providing training before start-up. The implications of such recruitment criteria should be borne in mind but are not discussed in this monograph except, as will be seen later, in as much as the education received in the schools necessitated subsequent training by the firm or undertaking hiring the young graduate.

In cases where training began before or during construction of the building, it was normally arranged for higher levels of personnel. As a rule they were sent to another factory belonging to the parent company, or else they attended formal courses at training institutions in the parent company's home country. Training at this level generally took several months. The manager of the industrial bakery (No. 10) and his deputy were appointed some four months ahead of scheduled start-up. The undertaking's foreman and key workers, who had all had experience in the sector but at a non-industrial level, were sent to other industrial-type bakeries for three months' in-plant training. At the oil refinery (No. 7) training the workforce began twelve, nine or six months before the running-in period: the higher the level of qualification required, the longer the period allowed for training.

Recruitment prior to start-up at one of the synthetic fibres plants (No. 2) also had been staggered in order to take account of the time needed to give foremen and charge-hands (brigadier) adequate training. The latter were taken on straight from technical school and sent for twelve months' training and practical experience at the firm's main plant. Their training was largely carried out in conjunction with the training of the foremen who had already been nominated to take up posts in the new plant. For the foremen themselves, theoretical courses were organised in textile technology at the parent company, the instruction being given by headquarters staff, and practical training was arranged for them in other plants of the same concern. By start-up time foremen and charge-hands constituted a team of people who already had experience of working together.

For another firm, manufacturing thin film plastics (No. 17), following this type of policy meant sending the engineers and assimilated technical and supervisory staff for two to four months' training at one of the parent company's plants in the USA which used identical equipment, processes, etc. The production control manager spent even longer — eight months — in the USA prior to construction of the plant in Europe. The same type of procedure was adopted by one of the motor accessories firms (No. 14) which organised training ahead of start-up for management and supervisory staff at all levels. The assistant foremen were sent to the parent company in the United Kingdom for training during the period of pilot production.

In countries with a centrally controlled economy, sending newly recruited workers for training in another plant is not necessarily limited to mutual arrangements with the parent enterprise. A substantial part of the training given the workers in the electric lamp factory (No. 29) was organised in plants located in other parts of the country. About 330 were trained in this way during 1965 and 1966. The undertaking started up its own in-plant training programme in 1966, but even at the time of the field study in December 1967 some 200 apprentices and workers with a low level of skill were still undergoing training at another plant. Similar methods were used in the nitro-chemical factory and the sugar refinery (Nos. 27 and 28). Most of the 400 workers trained before start-up for the wire and nail factory (No. 8) had received their training in similar plants elsewhere in the country. In addition, some of the factory's management staff were trained in undertakings in Eastern Germany, and others in the USSR. In the plate-glass factory (No. 18) a group of workers without any previous qualifications for or experience of the work were sent, on recruitment, for training in similar units and then returned to participate in the installation of the machines in the home plant. This group comprised chiefly persons who had been selected for work connected with equipment maintenance.

On the whole it can be said that in western Europe, except for training organised by and at the plant manufacturing the new equipment, training in other plants was confined to management and staff exercising supervisory functions, and to a nucleus of highly skilled personnel, chiefly on maintenance work, who were required for the start-up. In eastern Europe training in other plants was both more common and applied to a much wider range of personnel.

The role of the equipment manufacturers

The increasing use of complex machinery and installations, whether highly mechanised or fully automated, has been accompanied in the training field by an equivalent increase in the demands made on equipment suppliers to instruct operators and maintenance teams for their machines. This applies both in eastern and western European countries. Many of the plants visited indicated that at least part of the workforce had received such training and that most of it had been given during the installation and running-in phases. In some cases equipment purchase agreements provided for the manufacturer's training staff to be sent to the new factory to give initial training for both operators and maintenance staff. Sometimes this training was given at the new plant with operators and maintenance men acquiring the "know-how" of the equipment by taking part in its installation and receiving instruction from the manufacturer's personnel on the job. In other cases, courses were held at the manufacturer's own plant. Some manufacturers of electronic equipment run courses for electricians, for instance.

In the automatic spinning unit (No. 23) both production and maintenance workers were trained by the equipment manufacturers. Representatives of the latter were present during the whole of the running-in period and trained the first crew (foremen, prep-men, electricians and fitters). This was rather a special case, however. The automatic unit was a joint project between the textile mill and the equipment manufacturers, with the latter undertaking to do all the training required for the operation of their special machinery.

The Italian suppliers of equipment for the nitro-chemical plant (No. 27) played an important part in the training of the workforce. About 20 technical supervisors and workers from Italy spent more than two years in the plant during the construction work as well as the running-in period, while the plant itself sent a number of engineers and skilled workers to Italy for training. During the last year of construction of the sugar refinery (No. 28) the Polish suppliers of the equipment had about 25 representatives, qualified in various trades and at different levels, giving training on the job in the plant. Two hundred workers from the motor car plant were sent for one month to the manufacturers of the equipment, but the latter also sent 150 of their workers to the new plant for some 18 months, during which they gave informal on-the-job training to the operators of the new equipment. The English manufacturer of automatic bottling equipment supplied to one of the food processing firms (No. 9) sent representatives of the firm for two months to train the new plant's maintenance workers. In a motor accessories plant (No. 4) the foremen and assistant foremen were present while American and British technicians from some of the plants belonging to the same company installed and adjusted the machinery. Later the foremen were able to train the personnel under their supervision. The maintenance teams and set-up men were also trained during this installation period. The foreign staff spent between 9 and 15 weeks on the installation and training job. These men, however, were technicians and not trained instructors and encountered some communication difficulties which were aggravated by their being unable to communicate freely with the local workers.

Six foremen and senior control panel operators from the cement plant (No. 19) spent three months abroad and were then able to serve as instructors back at the home plant. A few prospective operators from a chemical plant (No. 21) were sent for training abroad for a period lasting two to three weeks. Training of the programmer, operators and maintenance crews for numerical control machines represented a rather special problem in undertaking No. 5. In addition, supervisory staff and technicians of a client, including the engineers and supervisors of the maintenance teams, sometimes spend from a fortnight up to two months with the manufacturer to learn about the tuning up and running-in of their new machines. Some purchasers sent only small groups of senior workers and foremen for such training.

In only some half dozen plants in both western and eastern European countries, in fact, had the equipment suppliers not been called upon to give any substantial amount of training. But even among this half dozen, as soon as any technical problems arose in connection with the new machinery the undertaking immediately turned to the equipment supplier for help in their solution.

Training during start-up and running-in

The field survey showed that in many cases installation of equipment, training of workers and running-in proceeded as a single operation lasting some three to four months. Consequently it was difficult to distinguish between the training given before start-up and that provided in the subsequent running-in stage. While this is particularly true, as has already been seen above, with respect to the training provided by the equipment manufacturers, the observation also holds good as regards the training provided by and within the undertaking.

In a synthetic fibres factory (No. 2), for instance, supervisors were trained before the works were constructed, the maintenance personnel and production workers for the first machines during the construction, and the remainder of the personnel during the running-in period. This undertaking made systematic use of the PERT (Programme Evaluation and Review Technique) method for planning and timing both recruitment and training. In the aluminium plant (No. 16) training was organised in two phases. First the workers and foremen were given mainly practical training intended to familiarise them with the machinery and equipment and to start production, the foremen receiving this training during construction and the workers during the running-in period. In the second phase, various specific short-term courses, lasting for a total of from four to ten hours, were conducted for the workers on, for example, measurement, hydraulics, pneumatics and trouble-shooting.

To some extent it could be said that the purposes of the training given before start-up differed from those of the training embarked on later. The former tended to be more in the nature of an initiation into specific techniques and technology required by the new equipment or process while the latter might be more accurately described as skill development through the acquisition of work experience. But here again it is often difficult to draw a clear line between the two. Gaining work experience can be quite a lengthy process. In one case (No. 1) it was considered to last six weeks even for jobs which could be learnt in a day. The workers, chiefly women, were initially trained on the job but later on efforts were made to arrange the training in special training bays away from production. In other jobs the full training took as much as six months. Main production workers in the nitro-chemical plant (No. 27) required up to three months' work experience after training. In another plant (No. 18) operators on the glass-forming machines were still short of full skill after many months of experience with the machines.

Duration of the training

Most of the training organised during the start-up phase of the plant's existence was carried out by and within the plant itself with, as has been seen, help from the equipment manufacturers and, in some cases, the parent undertaking. Generally it was given on the job. Its duration and content varied considerably with the type of product being made, the technical content and level of responsibility of the job in question, the system of training adopted and so on. Leaving aside the simplest form of induction training, which might occupy no more than a few hours, the field survey showed that in fact the training set in motion varied in duration from three or four weeks up to a full apprenticeship lasting three years or more, or to some eight to ten years of work experience accompanied by part-time study in evening or correspondence courses.

These longer periods of training, both the formal training within the undertaking and the full-time training undergone in a vocational or technical school prior to employment, are essential for obtaining an adequately qualified staff at specific skill levels and for maintaining training standards. And in fact most of the plants had had recourse to one or other of them in setting up the new unit or plant — or expected to do so in the future. Such long-term training schemes and programmes, however, rarely can be said to have been brought into existence solely for the staffing purposes of the plant in question. There were undoubtedly cases where apprentices started their training well before start-up and probably finished it long after the running-in period. Apprenticeship, however, is a permanent institution, just as are vocational and technical schools, and the implications of both types of training for the new firm getting under way are dealt with later on in this study in a general discussion of long-term training arrangements. The sections immediately following therefore, with some exceptions, do not cover standard apprentice training or full-time school-based training of a permanent nature but concentrate on specific, shorter training programmes or arrangements found necessary for getting into full production.

Training times and patterns

Taking, for example, the two synthetic fibres plants, training in the one (No. 26) took place during construction and running-in and lasted anything from one to twelve months. In the other (No. 2) production workers were, in almost all cases, given a course of accelerated training which lasted one month. At the end of this period they still required work experience to gain speed and accuracy. The time required to reach the desired standard might vary according to the individual learner but in any case took longer than one month. Throughout the whole of this work experience period the learner was put in the charge of an experienced worker who, while not doing any actual training, was there in case of need and made frequent oral reports on the learners during their first fortnight. At the end of this period a formal assessment was made on the progress achieved by the learners each of whom was interviewed. There was then a further period of follow-up.

The workers for a new chemical plant (No. 22), who in most instances had been carefully selected from among the "best workers" of the old plant and in many had graduated from a three-year course at a school run by the chemical combine itself, went through a special programme of part theoretical instruction, part practical experience. For two-and-a-half months they worked half a day and for the rest of the day had lectures on the new technology and on automatic control. This training was sufficient to enable the workers to master the new jobs quickly.

Production workers in a lamp factory (No. 29) got one to two months' training, but the machine setters in the same factory were under training for two to four months. In both cases it was considered that two months of additional work experience were required in order to master the job. In a factory producing electronic components for use in television etc., the production workers were trained on the job for periods varying in length from six weeks to six months. The production workers had courses of accelerated or analytical training, while higher management and the nucleus of key personnel received six to twelve weeks' training abroad. Workers in the group and final assembly departments of a large firm manufacturing computers only needed to have some elementary practical knowledge and skills. Consequently it was possible to train 200 of the 350 assembly workers employed in the two departments on the job in less than four weeks. On the other hand those working in the testing department required both practical skill and theoretical knowledge. The latter was acquired through full-time courses given within the undertaking: two months' formal training in basic electro-technics and electronics followed by practical courses on various types of machine. Their complete training took up to six months.

A breakdown of the time required for the full training of 161 employees in a factory manufacturing containers and other cardboard articles (No. 15), provides the following picture:

Duration	Number trained	Percentage of workforce
Up to four weeks	33	20.5
Up to three months	51	31.7
Up to one year	13	8.1
Up to three years	49	30.4
Three years and more	15	9.3

Among the fifteen employees requiring three years' training or more, are to be found workers such as production and maintenance electricians and automatic control technicians.

Wherever the system of training adopted consisted of a formal apprenticeship, as in the car plant (No. 6), the training time tended to be at least three-and-a-half years. When other methods were used, and when the specific job did not require either the level or the broad range of skills provided through a formal apprenticeship, the training period was invariably shorter. Kiln attendants and operators in the grinding mill at the brick factory (No. 25) were given six weeks' training, the extrusion operators had three months. At the steel rolling mill (No. 3) both the quality inspectors and the first roller operators working on the newest type of equipment had received training lasting nine months. It should perhaps be noted in this connection that the first roller operators had been promoted from the rank of second roller operator in another factory which used a different type of equipment. This undoubtedly had an impact on the duration of the training necessary. Operators at a motor accessories firm (No. 4) only had to be able to perform a few manual operations rapidly and required no theoretical knowledge. These workers normally received less than four weeks' training, although those working on very advanced and complex machines received more. Machine setters in the same firm, however, required high standards of technical knowledge and ability as well as knowledge of the basic concepts of machine-tool work, and their training took from four to seven months.

The longest period of formal specialised training and practical experience noted in the course of the survey was that required for the control panel operators in one of the chemical plants (No. 21). There were three principal methods of entry into the job:

(1) eight years of common basic school followed by 5 years at technical secondary school, giving the right to employment at step IV of an 8-step wage scale; after 9 years of industrial experience — if all went well -- he would be accepted for step VIII and become the "operator";

(2) completion of common basic school followed by three years of part-time technical courses in night-school and some 11 years' practical experience on the job would get him to the same point;

(3) completed general secondary education, followed by two-and-a-half years of technical night-school and ten-and-a-half years of industrial experience.

In all three cases the amount of practical experience considered necessary for the control panel operators' job was about the same: ten years. This was not a hard and fast rule, however. The same firm had a control panel operator who was a graduate of a technical college with only five years' work experience. The management admitted that this was an individual case and that the man had above average intelligence and great competence on technical work.

The table below summarises, for three departments, including the automation room, the type of training organised for production workers (as well as the supervisors in the weaving department) at one of the textile factories studied (No. 23). From it can be derived an idea of the range of training undertaken and its variety as regards both method adopted and duration of the training period.

Job title	Type of training	Duration
Spinning Department (workers assigned to one of four different rooms)		
Spinners[1]	Formal training by instructor off the job	Minimum duration 6 weeks; slow learners take longer
Doffers[1]	Promoted from spinners	6 weeks
Frame cleaners	On the job	Some days
Roving layers	On the job	1 week
Conveyor men	On the job	Some hours
(General personnel in spinning department working as required in all four rooms, including Auto. Room		
Roller picker	On the job	Some days
Traveller changer	On the job	1 week
Roller buffer	On the job	3-4 weeks
Automation Room (opening, carding and drawing)		
Prep tenders	Recruited from draw frame tenders and mainly intertenders. Training on the job done by foremen	5-6 months
Spinners	Formal training off the job	6 weeks
Doffers	Promoted from spinners	
Room assistants	On the job	8 weeks

(cont'd)

[1] Many spinning mills rate the spinner above the doffer. In this mill the doffers are promoted from good male spinners because high speed spinning is controlled by the doffer.

Weaving Department		
Weavers Helper weavers	Formal training off the job. Trained by instructor	Minimum duration 12 weeks
Supervisors (senior workers)	Apprenticeship	2 years plus 2 years' experience in weaving and beam gating

Further training after running-in

Once over the initial start-up and running-in periods, the new plant's training action tended to take two lines: the institution of further training programmes for specific, usually short-term objectives directly connected with improving the qualifications of existing personnel, and the establishment of long-term training schemes and structures with an eye to meeting future training requirements.

Within the former, two main trends could be noted, both of which are a direct outcome of the type of production process used in the plants and departments studied. Managements were interested in having good safety records in their plant, and they wanted to have a versatile labour force able to adapt to the changing demands of modern technology and production processes.

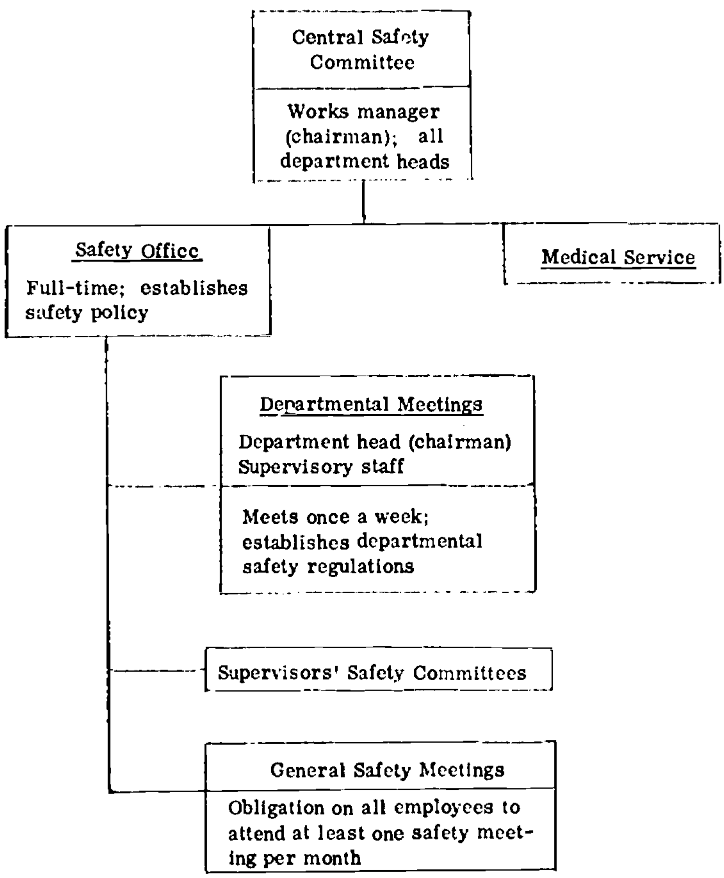
Safety training

Modern machinery is expensive to buy and unless carefully and safely used may become expensive to maintain and repair. To yield the highest return on the initial investment made it is obvious that the machinery must be used for the longest possible time and with as few interruptions as possible, for idle machines cost money. But machines may become idle for reasons other than reduction in turnover. Carelessness and unsafe practices giving rise to accidents either to employees or to the machines, may result in the equipment being out of commission for a time. The safety philosophy of one of the firms visited was very clearly stated. The safety of the employees was of the greatest interest to management, ranking in importance with production, quality of product and cost. Maintenance of safe operating procedures was of benefit far beyond any monetary savings, since the human values involved were of the greatest importance to both employer and community.

A considerable part of the further training provided by employers to their staff after the running-in period was therefore concentrated on safe working practices, accident prevention, good housekeeping, fire risks and health hazards. Managements recognised a special need to make their staff safety-conscious. The operator of modern automatic machinery may have little to do once the machine is running and while it is working smoothly, but vigilance is always necessary. One main purpose of safety training might be said to be to induce concentration and a sense of responsibility. Managements of plants using advanced technology considered it absolutely essential in order to combat the effects of monotony and the sense of isolation — both of which are frequent causes of accidents. Their concern took different forms. In some plants safety work clothes and footwear were issued free to all production workers; in others, instruction in safety precautions was an integral part of in-plant training; in still others, management had instituted a system of rewards to staff members for suggestions on improving safety measures in the plant.

Much of the safety training action was directed towards supervisory staff. One of the basic requirements at foreman level in one chemical plant (No. 24) was said to be safety consciousness, and advantage was taken of safety courses run by the British Safety Council which were attended by all supervisory and management level staff of the plant. In another plant (No. 4) meetings of particular groups of workers, presided over by the foreman in charge, were held from time to time to discuss specific safety measures. Courses in first aid were sometimes instituted and first aid teams established. In one of the motor accessories plants (No. 14) 10 per cent of the workers had received such training.

One of the most comprehensive safety programmes observed in the course of the study was in the plastics (thin film) plant (No. 17), which had a formal organisational structure consisting of a Central Safety Committee flanked by a medical service and full-time safety office. To assist the Central Safety Committee and to bring safety consciousness home to the workforce as a whole, provision was made for safety meetings and committees at three levels: the department, the supervisory staff and all the rest of the labour force. The respective functions and composition of each of these bodies are shown in the diagram overleaf.


Central Safety Committee
Works manager (chairman); all department heads
Safety Office
Full-time; establishes safety policy
Medical Service
Departmental Meetings
Department head (chairman) Supervisory staff
Meets once a week; establishes departmental safety regulations
Supervisors' Safety Committees
General Safety Meetings
Obligation on all employees to attend at least one safety meeting per month

The Central Committee established safety policies. On it sat all departmental heads, as well as other personnel members, and the works' general manager who acted as chairman. The safety office was in the charge of an economist who had had training in psychology. He was assisted by a member of the plant technical staff.

Departmental safety meetings were held weekly, presided over by the department head and attended by members of the supervisory staff. It was at these meetings that any departmental safety regulations required were established. At the employee level one of the purposes of the safety meetings was to assist in indoctrinating employees in the "safety philosophy" of the plant. Every employee had to attend at least one safety meeting a month.

Upgrading

Upgrading is one of a number of types of further training following the obtention of recognised basic skill qualifications. It may be described as training providing supplementary knowledge and skills in order to increase the versatility and occupational mobility of a worker. As such, it covers a wide range of subjects and fields of training and is achieved through an equally wide range of systems and methods. It is also, in many instances, difficult to distinguish clearly upgrading from other forms of further training, such as specialised training and training for promotion. Almost without exception, upgrading was part of the staff training policy of all the undertakings visited. Only two of the 29 case studies were out of line with this general trend (Nos. 8 and 15). Neither had made any special effort to organise any further training at all for its staff but followed a declared policy of "one man, one job". One of them, however, indicated that in future it was likely to have to revise this policy (No. 15).

In practice this demand for multiple skills was confined within the limits of one production section or one shop. The chemical industries, and particularly those using the highly-automated equipment employed in continuous flow processes, seemed to be specially fertile ground for the development of multiple-skill occupations, both in maintenance and in production work. It was common, for example, for a chemical operator to be made responsible for simple maintenance jobs and for general repair and maintenance mechanics to be taught to do electrical repair work. In one chemical firm (No. 24) every member of a production team had undergone the same training, was familiar with the whole process and knew all the operations to be performed. In one of the plastics manufacturing plants (No. 13) about 50 per cent of the workforce had been trained for more than one job.

Other examples were noted at one of the motor accessories firms (No. 14), where all workers were trained for more than one job so as to be interchangeable as required, and at the sugar refinery where a formal policy had emerged of developing a workforce with qualifications for several jobs. A gas lime-kiln operator had an additional responsibility as crane attendant, for instance. In addition, further training, including upgrading and updating, was systematically arranged for technical staff and skilled workers through courses organised by the Ministry of Food, together with the Regional Sugar Trusts, to inform production workers about latest developments in this field. The courses last up to one month and are usually given at a vocational school or institute. In 1967 they were attended by 36 workers from the refinery. In one of the textile concerns (No. 23) additional training had been organised for the maintenance electricians to give them broader competencies. At the time of this study one electrician had just come back from an electronics course arranged by the manufacturer of the equipment installed in the new automated unit and another was to be sent shortly on the same type of course. As a result the electricians could do jobs which previously had to be done by electrical sub-contractors (and were negotiating for higher wages recognising their increased knowledge).

Polyvalence or interchangeability of staff was considered desirable in assembly work also. Assembly workers in one plant (No. 12), most of whom were women, were initially trained for one special job. The assembly process, however, was divided into sub-sections and the assemblers were later moved from one sub-section to another so that they were competent to work on several job stations when the need arose.

The same undertaking had a very comprehensive programme of further training which went far beyond the narrow limits of upgrading training. Participation in the programme was open to all employees and was free of charge. It was given through part-time instruction in both technical and general subjects and the courses were run by qualified and experienced company staff or by teachers and specialists who were brought in from outside. Seminar techniques were much in evidence and the trainees were expected to participate actively. Technical courses lasting more than four hours were terminated by a practical test, but the test was not compulsory. At the time of the survey, some 70 courses were available in six broad categories: mathematics and sciences, electricity and electronics, manufacturing and production planning, company products (construction and use), management and organisation, and a category comprising what might be called "personal development" courses which included subjects such as public speaking, language (mother tongue), the psychology of human relations, etc.

The policy of multiple skills for versatility, if not of interchangeability of the labour force was particularly evident with respect to maintenance workers. It was frequently indicated to the researchers that a good maintenance man needed to be a kind of handyman or "jack of all trades", knowing something about everything and able to improvise when occasion arose. This was not meant to infer, however, that the maintenance worker did not also need to be a highly skilled, and often highly specialised worker.

Staffing plans for the firm manufacturing thin film plastics (No. 17) provided for two distinct kinds of maintenance work — general maintenance and control maintenance — but each cut across conventional occupational classifications. The general maintenance mechanics had to be qualified fitters, lathe operators and milling machine operators. The control maintenance mechanics were responsible for not only electrical and electronic but pneumatic maintenance as well. There was no place on the staff for a control maintenance worker who was only an electrician; he had to be qualified in the other two fields as well. In the same plant it was noted that one process operator might also be qualified as a laboratory worker, and another as a measuring instruments controller with the additional qualifications of a fitter, repairman and welder.

Multiple skills were also a prerequisite for maintenance workers in factories using numerically controlled machines: they needed to have not only the electrical and mechanical skills required for conventional machines but also a knowledge of electronics, a fairly extensive knowledge of hydraulics, and sometimes of pneumatics as well. Various means were used by the different firms to achieve the desired level of versatility or interchangeability in their workforces. Training for the control maintenance mechanics at the thin film plastics firm referred to above lasted about two years. During the first four months they followed full-time theoretical courses given by one of the engineers who had previously had a period of training with the parent company in the USA. Thereafter and for the next eight months they spent half their day on course and half the day at work. During the second year the training tapered off but the instruction was still given three days a week, four hours per day. Some 35 control maintenance mechanics who had undergone this training between 1964 and 1966 were still on the staff at the time of the survey. Training for general maintenance mechanics was less lengthy. It amounted to six months' theoretical instruction and six months' practical experience. Only the two first months were taken up by full-time instruction. During the remainder of the period the training was given half time.

At the oil refinery (No. 7) considerable reliance was placed on job transfer within the plant providing the workers an opportunity to acquire additional skills. This also permitted, in some units, a reduction in the number of workers since some of them could be transferred to other production lines. In one of the synthetic fibres plants (No. 26) training for second, and even for third skills took place outside normal working hours, the incentives for taking such training being the prospect of promotion and the resultant higher wages. In this way a polymerisation machine operator, for example, might also be responsible for operating the cutting machine.

The policy of multiple skills in another textile factory (No. 23) meant that individual production workers were able to work on more than one type of machine (usually three types). It was also noted that maintenance mechanics at this factory were trained electricians as well, and vice versa, while team leaders and foremen had all had training for additional skills. Technical upgrading courses of two to three months' duration were systematically organised at the plate-glass factory (No. 18). It was estimated that it usually took a worker 12 to 18 months to be upgraded, through training and experience on the job, from one wage category to the next. Much the same could be said of the cement works (No. 19), where the courses averaged three months' duration, and the petroleum products plant (No. 20) where upgrading courses lasting six months, part-time, are organised each year.

Quite apart from the advantages inherent in having a workforce whose individual members could be easily adapted to various jobs, it was generally felt that training for versatility among workers and foremen tended to give both categories a better understanding of the consequences for other departments of their own mistakes, and thus led to a greater individual and collective sense of responsibility.

Training for promotion

As has just been seen, technical upgrading was frequently, but not necessarily, a prelude to promotion to jobs considered to be a step or two up in the occupational hierarchy. Examples could be taken from one of the textile firms (No. 23) where all posts are filled according to a policy of promotion within the firm accompanied by appropriate upgrading training. Prepmen are normally recruited from inter-tenders — and inter-tender is one of the most difficult jobs in the plant. Their upgrading training was reckoned to take five to six months. The prepmen have to be skilled and intelligent workers and must, in addition, have aptitude for leadership and supervision. The need for above-average qualifications is illustrated by the case of an inter-tender who had been selected for promotion to prepman because of his good performance on the job, but was in fact a failure in his new posting.

In one of the synthetic fibres plants (No. 26) there were one-year courses for assistant foremen. The courses were divided into three months of purely theoretical instruction and nine months of combined theory and practice. The subjects covered were as follows: general technology — 100 hours; specialised technology — 220 hours; metal work — 100 hours; economic and labour legislation — 50 hours.

In a firm manufacturing numerical control machine tools (No. 5) which, despite its very modern product, might in some ways be likened to a high precision craft industry, further training was a permanent feature and aimed at both updating the personnel and giving them an opportunity to win promotion and achieve higher skill levels. The thin-film plastics firm (No. 17) also stressed the need for its production and maintenance staff to have access to further training. The firm followed a system of "stand-ins" or "understudies" for production jobs. A worker's understudy learnt the job while acting as his assistant. When the worker was absent (on holiday, or because of illness, for instance), the understudy automatically replaced him and benefited from a system of credit-hours during which he was entitled, provided he had successfully taken the relevant training, to draw the appropriate higher wage. Should the worker leave the firm, his understudy was ready to take over his job.

The supervisory function

Technical upgrading was also, in many cases, a means of entering supervisory categories of employment. Further training was a formal obligation for foremen at the oil refinery (No. 7). At the textile mill referred to at the beginning of the section on training for promotion, foremen were promoted from the shop floor on the basis of merit and performance. Until recently no special upgrading or other training had been organised for them but the firm was beginning to take advantage of courses organised by the Productivity Centre of the Textile Council. The courses cover such subjects as basic management techniques, production planning, costing techniques etc. The same policy was followed at the petroleum products plant (No. 20): foremen were usually promoted from among workers with a secondary technical education and given short-term training to prepare them for their new functions.

In the electronic components factory (No. 1) considerable attention was paid to training first-line supervisory staff (the charge-hands or "brigadiers"). The training provided included not only instruction in supervisory techniques and human relations but also technical courses specifically related to the unit or section of the person concerned. The former comprised courses in psychology, on social legislation and on oral and written methods of expression. Various methods and teaching aids were used: films, seminars, case studies and role playing, among them. For their technical training the charge-hands sometimes followed the same courses as the set-up men, maintenance mechanics, or even electricians specialising in electronics. The training had a definite bias towards trouble-shooting since the lower levels of supervisory staff at this undertaking were responsible for undertaking simple maintenance work.

Foremen and charge-hands in one of the synthetic fibres plants (No. 2) initially had systematic training on the job at a pilot or experimental production section run by the parent company. In addition they took various outside courses at the productivity centres. Their subsequent further training was mainly achieved through case study methods, through discussion sessions on subjects such as "what is a good worker?" and through talking over organisation problems with the manager during weekly meetings.

Foreman training was the principal field of further training at another of the chemical firms studied (No. 24). At supervisory and management level an in-plant training scheme was established in 1967, and internal training sessions under the direction of the personnel manager were being held once a month providing training in human relations and other supervisory skills. Training in human relations was also featured in a motor accessories factory (No. 4) where it was given to both foremen and charge-hands.

In general, however, after the nucleus of supervisors and senior technical staff required for starting up production had been trained — usually well ahead of time — subsequent supervisory training became part of a general and permanent over-all scheme of training covering all personnel categories. The programme organised by the computer factory (No. 12) for preparing potential supervisors, management and specialist staff for their future functions and responsibilities may be cited as a good example of this kind of training. To qualify for selection for training, candidates must have already demonstrated aptitude for leadership responsibilities. The training itself consists of several stages. To begin with there is a general upgrading course lasting one week. This is followed by a programme of intensive management training courses covering subjects such as management techniques, personnel management and wage systems, correspondence and report writing. There are also refresher seminars on functional management training, "training the trainer", the organisation of staff training, and so on.

Training methods and syllabi

The research study showed that many different training methods and instructing techniques were used but that nothing radically new had been instituted. Rather, the plants and undertakings seem to have used any method which was in line with current practices in the country concerned or common in the country of the parent company, and which was likely to meet immediate requirements. The comment of one plant management, where the most advanced and highly automated equipment was being used alongside modern but conventional machinery, may serve as an illustration of what was a fairly general view. According to this firm, training for automatic equipment should not be regarded as essentially different from training for conventional types of machinery. In some cases there might be more emphasis on theoretical knowledge, in others, less.

Training within the undertaking

Contrary to what might have been expected from reading the literature on the subject, it was evident that a large, and even an increasing amount of training was provided within the undertaking and that much of it was being given on the job. This is clearly shown in the table on pages 96 and 97, and in fact every plant visited had in-plant training arrangements for some or all of its workers. Several of the managements were of the opinion that on-the-job training was essential because of the special nature of their production. An operator of automatic machinery whatever the degree of skill required, can hardly acquire the necessary knowledge and experience except on the shop floor and through actually running the machines. Theoretical knowledge may be obtained in training institutions, but few such institutions are likely to have all the varieties of automated equipment for which practical instruction might be required. There are, of course, exceptions: Louvain University, for instance, has created a pilot centre with numerical control machines as well as a centre for the study of programming.

It follows that examples of in-plant and on-the-job training were noted in the plants manufacturing motor accessories, where it applied to all personnel except for a few management and supervisory posts, in the manufacture of strip steel and synthetic fibres, in the production of numerically controlled machine-tools and computers, at the brickworks and in the textile mills and at the plastics (thin film) plant. In the last-mentioned plant (No. 17) all production workers were trained within the undertaking, where they were given both theoretical and practical instruction. Part of the training objective was to influence work attitudes, and more especially to develop in the learners an ability to concentrate, safety consciousness and a sense of responsibility. In the other plastics plant (No. 13), on-the-job training was practically the only method used: foremen and fellow workers served as instructors. Some of them had come from another production unit belonging to the same company, others from the department which manufactured the machinery used in the plastics production units.

Induction training

There was usually little technical content in the induction training programmes even though they were in some cases much more elaborate than a brief welcoming ceremony followed by a tour of the works. One chemical firm (No. 24) gave its maintenance workers very short induction training on the job, another (No. 27) gave such training to its lower level employees, e.g. power shop workers, compressor attendants, transport and other general service workers. Occupational training which could be measured in hours only (for unskilled workers) was not regarded as a real course. In a textile mill (No. 23) many jobs fell into this category:

bale opener, conveyor man, bobbin and ring tube reacher, waste bagger, and so on. In the electronic components factory the first few days of employment for all production workers, chiefly women, were devoted to an introduction to all different activities of the plant. The formal tour of the works which was part of the introduction ceremony for all new employees at the thin-film plastics concern (No. 17) was followed by an audio-visual programme instructing about the manufacturing processes and the uses of the various types of product made by the firm. In the aluminium plant an introductory course consisted of a talk on the history of the company, a tour of the plant and a film showing the whole production process and the place of the products in the country's economy. All three parts of the course together lasted an hour and a half, but the management was planning to extend the course to a full day's duration.

Basic skill training

An outline of a course given to day-foremen, shift-foremen and operators together at a chemical company (No. 24) may serve to illustrate the type of basic instruction given for processes involving the use of automated machinery and advanced techniques.

Subject	Number of 2-hour lessons
Basic mathematics	10
Physical principles	12
Basic chemistry	2
Production processes	13
Plant equipment	3
Plant visits	4
Safety	11
Communication skills:	
oral and written	9
Human relations	4
General problems	4
Revision and tests	10
	82

The instruction was given by the superintendent and a process engineer. A relatively high proportion of time was devoted to review work and tests designed to ensure that the trainees had acquired a real grasp of the subjects covered. During the instruction in communication skills each course participant was required to give a five-minute talk on a subject of his own choice to help him learn to express himself orally. Various training aids were used to reinforce oral instruction: flow charts of the production process; a scale model of the plant; a manual of plant operation, covering such matters as process data, safety, quality control and equipment lists; a job manual and handouts containing summaries of specific points in the manuals.

Two of the textile undertakings (Nos. 2 and 23) provide additional examples of methods and syllabi. At the latter plant most of the training was provided on the job, but there was also a plant training school, equipped with mock-ups and various kinds of visual teaching aid, where off-the-job training could be provided, for instance for spinners, weavers and auto-coners. As a rule, on-the-job training was given by foremen and co-workers but for some jobs — e.g. draw-frame tender, inter-tender, spooler and beamer — it was given by special instructors.

Training syllabi were based on job analyses and were divided into two parts: talks and jobs. The talks were subdivided into background data and job knowledge. The background data talks were the same for all jobs and were considered part of induction training. They covered in all some two-and-a-half hours.

The syllabus for the auto-coner may be taken as an example. The auto-coner is employed in the cone-winding section. His training is given off the job and lasts three weeks.

Background talks:	Introduction to job and methods of training; company products; tour of other processes; system of payment; welfare
Job knowledge talks:	Basic mechanisms; counts and qualities; targets; faults analysis; patrolling; waste and housekeeping; safety
Job training:	Switching off machine; switching on machine; filling magazines; doffing full cones; cleaning waxing device; renewing worn wax roll; cleaning blockage in suction tubes; emptying sorting box (including cleaning conveyor jar); readying fluffing cone; replacing empty yarn tin; cutting off wraps from drum.

In the other textile firm (No. 2) the auto-coner operator was trained in a two-week course at the equipment manufacturer's. Production workers were trained on the job by analytical training methods. The instructing staff had all had some training in teaching methods, based on TWI Job Instruction principles. The instruction included demonstrations given on the machines, information sessions for the operators (by type of machine), films shown by the equipment manufacturers, articles in the works magazine, exhibitions demonstrating fabric samples woven with defective thread, and visits to the suppliers of materials. Occasionally -- every two or three months — an engineer from a manufacturer of textile machinery would be invited to the plant for a day to give a talk and answer any questions raised by the supervisors.

Production workers in the electronic components plant were for the most part initiated into the work through courses of accelerated training given on the job, although some of the instruction was provided in a special training unit within the plant. The training is essentially practical. The course starts with a period of training in elementary hand movements to develop dexterity. It then systematically takes up each of the elements of the product under manufacture, giving detailed instructions as to the movements and operations required in each case.

For maintenance personnel in the same factory a technical description was prepared for each machine. Together, the descriptions constituted a written course which was distributed to mechanics and electricians. Originally the plant's training staff had given these technical descriptions and information orally. Experience showed, however, that as some of the trainees already knew something about the subject it was preferable to provide them with written material which they could read for themselves and refer to when necessary, and on which they could ask for additional explanations or other information to be given them in class. Elementary descriptions of machinery and equipment had also been prepared and distributed to the machine operators (workers with qualifications at semi-skilled or specialised level) to stimulate an interest in their jobs and increase their efficiency. These descriptions set out to explain in general terms, with a minimum of theoretical detail, the job in hand — the functioning and uses, for instance, of a condenser — and to outline its key operations. In both cases the courses had been found to produce good results in terms of improved quality.

One of the more sophisticated in-plant training programmes was operated by a motor accessories firm (No. 4). As has already been seen in the relevant section above, this firm relied quite substantially on a system of planned rotation by which the most competent workers were moved to more complex and higher level jobs in a general effort to get a cohesive and versatile workforce. The undertaking was also one of the few to have made any systematic use of audio-visual methods and programmed instruction (PI) in its training programmes, using colour slides, tape recordings and teaching machines. At the time of the survey there were five such PI programmes in use:

(1) names and uses of the various types of product made by the company, and the procedures for visual inspection;

(2) setting up the different machines;

(3) procedures for tool changing;

(4) operation of certain equipment (e.g. welding; a programme for automatic lathes was being translated);

(5) inspection tests for quality control.

Training women employees as final control inspectors at the firm was done with the aid of multiple-choice question and answer training programmes. To test the effectiveness of the training the inspectors on the job are sometimes, without being aware that it is a test, passed specially prepared trays of finished items for inspection. The number and types of faults have been noted (they do not exceed what might be considered normal wastage); if the inspector fails to detect a sufficient number of the defects she has to take the audio-visual inspection training programme again. The PI programmes had all been constructed on the principles of linear presentation. They had been provided by the parent company which meant that they had originally been prepared in a foreign language and for a foreign learning situation and needed to be both translated and adapted.

This was not a unique situation. The experience of one plant (No. 17) with PI courses and other instructional materials provided by the parent company is given by way of example. A substantial amount of the training materials used by this firm was a direct import from the parent company. Numerous training aids included films and a wide range of manuals. The latter much resembled illustrated instruction sheets. But the instructions themselves required adaptation in order to compensate for cultural and educational differences between the different localities. In several cases, in fact, it was pointed out that to develop courses of PI which had only limited application was uneconomic.

As has already been described in some detail above, a considerable part of this firm's training effort was geared to safety training. Because of the risks inherent in the manufacturing process and the inability to arrest the process once it had begun, simulated breakdowns were used as part of the training during installation of the equipment and before start-up. For technical training, lectures were given by an engineer; on occasion one of the trainees had sometimes to prepare and give a talk on a particular technical problem under the guidance of the instructor. In this firm, as in all the others, however, a large part of the in-plant training was quite informal and occurred in daily contacts with the engineer and fellow workers.

It might be added here, almost as a rider, that language presented a problem in several of the cases studied — but less so as regards integration of foreign personnel in the work force than for understanding the intricacies of the new machines and equipment being installed. Many of them were manufactured in foreign countries and the only available technical documentation relating to them was often written in the language of the country of manufacture. In one or two instances this created some difficulties and some of the foremen and key production workers took evening classes (two hours a week) over an extended period to familiarise themselves with the terminology and language of the supplier or of the parent company. However, little was done to remedy the situation, which on the whole was not a very serious problem.

Training in training institutions

What help had the undertakings sought outside their own confines in training their personnel? Many, with highly developed apprentice training programmes or with elaborate and well equipped training centres of their own, felt themselves to be self-sufficient. Nevertheless, several examples were found of workers being sent by the undertaking to attend courses given by an outside body (other than the equipment manufacturer), or doing so on their own initiative.

Mention has already been made of the pilot centre for numerical control studies established at Louvain University in Belgium, where the programmer at plant No. 5 had been trained. This was by no means a unique case. There are many other institutions doing similar pioneer work and placing their facilities at the disposal of industry. The few that are mentioned below happen to have played a part in the staff training of some of the firms surveyed; they do not in any way constitute a comprehensive listing. Much of their work is concerned with safety training or management development. There were, for instance, the British Safety Council and the Industrial Society (also in the United Kingdom) as well as numerous university departments offering short courses (usually lasting from two days to two weeks) in production control, safety, interviewing techniques, etc. In the Federal Republic of Germany the German Institute for Plant Management (Deutsches Institut für Betriebswirtschaft) had played a part in training some of the personnel of the aluminium plant (No. 16).

Specific industries in the United Kingdom are today (i.e. since the 1964 Industrial Training Act) able to count on the services of the various industrial training boards (ITB) for either providing requisite training or otherwise helping the firm to obtain it. That was the case of the brickworks (No. 25) which could take advantage of the training centre established by the Construction Industry Training Board in which learner excavator drivers can attend a month's course. Textile mills in the United Kingdom can have recourse to the Cotton and Allied Textiles ITB, or can turn to the Productivity Centre of the Textile Council which runs courses on basic management, production planning, costing techniques and the like. Some of these courses were attended by foremen from plant No. 23.

In the USSR a rather special situation obtains. Part-time study through evening and correspondence courses is part of the accepted system of workers' upgrading and advancement. Several different ministries organise general and technical upgrading courses. The Ministry of Food, in collaboration with the Regional Sugar Trusts, for example, offers courses for technical staff and skilled workers from sugar plants. They last roughly one month and are intended to give information about the latest developments in the industry and generally to bring the workers' knowledge up to date. A chemical factory in the USSR, which is becoming a centre of the chemical industry in a Union Republic, had over two hundred employees taking part-time and correspondence courses at a chemical industry technical college and at a technological institute.

In Poland too, training institutions initially set up by and for a large undertaking or combine tend to become semi-autonomous, or to be taken over partly by the public authorities and end up by servicing the whole industry. The same may be said to some extent of training institutions in Czechoslovakia. Cases in point in the present survey are three of the food processing concerns which were located in the latter country and the Polish chemical concerns.

Institutional training for youth

All the above relates essentially to management training and skill development for persons already in employment. Training in training institutions for young persons prior to employment presents quite another picture. The managements of the plants visited were asked their views on the curricula of vocational and technical schools and their suitability as a preparation for work in a modern economy. Views differed on details, and were in any case coloured by prevailing practices as regards industrial training in the country concerned (i.e. largely school-based or chiefly in-plant training). The following are some of the main points brought to light during the inverviews, many of them constructive criticisms with an eye to the future.

There seems to be general agreement that vocational schools should provide a basic training, rather than a high degree of specialisation. The latter is held to be the responsibility of the employer. In an age of advanced technology, schools cannot be expected to possess in their workshops all the types of highly specialised machine and equipment found in production plants, nor can they be expected to have teaching staff competent to instruct on and about all types of modern equipment. Bearing out this opinion, the management of one company felt that vocational and technical schools should give a basic multi-purpose training, for example, for electro-mechanics, rather than train electricians and mechanics as separate specialised groups. What was needed, they said, was vocational school graduates "with good heads rather than well-filled ones". The pupils should have been taught basic principles and how to think logically — in short, the skills of analysis and synthesis.

There was a tendency, the research team were told, for some schools to enrol too many pupils for certain trades simply because a certain type of industry had been started up in the locality. Many boys were today, for instance, anxious to study electronics. But electronics might turn out to be a limited local employment market and electronics concerns might be more in need of good maintenance mechanics than electronics technicians. Unless the intake of the schools was carefully planned in consultation with the local industries, recruitment of the latter from the schools might turn out to be disappointingly low.

Another view expressed (No. 17) was that safety training should be given greater emphasis in school programmes, and that pupils were not always given sufficient insight into industrial atmosphere, essential works discipline and the importance of precise time-keeping in industry. Some vocational school graduates had never even visited a plant while undergoing institutional training, let alone had a period of practical work experience. Attention to these aspects would facilitate subsequent in-plant training and help to reduce staff turnover. The management of the steel mill (No. 3) did not consider that the school curricula were too remote from the needs of industry. They did, however, agree that an appreciation of broad principles was more important than the acquisition of too many different types of knowledge. In their experience, technical school and university graduates (at various levels) often had a tendency to stumble over fundamental, sometimes very simple, principles, which had never been properly understood. Such principles should be buttressed by the provision of good practical examples, rather than be taught solely in the abstract, with emphasis on teaching trainees to understand and deduce. It was also suggested that the workers' knowledge of their mother tongue was sometimes insufficient for clear written expression, particularly for report writing. The head of a vocational school in Poland gave much the same opinion about the pupils entering his school.

Another criticism heard was that the teaching of economics was often inadequate, or even non-existent, in vocational and technical schools. There was insufficient appreciation of the economic return required from the operation of an expensive piece of machinery. One firm (No. 17) felt that want of an understanding of elementary business economics contributed to a lowering of the workers' sense of individual responsibility for quality and output, which in turn had harmful repercussions on employer/employee relations. Another of the undertakings, a synthetic fibres plant (No. 26), in an endeavour to remedy the situation had felt it useful to introduce a 50-hour course in economics in the curriculum of its school for foremen.

One of the problems which may well face training institutions in Europe in the future will be that of keeping up with the most advanced technology, in both theoretical instruction and practical work in school workshops. As the use of the latest types of equipment becomes daily more common in industry, so it will also become more important, in the industrially advanced regions at any rate, for pupils to learn about and to handle them.

Long-term training arrangements

In describing measures taken by various of the plants for providing upgrading training and training for promotion, and in considering — however briefly — some of their programmes for supervisory training and management development as well as the training offered by outside institutions, this chapter has already moved into its last major section: the permanent or long-term arrangements made by the undertakings to ensure the continued availability of a workforce that is adequate both in number and in level and range of skills. This is indicative of one of the very real problems of this whole study. It has proved extremely difficult to separate special training measures necessitated by the newness of the plant, its product or its manufacturing process from those measures which would in any case be normal for a plant of a given size set up in a country or area subject to given regulations and practices.

Not all the factories and plants visited had attained the same level of training consciousness. The structure and administrative machinery underlying the training programmes described in preceding sections varied considerably according to the size of the undertaking, and the prevailing practices as regards in-plant and institutional training in the country concerned. It is also fairly easy to detect, where applicable, the influence of the parent company. By and large, however, the organisational structure tended to conform to known patterns.

In almost all cases responsibility for training was a function of the personnel departments. Four concerns — steel rolling, computer, plastic and aluminium plants (Nos. 3, 12, 13 and 16) — had technical staff in charge of production worker training, but in most cases these staff also exercised some personnel functions. Of the 29 undertakings surveyed, all but seven had appointed full-time training officers (in one case the appointment was very recent at the time of the researcher's visit and the training officer's duties and functions had not yet been clearly established). It should be noted here, however, that of the seven firms without a full-time training officer on the staff, four were located in the same country — Belgium — where it is customary for initial technical and industrial training for young people to be provided on a full-time basis within the school system and not within the undertaking itself. Industrial firms in Belgium do a considerable amount of adult training and have a well-developed supervisory training system; but the absence of an industrial apprenticeship tradition may well have had something to do with the non-appointment of a permanent training officer. Three of the four Belgian firms in question had special instructing staff and two had evolved highly systematic training programmes designed to give their production workers the desired level of manual dexterity and skill.

Early on in this chapter it was indicated that where full skilled-worker level qualifications were required, the training provided was generally of long duration and had to be planned for well ahead. In such cases it was usually provided either in an apprenticeship situation within the undertaking, or through a programme with full-time training in a school or centre combined with lengthy periods of work experience acquired on the job. In both cases the arrangements made by the undertaking were governed by current practices in the countries and industries concerned.

Apprenticeship

It is not the intention of this study to provide a detailed report on prevailing practices in the field of apprenticeship in the countries surveyed.[1] Nevertheless, some of the information gathered is of undoubted interest in this connection as examples of typical long-term training arrangements

[1] An analytical comparison of the background and evolution of apprenticeship in eight European countries — Austria, Czechoslovakia, Denmark, France, the Federal Republic of Germany, the Netherlands, Switzerland, the United Kingdom — has already been brought out by CIRF Publications in its monograph series: cf. European apprenticeship: effects of educational, social and technical developments on apprentice training practices in eight countries, Genève, CIRF Publications, ILO, 1966: CIRF Monographs, Vol. 1, No. 2, 276 p. (offset).

which served not only for the immediate problem of acquiring qualified production staff for the new plant but also that of ensuring the continued supply of such staff.

Of the seven countries covered by this survey, Czechoslovakia, the Federal Republic of Germany and the United Kingdom may be considered typical of countries relying on apprenticeship, in the formal sense of training under an indenture concluded with an undertaking, as the principal means of acquiring recognised trade qualifications. But even among these three there are substantial differences in the concepts and organisational structures underlying the apprenticeship system. A motor accessories factory in the Federal Republic of Germany operated an apprenticeship scheme for training skilled workers in the metal trades — fitters, tool- and die makers, lathe operators, electricians. There were also apprenticeships for laboratory assistants, materials testers and automobile mechanics. For the metal trades apprentices, the first year of the apprenticeship was spent in acquiring basic training in a school and the apprentices were quite outside the production cycle. Thereafter, and for the rest of the two or three years of his apprenticeship, the trainee rotated through all the departments within the plant. About one-third of the production and maintenance personnel in this company were skilled workers or apprentices in the metal trades.

In another company in the same country apprentice training was only one aspect of a comprehensive system which included the training of production workers and of management and supervisory staff, and voluntary further education for workers in their free time. Apprentice training was mainly for workers in the metal trades: electro-mechanics specialising in electronics, tool- and die makers, instrument mechanics, galvanisers. With the exception of the galvaniser, the training lasted three-and-a-half years. In the case of the galvaniser the apprenticeship was of three years' duration. The whole of the training at this level was in the charge of an engineer. As is customary in the Federal Republic, the apprentices took courses of related theoretical instruction (one day a week) at the local vocational school. The firm supplemented this instruction by giving them four to eight hours a week of theoretical instruction at the works.

Apprentice training for maintenance fitters (electrical) at the brickworks lasted five years. The first year of training began with a short induction course: a brief description of the company, its products and markets; conditions of work, pay, holidays, etc.; a tour of the production and maintenance shops; lectures and demonstrations on safety and first-aid, with emphasis on artificial respiration; a visit to the industrial safety exhibition and a period of workshop familiarisation under the guidance of experienced personnel. Trade training proper during the first year was given wholly off the job in a training workshop. An outline of the different phases is given below.

First year	Basic workshop practice: bench-fitting, centre-lathe operation, shaping, milling, grinding, sheet metal work, gas and electric welding, electrical installations; supplementary theoretical and practical training in internal combustion engines and motor maintenance.
Second year	Essentially devoted to applying basic skills already acquired to the overhaul and repair of electrical equipment and the maintenance, repair and installation of low-voltage wiring.
Third year	Maintenance, repair and installation of three-phase motors and associated equipment.
Fourth year	An introduction to automatic process control equipment: the apprentice begins to work on his own initiative under only general supervision, instead of, as formerly, under the direct supervision of experienced electricians.

Fifth year	Secondment to other works to gain experience, or to the manufacturer of the equipment used in the plant.

Throughout the apprenticeship, the trainee attended courses at the local technical college for one day a week, being granted day-release by the employer to do so.

In Czechoslovakia, if a young person wishes to enter employment directly from school, he is still under legal obligation in any case to undergo at least six months' training. If he takes up an apprenticeship, he signs a contract with an employer but his training, or at least a large part of it, takes place off the job in an apprentice school set up within the undertaking. If the specific undertaking is not big enough to warrant the establishment of an independent school, he may be sent to a school run by another undertaking in the same branch of industry. Similarly, a factory which needs workers with skills other than those taught in its own apprenticeship programme will recruit from other apprentice schools. The training programmes (and there are about 250 apprenticeable trades, each with a separate syllabus) are organised by the Ministry of Education in collaboration with the ministry responsible for the specific industrial sector.

In the oil refinery industry there are several such apprentice training centres, each with a three-year apprenticeship programme. The first two years are spent entirely in the centre; in the third year, there is practical work within the undertaking, with rotation during the first six months through various departments. During the second half of the third year, the apprentice specialises and works under the direct supervision of a skilled worker. At the end of the third year, when he has finished his training, he starts to work on his own, on a wage step a little more than halfway up the wage scale.

Much the same pattern was followed by apprentice training in the motor car plant (No. 6) and in the machine shop of one of the plastics plants (No. 13). In the former, the training lasts three years: during the first two years the apprentice has equal parts of theoretical and practical instruction; during the third year he works on a machine under the foreman's supervision and there is less theoretical instruction. In the plastics plant apprentices are accepted for various of the metal trades in the machine construction department, which is quite separate from the plastics production plant. The period of apprenticeship is three to three-and-a-half years. The boys have 25 or 26 hours of practical work during the week and between 11 and 14 hours of theoretical instruction, rather more than the average amount of time given for related instruction. The firm had not found it necessary to make any specific changes in the training programme to take account of the very advanced technology being applied in the construction of the equipment.

Apprenticeship in a chemical combine in Poland also had a duration of three years. Training was given up to skilled worker level in the following fields: technology of chemical production, chemical analysis, chemical machinery and equipment, electrical equipment, control and measuring instruments, and automation. As in many of the schemes described above, the apprentices were trained in an apprentice school run by the plant.

Plant training schools and centres

Quite apart from the apprentice training schools such as those set up in Czechoslovakia, a number of the undertakings visited had established their own training centre or a special training unit within the plant. This was the case with the electronic components factory (No. 1), the nail and wire-making factory (No. 8), the aluminium plant (No. 16) which had special classrooms for instructing the personnel, and one of the synthetic fibres plants (No. 26), which had its own technical school able to accommodate some 600 trainees. Establishment of such a school or centre was, in fact, one way of ensuring tailor-made curricula and training programmes as well as adaptation to new technology in the plant. It was the latter, for instance, which had made the aluminium plant (No. 16) introduce hydraulic and pneumatic control as a subject in its apprenticeship programme, and which had made one of the big chemical combines (No. 21) decide shortly to introduce "pneumatic control and measuring devices" into its technical school syllabus.

Such action was more common among the concerns in eastern Europe than in those visited in the west European countries. One of the chemical combines in Poland can be given as a case in point. It ran four different types of school:

- a vocational school giving a 3-year full-time course for young people leaving common basic school;
- a technical school with a 3-year course (both full-time and part-time) for graduates from the vocational school;
- a technical school providing a two-and-a-half year course of full-time study for pupils who have graduated from general secondary education; and
- a technical secondary school (or technical college) with a 5-year full-time course for common basic school leavers.

It should be noted, however, that the last-mentioned school, although located at the plant, was actually run and financed jointly by the Ministry for Education and the Ministry for the Chemical Industry. Most of the workers for the new plant had received all their training in the first and third types of school.

The same sort of network of company schools existed within another chemical combine in the same country, except that the 5-year technical secondary school was broader in scope, servicing the whole branch of the industry. At the time of the survey some 3,500 persons were studying at one or other of its schools.

In the USSR the training establishments are usually formally autonomous but many are run by industry and/or local authorities. In the course of time what began as a plant school becomes the training and education centre for a particular industry within a given region.

A slightly different arrangement was shown to exist among the group of food processing concerns. The dairy (No. 9), for instance, belonged to a group of dairies handling some 1,000,000 litres of milk daily. The group had a common training programme, the costs of which were shared among all the associated dairies, with the training being made available, as required, to each and every one of the plants in the group. Similar group training schemes had been set up for the other food processing combines, the bakery (No. 10) and the meat-processing factory (No. 11).

Instructing staff

As has been seen all through this study, it was common in many plants for foremen and technical staff to take care of the in-plant training although some plants, particularly those running formal courses in their own schools and training centres, had qualified teachers and instructors as well. At the oil refinery's training centre, instruction was mainly given by foremen and chief operators, but also by members of the maintenance and electrical departments. Training on new production lines was given by a technologist from the special start-up group, which also prepared manuals for the use of the instructors. Other factories where the training was being given by works engineers, foremen and operators were the sugar refinery (No. 28), the bakery (No. 10) and the dairy (No. 9), the steel rolling mill (No. 3) and the textile and synthetic fibres plants (Nos. 2, 23 and 26). In the last-mentioned plant full-time instructors as well as technical staff, foremen and skilled workers were all employed as trainers. Engineers and foremen acted as instructors at the electric lamp factory (No. 29). This concern had developed its own in-plant training programme, which had been prepared by the technical staff and included some 150 hours of theoretical instruction. Another example was the computer plant (No. 12) where the training division consisted of an engineer and three full-time instructors. They were assisted, as required, by three experienced engineers who were made available for giving related theoretical instruction.

No special measures were reported to have been taken for instructor training as such, but it has already been seen in preceding sections of this study that, where training was specially organised for supervisory and management staff, the programmes usually included training in communications skills and in instructing techniques generally.

CHAPTER V - SUMMING UP

Automation is one of the most used and least understood words in current writing on industrial organisation and manpower planning. It tends, at one and the same time, to be blamed for present industrial ills and looked to as a cure for them. In actual fact, the incidence of truly automated processes is low and opinions seem to be based as much on fantasy as on fact.

In the present study we set out to examine the impact which automated production processes, or at least processes depending on an advanced technology might have on new or newly established industrial concerns in their efforts to assemble and train an adequately qualified workforce. Size of workforce and changes in job content were important only in so far as they constituted factors affecting the actual recruitment and training policies and measures adopted.

As indicated in the preface, it was decided to approach the problem in two ways. One was to review current opinion and literature on the subject; the other was to make case studies of the experience of industrial plants and undertakings which, within the recent past, had had to recruit and train staff for starting up a new line of production, or radically modifying production by introducing automated or technically very advanced equipment or production processes. The opinions expressed in the published material and the findings of the case studies could then be confronted and perhaps some conclusions of a general or a specific nature could be drawn.

Some implications have already been foreshadowed in earlier chapters. The present chapter attempts to determine to what extent the purposes of the study have been achieved and to assess its implications.

Skills and job content

One of the main controversies shown up in the survey of current literature in chapter II concerns changes in skill requirements of the labour force as a result of modern technology. Some authors feared a general downgrading process for the many and a strong move towards higher and more highly specialised skills and knowledge for the few. Changes in skill structures were certainly noted in the field work, but the changes were relative. The proportion of skilled workers to semi-skilled, both terms being used in the traditional sense, may have changed to the detriment of the former, but the levels of skill of both seem to have gone up in relation to what was required of them a generation ago. This is one of the main occupational trends today: the narrowing gap between the semi-skilled and the skilled worker in the initial stages. Both, in all likelihood, have started off with the same broad basis of general education and training but the skilled worker will have carried his training further through successive stages of specialisation, both vertical and horizontal.

The latter horizontal and vertical movements are particularly evident in the composition of the maintenance staff needed for new, modern production processes. Here the findings of the survey confirm some of the views expressed in the literature studied and analysed in chapter II. Skilled workers and technicians employed on maintenance work need to have a more sound technical knowledge than ever before of the equipment and processes they are handling, and their competence must be broader in scope. It is no longer possible, for instance, for mechanical maintenance to be divorced from electrical or electronic maintenance.

But changes in job content are not the only reason why maintenance men need to know more, to have higher qualifications. It is in fact essential for them to have today both a broader and a more thorough training in order to be able to adapt constantly to new techniques and new types of problem. Moreover there is a change in emphasis in the types of skill required. Ability to analyse and to diagnose, and a generally higher level of intelligence are the main criteria, and there is some evidence to show that a considerable amount of general upgrading and other types of further training is constantly taking place.

The extent to which these higher level qualifications are required, and the volume of training action taken by individual firms to see that their maintenance staff acquire them vary, chiefly in relation to the availability of supporting maintenance services in the vicinity. The extent to which a firm is able to draw on the services of contractors, equipment suppliers or specialised technical consultants will obviously heighten or lessen the need for it to carry out its own maintenance work and train its own men to do it. On the whole, however, these observations relate to a comparatively small number of employees.

A workforce with multiple skills was considered desirable by many of the firms with a view to increasing the adaptability and interchangeability of their production staff also, but the types and levels of skill demanded were not necessarily very high. There were the cases noted of the gas lime-kiln operator who had been trained for an additional responsibility as a crane attendant, and the assembly workers in the computer manufacturing firm who were systematically moved from one sub-section to another so that they were competent to work on several job stations when the need arose. In both instances the acquisition of such subsidiary skills was due less to the requirements of advanced technology than to recognition of versatility as a desirable goal in itself — one which would be beneficial to the worker, the undertaking and the national economy in terms of increased occupational mobility, greater employment stability, an improved economic situation and, for the worker, occupational and social advancement.

Special measures?

It has been assumed by many that radical innovations in a production process require new and complex measures in order first to attract job applicants of the right calibre and then to prepare them for their new responsibilities. This does not seem to have been borne out by the study. In almost all cases the measures used by the plants to recruit and train their staffs were by no means new. Moreover, their recruitment difficulties seem to have been the result of factors — a tight employment market, for instance — unrelated to the new technology. Similarly, the essential training seems to have constituted far less of a problem than might have been expected.

Why should this be so? Should it be concluded that the problems of finding suitable manpower for industrial firms have been grossly exaggerated?

Part of the answer may lie in the research method used for the study. We have taken our sample in an industrial society. If the specific skills and knowledge required were not available there was nevertheless near at hand a pool of potential employees whose qualifications were sufficiently close to the skill requirements to need little more than an effort of adaptation lasting in most cases not more than a few months. They could be drawn from the parent company. In some cases they could be "poached" from other firms having a need for personnel with more or less the same basic qualifications and having already trained a workforce at the different levels required. Whether the personnel were obtained from the parent enterprise or another, however, the result was the same: the new plant did not have to concern itself much with providing broad basic training because that job had already been done. The important point is that the workforce was right on the spot, or at least not very far away.

Advance planning

Essentially three major trends were observed, all three of which support findings in the literature survey. The first is the early and detailed planning which went into the setting up of the new plant and development of its workforce. Manning tables were the rule, and the managements had no hesitation in calling in outside experts — the equipment manufacturers, for instance — to assist in drawing them up. It is true that one case was noted of too much preparatory time being allowed, but the unit was small and the firm merely had to adjust downwards this time element when it set up subsequent new departments. The pre-planning was still required. More significant perhaps is the fact that in the only case in which real recruitment difficulties were reported they were attributed to the fact that the manning tables had been received too late for effective and timely recruitment action.

Planning at two levels

The second major trend is that in their recruitment and training action managements have tended to work at two levels. They have planned separately for, on the one hand, a small, key group of staff comprising chiefly higher level skilled workers, technicians, maintenance staff, supervisors and junior and senior management, and on the other hand, the bulk of the production staff who were often not needed on the job until just before production began in real earnest.

It is on the first group – the key nucleus staff – that the heaviest investment in time and money had invariably been made. Here is where, in western Europe, one finds the longest periods of training experience with the parent company or with the equipment manufacturers. It is these men who have been recruited longest in advance and who have had to meet the highest initial qualifications prior to recruitment. It is the functions of this group which, as was seen in chapter III, some of the eastern European countries have sought to fill by creating "start-up teams", a sort of flying squad specially trained for the job of starting up new production units. Once the new plant is operating fully, this group – or some members of it – can be moved on to the next start-up job leaving behind a workforce which has already been trained and has acquired sufficient work experience to carry on along the lines worked out for it.

That none of the undertakings reported any real difficulty in bringing together this essential start-up group can almost certainly be attributed to the small – sometimes very small – numbers required and to an educational and economic framework which made it possible for the plants to select their employees carefully.

For the great mass of semi-skilled or specialised workers required, it became abundantly clear in the course of the survey that the main qualifications demanded were adaptability and trainability. The managements cannot be said, on the whole, to have gone looking for ready trained staff. They expected to have a training job to do. This observation is valid for the key group also: with one or two exceptions the plant assumed full responsibility for training and planned well in advance for it. But in order to facilitate their training task they went out after the people who would be easiest to train, would require the shortest possible time and the least amount of training to become fully productive.

A young workforce

These considerations have had their impact on the characteristics of the workers engaged and the essential qualifications sought. The accent has been on youth. One firm deliberately structured its intake to include a representative range of age groups, but this was an exception. In most cases the managements had sought young workers, on the assumptions that young people are more adaptable and that they have had an education which is better suited to the requirements of a modern industrial society. They have, for the same reasons, discriminated whenever possible in favour of people who have had a good general education, who have learnt how to think for themselves. A degree of technical competence or of work experience was undoubtedly an advantage but it was not essential. As one firm put it: they wanted good heads, not well-filled ones. It is significant that, even in Belgium where industrial training is given in a school situation and not through an industrial apprenticeship, the firms wanted the schools to give the youngsters merely a general, all-round preparation for entry into employment, and doubted the appropriateness or even the ability of the schools to teach the skills immediately needed on the job. The specific adaptation to work in the plant would be given within the undertaking and largely in production.

The managements have also looked for qualities linked with intellectual maturity and stability, one going so far as to give preference to young married persons on the hypothesis that they would be likely to be more stable in employment.

Choice of sample

Should it be concluded from this study that the fears of the impact of automation and highly advanced technologies on the manning problems of industrial firms are unfounded? A preliminary warning has already been given regarding the possible distortion that may have resulted from the methods used in selecting the sample. It is reasonable to query the extent to which the undertakings chosen were both representative and likely to provide a generally applicable answer to the questions asked.

The sample was varied enough to cover a wide range of production processes and industries. The plants ranged in size from less than 100 employees to well over 6,000 and, in one case, 10,000. On the face of it, therefore, the sample might be said to be representative as regards size, production process, range of product and national economic, social and educational framework. A closer look, however, reveals that even the small firms selected have some of the attributes of the large industrial complex. They were backed up by the resources of the parent company, buttressed by an industrial tradition, or guided and assisted by a public body specially set up for rendering such assistance. It may easily be questioned whether a small firm in an industrially advanced country could have achieved the same results without the benefit of such backing in men, money and materials.

In an industrially less advanced society, or in a developing country, even the large firm working on its own would probably encounter far more serious problems. This was one of the conclusions to be drawn from the experience of a large chemicals firm setting up new production units in various and very wide-spread parts of India during the 1950s and 1960s. Writing about it later, the company's chief training and manpower adviser describes how the initial units had been set up with foreign collaboration. The author concludes his article:

> "... What we have been doing at Gorakhpur and Namrup has given us a wealth of experience on which to draw at the various development stages of all the FCI [Fertilizer Corporation of India] factories and proposed plant extensions. Behind the whole pattern lies the Corporation's recognition of the need for planning, experimentation and research. This type of approach has paid off. Our new projects are now all FCI planned and developed. We have in fact been able to rely on the work of our own Planning and Development Division which is now equipped to undertake the complete execution of fertilizer plants on the basis of its own know-how, indigenous design and engineering."[1]

A patient and parallel build-up of plants and labour force over some eighteen years had paid good dividends.

In the face of the evidence, therefore, it would seem safe to say that large firms or firms with substantial backing are sufficiently well equipped in resources and know-how to be able to contain their manning problems within reasonable proportions. The smaller ones are not.

Another point to be made is that all the plants could be said to be reasonably "training conscious", and some of them exceedingly so. Even in the cases where at first sight such training consciousness might be doubted, it is usually because the over-all responsibility for manning has to some extent been assumed by an "outside" authority, such as the parent undertaking, a national planning commission or a ministerial department for the industry concerned. No one disputed the need for a training effort.

The choice of the sample may also be one of the reasons for the lack of information regarding the mental health implications of advanced

[1] cf. AGARWAL, O. P. "Chemical fertilizer" in Training for Progress, Vol. 7, No. 2, 1968, pp. 3-10.

technology touched on in chapter II. Most of the undertakings selected were very new. The time span available for study was consequently too short to permit systematic assessment of the repercussions of the new technology or production process on the mental health of the personnel. Moreover, as has been pointed out above, the workforces were almost invariably young. The great majority were too young to have had to break with old work habits and cope with the stresses of adapting to new processes.

In conclusion, it might be interesting to consider the problem from another point of view. It is reasonable to suppose that the fears expressed in current literature about the manning implications of advanced technology have their foundations somewhere — and not necessarily only in the general apprehensions of employers and employees, the vague fears which always tend to arise in periods of change. Where, then, will these implications become apparent? Might they not be felt most in other plants and undertakings — those from which some of the firms described in this study may have "poached" employees and which have thus been deprived of a source of staff they counted on for the future? The new firm, the wealthy firm has been able to attract good employees through incentive schemes, promotion prospects, etc. The implications are clear in the policy decision taken by one of the plastics firms studied to limit its recruitment from neighbouring undertakings to a fixed number (not more than two or four), by category and size of firm, per year. There may in fact be a whole series of repercussions which are taken care of by planning and training action at a number of levels and in different spheres. The final impact of such chain reactions may well be seen best in the training provided by "traditional" or small undertakings, and especially in the ability of the latter to retain the staff they have trained. An examination of secondary impact on other plants and in other industries might well have produced a slightly different picture.

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APPENDIX II

Revised
25 January 1968

QUESTIONNAIRE

"Recruitment and training of labour in newly-established plants using advanced technology"

(Research at plant level)

Introductory note

The project is concerned only with production and maintenance workers (unskilled, semi-skilled and skilled), supervisors and technicians. Such categories as higher management, administrative, commercial and clerical personnel are excluded.

Since the object of the study is to determine the recruitment and training problems arising from the use of technologically advanced equipment in newly established plants, it is important, when collecting information, to secure a clear picture of what is considered as advanced machinery and equipment in the particular plant being studied. A plant may have only a few examples of advanced technology while the bulk of the equipment is "routine" or "ordinary". The nature of the modern equipment should be described, making reference to the degree of a worker's control over the production process and the extent to which the machine's activity is carried out without his intervention. Reference should also be made to how changes in the machine's activity are made — i.e. by a worker exercising his control of the machinery, or by a computer or other control device. (see Question 4)

This questionnaire is designed to be used as a guide during the interviewing. Modification of the questions, or their sequence, etc., may be required in the course of the questioning.

I. Description and history of the plant

1. Where is the plant located?
2. What products does it produce?
3. A short description of the main production processes and shops.
4. Machinery and equipment installed:
   (a) What are the technologically most advanced pieces of equipment? (Give a description together with the number of employees working on such equipment)
   (b) Are these the types of equipment for which operators require:

       the highest skill?
       the longest training?
       If not, explain.

   (c) Are these the types of equipment for which repair men require:

       the highest skill?
       the longest training?
       If not, explain.

5. Any distinctive features of the plant as compared with similar existing ones.
6. When was construction of the plant started?
7. When was it completed?
8. What is the size of the plant — number of workers?
9. What is the planned production capacity?
   (a) When was it attained?
   (b) When is it expected to be attained?

II. Workforce requirements and recruitment

1. At what stage in planning for the new plant was the occupational structure of the workforce determined?

   Who was responsible for establishing these manpower requirements?

   On what basis were they established?

2. What role, if any, did the new plant management play in establishing the manpower requirements?

3. Did changes in the manning tables become necessary after production had started? If so, what were the changes and why did they have to be made?

4. Was an adequate workforce available for the start-up?

5. When was recruitment started? When completed? If possible, give details by categories of workers.

6. What methods of recruitment were used? (List all measures such as advertisements, transfers from other plants, appeal to construction workers, notice in vocational schools, etc.)

7. What methods were most effective and why?

8. Were any special incentives provided to attract the required workforce (housing facilities, bonuses, pension schemes, relocation payments, other incentives)?

9. Were any tests used in the selection of applicants?

10. Sources of the workforce and the approximate percentage from each source:

    (a) technical schools

    (b) apprenticeship

    (c) other factories making the same or similar products
        (i) in the area
        (ii) in other areas

    (d) factories making other products
        (i) in the area
        (ii) in other areas

    (e) other plants of the same company or enterprise

    (f) agriculture

    (g) unemployed workers

    (h) migrant workers

    (i) other sources

11. What role, if any, did collective agreements play in the recruitment and training of the workforce?

12. What unforeseen difficulties arose in recruitment? Did the recruitment plans prove to be practicable? What adjustments were required?

III. Placement and training of workers

1. Occupational structure of the present workforce (by job title or job category).

   Additional data concerning the workforce — educational achievement, type of pre-hiring experience, age.

2. When the plant started, what percentage of the workforce could be immediately employed without additional training? What percentage required a short (up to four weeks) induction training? Breakdown of this by occupations.

3. With respect to the jobs associated with the highly advanced technology described in question I-4, what were the qualifications required of the workforce?

   (a) Operators
   Practical skills
   Theoretical knowledge
   Behaviour

   (b) Maintenance staff
   Practical skills
   Theoretical knowledge
   Behaviour

   Considering the workers assigned to those occupations, to what extent did they possess those qualifications before being hired for the job?

   Where did they get such training?

4. After hiring, what percentage of the production workers received training? Was the training mainly directed to improve practical skills or to provide theoretical knowledge.

   Where did they get such training?

   (a) outside the undertaking at existing training facilities (schools, etc.)

   (b) at other plants of the company

   (c) at the suppliers of equipment

   (d) within the plant (was it "on-the-job" or other?)

5. The timing of training (differentiate between occupations)

   (a) before construction

(b) during construction

(c) during running-in period.

6. Extent to which training was formalised with curricula, rotation plan, etc.

What training methods were used?

7. For in-plant training, who were the instructors and how had they received their training? (Give details where possible concerning different occupations):

(a) foreman

(b) co-workers

(c) manufacturers' representatives

(d) special instructors.

8. How was the training financed?

9. Was in-plant transfer employed as part of the process of developing a satisfactory workforce — including development of a reserve force with qualifications for several jobs?

10. Did the problem of psychological adjustment arise during the running-in period?

Do you pay much attention to the type of behaviour of the worker?

11. Particular manpower difficulties encountered during run-in period and how were they overcome?

12. With respect to the vocational training schools, would you suggest any changes in curricula and methods of training of workers for plants similar to yours?

13. Lessons learned from the experience of the undertaking — i.e. what procedures would you change next time?

14. Research done in undertaking which might be relevant for the study, such as job analyses, work study, employment structure studies, personnel research, evaluation of training.

15. In comparison with a new plant using conventional equipment, what were the special problems encountered in recruiting and training workers for this plant which uses advanced technology?