



**TOGETHER**  
*for a sustainable future*

## OCCASION

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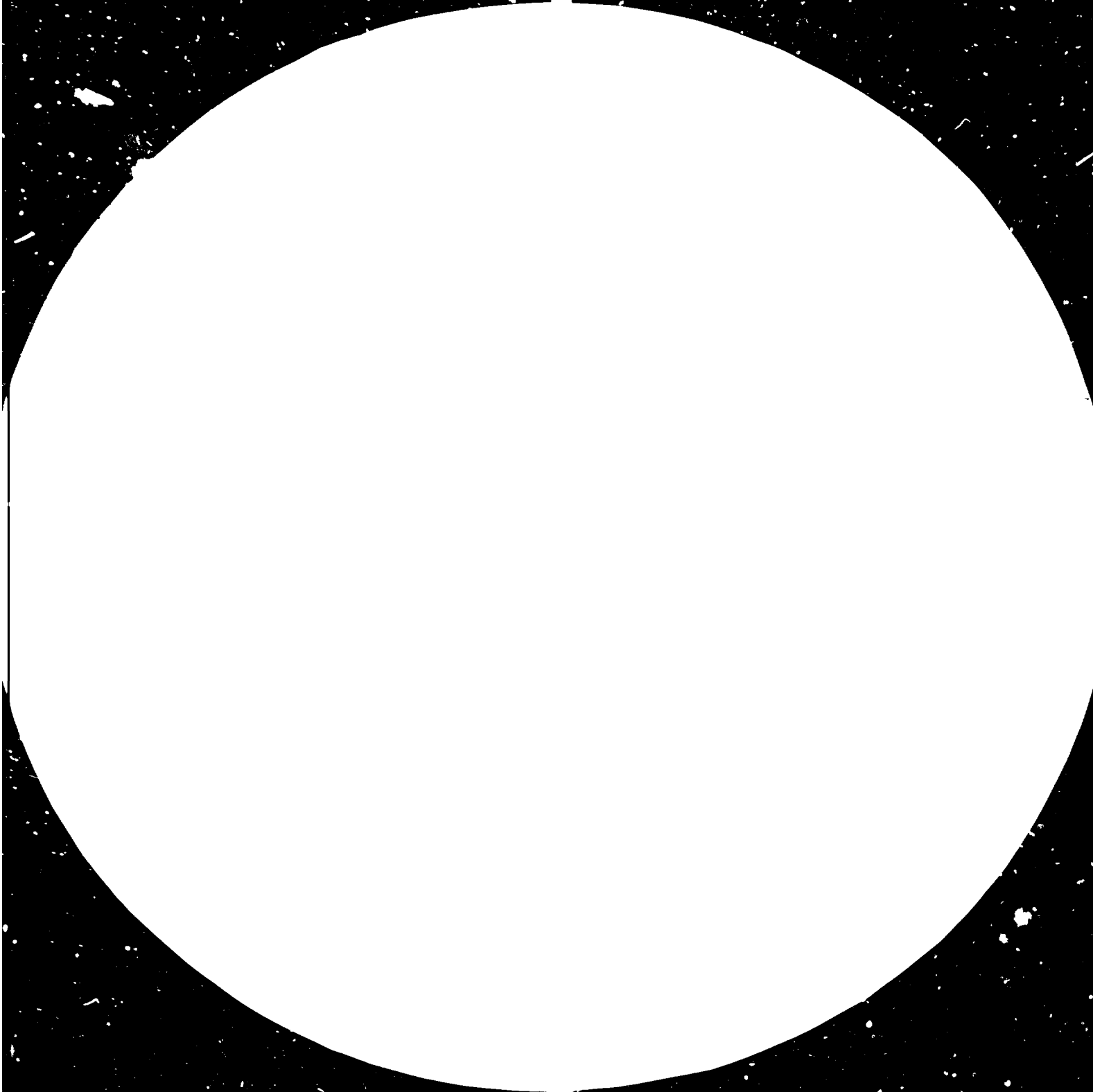
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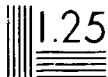
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## *Preface*

Since 1967, the United Nations Industrial Development Organization (UNIDO) has adhered to its mandate "to promote and accelerate the industrialization of the developing countries" by responding to requests for technical co-operation in all aspects of industry from the Governments of those countries.

This commitment to industrialization as a means of improving the living standards of nearly three quarters of the world's population, which was first outlined in November 1966 by the United Nations General Assembly in its resolution 2152 (XXI), has since been intensified. The Lima Declaration and Plan of Action on Industrial Development and Co-operation, which was adopted by the Second General Conference of UNIDO in 1975, called for an international effort to increase the developing countries' share of world industrial production to 25 per cent by the year 2000. This goal was further emphasized at the Third General Conference of UNIDO, held at New Delhi, India, in early 1980, with the adoption of the New Delhi Declaration and Plan of Action on Industrialization of Developing Countries and International Co-operation for their Industrial Development.

In the series of booklets *UNIDO for Industrialization*, of which this is one, an attempt is made to describe briefly the contribution of UNIDO, through its Division of Industrial Operations, to the industrialization of the developing world and to give examples of what has been done and will continue to be done to accelerate the process.

## FINANCING UNIDO ACTIVITIES

The bulk of the costs of UNIDO administration and research, now approaching \$US 48 million annually, is met from the **regular budget** of the United Nations, as are some lesser expenditures reserved for certain advisory and training activities. Once UNIDO achieves the status of a specialized agency within the United Nations family, it will cease to be funded from central sources of the United Nations and will rely on its own budget based upon contributions from its member States.

Technical assistance programmes for projects in developing countries, however, are funded from varied sources, the most important of which are summarized below.

By far the largest share of the field activities of UNIDO, some 70 per cent of the total, is funded from the **United Nations Development Programme (UNDP)**. Thus, a high proportion of UNIDO field projects are subject to UNDP approval before implementation. Since the ultimate source of this money is the contributions of the member States themselves, both developed and developing, it can truly be said that UNIDO field activities are self-help programmes, initiated only at the request of Governments of developing countries and using funds to which many developing countries themselves contribute. These funds are allocated to particular countries from UNDP sources up to a predetermined amount known as the indicative planning figure (IPF). They cover the whole spectrum of United Nations assistance to those countries, industrialization being only one of many programmes needing financial support.

Country programmes normally have a five-year span; and the available funds, which vary from country to country and are weighted in favour of least developed countries, must be allocated to specific projects within a country during the five-year period.

**Special Industrial Services (SIS)** funds are confined to a narrow range of expert services provided for unexpected high-priority projects that are called for from time to time. The programme is restricted to short-term projects of limited cost, and during recent years \$US 3.5 million has been set aside annually to support it.

The **United Nations Industrial Development Fund (UNIDF)** was created to finance innovative projects, preferably projects having a multiplier effect. The Fund consists of contributions pledged by individual Governments, and in some cases the purpose of the contribution is specified. Pledges are made in convertible and non-convertible currencies.

**Trust funds** are provided by participating Governments for specific projects to be executed by UNIDO in accordance with agreements reached with the contributing countries. They are used, typically, for technical assistance, expert services and specialist training.

The small regular programme of technical assistance provides funds for types of technical assistance that either complement other programmes or do not lend themselves conveniently to alternative means of financing. In particular, this type of funding permits a certain degree of flexibility in spending, since the allocation of the funds available is entirely under the control of the principal policy-making organ of UNIDO, the Industrial Development Board. Programmes are designed to reflect the emphasis on special measures for the least developed countries, on technical co-operation among developing countries and on establishing and strengthening industrial training facilities in developing countries.

## Foundry industry

The foundry industry belongs to the metal-forming activities of the metallurgical industries and represents perhaps the oldest and most traditional method of manufacturing in history. It may play a critical role during the various stages of economic development, even in the least developed countries, and is therefore of great interest to developing countries.

In the developing countries, the foundry is in many cases a supplier of simple spare parts, with a smaller portion of its production being incorporated in new, locally built equipment. Nevertheless, plants that melt and cast many hundreds of tons per day and those that produce only a very few tons of cast parts per day can be found in the developing as well as the developed world - each plant size fulfilling an indispensable role in supplying the castings required by industry, agriculture, homes etc.



*Tapping in a grey-iron foundry*

### UNIDO POLICY

To fulfil its mandate "to promote and accelerate industrialization of developing countries with emphasis on the manufacturing sector", UNIDO endeavours to ensure that industry shall be provided with the basic general

services that will guarantee its operation. The efforts of UNIDO are therefore directed towards the establishment of industry within the developing world and promotion of its technical progress.

UNIDO regards the foundry industry as one of the essential industries, as it is complementary to any metalworking or metal-processing activity.

## **UNIDO ASSISTANCE**

Where markets or available capital and technical resources are restricted, UNIDO can assist in establishing a foundry in conjunction with other related industries, such as a rolling mill or forging shop, in order to utilize fully the equipment and qualified personnel available. UNIDO can also promote the technical progress of the foundry industry by assisting in establishing laboratories and quality and process control systems and by introducing more sophisticated manufacturing processes.

The establishment and progress of a foundry with the characteristics set out below can be considered indispensable to the satisfactory progress of any industrial development programme. When the areas for action have been identified, UNIDO can, upon request, give technical and administrative assistance.

### **The small jobbing foundry**

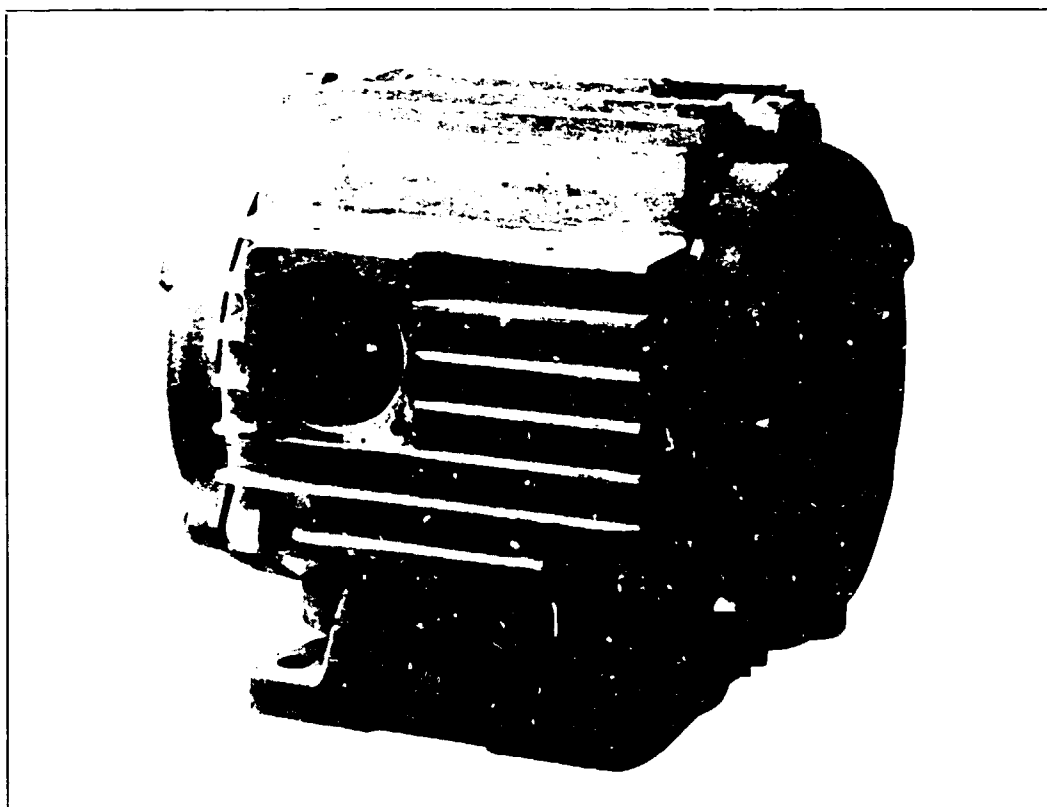
The small jobbing foundry can be found in almost all except the least developed countries. The purpose of a small foundry in developed and many developing countries is to provide an elastic service to industry and agriculture, or any sector of the economy that requires small quantities of high-quality castings, and very rapidly. It must therefore be versatile, flexible and technologically competent, since it will be expected to melt and cast practically all the alloys produced by normal foundry practice and to replace sophisticated parts by spares that must give service at least until an imported spare part arrives.

While the production costs of a small foundry are higher than those of a large foundry, the difference is usually not great.

### **The small jobbing foundry in a least developed country**

A foundry in a least developed country may have greater responsibilities, as it will probably be the only foundry in the country or region capable of producing quality castings. It must therefore be even more versatile in its range of products, since it will be expected to produce castings that would in the developed countries normally be handled by large production foundries. In addition, the foundry will be expected to select the correct material for an application and to advise the consumer on matters not always directly related to foundry products or operations.





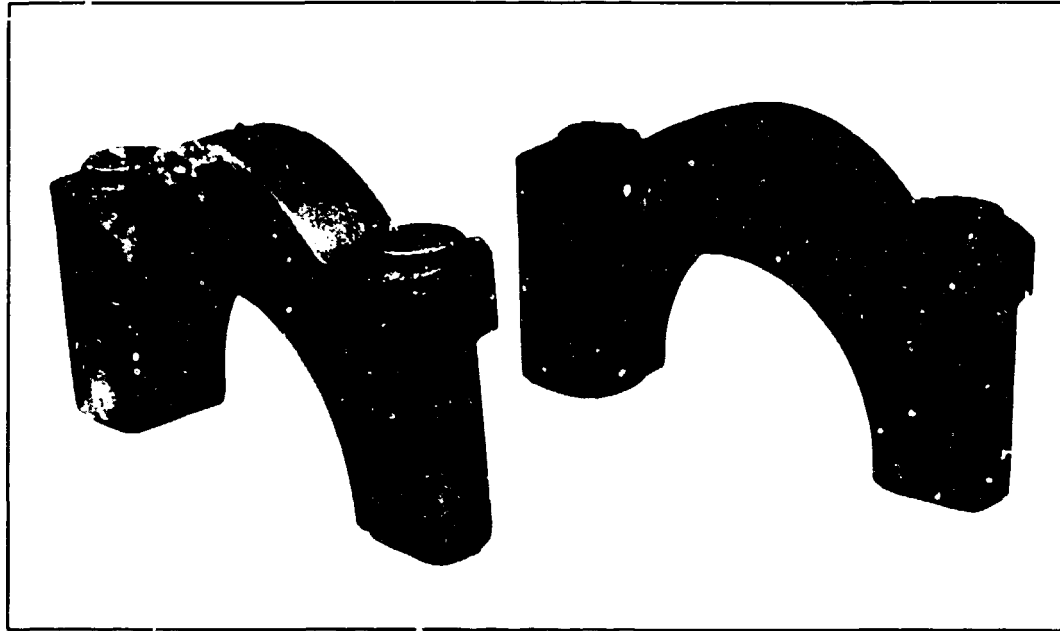
*Inoculated grey-iron casting for an electric motor*

The foundry will also substitute locally produced goods for imports; the shipping and handling costs for many low-cost elements may more than double the price for the importing country, a price that must be paid in scarce foreign exchange. The existence of a foundry will permit not only the direct substitution of imported castings but in some cases also the local manufacture of equipment in which castings are used, even should these castings be of minor importance.

Within a small jobbing foundry in a least developed country, machine shops and sheet-metalworking operations are also frequently required. With these two essential additional operations, a versatile foundry can offer the most adequate service and can rapidly construct or reconstruct those items of equipment necessary for the progress of the smallest production unit.

To sum up, the objective of a small foundry in a least developed country, as envisaged by UNIDO, is:

- (a) To maintain existing machinery and equipment in operation by supplying or substituting parts and by providing technical assistance;
- (b) To assist, by supplying parts and technical assistance, in the construction of new equipment;
- (c) To make substitutes for imports;
- (d) To work with and perhaps promote the establishment of other metal-forming or metalworking activities.



*Semi-finished castings*

#### **Foundry with integrated rolling mill and forging shop**

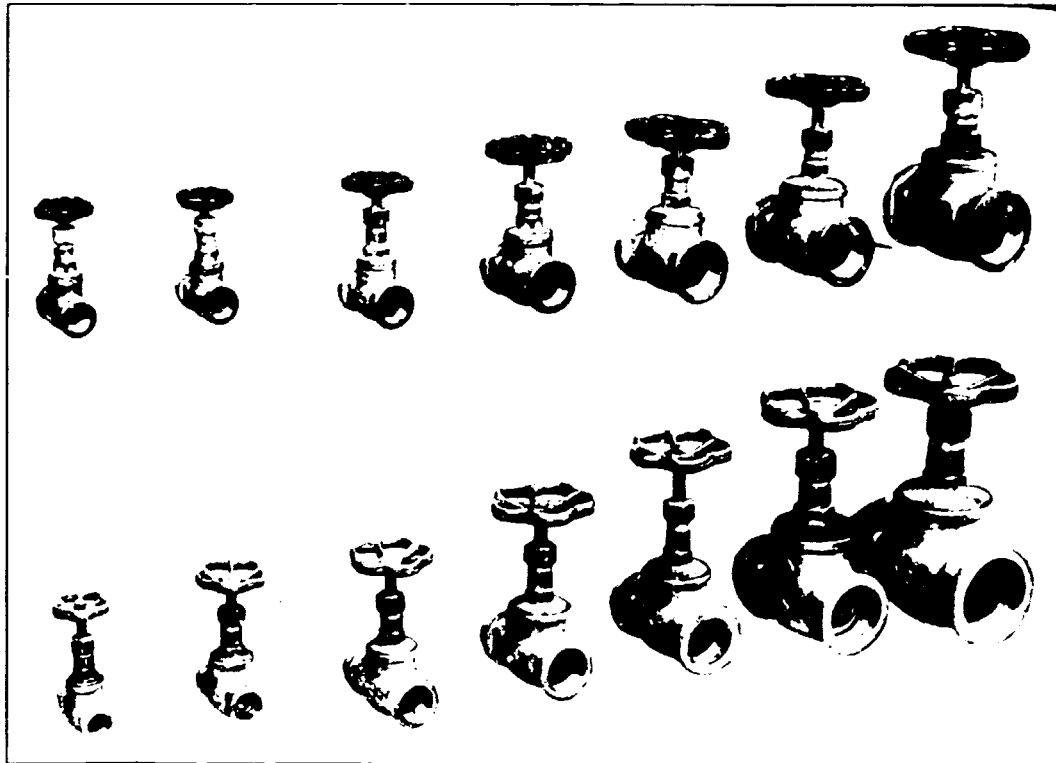
In a developing economy there will always be a considerable need for low-tensile steel rods for reinforcing concrete, simple constructions and general mechanical work. There will also be a constant demand for simple forged agricultural implements, hand tools, bars etc. Such products may be manufactured using low-cost equipment, such as a simple non-automated rolling mill and forging hammers, if there is a ready availability of ingots for the rolling mill and for stock for the forge.

A foundry has the equipment to provide ingots to the rolling mill, and a rolling mill can break down ingots to bar stock for the forge (if the stock is not imported). Considerable savings in equipment, manpower and technical expertise can therefore be achieved if these operations are combined within one plant.

If they are combined, however, much more scrap steel will be needed to feed the melting furnaces. UNIDO therefore suggests establishing such a plant only in those areas where there is a guaranteed availability of scrap steel, from the local market or imports.

#### **Technical co-operation among developing countries (TCDC)**

In many developing countries the foundry subsector is highly sophisticated. For instance, India, whose commercial foundry tradition is very old, is a considerable exporter of high-quality castings. Argentina and Mexico have well-developed automobile castings industries, producing engine blocks etc. Peru produces high-quality replacement parts for ore-crushing machinery.



*Water valves made from brass castings*

Such countries are a very important source of technical assistance for other developing countries; their experts are increasingly recruited, and their installations may be used for training foundry personnel from the developing world. The advantages to be gained from tapping this source are many, but perhaps of greatest importance is that such experts understand the problems of a developing country.

This concept of TCDC is exemplified in pilot foundries as well as regional training units.

As its name suggests, the pilot foundry was conceived as a small but complete production unit, capable of producing high-quality castings using one or more melting methods and a series of sand-moulding systems. The installations of such a foundry may serve originally for training local or national foundry personnel, and are generally under the management of an institution for higher education, apprentice training programme or similar.

A regional training unit is essentially a pilot foundry at the international level, that is, it will have to meet the requirements of trainees from different technological environments. Established within the borders of a region by the agreement of a group of countries, such a unit assists personnel from that region in acquiring specific skills within the complete range of small foundry activities.

#### **PROJECT PROPOSALS FOR UNIDO ASSISTANCE**

Projects may be proposed to UNIDO, through the local resident representative of the United Nations Development Programme (UNDP); by Governments; public and private institutions; industry, both public and

private; and by individuals. In its turn, UNIDO may also identify possible projects, based on reports of other organizations or on the reports or suggestions of UNIDO officers in the field.

Descriptions of possible proposals and their scope given below should be considered illustrative of the activities of UNIDO in this field and not a definitive and exclusive list.

### **Pre-investment and advisory services**

Upon request, UNIDO provides experts to make pre-investment studies such as feasibility and market studies and to select the appropriate technology for a plant.

### **Market study – product identification**

A market study is the base for any investment and growth programme, but it must be accompanied by a knowledge of the casting processes and the production development procedures. This knowledge can be provided through UNIDO.

### **Regional training unit**

As mentioned above, a regional training unit is a fairly sophisticated technology plant. While usually attached to a public or state institution, such as an institution for higher education, a technical training centre or similar, it may also be an independent facility. Such a unit comprises:

- Technical library

- Complete foundry laboratory

- Small machine shop for maintenance work for preparing specimens for testing

- Foundry, with melting units, sand preparation and handling equipment, cleaning and fettling sections, heat treatment and others, as necessary

UNIDO may be required to assume the responsibility for all phases of development of a unit or merely to complete an existing installation. The technical project, equipment and staff training are provided, as necessary, and in exceptional cases UNIDO may also contract the civil engineering works.

Students from the region are helped to master foundry techniques and theory within programmes directed at the various levels of operation and on a progressively higher technical level, in accordance with actual requirements. They may return to continue training as necessary.

The unit fulfils the critical role of consultant to foundries within a region (and outside where possible), and its laboratories are available to assist in determining process variables and in strengthening product

quality control in implementing of appropriate foundry technologies and laboratory and quality control methods.

Although it is not envisaged as a commercial enterprise, a regional training unit may utilize its equipment for producing castings for local sale if the market so requires and if government commercial policy permits. Together with the income generated by the laboratory, this helps to defray operating costs and to make a unit self-supporting.



*Training in a demonstration pilot foundry*

### **Commercial foundry**

UNIDO is able to consider any project involving a commercial foundry. It may assist through the provision of experts to raise the technological level of one or more foundry processes, through training programmes for personnel in or out of the home plant, through the supply of essential laboratory equipment, or through market studies, feasibility studies, project elaboration, project engineering drawings etc. Under very special circumstances, UNIDO may assume total technical responsibility for a turnkey project. The availability of any of the services for a given country depends on local conditions.

### **Foundry integrated with other productive activities**

The existence of a proved market for metal products such as simple forgings, rods and bars for reinforcing concrete, and simple rolled shapes such as angle iron may necessitate the establishment of a forging shop or small rolling mill or both. There may be a growing mining or other manu-

facturing industry that requires machined castings, and thus a machine shop must be installed.

If there is a sufficient supply of raw materials and a feasibility study is positive, UNIDO may actively promote the establishment of a multipurpose operation, with the foundry as the basic activity. Such an operation costs little more than the basic foundry project and offers distinct savings when compared with a series of isolated plants, by avoiding duplication of such elements as management and administration, technical staff, laboratories, building and infrastructure. In certain operations considerable savings will be evident. For example, ingots will not need to be cooled and reheated so drastically before being fed to the rolling mill; there will be no need to accumulate large stocks of ingots and bars for the rolling and forging operations, as would be the case if they were imported.

Care has to be taken, however, to ensure that no one of the activities becomes dominant.

### **Foundry and metallurgical laboratory**

UNIDO can advise on the structure and work methods to be used for quality control of raw materials, process control within the plant and the final quality checks of finished products. Types of equipment will be recommended in accordance with the production processes in use or to be used. If necessary, adequate training of personnel will be assured through on-the-job training or fellowship programmes.



*Foundry laboratory*

### **Technological improvement and technology transfer**

UNIDO is able to assist in improving existing operations by upgrading techniques, introducing more adequate or modified process con-

trols, and suggesting minor modifications to equipment and organization of the operations. Where necessary, assistance may be given in the introduction of new production methods or processes or technology changes, as requested by Governments.

### **Foundry process design**

As indicated above, UNIDO may undertake project engineering etc., including changes to and expansion of existing plants, where it may be advantageous to restructure or produce a new design for some section of a plant.

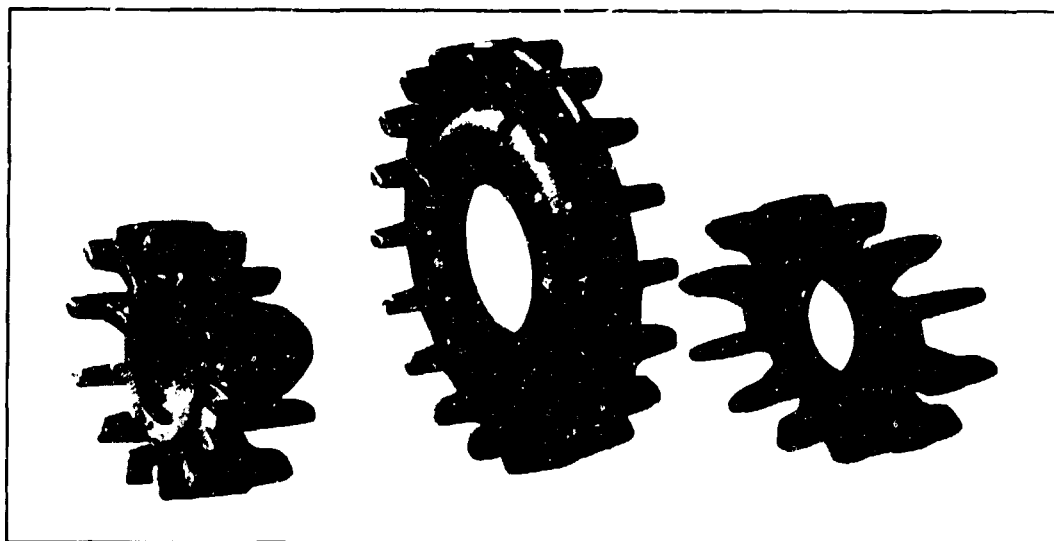
### **Introduction of new casting processes**

Several casting processes exist, designed for the production of precision castings or for large production runs of small and medium-size parts.

The investment casting process is used for the production of high tolerance castings from carbon, low- and high-alloy steels and some irons and super alloys. The die-casting and permanent-mould processes are used to produce high tolerance castings from low melting-point alloys, such as zinc, aluminium and copper-based materials.

In investment casting, a mould is manufactured from a ceramic refractory material and is used once only, whereas the die-casting mould and permanent mould are made of steel, cast iron or bronze and are used continuously.

Such processes are not capital-intensive, but they require experienced personnel to manufacture the moulds. The manufacturing cost per casting largely depends on the cost of the moulds, since the productivity is usually very high. The introduction of such processes requires a careful market study, which UNIDO experts can undertake upon request.



*Modular cast-iron spare parts for the textile industry*

### **Pattern and match plate design and manufacture**

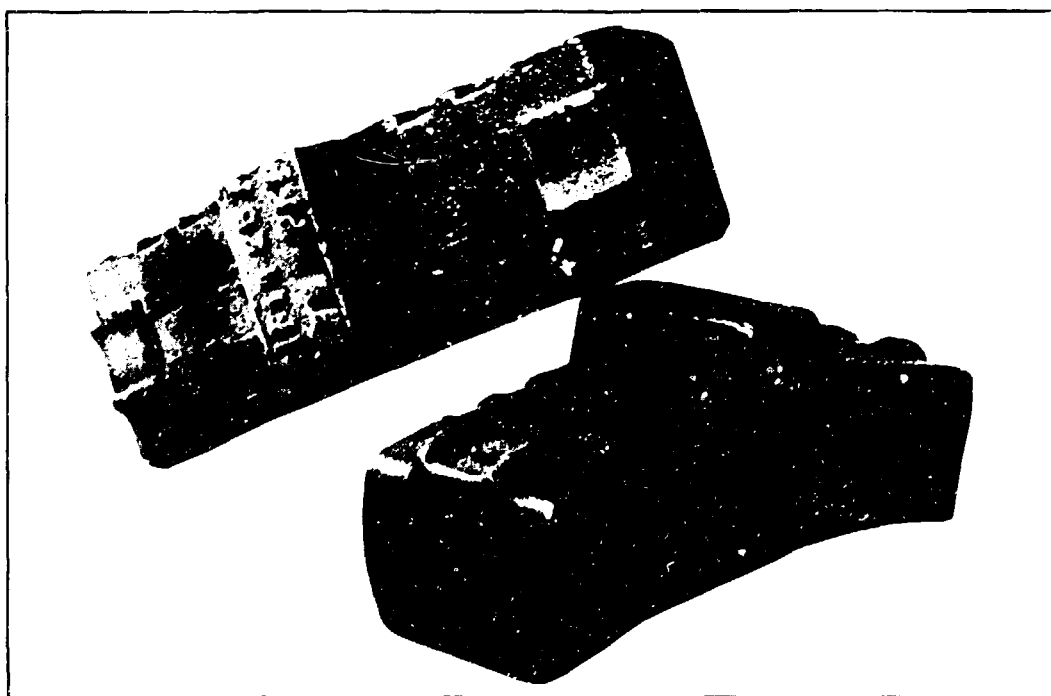
It is generally true that the success of a foundry may well depend on the capability of the pattern design and manufacturing section, and any foundry project should therefore define this area as soon as possible. It should also be remembered that the manufacture of patterns is a slow process, and that a large number are required by a jobbing foundry.

UNIDO attaches great importance to the introduction and consolidation of concepts and capabilities in the field of pattern and match plate design and manufacture and, upon request, may also provide assistance in this area.

### **Standardization, process and quality control methods**

Processes for the production of different types of cast steel differ. The same may be said of any alloy group; and the diversity of steels, irons etc. available can cause major problems to a foundry, which may be required to produce small quantities each of many classes of steel or iron, classified under many different national and other standards. To avoid this impossible situation, a foundry must select a series of materials to offer as standard production to permit the standardization of work method and processes.

The standardization of processes results in simpler process control methods, and thus the problems of quality control are reduced to a minimum. UNIDO is able to assist in standardization and in the introduction of suitable process and quality control by providing experts for industrial and institutional field work and by advising on, and in some cases purchasing, the necessary laboratory equipment for non-profit technical centres or demonstration units.



*Brake shoes made of cast grey-iron*



### **Reconstruction of existing foundry facilities**

Programmes to expand or improve products generally call for existing installations to be modified. This is usually considered an opportunity to restructure some operations not directly involved in a programme, since it can be done at little extra cost or inconvenience. UNIDO is able to advise in determining those areas where assistance may most profitably be supplied.

### **Improvement of foundry management**

Beginning with their reception and storage, raw materials must be moved in and out of the productive process systems and then subsequently processed for reuse or discarding. Production methods must therefore be organized in terms of production programming and materials handling, to attain the maximum possible efficiency and the most consistent quality in the finished product.

### **Commissioning of foundry plants**

The start-up and early months of operation can be considered one of the most critical periods in the life of a plant, during which work methods and systems are adjusted and modified. The correct judgement during this period of conditions and requirements is critical to the process of achieving optimum efficiency, determining the cost of start-up, and determining the percentage of capacity that will be available in the future. UNIDO assistance may be requested in optimizing the start-up operation.

### **Use and care of appropriate refractory materials**

The use of the appropriate refractory is of paramount importance for a developing country. Such factors as cost, storage life, operational life under different melting conditions, ease of patching and repair, and compatibility with other materials must be carefully studied. The possibilities for using locally produced raw materials to reduce import and inventory costs must always be considered. UNIDO services in this respect are readily available.

### **Foundry coke or charcoal**

The selection and correct processing of adequate grades of coal, or their substitution with specially processed grades and mixtures of coal and other sources of hydrocarbons, is under continuous study and development.

In certain areas of the world, notably Brazil, foundry coke has been replaced in part by wood charcoal. Since wood is a renewable resource, under correct management it can represent a permanent and very cheap source of reductant for pig-iron production and of energy for melting cast iron. For this reason, UNIDO has sponsored work in this field and can furnish expert assistance to those countries wishing to investigate the production of coke or charcoal for use in metallurgical processes, specifically in cupolas for foundry operations.

*For further information on UNIDO activities in the foundry industry, contact:*

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