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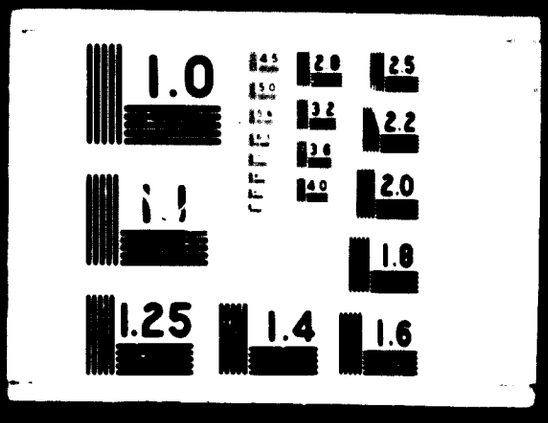

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TRAINING FOR INDUSTRIAL PRODUCTION OF PROTOTYPE MACHINERY

by

A. D. Bates

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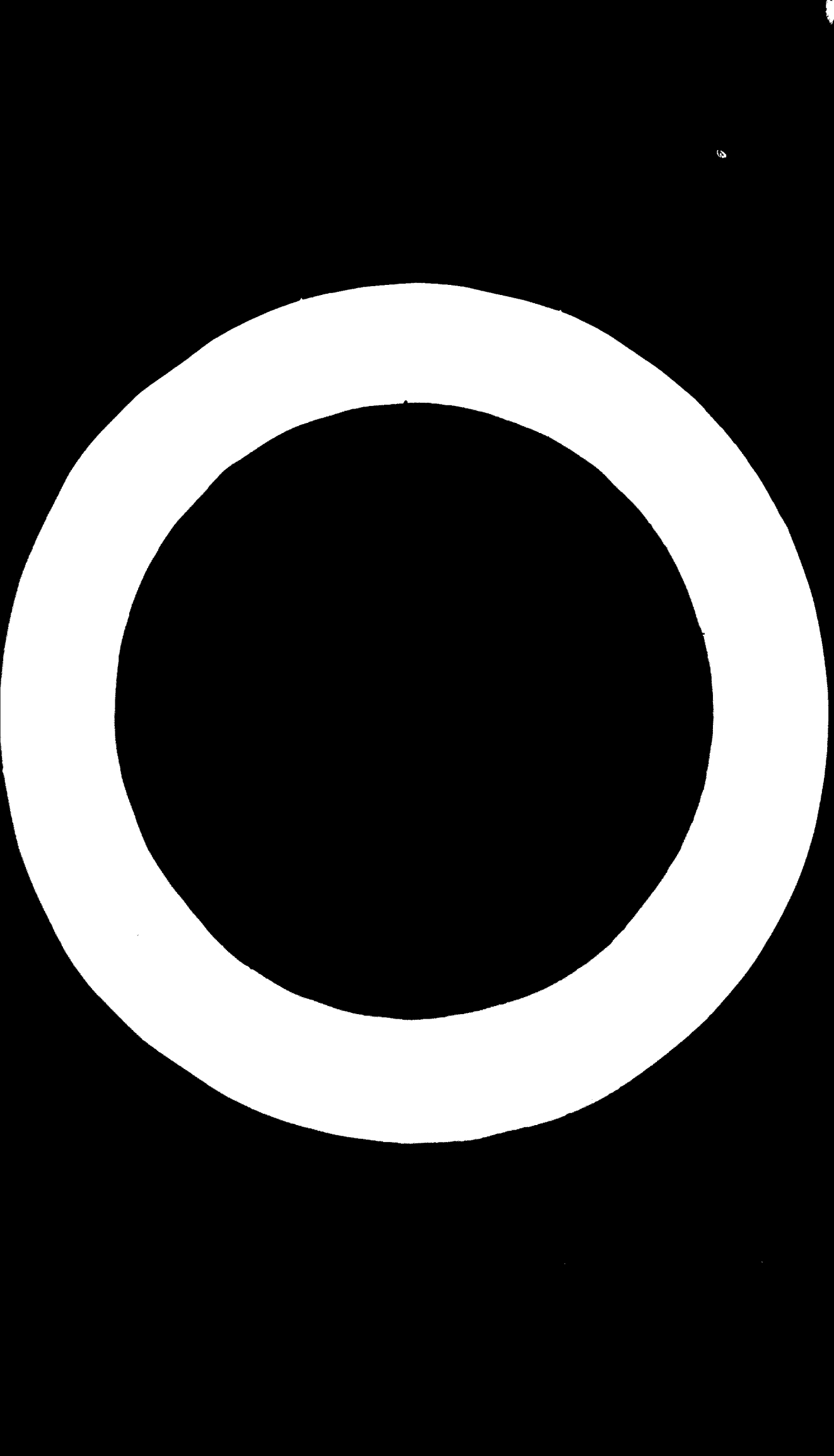

Training for Industrial Production of Prototype Machinery

BY A. D. BOHRA

THERE IS IN India a very large number of small industrial establishments, employing some 3.5 million people and adding 4,550 million rupees (approximately one billion dollars) to the value of the materials they process (excluding textiles). Thus far, their main contribution to the economy has been to help meet the increased demand for consumer articles. Now, they are increasingly taking up the manufacture of simple producer goods for industry and agriculture and of component parts of more complex capital goods produced by large industrial undertakings. Thus, closer relationships are being established among small industries and between them and the rural economy on one side and large-scale industry on the other.

Small-scale industries are defined in India as enterprises having a capital investment of 500,000 rupees (about $100,000) or less, in certain cases even one million rupees (about $200,000) or less. Units of the maximum size may have adequate access to capital and be modern in every respect. Most units are, of course, much smaller. Characteristically they lack bargaining strength in buying and selling and in securing capital. Their internal organization is little specialized, one to three persons carrying out all technical and managerial functions. These weaknesses become particularly evident when new lines of production are to be developed, especially certain lines of producer goods never before manufactured in the country, either by small enterprises or, not infrequently, by large concerns. In view of the fact that the Government is deliberately promoting the indigenous manufacture of goods hitherto imported from abroad, the undertaking of industrial operations completely novel to India is a common occurrence.

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It is the view of the Government of India that small-scale industries help to ensure an equitable distribution of the national income, mobilize resources of capital and skill which would otherwise be idle, and avoid some of the socio-economic problems created by industrialization. Consequently, the Government has taken many steps to promote this economic sector, including the extension of advisory services on improved methods of production and management, help with purchase of new machinery, provision of factory space in modern industrial estates and dissemination of modern knowledge through a nation-wide Industrial Extension Service and training institutions. The Government's policy is aimed at helping small-scale industry to become a more self-reliant and self-supporting sector of the national economy.

The fact, referred to above, that small-scale industries are increasingly undertaking the manufacture of new types of producer goods has led the Government to provide them with a new form of assistance. A number of Prototype Production and Training Centres are being set up in different parts of the country, with a view to carrying out the following tasks:

(*a*) The development and production, with foreign collaboration if necessary, of prototypes of machines, implements, tools, accessories, component parts and the like at present being imported but which are suitable for subsequent reproduction on commercial lines by small-scale units;

(*b*) The development and production of prototypes of improved types of machines now manufactured in India but not to adequate standards and, at a later stage, of new types of machinery and equipment especially well suited to the needs of small industrial units in India, and

(*c*) The practical and theoretical training of the operative staff of small-scale units and of the technical staff of the Government Extension Services engaged in assisting small industrial units to carry out the above tasks.

As a subsidiary function, the Prototype Production and Training Centres are themselves also intended to undertake the manufacture of such component parts or to carry out such phases of production for which facilities do not exist in the small units; however, this may be done only if it does not hamper the attainment of the three main tasks.

Thus, the Centres are intended to serve a number of small

industrial units as a common development department, providing them with the necessary technical knowledge and training their personnel, to enable them to undertake commercial production of new items of considerable importance for the further development of industry, especially in their own sector. At the same time, it is expected that each Centre would serve as a model for similar training centres to be set up by the Government or other agencies and that the organization and operation of each Centre would be a model both for individual small-scale units and for co-operative groups of such units engaged in complementary industrial operations.

Thus far, three Prototype Production and Training Centres have been established and are functioning. The first Centre, set up at Rajkot (Gujerat) in 1957 with the help of the United States Government, was originally intended to function as a central workshop providing a wide range of services for the establishment of model production units suitable for operation on a small scale, such as manufacture of furniture or wire products. This purpose, however, was abandoned when it was considered that the demonstration value of setting up model production units could not outweigh the disadvantage of having these compete directly with existing small commercial units and it was decided that the Rajkot Centre would specialize in training for production of machinery for foundry, wood-working and sheet metal manufacturing. A second Centre is at Okhla, a suburb of Delhi. It was established in 1959 with the help of the Federal Republic of Germany and specializes in training for production of prototype machine tools. This Centre is described in some detail below. The most recent addition to the chain of Centres is at Howrah, a part of Calcutta. It has the help of the Japanese Government and concentrates on industrial machinery particularly suitable for small industry and on electrical instruments for switchboards.

Each Centre is an all-India institution in the sense that it services small units all over the country. Present plans envisage the establishment of twelve additional Centres, each specializing in a specific range of producer goods. It is expected that a network of fifteen Centres will be sufficient to meet all the current and prospective development and training requirements of the small-scale industry sector, and will need to be expanded only when new lines of products have emerged from the inventive processes of modern science.

To make the description of the Prototype Production and Training Centres as concrete as possible, the illustrations in this article will refer to the operations of one of them, the Centre at Okhla. This will permit not only the guiding principles common to all Centres to be presented but also some of the problems which confront them in practice.

OPERATION OF THE CENTRES

FOUR MAIN STAGES may be distinguished in the operation of the Prototype Production and Training Centres.

(i) *Selecting the item*

Only those items are selected for prototype development at a Production and Training Centre which are suitable for manufacture by a small industrial unit with the necessary tools and technical qualifications. In the selection, machines at present not manufactured in India enjoy the highest priority, even if production involves collaboration with a foreign firm. Apart from the overriding aim of replacing imported products by indigenous manufacture, the following factors, among others, are considered in selecting the products for prototype manufacture: rugged and foolproof design; accuracy in operation; small power consumption; satisfactory output; interchangeability of parts; ready availability of servicing and spare parts; low cost of maintenance, and low purchase price.

(ii) *Negotiating foreign collaboration*

Once an item has been selected for prototype manufacture, negotiations start with some of its foreign manufacturers. The rights to be acquired need to cover manufacturing according to the original design, and, if necessary, modifications in the design to suit Indian production and marketing conditions. The contract usually includes the import of a few complete sets of ready-to-assemble components with which to start off work in the assembly shops without delay. When necessary, the contract can specify a lump sum payment for technical knowledge and royalty payments for a specific period. In these matters the Centre plays an essential intermediary role, since it is hardly possible for the small manufacturers either to enter into or to complete successfully direct negotiations for a transaction of this type with the foreign manufacturer of the original piece of machinery.

(iii) *Planning design and engineering and setting up the production line*

Once an item has been selected for prototype manufacture, the Centre carries out some or all of the following functions:

(*a*) Design or redesign of the product;

(*b*) Preparation of process schedules;

(*c*) Manufacture of jigs, fixtures and tools for production, and

(*d*) Manufacture of a sufficient number of prototypes to ensure smooth production.

At this stage, the Centre may need to be in touch with some of the technological research institutions in India. It is expected that particularly close relationships will be established soon with the Machine Tool Design Institute now being set up by the Government in Bangalore.

(iv) *Providing training and assistance to the small unit for commercial production*

All of the technological knowledge acquired during prototype manufacture and assembly is then handed as a "package" to selected small units for commercial production. As part of the training, the prototype is handed over to the unit together with all drawings, process schedules and instructions from the original manufacturer. Further advice is extended regarding machinery and other equip-

ment, raw material supplies, and other production requirements.

Specialization and co-operation

Prototype production of any machine at a Production and Training Centre is usually confined to a small number, what might be called a "zero" series. In general, a small-scale enterprise is not expected to manufacture a whole complex machine by itself, since it seldom has the necessary facilities. The trend towards increased specialization within each unit and co-operation between units, which is encouraged by the Government of India—special incentive schemes have been introduced for this purpose—is brought to bear upon the present case. Accordingly, a prototype is split into several component parts, one or several of which are manufactured by different small units and it is then assembled in another small factory.

It may be noted in this connexion that increased specialization helps to overcome other major obstacles. Some of these arise from the basic discrepancies between the general levels of technology in India and those in highly industrialized countries. Others may arise from legal restrictions—for instance, proprietary rights—on the manufacture of certain machine parts. Specialization in a country like India allows production to proceed in progressive stages, from early manufacture of the less complex parts of a machine and their assembly along with imported parts, to indigenous manufacture of an increasing number of parts, and finally to domestic production of the whole item. In this way, specialization does not wait on industrial development but, on the contrary, makes it feasible.

An example may show how this development takes place in practice. At the Okhla Centre, three types of machines, manufactured in the Federal Republic of Germany, were taken up for initial development: a small bench lathe, a tool and cutter grinder and a milling machine. From 1960 to 1962, detailed drawings were prepared for undertaking, in the period 1962 to 1966, the following production programme for these items at the Centre:

Machine	*1962*	*1963*	*1964*	*1965*	*1966*
Precision lathe (Weiler)	100	150	200	—	—
Tool and cutter grinder (Hahn and Kolb)	—	50	125	175	100
Horizontal milling machine (Steinel)	—	100	150	200	—
TOTAL	100	300	475	375	100

The reasons for which a relatively large number of machines are to be produced at the Centre are that it is desired to perfect prototype production and to implement a broad training programme built around a regular production line. Production of these machines by the Centre is to be discontinued in 1967.

The terms of collaboration between the Centre and the German manufacturers allow Indian small units to produce and sell these machines in the country. At the beginning, some complete sets of components were imported, ready to assemble. This allowed the fitting and assembly sections of the Centre to begin working at the same time as the sections manufacturing component parts—that is, the foundry, the forging shop and the machining shop—were starting their own operations. It is envisaged that the imports of component parts will be gradually reduced until finally they comprise only those items which carry proprietary rights or which are not manufactured anywhere in India.

A parallel method is followed for familiarizing small entrepreneurs with the products and processes developed at the Centre. At first, all the components and parts are provided to the unit for study and assembly, and, as the unit begins to manufacture its own parts and other units take up the manufacture of other parts, the Centre gradually fades out of the picture.

An effective form of organization would be to set up a functional industrial estate as a counterpart to a Prototype Production and Training Centre. Such an estate is devised for small enterprises producing parts of a given article, assembly being made in one of the units of the estate. The Centre would provide training and guidance to the small units and, if necessary, would in the beginning manufacture certain parts and undertake the assembly of the product. Later on, these functions would be taken up by some of the occupants of the estate. The Centre would continue to provide technological guidance and, if need be, common design and toolroom facilities.

Modifications in design, raw materials and process schedules

It is to be expected that, because of differences in levels of technology and in available facilities, the collaboration between the Centre and the foreign manufacturer and between it and the small units will be active for a long time. The fact that a few complete sets of components are originally imported from abroad does not usually mean that the product for which manufacturing rights have been obtained can be copied *in toto*. Certain parts may be far too complex to be copied in India, at least for some time, or may be far too expensive to manufacture. Such parts would continue to be imported from abroad.

Modifications of the product are often needed to meet local conditions, and the Centre has an important role to play in devising adaptations of processes and equipment.[1] Minor changes may need to be made in the sizes of such items as screws, nuts and bolts, so that they conform to standards in common use in India. Major changes may, for instance, be effected in raw materials specifications in order to bring them into line with resources available in the country. The case of steel is particularly serious in this respect.

In a highly industrialized country, securing the specified steel may be a matter of lifting the telephone and getting it "off the shelf". In a developing country such as India, where most of the steel alloys required are imported from abroad, this presents a grave and very difficult problem.

Even though the requirements of small units for any particular type of steel alloy may be very small, and even when they are given an import licence meeting their individual requirements, actual supply to the required standard and in the proper time cannot always be guaranteed. Foreign manufacturers of steel alloys are not much concerned over the small requirements of a single importer. Quite often, the types of steels required are not included in their current manufacturing programme and they may be reluctant to accept special orders for small quantities. Moreover, small industrial units are not in a position to carry large stocks of every type of steel required. These difficulties compound others arising for instance from the shortage of foreign exchange, and constitute a serious obstacle to the development of small-scale industries.

For the Prototype Production and Training Centres, the problem breaks down into two major parts. The first question is that of rationalizing the use of steel. In many cases, the wide variety of steels originally specified for the production of a machine can be reduced without affecting to any appreciable extent the quality of the product. Reducing the number of different types of steel to be imported makes it possible to increase the volume of orders for each individual type and so to induce foreign manufacturers to include such orders in their production programme. In the second place, the Centres will need to assure the small entrepreneurs that the substitute materials will be as good as those that they have used thus far, instruct them in the use of heat treatment processes appropriate to the new types of steel, and extend other advice and assistance. The Government is now considering the possibility of setting up, as part of the facilities of each Centre, a raw materials depot with a view, in particular, to importing special steels and supplying them to the small units in the region. Another, perhaps less obvious example of the need for local modification, relates to the type of lubricants to be used for the prototype machine. The basic principle in the area of design or modification of the existing design is to simplify by maximizing the number of standard component parts and minimizing the number of types and sizes of raw materials.

Replanning the process schedules for the manufacture of various components and the tools, jigs and fixtures required for manufacture is another important kind of modification carried out at the Centres. The technical information on this aspect supplied by the foreign manufacturer is at best a good guide. The schedules have to be modified to suit the scale of production and the type of machinery available not only at the Centre, but, more importantly, at the units which will undertake the commercial production. In the most extreme cases, the original methods are practically irrelevant to the developing country, for instance, when the machine to be developed as a prototype is to standard in the country of origin that it is mass-produced on highly productive automated equipment.

TRAINING

Training the staff of the Centres

The third main function of the Centres—training—is closely integrated with their production function. It is, in fact, attempted through supervised production. The staff of the Centres is trained by foreign experts before it begins to provide instruction to the workers of the small enterprises. The experts train the staff of the Centres through day-to-day work, exactly as, at a later stage, the staff will train the workers. To train the staff, the prototype production programme has been phased into three stages providing for progressively advanced instruction.[2] These are:

(*a*) Development of machinery and equipment through foreign technical collaboration with such modifications in design or manufacture as may be required to suit Indian conditions;

(*b*) Improvement of sub-standard products already manufactured in India by modifying design, processes, type of raw material and so on;

(*c*) Design and development of entirely new machines to suit local needs or export markets.

As the staff and the foreign experts take these steps together, they also develop ancillary appliances and tools. Special work benches, cupboards and portable, hand-operated cranes are some of the many items developed in this way at Okhla. While they have been developed in the first place for the Centre's own use, they have attracted the interest of many small manufacturers, some of whom wished to procure the new appliances and tools for their own use, and others to procure the drawings in order to manufacture the items for commercial purposes. Such type of subsidiary contribution by the Centres may be important enough to affect the planning of their production programmes.

Training the workers of the small units

Training the workers of the small units is the key element in passing from prototype production to commercial manufacture. If training is to be fully effective, it must be preceded by a careful selection of small-scale industrial units promising best to achieve commercial production of new items, a difficult task because many factors may make or mar this promise, such as the experience of the unit, its material resources, and the personality of the entrepreneur.

In spite of these difficulties, the selection of the units should be attempted well in advance of starting prototype production. An early association would yield immediate practical benefits in addition to the obvious long-term ones,

[2] In addition, special courses are organized for qualified technical and other personnel of the nation-wide extension organization in India, who provide technical assistance to small enterprises, and whose need is to keep up to date in their various fields of specialization.

since some forms of training could be provided to the various operating personnel as early as the planning stage, and be continued and developed as production is undertaken by the Centre. Thus, while the processes are being planned in the Centre, the supervisor of the small unit can be brought to the Centre for special training in this phase of the work. When tools are being designed and then manufactured for prototype production, the tool makers may be called in, and the moulders and machinists when the components are being cast or machined. Such a procedure would ensure the participation of the various categories of personnel in every stage of development of the product.

Proper training arrangements should greatly reduce or even eliminate disturbances and difficulties in the units resulting from absence of staff away for training. The problem need not arise significantly or at all in units newly set up for the purpose of producing the prototype machine commercially, provided the units are selected early enough. Their staff can then work along with the staff of the Centre as the latter develops the prototype, and begin work in their own unit whenever a stage of training has been completed. The position need not be different if an existing unit intends to expand into this new line of manufacture, since it will need new staff in any event. Disturbances can affect units which wish to change over from an earlier line of production to the new one, or which request from the Centre modifications in their established designs for reintroduction in the same shops. In such cases, the changes in design may be as upsetting as the training of the staff.

Technical personnel of small-scale units

There are in general three levels of technical personnel in a small enterprise in India: workers, technicians, foremen or supervisors, and superintendents or technical managers. In very small units, these levels are usually compressed into two and sometimes even one. Originally, the Prototype Production and Training Centres were to provide advanced training only to personnel having already acquired basic skills through formal training or experience. Now that some basic training courses have been organized for certain categories of technicians and foremen, the Centres have assumed responsibility for improving the technical skills of all three categories of technical personnel.[3]

To supplement such basic training, the Centres organize separate courses for skilled workmen, supervisors and engineers. Originally, the following qualifications were laid down for selecting trainees in these categories:

(i) *Skilled workmen:* minimum experience of three years, excluding period of earlier training;

(ii) *Foremen:* diploma holders with three years of practical experience; or skilled workers who after finishing the course under (i) above have further experience of about two years; or non-diploma holders with five years of practical experience, possessing prescribed qualifications;

(iii) *Superintendents and shop-masters:* practising superintendents and shop-masters, and foremen with minimum experience of five years.

While these selection standards could not be applied rigidly, minimum standards providing for practical and theoretical tests for all candidates before admission have been prescribed and held to for each course.

Emphasis on practical training

In all their courses the Centres emphasize practical training. Theoretical subject matters are left to be dealt with in vocational schools and colleges. At the Centres, teaching is focused on those aspects which allow the trainees to realize the causes and the advantages of each task. Such training has obvious limits: for instance, while the Centres can provide practical training to design and development engineers, they cannot go so far as to train them in machine construction; this is left to higher technological institutions in the country.

Since most of the trainees are already employed in small units, whether newly established or not, or in the Government's extension organization, both of which find it extremely difficult to spare their personnel for long, the training period must be as short as possible. Originally, none of the training courses lasted longer than six months. A few longer courses have now been organized for special purposes and for trainees who are to be employed in completely new vocations.

At the Okhla Prototype Production and Training Centre, the training courses cover the following subjects: turning, milling, gear-cutting, planing, grinding, fitting and assembly, heat treatment, electroplating, tool room, foundry, forge and sheet-metal work, welding, wood-working, pattern-making, materials testing, inspection and draughtsmanship and maintenance.

In the middle of 1962, there were 150 trainees at Okhla, divided into six categories:

(a) Skilled workers from small industrial enterprises in the age group of seventeen to thirty, employed in the engineering sections of their units. These workers have had one to three years' experience in the trade which they have chosen for training. They are able to read, write and understand English. Preliminary selection of the candidates was made by the Small Industries Service Institute which is the Government's extension agency at the state level, and the

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[3] Technical education is provided in India by the following institutions:

Technical high schools:
General education with emphasis on technical instruction

Trade schools, power technical schools and industrial training institutes:
Practical and theoretical training in particular trades, such as turning, fitting, welding and the like

Specialized schools such as those organized by ordnance factories and large enterprises of the public sector:
Practical and theoretical training in certain trades to meet specific requirements of the factories

Schools of engineering and polytechnic institutions (diploma courses):
Practical training with theoretical background in a field of engineering, such as mechanical and electrical engineering, ceramics, etc.

Engineering colleges (degree courses):
Theoretical training with practical bias in one field of engineering.

final selection by the Okhla Centre. The duration of training is six or twelve months, depending on the experience of the trainee. Each trainee is paid a monthly stipend of fifty rupees and provided with free furnished accommodation.

(*b*) Regular apprentices who are "freshmen" having passed matriculation, or an equivalent grade in science and drawing, and who have been recruited from all over India through advertisements in the leading newspapers. The course organized for them lasts three years. During the training, the trainees are paid a monthly stipend of fifty rupees for the first year, sixty for the second year and seventy for the third year.

(*c*) Trainees from Industrial Training Institutes, at the Centre for advanced training for one year. These trainees have had at least one year's experience in the trade, and have been admitted after the nominees of small industrial enterprises have been accommodated. They are subject to the same rules and regulations, and receive the same stipend as the latter.

(*d*) Graduate apprentices, at the Centre for training on an *ad hoc* basis. These trainees have competed for places with those from the Industrial Training Institutes, but do not receive any stipend or hostel accommodation.

(*e*) Assistant draughtsmen in training at the Centre, matriculates with at least twelve months' previous training in draughtsmanship.

(*f*) Junior trainees in draughtsmanship, matriculates in the age group of seventeen to twenty years with at least some basic knowledge in this skill.

It is expected that the total number of trainees at Okhla will increase as follows in the next few years:

Type of course	*Number of trainees*			
	1962	*1963*	*1964*	*Total*
Three years' apprenticeship course	—	—	21	21
Six months' course	207	240	240	687
Twelve months' course	100	200	200	500
Courses for assistant instructors, technical assistants, assistant draughtsmen, junior draughtsmen, etc.	69	140	140	349
TOTAL	376	580	601	1,557

Not included in this compilation are the technical specialists of the Government's extension organization and technical training institutes who come on an *ad hoc* basis for three to six months. They do not receive special stipend or accommodation.

Methods and contents of training courses

A number of broad guide-lines are used in framing the syllabi for the three main categories of trainees, the period of the courses varying with the nature of the trade and the grade of the trainees:

Skilled workmen are given theoretical training covering fundamental principles of different operations, types of machines and tools, blueprint reading, raw materials supplies and manufacturing techniques relating to their trade; and practical training in the operations allied to their trade and in the manufacture of component parts of machines and machine tools;

Foremen are given practical and theoretical training covering machine tools, structure and composition of raw materials, and manufacturing processes; inspection and testing, blueprint reading, design and manufacture of simple tools and implements; and practical training in operations allied to their trade and in the manufacture of parts of machines and machine tools;

Shop-masters and superintendents are given, in addition to the training imparted to foremen, courses in time and motion study, cost accounting, design and manufacture of simple machines, jigs and fixtures, and workshop management, including planning and production control.

In order to ensure that the setting for practical training approximates closely normal production conditions, all production departments of the Centres are organized on regular production principles. After an initial period of a few weeks, trainees are attached to permanent staff members of the Centre who supervise their work. They receive preliminary instructions on the job and are then expected to execute their work according to established standards. Supervision is maintained until such standards are achieved.

SOME OPERATIONAL QUESTIONS

LIKE OTHER ORGANIZATIONS, the Prototype Production and Training Centres have their share of day-to-day operational problems, the effective solution of which mainly depends upon the quality of their staff. In the following, some operational problems special to this new type of organization are examined, and some indications are given concerning the range of material resources required to set up new Centres.

Production-cum-training

The theoretical case for training personnel through actual production processes leading to finished products is a tight one, but such integration has real difficulties built into it. One problem is that production conditions for the manufacture of prototypes are not the same as for commercial manufacture. According to principle, when the two are proximate, the time has come for production to be trans-

ferred from a Centre to a commercial unit. However, if the principle were followed, it would not be possible to operate a Centre on a regular schedule since production schedules would change far more frequently than is sound for purposes of training. To avoid this danger, fewer items have been taken up for prototype production at the Centres than would have been desirable and the production of at least some items at the Centres is being continued well beyond the time needed to develop the prototype for commercial production.

The remedy to the above danger gives rise to another one, namely, that the attention of the staff of the Centre may veer away from the primary goal of manufacturing prototypes and training personnel to the subsidiary one of undertaking commercial production at the Centre itself. Encouragement has been officially given to the Centres to accept job orders on a non-commercial basis so as to put the equipment to maximum use, although it has been clearly stated that such orders could only be accepted if they would not hinder performance of the Centre's primary functions. The operative question is whether commercial production threatens to preoccupy the attention of the Centres' staff. Whether this danger is avoided or not depends to a large extent on the criteria by which higher levels of the Government evaluate the operations of the Centres. It can be minimized if they assess the operations primarily in terms of the original goals of the Centres and do not allow themselves to be sidetracked into assessing these institutions as if they were commercial units.

Staff of the Centres

As in all training institutions, the number and quality of the staff of the Centres are the main factors influencing the speed and quality of the work, both as regards prototype production and training. They determine the "atmosphere" of the Centre and the extent to which the staff can communicate to the trainees important matters beyond immediate technical training, such as, in the management field, record keeping procedures, inventory control systems, costing and financial accounting, and still more generally, standards of good order, cleanliness and punctuality; and, even beyond that, standards of personal responsibility and co-operation.

Persons able to live by such standards and communicate them to others are rare anywhere, and especially in rapidly industrializing countries. One consequence of this shortage is that the best among the trainees tend to be retained by the Centres on their permanent staff, while at the same time the Centres lose experienced staff very frequently. There is no doubt that quick turnover of staff affects the Centres' regular programmes adversely. It seems that the only way of remedying this difficulty is to organize a continuing programme of staff training, once the limitations imposed by the government machinery on recruitment of permanent staff can be relaxed.

Sharing the expenditure

In principle, all three parties to the benefits of training are to contribute to its cost: the Centre, the trainee himself, and the small unit which has deputed him. The small unit may pay the trainee a part of his normal salary for meeting family expenses during the training period. The trainee may cover some additional "out-of-pocket" expenses. In practice, it has been found difficult to enforce this principle rigidly without losing the interest of small entrepreneurs in sending their staff, and that of the staff in coming, to the Centre. This touches major questions relating to the appreciation accorded in rapidly industrializing countries to learning practical skills and to the traditional relations between people and their government. Meanwhile, the stipends paid to trainees are adequate to meet their cost of living at the Centres.

ORGANIZATION OF NEW PROTOTYPE PRODUCTION AND TRAINING CENTRES

THE ORGANIZATION AND working conditions as well as the buildings and campus of each Centre should be so planned that they not only fit into the development programmes but also leave the trainees with a lasting memory of their stay at the Centre and establish and develop ties between them and this institution in the future. Every facet of the Centre's organization and activity should promote better human and professional communication.

Some features of the Okhla Centre

The buildings and their layout can in themselves be prototypes. At Okhla, extensive use has been made of prefabricated components in putting up the structures. The roofs are of light foam-concrete slabs which are both neater and considerably cheaper than other load-bearing materials. Since the Okhla Centre was built, these features of its construction have been adopted by many industrial units.

In view of the fact that no regular production programme is ever scheduled for a definite period ahead, all sheds at Okhla are so designed that the layout of machinery and the sequence of operations can be readily changed. There are no inside pillars. The roof spans and the over-all length of individual sheds are great.

Similar considerations have determined the layout of the electric installations. An overhead wiring system has been installed. The distribution lines in the factory sheds branch off from the feeders along the larger walls and are carried on pillars standing on the floor with only light fastening. The arrangement can be easily adjusted to every change in the layout of machinery.

Another special feature of the Okhla Centre is the provision of a visitors' gallery running along the entire length of its main sheds. A production factory would not need this, but a Prototype Production and Training Centre is a place where visitors—officials, technicians, owners and managers of workshops and factories, students, people from all walks of life—come every day. Permitting free access to the Centres is an effective way of demonstrating development work in a stimulating and convincing manner. The gallery provides visitors with an unobstructed view of activi-

nes in the shed while preventing them from interfering with the regular flow of work.

Some less important features of the buildings include the following: the administrative buildings and classrooms are away from the workshops, to avoid noise, dirt and gases; stores are at one end of the workshops—though in close proximity, they need to be separate in order to reduce fire risk; workshops liable to accumulate or disperse dirt or dust are situated as far as possible from those requiring freedom from dust; wide traffic lanes are provided in the workshops for floor level transport of materials; inter-shed transport is effected by suitable lift-type carriage and battery-type electric carriage; an overhead travelling crab system is a desirable feature along the entire length of the two transport lanes.

Machinery and equipment

As a rule, small-scale enterprises employ principally general-purpose machines, and it may take a long time before they are able to acquire labour-saving machinery involving high investment. Accordingly, if a Prototype Production and Training Centre is to meet the needs of small enterprises, its equipment and machinery should not be of the very latest and most modern type. If they were, the training received would be of little use to the workmen upon return to their units. On the other hand, the Centre's equipment should be better than the sub-standard machinery usually available in small enterprises. The equipment should therefore be standard and well above the general level of small industry, though within its reach with some effort. Some special equipment to provide common service facilities to small units must also find a place in a Centre. In India, examples of such equipment are gear-manufacturing and jig-boring machines.

The selection of machinery for a Centre poses major problems of a special nature inasmuch as the production programme—that is, the nature and quantum of the workload on different types of machinery—is not known in advance. The production programme will vary with changes in the prototype programme, and the latter should be projected in advance so as to have a balanced availability of machinery and equipment. The provision by the Centre of common service facilities (for instance, heat treatment and laboratory testing) and the use of machinery for job orders both help to ensure a balance in the utilization of equipment which might be difficult to achieve in the production of prototypes alone.

The equipment for individual workshops and the inventory of parts and supplies required for carrying out all phases of work and practical training cannot be planned in detail far in advance, and will in part be contingent upon the development of the prototype programme. The Okhla Centre, which specializes in machine tools, has all the sections required in a modern engineering workshop: machine shop, foundry, carpentry, smithy, metal finishing shops, design office, sheet-metal shops, and so on. Each section is well equipped to cater to the normal requirements of all phases of the Centre's activity. In the initial stages, some outside job orders were taken to utilize idle equipment and to organize proper training while the normal work of the Centre gained momentum. The equipment at Okhla cost nearly six million rupees ($1.2 million) for a training capacity of 250.

The lecture rooms are simple but are furnished with teaching aids, such as projectors for films, film-strips, and overhead projection. Extensive use of audio-visual aids helps in reducing the period of training.

Personnel

Since the activities of the Centres are both very important and quite new to India, it is essential to get the best available persons in the country on their staffs. In some cases not even the best available is good enough, and assistance from foreign governments in the form of services of technical experts is needed to support the indigenous talent. In India, specialized assistance from abroad has been obtained in many fields, particularly design, time study, work measurement and job preparation.

While the foreign experts' knowledge in their fields of specialization can safely be assumed, more often than not their experience of India is limited or nil, and they may not therefore readily fit their knowledge to the actual working conditions. When a foreign expert teams up with an Indian there can be a happy blending of the former's technical knowledge and the latter's local experience. In the Centres, as in other institutions or factories, the foreign experts are placed in positions where they do not have to implement the programme directly, but are expected to provide advice and training. In the Centres, the local staff member is held fully responsible for the working of his section, and foreign experts assist him in doing the job. The key role of the foreign expert is clearly that of training his counterpart to do a job rather than doing the job himself. It is usually possible for the Indian counterpart to take over full responsibility within three years.

There are certain limitations to training Indian personnel at the Centre with the help of foreign experts, particularly as regards technical staff at the higher levels. There are programmes for sending personnel abroad for further training, whenever possible at the foreign firms which collaborate with the Centre in its manufacturing programme. Overseas training is preceded by six months to one year's work at the Centre, as it has been found that only then does the staff obtain full benefit of its stay abroad. Overseas training is granted subject to a guarantee from the trainee that he will serve with the Centre for a specific period upon his return to India.

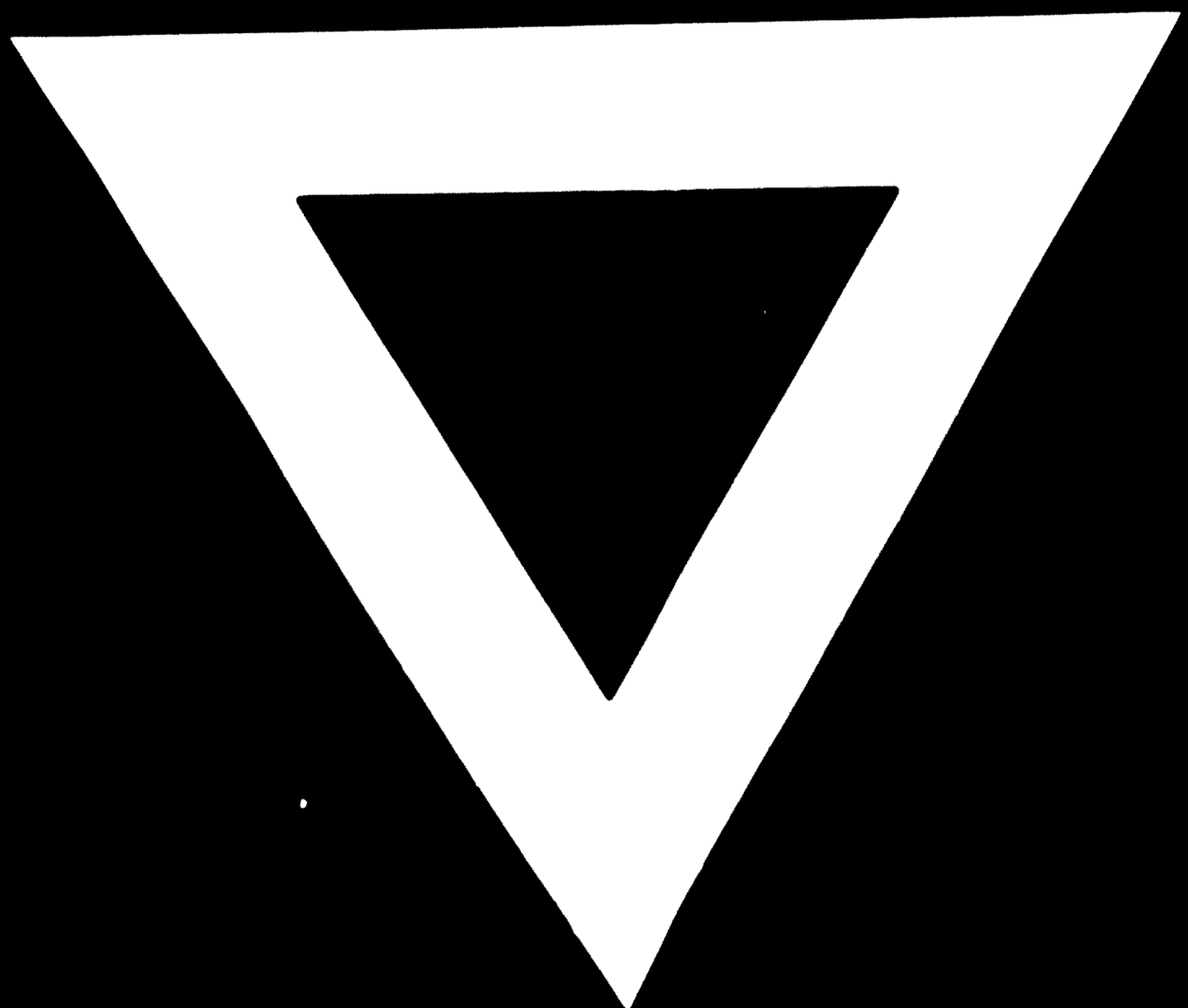
Financing

The initial investment in each Centre thus far established in India has been about ten million rupees ($2 million). About half of this expenditure has been met by foreign countries—the United States at Rajkot, the Federal Republic of Germany at Okhla and Japan at Howrah. Their contribution includes the foreign exchange costs of equipment, expenditure on foreign staff for an initial period of three years, and training costs of Indian instructors abroad. The rupee costs of the project for land and buildings, Indian staff and other working expenses are met by the Government of India.

CONCLUDING REMARKS

THE PROTOTYPE PRODUCTION and Training Centres are an important new link in the chain of institutions servicing and assisting small-scale industries. By concentrating on producer goods which can both be manufactured and used by these industries, they contribute directly to the acceleration of industrial growth. By fostering complementary relationships between small-scale industries, they contribute to strengthening this economic sector. Their work is complementary to that of technological research institutes in solving the problem of adaptation of equipment; to that of small-scale industries service institutes and industrial extension centres in providing specialized technological assistance and advice; and to that of educational and training institutions in providing specialized practical instruction.

Since the major function of Prototype Production and Training Centres is to facilitate the transfer and adaptation of technologies developed in the advanced countries, foreign assistance will in most cases be necessary to set up such institutions in the industrializing countries and to provide guidance and training, including fellowships, in the first stages of their operation. In India, such assistance was provided under bilateral agreements. It is suggested that industrializing countries could usefully request it also from international organizations. In some cases, expert advice may be needed to conduct investigations prior to starting a programme of establishment of Centres. In many cases, the supply of funds to meet the foreign exchange costs, in particular those of equipment, would be a useful adjunct to the provision of expert help and fellowships, when permitted by the statutes of the contributing organization.



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