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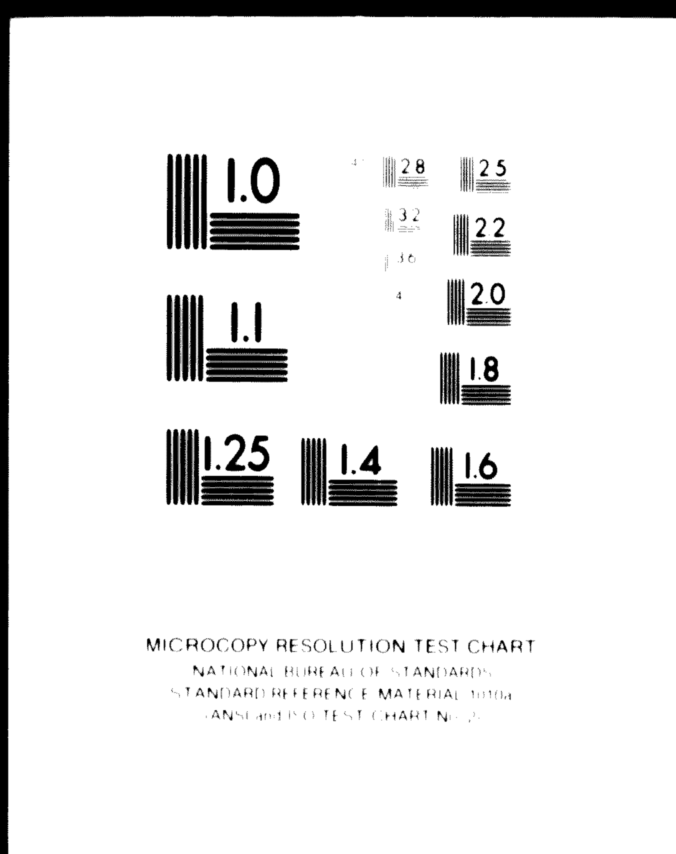
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ADVISORY SERVICES REPORT

FOR

SMALL SCALE INDUSTRIES DEVELOPMENT ORGANIZATION,
GOVERNMENT OF INDIA

ON

India. MODERNIZATION OF FOUNDRIES AND RE-ROLLING MILLS
IN THE SMALL SCALE SECTOR

by

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June 1973

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
Bangkok, Thailand

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RESTRICTED

MODERNIZATION OF FOUNDRIES AND RE-ROLLING MILLS IN THE SMALL SCALE SECTOR IN INDIA

June 1973

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SUMMARY AND RECOMMENDATIONS

This 6-week study was made for the Small Scale Industries Development Organization (SSIDO), Government of India, to assist in the modernization of foundries and re-rolling mills.

METALS IN THE SMALL INDUSTRY SECTOR

Significant role of small metal units

Small industries are playing a crucial role in India's development, due in no small measure to Government's assistance programmes and their effective implementation by SSIDO. Small metal processing units (excluding equipment manufacture) have doubled their outputs in the last five years, and today represent an estimated 15 per cent of the total small industry sector in terms of product value, (para 16, table 1).[a]

In view of their importance, it is considered necessary that metallurgical activities be further strengthened at SSIDO. Resources and personnel available, it would be desirable to have a Metallurgy Directorate at SSIDO itself and Deputy Directors (Metals) at SISIs in Maharashtra, Tamil Nadu, Delhi and other states which have a metals activity.

Need for reliable data

At present, practically no statistical data is available on foundries and re-rollers in the small sector. As a pre-requisite to a modernization programme, it is necessary to compile up-to-date statistics on capacities and production, to enable rational planning for raw materials, credit, training and so on.

Foundry and rerolling industries

Foundries

Roughly, there are some 6,000 foundries in India, of which about 5,000 are registered units in the small scale sector. The bulk of them produce grey iron castings, with rather a small number of malleable iron, steel and non-ferrous units. These 'backyard foundries', representing

/ about

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a/ Figures in brackets refer to paragraphs and tables in the text of the main report.

about ~~one-sixth~~ one fourth of India's total iron casting output, are doing a remarkable job. Using inferior raw materials and with minimal equipment, they produce castings of a quality and at a cost which serve a limited purpose, (paras. 22-23).

Geographical distribution

The bulk of them are around Batala, Ludhiana and Jullunder in Punjab, Agra in Uttar Pradesh, Ahmedabad in Gujarat, Madras and Coimbatore in Tamil Nadu, and Bombay in Maharashtra, (Fig. 1). Today there is no dearth of orders for foundries and most could sell twice as much if bottlenecks of raw materials, finance and technology could be resolved. The 1970-71 demand of about 2 million tons iron castings (excluding pipes) is expected to rise to 3.4 million tons by the end of the Fifth Plan. Small foundries can meet a larger part of this demand by modernization and better capacity utilization.

Rerolling mills

The rerolling mills generally roll scrap to bar products. Most of them are located in Punjab, UP and West Bengal. Today, with the acute shortage of steel, they are able to make a significant contribution to the economy (and also make good profits), even though again many operate with obsolete facilities. They play a useful role in salvaging a by-product (scrap) and converting it, at low cost, into usable materials.

Scrap distribution inequitable

Practically all available billets go to the 116 mills registered with the Steel Re-rolling Mills Association (SRMA). Some 30 per cent of scrap also goes to 96 scrap rerollers who are SRMA members. This leaves about 175,000 tons per year of scrap for allocation to 748 units in the small scale sector, that is 5.5 per cent of their two-shift capacity. While the controversy over rational allocation of billets and scrap continues, all units - small and large - remain under-utilized, though in varying degrees. There is a good case for a comprehensive reassessment of capacities in this industry, which could form the basis for a better evaluation of its role and a rational distribution of the limited billets and scrap available, (paras. 29-34, tables 4-5).

/ Obsolescence

Obsolescence of existing units

In about a month in the field, 84 foundries and mills were visited. During these trips the adviser was ably assisted by Mr. J.N. Bhakta, Deputy Director (Metallurgy). Based on observations on a small sample (about 2 per cent of total) and some norms for obsolescence, 70 per cent of the founders can be considered obsolete and 45 per cent of the rerollers. This is somewhat higher than the Newalkar Committee estimate of 35-50 per cent obsolescence in this sector, (para 36)

Consequences of backward technology

The consequences of backward techniques are excessive materials consumptions and poor operating yields, high rejections and inadequate product quality, limited product range, imbalances at processing stages and unsatisfactory working conditions. Under today's market conditions, the quality and range of their products are tolerated; tomorrow, they may not be, (para 38).

The need for modernization

Why modernization?

In a modernizing society, technological modernization is an inevitable component - whether in large scale industry or small. The alternative - stagnation - means slow but inevitable death. There is an urgent need to up-grade equipment and practices in the metals field in order to improve product quality through appropriate techniques, to reduce costs through higher equipment and labour productivity, to enlarge the product range for greater import substitution, and to improve the working environment. In most situations, it is cheaper to modernize and consolidate existing units rather than build new ones; concurrently, additional nucleii for growth have to be created in regions as well as in product lines which have remained undeveloped.

The low-cost, low-volume technology which the small units have evolved over the years has now to be revitalized, not replaced. In this process, not a single worker need be discharged although he may have to be deployed; not a single expenditure made which cannot, after an initial period, be recovered many-fold through lower costs, expanded production, and enhanced reputation for quality products, (paras 46-50).

/ Some

Fears expressed

Some fears were expressed regarding modernization, such as, the possibility of nationalization, or the loss of benefits by crossing the Rs 7.5 lakh investment restriction, or possible shortages of raw materials and markets after incurring costs on modernization, or major delays in implementing the programme. These anxieties can be allayed by careful explanation -- and action to match, (para 55).

UPGRADING THE TECHNOLOGY AT FOUNDRIES

During visits to foundries in 16 cities in various parts of India, the present facilities and practices were observed, data recorded on a comprehensive questionnaire, the type of improvements possible evaluated, and assistance given on queries raised. Meetings were also held with Industries Directorates, trade associations and others.

Profile of typical foundry

Typically, existing grey iron foundries visited had a production of 70-80 tons/month and an investment in equipment of Rs 50,000 - 70,000.a/ They usually run one or two cupolas of 24" to 30" internal diameter, and practically no other equipment. An analysis of the units studied indicates that 60 per cent had no technical staff, 60 per cent had no sand preparation facilities, 79 per cent had no machine moulding, and 88 per cent had no chemical or physical testing equipment, (paras 60-64).

	No. of units	% of total (33 units)	% in each size group, by No. of employees			
			0-20	21-50	51-100	Over 100
Technical staff	13	40	20	46	20	80
Sand preparation equipment	13	40	20	39	80	40
Machine moulding	7	21	20	8	60	20
Shell moulding	1	3	10	-	-	-
CO_2 process	5	15	-	8	40	40
Fettling equipment	15	46	40	31	60	80
Laboratory facilities	4	12	-	-	20	60
Equipment cost over Rs 100,000	14	43	10	31	80	100

/There is

a/ US$1 equals about Rs 7.50. The term 'lakh' denotes 100,000 and 'crore' 10,000,000.

There is an interesting similarity in size and technical level between small Indian foundries today and foundries in Japan in 1958. Since then, as a result of a massive modernization effort, the Japanese foundry industry has made phenomenal progress -- this gives hope and indicates the scope for improvement in India also, (para 65).

Layouts

Haphazard growth

Layouts at most Indian foundries are quite unsatisfactory. As they have grown over the years, new equipment has been added in a haphazard manner without consideration of the flow of materials (Fig. 3). In many units, most of the work is done in the open air, without any shed at all. From the date land is available, the cupola is fabricated and the first castings produced within 30 days!

Using simple planning techniques, the layout of most foundries could be improved radically and with only small expenditure on relocation of some equipment and purchase of materials handling facilities (bins, wheel-barrows, trolley-line, geared ladle, hand-operated crane). SISIs and NPCs could draw up alternative cupola foundry layouts which, with minor modifications, would suit most requirements (Fig. 4).

Labour

Labour productivity ranged from 0.5 to 2.0 tons per man-month. With some work simplification and mechanical aids it should be possible to produce 1 ton per man-month for medium-weight jobbing orders and 3 tons or more for heavy castings.

Arduous conditions

Most of the workers are paid on a piece-rate basis and much of the work is done by contract labour. For this reason, and due to the low wages (Rs 130-200 per month), the proprietor has no interest in installing new equipment, or even in using what is installed. The working conditions are often arduous, unhygenic and unsafe. Not a single safety device or first aid kit was seen. The small

/foundries

foundries are hardly meeting, what the behavioral scientists call, the 'maintenance needs' of their staff. They are still far from meeting the 'motivational needs', namely, the need for recognition and respect as an individual, for involvement in the task, and for challenge, (paras 71-74).

Possible improvements in cupola practice

For the types and qualities of grey iron castings being produced, the conventional cupola is undoubtedly the most economic, even though its thermal efficiency is only 25 per cent. However, the design of the cupola and its operation, control and maintenance in the small foundry are not satisfactory. Present cupola outputs and expected outputs with improved practice are shown in Fig. 2.

Standard cupola designs needed

SSIDC needs to have standard designs and fabricating drawings of three alternative cupola sizes (say 24", 30" and 48") prepared again, based on up-to-date technology and specifically suited to the inferior raw materials now available to the small foundries. Although such designs were said to exist, at none of the SISIs visited were they available. Parameters and outputs for typical practice are estimated in Table 8 and a cupola design suggested in Fig. 5.

Except for two units visited, the cupola was being charged manually by carrying heavy head-loads up a steep ladder. An electrically-operated skip discharging direct into the cupola could be fabricated locally for Rs 6,000 - 8,000. This together with a weighing scale would greatly facilitate and regularise cupola charging.

Suggestions for improvement

Factors in cupola operating practice which affect day-to-day efficiency include air blast; bed coke height; charge proportions, analyses and size; coke ratio and charging practice; and metal temperature control. Suggestions for improvement are given in the report (paras 76-83).

/Moulding

Moulding

Major advances are taking place not only in mass production but also in jobbing work. Precision moulding techniques are gradually replacing the traditional hand moulding methods, in order to produce accurate components with consistent reproducibility and low costs. With the increasing sophistication of industrial casting requirements in India in the Fifth Plan, the small sector foundries will have to switch over to some of these moulding techniques in the coming years.

Sand preparation essential

One of the basic steps in small foundry modernization should be proper sand preparation which includes cleaning and screening, removing metallics, measuring sand and additives, aerating and effective mulling to ensure uniform properties throughout mix. At the same time, some testing equipment is essential for routine shop tests on sand permeability, moisture, strength and mould hardness. Such control equipment would cost about Rs 5,000 and even a small foundry can afford this. Sand testing itself is meaningless unless proper co-relation is established with resultant casting quality.

New moulding methods

Where sand and gas costs permit, the use of CO_2 moulds needs to be encouraged. Shell moulding is also well suited for small foundries, and two units visited were using it successfully. For repetitive light and medium weight castings moulding machines, either hand-operated or jolt-squeeze type, are considered very desirable. Greater use needs to be made of snap flasks and stack moulding, where possible, (paras 89-91).

Fettling

This is generally a bottle-neck which is tackled by massive use of manual labour on contract basis. Apart from an occasional grinder, no equipment is used. Shot-blasting equipment, pneumatic chippers, swing grinders and tumbling barrels would be useful additions in most fettling departments.

/If all

Aggregation of needs

If all the requirements for testing equipment, cupola blowers, light cranes, mullers, etc. for industry-wide modernization were aggregated and bulk orders placed, then manufacture would be facilitated and prices reduced.

Testing and quality control

In addition to sand-testing equipment, a progressive small foundry, particularly if it is producing graded castings, should have (a) chemical laboratory for rapid carbon and sulphur determination, (b) universal testing machine for tensile and transverse tests and hardness testing, (c) bend and impact test equipment for malleable irons, (d) metallographic testing for special irons. Of course, as important as having this equipment, is to have the will to use it, day in and day out.

Check-list of quality controls

An effective quality control programme requires attention to a variety of variables, together with feed-back of data on resultant casting quality. A check-list of factors would include:

Materials & supplies

Analysis of pig iron and purchased scrap
Segregation of plant return scrap
Specifications of ferro-alloys and innoculants
Limestone quality, sulphur in fuel oil
Sieve analysis of silica sand to determine grain size distribution
Clay and moisture contents of sand

Moulding process

Sample castings for every new pattern
Quality and accuracy of patterns
Core fit, deterioration of mould boxes
Sand mulling, aerating cycles
Sand proportioning by weight or volume
Tests for moisture, permeability, green strength
Testing of return sand
Mould hardness and core hardness testing
Methoding of castings

/Melting

Melting process

Charge calculation and weighing
Chill test, carbon determination
Check pouring temperature with optical pyrometer
Control cooling and shake-out times
Temperature measurement of heat-treatment cycle

Finished casting

Inspection for dimensions, surface, casting defects
Analysis of rejections and modification of procedures
Hardness tests, microscopic examination of structure
Tensile and transverse tests of test bars
Yield strength and elongation for ductile materials
Spectrographic analysis of carbon, sulphur, phosphorous, and other elements for special irons
Impact testing for malleable iron

With phased introduction of the above checks as part of an overall quality control programme, the present casting rejection rate of over 15 per cent could be halved and the unit's reputation enhanced.

Capacity utilization

Only 20% utilization

In spite of good demand for castings, the iron foundries in the small sector are estimated to be operating at only about 20 per cent of their capacity. The recent electric power shortage has aggravated this problem. The technological improvements discussed in the report together with better raw materials availability and credit facilities, could improve capacity utilization, (paras 96-98).

Foundry mechanization economics

The small founder is caught in a vicious circle: he cannot modernize because he lacks money, and buyers will not pay more because his foundry is not modern enough to produce quality products! The foundry owner may feel that even if he improved his castings, the requirements of the market and the force of competition are such that he would not get a higher price. But even today there are buyers who are willing to pay more for better-quality castings; in tomorrow's market the 'modernized' unit would be more viable than the obsolete one.

/In the

Attractive returns

In the report a hypothetical analysis has been made of a foundry with a low existing level of technology and its economics after modification of practices and addition of equipment (para 100, tables 9-11). The results can be summarized as follows:

	Existing	Modernized
Production, tons/month	26	136
Manpower, staff	36	77
Salary cost, Rs/month	6,600	22,980
Investment, Rs	70,000	325,000
Production cost, Rs/ton	1,300	1,050
Casting sales price, Rs/ton	1,350	1,500
Pre-tax profit: total capital, %	12	88

Malleable iron castings

The investments and techniques needed for malleable iron production are well within the capabilities of the small sector, and with greater assistance from SISIs such units could play a larger role.

The oil-fired rotary furnace (with good monolithic lining, recuperation for heat economy, and pyrometric control) is considered a preferred unit for small malleable foundries. A hot-blast cupola could also be used, but a conventional cupola should be discouraged. Electric furnace melting and electrically-heated annealing furnaces may not be within the investment limits of the small sector, (paras 114-121).

Serious raw material problems

The most serious difficulties to be overcome are the high ash and poor strength of coke supplied to small foundries together with the high and varying phosphorous in pig iron. Dilution of charge with 30-40% steel scrap is a partial solution, while purchase of special foundry irons with low sulphur and phosphorous at high costs is another. Each plant has to work out its own charge compositions and its own malleabilizing cycles, to suit the available materials and desired end-uses.

/A modernized

Malleable foundry parameters

A modernized small malleable iron foundry would have typical parameters indicated in Table 13. For an investment of Rs 7.5 lakhs, annual sales would be Rs 21 lakhs, giving a pre-tax profit of over 60% on total capital.

Non-ferrous castings

Most non-ferrous foundries currently use coke-fired crucibles. Costs could be reduced by extending the life of crucibles through careful handling and melting procedures. At the same time, the economics of electric melting units should be given careful consideration.

The units visited generally use green, skin-dry and dry sand moulding. There is now enough experience on shell moulding and die casting in the small scale sector to warrant their adoption in the modernization of non-ferrous foundries. An outline of a 'modern' brass foundry is presented, (paras 129-134, fig. 6).

Pressure die casting

There is good scope for pressure die casting units provided that zinc and aluminium alloys can be made available in required quantities, die steel is supplied at controlled rates, and an inexpensive die-casting machine can be designed and fabricated indigenously.

Steel foundries

Practically all the six steel foundries visited produced alloy and stainless steel castings which require a high level of operating techniques and sell for upto Rs 45,000/ton. They use a variety of melting processes - thermit melting, mains frequency and high frequency induction melting, indirect arc furnace, plasma arc furnace, electric resistance furnace. However, the most suitable unit is considered to be the electric direct arc furnace. The need for proper sand preparation, testing and machine moulding is even greater for steel castings.

/To demonstrate

To demonstrate the viability of a steel foundry based on electric arc furnace a preliminary exercise is made in the report, (para 148, appendix 9). A foundry with even a small 1-ton arc furnace, producing 540 tons good castings/year, would require an investment of Rs 10 lakhs in equipment. While there are good reasons for retaining the present investment limit of Rs 7.5 lakhs for the small sector, here is a reason for extending the limit in order to include processes which are otherwise suited to this sector.

Small foundry of the future

Ductile iron - growth metal

Looking a little into the future, it seems clear that small foundries will have to expand into alloy steel and malleable iron castings. But the growth metal of the future will be ductile iron. It may be noted that in the U.S., tonnage of ductile iron castings produced overtook malleable iron in 1967 and further overtook steel castings in 1970. A research project is needed -- perhaps at one of the universities with foundry curricula -- to bring ductile iron within the technical and financial capabilities of the small sector.

Future outlook

The small foundry of the future could be designed to produce grey iron, ductile iron, ordinary and alloy steel castings using the same equipment. New 180 and 540-cps induction furnaces and arc furnaces could be the common melting units. Conventional green and dry sand moulding could be eliminated by complete chemically bonded systems. Polystyrene and epoxy patterns together with chemically bonded sand cores would provide flexibility. Mold blast cleaning would replace the conventional shake-out. It may be years before these techniques come to the small Indian foundry, but SSIDO should encourage thinking in this direction, so that progress is accelerated.

To survive the road ahead, work on modernization must start now. Let it not have to be said of the small foundries in India:

They rode the boom
Until the bust,
Now their patterns
Gather dust.

/IMPROVING

IMPROVING THE OPERATIONS OF REROLLERS

The scope for modernizing scrap rerolling operations is less and the need not as urgent as for foundries. Nevertheless, there are areas where costs could be reduced and products diversified by adoption of better equipment and techniques.

Typical scrap reroller

Typically, the scrap rerolling mill has 4 or 5 8"-stands with a batch type coal-fired furnace. Large manual force (on contract) is used to cut scrap for rerolling. There is no cooling bed. The mill equipment is often made at the factory itself, costing about Rs 2 to 3 lakhs. Generally only bars of 10-12 mm dia are produced. Output of an 8" mill with 200 hp drive is about 8 tons based on 8 to 10 hours rolling per day. Scrap is purchased at Rs 1,000 - 1,100 per ton and bars sold at Rs 1,800 - 1,900 per ton, (paras 151-158).

Suggestions for improvements

The types of improvements which may be considered for rerollers include the provision of small shears for scrap preparation, and replacing motor (or augmenting it by additional motor) when drive is inadequate. A 10" mill should have a drive of about 400 hp. Where possible, the V-belt needs to be replaced by reduction gear and batch-type furnace converted from coal to oil firing, with proper arrangements for combustion and temperature control. A pusher-type furnace could be added to allow for rolling of billets when available, as well as for rolling uniform types of scrap. A simple mono-rail would facilitate movement of billets or heavy scrap from furnace to first rolling stand.

Design of mill stands could be greatly improved and fibre bearings adopted. Where possible, 14" or 16" roughing stands could be added to enable use of larger billets and improve production. Repeaters can be designed for the finishing stands, provided scrap of uniform type is available. This would obviate manual looping. Provision of cooling bed and shear for cutting of products to required lengths is considered desirable. In some situations, coilers could be useful.

/Rolling of

Product diversification

Rolling of angles (upto 50 x 50 x 6 mm) and flats (upto 75 mm width), special sections such as gate rounds, drop rods, window sections and hexagonals for export as well as hoops, joists, ribbed bars and cold rolled strip could be taken up where mill facilities and markets warrant this, (paras 159-164).

Table 17 indicates the approximate production that may be expected from a well-run mill, rolling prepared scrap to 3/8" round, on the basis of one 8-hour shift per day, 25 days per month. If 2" x 2" billets were used, production would be approximately double. Fig. 8 suggests a typical good layout.

Contrary to the view generally encountered among rerollers, it would be possible to use a pusher-type furnace and repeaters when rolling scrap, provided that good re-rollable scrap is purchased and carefully cut to pieces of uniform size. In this connection, the description of a plant in Thailand is given (Fig. 9) which rolls scrap plate cuttings in a modern mill producing over 1,000 tons per month of 9 mm rounds on two-shift basis, (paras 167-168).

Alloy steel rolling

The present situation of inferior quality reinforcing rounds selling for over Rs 1,800 may not long continue and re-rollers must prepare now for more efficient operations and diversified products. Some rerollers who have good equipment could examine the possibility of adding facilities for rolling of alloy steel ingots. This should be possible by installing 16" stands ahead of existing mill, proper control of re-heating, reducing mill speed to 60-120 rpm, adding some conditioning and slow cooling facilities, (paras 172-175).

The advent of the MICRO MILL

Semi-integrated plants with arc furnaces (the so-called 'mini mill') are getting smaller (say 20,000 tons/year) and still operating competitively against large fully integrated plants, because of their inherant advantages. If to these advantages are

/added

added the ingenuity and low overheads characteristic of the small scale sector, could steel ingots be made economically at say plants of 4,000 tons/year capacity? The answer appears to be YES, given the present steel market conditions.

Micro mill could be viable

Preliminary capital and operating cost calculations in this report indicate that a very small steel mill could be designed to produce 4,600 tons ingots/year from one 2-ton electric arc furnace at an equipment cost of about Rs 10 lakhs. This plant (which may well be called a 'MICRO MILL') could take scrap costing average Rs 500/ton and produce billet-size ingots at a total cost of Rs 1,000 a ton after providing for interest and depreciation charges. Such steel is being sold at Rs 1,500 per ton, but even assuming a lower selling price of only Rs 1,250/ton, the plant would give attractive returns, (paras 176-180, tables 18-20).

One could imagine a situation where two dozen such MICRO MILLS (each mill linked to one existing but modernized small scale reroller) are built all over India at a total investment of about Rs 3 crores, to provide 100,000 tons of steel. Admittedly, this would put pressure on the limited melting scrap and electric power resources of the country, but the quantities needed are not large and the benefits derived could be substantial.

THE PROBLEM OF RAW MATERIALS

When asked about possible bottle-necks in improving their operations, 90 per cent of the foundries gave raw materials difficulties as the major limitation. Unless materials for two-shift operation at the "modernized" units are assured -- and assurances can actually be implemented -- the entrepreneur may see no purpose in modernizing.

Pig iron - off-grade & mixed grade

Pig iron supplies continue to be erratic, with no supply for six months and then suddenly a block rake-full which must be lifted by the small foundries or foregone. Most of the supplies comprise off-grade or low-silicon grades, while the weight of pigs offered is often too heavy for manual handling. More serious are the problems of mix-up in grades and heavy pilferage.

/As material

As material movements by block rakes are preferred, bulk purchases and stock-piling become inevitable. A good course would be to enable foundry co-operative associations to stock foundry iron to a much greater extent than at present, for prompt supply to their members. At the same time, small foundries need to be educated to use the correct grade of iron. Grade III is suitable for most of their work, (paras 183-186).

Coke - quality unsatisfactory

Coke quality is perhaps the single most important factor in efficient cupola operation, and the inferior quality of Indian coke is the major cause of low operating efficiencies at small foundries. Ash content is upto 30 per cent and more, when it should be half this. Chemical analyses should be uniform for standardised cupola operation but, in practice, small foundries have to take whatever grade is available and at widely fluctuating open market prices. Coke size and structure should be uniform, but are seldom so.

Coke is now being supplied on "no complaint basis", that is, no complaints regarding mix-up or substitution of qualities would be entertained; if any complaint was made, supplies would be suspended until the case had been fully investigated, which may take a year or more. The foundry is thus forced to accept any supply rather than no supply at all, (paras 187-193).

Problems of inferior coke quality due to a poor resource endowment must be lived with; but problems of mix-up, pilferage, delays and exhorbitant prices from "unsponsored quotas" can and must be avoided.

Distribution machinery

While committees have already studied problems of distributing scarce raw materials, one more quick analysis of the distribution machinery for pig iron and coke to small foundries may be useful, particularly in the context of the proposed modernization programme. Complaints made to SISI officers and Industry Directorates regarding short supplies, supply of off-grades, etc. need to be promptly attended.

/Solutions

Rerollable scrap

Solutions to the shortage of rollable materials are not easy. Organizing vigorous scrap collection campaigns at the state, district and tehsil levels could unearth good quantities. Scrap from agricultural machinery in rural areas may be sizeable, which could be collected by agents at scrap dumps sited at tehsil headquarters.

The import of re-rollable scrap needs serious consideration. For instance, good plate scrap is being imported into Thailand at US$130 to 140/ton c.i.f. (about Rs 1,000/ton). Starting ship-breaking centres in India is another possibility. Consideration may also be given to producing billets in the small sector itself. Distribution of the limited available materials on the basis of a re-assessment of re-rolling industry capacity would appear to be justified, (paras 194-197).

CREDIT FACILITIES

More assistance needed

Next to raw materials, the major problem of small foundries and rerollers was the lack of adequate finance for working capital and investment. Total loans flowing to small industries are only 10 per cent of advances to medium and large sectors. The National Small Industries Corporation, State Directorate of Industries and State Small Industries Corporations are providing financial assistance exclusively to the small units, however, the bulk of advances to this sector (more than four-fifths) come from the commercial banks and the State Bank of India. While some units had no problems in securing credit, the majority expressed dissatisfaction at the delays and difficulties. Being generally a one-man show, the small factory proprietor often does not have the means or the time to carry on a continuous dialogue with the financing institution. He requires more guidance from the SISIs in providing the data needed on viability, market, etc.

/Of the total

Working capital

Of the total institutional credit to small industries, only 12 per cent is utilized for financing equipment. The balance is in the form of cash loans for operational needs. Increased working requirements will now have to be arranged for the 'modernized' units due to enlargement of capacity and also better capacity utilization. The problem of working finance is aggravated by the practice of many large companies to delay payments (60 days or more) for supplies from the small units. Legislation by which amounts due are credited to the small units by banks directly in specified conditions may well be a solution, (paras 200-201).

NSIC has no funds available which could be allocated specifically for modernizing the small units. Whether credit should be made available for this programme at subsidised rates or at normal bank rates is perhaps less important than that specific funds should be earmarked and provided with the minimum delay.

LABOUR AND MANAGEMENT

If labour in the small sector does not have the skills in new techniques or the motivation to use them, the fault is as much that of management which has failed to provide the training and the conditions for improved practices. More enlightened personnel policies, bonus plans, suggestion schemes, safety campaigns and welfare facilities would secure a commensurate response from workers in the form of better quality and output.

Productivity at good level

Even so, productivity measured as value added per worker is often of the same order in small foundries as in large ones. This, together with low overheads, at times neutralises the advantages of mass production at the bigger plants. A reason for good productivity is that in a small unit, the supervision is generally stricter and the worker works harder as he is constantly under threat of being fired if his output is unsatisfactory.

/Supervisory

Supervisory personnel

The barefoot manager

Two-thirds of the units visited had no technical personnel. Clearly, the conditions at most small foundries and rolling mills are so severe and the technical requirements so different, that an engineer out of orthodox engineering institutes may not initially be useful and may not long survive. What is needed is a new cadre of technician - "the barefoot manager" - oriented specifically to the technical and human problems of small scale foundries/mills, (paras 209-212).

Selected engineers need to be given special 3-6 months training courses in foundry technology (course outline suggested in appendix 13) together with practical experience of one year on the foundry floor, before they could be usefully employed at small foundries. The "mistry" would still have a key role to play.

Re-orientation of IIF activities

The Indian Institute of Foundrymen needs to re-orient its approach and devote greater attention to small foundries, by providing special technical seminars, publications as well as special membership requirements.

Inter-plant study teams

Small foundries and rolling mills have much to learn from each other. A programme of visits, by say a group of foundrymen from Ludhiana to Kolhapur, and a group from Howrah to Bangalore, would be of considerable value. Such a group should consist not only of managers, but of 2 or 3 persons from each plant - say, the proprietor, a mistry and a skilled worker; in this manner, the absorption of new technology could be facilitated.

Posters & publications

There seemed to be a lack of technical appreciation, even at the supervisory level, of the metallurgy of iron-making, cupola operating practice, casting defects and their remedies, sand testing procedures and safety instructions. Pictorial wall charts, with explanations in the language of the region, together with simple technical articles, need to be brought out by the local SISIs, NPCs, IIF and trade associations.

/Management

Management

The lack of managerial talent is a serious handicap in the small industry sector. The entrepreneur has the initiative to set up a new factory, but needs help in bringing it to full production, in utilizing new management techniques, in organizing his staff to work as a team towards long-term objectives. He also needs frequent exposure to new ideas, (para 217). The most dynamic units were those started by young technocrats under the entrepreneur scheme.

Use of small consultant firms

Where, due to small size of operations, full-time professionals cannot be employed, the small unit needs to utilize specialized management services. In addition to help available for SISIs and NPCs, encouragement needs to be given to local personnel, retired technicians, and others to start small consulting groups specifically for small scale industries. In turn, the small units should be educated to use such outside services. It was, therefore, gratifying to see the use being made by one small non-ferrous foundry of a consultant for long-range corporate planning, (fig. 11).

Need for management controls

The very nature of jobbing work makes it essential to accurately plan production and control the large number of patterns and casting orders moving concurrently through the shop. Then, materials and stores constitute the bulk of the production expenditures and proper purchasing and inventory control procedures could help cut down costs. Again, a jobbing foundry requires accurate collection and analysis of costs in order to make correct marketing decisions.

However, in practically all small units, no production planning, inventory control or costing are being done. Model schemes could be prepared by SISI staff and these techniques could also be promoted during in-plant studies. Unfortunately, in recent years very few in-plant studies have been done in foundries by SISIs.

Refresher studies

In order to be able to give more effective assistance, selected SISI staff need fresh exposure to new foundry/rolling techniques by being sent on short specific fellowships to countries with similar small industry activities (for example, Japan). SISI personnel could also benefit by spending say 6 months at advanced foundries/rerollers in India itself, so that they can study at first hand the improved techniques as well as the practical problems of operation, financing and materials procurement. Staff at the SISI levels could be rotated with those at Delhi, so that each has a better appreciation of the others' difficulties.

Marketing

Another gap is the marketing of the castings produced at the small foundries. In places such as Ludhiana and Batala, the bulk of iron castings are sold within a radius of 100 km and at low prices of Rs 850/ton. At the same time, factories in Delhi producing tractors (mainly for sale in Punjab) are buying their casting requirements from small foundries as far afield as Bangalore. These Punjab units had practically no idea of the market beyond their door-steps. On the other hand, some large equipment manufacturers could not find suitable small foundries to meet their casting requirements.

'Each one, adopt one'

The large units, in their mutual interest, should establish effective Vendor Development Groups to give technical and financial assistance to the small foundries. It is not enough just to give the pattern; more is needed, for instance: advances to purchase materials, runner and riser designs, occasional technical personnel to assist in casting and quality control, (para 222).

The export game

While some small units have made good exports in certain labour-intensive items, most have no knowledge of the complexities of the export game, or at best only a marginal interest for prestige purposes. Yet, if properly organized and assisted, the scope for small foundry and re-rolling mill exports is good.

/The Agra

The Agra founders, for instance, are already exporting about Rs 1 crore of castings and were sending a study team to West Asia to increase their exports of weights and measures. A small Bombay foundry is exporting know-how on malleable iron to Kenya.

A multiplicity of agencies- NSIC, Sub-contract Exchanges at SISs, EEPCs, and others - are involved in one type of programme or another to help small factories in marketing their products, both at home and abroad, but these units still seem to lack tangible assistance. In turn, the small foundries tend to depend much too much on government help. In marketing particularly, self-help may be the best help, and foundries should consider strengthening their co-operative associations for selling their products.

<u>Strengthening the co-operative associations</u>

Self help, best help

The time has come when small founders and rerollers must be helped to help themselves, through their own co-operative effort. Greater contribution of their own money and time would make for better utilization of resources, greater initiatives for modernization, more satisfaction when they are successful, and less tendency to blame government if they are not.

Presently, the main tasks of the local foundry and engineering associations seem to be to agitate for more raw materials and maintain liaison with government departments. They need to be strengthened to take on more responsibilities, in enlightened self-interest. For instance, they could usefully compile production/capacity statistics, organize inter-firm comparisons, set up an expert panel for technical assistance and publish a technical bulletin in the local language for factory personnel. Inter-plant study tours and other training activities could be arranged, (paras 230-234).

/In due

In due course, a headquarters building could be built with library, seminar rooms and co-operative laboratory facilities for sand, chemical and physical testing. Even some research investigations, specific to the area, could be handled. Weighment facilities, sand grading plant, trucks and heavy equipment could also be operated on a co-operative basis.

Co-operative testing and research

More importantly, the trade association could play a bigger role as a "materials bank" as well as in providing positive marketing assistance to its members by negotiating bulk orders, assisting in preparing tenders and organizing market surveys.

Pilot project

A few trade associations could be selected for a pilot project, model 'articles of association' and operating procedures be prepared and their staff trained for a period of say 6 months. The lessons learnt could be of value in strengthening other such societies.

Some form of financial grant by state or central government to strengthen the working of these associations, particularly in the fields of co-operative testing facilities, materials stocking, training and marketing, would be of great value.

All-India Small Foundries Association needed

It would be useful to form an All-India Small Foundries Association, along the lines of the new body for small rerollers. While the local associations have a key role in view of their intimate knowledge of conditions in their areas, a national institution could more effectively undertake activities of an inter-state nature and closer liaison with agencies at the centre.

/ IMPLEMENTATION

IMPLEMENTATION OF MODERNIZATION

By and large, the knowledge of new processes and techniques is available within India; what is needed is the transfer and dissemination of this technology to 6,000 small foundries and rerollers, starting with 100 units as a pilot project.

SSIDO has prepared a comprehensive programme for modernizing selected small foundries/re-rollers (and four other industries) during the Fifth Plan. This has been accepted by Government in principle and details are being worked out. There is now urgent need for activities to start and proceed in the correct sequence, according to a critical path network, and with full participation by the state Industries Directorates.

Preparation phase

Assistance package

In the preparation phase, the first task is to finalize the 'assistance package'. The inputs are inter-linked and if the package is fragmented, its implementation would be more difficult and less effective, (paras 241-250).

Then, the experienced staff needed has to be put rapidly in position at the central Modernization Directorate and at the state SISIs. A suggested pattern of organization is indicated in Fig. 12.

Promotion campaign

An active promotion campaign is required to acquaint all persons involved with the proposed scheme as well as to hear their ideas and difficulties regarding its implementation. This could include seminars with state government officials and SISIs, meetings with trade associations, brochures and news releases. Implementation would be difficult unless forces at the state and district levels are fully mobilized.

Selection of firms

Impartial selection of firms according to well defined criteria is important for the success of the programme. Suggestions regarding criteria and a foundry evaluation scheme are indicated in the report, (table 21).

Implementation phase

In-plant studies

In-plant studies to determine the new technology and other inputs needed by each selected unit should be in sufficient depth and undertaken by an experienced team. SSIDO staff may need to be supplemented by engaging outside experts. This task force should be responsible for the complete study as well as for its implementation and periodic follow-up, (paras 251-256).

Task force approach

Assuming that 80 foundries and 20 rerollers are to be selected for modernization, five teams would be needed. One team could be located in each major region and could complete about 20 studies during the course of one year. A good team combination would be (a) an Indian foundry/rerolling expert (perhaps a retired plant operator who could be engaged for one year) or SISI technologist, (b) a planner/industrial economist from the National Productivity Council or other institution, and (c) a management/training specialist from the local SISI.

Scope of work

A comprehensive outline of the scope of work to be covered is given in the report (para 254). The actual implementation of the study proposals for improved equipment and techniques may take 3 to 12 months. During this period, the small unit would need constant help from the study team, the local SISI, the Modernization Directorate, and the Industries Directorate.

Follow-up phase

Five yearly & annual plans

After modernization, the plant has to be kept operating at a high technical level, without slipping back into its old ways. A Five Year Modernization Programme would be useful for each unit, giving targets for production, productivity, quality and exports. Each year, an Annual Plan would give specific inputs and outputs. The modernized unit should be required to submit a quarterly report in an agreed format describing its performance, yields, materials consumptions. The staff at the local SISI should make a visit at least once a quarter to assist in specific problems, (paras 257-259).

/The modernized

The modernized unit, as a matter of obligation, should permit personnel from other foundries-rerollers to visit their plants, in order that the benefits of modernizing get widely disseminated.

Possible schedule of activities

A tentative phasing of activities for modernizing foundries/rerollers is suggested in Fig. 13. Unless the time dimension is kept in close control, the programme will lose impact and direction.

Implications of modernizing

For the 100 foundry/reroller units alone, leaving aside the other four industries, the costs and benefits of this modernization programme could be roughly as given in Table 22. For fixed outlay of about Rs 2 crores, the additional production could be about Rs 15 crores/year, apart from increased employment and other intangible benefits.

The continuing pursuit of modernization

Active participation in professional activities

Even after the 5-year scheme is over, the modernized units have to maintain and accelerate the technological pace themselves as well as help other small units to reach comparable standards. It is suggested that they participate actively in the activities of the local foundry or rolling mill association as well as programmes of local NPCs, management associations and other groups which may help, directly or indirectly, in the activities of the factory. Joining the Indian Institute of Foundrymen and becoming a part of the community of Indian foundry professionals would increase their exposure to technical developments, improve their image and give the large foundries a better appreciation of their problems and potentials.

As part of their continuing activities, the modernized units should arrange for their technicians to periodically visit other small and large foundries, within India and also abroad. Outside consultants may be engaged to prepare studies on long-range corporate planning, production control, management re-organization, value analysis, and similar subjects.

/Their

Training - a must

Their personnel should be sent frequently for training courses, covering technicians, supervisors as well as managers. Not only have techniques of good foremanship to be taught, but also new attitudes for making and keeping the dignity of the worker as an individual. The small unit should attempt to establish active dialogue with a major manufacturer, leading to a marketing tie-up for long-term component sub-contracts. Finally, all activities of the small unit should be directed towards expanding beyond its small size and joining the ranks of medium and large factories.

POSSIBILITIES OF UNIDO/ECAFE ASSISTANCE

In the India Country Programme specific funds have been provided for 'Modernization of SISIs and Quality Control for Small Industries' and 'Development of Appropriate Technology'. Consideration needs to be given to utilizing these and other sources (such as SIS assistance) for modernizing the Indian foundries and rerolling mills. Some areas of possible assistance are indicated below:

1. Study tours by SISI personnel of foundries/rerollers

Object: To familiarize SISI metallurgists with recent techniques.

Scope of work:

(i) Four fellowships are visualized for study tours:
Three in foundry field (two ferrous, one non-ferrous);
One in rolling mill field.

(ii) The studies will cover a period of 4 weeks each in Japan, to study specific technical aspects of small foundry/rerolling unit design, operation and maintenance.

(iii) Detailed reports will be prepared on plant visits, with specific reference to modernizing the Indian units.

2. Assistance to co-operative trade associations

Object: To strengthen trade associations to enable foundries/rerollers to help themselves. For this purpose, four co-operative societies, one in each region, may be taken initially as a pilot project.

Scope of work:

An expert in co-operative societies administration may be made available for a period of 6 months to prepare the framework for the following:

(i) Policies and procedures for additional co-operative activities.

(ii) Laboratory testing facilities for sand testing, chemical and physical testing.

(iii) Data collection, inter-firm comparison, publications and other activities.

3. Implementation of this report

Object: To assist SSIDO by providing an independent view-point in the arrangements to be made for the proposed modernization programme.

Scope of work:

The regional adviser's services could again be made available for the purpose of:

(i) Final selection of foundries/rerollers for modernization.

(ii) Implementation of the suggestions made in this report.

I. INTRODUCTION

Background

1. Among the ECAFE countries, the major strides made by India in developing heavy industries and a basic technological infrastructure are widely acknowledged. No less spectacular, and perhaps more significant, has been the growth of India's small scale industries during the last eighteen years.

2. The need to stabilize and again accelerate this growth has been engaging the attention of the Government's Small Scale Industries Development Organization. It became clear that if these small units are not again to undergo a severe recession as they did in 1965-67, they must be enabled to replace their obsolete equipment and techniques in order to improve their competitive position, both in costs and quality, in domestic and international markets.

3. The Newalkar Team's report (1968) proposed a modernization programme for five selected industries, namely, foundry and re-rolling, machine tools, automobile accessories, domestic electric appliances and hosiery. It is now intended to pursue this actively in the Fifth Plan (1974-79), for which a budget of Rs 90 crores has been visualized. Towards this end, SSIDO has set up the nucleus of a separate Modernization Directorate.

Terms of reference

4. In order to assist in the upgrading of technology at foundry and re-rolling units in the small industries sector, SSIDO requested the services of the UNIDO/ECAFE Regional Adviser on Metallurgical Industries.

5. The original request was for a six-month study, which is indeed the time that would be required for this comprehensive task. However, as such industrial advisory services are primarily to make broad techno-economic studies and to identify the further work needed, this study has

/ had

had to be restricted to six weeks. The terms of reference comprised advising SSIDO on a modernization programme as follows:

(i) To study the foundry and re-rolling industry in India from the view-points of obsolescence of machinery and methods, and suggest steps to be taken to improve and modernize it, in order to achieve optimum and fuller utilization of installed capacities in the re-rolling industry, and improvement in quality of castings and their economic production;

(ii) To suggest steps to be taken regarding modernization of these industries and types of assistance to be provided by government to small scale industries in this field;

(iii) Policies to be adopted by the small units to continue this programme on a perennial basis after the expiry of the five year time-bound Modernization Programme.

Method of work

6. The regional adviser was in India from 8 April to 22 May 1973. In this period of six weeks, some 84 plants in 16 cities were visited and meetings held with government officials, trade associations and others. It is a pleasure to record that in many of these discussions, the services being rendered by the staff of the Small Industries Service Institutes were well spoken of.

7. Coincidentally, some of the same units had been studied by the adviser 16 years ago when working with M.N. Dastur & Co, in connexion with an industrial capacity assessment for the Iron and Steel Controller. (Unfortunately, the plants have changed very little - only grown a lot older!)

8. The adviser was accompanied in India by Mr. J.N. Bhakta, Deputy Director, SISI Hyderabad. The primary object of the field visits was to assess, at first hand, the present level of technology, the potential for up-grading it, and the type of arrangements needed for modernization.

/ Pertinent

Pertinent data regarding the plants' practices and plans was compiled in a questionnaire and advice on specific operating problems was given. The opportunity was also taken to acquaint various trade associations with the broad outlines of government's proposed modernization programme.

This report was completed at Bangkok on 8 June 1973.

Acknowledgement

9. The co-operation of Mr. Nanjappa, Development Commissioner, and Mr. Raman, Director Modernization, SSIDO, are gratefully acknowledged. At all cities visited the local SISI staff were helpful in arranging discussions and visits - often four or five plants a day in 44°C temperatures. The adviser benefited by discussions with Mr. Bhakta who assisted him ably throughout the field trips.

10. A large number of persons were met in India on this assignment and a partial list is in Appendix I. The plants visited are shown in Appendix II, and the itinerary followed in Appendix III.

II. SMALL SCALE METAL INDUSTRIES AND MODERNIZATION

Small industries in the overall context

11. The small scale factories[1] (over 280,000) represent 90 per cent of the total number of industrial plants in India while their gross output (around Rs 1,450 crores) is about one-third of the country's total product value. For a fixed investment in the small industries sector of around Rs 250 crores, employment is provided to 3.3 million people. (While clearly the complementary development of both large and small industries is needed, it may be noted that a single large project such as a two million ton integrated steelworks would involve an investment of say Rs 800 crores and provide direct employment to perhaps 25,000 persons). When similar industries are compared, the value added per unit of fixed investment is reported to be 1.6 in the small scale sector as compared to 0.36 in the large scale sector. Fixed investment per worker is Rs 2,500 in small against Rs 17,500 in large industries.

12. In the Fifth Plan, a government outlay of Rs 350 crores has been proposed on small industries and it is expected that almost two million new jobs may be created. By any measure, this sector is playing a crucial part in India's development, and indeed has a privotal role in other ECAFE countries which have major employment problems and limited financial resources.

Metals in the small scale sector

13. A decade ago, metallurgy in the small scale sector in India generally meant only foundries and heat-treatment shops. Since then, large numbers of new processes have been added in the ferrous and non-ferrous fields, such as metal finishing, forging and power metallurgy, to name just a few.

1/ Defined as units in which investment in plant and equipment is under Rs 7.5 lakhs (US$ 100,000).

14. Further, due to the efforts of SSIDO, there is better appreciation of the significant role of metallurgy, for instance, better selection of tool steels, some recognition of the value of quality control and use of ISI standards, testing and heat-treatment of products at the SISI centres, utilization of metallurgical waste products, and import substitution by production of new items.

15. The Annual Survey of Industries - 1967 indicates the contribution of metal and metal-based industries in the small scale sector (Table 1). It will be noted that as early as 1967 these industries covered 9,259 units, employing 309,789 workers and had a total output of over Rs 430 crores. Of the above, the basic ferrous and non-ferrous units which supply their products (such as castings) to the metal-based equipment manufacturing industries covered over 2,000 units employing 77,000 workers, and had an output of Rs 130 crores. Since 1967, expansion in these basic metal industries has been at a rate of about 20 per cent per year, that is, two-and-half fold in the last five years.

16. In the absence of complete statistics, it is roughly estimated that the basic metal industries mentioned above (excluding metal-based equipment manufacturing industries) represent about 15 per cent of the total small industries output.

Strengthening of metallurgy activity at SSIDO

17. In view of the importance of metal industries in the small scale and the significant role they have been selected to play in the proposed modernisation programme, it is considered necessary that metallurgical activities be further strengthened in SSIDO.

18. At present there is no Metallurgy Division in the central organization. Further, out of a total of 849 technical experts on the SSIDO staff as on 31 March 1971 (Report 1970-71 Small Scale Industries, DCSSI, New Delhi), only 50 were in the metallurgy field; against this, there were, for instance, 247 in mechanical engineering. The 1970-71 report also indicates that a Deputy Director for Metallurgy is located

/ at

Table 1: Metal and metal based industries under small industries sector, 1967

	Group	Factories reported Nos	Invested capital Mill. Rs	All employees Nos	Worker emoluments Mill. Rs	Total output Mill. Rs	Value added Mill. Rs
341.1	Iron & Steel (metal)	402	180.5	17,612	30.3	523.0	433.7
341.3	Iron & Steel castings & forgings	785	147.0	28,077	46.3	258.6	66.2
341.4	Iron & Steel structurals	391	117.3	17,700	34.6	168.0	48.2
341.5	Iron & steel pipes	143	36.5	5,205	8.2	76.8	13.0
341	Total iron & steel basic industries	1,721	481.5	68,594	119.4	1,026.4	170.8
342	Non-ferrous basic metal industries	321	83.5	8,634	15.9	255.3	36.9
350	Mf. of metal products except machinery & transport equipment	3,070	70.4	104,637	146.7	1,245.4	245.2
360	Mf. of machinery except electrical machinery	3,115	653.5	99,260	200.8	1,121.9	321.4
370	Mf. of electrical machinery & appliances	1,032	351.7	46,699	99.8	659.4	156.4
	Total metal-based industries	9,259	2,177.0	309,789	582.6	4,308.6	930.8

at SISI's in only six states, while there is none in important industrial areas such as Maharashtra, Tamil Nadu and Delhi. Resources and personnel available, it would appear highly desirable to have a Metallurgy Directorate at SSIDO itself and Deputy Directors at SISI's in all states and functions (such as raw materials procurement) which have a metals component.

Small scale foundry industry in India

19. Castings for industrial applications being produced in India can be broadly classified as follows:

I. Iron castings

a) Grey iron castings
b) Malleable iron castings
c) Alloy iron castings
d) Ductile iron castings (nodular and SG iron)
e) Spun and vertically cast pipes

II. Steel castings

a) Carbon steel castings
b) Alloy and stainless steel

III. Non-ferrous castings

a) Copper-base castings
b) Zinc-base castings
c) Aluminium-base castings

20. Due to the investment restriction of Rs 750,000 to qualify as a small scale unit, ductile iron and steel castings are generally not produced in this sector. Both ferrous and non-ferrous foundries are in three categories, namely, (i) those doing jobbing work, (ii) foundries on regular production items, and (iii) captive units making castings for their own end-products.

21. Presently, practically no statistical data is available on foundries in the small scale sector. As a pre-requisite to a modernisation programme, it is necessary to compile up-to-date statistics on foundry capacities and production, to enable rational planning for raw materials, new equipment, personnel training and so on.

/ Roughly

22. Roughly, there are some 6,000 foundries in India, of which 5,000 (about 85%) are registered units in the small scale sector. In addition, there are a large number of foundries not registered with any agency. The bulk of the foundries produce grey iron, with a rather small number of malleable iron, steel and non-ferrous foundries.

23. Assuming that the average output of the small iron foundries is about 150 tons/year and average selling price Rs 1,200 per ton, we have a total annual production of about 600,000 tons at a value of Rs 70 crores per year. This would represent about one-fourth of India's total iron casting output.

Recent statistics of size-wise distribution of all foundries were not available. Judging by trends and this field survey, rough estimates are given in Table 2. Most of the foundries in the small sector would have less than 100 employees and below 600 tons/year production.

Table 2: Size-wise distribution of iron foundries in India

A. By number of employees

Employees	% of foundries
Below 50	66
51 - 100	14
101 - 200	8
Above 201	12

B. By tonnage of production

Production (tons/yr)	% of foundries
Below 250	34
251 - 600	24
601 - 1200	16
Above 1200	26

24. Geographically, almost 60 per cent of the iron foundries continue to be located in five states: around Batala, Ludhiana and Jullunder in Punjab (about 1,000 units), Agra in Uttar Pradesh, Ahmedabad in Gujarat, Madras and Coimbatore in Tamil Nadu and Bombay in Maharashtra. Distribution of iron castings by states is shown in Fig. 1.

/ Market

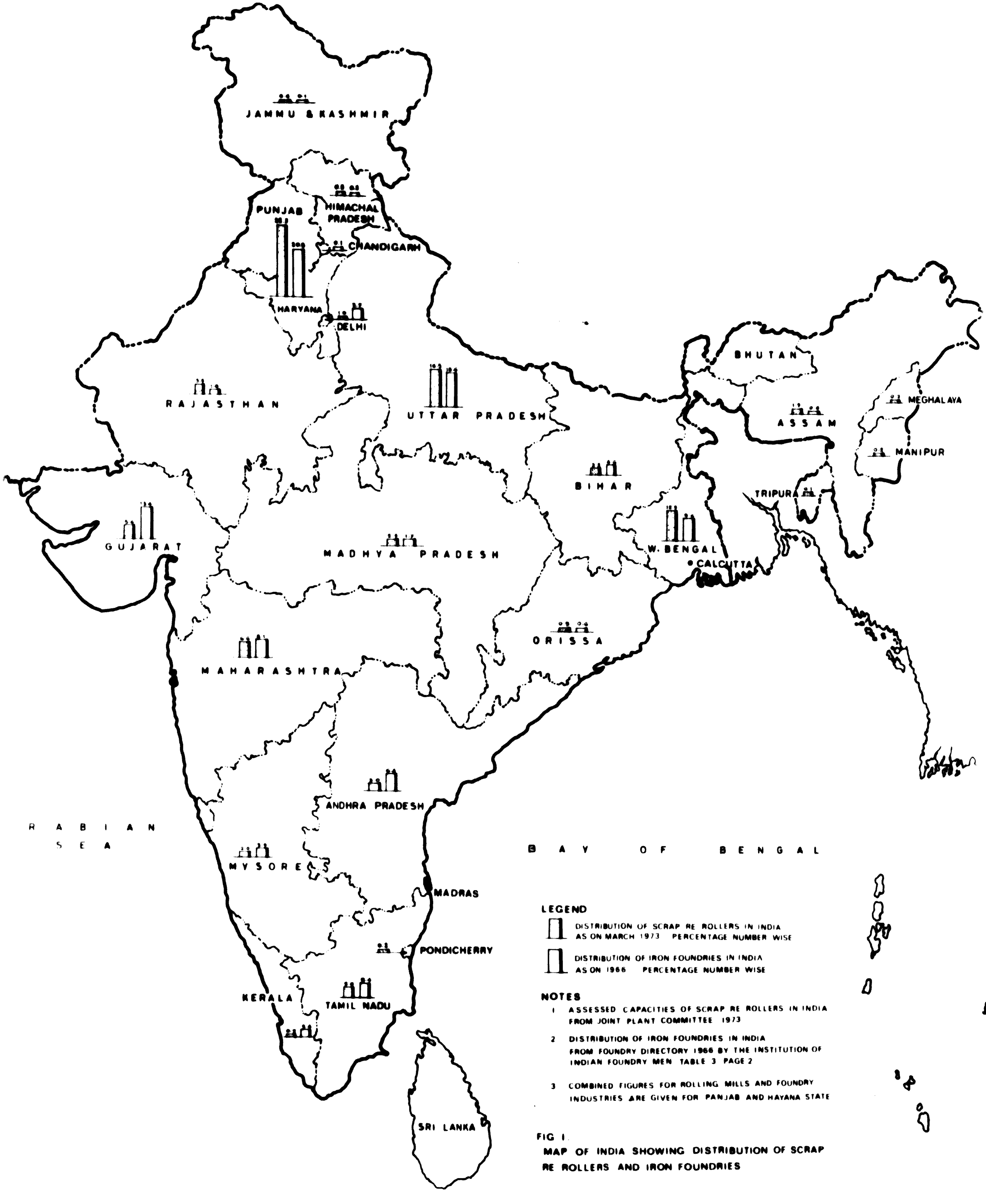


FIG 1.
MAP OF INDIA SHOWING DISTRIBUTION OF SCRAP RE ROLLERS AND IRON FOUNDRIES

Market for foundry products

25. Today there is no dearth of orders for foundries, and most of them could sell twice as much if bottlenecks of raw materials, finance and technology could be resolved. Castings of higher quality are now required for manufacture of more sophisticated equipment. While demand has grown rapidly in the last decade, foundry technology has not kept apace.

26. Domestic demand for various foundry products, as recently estimated by the Indian Engineering Association, is indicated in Table 3. The 1970-71 demand of about 2 million tons of iron castings (excluding pipes) is expected to rise to 3,416,000 tons by the end of the Fifth Plan. Small scale foundries can meet a larger part of this demand by modernization and better utilization of capacity.

Table 3: Future demand for castings
(in tons)

	1975/76	1978/79
A. Ferrous (iron and steel)		
a) Non-pipe castings		
Grey iron castings	2,991,200	3,361,300
Ductile and alloy castings	12,430	14,800
Malleable iron castings	35,760	40,700
Sub-total:	3,039,390	3,416,800
b) Pipe castings		
Cast iron spun pipes	300,000	340,000
Vertically cast pipes	247,000	285,000
Sub-total:	547,000	625,000
c) Steel castings		
Carbon steel	177,150	205,000
Alloy steel	33,890	40,900
Sub-total:	211,040	245,900
Total:	3,797,430	4,287,700
B. Non-ferrous (industrial metals)		
a) Copper base alloy castings	15,000	19,500
b) Zinc base alloy castings	7,500	10,000
c) Aluminium base alloy castings	22,000	29,000
Sub-total:	44,500	58,500
GRAND TOTAL (A+B):	3,841,930	4,346,200

27. The modernizing of existing foundries is discussed in Chapter III and the raw materials and other production factors in Chapter V.

/ Re-rolling

Re-rolling industry in India

28. In the re-rolling industry, the polarisation is not so much by size as by units which roll billets allocated to them through the Steel Re-rolling Mills Association (SRMA), and those which roll scrap allocated through the Director of Industries (DI). A large number of these scrap re-rollers are members of the newly-founded All India Steel Re-rollers Association. Most such units could roll scrap as well as billets if these were made available.

29. The re-rolling industry, both billet and scrap, has been estimated to involve a capital outlay of Rs 40 crores and provide direct employment to about 80,000 persons. The re-rollers contribute about 50 per cent to India's total production of bars and rods. Rough estimates of capacity and production of re-rollers are shown in Table 4.

Table 4: Capacity and output of re-rolling industry

	No. of unit	Capacity (2-shift basis) t/yr	Production (1971) t/yr	Capacity utilization %
DI				
Scrap re-rollers	748	3,180,000	(1,500,000)	47
SRMA				
Billet re-rollers	116	3,300,000	620,000	19
Scrap re-rollers	96	295,000	150,000	51
Total:	960	6,775,000	2,270,000	39

30. According to estimates by the Natural Council of Applied Economic Research, the country's total demand of bars and rods would rise to 2.2 million tons by 1975 and 3.7 million tons by 1980. In other words, existing re-rolling capacity itself is twice the probable demand in 1980.

/ however

31. However, estimates of capacity are somewhat arbitary with each state agency adopting its own basis for calculation. There is indeed a good case for a comprehensive re-assessment of capacities in the re-rolling industry, for which a suitable framework exists in the work of the Technical Committee, 1966. This could then form the basis for a better evaluation of the role of re-rollers in the overall economy as well as a more equitable distribution of the limited billets and scrap available.

The small scrap re-rollers

32. Table 5 on the next page shows the present capacity of scrap re-rollers. It will be noted that in the period 1966-73, capacity of units under the Industries Directorate increased steeply from 907,000 tons/year to 3,180,000 tons/year. Each unit would appear to have an average capacity of rolling about 4,000 tons/year of bar products from steel scrap. The geographical distribution of these scrap re-rollers is shown in Fig. 1. It will be noted that the bulk are in Punjab (159 units), followed by UP and West Bengal. These three states together with Maharashtra, Gujarat and Haryana, account for 70 per cent of the total scrap re-rolling capacity.

33. It has been contended that these scrap re-rolling mills came up in various states in spite of the central Government's efforts to discourage them. As it happens, due to difficulties and delays at the integrated steel plants and the rising Indian requirements, the shortage of steel continues to be acute and the scrap re-rollers are now able to make a significant contribution to the economy (and also make good profits), even though many operate with obsolete facilities and produce sub-standard products. Also, they play a useful role in salvaging a by-product (scrap) and converting it into a usable material (bars and rods).

34. Practically all available billets go to the 116 rerollers registered with SRMA. Some 30 per cent of available scrap also goes to 96 scrap re-rollers who are members of SRMA. This leaves about 175,000 tons of scrap for allocation to about 750 units in the small scale sector, that is, a mere 5.5 per cent of their probable capacity. While the controversy over rational allocation of billets and scrap continues, practically all units - small and large - remain under-utilised, though in varying degrees.

/ Obsolescence

Table 5: Assessed capacities of scrap re-rollers in India
(in tons/year)

State	Capacity as per Technical Committee, 66			Capacity in March 1973 as per JPC estimate					
				SRMA		DI		Total	
	SRMA	DI	Total	Nos	Tons	Nos	Tons	Nos	Tons
MP	-	23,200	23,200	-	-	25	1,05,380	25	1,05,380
UP	34,050	90,700	1,24,750	15	41,858	125	4,25,090	140	4,66,948
AP	-	18,000	18,000	-	-	26	1,29,442	26	1,29,442
Bihar	6,200	33,800	40,000	3	6,200	24	1,19,894	27	1,26,094
Punjab	1,46,400	2,59,900	4,06,300	49	1,46,850	159	5,59,711	208	7,06,561
Rajasthan	5,350	25,900	31,250	4	6,082	29	1,17,569	33	1,23,651
Haryana	15,700	28,400	44,100	5	15,709	61	2,35,900	66	2,51,609
Gujarat	11,700	45,000	56,700	4	11,700	44	2,30,590	48	2,42,290
Maharashtra	16,250	93,100	1,09,350	5	17,630	51	3,74,981	56	3,92,611
Kerala	-	5,300	5,300	-	-	6	21,900	6	21,900
Tamil Nadu	32,650	9,100	41,750	9	32,650	33	1,17,849	42	1,50,499
West Bengal	11,100	2,74,900	2,86,000	5	11,100	104	4,06,010	109	4,17,110
Assam	3,900	-	3,900	1	3,900	15	1,23,100	16	1,27,000
Delhi	1,600	-	1,600	1	1,600	8	26,350	9	27,950
Mysore	-	-	-	-	-	17	74,600	17	74,600
Orissa	-	-	-	-	-	4	22,200	4	22,200
J & K	-	-	-	-	-	3	21,000	3	21,000
Nagaland	-	-	-	-	-	2	8,400	2	8,400
Pondicherry	-	-	-	-	-	2	9,300	2	9,300
HP	-	-	-	-	-	4	20,300	4	20,300
Manipur	-	-	-	-	-	2	12,000	2	12,000
Tripura	-	-	-	-	-	1	5,000	1	5,000
Meghalaya	-	-	-	-	-	2	13,200	2	13,200
Chandigarh	-	-	-	-	-	1			
Total	2,84,900	9,07,300	11,92,200	101	2,95,279	748	31,80,766	849	34,76,045

Obsolescence of existing units

35. The majority of foundries visited were 5 to 25 years old (and some in traditional areas such as Howrah and Agra were started 60 to 70 years ago). They have not changed much since they began - while in this period foundry techniques have advanced considerably. The technology which was developed to suit the factor endowments of these regions at earlier times is no longer suited to today's needs.

36. Only a small sample of units was examined (about 2% of total) and there is no clear measurement of obsolescence, but to hazard an estimate, 70 per cent of the iron foundries can be considered obsolete and 45 per cent of the re-rollers. This is somewhat higher than the Newalkar estimate of 35-50 per cent obsolescence in this sector.

37. Much has been done in India to nurture the small scale sector. But unless the technological stagnation in a number of fields is soon overcome and these units made self-reliant, it is likely that in the next five years, people may question why special facilities should continue to be given to what a senior official referred to as "a pampered sector where the exploitation of labour is the maximum".

38. Consequences of backward techniques at existing foundries and re-rolling mills include the following:

1) The consumptions of materials are high, for example, at times 250 kg of coke per ton iron castings against a possible 170 kg/ton, or say 450 kg steam coal to heat a ton of billets against a possible 300 kg/ton.

2) The yields of good products from metallic charge are low - often only 50 per cent in the case of grey iron castings and 80 per cent for re-rolled bars. The above factors tend to increase production costs.

3) The rejection rate of castings is high, generally 15 per cent or more when it could be halved. The surface condition, dimensional accuracy and strength of castings as well as rolled sections is quite unsatisfactory.

/ 4)

4) The more sophisticated, higher value products remain out of technical reach, so that profit margins are small on highly competitive, low-technology items.

5) The production of good castings remains an art, a matter of chance, not a sure, scientific day-in and day-out affair.

6) The imbalance in capacities of production equipment at various processing stages causes frequent bottlenecks and curtailment of production.

7) Due to inadequate attention to layout, ventilation and materials handling facilities, the working environment is generally arduous, unhealthy and unsafe.

39. Of course, obsolescence itself is relative - a cupola which is out-of-date in Europe may not be so in India, and indeed a re-rolling mill considered obsolete in Maharasthra may operate viably in Gobindgarh. For our purpose, a foundry or rolling mill can be considered obsolete when the quality or range of its products does not meet the required standards and its costs cannot be competitive under normal economic conditions (Today, even obsolete units are making profits, although operating at only one-half of capacity).

40. There is yet another dimension to the problem: the quality of the environment in which the staff works. A plant where a worker has to move heavy castings (50 kg each) manually all day, or which has no proper ventilation, or minimum safety devices, must be considered obsolete in terms of today's norms.

The proposed modernization programme

41. In a modernizing society, technological modernization is an inevitable component - whether in large scale industry or small. The alternative - stagnation - means slow but inevitable death. The modernisation of small scale industry in India is no new concept - indeed, as early as 1948, the Industrial Policy Resolution proposed that small

/ factories

factories be provided a 'package' of inputs including "raw materials, cheap power, technical advice, organized marketing of their products and where necessary, safeguards against intensive competition by large-scale manufacturers, as well as on the education of the worker in the use of the best available techniques".

Then again, the Second Industrial Policy Resolution of April 1956 reiterated: "The State will, therefore, concentrate on measures designed to improve the competitive strength of the small-scale producer. For this it is essential that the technique of production should be constantly improved and modernized, the pace of transformation being regulated so as to avoid, as far as possible, technological unemployment".

42. In most situations, it is cheaper to modernize and consolidate existing units rather than build new ones; at the same time, additional nucleii for fresh growth have to be created in regions as well as in product lines which have hitherto remained undeveloped. These new products should be such as can fulfill the urgent needs of import substitution as as well of increased exports in the Fifth Plan.

43. It is now rightly proposed by the Government of India to concentrate efforts on modernizing foundry and re-rolling mills together with four other industries, in the initial years of the Fifth Plan. From these industries, some 300 units will be selected for a "time-bound package programme". This modernization package includes credit arrangements at concessional rates, subsidy and tax concessions, intensive technical assistance, supply of raw materials and other inputs. The facilities presently envisaged by SSIDO are now being examined by various government agencies and it is possible that some of the assistance proposed may be reduced or modified.

/ Objectives

Objectives of modernization

44. The four major objectives of revitalizing technology in the metals field can generally be stated as follows:

1) To upgrade the quality of castings and rolled products through appropriate technology and control techniques;

2) To reduce costs through higher equipment and labour productivity, in order to improve the competitive position in domestic and export markets;

3) To enlarge the product range for greater import substitution;

4) To improve the working environment.

45. Foundries and re-rolling mills are both concerned with the shaping of metals. In both industries there is presently an unlimited market. But the rationale for modernization is different. The foundry involves a series of technology-oriented operations, requiring testing and control at each stage in order to achieve good operating yields and high product quality. The product itself can take many forms and a variety of compositions. On the other hand, scrap re-rolling is a straight-forward mechanical operation resulting in a limited range of products, generally only one item - reinforcing bars.

46. Historically, iron foundries in the small-scale sector in India have adopted the most rudimentary techniques, only a small step forward from the age-old 'adibasi' iron smelters. The castings produced do not consistently meet the required standards. There is thus a clear need to upgrade processes and equipment.

47. As far as scrap re-rolling is concerned, there is scope for improvement but it is comparatively limited. Better equipment will in most cases give better yields, improved quality and higher throughputs, but due to the acute shortage of re-rollable materials and buoyant market for steel, the incentive to modernize is limited. However supply of rolled steel from the integrated plants could, hopefully, rise in the future and then these scrap re-rollers may be in serious trouble, unless they take the opportunity now to improve quality and diversify output.

48. Clearly, both founders and re-rollers are not to be modernized for the sake of modernization. The low-cost, low-volume technology which they have evolved has to be revitalized, not replaced. The new machinery as well as balancing facilities must be carefully selected and adapted to suit the specific products, moulding materials available, labour skills and other conditions in each individual unit. Prestigue purchases of say a mechanized sand handling system are clearly unnecessary.

49. While on his first consultancy assignment 20 years ago, work simplification at a steel foundry in India, this adviser had recommended - and got the management to provide at some cost - special fettling tables, so that the worker could clean castings while standing comfortably rather than squat all day on the floor with hammer and chisel. But within a week, the workmen were squatting on top of the tables! This is the kind of 'modernization' which the small scale sector can easily do without!

50. In the process of modernization, not a single worker need be discharged, although he may have to be re-deployed. As capital is a scarce resource, the investment in modernization should be the minimum needed and should, after an initial period, be recoverable through lower costs, expanded production, and enhanced reputation for quality products.

51. By and large, the technology needed to improve operations is already available within the country, at the large foundries, consulting firms, foundry equipment manufacturers, technical societies, national research laboratories and foundry training institutes. What is needed is to organize the effective transfer and dissemination of this technology to the small foundries which are scattered throughout the country. Similarly, the improved equipment proposed does not need to be imported - it can, without exception, be manufactured in India, in fact, much of it can be fabricated in the small sector itself, provided equipment designs are made available.

52. Some reactions to the idea of modernization were interesting. At a foundry which sorely needed essential equipment, we asked, "If you were given Rs 50,000, how would you spend it?" The reply: "I would rather buy raw materials." At another dilapidated foundry, the reply to the same

/ question

question was: "I would build a new foundry and run both the new and old one." One foundry proprietor explained: "We will not buy shot blasting equipment because although the customer would be pleased to have shot-blasted castings, he will not please us by paying anything extra!"

53. In certain fields the technical level at the small units is reasonably high and the need is not to add or replace equipment but to re-condition it. Prices of new machines have risen rapidly - for instance, an imported die casting machine which cost Rs 50,000 five years ago and Rs 85,000 three years ago, today costs Rs 1,10,000 (The indigenous equipment is even more expensive). In such circumstances, it may be more economical to 'modernize' the old machine at some cost.

54. In some areas, the factory sheds made of wood poles and matts are in dilapidated condition, allowing rain to enter and preventing the installation of overhead cranes. If new equipment is to be provided under any modernization programme, the shed itself must also be changed, requiring additional finance.

<u>Fears expressed regarding modernization</u>

55. During discussions with trade associations and individual entrepreneurs, some anxieties were expressed regarding the proposed programme:

<u>Nationalization</u>: There was an unreasonable anxiety that once a unit became efficient it would get nationalized. "Why for modernization", one person asked, "if followed by nationalization?". Surely, the small scale sector, by its inherent characteristics, would have the lowest priority in any nationalization programme, and this could be readily explained.

<u>Neglect of other small units</u>: The view was expressed that units selected for modernization would become an 'elite class', and that the discrimination against the others would be resented. Moreover, the SISI's in their pre-occupation with this programme may neglect the services which should be rendered to all units. There may be a danger of this happening, unless the SISI staffs were strengthened specifically for modernization.

/ Transformation

Transformation to medium scale units: There was a 'psychological fear' that with the additional investment for modernization, units may lose their present small industry status and corresponding benefits. However, units which have the vitality to expand from small to medium scale should be encouraged to do so, as they would derive other kinds of benefits and scale-economies not available to small units.

Implementation gap: Finally, the view was repeatedly expressed that while Government's modernization programme looked good on paper, it may not be implemented fairly and efficiently. Clearly, if there is further delay in starting work, or if the 'package' of inputs now visualized is taken up only in a piece-meal manner, then the programme would not have the desired results. This would indeed be unfortunate because the need to modernize these small foundries is urgent and the benefits to the economy could be substantial.

/ III.

III. UPGRADING THE TECHNOLOGY AT FOUNDRIES

56. The 'back-yard foundries' in the small scale sector - some 5,000 of them all over India - are doing a remarkable job under adverse conditions. Using pig iron and coke of quality which founders in other countries would spurn and utilising the barest minimum of equipment, they are producing castings of a quality and at a cost which serve a limited purpose.

57. If the ingenuinty of these founders could be channelised and their age-old practices modified, the range of their products could be extended and quality improved. Existing facilities and scope for modernisation in the grey iron, malleable, non-ferrous and steel castings fields are reviewed below.

A. GREY IRON CASTINGS

58. As already noted, the bulk of the small foundries produce grey iron in conventional cupolas. Approximately 2 per cent of the total number of casting units in the country was visited. At each city the SISI staff was requested to make a careful selection of factories which could be considered typical, together with some which operated at low technological levels and others with better-than-average practices. While this small sample cannot be considered representative, it did serve to give an over-view of present operations, problems and potentials.

Existing equipment and practices

59. In visits lasting a couple of hours each it was possible to give only limited advice and assistance on queries regarding cupola operation, moulding methods and quality problems; detailed in-plant studies are needed to give specific recommendations and observe the results achieved.
A specimen of the questionnaire filled out on present practices is shown in Appendix 4. The facilities of the units are described in Appendix 5. These are summarised in Table 6 on the next pages.

/Table 6:

Table 6: Summary of iron foundry fa[illegible]

Unit	Products	Investment Rs	Labour (on roll + contract)	Techn. Staff	Ave. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	
J.K. Foundry, Faridabad	CI castings	15,000	24	1	30	1,500	1-24" cupola	Ma
Gossul Foundries Pvt. Ltd, Kanpur	CI castings	50,000	0+30	-	8	for self use	1-24" cupola, 1-30" cupola (not connected)	Sa (
Bharat Foundry Pvt. Ltd, Calcutta	Grey & Alloy castings	100,000	45+65	2	200	1,800	1-36" cupola, 1-24" cupola	[illegible]
Bengalee Silpi, Calcutta	CI castings	50,000	38	-	40	1,200	1-42" cupola, 1-30" cupola	Ma
Ramakrishna Iron Foundry, Howrah	CI castings	163,000	60+18	-	150	1,700	1-42" cupola, 1-30" cupola	S
R.V.S. & Co, Mysore Road Bangalore	CI castings (sewing m/c frames to Usha)	60,000	25	1	12	1,280	1-18" cupola	Ma
Mysore Foundries, Bangalore	M/c tools, pump, electric motor & genl. CI castings	175,000	90	3	70	1,700	1-36" cupola, 1-24" dia cupola	Sa
V.R. & Bros, Bangalore	CI castings & grinding media	500,000	150	1	70	1,700	Induction fce (800 kg), 27" & 37" cupolas	[illegible] si

SECTION 1

...ry of iron foundry facilities

Melting Units	Sand Preparation	Mould Preparation	Core Machinery	Fettling	Quality Control
1-24" cupola	Manual	Manual	CO_2 process	Manual	Visual
1-24" cupola, 1-30" cupola (not connected)	Sand mixer (not being used)	1-mould m/c (not being used)	Manual	Manual	Visual
1-36" cupola, 1-27" cupola	Manual	Manual	Manual	Pedestal & portable grinders	Trans. testing m/c
1-42" cupola, 1-30" cupola	Manual	Manual	Manual	Manual	Visual
1-42" cupola, 1-30" cupola	Sand muller	Hand operated moulding m/c self fabricated - 6 Nos. (none in operation at present)	Manual	Flexible shaft grinders	Visual
1-18" cupola	Manual	Manual	Manual	Pedestal & portable grinders	Inspected by Usha Sewing M/c Co.
1-36" cupola, 1-24" dia cupola	Sand muller	Pneumatic pin lift type, turn over type & hand-operated moulding m/c	CO_2 & oil sand core	Tumbling barrel, grinders - fettling is mostly sub-contracted	Visual
Induction fce (800 kg), 27" & 37" cupolas	Mullers, power sieve	Manual	CO_2 process	Grinders, tumbling barrel	Chemical & physical laboratory

/Bangalore Engg.

SECTION 2

Unit	Products	Investment Rs	Labour (on roll + contract	Techn. Staff	Ave. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units
Bangalore Engg. Industries, Bangalore	Shell moulded CI castings	225,000	10	3	20	4,000	Sklenar oil fired reverbratory tilting furnace-200 kg/capacity
Uchayamkar Iron Works, Kolhapur	CI castings for m/c, sugar cane crusher spares etc.	50,000	26	-	70	1,080	1-30" cupola, 1-18" cupola
Jay Bhavani Iron Works, Kolhapur	Oil engine parts & genl. CI castings on job order	24,000	16+12	-	20	1,500	1-28" cupola
D.M. Foundries, Kolhapur	CI castings for large scale units & genl.	20,000	12	-	25	800	1-28" cupola
Hind Casting & Iron Works, Kolhapur	Light & heavy wt. CI castings on job orders	33,300	28+10	2	200	800	1-30" cupola
Shri Dut Engg. Corpn, Kolhapur	Sand & centrifugally cast liners	80,000	24	2	48	2,000	1-24" cupola
Yashwant Iron & Steel Works, Kolhapur	CI castings by mechanite process	197,850	90	3	70	2,500	2-28" cupola
Pakco Engg. Pvt. Ltd. Kolhapur	CI castings on job orders	40,000	20	-	30	1,500	1-24" cupola
Kulkarni Enterprises, Sangli	CI castings on job orders	100,000	120	4	120	2,000	1-28" cupola 1-24" cupola

SECTION 1

Melting Units	Sand Preparation	Mould Preparation	Core Machinery	Fettling	Quality Control
Sklenar oil fired reverbratory tilting furnace-200 kg/capacity	Resin-bonded shell moulding sand	Cronig shell moulding m/c German make	German make shell core shooter with electric core oven	Manual	Visual
1-30" cupola, 1-18" cupola	Manual	Manual	Manual	Manual	Visual
1-28" cupola	Sand muller & sand testing equipment	Manual	Manual	Pedestal grinders, tumbling barrel etc.	Chill tests & visual
1-28" cupola	Sand muller & sand testing equipment	Manual	Manual	Pedestal & hand-grinder	Chill tests
1-30" cupola	Manual	Manual	Core mixer & manual	Tumbling barrel, grinders, crane etc.	Visual
1-24" cupola	Sand muller	1-moulding m/c (not in use)	Manual	Tumbling barrel, & grinders	Wedge-test & hardness tester
2-28" cupola	Sand muller 4-power sieve	Hand moulding machine	Manual	Pneumatic chipper, grinder & tumbling barrel	Wedge test, hardness tensile & chemical tests
1-24" cupola	Muller	2-pneumatic moulding m/c	Manual	Tumbling barrel	Wedge test
1-28" cupola 1-24" cupola	Muller	2-hand operated m/c (two pneumatic m/c being installed)	Mixer & oven	Sand blasting, tumbler & grinders	Wedge test

/Bharatiya

SECTION 2

Unit	Products	Investment Rs	Labour (on roll + contract	Techn. Staff	Ave. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	
Bharatiya Foundries, Bombay	CI castings for flushing systems	60,000	19	1	30	1,750	1-1t cupola 2-pit furnaces	Mu
Kajeco Ind. Agra	CI pipes & fittings, man-hole cover	175,000	230	3	600	1,000	1-48" cupola	Man
Indian Iron Foundry, Agra	CI weights, pump parts	100,000	50+50	-	200	900	1-42" cupola	Man
Satya Indl. Corp, Agra	CI Rly castings, man-hole covers, pipes	100,000	100+100	-	400	700	1-48" cupola	Man
National Iron Fdry, Agra	CI castings for own products & basis	32,000	51+10	3	40	1,000	1-28" cupola, 1-30" cupola & crucible furnaces	Sa
Kisan Fdry, Ludhiana	Heavy CI castings on jobbing basis	50,000	14+0	-	40	1,000	1-36" cupola 1-39" cupola	M
Modern M/c Tools & Engg. Works, Ludhiana	Heavy CI castings on jobbing basis	60,000	5+15	-	30	1,200	1-33" cupola, 1-24" cupola, 1-16" cupola	Ma
New India Foundry, Ludhiana	Heavy CI castings on jobbing basis	50,000	16	-	40	1,000	1-42" cupola 1-36" cupola	Ma
Bharat Jyotee Mechanicals, Ludhiana	CI castings for grinding & Hosiery machines	20,000	3+5	2	10	1,700	1-36" cupola, 1-16" cupola	Ma
Hindustan Castings, Ludhiana	Heavy CI castings on jobbing basis	30,000	12	-	25	1,000	1-30" cupola	Ma

SECTION 1

Melting Units	Sand Preparation	Mould Preparation	Core Machinery	Fettling	Quality Control
1-1t cupola 2-pit furnaces	Muller	2 jolt squeeze 2 turn-over machines	Core blower	Pedestal & hand grinders	Visual
1-48" cupola	Manual	Manual	Manual	Pedestal & grinder and tumbling barrel	Chemical and mechanical test
1-42" cupola	Manual	Manual	Manual	Pedestal grinding	Test done by outside agencies
1-48" cupola	Manual	Manual	Manual	Pedestal grinder	Tensile, drop & hydrolic load test
1-28" cupola, 1-30" cupola & crucible furnaces	Sand mill	Hand moulding machine	Manual	Manual	Chill test & visual
1-36" cupola 1-39" cupola	Manual	Manual	Manual	Manual	Visual
1-33" cupola, 1-24" cupola, 1-16" cupola	Manual	Manual	Manual	Manual	Test done by outside agencies
1-42" cupola 1-36" cupola	Manual	Manual	Manual	Manual	Visual
1-36" cupola, 1-16" cupola	Manual	Manual	Manual	Manual	Hardness test
1-30" cupola	Manual	Manual	Manual	Manual	Chill test & visual

/Indian M/c

SECTION 2

Unit	Products	Investment Rs	Labour (on roll + contract	Techn. Staff	Ave. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	Sa Pre
Indian M/c Tools, Batala	CI castings for own m/c tools	100,000	35	1	125	800	1-36" cupola, 1-48" cupola	Manu
Delux Kuthali Works, Batala	CI castings on jobbing basis	110,000	5+25	2	400	850	1-36" cupola, 1-48" cupola	Sand machi
Hero Engg. Works, Batala	Chilled CI rolls & m/c tools parts	20,000	20+4	3	25	350	1-33" cupola	Manu
Sharda Fdry, & Engg. Works, Batala	Heavy CI castings for own m/c tools	250,000	15+25	1	80	1,200	1-48" cupola, 1-33" cupola	Sand
Bombay Fdry & M/c, Amritsar	CI castings for printing press	75,000	8+7	1	20	1,500	1-30" cupola, 1-18" cupola	Sand
Victor Tools, Jullundur	CI castings for hand tools	125,000	25	1	100	1,600	1-30" cupola	Sand

SECTION 1

Melting Units	Sand Preparation	Mould Preparation	Core Machinery	Fettling	Quality Control
1-36" cupola, 1-48" cupola	Manual	Double box & sweep moulding	Manual	Manual	Hardness tester pyrometers
1-36" cupola, 1-48" cupola	Sand seiving machine	Manual	Manual	Manual	Visual
1-33" cupola	Manual	Manual	Manual	Manual	Test by outside agencies
1-48" cupola, 1-33" cupola	Sand muller	Manual	Manual	Manual	Test by outside agencies
1-30" cupola, 1-18" cupola	Sand muller	Manual	Manual	Pneumatic chippers & grinders	Wedge test
1-30" cupola	Sand muller	2 jolt-squeeze moulding machine	Manual	1-coke fired annealing furnace	Hardness test

SECTION 2

Factory size:

60. Units ranged from productions of 10 tons castings per month to those with 400 tons per month. Break-downs by outputs and personnel strength are given below:

Output

Production tons/month	Units No.	Units % of total
0 - 50	18	55
51 - 100	6	18
101 - 200	6	18
201 - 300	-	-
Over 300	3	9
Total	33	100

Staff

No. of employees	Units No.	Units % of total
0 - 20	10	30
21 - 50	13	40
51 - 100	5	15
Over 100	5	15
Total	33	100

61. It is interesting to note that in the Japanese iron foundry industry, including large and small units, in 1958 (before their major foundry modernisation programme got underway), the distribution by number of employees was as follows:

Staff

No. of employees	Units as % of total
0 - 20	44
21 - 50	31
51 - 100	11
Over 100	14
Total	100

The proportion of units with staff of under 50 persons was in fact higher in Japan in 1958 than in India today.

/Equipment

Equipment and processes:

62. Practically all units employed only cupolas, with a few using crucibles. The pattern of cupola sizes is indicated below:

Cupola size I.D. in inches	Units No.	Units % of total
18" & under	6	12.5
19 - 24"	8	16.5
25 - 30"	13	27.0
31 - 36"	11	23.0
37 - 48"	10	21.0
Over 48"	-	-
Total	48	100.0

63. Generally, the cupolas are operated once a week for 4 or 5 hours, while in some places (as in Agra) they are operated every alternate day and in others (for instance, Batala) only once or twice in a month for heavy machine tool beds, etc. The hourly output for cupolas of various sizes is shown in Fig. 2. It may be noted that these are figures reported by the factory and there was no opportunity to check these. Cupolas were around 30" dia and are estimated to be producing about 2 tons/hour.

64. The characteristics of the foundries visited are summarized in Table 7. It will be noted that 60 per cent of the units had no technical staff whatsoever, 60 per cent had no sand preparation facilities, 79 per cent had no machine moulding and 88 per cent had no chemical or physical laboratory facilities. In more than half the units, the investment in plant and equipment was under Rs 100,000. If lack of facilities listed in the table below is taken as a measure of obsolescence, then over 70 per cent of the units could be considered obsolete. While a large proportion of the bigger units (over 100 employees) had technical staff, fettling and testing equipment, they did not have sand preparation or moulding machines.

/Fig. 2

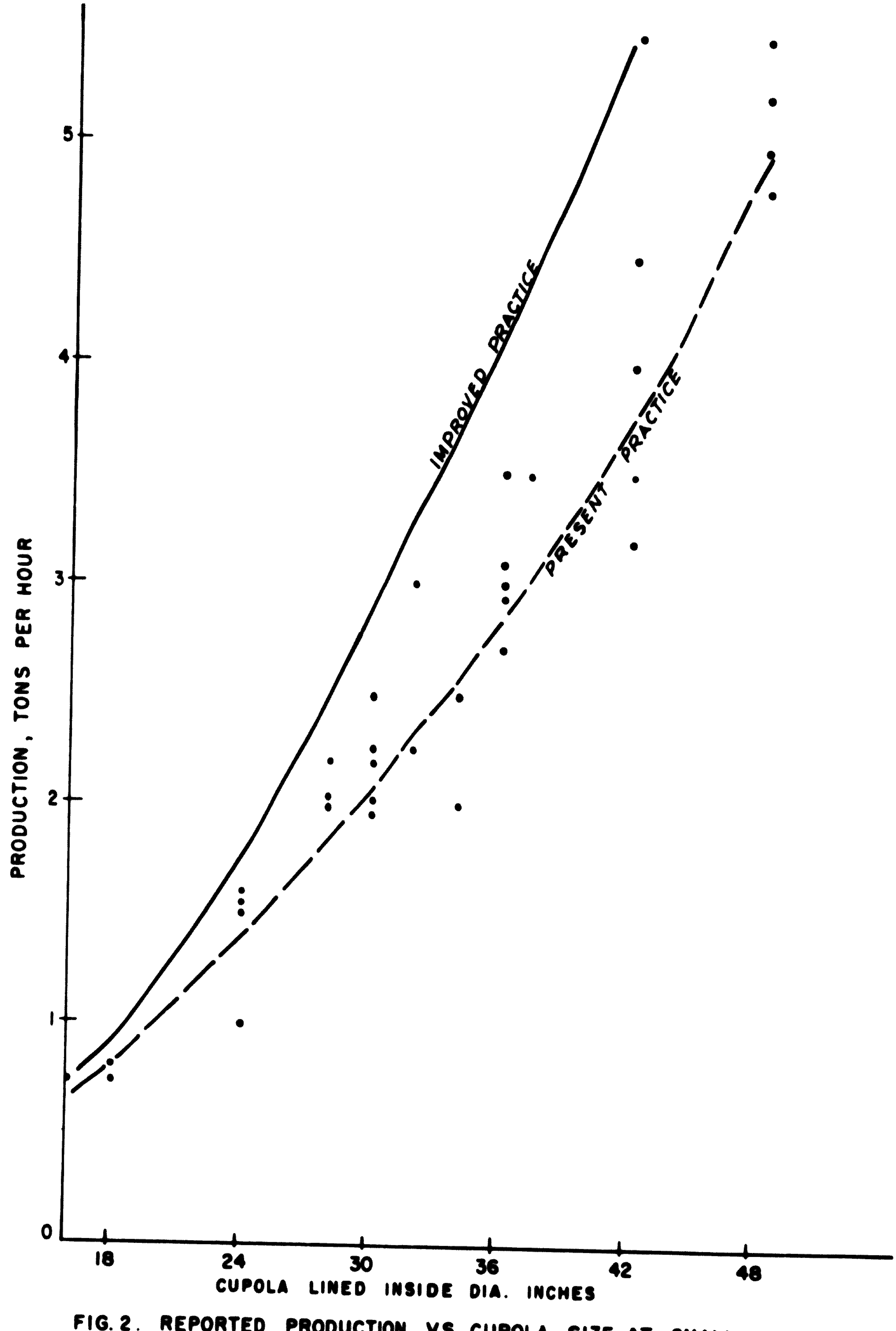


FIG. 2. REPORTED PRODUCTION VS CUPOLA SIZE AT SMALL INDIAN IRON FOUNDRIES

Table 7: Small iron foundries using specified facilities

	Total No. of units	% of total (33 units)	% in each size group, by No. of employees			
			0-20	21-50	51-100	Over 100
Technical staff	13	40	20	46	20	80
Sand preparation equipment	13	40	20	39	80	40
Machine moulding	7	21	20	8	60	20
Shell moulding	1	3	10	-	-	-
CO_2 process	5	15	-	8	40	40
Fettling equipment	15	46	40	31	60	80
Laboratory facilities	4	12	-	-	20	60
Equipment cost over Rs 100,000	14	43	10	31	80	100

65. A comparison with foundries in Japan in 1958 is as follows :

	% of total	
	Small foundries visited India, 1973	All foundries Japan, 1958
Machine moulding	21	22
Shell moulding	3	5
CO_2 process	15	27
Laboratory facilities	12	12

There is indeed a similarity between conditions in Japan in 1958 and in India today. Under the impetus of various government programmes, the Japanese foundry industry has made phenomenal progress in the last 15 years -- and this serves to indicate the possible scope for improvement in India also.

/66.

66. On the basis of the above observations, a typical grey iron foundry in the small scale sector in India can be said to have the following profile:

1) Average monthly production is around 15-20 tons, that is, 180 to 240 tons/year. Investment in foundry plant and equipment is approximately Rs 50,000 to 70,000.

2) Melting equipment consists of one 30" cupola and a 24" cupola, with one cupola giving about 10 tons of metal per cast. Bed coke height is inadequate, no ferro-silicon or soda-ash are used, metal temperature is low, and the cupola is frequently jammed.

3) There is no sand preparation, bentonite is seldom added and sand strength is low, giving rise to casting defects. Moulding and core-making operations are done manually with dry sand practice.

4) Tumbling barrel and pedestal grinder are available but fettling is almost wholly manual.

5) Plant has no technical personnel, no sand testing or other laboratory facilities, no quality control procedures, and practically no records. Rejections (if properly inspected) are over 15 per cent. Metallics yield is only 50-60 per cent while coke rate is 250 kg per ton iron melted.

6) The unit has no pattern shop -- generally, the party supplies his own pattern.

7) Due to chronic difficulties in securing coke and pig iron as well as shortage of capital, the management has little interest in improving operations, even though there is presently an unlimited demand for castings.

<u>Layout</u>:

67. The layout of small foundries leaves much to be desired. As they have grown over the years, new equipment has been added without consideration of the flow of materials. Sand, coke, iron, moulds, cores and castings are carried back and forth, without the aid of any handling equipment. The type and arrangement of sheds do not allow an overhead crane to be installed; indeed, not even a wheel-barrow was seen! In the long-term, as labour costs rise, simple mechanical aids would certainly be useful.

/The layout

68. The layout of one of the units visited in Howrah is shown in Fig. 3. The haphazard movement of materials causes bottle-necks and high costs. At many of the foundries in Punjab, moulding, casting and fettling operations are carried out around the cupola in the open air. From the date land is purchased, the cupola shell is fabricated and the first castings produced within 30 days!

69. Using simple layout planning techniques, the layout of most foundries could be improved radically and with only small expenditure on relocation of some equipment and purchase of minimal materials handling facilities. This is a subject to which SISIs and NPCs can usefully contribute. It should be possible to draw up two or three alternative cupola foundry layouts, which with minor modification could suit most requirements. A suggested layout of a small foundry with good arrangement of equipment and uni-directional materials flow is shown in Fig. 4.

<u>Labour</u>:

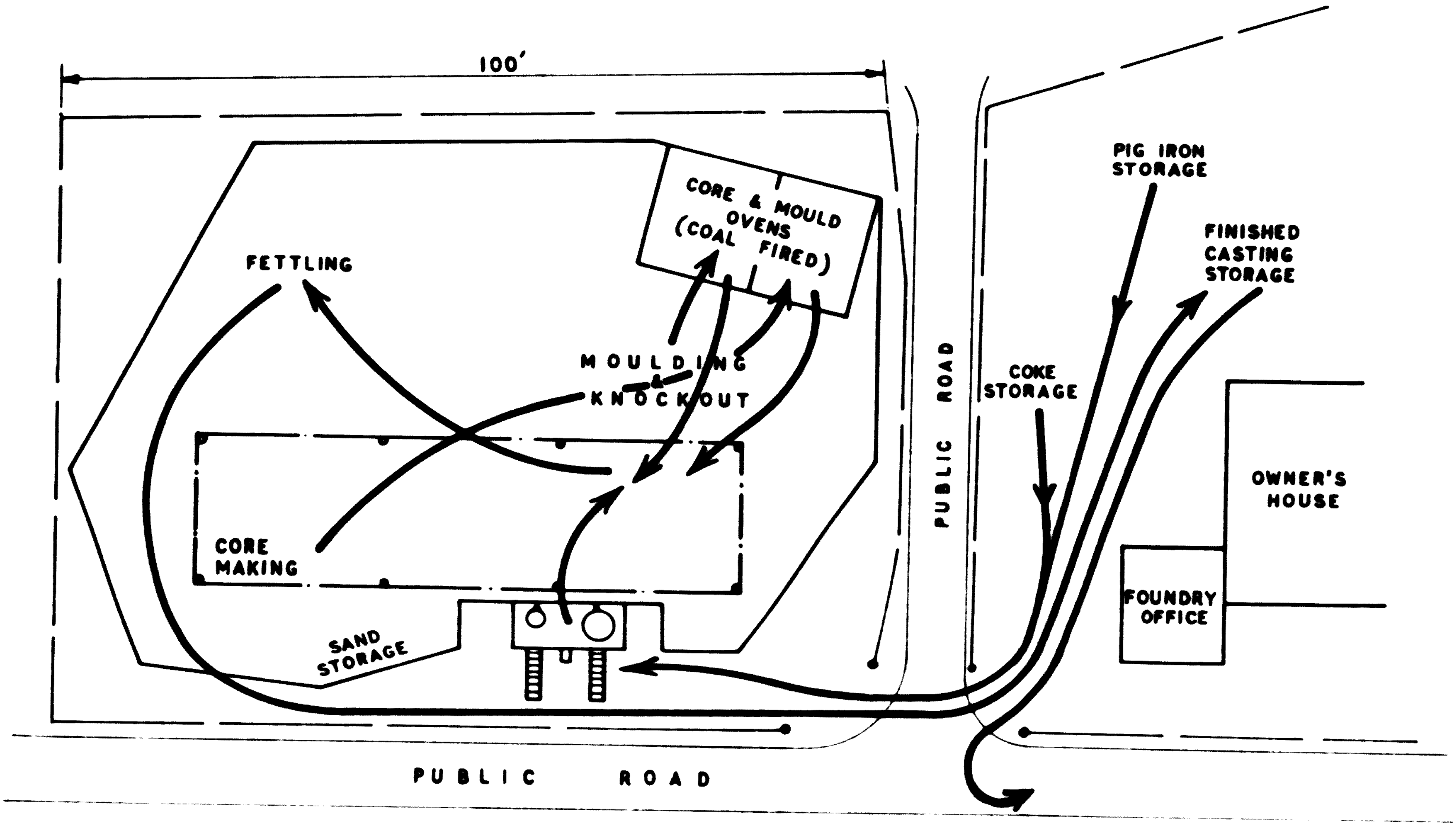
70. Depending upon the type of castings, labour productivity ranged from 0.5 to 2.0 tons per man-month. With some work simplification and mechanical aids it should be possible to produce 1 ton per man-month for medium weight jobbing orders and 3 tons or more for heavy castings.

71. Most of the workers were paid on a piece-rate basis and only at one foundry (Kulkarni Enterprises, Sangli) was a well-designed incentive bonus plan observed. Much of the fettling work is done by outside contract labour while in some cases only materials and cupola are provided while the contractor undertakes all work at a 'per-ton' good castings rate. Because of near-total reliance on contract labour, the proprietor has no incentive to install new equipment or even to use what is installed.

72. In Batala and Ludhiana, a labour gang goes from foundry to foundry on the days of casting, to light the cupola, charge it and deliver iron to the moulds. Due to the low labour costs (Rs 150-200 per man per month) and cheap sand (Rs 25/100 cu ft), grey iron castings are being sold at a low price of Rs 850/ton.

/Fig. 3

FIG. 3 LAYOUT OF SMALL-SCALE IRON FOUNDRY (NOT UN-TYPICAL)
(STARTED 1901, PRESENT PRODUCTION 150 TONS/MONTH)



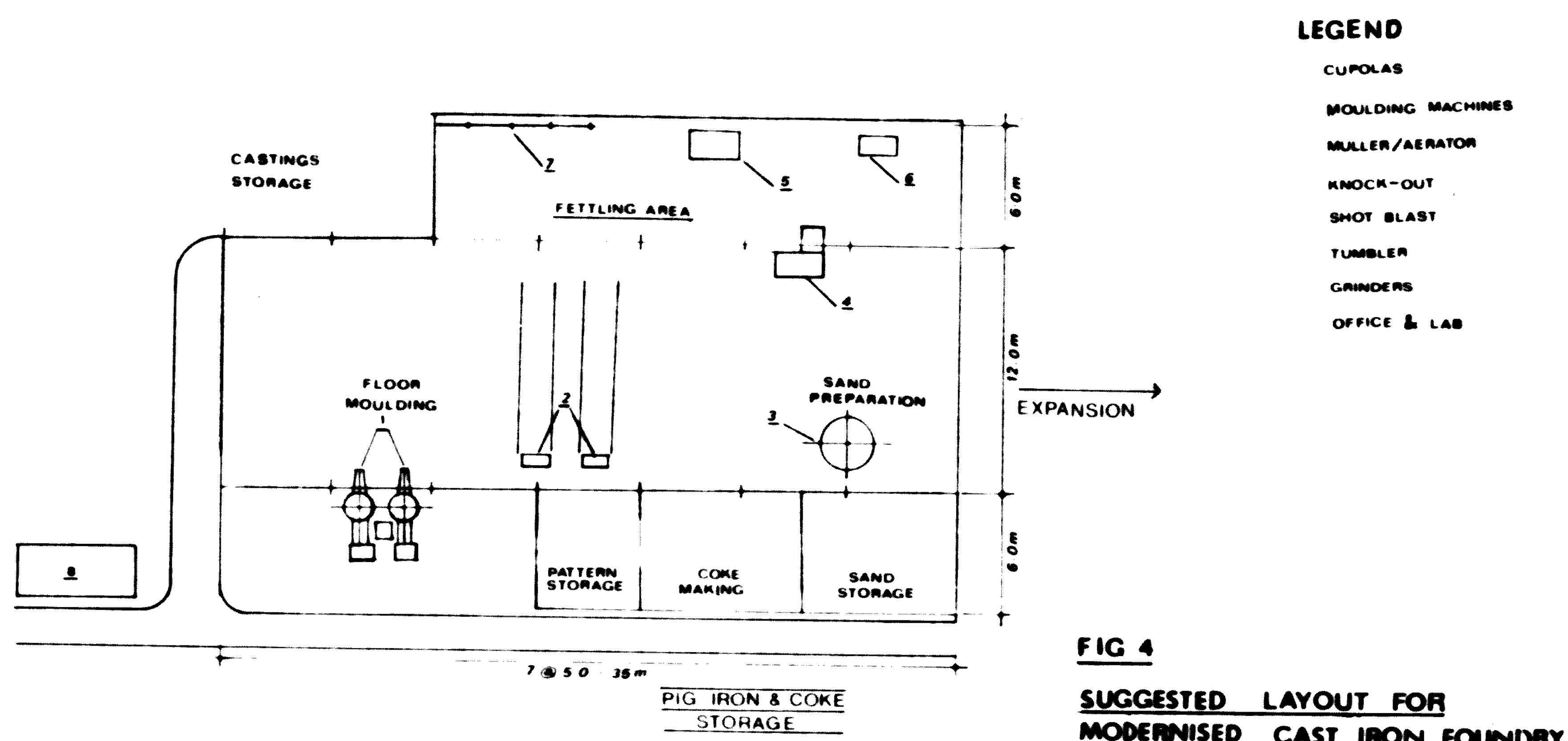


FIG 4

SUGGESTED LAYOUT FOR MODERNISED CAST IRON FOUNDRY

73. In many towns, the small foundry entrepreneur can be said to be exploiting labour which, without protection from unions or government, is forced to work long hours at low wages in unhygienic and unsafe conditions. The working environment needs to be improved and minimum standards enforced. Without such improvement, the modernisation of foundries can have no meaning for the people who are most concerned.

74. Most of the iron foundries are proprietorships. In Punjab, if a proprietor has some money he would rather build a new foundry than improve the old one. When his son has grown up, he builds a cupola for him in an adjacent plot, the next son gets a re-rolling mill, and so on. Indeed, some "family planning" is needed for foundries, to prevent further proliferation.

Possible improvements in equipment and practice

75. The shortcomings of existing foundries, as discussed above, themselves suggest the changes that could and should be made. These are reviewed below:

Melting Processes:

76. The progression of developments in iron melting technology has been more or less as follows:

Crucible furnace
↓
Cold blast cupola
↓
Hot blast cupola
↓
Enriched blast cupola
↓
Reverberatory furnace
↓
Rotary furnace
↓
Arc furnace
↓
Core-less induction furnace
↓
Channel induction furnace
↓
Horizontal continuous induction furnace.

/77.

77. The coke-fired crucible and oil-fired tilting crucible furnaces have given way to the cupola which is the predominant melting unit in the foundry sector. For the types and qualities of grey iron castings being produced, the cupola is undoubtedly the most economic, even though its thermal efficiency is only 25 per cent. For malleable, high-duty and ductile irons, the cupola in combination with some furnace, or other air and electric furnaces may be considered.

78. However, the design and construction of the cupola and its operation, control and maintenance in the small foundry are often unsatisfactory. Suggestions for improvement were discussed during visits.

79. Cupola design:

SSIDO needs to have standard designs of two or three alternative cupola sizes/types prepared. Although such designs were said to exist, at none of the SISI's visited were they available. Such designs and working drawings, based on up-to-date technology and specifically suited to the inferior raw materials now available to the small foundries, could be of great value.

80. The melting rate to be expected can be estimated by a formula such as:

$$\text{Melting rate (tons per hour)} = \frac{\text{Fuel burning rate (lb/hr)} \times \text{iron:coke ratio} \times 1/4 \sqrt{\text{wind box pressure}}}{2{,}000}$$

Fuel burning rates vary from 450 to 1,800 lb/hr for cupolas of 24" to 48", while fuel ratio is from 4 to 8:1 and wind pressure 8 to 24 oz. Taking typical values under good Indian conditions, the melting rates, charge, blower characteristics, etc. that may be expected under good conditions have been estimated in Table 8. It will be noted that these outputs, based on iron:coke ratio of 8:1 and prime foundry coke, are higher than present practice in the small scale sector, but could serve as targets towards which cupola operation could move.

81. In only two of the units visited was the cupola being charged by a mechanized skip - in all other cases charging was by carrying heavy head-loads and up a steep ladder. An electrically-operated skip with a side-dump bucket which discharges direct into the cupola could be fabricated locally for Rs 6,000-8,000. This, together with a weighing scale, could greatly facilitate and regularize cupola charging at the small foundry.

/Table 8:

Table 8: Typical cupola parameters

Shell diam. (in.)	Thickness of lower lining (in.)	Diameter inside lining (in.)	Area inside lining (sq.in.)	Melting rate with iron: coke ratio of (tons/hr)		Bed coke height above tuyeres (in.)	Charge (lb)				Blower		Total area of tuyeres (sq.in.)
							Coke	Iron		Flux	cfm	discharge pressure (oz.)	
				6:1	8:1			6:1	8:1				
27	4.5	18	254	0.7	0.8	28-34	20	120	160	4	640	8	32
36	4.5	27	572	1.7	2.0	36-42	45	270	360	[illegible]	1430	16	118
41	4.5	32	804	2.2	2.7	40-46	65	390	520	13	2000	16	121
51	7.0	37	1075	3.0	3.6	40-46	85	510	680	17	2700	16	182
66	9.0	[illegible]	1800	6.0	7.0	45-57	145	870	1160	29	4500	24	347

82. A typical equi-blast/balanced-blast cupola of 48" dia is shown in Fig.5. Height of cupola, blast pipe connection, location of iron and slagging spouts, dimensioning of tuyeres and selection of blowers have an important influence on thermal efficiency and cupola performance.

Cupola operation:

83. While cupola design and dimensions can be checked and rectified once and for all, cupola operating practice is the significant factor which affects day-to-day efficiency. The following variables need attention:

(i) Air blast: To control air supply to optimum level, a control valve on wind pipe and U-tube pressure gauge on wind belt are necessary. Generally, air through tuyeres should be around 1300 cfm requiring a blower output of say 1430 cfm at 16 oz pressure for a 30" cupola.

(ii) Bed coke height: This is a critical factor as bed coke serves the important functions of supporting the charge, providing the combustion to melt it, and the incandescent bed through which metal droplets pick up temperature. A practical method is to adjust bed height to the level of lining erosion on previous melts.

A check by drop rod to ensure proper height is necessary before regular metal charging.

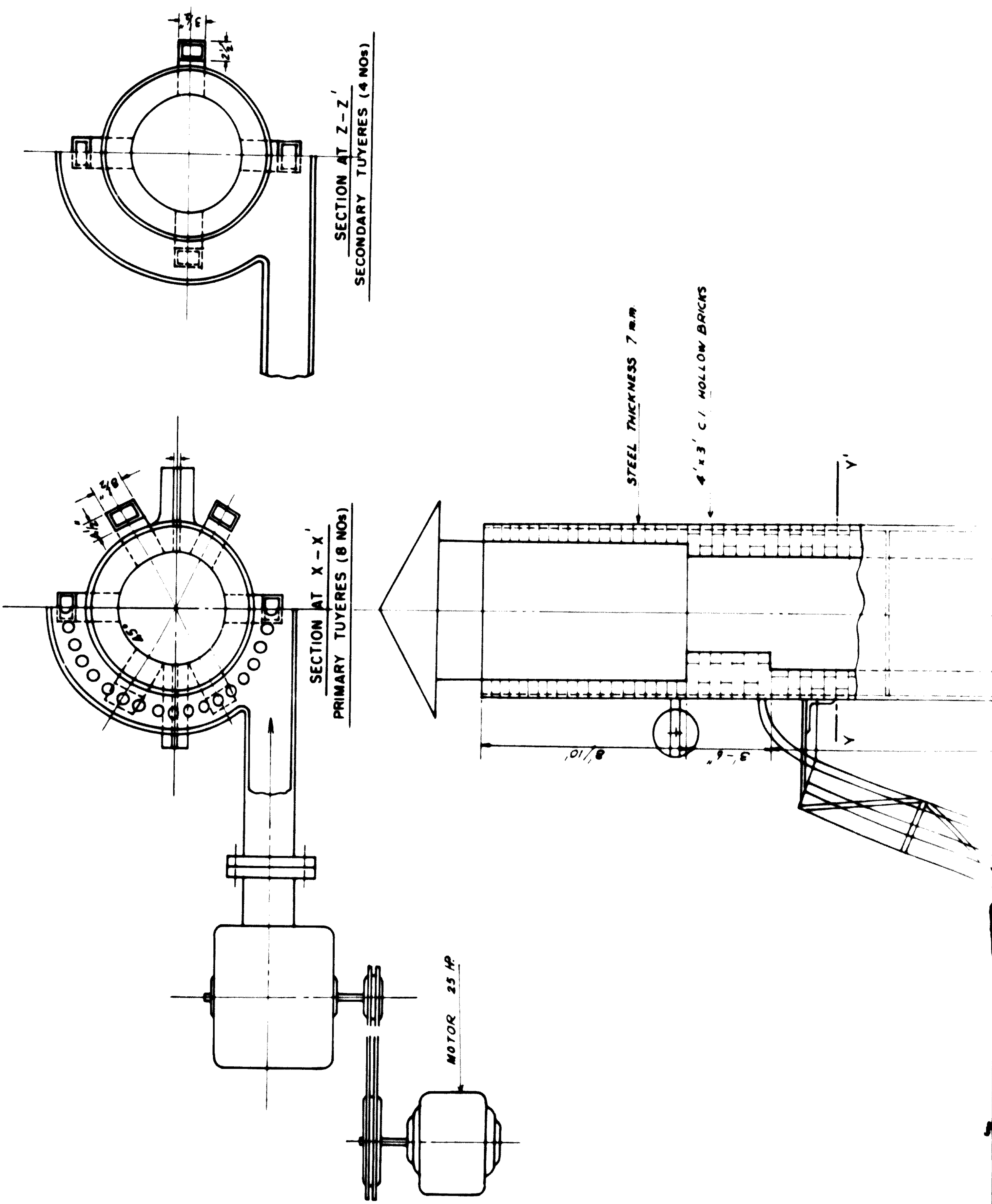
Limestone/Brixblock needs to be charged over the bed coke.

(iii) Metal charge and composition: Improper charge proportions give rise to poor melting rate, heavy shrinkage, hard castings and off-grade metal composition. Therefore, charge calculation based on known analyses and melting loss together with careful weighment of metal and ferro-alloys are essential.

The analyses and sizes of charge materials have a predominant effect on cupola operation. The following sizes may be aimed at, although it is appreciated that each foundry must evolve its own practice based on available materials:

Cupola diameter, inches	24	30	36	42	48
Size of coke, inches	2	2½	3	3½	4
Size of scrap, inches	7	9	11	13	14

/(iv)


SECTION AT Z - Z'
SECONDARY TUYERES (4 NOs)
SECTION AT X - X'
PRIMARY TUYERES (8 NOs)
STEEL THICKNESS 7 mm
4'x3' C.I HOLLOW BRICKS
Y'
Y
8'10"
3'-6"
MOTOR 25 HP

SECTION 1

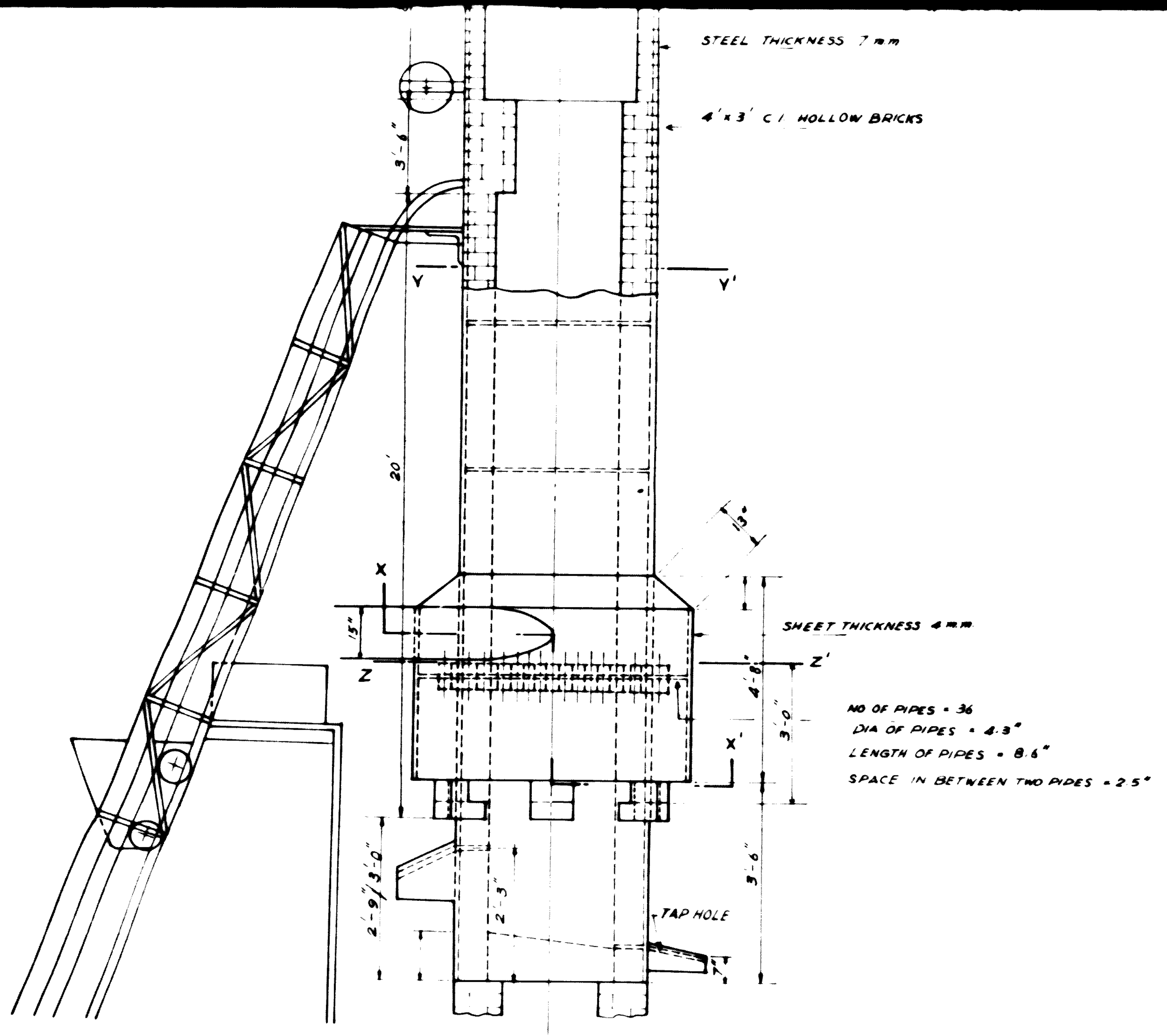


FIG. 5 SUGGESTED DESIGN OF 48" EQUI- & BALANCED BLAST CUPOLA

(based on design proposed by NML Field Station, Batala)

(iv) <u>Coke charge and ratio</u>: As melting rate, temperature, and to some extent metal composition depend on coke ratio, it is necessary to compute the coke needed and weigh the charge.

An additional split coke charge should be provided along with every seventh charge in order to replenish the bed coke.

For better fuel economy, some **soaking** time (say 45 to 60 minutes) should be allowed after completing charging to door level before starting the blower.

Delays and difficulties in opening the tap-hole can be avoided by a wooden form of suitable design while making up the tap-hole.

(v) <u>Metal control tests</u>: The 'wedge test' is a simple instant method to note the change in iron composition and suitability of metal for different casting specifications. Any variations from the normal chilling character should be treated with proper innoculant, etc.

Temperature variation needs to be observed with an optical pyrometer.

Test bars for physical and chemical tests should be poured regularly, and results co-related with casting quality.

Cooling and shake-out times should be determined for each type of casting and recorded for future use.

84. <u>Moulding:</u>

Developments in moulding methods have been as follows:

Skin dried mould
↓
Baked mould
↓
Green sand mould
↓
CO_2 mould
↓
Fluid sand mould
↓
Silicate mould

Hand-operated machine mould
↓
Pneumatic machine mould
↓
Slinger mould
↓
High-pressure hydraulic mould

Permanent mould
↓
Pressure die casting
↓
Lost wax process

85. Major advances are taking place not only in mass production but also in jobbing work. Precision moulding techniques are gradually replacing the traditional hand and machine moulding methods, in order to produce accurate machines parts, with consistent reproducibility and low costs. With the increasing sophistication of industrial casting requirements in India in the Fifth Plan, the small sector foundries will have to switch over to some of these moulding techniques in the coming years.

86. As noted, present practice is predominantly hand moulding on the shop floor or in double-boxes, using dry sand and occassionally green sand. Cores are also made manually in dry sand or oil sand. Sand is prepared by shovelling, mixing, and sieving manually.

87. One of the basic steps in small foundry modernisation should be proper sand preparation which includes cleaning and screening, removing metallics, measuring sand and additives, aerating and effective mulling to develop the full value of the binders and ensure uniform properties throughout each and every mix. At the same time, the minimal testing equipment is essential for routine shop tests on atleast (a) sand permeability, (b) moisture, (c) strength and (d) mould hardness. Such control equipment would cost about Rs 5,000 and even a small foundry can afford this. Sand testing itself is meaningless unless proper co-relation is established with resultant casting quality.

88. Where sand and gas costs permit, the use of CO_2 moulds needs to be encouraged. Shell moulding is also well suited for small foundries, and two units visited were using it successfully.

89. For automobile and railway castings, oil engine and machinery parts, pipe fittings, valves and other repetitive light and medium weight castings moulding machines, either hand operated or jolt-squeeze type, are considered very desirable. Also, greater use needs to be made of snap flasks and stack moulding, where possible. Where flasks are made by the foundry itself, the design should provide for an accurate match through use of machined joints and pin-holes with hardened bushings.

/Machine

90. Machine moulding would (i) greatly increase (double or more) the number of moulds made with the same labour, (ii) reduce the rejections in castings substantially, (iii) make for a better flow of materials and working environment, and (iv) enable production of castings with uniform, consistent weight and surface finish.

91. For the type of operations at small foundries, core blowing equipment is not generally necessary. But there is considerable scope for improving the core drying and mould drying facilities. The oven should provide a uniform measured temperature throughout and a flow of hot, dry air to ensure good drying and baking.

92. <u>Fettling:</u>

This operation is often a bottle-neck at Indian foundries. The problem is tackled at the small foundries by massive use of manual labour on contract basis. Apart from an occassional pedestal or portable grinder, no equipment is used. Shot-blasting equipment, pneumatic chippers, swing grinders and tumbling barrels would be useful additions in most fettling departments.

93. <u>Materials handling:</u>

At small foundries which have reached a certain level of sophistication, the use of pallet conveyors for moving moulds and vibratory knock-outs need to be considered. Similarly, narrow-gauge trolley lines to drying ovens and fettling areas would be desirable. A hand-operated 4-ton crane could find many uses inside the foundry. Other simple aids include geared ladles, wheelbarrows and bins for storage and movement of small castings. While the primary aim is to produce high quality castings, an important secondary objective is to utilize labour effectively without avoidable fatigue.

94. <u>Testing equipment:</u>

In addition to sand-testing equipment, a progressive small foundry, particularly if it is producing graded castings, should have (a) chemical laboratory for rapid carbon and sulphur determination (b) universal testing machine for tensile and transverse tests and hardness testing (c) small lathe for sample preparation, (d) bend and impact test equipment for malleable irons (e) metallographic testing for special irons. Ofcourse, as importent as having this equipment, is to have the will to use it, day in and day out.

/95.

95. If all the requirements for testing equipment, cupola blowers, light cranes, mullers, etc for industry-wide modernisation were aggregated and bulk orders placed, then manufacture would be facilitated and prices reduced.

Utilization of foundry capacity

96. In spite of good demand for castings, the iron foundries in the small sector are estimated to be operating at only about 20 per cent of their capacity. The technological improvements discussed above, together with better raw materials availability and credit facilities, could improve capacity utilization many-fold.

97. A new factor limiting utilization is the recent electric power shortage all over India. Frequent and prolonged power cuts, often without notice, are greatly affecting the rhythm of foundry operations, as also of other industrial production. If the power cut is less than two hours, an operating cupola could generally be re-started, but a power stoppage while melting in an induction furnace results in a ruined lining and loss of expensive metal. Workers also suffer as they get only half-pay while power is off.

98. Those foundries which switched from coal-fired furnaces to more efficient oil firing are suffering due to shortage of oil; those who changed to even more efficient electric furnaces are now suffering the most due to the power shortage. So, they ask, why modernise? Some grey iron foundries are installing their own diesel generators, others are putting up oil engines as stand-by for cupola blowers, while one unit had a sleepy old man to turn a bicycle-wheel-operated blower for his crucible when the electricity went off!

The economics of iron foundry mechanisation

99. The small founder is caught in a vicious circle: he cannot modernise because he does not have the money, and buyers will not pay him more for his castings because his foundry is not modern enough to produce quality products! In fact, the foundry owner feels that even if he improved his castings, the requirements of the market and the force of competition are such that he would not get a higher price. This is partially true, but it is a short-term view. Even today there are buyers who are looking for better-quality, higher-priced castings, and in the future the 'modernised' small foundry would be more viable than the obsolete one.

/100.

100. Consider the hypothetical case of a typical small iron foundry, before and after modernisation:

101. Existing facilities:

Initially it consists of one 30" cupola producing 2 tons/hr. It is operated about 4 hours/day, 6 times a month to melt 48 tons of metal/month, which gives 26 tons good castings/month (ungraded, average 20 kg/piece).

102. The unit has one pan-roller type sand muller for preparing all types of sand but moulding is manual, on the floor or in double boxes, in dry and green sand. There is a pedestal grinder and portable grinder, but no equipment for materials handling or for testing and quality control.

103. Cost of plant and equipment is Rs 44,000 while annual sales turn-over is Rs 4.2 lakhs. There are 36 people on roll but no technical staff.

104. Modernised facilities:

If the factory has enough space available and the owner has a progressive interest in improving his facilities, then many of the techniques reviewed above can be added to his existing set-up. The 30" cupola can be upgraded by (i) increasing its height to five times the diameter, (ii) installing a skip-hoist charging system, (iii) improving blast control by providing pressure and volume measuring devices, (iv) using an optical pyrometer and other metal control tests, (v) carefully proportioning and sizing the charge materials, (vi) close supervision of melting practice and (vii) proper patching and maintenance. A second up-to-date cupola of similar size is added.

105. One cupola could then operate at a rate of about 2.75 tons/hour, 6 hours a day and 12 days a month, to give around 200 tons metal/month. Rejections would be lower and about 136 tons good castings/month (upto Grade 22) could be produced.

106. Sieve-cum-aerator, sand testing equipment, mould hardness tester, with two hand moulding machines (100 complete moulds/shift) would be installed. About one-third of the output would be floor-moulded heavy castings (upto 4 tons piece-weight). For cores, sand mixer and oil-fired oven are visualised. Oil and CO_2 cores, where feasible, would be used.

/107.

107. Additional fettling equipment would include a tumbling barrel, swing frame grinder and pneumatic chipper. Hand-operated crane (4 ton capacity), geared ladles, vibratory shake-out and a trolley line are added. For testing and quality control, a small chemical lab and a universal testing machine are purchased. As a result of better casting quality and grade, selling price can be expected to increase from Rs 1,350/ton to Rs 1,500/ton.

108. Capital costs of the foundry, before and after modernisation, are estimated in Table 9. Labour force is estimated in Table 10.

/Table 9

Table 9: Equipment cost of small iron foundry before and after modernisation

Existing		Modernised (additional cost)	
Melting			
One 30" cupola	18,000	Modifications to existing cupola	12,000
		Second 30" cupola	28,000
Sand preparation			
Muller	7,000	Sieve-cum-aerator	4,000
		Sand testing equipment	5,000
Mould/core making			
Mould boxes, tools	5,000	Two hand-moulding machines	25,000
Mould drying oven	5,000	Core sand mixer	5,000
		Core oven	5,000
		Addl. mould boxes, etc.	6,000
Fettling			
Pedestal & hand grinder	6,000	Tumbling barrel	5,000
		Swing-frame grinder	4,000
		Pneumatic chipper	3,000
Testing			
	---	C & S determinator	10,000
		Universal testing m/c	25,000
Materials handling			
	---	Hand-operated crane	15,000
		Trolleyline & shake out	11,000
		Geared ladles, etc.	3,000
Utilities			
Power, water	3,000	Power, water	5,000
		Contingencies	10,000
Total equipment cost	Rs 44,000	Additional equipment cost	Rs 181,000
		Total equipment cost after modernisation	Rs 225,000 a/

a/ When buildings cost is included, the total fixed capital may be taken at Rs 70,000 for the existing foundry and Rs 325,000 after modernisation

Table 10: Foundry labour force before and after modernization

Existing			Modernized		
Personnel	No. on roll	Monthly cost Rs	Personnel	No. on roll	Monthly cost Rs
Foreman	1	300	Manager	1	800
Mistry	2	500	Accountant	1	500
Moulders	10	2,000	Foreman	1	500
Fettling	8	1,200	Clerks/stenographer	2	500
Helpers	15	1,500	Supervisor	2	800
Total:	36	5,500	Moulders	26	6,500
Add 20% for PF etc.		1,100	Cupola operators	4	1,000
Labour cost:	Rs	6,600	Fettling	16	3,200
			Helpers	15	2,250
			Electricians/fitters	4	1,600
			Laboratory & QC.	5	1,500
			Total:	77	19,150
			Add 20% for PF etc.		3,830
			Labour cost:		22,980

109. It will be noted that while the labour force has doubled, the monthly wage bill has more than trebled, due to higher costs assumed for better trained and motivated staff. At the same time, output of good castings has increased five-fold - from 26 tons to 136 tons per month.

The production cost and profitability estimates are presented in Table 11. At the modernized foundry production costs are lowered by almost 20 %, while the pre-tax return on total capital increases considerably. This hypothetical exercise assumes of course that the market would be there for increased production (which is quite possible) and that the increased quantities of pig iron and coke would be available (which is unlikely).

Table 11: Estimates of production cost before and after modernisation

	Price/ton (Rs)	Existing: consumption ton/month	Existing: cost Rs/month	Modernised: consumption ton/month	Modernised: cost Rs/month
Materials cost					
Pig iron	550	26	14,300	105	57,750
Purchased scrap	450	6	2,700	45	20,250
Foundry returns	450	20	9,000	60	27,000
Coke	350	12	4,200	33	11,550
Limestone	10	2	20	10	200
Alloys, etc.			700		3,000
Total			30,920		119,750
Less credit for foundry returns	450	20	9,000	60	27,000
Net materials cost			21,920		92,750
Cost above					
Labour cost			6,500		22,980
Consumables (sand, etc.)			700		4,000
Power & water			400		2,200
Pattern expenditure			1,000		6,100
Repair & maintenance			500		3,000
General plant overheads, rent, etc.			500		4,000
Cost above materials			9,700		42,280
Production cost			Rs 31,620		Rs 135,030
Fixed charges					
Depreciation on plant @ 7%			410		1,900
Interest on capital investment @ 9%			525		2,440
Interest on working capital @ 10%		(on Rs 100,000)	830	(on Rs 500,000)	4,175
Total cost of sales			33,385 (i.e. Rs 1,300/ton)		143,545 (i.e. Rs 1,050/ton)
Profitability					
Sales receipts/month		(26t @ Rs 1,350/t)	35,100	(136t @ Rs1,500)	204,000
Pre-tax profit/month			1,715		60,455
Annual pre-tax profit			20,580		725,460
Profit:Sales			4.6%		29.6%
Profit:Fixed capital			29.4%		223.0%
Profit:Total capital employed			12.0%		88.0%

B. MALLEABLE IRON CASTINGS

110. Due to the steel-like properties of malleable iron, its tensile strength of over 20 tons/sq in, good elongation and bend properties, impact resistance and good machinability, such castings have a wide range of application in automobile accessories, textile, agricultural and railway equipment, and a variety of machine components. The investments and technique needed are well within the capabilities of the small scale sector, and with greater encouragement from SISIs, small malleable iron foundries could play a larger role in the country's industrial development.

Existing malleable foundry facilities

111. Five small units were visited, as described in Appendix 6 and summarized in Table 12.

112. Equipment: Melting processes being used were cold blast cupola and oil-fired rotary furnaces; annealing was generally in conventional room-type furnaces, oil or coal fied, where packed pots are loaded and unloaded manually. With such equipment malleable iron is being produced but its quality and metallographic structure cannot be of a high consistent level.

113. Products: Presently, products consist generally of pipe fittings, automobile accessories and machinery parts. Keeping track of the large number of patterns and the fettling of castings are often bottle-necks. It seems likely that in the next stage of sophistication of small scale foundries, the production of spheroidal graphite iron castings will have to be taken up.

Suggestions for modernization

114. In order to achieve consistent properties in malleable castings, the following aspects need attention:

(i) The metal must be sufficiently fluid at casting temperature, and castings of varying cross-sections should be internally sound and not graphitise in the 'as-cast' condition;

/ (ii)

Table 12: Summary of malleable iron foundry facilities

Unit	Products	Investment Rs	Labour	Tech. Staff	Ave. prodn. (t/mth)	Sale Value (Rs/t)	Melting Units	Sand Preparation	Mould Prep.
Metro Malleable Mfg.(P) Ltd, Bangalore	Malleable & CI castings	300,000	250	7	130 C.I.	2,000	2-30" cupolas	sand muller, power sieve & aerator	8 hand m/c, 4 squeeze 1 turn m/c
FCG Malleable	Malleable castings & pipe fitting	400,000	75	2	125	3,000	1-18" hot-blast cupola	muller, power sieve	4-hand operat. machin.
Salvi Super Structure, Bombay	Malleable castings & pipe fitting	581,800	150	8	120 (75 C.I. 45 M.I.)	2,250 C.I. 4,250 M.I.	1-2½t & 1-1 1/4t oil fired rotary furnaces	muller	mouldin.
J.M.P. Mfg. Co, Jullundur	Malleable castings for automobile spares	175,000	30	3	60 M.I. 10 C.I.	2,300 1,700	2-700 kg oil fired rotary furnaces	muller, power sieve	2 jolt-s. mouldin.
Sethi Ind., Jullundur	Malleable castings for industrial chains	200,000	35	-	20	3,000	1-500 kg oil-fired furnace	Manual	Manual

SECTION 1

e 12: Summary of malleable iron foundry facilities

ch. Staff	Ave. prodn. (t/mth)	Sale Value (Rs/t)	Melting Units	Sand Preparation	Mould Preparation	Core Preparation	Fettling	Quality Control
7	130 C.I.	2,000	2-30" cupolas	sand muller, power sieve & aerator	8 hand mould m/c, 4 jolt-squeeze m/c, 1 turn over m/c	Core ejector: one	Tumbler, grinders, power hack-saw	Wedge & bend tests
2	125	3,000	1-18" hot-blast cupola	muller, power sieve	4-hand operated machines	Core oven	Tumbler & pedestal grinders	Wedge & bend test
8	120 (75 C.I. 45 M.I.)	2,250 C.I. 4,250 M.I.	1-2½t & 1-1 1/4t oil fired rotary furnaces	muller	moulding m/cs	Manual	Tumbler, pedestal & hand grinder	Sand testing, physical and chemical tests
3	60 M.I. 10 C.I.	2,300 1,700	2-700 kg oil fired rotary furnaces	muller, power sieve	2 jolt-squeeze moulding m/cs.	Manual	Grinders	Tests done by outside agencies
-	20	3,000	1-500 kg oil-fired furnace	Manual	Manual	Manual	Grinders	Tests done by outside agencies

SECTION 2

(ii) On annealing at the required time/temperature regime, the iron carbide must be fully decomposed, in order to achieve the specified physicals.

115. These conditions require high casting temperature and close composition control. The higher the carbon and silicon contents, the greater is the tendency for mottling. In more sophisticated foundries, the use of direct reading spectrograph to analyse the molten metal rapidly would enable adjustment by additions, before metal is tapped and poured into moulds.

116. With the abominable and varying quality of Indian coke and pig iron, such control is practically impossible to achieve consistently in the normal cupola. The oil-fired rotary furnace (with good monolithic linings, recuperation for heat economy, and pyrometric control) is considered a preferred unit for small malleable foundries. A well-designed hot blast cupola could also be used, but a conventional cupola should be discouraged. Electric furnace melting and electrically-heated annealing furnaces would not be within the investment limits of the small sector.

117. Due to its comparatively low carbon and silicon contents and consequent higher melting point and heavy solidification shrinkage, pattern design and moulding methods for malleable iron call for special care including liberal provisions for runners, rises and internal/external chills. Moreover, the higher casting temperature requires sand of high refractoriness and permeability. This, in turn, requires synthetic silica sand-bentonite mixtures together with routine testing of moulding sand. The type of castings in the malleable range lend themselves to machine moulding, either hand or pneumatic.

118. While for small scale operation, the room-type annealing furnace is the cheapest available, nevertheless, its operation needs considerable improvement: handling of pots could be mechanized by forklift or bogey and the temperature cycle controlled by pyrometer. Present annealing cycles (at times 130 hours and over) would be shortened by proper packing, loading and temperature control of furnace.

/ The most

119. The most serious difficulties to be overcome are the high ash and poor strength of coke supplied to small foundries together with the high and varying phosphorous in pig iron. Dilution of charge with 30-40 % steel scrap is a partial solution, while purchase of special foundry irons with low sulphur and phosphorous at high costs is another. Each plant has to work out its own charge compositions and its own malleabilizing cycles, to suit the available materials and desired end-uses.

120. The design and manufacture of inexpensive shot-blasting equipment for small foundries would remove present bottlenecks in fettling.

121. A modernized small malleable iron foundry would have typical parameters indicated in Table 13. For an investment of Rs 7.5 lakhs, annual sales would be Rs 21 lakhs, giving a pre-tax profit of over 60 % on total capital.

C. NON-FERROUS CASTINGS

Existing non-ferrous foundries

122. Particulars of units visited are described in Appendix 7 and facilities summarized in Table 14. Most units in the small scale sector use coke-fired crucible furnaces. Generally control on quality of raw materials, metal in the furnace, moulding sand preparation and moulds is inadequate. There is considered to be good scope for reducing costs by extending the life of crucibles through careful handling and melting procedures.

123. The selection of the melting unit depends not only upon the quality of the castings to be produced, but also on economics. Due to the high cost of electric furnaces (indirect arc, resistor or induction types) as well as high electricity charges in many regions, such equipment is rarely being used. In any modernization programme, the economics of electric melting units should be given proper consideration, as the cost of end-products is attractive.

Table 13: Operating parameters of "modern" small malleable foundry

Products: 50 tons/month of pipe fittings & light castings.
Average sales price Rs 3,500/ton.

Main equipment: One hot blast cupola (cap. 1 t/hr).
One sand mixer (4 t/hr).
Six hand moulding machines.
One oil-fired annealing furnace (cap. 6 tons).
One oil-fired cove oven.
Galvanising, fettling, testing equipment.

Capital cost:

	Rs
Equipment	6,00,000
Building, etc.	1,50,000
Total	7,50,000
Working capital	2,50,000

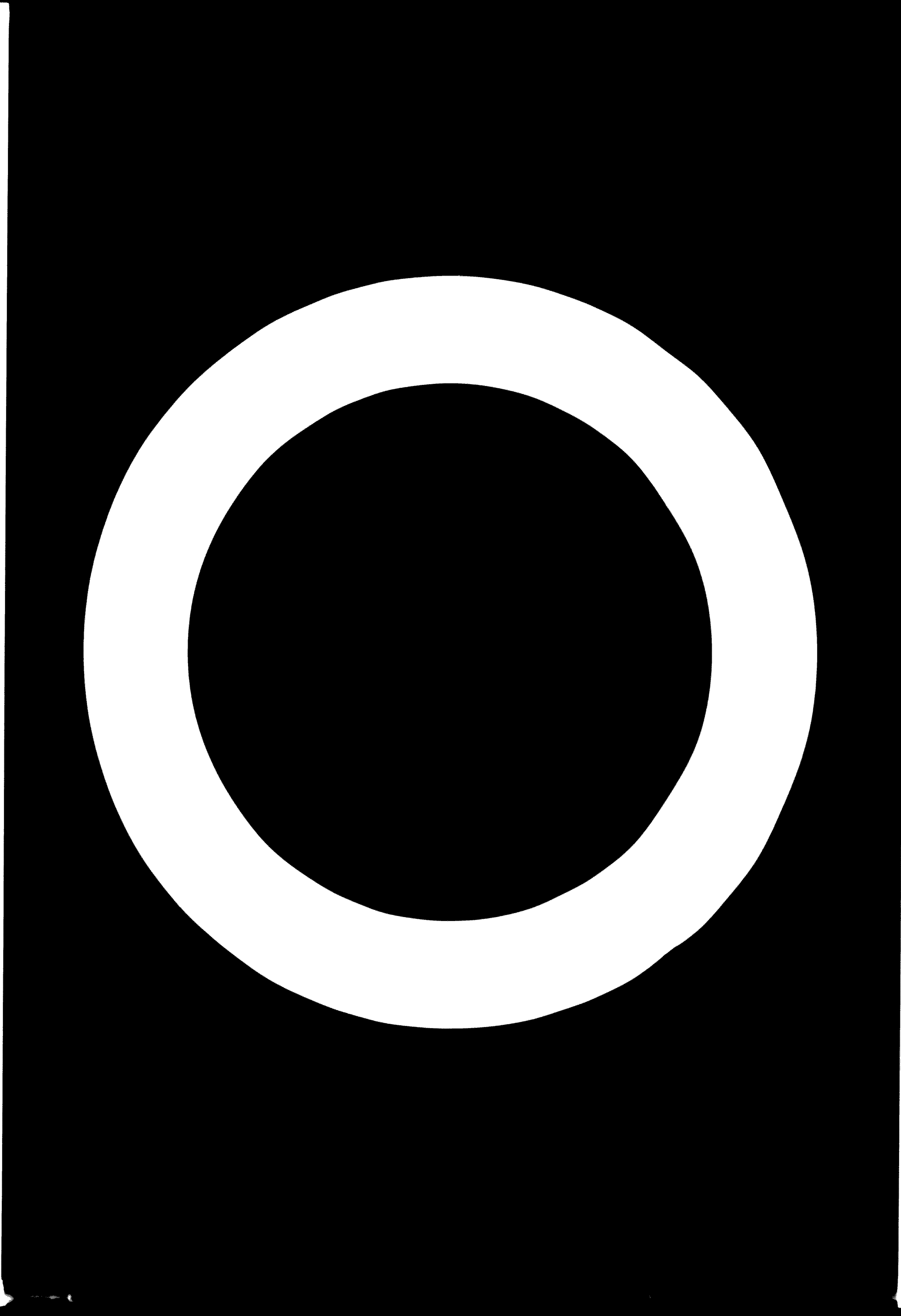
Labour force: 75 men (including supervisory).

Production cost:

	Rs/ton castings
Materials and supplies	Rs 1,650
Labour, maintenance, etc	550
Works cost	2,200
Depreciation @ 7%	88
Interest on fixed capital @ 9%	112
Interest on working capital @ 10%	42
Total cost	2,442

Profitability:

	Rs/year
Sales receipts	21,00,000
Pre-tax profit	6,34,800
Profit : total capital	63 %



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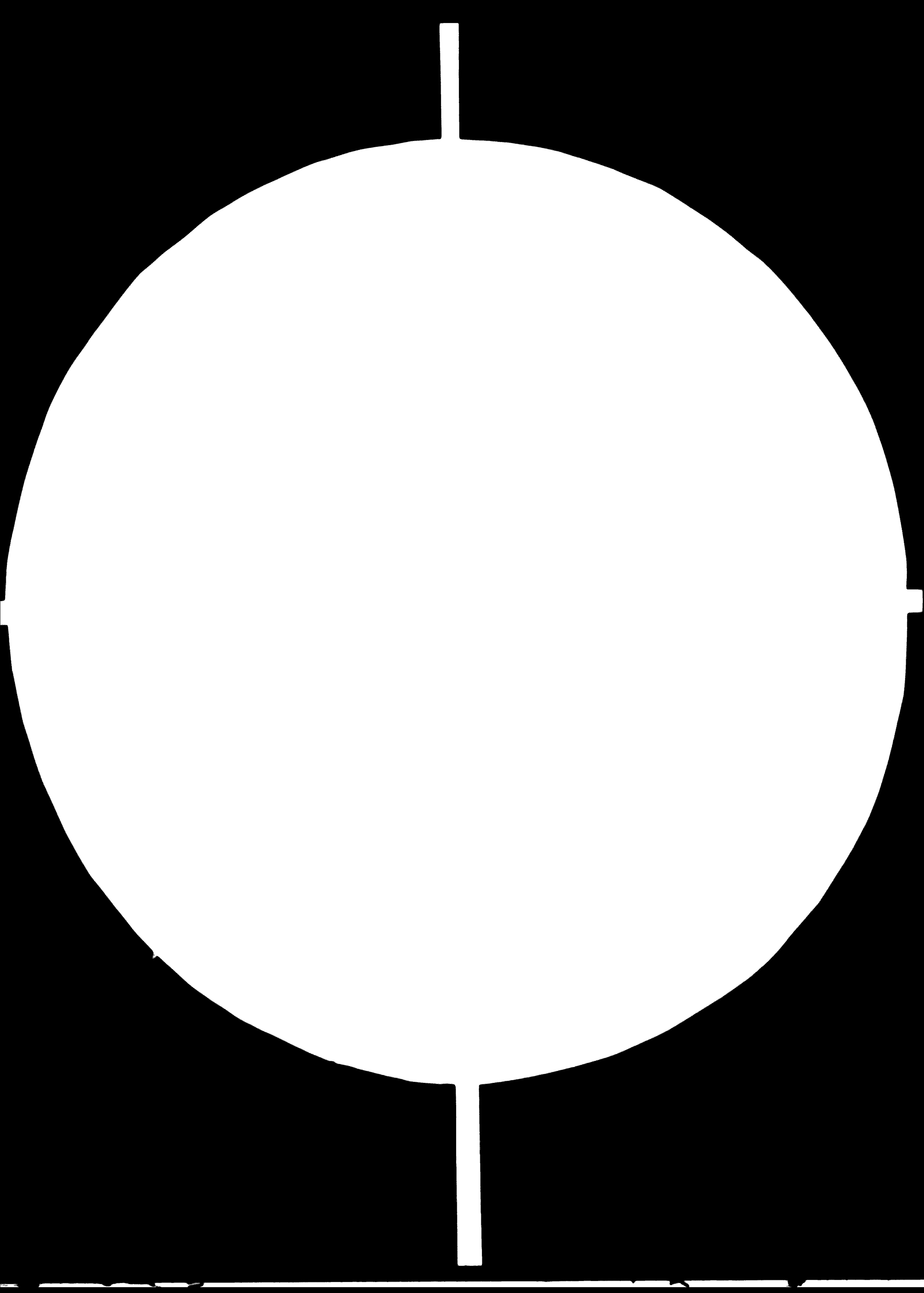

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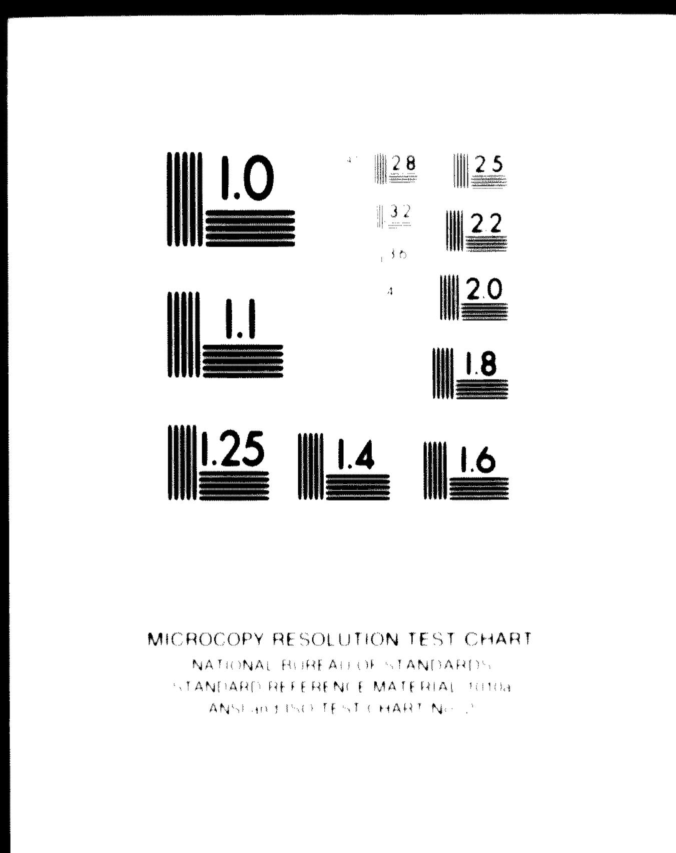
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Table 14: Summary of non-ferrous foundry facilities

Unit	Products	Investment Rs	Labour (on roll + Contract)	Tech. Staff	Ave. prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	Sand Prepara[illegible]
Vulcan Eng. Works, Calcutta	Small non-ferr. castings for architectural uses, etc.	20,000	44	2	8t copper base alloys	20,000	4 pit furnaces	Manual
Non-ferrous Industries, Calcutta	Copper base castings for impellers, etc.	40,000	18	Nil	4t	22,000	2 pit furnaces	Manual
Annapurna Cooker, Bangalore	Copper & aluminium castings	750,000	96+20	2	20t	15,000	6 oil-fired tilting crucible furnaces	Muller riddle
Bangalore Eng. Industries, Bangalore	Non-ferrous & CI castings	225,000	10	1	20t (mainly CI)	4,000 (mainly CI)	Skelnar oil-fired furnace (200 kg)	-
[illegible]in Patel & Co, Bombay	Aluminium & copper base alloy castings	100,000	35	1	4t	14,000	6 oil-fired bail-out type crucibles	Muller etc.
Sant Brass Metal Works, Jullunder	Brass castings for valve & pipe fittings	160,000	10	Nil	25t	15,000	6 oil-fired pit crucibles	Manual

SECTION 1

[illegible]ble 14: Summary of non-ferrous foundry facilities

[illegible]r [illegible]ll + [illegible]ct)	Tech. Staff	[illegible]ve. prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	Sand Preparation	Mould Preparation	Core Preparation	Fettling	Quality Control
	2	8t copper base alloys	20,000	4 pit furnaces	Manual	Manual	Manual	Manual	Visual
	Nil	4t	22,000	2 pit furnaces	Manual	Manual	CO_2 cores	Manual	Visual
+20	2	20t	15,000	6 oil-fired tilting crucible furnaces	Mullers, riddles	6 moulding m/c (manual)	Core-blower, CO_2 cores	Grinders etc.	Chemical & physical lab.
	1	20t (mainly CI)	4,000 (mainly CI)	Skelnar oil-fired furnace (200 kg)	-	Shell moulding	Core shooter	Grinder etc.	Visual
	1	4t	14,000	6 oil-fired bail-out type crucibles	Muller, etc.	Manual	CO_2 process	Grinders etc.	Visual
	Nil	25t	15,000	6 oil-fired pit crucibles	Manual	Manual	Manual	Manual	Visual

/Super Electrical

SECTION 2

Unit	Products	Investment Rs	Labour (on roll + Contract)	Tech. Staff	Ave. Prodn. (t/m)	Sale Value (Rs/t)	Melting Units	Sand Prep
Super Electrical & Eng, Faridabad	Pressure die castings for scooters & autos	900,000	140+60	2	30t	13,000	-	-
Prescot Enterprises, Calcutta	Pressure die & sand moulded castings	220,000	30+50	1	3t	12,000	-	-
Mysore Auto Service, Bangalore	Zinc die castings	40,000	38	5	7t	11,000	-	-
National Die Casting, Bombay	Aluminium pressure and gravity die castings	250,000	86	2	7t	14,000	Nine oil-fired crucible furnaces	-

SECTION 1

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[illegible]	Tech. Staff	Ave. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	Sand Preparation	Mould Preparation	Core Preparation	Fettling	Quality Control
+60	2	30t	13,000	-	-	Five process (80 to 400t)	-	Grinders, etc.	Own design office + tool room.
+50	1	3t	12,000	-	-	Three cold-chamber presses (40to 100t)	-	-	Visual
	5	7t	11,000	-	-	Three hot chamber m/cs	-	Grinders etc.	Visual
	2	7t	14,000	Nine oil-fired crucible furnaces	-	One cold chambers press (60t)	-	Grinders etc.	Physical & chemical lab.

SECTION 2

. . . . . .

124. Currently, melting losses are high. With proper fluxes and covers, this could be kept down to 1 per cent in the case of bronzes in crucible furnaces and to 3 per cent in reverbaratory furnaces. Similarly, with proper melting and moulding controls, casting rejections should be limited to 6 - 10 per cent.

125. Selection of an appropriate moulding method again depends on economics (cost of equipment and mould making), tolerances required and number of pieces to be cast. Most of the units visited use green, skin dry and dry sand moulding. But there is now enough experience on shell moulding and die casting in the small scale sector, to warrant their adoption in the expansion and modernization of non-ferrous foundries.

126. Most foundries have no equipment for tensile, hardness or other tests (except pressure tightness testing where required). A comprehensive programme of quality control should cover the selection of charge, melting practice, pouring temperature and mould quality, in order to minimize defects commonly encountered (such as shrinkage, gas unsoundness, segregation, indusions as well as cold-shuts, mismatches and run-outs).

127. Some progressive non-ferrous foundry units were encountered, for instance, Annapurna Cooker Co, Bangalore, which has six oil-fired tilting crucible furnaces and six moulding machines and is planning a major diversification and modernization programme.

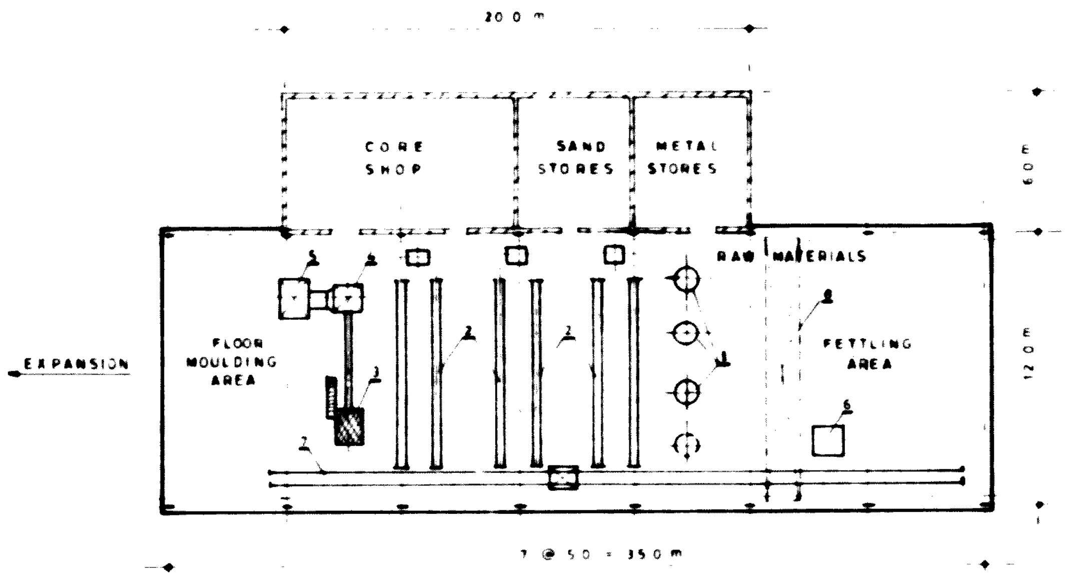
Suggestions for modernization

128. The main problems in modernizing non-ferrous foundries which have to be tackled include:

(i) Difficulties in supply of aluminium, copper, lead and zinc;
(ii) Change over to more efficient melting and moulding processes;
(iii) Further diversification of product lines.

129. A typical "modern" jobbing brass foundry for producing pump bodies, impellers, valves, bushes, etc. (max 50 kg wt) may have layout and facilities shown in Fig. 6. Floor space is taken at 150' by 40' and the plant may employ 35 workers. The layout can be so designed that some facilities (such as roller conveyors, sand preparation system) can be added later, as required.

/ Moulding



LEGEND

1. CRUCIBLE FURNACES
2. MOULDING MACHINE
3. KNOCK OUT
4. SCREEN
5. HOPPER
6. SHOT BLAST
7. BOGIE TRACK
8. FUTURE HAND OPERATED CRANE

FIG. 6

TYPICAL LAYOUT OF SMALL BRASS FOUNDRY

SCALE 1:500

130. Moulding: Most of the moulds are made on three portable jolt-squeeze machines using aluminium patterns and snap flasks. Each machine produces 100 complete moulds per shift. The moulds are placed on roller conveyors.

131. Melting: This is done in three 200 lb gas-fired crucible furnaces, whose tops are 2' above floor level. Crucibles are withdrawn, skimmed and moved by light overhead crane to the pouring lines. The cast moulds are pushed to a transfer buggy, which takes them to a knock-out station.

132. Sand reconditioning: Used sand from the knock-out is conveyed to a vibrating screen and then into an overhead hopper. New sand, as required, is added to the vibrating screen. The reconditioned sand is distributed to the moulding stations by wheel barrow.

133. Fettling: From the knock-out, castings are placed in bins and moved to the fettling shop, which contains a small sand blast unit, grinding wheels and pneumatic chisels.

134. Four pressure die casting units were visited. This is a field in which there is good scope for small units, provided that:

(i) Their main raw materials (zinc and aluminium alloys) are made available at steady prices and in required quantities. Presently supplies from MMTC, based on about 30 per cent of machinery value, last for only half-month instead of one year.

(ii) Die steel is supplied at controlled rates (presently, purchases have to be made in the open market at Rs 30 to 60 per kg, against controlled price of Rs 12), and

(iii) An inexpensive die-casting machine can be designed and fabricated indigenously.

D. STEEL FOUNDRIES

135. Due to the more sophisticated requirement in this field, the technical competence of the entrepreneurs as well as the equipment were generally better than at the iron foundries. It may be noted that practically all these units produced alloy and stainless steel castings which require a high level of operating techniques and quality control. These alloy steel castings were being sold at upto Rs 45,000/ton.

/ Existing

Existing steel foundry facilities

136. Facilities at the six small steel foundries visited are described in Appendix 8 and summarized in Table 15.

Steelmaking equipment

137. In order to suit the small quantities of steel needed, a variety of processes were adopted, namely:

Thermit melting (in crucibles)
Main frequency and high frequency induction melting
Indirect arc furnace
Plasma arc furnace
Electric resistance furnace

138. Due to the inappropriate choice of process, it was noted that entrepreneurs often had two types of furnaces and were planning to experiment with yet a third type. Furnaces sizes varied from 50 kg to 1,500 kg. In spite of the small size of operations, two out of the six units had equipment costing over Rs 7.5 lakhs while one barely managed to stay within the small industry limit because it had no moulding facilities and produced only billets.

139. On the sand preparation, moulding and fettling side, the facilities available were generally poor. Two units, however, were doing shell moulding.

Products

140. Most of the units are producing special steel castings in spite of the lack of appropriate equipment and testing facilities. Mention may be made of some ingenious operations:

141. Frontier Engineering, Kanpur, which makes steel rims by casting from thermit process. These rims are used as replacements in Tata trucks to enable them to carry substantial over-loads. A 15-kg rim, after machining, sells for Rs 72.

/ Precision

Table 15: Summary of steel foundry facilities

Unit	Products	Investment Rs	Labour	Tech. Staff	Avg. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	Sand Preparation
Frontier Eng. Corp, Kanpur	Steel rims	N.A.	6	nil	7	4,000	Crucible (thermit)	Manual
Kanpur Steel & Ferro-alloys, Kanpur	M.S. and alloy steel ingots	7,30,000	24	1	200 (ingots)	15,000	High-frequency induction furnace (½t) & indirect arc furnace (100kg)	---
Precision Tools & Castings, Lucknow	Alloy & stainless castings for pumps & valves	15,00,000	47	1	5	45,000	Plasma arc furnace (15 kg) & indirect arc furnace (50 kg)	Muller
J.G. Chakravarti & Co, Calcutta	Alloy steel & alloy iron castings	4,00,000	36	5	10	5,000 to 25,000	Mains frequency induction furnace (t) & cupola (1½t) for special iron	Muller Sieve
Tembe Industries, Kolhapur	M.S. Manganese steel and alloy steel castings	8,00,000	150	2	25	6,000	Electric resistance furnace (750 kg)	Muller
Sarrodya Foundry & Engineers, Bombay	Steel and CI castings	1,25,000	15	nil	0.8 t (steel), 127 C.I.	10,000 (steel) 2,000 (CI)	Indirect arc furnace for steel & skelnar furnace for C.I.	Muller

SECTION 1

Table 15: Summary of steel foundry facilities

Tech. Staff	Avg. Prodn. (t/mo)	Sale Value (Rs/t)	Melting Units	Sand Preparation	Mould Preparation	Core Preparation	Fettling	Quality Control
nil	7	4,000	Crucible (thermit)	Manual	Manual	---	---	Visual
1	200 (ingots)	15,000	High-frequency induction furnace (½t) & indirect arc furnace (100kg)	---	---	---	---	Visual
1	5	45,000	Plasma arc furnace (15 kg) & indirect arc furnace (50 kg)	Muller	Shell moulding (investment casting being tried)	Core blower	Grinders etc.	Visual
5	10	5,000 to 25,000	Mains frequency induction furnace (½t) & **cupola (1½t) for special iron.**	Muller Sieve	Manual	Manual	Pedestal grinder, etc.	Sand testing & mechanical tests
2	25	6,000	Electric resistance furnace (750 kg)	Muller	Moulding machines & shell moulding	Manual	Pedestal swing-frame grinders, etc.	Chemical & physical testing, laboratory
nil	0.8 t (steel), 127 C.I.	10,000 (steel) 2,000 (CI)	Indirect arc furnace for steel & skelnar furnace for C.I.	Muller	Manual	Manual	Pedestal grinder, etc.	Visual

SECTION 2

142. Precision Tools & Castings, Lucknow, which has developed good operating practices and a high reputation for stainless steel pumps and valves. Using plasma arc melting, the unit produces about 5 tons per month and castings are sold at rates of upto Rs 45,000 per ton. A 100 kg induction furnace, shell moulding and investment castings are now planned.

143. Sarvodya Foundry, Bombay, which produces only 0.8 tons of steel castings per month in a small room. The owner, a homeopath by hobby, entered the alloy castings field as "metallurgy and homeopathy both operate on the same principles of simile".

144. N.G. Chakrvarti, Calcutta, which has a well-planned foundry producing a wide range of alloy steel and iron castings. Typical products of this unit are shown in Fig. 7.

Suggestions for modernizing steel foundries

145. The market for steel castings, specially alloy steel castings, is presently good and small scale units could play an important role in this field. There is scope for improving operations of existing units, as follows:

(i) For steel castings, more than for gray iron castings, it is considered essential to have equipment for sand preparation (mixer, power sieve) and sand testing (permeability, strength and moisture).

(ii) Likewise, the use of green sand and moulding machines or of shell moulding, where economic, is recommended.

(iii) Chemical and physical testing equipment together with rigorous analyses of defective castings could bring down rejections to under 8-10 %, as against over 15 % at present.

(iv) The selection of steel-making process would of course depend upon a number of factors, such as size of furnace unit to suit the casting weight, relative cost of electricity and fuels, and the financial resources available. But generally the following observations can be made:

/ Furnace

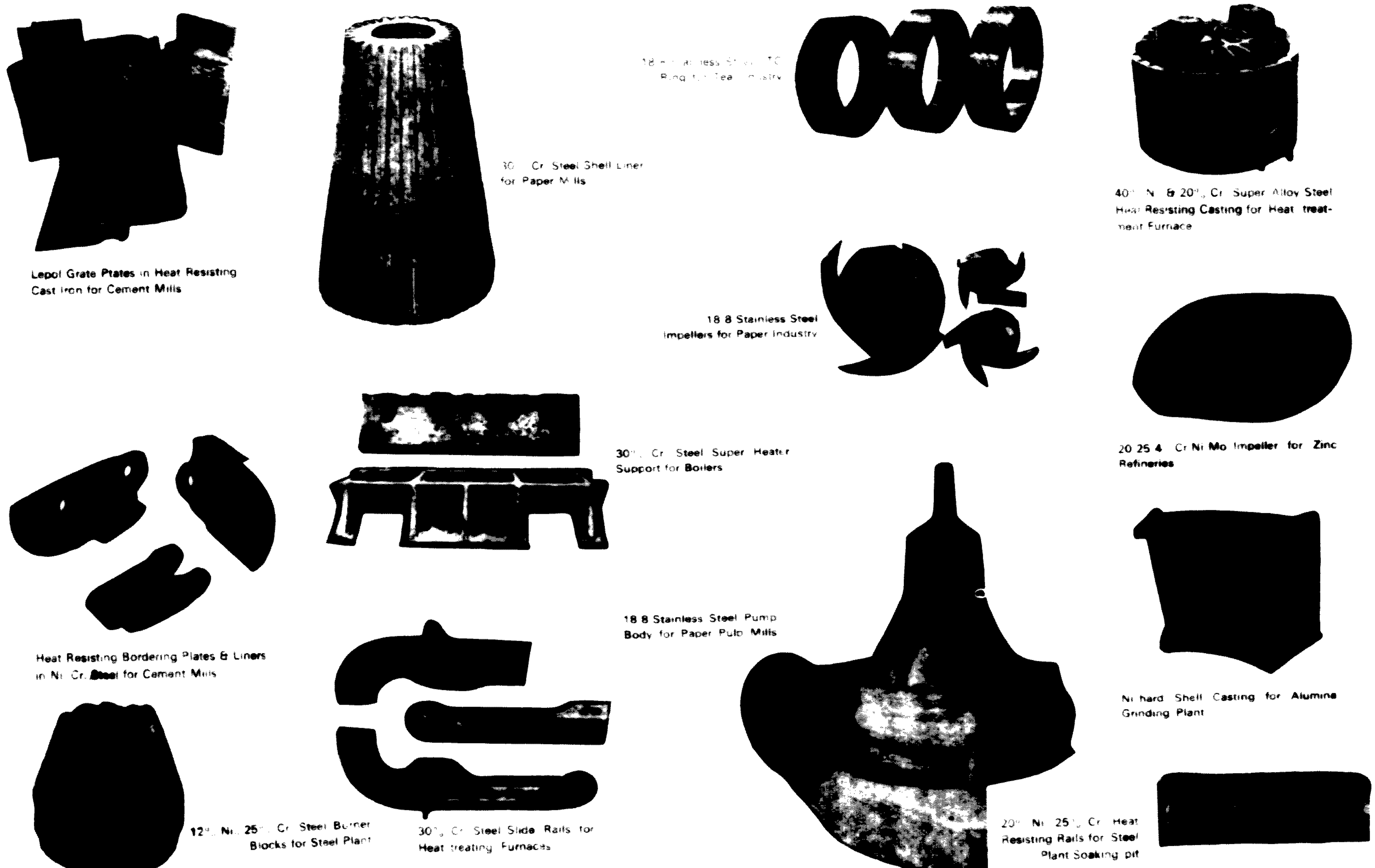


Fig 7 THE ALLOY STEEL CASTINGS PRODUCED IN FOUNDRY

Furnace capacity desired	Choice of process
0.1 to 1.0 ton	Induction type
1 to 10 tons	Electric arc furnace
Over 10 tons	Electric arc furnace (or open hearth under special circumstances)

It may be mentioned that in the Japanese steel foundry industry in 1959, 88 per cent of production was from arc furnaces, 6 per cent from induction furnaces and 6 per cent from open-hearths; since then proportion of arc furnace steelmaking has increased further.

146. For the small scale sector in India, the induction type electric furnaces may be considered appropriate only for production of limited tonnages of special steels. Other types such as indirect arc and resistance furnaces should not be encouraged except under special circumstances. However, in the long-term, the most suitable steelmaking unit is the electric direct arc furnace. It combines flexibility in the use of varying types of scrap, high throughputs and low operating costs. Average of 6 heats/day in arc furnaces and yields (metallics to good castings) of 50 % plus should be aimed at.

147. Due to the shortage of electric power and steel scrap in India, consideration could also be given to use of cupola for making liquid iron and refining this in a side-blown converter. The National Metallurgical Laboratory has done some work on this, but there is not much experience in India on a commercial-sized operation. However, with the difficult circumstance regarding electric power, SISI in cooperation with NML and others should undertake a feasibility study and project design for such a unit.

<u>Design and cost parameters of small steel foundry</u>

148. In order to demonstrate the viability of a small steel foundry, an exercise has been made below. A 1-ton electric arc furnace is selected as the steelmaking unit. It should be able to produce average 5 heats per

/ day

day to give 750 tons/year of good steel castings. However, conservatively, the following design basis may be considered:

One 1-ton arc furnace

Average 4 heats per day, 300 days working per year

Annual production 1,200-ton liquid steel giving 540 tons of finished casting per year (on basis of 50 % yield and 10 % rejections)

Foundry building 35 m x 12 m shed with 30 x 5 lean to.

149. Such a plant would require equipment worth about Rs 10 lakhs (including furnace and moulding) and a total investment of Rs 15 lakhs. The investment, manpower, and production cost estimates are presented in Appendix 9. Total costs including fixed charges come to about Rs 2,775 per ton while this type of steel casting could be sold at about Rs 4,000 per ton. This plant and equipment, with some additions, could be used to make alloy steel castings.

/ IV.

IV. IMPROVING THE OPERATIONS OF RE-ROLLERS

150. The scope for modernising scrap re-rolling operations is less and the need not as urgent as for foundries. Nevertheless, there are areas where costs could be reduced and products diversified by adoption of better equipment and techniques.

Existing re-rolling facilities

151. During the course of this study 15 re-rollers in various parts of India were visited. Their facilities are described in Appendix 10 and summarised in Table 16.

Equipment: The bulk of the mills had the following characteristics:

1) Large manual force (mostly on contract) to chisel, gas-cut and shear steel scrap in preparation for rolling,
2) Batch-type, coal-fired re-heating furnaces with poor fuel economy,
3) Generally, 4 or 5 stand 8" mill with gun-metal bearings, manual screw-down, and no repeaters,
4) Inadequate HP on main mill drive and V-belt transmission,
5) Steel rolls in stands No 1 and 2, alloy steel in No 3 and chilled rolls in No 4 and 5,
6) No cooling bed or product shear,
7) No over-head crane or other handling equipment.

152. These mills are generally made at the factory itself, the total equipment costing about Rs 2,00,000 to 3,00,000. The "parts list" for a typical 8" mill is shown in Appendix 11.

153. Mill sizes and drive HP of the mills visited were as follows:

Mill size		Mill drive	
Roll dia	No of Unit	HP	No of Unit
6"	2		
7"	2	under 150	-
8"	7	150 - 299	5
10"	6	300 - 499	9
16"	2	Over 500	3

/It may be

Table 16: Summary of steel re-rolling ...

Unit	Products	Investment in equipment Rs	Labour (on roll + contract)	Technical Personnel	Average Production tons/month
Singh Plate Mill (P) Ltd., Kanpur	M.S. Rounds & Light Sections	2,00,000	40+5	1	200
Gupta Steel Industries, Kanpur	M.S. Rods,	1,50,000	40	Nil	200
Katia Steel Rolling Works, Calcutta	M.S. Rods, flats, angles, channels etc.	6,80,000	75	Nil	450
"WE ARE FOUR", Calcutta	M.S. Hoop Iron & Strips (for export)	1,15,000	23	1	30
Agarwal Brothers Steel Rolling Mills, Bangalore	M.S. Rounds, squares, Hexagon flats	2,50,000	43+11	Nil	150
Bangalore Re-rolling Mills Pvt Ltd., Bangalore	M.S. Rounds & flats	7,00,000	60	Nil	400
Bharat Steel Re-rolling Mill, Bangalore	M.S. Rounds, angles & flats	7,00,000	65+6	2	300
Krishna Steel Industry, Miraj	M.S. Rounds	3,00,000	40	Nil	120
Eskay Steel Rolling Mills, Bombay	M.S. Rounds, flats, angles	2,00,000	35+10	1 (part-time)	200

SECTION 1

ry of steel re-rolling mill facilities

chnical rsonnel	Average Production tons/month	Sale Value Rs/ton	Starting Material	Material Preparation	Re-heating	Rolling Mix	Cooling Bed
1	200	1,400	Billets	Shears	Coal-fired pusher-type	10"-5 stands 350 HP	Fair
Nil	200	1,600	Scrap	Nil	Coal-fired batch-type	8" -4 stands 200 HP	None
Nil	450	1,800	Billets & scrap	Shears	Oil-fired pusher-type (2-3 t/hr)	8" -6 stands 350 HP 6" -5 stands	Fair
1	30	2,700	Skelp	Slitter	--	10"-single 2-hi stand, 8" -single 2-hi stand	Coilers with 7.5 HP Motor each
Nil	150	1,700	Scrap	Shears	Two oil-fired batch-type furnaces	8" -5 stands 150 HP	Fair
Nil	400	1,800	Billets	Shears for 4" sq billet	Oil-fired pusher-type (5'x25') & batch-type	10"-5 stands 550 HP	Good
2	300	1,960	Scrap	Nil	Oil-fired pusher-type (6'x42') & batch-type (6'x20')	10"-6 stands 500 HP	Good
Nil	120	1,850	Scrap	Shears	Oil-fired batch-type (6'x10.5')	7" -5 stands 200 HP, 320 RPM	None
1 rt-time)	200	1,750	Scrap	Shears	Oil-fired batch-type	7" -6 stands 250 HP, 350 RPM	Fair

/Agra Steel Corp.

SECTION 2

Unit	Products	Investment in equipment Rs	Labour (on roll + contract)	Technical Personnel	Average Production tons/month
Agra Steel Corp., Agra	M.S. Rounds & angles	2,50,000	50	1	200
Jai Bharat Rolling Mill, Gobindgarh	M.S. Rounds, joists (125x75mm) & hoops (19-20g)	9,00,000 (two mills)	90+30	1	750
Surendra Steel Rolling Mills, Gobindgarh	M.S. Rounds, joists	9,00,000	100+35	1	750
Jay Industries, Gobindgarh	M.S. Rounds & angles	3,50,000	28+15	1	250
Fonsla Industries (Rolling), Jullunder	M.S. Rounds & angles	4,50,000	37+25	Nil	400

SECTION 1

nical ...nnel	Average Production tons/month	Sale Value Rs/ton	Starting Material	Material Preparation	Re-heating	Rolling mix	Cooling Bed
1	200	1,600	Scrap	Manual	Oil-fired batch-type (5'x21' & 5'x16')	8" -6 stands 500 HP	Fair
1	750	2,200	Billets	Shears	Oil-fired pusher-type (22'x6')	16"-5 stands 330 HP + 300 HP 8" -6 stands	Good
[illegible]	750	2,200	Billets	Shears	Oil-fired pusher-type	16"-6 stands 400 HP + 350 HP 8" -6 stands	Good
1	250	1,600	Scrap	Shears	One oil & one coal-fired	10"-6 stands 400 HP, 290 RPM	None
Nil	400	1,800	Scrap	Shears	One oil & one coal-fired	6" -4 stands 250 HP 10"-5 stands 350 HP	None

SECTION 2

154. It may be mentioned that the two units with 16" mills had an investment of Rs 9,00,000 each which is outside the definition of a small scale unit. The high investment was due to the fact that each company had two rolling mills. A single 16" mill may well come within the small industry limit.

155. The furnace equipment was generally inadequate. Those units which had changed from coal to oil firing were experiencing difficulty due to the fuel oil shortage - consequently, some mills are having oil furnaces, with coal fired furnaces as stand-by. Instead of cooling bed, most plants had only a M.S. channel on which the bar was run out and then transferred manually to the ground.

Products: Most units produced bars and rods of 10-12 mm dia, starting from prepared scrap. Average production per mill of 8" dia and 200 HP motor was about 8 tons/day (approx. 8 to 10 hours rolling), that is, about 200 tons/month. The main difficulty was in securing adequate re-rollable scrap. Depending on scrap quality, its price was Rs 1,000-1,100 per ton. If some of the re-rollers were given billets, their output would be almost double that with scrap.

156. Re-rollers in Gobindgarh — such as Surendra and Jai Bharat — have diversified their output to include large joists on well as hoops. By attaching ingenious frames with vertical rolls to the last three stands of a 16" mill, they are able to roll 140 x 75 mm joist (from 112 mm sq billet) and 125 x 75 mm joist (from 100 mm sq billet). Such joists are selling at Rs 2,200/ton (against Rs 1,800/ton for rounds).

157. One re-roller in Calcutta — Katia — is producing special sections (gate rounds, drop rods, tension bars) in an 8" mill and exporting about 300 tons/month to the U.S.

158. Another Calcutta plant cold rolls narrow strip, hoops and strapping from skelp. This unit, appropriately called "WE ARE FOUR", was started by four young men - a technician, an accountant, a salesman and a commerce graduate - under the Government's 'entrepreneur scheme'. With a fixed investment of Rs 1.15 lakhs (wholly borrowed, at 10.5% interest and 5 year pay-back), they expect to have a sales turnover of Rs 12 lakhs in the third year of operation (1973). The process flow is as follows:

/Purchased skelp

Purchased skelp (146 mm wide x 2.9 mm thick, coil weight: 1 ton) → Slit to three stips of 48 mm each → Pickle → Cold roll in four passes to 22-26 g. at one 10" 2-high stand (75 HP) → Slit to 12 mm or 18 mm width → Hoops blued in pot furnace

About 30 tons/month of baling hoop are produced. Skelp is purchased at Rs 1,388/ton (or Rs 1,900/ton in open market) and hoop sold at Rs 2,700/ton.

Labour: Productivity is of the order of 4 tons rods per man-month of employment Half the mills had no technical personnel whatsoever. A number of operations such as preparing scrap and charging it into the re-heating furnace are done by contract labour. A team of four men is used to cut defective 10" sq blooms to re-rollable size by hammer (60 kg weight) and chisel. For this arduous manual operation the team is paid Rs 200/ton and their output is about one ton per day.

Factors affecting rerolling output

159. A large number of factors affect the capacity and efficiency of a re-rolling mill. These include the mill layout, size and number of stands, mill HP, finishing speed and transmission type, furnace type and capacity, and the type of cooling bed and auxiliary facilities. In addition, there are intangible factors such as the technical experience of the operating personnel.

160. For a batch-type coal-fired furnace, the heating rate for scrap would vary from 20 to 30 lbs per sq ft, while with oil firing the rate would be somewhat higher. Thus, a single oil-fired furnace of 15' x 5' hearth should be able to deliver over 1 ton per hour of heated scrap for rolling.

161. The theoretical mill capacity may be based on the assumption that the finishing stand is being utilized 100% of the rolling time - that is, a hypothetical situation whereby the rod is continuously in the finishing stand. Thus,

$$\text{Theoretical capacity (tons/hour)} = \frac{\text{F.P.M.} \times \text{Section Wt (lbs/ft)} \times 60}{2240}$$

$$= \text{F.P.M.} \times 0.0107 \text{ (for 3/8" round)}$$

/However,

However, in actual practice the rod may be in the last stand for only 25 to 50% of the time while rolling billets, and 10 to 30% while on scrap.

162. Thus, if the RPM of a 8" finishing stand is 260 (that is 540 FPM) and finishing stand utilization is say 25% for scrap, then the actual mill capacity would be (540 x 0.0107) x 25% = 1.44 tons/hr. This output could be obtained if the furnace has corresponding heating capacity, passes are appropriately designed, and there were no bottlenecks such as in removal of finished products.

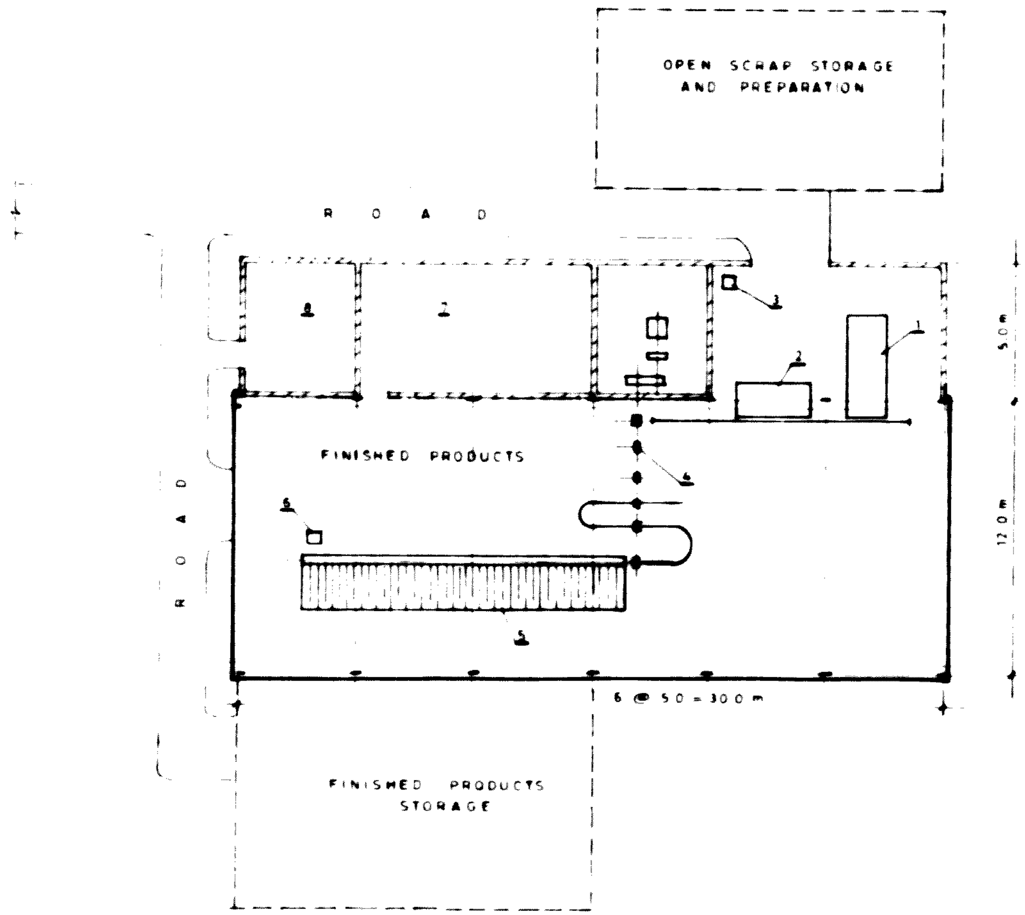
Suggestions for modernising rolling mills

163. Many of the existing re-rolling mills could be modified by incorporating some of the suggestions indicated above. With improved facilities their present production rates could be almost doubled while product quality would be improved. A suggested layout is shown in Fig. 8 wherein the receipt of incoming scrap/billets and despatch of finished products follows a unidirectional flow.

164. The types of improvements which may be considered for rerollers include the following:

1) Provision of small shears for scrap preparation,
2) If mill drive is inadequate, possibility of replacing motor (or augmenting it by additional motor) may be considered. A 10" mill should have a drive of about 400 HP. Where possible, the V-belt be replaced by reduction gear,
3) Batch-type furnace be converted from coal to oil firing, with proper arrangements for combustion and temperature control,
4) A pusher-type furnace be added to allow for rolling of billets when available, as well as for rolling uniform types of scrap,
5) A simple mono-rail be installed to move billets or heavy scrap from furnace to first rolling stand,
6) Design of mill stands could be greatly improved and fibre bearings adopted. Where possible, 14" or 16" roughing stands could be added to enable use of larger billets and improve production,

/7) Repeaters



LEGEND

1. PUSHER TYPE FURNACE FOR BILLETS
2. BATCH TYPE FURNACE FOR SCRAP
3. SCRAP SHEAR
4. 5 STAND 10" MILL
5. COOLING BED
6. SHEAR
7. ROLL TURNING
8. OFFICE

FIG. 8

LAYOUT OF MODERNISED SMALL ROLLING MILL

SCALE 1:500

7) Repeaters can be designed for the finishing stands, provided scrap of uniform type is available. This would obviate manual looping,

8) Provision of cooling bed and shear for cutting of products to required lengths is considered desirable. In some situations, coilers could be useful,

9) Rolls be cut for rolling of angles (upto 50 x 50 x 6 mm) and flats (upto 75 mm width), in order to diversify output,

10) Rolling of special sections such as gate rounds, drop rods, window sections and hexagonals for export as well as hoops, joists, ribbed bars and cold rolled strip could be taken up, where mill facilities and markets warrant this.

165. Table 17 indicates the approximate production that may be expected from a well-run mill, rolling prepared scrap to 3/8" round, on the basis of one 8-hour shift per day, 25 days per month. If 2" x 2" billets were used, production would be approximately double.

/Table

Table 17: Estimated scrap re-rolling mill capacities

	6" Re-rolling Mill	8" Re-rolling mill	10" Re-rolling mill	12" Rougher
Main Equipment	1 - pinion stand 4 - 3 high stands 1 - 2 high stand 200 HP motor Oil fired furnace(4'x6')	1 - pinion stand 4 - 3 high stands 1 - 2 high stand 300 HP motor Oil fired furnace(5'x8')	1 - pinion stand 4 - 3 high stands 1 - 2 high stand 400 HP motor Oil fired furnace(5'x10')	1 - pinion stand 2 - 3 high rougher
Capacity (3/8" round from scrap)	0.80 ton/hr b/ (160 tons/mo) c/	1.5 ton/hr. (300 tons/mo)	2.0 ton/hr. (400 tons/mo)	---
Equipment Cost a/ (Mech., Elec.& furnace)	Rs 3,00,000	Rs 4,70,000	Rs 6,80,000	Rs 4,50,000
Number of workers	40	55	62	

a/ Cost of building and equipment erection may be taken at additional 60% of equipment cost.

b/ With billets, production would be almost double.

c/ Assume 8 hours/day, 25 days/month; generally, however, these mills are run for 10-12 hours a day, giving a higher production.

. . . .

Modern techniques are viable

166. The view was often encountered in India that it is not technically possible to adopt more sophisticated equipment (such as pusher-type re-heating furnace, repeaters, or mechanised cooking bed) when rolling from scrap. However, if good re-rollable scrap could be purchased and cut to fairly uniform size, then these devices could be used.

167. In this connection, mention may be made of the Chonviriya Steel Co, Bangkok, Thailand, which rolls only scrap plate cuttings into 6 - 9 mm dia rods. The layout of the mill is shown in Fig. 9. Imported plate scrap is carefully sheared to 10 kg pieces and piled on short lengths of round bars which are then pushed through an oil-fired furnace (6 ton/hr capacity). The mill consists of 2 roughing stands, 6 intermediate and 4 continuous finishing stands, driven by 3 motors having a total of 1,500 HP! Repeaters are provided on both sides of the intermediate stands, and two strands are rolled simultaneously in the intermediate and finishing stands.

168. On 9 mm rounds, this mill is now rolling 40 tons per day (16 hours/day). It is soon to be put on three shifts, and is expected to reach an output of over 1,500 tons/month. The imported scrap costs US$ 130-140/ton c.i.f. (Rs 1,000/ton) and wire rod is sold at $ 200/ton (Rs 1,500/ton). The above example is given only to indicate that even scrap rolling is amenable to modern techniques, where conditions and government policies are favourable.

169. Even with partial modernisation and under Indian conditions, the benefits could be substantial. Consider a 10" rolling mill which is today producing 200 tons/month of 3/8" rounds from scrap. Modernisation of this mill, adopting the improvements discussed above, could be taken up. The capital cost and labour force as well as operating cost and profitability are estimated in Appendix 12.

170. It will be noted that materials constitute 88 per cent of total costs, while other major cost components are labour and interest on working capital. It may be mentioned that the labour salaries assumed are much higher than are normally paid in the small scale sector. In spite of this, and in spite of the

/high cost of

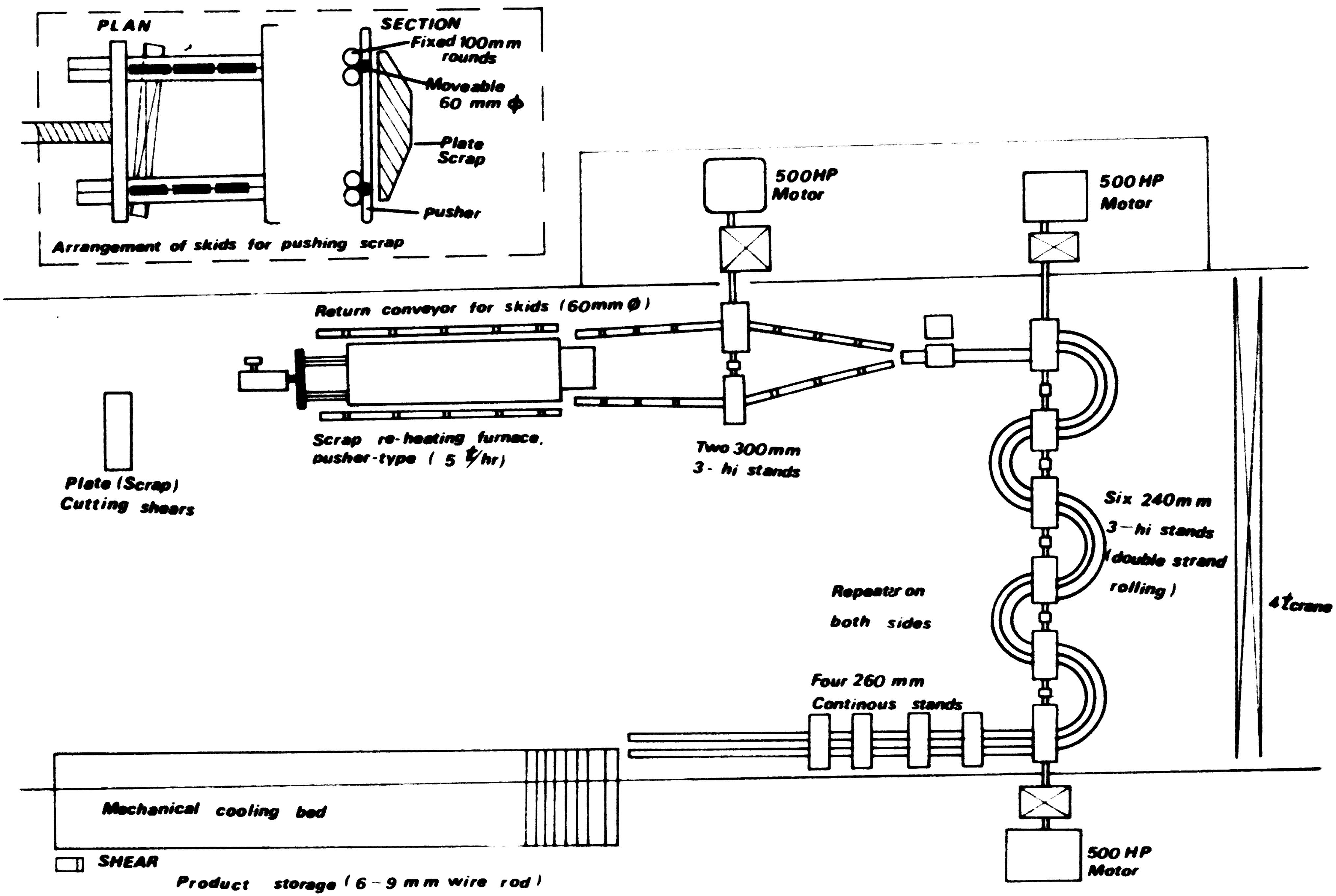


Fig 9. Layout of Mechanised Scrap Re-rolling Mill

high cost of re-rollable scrap, the profit before taxes is 66% of total capital or 226% of fixed capital. It is no wonder that the rush to install re-rolling mills continues; even operating on only one shift or less they make handsome profits.

171. This situation of inferior quality reinforcing rounds selling for Rs 1,800 per ton (US$240) cannot long continue, and the re-rollers had better prepare now for more efficient operations and diversified products in the future. This ofcourse requires that materials for rolling (billets or good rerollable scrap) are available, as discussed in chapter V.

Alloy steel rolling

172. At some Indian plants where mill layout and motor HP permit, the possibility may be considered of providing additional facilities and operating know-how to roll low-alloy steels. There are a number of ingot producing mini-mills mills coming up in India and it may be possible to buy alloy steel ingots from some of them for rolling. Preferred ingot size would be about 175 to 200 mm sq, from the view-point of quality. However, for low alloy steels (total alloy content less than 3 to 4%), smaller ingots of say 125 mm sq may also be considered. In that case, it would be necessary to ensure that the minimum reduction from ingot to final rolled product would be around 10:1. If such ingots are required to be rolled, a 16" 2-stand 3-hi mill would have to be installed ahead of the existing 8 to 10" re-rolling mill.

173. Firth Sterling Co at Thana presently has a 10" 7-stand 3-hi rolling mill for rolling high speed and other alloy steels from purchased billets of 60 to 75 mm sq. The proposed new plant of Firth Sterling at Nagpur will have 16" 2-stand 3-hi mill for rolling 125 to 150 mm sq ingots of low alloy steel.

174. The existing batch-type or pusher-type furnace of the rerolling mill can be used for reheating of low alloy steel. However, it will have to be ensured that combustion is proper to avoid excessive scaling. For rolling of alloy steel, the mill speed should be slow, 60 to 120 RPM would be preferred. Hence, this aspect should be looked into while considering the existing rerolling mill. Further, it would be worthwhile to have ball bearings instead of fibre bearings on the last two stands to ensure better finish and close tolerance of the product.

/Swing grinder

175. Swing grinder and pneumatic chipping machines should be provided for surface conditioning of the alloy steel ingots and billets. For low alloy steels, heat treatment and slow cooling facilities are generally not required. However, if high alloy steels are to be rolled, these facilities would be essential. Experienced staff on rolling of alloy steels, as well as proper testing and inspection facilities are needed to ensure satisfactory product quality.

The advent of the "micro-mill"

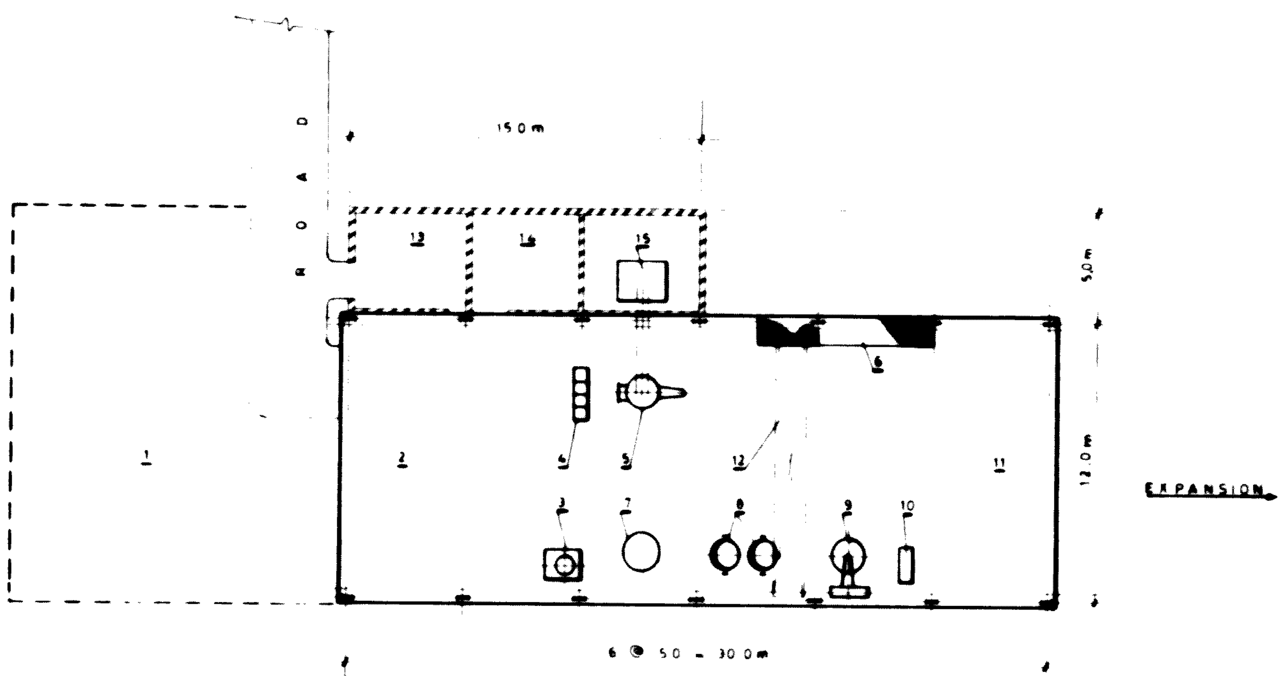
176. While a large number of arc furnace plants (so-called 'mini mills') continue to be installed in India, the demand of re-rollers for ingots and billets remains unsatisfied. Moreover, even these mini-mills involve investments which are greatly in excess of the small scale limit. Technological developments in the last few years have enabled semi-integrated plants with outputs of 50,000 ton/yr (even 20,000 tons/year) to compete with large integrated steelworks, because of their inherent advantages of low investment in arc furnaces, low over-heads, faster construction, higher productivity, and nearness to markets. Can ingot-making plants of even smaller size be run viably?

177. Having studied this problem at first-hand, it seems logical to consider a plant, specially designed for the small scale sector, with one 2-ton arc furnace producing only about 4,600 tons of small ingots per year. Hitherto such a unit has been considered as abnormal and uneconomic. But the Indian steel situation itself is abnormal, and the Indian small entrepreneur has the ingenuity to make the uneconomic economic. The proposed small steel plant could well be called the "MICRO-MILL". Based on preliminary study and quotations from three suppliers of such equipment, the design basis and capital cost are estimated in Table 18, the plant manning in Table 19 and production cost in Table 20 & layout in Fig. 1.

178. It will be noted that starting with scrap at an average price of Rs 500/ton the MICRO-MILL could produce billet-size ingots at a total cost of Rs 1,000/ton after providing for all interest and depreciation charges as well as excise duty. Currently such steel is being sold at Rs 1,500 per ton but even assuming a lower selling price of Rs 1,250 per ton, the plant would have a pre-tax profit of Rs 10,00,000 per year, that is, 75 per cent return on fixed capital or 43 per cent on total capital employed.

179. This, of course, is possible because of the present steel market situation and the low operating over-heads in the small scale sector. It also requires that the MICRO-MILL is designed carefully on a tight budget, without any "frills". Even so, the cost of equipment (Rs 9.9 lakhs) would be outside the present small sector definition.

180. One could hypothise a situation where 24 such MICRO-MILLS (each mill linked to one existing but modernised small scale re-roller) are built all over India at a total investment of about Rs 3 crores, to provide 100,000 tons of steel. Admittedly, this would put pressure on the limited melting scrap and electric power resources of the country, but the quantities needed are not large and the benefits derived could be substantial.



LEGEND

1. OPEN SCRAP YARD
2. SCRAP STORAGE
3. WEIGHING M/C.
4. ADDITION BIN
5. 2 T. ELEC. ARC FURNACE
6. CASTING PLATFORM
7. ROOF LINING
8. LADLE REPAIR
9. LADLE HEATER
10. DRYING OVEN
11. FINISHED PRODUCTS
12. HAND OPERATED CRANE
13. S.M.S. OFFICE
14. LABORATORY
15. TRANSFORMER ROOM

FIG. 10

TYPICAL LAYOUT OF MICRO STEEL MILL

SCALE - 1:500

Table 18: Design basis and capital cost of proposed micro-mill

Design basis

One 2 ton arc furnace with swing roof transformer 1250 kVA

Average 7 heats/day, 330 days/year

Production: 4,620 tons liquid steel/year

(or 4,160 tons ingots)

Melt shop building 12 m x 30 m with 5 m x 15 m lean-to.

Capital cost	Rs
2-ton arc furnace with swing roof, 1250 kVA transformer refractory lining, charging bucket and slag pot	6,50,000
Crane for charging & teeming	1,00,000
Ingot moulds, ladles, ladle preheaters, weighing machine and other miscellaneous equipment	45,000
Laboratory equipment	15,000
Electrical power equipment	90,000
Utilities including piping	80,000
Maintenance & repair equipment	5,000
Miscellaneous tools etc.	5,000
Equipment cost:	9,90,000
Building 435 sq m at Rs 300/sq m	1,30,500
Equipment erection	1,00,000
Plant cost	12,20,500
Engineering & contingencies	1,00,000
Total plant cost:	13,20,500

/Table

Table 19: Labour force at micro-mill

	No. on roll	Monthly cost
		Rs
Supervision		
Manager	1	1,500
Accountant	1	800
Clerks/storekeeper	2	500
Peons/watchmen	4	800
Production		
Foreman/melter	4	4,000
Scrap preparation	9	1,800
Furnace helpers	6	1,200
Teeming	6	1,200
Refractory work	3	750
Gas cutters	2	500
Chemist	2	700
Crane driver	4	1,200
Inspector	1	400
Maintenance		
Fitters	2	800
Electricians	2	800
Total	49	16,900
Add 20% for P.F. etc		3,380
Labour cost		Rs 20,280
		(Rs 2,43,360/year)

/Table

Table 20: Production cost and profitability at "Micro-Mill"
(Basis: Production 4,160 tons ingots)

Materials	Cost per ton material Rs	Consumption per year tons	Cost per year Rs	Cost per ton ingot Rs
Steel scrap	500	5,082	25,41,000	508
Ferro manganese	1,300	46	59,800	14
Ferro silicon	2,700	46	1,24,200	30
Aluminium	7,000	9	63,000	15
Lime	100	231	23,100	6
Fluospar	2,000	23	46,000	11
Total				584
Less: Credit for scrap - 80 kg at Rs 500				-40
Net materials cost				544
Cost above materials				
Electric power, kWh		32,34,000	4,20,420	101
Electrodes	8,000	28	2,24,000	54
Fuel oil			10,000	2
Refractories			2,50,000	60
Oxygen/burshane			41,600	10
Labour & supervision			2,43,360	58
Maintenance			12,000	3
General plant expense			21,000	5
Cost above materials				293
Works cost				837
Fixed charges				
Depreciation on plant & equipment at 7%			85,500	21
Interest on capital investment @ 9%			1,19,000	29
Interest on working capital of Rs 10,00,000 @ 10%			1,00,000	24
				74
Production cost:				911
Excise duty per ton				87.50
Total cost (incl. duty)			Rs	998.50
				(say Rs 1,000/ton)

V. RAW MATERIALS AND OTHER PRODUCTION FACTORS

181. Apart from technology, the other inter-related inputs needed to improve operating efficiency and capacity utilization are materials, money, markets, manpower and management. While there is a multiplicity of agencies set up to provide assistance on these to the small scale sector, the entrepreneur has often to run from pillar to post to secure his minimum needs.

A. RAW MATERIALS

182. When asked about possible bottle-necks in improving their operations, 90 per cent of the foundries listed raw materials difficulties as the major limitation. Unless materials for two-shift operation at the "modernised" units are assured - and assurances can actually be implemented - the entrepreneur may see no purpose in modernising.

Pig iron

183. All India iron casting production has trebled in the last decade. However, the supply of foundry iron - the main input - has not kept abreast of needs and this has continued to be a major obstacle to rational and efficient growth. For the purpose of planning foundry iron production it may roughly be assumed that one ton of iron is needed to make one ton good castings. Thus, the small foundries today need around 350,000 tons of iron, and this would rise substantially in the Fourth Plan.

184. The types of problems reported were as follows:

(i) Presently the bulk of the iron supply to small foundries comprises off-grades or low-silicon foundry grades.

(ii) Mix-up in grades in supply to small scale units is the maximum because of the nature of the distribution system. For engineering castings, small foundries generally need Grade II iron (2.25 - 2.75% Si) and for non-industrial castings Grade III iron (1.75 - 2.25% Si). However, they have no choice and have to take whatever mixed-up and off-grade materials that are offered, or not have any at all. This results in casting defects as well as use of expensive ferro-alloys.

/(iii)

(iii) The weight of pigs often offered to small units (45 kg) is too heavy for their manual handling operations.

(iv) Irregularity in supplies. There may be no foundry iron for six months and then suddenly a large tonnage in block rake is offered which has to be lifted or completely foregone.

(v) Some state small industry corporations which act as distributors of iron and steel materials charge high handling charges (upto 20%) which puts the small units at a disadvantage compared to those which receive materials direct from producers.

(vi) Small operators are hesitant to utilise their own quotas as there is often heavy pilferage in open wagons alloted to foundries. 'Road permits' for bringing pig iron, from say Durgapur to Calcutta, are not allowed. They therefore prefer to pay Rs 560/ton on the open market rather than the controlled rate of about Rs 480/ton.

(vii) Another reason for not using their quotas is that they do not have the working capital to make large cash deposits months before actual receipt of the material.

185. For production of high-grade iron, low phosphorus pig iron is essential. While the costs of such iron from the Mysore and Sandur plants are very high (as much as Rs 750/ton), the small foundries generally expressed satisfaction at their adherence to specifications and regularity of supply.

186. Shortages of foundry iron, erratic supply, mix-up of grades, non-availability of appropriates grades for small scale foundries are chronic, although recently the problem is not as acute due to surplus production from Bokaro. Recommendations for minimising difficulties have been made by the Pig Iron Panel (1965) and other bodies. In connection with the special needs of the small foundries and the proposed foundry modernisation, the following suggestions may be considered:

/(i)

(i) Foundry co-operatives and state small industry corporations be further enabled to stock foundry iron to a greater extent than at present for prompt supply to their members. As material movements by block rakes are preferred, bulk purchases and stock-piling become inevitable. This 'materials bank' approach would go a long way in reducing the hardships of the small entrepreneur. At large consumption centres, additional H.S.L. stockyards are needed.

(ii) Small foundries be "educated" to use the correct grate of iron. Grade III iron is suitable for the majority of applications.

(iii) All possible efforts be made at the steel plants, loading stations, transhipment points and stockyards to avoid human errors which cause mix-up of grades.

(iv) Complaints made to SISI officers and Industry Directorates regarding short suppliers, supply of off-grades, etc. be acted upon promptly, so that the small foundry man is not forced to spend his limited time and resources on fruitless missions.

Coke

187. The quality of coke is perhaps the single most important factor in efficient cupola operation and the inferior quality of Indian coke supplied to small foundries is perhaps the prime cause of their high fuel consumptions and low operating efficiencies.

188. Generally speaking, for production of quality iron the following coke characteristics are needed:

(i) Ash content: The ash content of coke should be low, preferably below 15%, as for instance, in the cause of Premium By-Product coke from Loyabad or Bareri. As it happens, most Indian coke now has upto 30% ash and some bee-hive coke exceeds 35%.

(ii) Uniform chemical analysis: Sulphur should be less than 0.8% and phosphorus under 0.01%. Above all, analyses should be uniform for regular, standardised cupola practice. However, small foundries have no assurance of supply and have to buy whatever grade is available at any particular time and at widely fluctuating open market prices. In Punjab, coke prices were at times Rs 600/ton, even higher than pig iron.

/(iii)

(iii) Uniform size: Carbon absorption, reaction rates and metal temperature are related to coke size, which should average between 1/10 and 1/5 of cupola internal diameter. In foreign countries, the foundry operator can specify the size he wants but in India he has to be satisfied with what he gets - coke from 10 mm to 3,000 mm.

(iv) Uniform strength and structure: Resistence to shatter on impact is important in maintaining coke size throughout shipping, handling, charging and melting. This, in turn, requires good coal quality and good coke oven practice. Upcountry foundries consider that if the coke delivered by rail is say 10% less than indented and paid for, they are fortunate (cases were reported where on opening a 20-ton coal wagon, only one ton of coke was found!).

189. Problems of inferior coke quality due to a poor resource endowment must be lived with; but problems of mix-up, pilferage, delays and exhorbitant "open market" prices due to human failings can and must be avoided.

190. The recent nationalization of merchant coke supplies and the diversion of railway wagons to food movements have aggravated the problems of coke supply, but it is hoped that these would soon be overcome.

191. At present, certification from the state Industries Directorate for supply of coke to a unit must go through various other agencies who can delay, reduce or deny the quantity authorised. At times, we were informed, the middleman arranging the supply would cable the small foundry that its sponsored quota was not available, but supply could be made immediately from the "unsponsored quota" - at greatly enhanced prices.

192. Also, we were shown a quotation from Bharat Coking Coal Ltd. for coke supply on "no complaint basis", that is, no complaints regarding mix-up or substitution of qualities would be entertained; if any complaint was made, supplies would be suspended until the case had been fully investigated, which may take a year or more. The foundry was thus forced to accept any supply rather than no supply at all.

/To improve

193. To improve coke supplies, the same suggestions as in the case of pig iron may be given consideration. Foundry trade associations should play a greater role in purchasing, stocking and distributing coal and coke stocks. Block rake movements require coal/coke stockyards at major consuming centres.

Re-rollable scrap

194. The major bottleneck of the scrap re-rollers is the non-availability of re-rollable scrap or billets. Their quotas from the Directorate of Industries are inadequate for their capacities and they have therefore to rummage all over the district (and at times all over the country) to secure additional supplies. One re-roller in Jullunder was buying old but unused artillery shells (about 150 mm long), removing the gunpowder by drilling at one end, and then rolling to reinforcing rounds! In fact, he would roll any steel material which offered a margin of Rs 200/ton between scrap and finished product. Undoubtedly, if better materials were available, such practices would not be necessary and even mills with existing facilities could increase their output.

195. A material that has recently been made available is 10-ton slab ingots from Rourkela. These are being supplied in the Bangalore area, for instance, at cost of Rs 600/ton plus excise duty, ex-Rourkela (or Rs 750/ton, plus duty, if cut into five pieces). This has to be further gas cut by the re-roller to 100 mm section pieces. Allowing for substantial burning loss and gas cutting cost, the cost of this material comes to about Rs 1,000/ton (plus rail freight from Rourkela). Even so, it is a preferred material due to the higher yields and outputs in rolling, when compared to scrap.

196. If re-rollable scrap costing about Rs 1,100 per ton is used, there is a wastage of upto 5 per cent in preparing the odd-shaped materials for re-rolling (this waste scrap is sold to arc furnace operators at a rate of Rs 500 per ton). From the prepared material, the burning loss in the furnace and the rolling/cutting loss in the mill are another 6-8 per cent. Thus, the overall yield from purchased scrap to rolled bars may be under 90 per cent (as against say 95 per cent when rolling from billets). Moreover, the mill throughout when rolling scrap is only approximately half that from billets.

/Solutions

197. Solutions to the shortage of rollable materials are not easy. Ideas which are already engaging Government attention include:

1) Organising vigorous scrap collection campaigns at the state, district and tehsil levels. Scrap from agricultural machinery in rural areas may be sizeable, which could be collected by agents at scrap dumps at tehsil headquarters;

2) Import of re-rollable scrap. Good rerollable plate scrap is being imported into Thailand at US$130 to 140/ton c.i.f. (about Rs 1,000/ton);

3) Starting ship-breaking centres;

4) Improving the distribution system so that legitimate users can get their supplies direct at controlled prices;

5) Finally, consideration may be given to producing billets in the small sector itself, as discussed in Chapter IV.

B. CREDIT FACILITIES

198. Next to raw materials, the major problem of small foundries and re-rollers was the lack of adequate finance for working capital and investment. Total loans flowing to small industries are only 10 per cent of advances to medium and large sectors. The National Small Industries Corporation, State Directorate of Industries and State Small Industries Corporations are providing financial assistance exclusively to the small units, although the bulk of advances to this sector (more than four-fifths) comes from the commercial banks and the State Bank of India.

199. The small factories visited expressed divergent views on credit availability. Some had no problem in getting advances, generally from their banks, but the majority expressed dissatisfaction at the delays and difficulties. For instance, a leading Calcutta foundry complained that it had not succeeded since one year in hire purchase of testing equipment from NSIC, after clearances from DI, TDA, EEPC, etc. had been obtained.

/Being

200. Being generally a one-man show, the small factory proprietor often does not have the means or the time to carry on a continuous dialogue with the financing institution. He requires more guidance from the SISIs in providing the data needed on viability, market, etc.

201. It may be noted that of the total institutional credit to small industries, only 12 per cent is utilized for financing equipment. The balance is in the form of cash loans for operational needs. Increased working requirements will now have to be arranged for the 'modernised' units due to enlargement of capacity and also better capacity utilization. The problem of working finance is aggravated by the practice of many large companies to delay payments (60 days or more) for supplies from the small units. Suggestion has already been made for legislation by which amounts due may be credited to the small units by banks directly in specified conditions.

202. It is interesting that of the Rs 65 crores of hire-purchase machines delivered by NSIC upto 1972-73, 45 per cent was in the metals and engineering field. Moreover, the bulk of the machines (55 per cent) went to five states which already have a dynamic small industry sector, namely, Maharashtra, Tamil Nadu, Gujrat, Utter Prodesh and West Bengal. Of the applications received by NSIC, only 50 per cent (by value) were accepted. Even so, the defaults in payment have reached the alarming rate of 14.5 per cent.

203. NSIC has no funds available which could be allocated for modernising the small units. Whether credit should be made available for this programme at subsidised rates or normal bank rates is perhaps less important than that specific funds should be earmarked and made available with the minimum delay.

C. LABOUR AND MANAGEMENT

204. Small factories live not by materials and machines alone -- the other essential input is MAN himself. The foundry worker in many regions in India has inherent skills in moulding, core-making and pattern-making, which have played a significant role in developing a low-cost foundry industry. If labour today does not seem to have the motivation or knowledge of new techniques, the fault lies as much with management for not providing training in such methods.

Productivity

205. Even so, productivity measured as value added per worker is often of the same order in small foundries and re-rolling units as in large ones. This, together with low overheads, often neutralises the advantages of mass production and modern technology at the bigger plants. A reason for good productivity is that in a small unit the supervision is stricter and the worker is constantly under threat of being fired if his output is unsatisfactory.

206. In Bangalore, for instance, it was reported that heavy duty CI castings were being purchased by HMT from a small foundry at Rs 2,500/ton while their own cost was Rs 3,500/ton. In spite of higher costs the purchaser may at times prefer to make his own castings to utilise his large investment.

207. Generally, in large and medium industries there is a disincentive to employ labour due to the increasing labour legislation and major tax advantages in expenditures on new equipment. However, in the small sector, which manages to stay outside the labour laws, the disincentive is for mechanization. The low labour wage (around Rs 130/month for unskilled workers and Rs 200 for skilled workers) is a further disincentive. If at the small units, labour could be better paid, motivated and upgraded for better quality work, there would be a better case for modernising their operations.

/More

208. More enlightened personnel policies, bonus plans, suggestion schemes, safety campaigns, and welfare facilities to improve working conditions should secure a commensurate response from the workers in the form of enhanced quality and greater production.

Supervisory personnel

209. Roughly two-thirds of the units visited had absolutely no technically qualified personnel. They were being run by "mistries" who over many years had acquired considerable skill in the art of founding and rolling. Some units were headed by engineers who happened to be the sons of the owners; as one of them said, he was there "by chance, not by choice".

210. The most dynamic units were those which were started by young 'technocrats' with a strong urge to be independent and to take up the challenge of new technology. One such entrepreneur often worked 16 hours a day and at times slep overnight at his iron foundry. His unit had cost Rs 1.2 lakhs and in the second year of operation had a sales turnover of Rs 4.5 lakhs; as it did not offer much challenge now, he planned to sell it and build a bigger new factory.

211. Many of the factory owners felt that a young graduate or diploma engineer would not be of much use to them and may not be able to co-exist with the "mistry". For similar reasons, they had not taken up the scheme to utilise a fresh engineer in their unit, although part salary cost would be borne by Government.

212. Clearly, the conditions at most small foundries and rolling mills are so severe and the technical requirements so different, that an engineer out of orthodox engineering institutes may not initially be useful and may not long survive. What is needed is a new cadre of technician - "the barefoot manager" - oriented specifically to the technical and human problems of small scale foundries/mills.

/Some

Some suggestions on training are indicated below:

213. Refresher courses: Selected engineers need to be given special 3 - 6 months training courses together with practical experience of at least one year on the shop floor. Then, they could be useful at foundries, for instance, those who have opted for the Modernisation Programme. The suggested outline of topics for such a course is given in Appendix XIII. Of all the centres visited, only at one - Batala - had a foundry course been given in the last year or so.

The "mistry" would still have a significant role, to be supplemented by the engineer's grasp of the technical aspects of raising productivity and controlling quality. The "mistry" himself needs to go through a specially designed course which would give him a better appreciation of modern techniques.

214. Special IIF Services: The activities of the Indian Institute of Foundryman, the premier professional society in this field, are mainly directed towards the large and medium foundries. Their membership, office-bearers, technical meetings and publications are primarily for, from, and by large units. In the changing national situation, it would seem logical for IIF to devote greater attention to the smaller and less-developed foundries, by organising for them special training programmes, technical seminars and papers as well as special membership requirements. This is an opportunity for the large foundries to give a real hand to their colleagues, by making available funds to IIF for these activities.

215. Inter-plant study teams: Small foundries and rolling mills have much to learn from each other. A programme of visits, by say a group of foundrymen from Ludhiana to Kolhapur, and a group from Howrah to Bangalore, would be of considerable value. Such a group should consist not only of managers but of 2 or 3 persons from each plant - say, the proprietor, a mistry and a skilled worker; in this manner, the absorption of new technology could be facilitated.

/Posters

216. **Posters and publications**: There seemed to be a lack of technical appreciation, even at the supervisory levels, of the metallurgy of iron-making, cupola operating practice, casting defects and their remedies, sand testing procedures and safety instructions. Pictorial wall charts, with explanations in the language of the region, together with simple technical articles, need to be brought out by the local SISIs, NPCs, IIF and trade associations.

Management

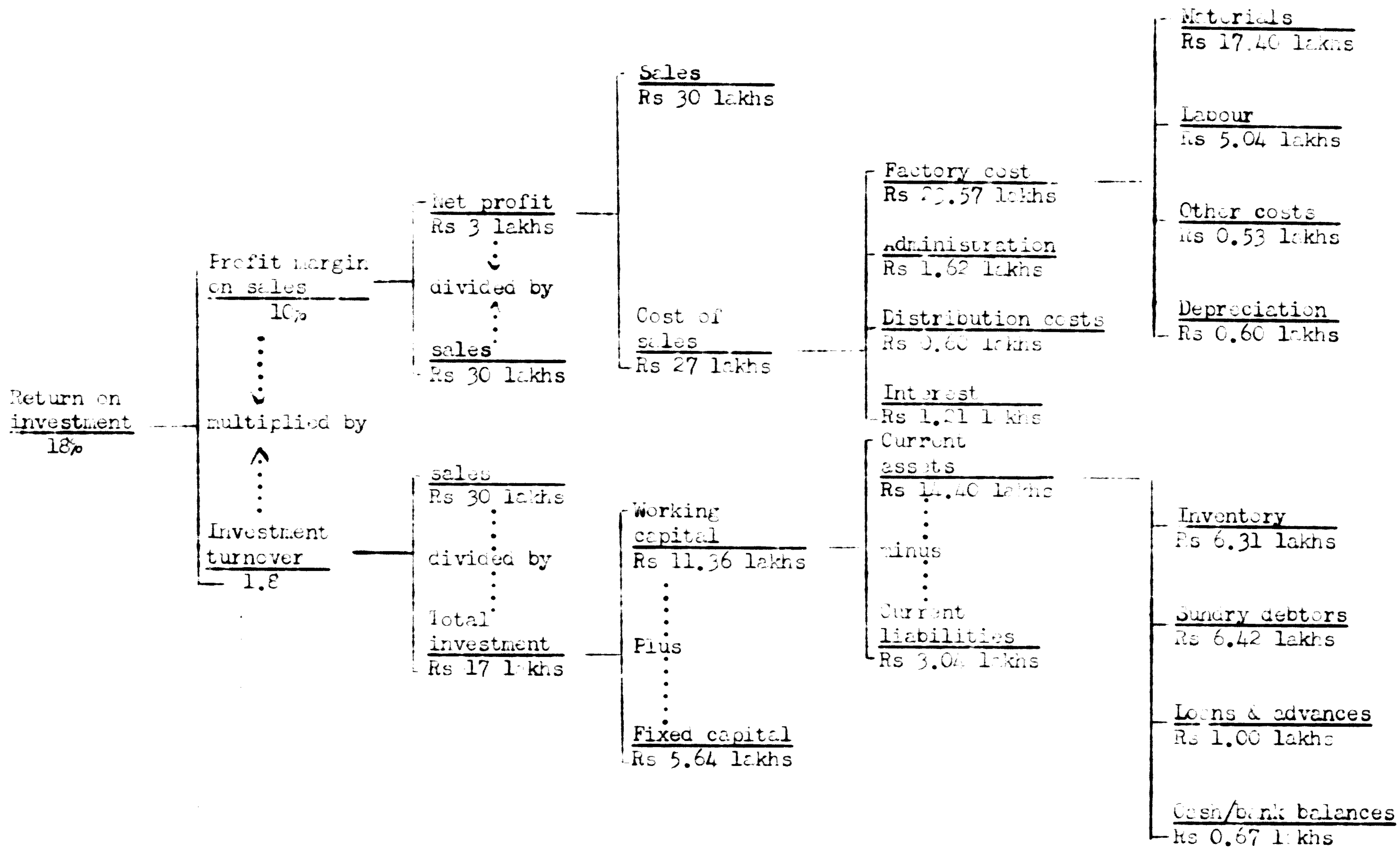
217. Modernisation must start in the mind of the management. Unless the factory owners and managers clearly see the need to upgrade process technology as well as their own management techniques, there can be no real progress. The lack of adequate managerial talent is a serious handicap of the small industry sector. Moreover, due to their limited resources, small enterprises are not able to employ specialized management services. Indeed, the bulk of the companies have not been made aware of new management techniques that could be adopted for their requirements.

218. It was therefore gratifying to have visited a progressive non-ferrous metals foundry - Annapurna Cooker Co., Bangalore - which has engaged a small firm of management consultants and is in the process of implementing a comprehensive programme of inventory control, incentive bonus and long-range corporate planning. The firm, which has invested Rs 7 lakhs in foundry and machine shop equipment, had the following history of pre-tax profit on annual sales:

	Rs Lakhs	
	Profit	Loss
1966-67	2.60	
67-68		0.84
68-69		1.39
69-70	0.29	
70-71	1.73	
71-72	0.69	

219. This year they plan a profit of Rs 3 lakhs on a sales turnover of Rs 30 lakhs, representing a return of 18% on total capital employed. Materials alone represent 65% of the total cost of sales, and labour another 19%. Their proposed profit path, based on a simplified Dupont Chart, is shown in Fig. 11.

Fig. 11: Proposed profit plan (1972-73) of small non-ferrous foundry



It may be mentioned that the firm is embarking on a modernisation project which expects to raise sales to Rs 1 crore by 1978-79. Such aspirations -- and forward planning to attain them -- are unusual in the small scale sector. A vast potential for improvement exists if more small entrepreneurs could use simple management planning and control techniques. This is an area in which local SISI and NPC units should play a larger role.

D. MARKETING

220. Another critical gap is the marketing of the castings produced at the small foundries. In places such as Ludhiana and Batala, the bulk of iron castings are sold within a radius of 100 km and at low prices of Rs 850/ton. At the same time, factories in Delhi producing tractors (mainly for sale in Punjab) are buying their casting requirements from small foundries as far afield as Bangalore. These small units had practically no idea of the market beyond their door-steps. On the other hand, some large equipment manufacturers could not find suitable small foundries to meet their casting requirements.

221. In many cases, the small foundries have no basis for estimating the cost of their castings. They ask what the customer is prepared to pay, accept the order in high hopes, and make losses on this order without knowing it. Today, the plant may get by even with such practices, because castings market is buoyant due to the increased demand for pumps to fight the drought, oil engines to overcome the power shortage, and so on. But better casting and selling strategies are needed for the buyers' market which will inevitably come again.

'Each one, adopt one'

222. The large units, in their mutual interest, should establish effective Vendor Development Groups to give technical and financial assistance to the small foundries. It is not enough just to give the pattern; more is needed, for instance: advances to purchase materials, runner and riser designs, occasional technical personnel to assist in casting and quality control.

/The merging

223. The merging of small foundries with large manufacturers may not be the answer. The small entrepreneurs' individualism and method of work may not be compatible with those of the large corporation. But strong marketing links, based on mutual appreciation of each others' strength, could provide the basis for long-term co-operation.

Diversification vs specialization

224. A pressure die-casting unit operator said: "One would diversify to difficult products only when he is hungry or ambitious, and right now we are neither!" Should the small foundry continue to produce simple low-margin castings or attempt new types, new processes and new end-products? Should the re-roller concentrate on just bar products or develop a variety of new sections, which may mean shorter production runs and initially higher rejections?

225. Each company must seek its own salvation. Generally, though, it would seem prudent that, while times are good, progressive small units should set aside some resources to develop a new product line. Once this is established, all efforts can be to specialise in it. Thus, modernisation must be accompanied by diversification and specialization.

Export possibilities

226. While some small units have made good exports in certain labour-intensive items, most have no knowledge of the complexities of the export game, or at best, only a marginal interest for prestige purposes. Yet, if properly organised and assisted, the scope for small foundry and re-rolling mill exports is good. The Agra founders, for instance, were sending a study team to West Asia to increase their exports of weights and measures.

227. A small foundry, with technical capability for the export market, had a sad tale to tell: A casting sample for a large order from U.K. could not be cleared in spite of a two year dialogue with the Customs authorities; ultimately it was auctioned by Customs without the foundry's knowledge, and had then to be re-purchased from the buyer!

228. On the other hand, a small Bombay foundry - Salvi Super Structure - had succeeded not only in exploiting castings, but also in exporting the know-how to set up a complete malleable iron foundry in Kenya.

/ A multiplicity

229. A multiplicity of agencies - NSIC, Sub-contract Exchanges at SISs, EEPCs, and others - are involved in one type of programme or another to help small factories in marketing their products, both at home and abroad, but they still seem to lack tangible assistance. In turn, the small foundries tend to depend much too much on government help. In marketing particularly, self-help may be the best help, and foundries should consider strengthening their co-operative associations for selling their products.

Strengthening the co-operative associations

230. At each of the towns visited a useful discussion was held with the foundry and rerolling mill trade associations. In some places, particularly in Punjab, there were three or more such societies in each field which probably results in some conflict. Most of these associations had meagre resources and inadequate staff. Their main tasks seemed to be to (i) agitate for more raw materials, and (ii) maintain liaison between their members and Government departments.

231. An example of a group doing good work is the Agra Iron Founders Association. It has 180 cupola and crucible foundry members with sales of around Rs 8 - 10 crores annually, including exports of about Rs 1 crore. They have constructed their own building with good conference facilities and are now seeking funds to set up a co-operative foundry testing laboratory.

232. Some functions which these co-operative associations could usefully undertake are as follows:

(i) Compilation of capacity and production statistics.

(ii) Organizing inter-firm comparisons. This requires a monthly questionnaire to be completed by participating firms. The information is then analysed, expressed in the form of ratios, and results returned to participants, showing the worst, the middle, and the best performer, without actually naming the firms. Typical financial and technical ratios for an iron foundry may include.

/Technical

Technical	Financial
Total men-hrs/net good castings	Profit/total capital employed
Coke used/liquid iron	Profit/fixed assets
Net good castings/total metallics charged	Profit/sales
	Sales/total capital employed
Net good castings/liquid iron	Labour cost/sales
	Material cost/sales
	Overheads/sales

(iii) Publishing a monthly trade and technical bulletin in the local language for factory personnel.

(iv) Establishing a HQ building with library, seminar rooms, etc.

(v) Arranging inter-plant study tours and other training programmes.

(vi) Setting up an expert panel to give technical guidance to members, appraising them of new techniques, solving production problems.

(vii) Establishing a 'materials bank' so that member are not handicapped by temporary shortages.

(viii) Maintaining some trucks and other heavy equipment which can be hired out to members for occasional use.

(ix) Operating weighing facilities.

(x) Setting up a sand grading plant for supply of graded sand to members.

(xi) Giving financial help in the form of loans to members and their staffs.

(xii) Installing sand testing, chemical and physical testing equipment.

(xiii) Providing positive marketing assistance to members by negotiating and accepting bulk orders, assisting in preparation of tenders, organising market surveys, etc.

/Some

233. Some form of financial grant by state or central government to strengthen the working of these associations, particularly in the fields of co-operative testing facilities, materials stocking, training and marketing, would be of great value.

234. It would be useful to form an All-India Small Foundries Association, along the lines of the new body for small rerollers. While the local associations have a key role in view of their intimate knowledge of conditions in their areas, a national institution could more effectively undertake activities of an inter-state nature and closer liaison with agencies at the centre.

/ VI.

/V.

VI. IMPLEMENTATION OF MODERNISATION

235. At one of the trade association meetings addressed by the metallurgical adviser, the chairman summed up the discussion as follows: "For modernizing us, the first thing which needs modernisation is the SSI administration". There is no doubt that technology upgrading is urgently needed but it has a good chance of failing unless the machinery for implementation is properly devised. It is also clear that implementation will be halting and ineffective unless forces at the state and district levels are fully mobilised.

236. Some problems of which SSIDO is well aware but which await solution are as follows:

237. <u>The communications gap</u>: Many Directorates of Industries as well as SISIs do not yet seem to be aware of the programme which Government has in mind; those who heard of it had only a vague conception and no conviction regarding its usefullness. An active promotion campaign is essential.

238. <u>The staff bottle-neck</u>: In addition to a Director Modernisation and Deputy Director in Metallurgy (and the other four industries) as already visualised at the center, a special Deputy Director (Metallurgy) is considered necessary for modernisation work at SISIs in each of the four or five geographical areas from which foundries and re-rollers are to be selected.

239. <u>The time constraint</u>: This "time-bound action programme" recommended by the Newalkar Committee in 1968, has yet to get off the ground. As Mr. Newalkar remarked to the regional adviser: "My report on obsolescence has itself become obsolete". There is now urgent need for activities to proceed in the correct sequence and in pre-determined times, according to a critical path network. First things must come first. It may, for instance, be counter-productive to rush to enroll units for this programme (on payment of Rs 500) when the facilities to be provided have not yet been cleared with Government and the staff to implement it is not yet in position.

240. The programme for modernisation of foundries and re-rollers could proceed in three phases, namely, preparation, implementation, and follow-up. The activities involved are described below.

/A. PREPARATION

A. PREPARATION PHASE

Finalisation of the assistance package

241. The programme has rightly been conceived of as a 'package', but due to delays and financial constraints there is danger that the package will get fragmented, and its implementation will become more difficult and less effective. The inputs are inter-linked, and therefore, for instance, the supply of new machinery without working funds, raw materials or technical assistance may only aggravate the imbalances. Appendix 14 outlines the inputs as proposed by SSIDO and which have now been the subject of discussions between the agencies involved.

242. As Government has already accepted the programme in principle, it is considered essential that a minimum package of inputs be agreed to at the earliest, before substantive work can proceed.

Setting up the organisation

243. As noted, the experienced staff needed at the central Directorate and state SISIS should be placed in position according to a pre-determined schedule. In addition, Modernisation Promotion Cells would be needed at the state Industries Directorates. To be effective, personnel should have the requisite physical facilities, such as transport and office equipment. A suggested organisation pattern is shown in Fig. 12.

244. There is a need to give existing SISI officers periodic exposures to: (i) practical operating problems by enabling them to actually work again at modern Indian foundries and re-rolling mills, (ii) new techniques in foreign countries by sending a larger number abroad for specific studies on fellowship programmes, and (iii) problems of policy planning and co-ordination, by rotating them with staff at SSIDO headquarters. This would also give the central personnel an experience of the many difficulties at the state and district levels.

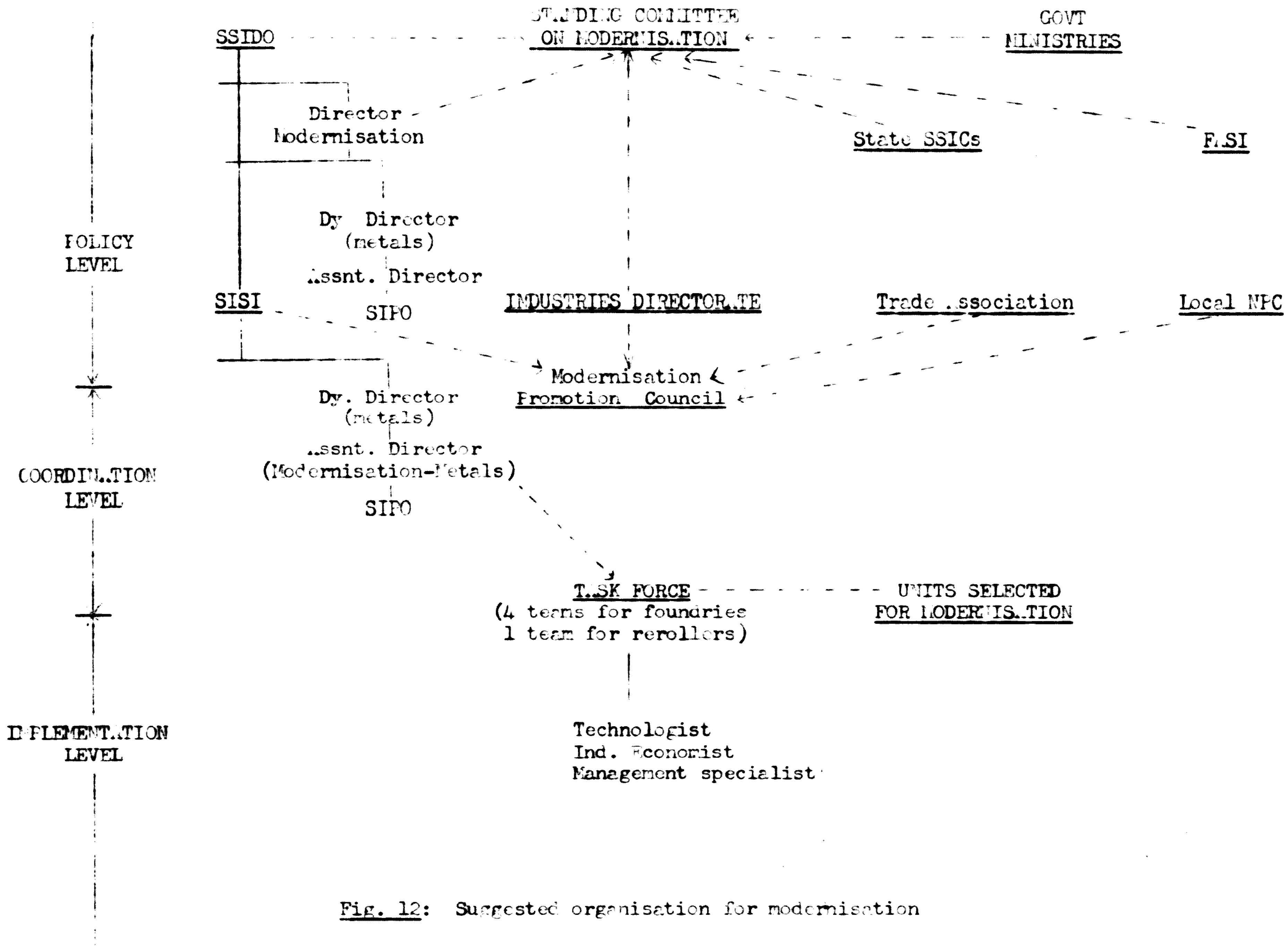


Fig. 12: Suggested organisation for modernisation

Promotion campaign

245. The agencies who will ultimately be responsible for the scheme and the founders/rerollers to be modernised need to be fully briefed on its remifications. This requires a well-designed information campaign including (i) brochures and news releases, (ii) seminars of DI and SISI officers upto the SIPO level, (iii) meetings with trade associations.

246. Unless there is a wider exchange of views and unless the difficulties and ideas of people at the implementation level are heard and incorporated in the plan, the scheme would run into numerous problems at a later date.

Selection of firms for modernisation

247. **After** the benefits to be provided have been finally formulated and widely promulgated, only then should the units be invited to register for modernisation. As the 4,000 foundries and 800 re-rollers in the small industry sector constitute more than half of the total number of units in the five industries selected for modernisation, it may be assumed that, say, 80 foundries and 20 rerollers are selected (out of the initial 300 units).

248. On proper and impartial selection will depend, to a great extent, the success or failure of this programme. The view was expressed that this selection should not be left entirely to state Government agencies who may be subject to outside pressures. The Modernisation Directorate, local SISI and representative trade associations could make the initial selections, to be finalized by the state Director of Industries. If required, the UNIDO regional adviser could be of assistance.

249. The criteria to be adopted for selection of foundries and rerollers could include the following:

(i) The willingness and enthusiasm of the management to modernise, their credit-worthiness, and the presence on their staff of technology-oriented persons who could grasp new ideas and be capable of implementing them.

(ii) The suitability of their product line to the upgrading of technology on the one hand, and to the probable market, on the other. A foundry which utilizes say half of its output in its own end-products, or which has a working relationship with a large manufacturer, would be appropriate.

/(iii)

(iii) Their performance, managerial and financial, over the last say 5 years. In the initial scheme, a very new unit or one already well-advanced may not be suitable for modernisation, as it could be expected to have the capability to plan its own modernisation. On the other hand, a very old or obsolete unit may not have much potential for improvement. Generally, unless an iron foundry operates its cupola at least once a week for four hours or more, it may not be an appropriate choice.

(iv) Their existing facilities and output. It should be possible to formulate a simple scheme for Enterprise Evaluation. Preliminary selection could then be made from questionnaires to be filled out together with the initial application. For rolling mills, a rating formula of the type given in the Report of the Technical Assessment Committee (1966) could be used. For iron foundries evaluation, a preliminary scheme is suggested in Table 21.

250. This tentative schedule needs further study and refinement. Suitable cut-off levels could be determined, for instance, over 65 points: good; 30-64: fair and suitable for modernisation; under 30: poor.

/Table 21:

Table 21: Suggested small foundry evaluation scheme

		Points	
Melting:	Cupola size/design (24" & over)	7	
	Mechanical charging	3	
	Blower HP (appropriate to size)	5	
	Pressure & temperature instruments	5	20
Sand preparation:	Muller	3	
	Aerator	2	
	Power screen	2	
	Sand handling equipment	3	10
Moulding:	Pneumatic moulding machine	4	
	Moulding machine, hand operated	3	
	Special moulding process (shell, etc.)	3	
	Pattern shop	3	
	Drying oven design	2	15
Core-making:	Core blower	4	
	Core type	3	
	Drying oven design	3	10
Fettling:	Shot blasting	3	
	Swing grinders	3	
	Pedestal/portable grinders	2	
	Tumbler	2	10
Layout and materials handling:	Over-head crane	4	
	Trolley line	3	
	Roller conveyor	3	10
Quality control:	Tensile, hardness test equipment	5	
	Sand testing/mould hardness testing	5	
	Chemical testing	3	
	Wedge test	2	
	Technical staff (one or more)	6	
	Record keeping	4	25
	Total		100

/B.

B. IMPLEMENTATION PHASE

Inplant studies

251. In preparing studies on the needs of each selected unit, the following aspects are considered pertinent:

(i) The project report should be in sufficient depth and cover the whole spectrum of problems from selection of appropriate products, layout, and new processes through to cost-benefit analyses of the recommendations and action plan for implementation;

(ii) The study is prepared by competent personnel with practical experience of foundry/re-rolling technology, design and operations;

(iii) Even if two or more agencies are involved in the study, one 'project co-ordinator' is made responsible for the planning of the entire work of the 'task force'. Preferably, this co-ordinator should be a technologist;

(iv) This task force should be responsible for (a) preparing the study, (b) implementing its recommendations, and (c) also following-up periodically to ensure that there is no sliding-back;

(v) All aspects of the work should be undertaken in close co-operation with the entrepreneur himself as well as in co-ordination with the central Modernisation Directorate and local SISI.

252. Assuming that 100 in-plant studies are to be made -- that is, 80 foundries (ferrous and non-ferrous) and 20 re-rollers -- this would need five teams. The teams could be located in four regions and each team could complete about 20 studies in the course of one year, that is, an average of $2\frac{1}{2}$ weeks per study. The initial studies may require a longer time, in order to evolve the methodology, secure up-to-date quotations for equipment, prepare typical drawings, etc.

253. The thoroughness and usefullness of this ambitious exercise will depend upon the competence of the task force. SSIDO does not have enough men of the requisite experience while there are financial constraints in engaging outside experts. A good team combination would be as follows:

/(i)

(i) An Indian foundry/re-rolling consultant or retired plant operator from within the region whose services could be contracted for a period of one year;

(ii) A planner/economist from the National Productivity Council or other institution, and

(iii) A management/training specialist from the local SISI.

The composition of the team would of course vary depending upon circumstances.

254. Each study should cover as much of the scope of work and answer the kind of questions outlined below, as appropriate:

1) <u>Analysis of existing operations</u>

Historical background - past production data - present facilities and layout - what are the specific bottlenecks in raising quality and output? - what are the unit's inherent strengths and weaknesses?

2) <u>Pattern of demand and proposed product-mix</u>

Field-survey of market trends, next year and five years later - probable share of market - product specifications - marketing arrangements - possibilities of supply link-up with large scale buyers - what are possibilities of diversification of products? What range of prices could the products command?

3) <u>Selection of technology and equipment</u>

Choice of new processes - their suitability for the product-mix and prevailing costs - can the technical skills be developed to operate, control and maintain the appropriate processes and practices?

4) <u>Modification of plant layout</u>

Revised materials flow - relocation of existing equipment and siting of new - Are an overhead crane, roller conveyor or trolley-line really necessary or would they only displace labour without commensurate benefits? What provision should be made now for future expansion and diversification?

/5)

5) Requirements of materials and supplies

Quantities and specifications needed - possible sources of supply and probable prices - outline of materials management - what government machinery must be set in motion now to ensure additional and reliable supplies?

6) Utilities and services

Requirements of water, power, lighting, compressed air - design of utilities distribution systems.

7) Quality control and record keeping

Testing and control equipment - suggested procedures and records for analyses of rejections, stores consumption, etc. - quality control organization and quality targets - production planning and control.

8) Estimated capital cost of modernisation

Cost-benefit analysis for major equipment items - possible sources - possibilities of self-manufacture - alternatives for further cost reduction.

9) Personnel programme

What numbers and types of personnel will be needed and how will they be trained? - redeployment of surplus labour - improvement of the working environment - work simplification possibilities - incentive bonus plan - total labour salaries and perquisites - productivity gains.

10) Estimated production cost and financial analysis

Analysis of yields and rejections - per month and per ton cost of products - possible sales receipts - depreciation and interest charges - profitability ratios - payback and DCF - break-even analysis - margins for different products.

11) Long-term development plan

What will be the probable growth pattern of the unit in the context of market and other conditions next year, five years later?

12) Implementation of modernisation scheme

Possible financing sources - CPM network - organization and procedures for expediting equipment purchase, engineering, construction - implementing the process techniques, record-keeping, quality control systems - training of personnel.

/Implementation

Implementation of recommendations

255. The actual implementation of the study proposals for improved equipment and techniques may take 3 to 12 months. During this period the small units would need intensive help from the study team, the local SISIs, and the modernisation directorate.

256. Major activities during this period would include (a) securing the required finance, (b) placing orders for equipment, (c) modifying the layout and installing new facilities, (d) arranging increased working capital, (e) procurement of additional raw materials, (f) organizing personnel training, (g) implementing the quality control and record-keeping procedures, and (h) securing increased orders for products.

C. FOLLOW-UP PHASE

257. Modernising the plant is only half the battle. The real struggle will be in keeping the improved facilities operating at a high technological level, year-in and year-out, even after the initial 5-year programme. The following suggestions may be given consideration:

(i) A Five-Year Modernisation Plan be prepared for each sector (e.g. Foundry/Rolling Mills) as well as for each selected factory, giving specific targets for production, productivity, quality, exports.

(ii) Each year an Annual Plan be prepared, setting out in detail the inputs and outputs expected, and how the tasks are to be accomplished.

(iii) The modernised unit be required to make a quarterly report, in an agreed format, stating (a) the monthly production, (b) labour employment and productivity, (c) materials consumptions, (d) rejections and yield, (e) specific bottlenecks for improved quality and production.

(iv) The Deputy Director (Metallurgy) at the local SISI make an inspection visit to each unit say once every quarter to assist in specific problems and check the performance.

/(v)

(v) A seminar of all modernised units in a region be organized every six months where they can exchange ideas and find common solutions to problems.

(vi) The modernised units should, as an obligation, permit personnel of other foundries/re-rollers to visit their plants, in order that the benefits of modernisation get widely disseminated.

Possible schedule of activities

258. A tentative phasing and duration of activities for modernising foundries/re-rollers is suggested in Fig. 13. Unless the time dimension is kept in close control, the programme will lose impact and direction.

Implications of modernising

259. Until the plan is better defined, it is difficult to visualize its costs and consequences. For the 100 foundry/re-roller units alone, leaving aside the other four industries, the implications could be roughly as given in Table 22.* For an outlay of about Rs 2 crores, the additional production would be about Rs 15 crores/year, apart from increased employment and other intangible benefits.

The continuing pursuit of modernization

260. Apart from the time-bound nonmodernization activities discussed above and even after the programme is over, the small units have much to do, in order to maintain a high technological level themselves as well as help other small units reach a comparable standard. Activities which could be undertaken on a continuing basis include the following:

(i) Participate actively in the activities of the local foundry or rolling mill association and help organize an all-India foundry association.

(ii) Join programmes of local NPCs, management associations and other civic groups which may help, directly or indirectly, in the activities of the factory.

/ (iii)

(iii) Become a member of the Indian Institute of Foundrymen, study their publications and attend their technical meetings. Becoming a part of the community of Indian foundry professionals would help improve the image of the small foundries and give the large foundries a better appreciation of their problems and potentials.

(iv) Arrange for its technicians to periodically visit other small and large foundries.

(v) Engage outside consultants to prepare studies on long-range corporate planning, production control, management re-organization, value analysis.

(vi) Send its personnel frequently for training courses. These should cover not only technicians but also supervisors and managers. Not only have techniques of good foremanship to be taught, but also new attitudes for making and keeping the dignity of the worker as an individual.

(vii) Establish active dialogue with a major manufacturer, leading to a marketing tie-up for long-term component sub-contracts.

(viii) Finally, the object of a small unit should be to expand beyond its small size and join the ranks of medium and large factories.

/ Fig. 13

Fig. 13: Tentative schedule of modernisation activities

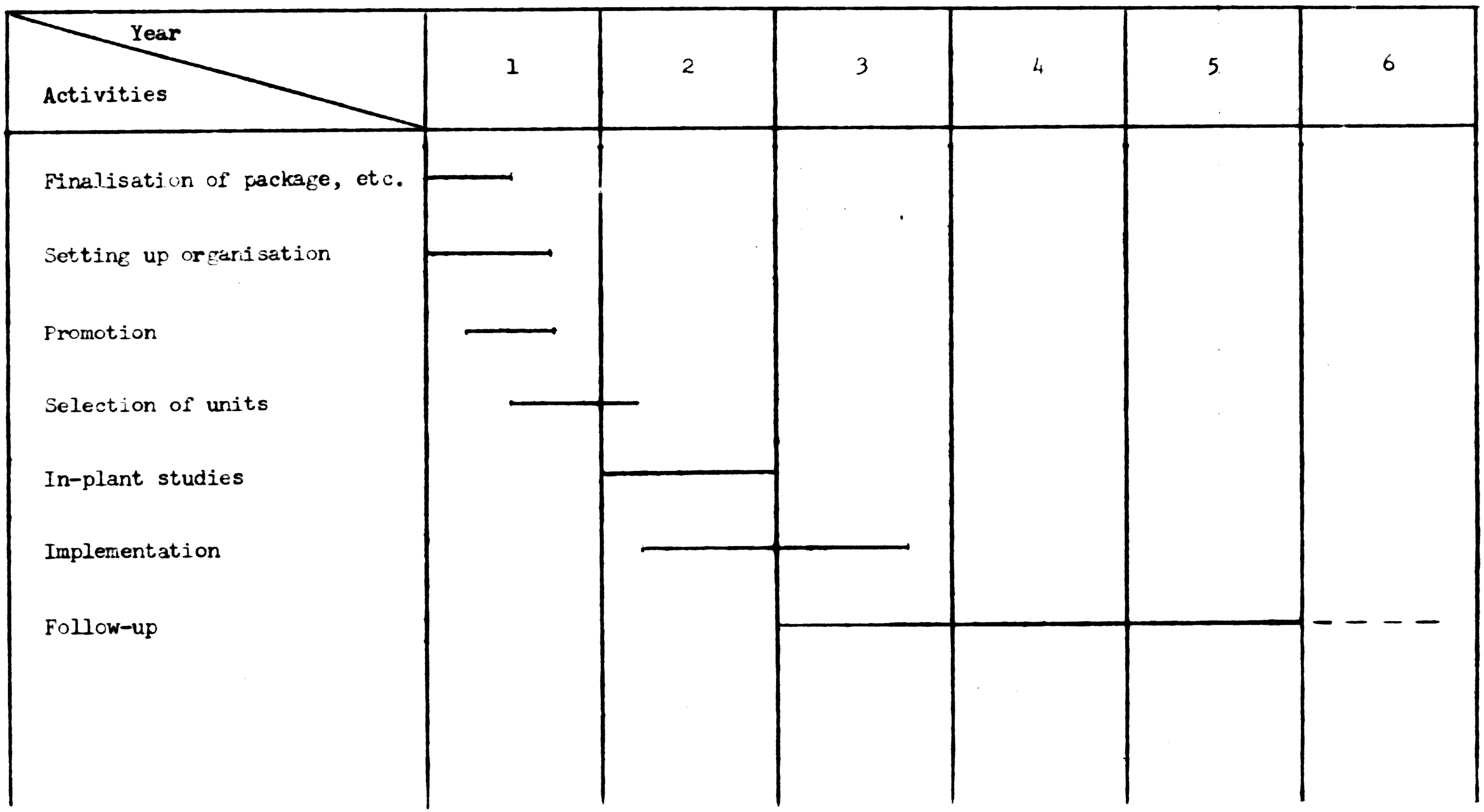


Table 22: Costs & benefits of modernising selected foundry/re-rolling units

	Foundries (80 units)		Rerollers (20 units)	
Assume average	**Existing**	**Modernised**	**Existing**	**Modernised**
Investment, per unit	Rs 50,000	Rs 2,00,000	Rs 250,000	Rs 7,00,000
Production, per unit	800 t/yr	1,500 t/yr	2,400 t/yr	4,800 t/yr
Inputs for modernisation costs				
Inplant study personnel		12 person for 1 yr		3 person for 1 yr
cost		Rs 2,40,000		Rs 60,000
Credit for new facilities		1,20,00,000		90,00,000
Working capital		4,00,00,000		3,40,00,000
Total		Rs 5,22,40,000		Rs 4,30,60,000
Raw materials needed per year				
Pig iron/scrap		120,000 t		--
Coke		25,000 t		--
Rerollable scrap		--		100,000 t
Training				
Supervisors/mistry		80		20
Skilled workers		160		[illegible]
Possible benefits				
Additional product, tons/yr		56,000 t castings		48,000 t rolled products
Additional product, value/yr		Rs 7.28 crores		Rs 8.60 crores

A P P E N D I C E S

APPENDIX I

PERSONS MET IN INDIA

New Delhi

Ministry of Industrial Development	- Mr. Abid Hussain
Development Commissioner (Small Scale Industries)	- Mr. K.L. Nanjappa Mr. G. Raman Mr. S. Raghaviah Mr. T.N. Basu Mr. M.K. Verma Mr. K.M. Dargar
Small Industries Service Institute, Hyderabad	- Mr. J.N. Bhakta
National Small Industries Corporation	- Mr. K.N. Sapru Mr. P. Rajakrishnan Mr. Sethna
All India Steel Rerollers Association	- Mr. Ved Wadhwa Mr. Satwant Singh
National Productivity Council	- Mr. G.R. Dalvi Mr. P.R. Srinivasan Mr. R.S. Gupta

Faridabad

Super Electrical & Engg. Co.	- Mr. Mittal Mr. Dalal
J.K. Foundry	- Mr. J.K. Batra

Agra

Small Industries Service Institute	- Mr. N.R. Lodh Mr. P.D. Chadha
Agra Iron Founders Association	- Mr. B.L. Singell Mr. S.N. Kaushal Mr. B.L. Singell

/ Kajeco

Kajeco Industries	- Mr. Vijay K. Agarwal
India Iron Foundry	- Mr. M.R. Agarwal
Satya Industrial Corp.	- Mr. H.S. Singell
Diwan Chand S.P. Jain	- Mr. S.P. Jain
Agra Steel Corp.	- Mr. Poonamchand
National Iron Foundry	- Mr. Raman

<u>Kanpur</u>

Small Industries Service Institute	- Mr. R.L. Biswas Mr. S.C. Mukherjee Mr. T.D. Srinivasan
Directorate of Industries	- Mr. A.K. Sharma Mr. A.S. Kotwal
Foundries & Engineering Works Association	- Mr. Kripal Singh Mr. V.C. Kapur Mr. S.P. Gupta Mr. J.N. Bhargava Mr. Pritam Singh
Singh Plate Mill Private Ltd.	- Mr. Kripal Singh
Singh Engineering Works	- Mr. Inder Singh
Cossul Foundries Pvt Ltd.	- Mr. Kapur
Vijay Metal Works	- Mr. S. Gupta
Mr. P.G. Karmakar & Sons	- Mr. S. Karmakar
Gupta Steel Industries	- Mr. Gupta
New Gupta Foundries	- Mr. Gupta
Frontier Engineering Corp.	- Mr. K.L. Bhatia
Kanpur Steel & Ferro-Alloys	- Mr. C.A. Raman Mr. S.M. Mathur

/ Lucknow

Lucknow

Precision Tools & Castings P Ltd.	- Mr. S.C. Agarwal
Encardio-rite Electronics P Ltd.	- Mr. Deepak Gujral

Calcutta

Small Industries Service Institute	- Mr. S.K. Ghosh Mr. A.K. Banerjee Mr. Das
Iron & Steel Control	- Mr. R.M. Krishnan
Directorate of Industries, Govt. of West Bengal	- Mr. A.K. Garai Mr. S. Chakravarti
Federation of Associations of Small Scale Industries	- Mr. Lohia Mr. Rangilal Mr. Dutta Mr. B. Banerjee
All-India Steel Re-rollers Association	- Mr. B.L. Kanoria
Steel Re-rolling Mills Association of India	- Mr. A.C. Das Gupta Mr. S. Banerjee
Steel Furnace Association of India	- Mr. D. Srinivasan
Foundry Research Station, National Metallurgical Laboratory	- Mr. Banerjee
M.N. Dastur & Co, Consulting Engineers	- Dr. M.N. Dastur Mr. T.V.S. Ratnam Mr. C.J. Dave
Bharat Foundry Pvt Ltd.	- Mr. S. Niyogi Mr. A.K. Bhattacharya Mr. A.K. Biswas
Bingalee Seelpi Pvt. Ltd.	- Mr. A.K. Mitra
Katia Steel Rolling Mills	- Mr. S. Dhawan
Ramakrishna Iron Foundry	- Mr. N. Sinha
N.G. Chakravarti & Co	- Mr. N.G. Chakravarti

/ Vulcan

Vulcan Engineering Works	- Mr. Ghosh
"We are Four"	- Mr. Bhattacharya Mr. Se.
Mascot Enterprise	- Mr. A. Mitra
Cintrex Company	- Mr. T. Bhattacharji
Non-ferrous Industry	- Mr. A. Muckerjee

Bangalore

Small Industries Service Institute	- Mr. G.N. Murthy Mr. S.P. Sinha
Directorate of Industries	- Mr. Zajar Saijullah
All Mysore Small Scale Industries Association	- Mr. N.B. Manay Mr. G.R. Kota Mr. Krishnamurti
Metro Malleable Manufacturers P Ltd.	- Mr. H.H. Nassur
P.V.S. & Co	- Mr. Koogashanker
Annapurna Cooker Co	- Mr. V.S. Kashyap
Management Advisers Pvt Ltd	- Mr. B.S.N. Bhushan
V.R. & Brothers	- Mr. V.R. Girichandrappa
Agarwal Steel Rolling Mills	- Mr. R.K. Agarwal
Mysore Auto Service Pvt Ltd	- Mr. S. Nedungadu
Bangalore Engineering Industries	- Mr. B.S. Nagaraj
Bangalore Re-rolling Mill	- Mr. Reddy
Bharath Steel Re-rolling Mill	- Mr. V.P. Gulve
Bhoruka Steel Ltd	- Mr. S.N. Agarwal

/ Kolhapur

Kolhapur

SISI Extension Center	- Mr. Bhatt
Kolhapur Engineering Association	- Mr. N. Tendulkar Mr. T.D. Bhure
Menon & Menon Private Ltd	- Mr. Menon
Uchagaonkar Industries	- Mr. Angadi
Jay Bhavani Iron Works	- Mr. T.D. Kulkarni
D.M. Foundry	- Mr. S.G. Desai
Hind Castings & Iron Works	- Mr. P.N. Dalal
Shri Dut Engineering Corp.	- Mr. S. Desai
Yeshwant Iron & Steel Works	- Mr. K. Samani
Versatile Engineers	- Mr. M.L. Navave Mr. V.K. Kulkarni
Pakco Engineering Pvt Ltd	- Mr. Y.P. Powar
Tembe Industries	- Mr. Hardikar
Mahavir Metal Industries	- Mr. Jain
M.S. Hudli & Sons	- Mr. M. Hussain

Miraj/Sangli

S.C.G. Malleable Casting Industries	- Mr. C. Shah
Krishna Steel Industry	- Mr. Singh
Kulkarni Engineering Associates Pvt Ltd.	- Mrs. P.P. Kulkarni

Bombay

Small Industries Service Institute	-	Mr. Diwakar Mr. Ghanekar Mr. Satyanarayan
Maharashtra Small Scale Industries Development Corporation	-	Mr. G.B. Newalkar Mr. S.L. Tamhane
National Diecasting Co	-	Mr. N.B. Amin
Amin Patel & Co	-	Mr. Patel
La Prensa Pvt Ltd	-	Mr. Bramavar
Sarvodya Foundry & Engineers	-	Mr. Shatilal Shah
Salvi Superstructure	-	Mr. R.R. Salvi Mr. A.K. Ghosh
Eskay Steel Rolling Mills	-	Mr. B.B. Tandon
Aeron	-	Mr. Sharma
Sai Industries	-	Mr. Khatri
Bharatiya Foundries	-	Miss Bharati Ashar

Chandigarh

Directorate of Industries	-	Mr. Hardial Singh Mr. S.S. Gill Mr. R.S. Jolly
Small Industries Service Institute (Ludhiana)	-	Mr. G.D. Duggal Mr. Roy

Mandi Gobindgarh

Directorate of Industries	-	Mr. J.S. Ranghawa
Jay Industries	-	Mr. Ramji Dao
Jai Bharat Rolling Mill	-	Mr. M.P. Gupta
Ajanta Steel Rolling Mill	-	
Surendra Steel Rolling Mill	-	Mr. Mangatrai

Ludhiana - Goraya

Small Industries Service Institute	- Mr. Manmohan Singh
Government Industrial Development cum Service Center (Engineering)	- Mr. H. Monga
Quality Marking Center	- Mr. G.S. Sindhu
Kisan Industry & Foundry Works	- Mr. Igbal Singh
Modern Machine Tools & Engineering Works	- Mr. S.S. Bawa
New India Foundry	- Mr. Bakshish Singh
Bharat Jyoti Mechanicals	- Mr. T.L. Thapar
Hindustan Castings	- Mr. Manjeet Singh Mr. Charanjit Singh Gill
Ram Lal & Sons	- Mr. Ram Lal
Jodh Singh Sembi & Sons	- Mr. Jodh Singh
Sadhu Singh & Sons	- Mr. Jagjit Singh

Batala

Small Industries Service Institute	- Mr. O.P. Nagpal
NML Foundry Station	- Mr. Verma
Quality Marking Center	- Mr. R.C. Jain
Indian Machine Tools	- Mr. Subhas Sekri
Deluxe Kuthali Works	- Mr. Darshan Lal Mr. Sat Pal
Hero Engineering Works	- Mr. Saruul Singh
Batala Engineering Works	- Mr. T.S. Dhingra
Sharda Foundry & Engineering Works	- Mr. R. Sekhri
Atlas Engineering Industries	- Mr. W.C. Kawatra
Batala Factories Association	- Mr. J.C. Shukla

/ Amritsar

Amritsar

Government Development Center	- Mr. Ajmer Singh
Bombay Foundry & Machines	- Mr. Amrik Singh
Auto Piston Pvt Ltd	- Mr. Sadhu Singh

Jullunder

JMP Manufacturing Co.	- Mr. Madan Gopal
Pensa Industries (Rolling Mill)	- Mr. Nandlah
Sant Brass Metal Works	- Mr. S.R. Thakur
Victor Tools	- Mr. Tilak Rai
Sethi Industries	- Mr. Narinder Singh
Leader Engineering Work	- Mr. D.D. Sehgal
	Mr. V.K. Choudhury

APPENDIX II

SMALL SCALE METALS PLANTS VISITED

Name of unit	Line of manufacture
A. Iron Foundries	
1. J.K. Foundry, Faridabad	Light iron castings for direct sale.
2. Cossul Foundries Pvt Ltd, Kanpur	Captive foundry producing iron castings for agricultural implements and machinery.
3. New Gupta Foundries, Kanpur	Iron castings.
4. Bharat Foundry Pvt Ltd, Calcutta	Iron castings for railway brake components.
5. Bengalee Seelpi Pvt Ltd, Calcutta	Iron castings for paper and jute machinery.
6. Ramakrishna Iron Foundry, Howrah	Iron castings for steel mill spares, machinery components
7. Metro Malleable Mfrs Pvt Ltd, Bangalore	Wide range of non-ferrous castings.
8. P.V.S. & Co, Bangalore	Iron cast frames for sewing machines.
9. V.R. & Bros, Bangalore	Iron castings and grinding media
10. Menon & Menon Pvt Ltd, Kolhapur	Alloy and high duty CI castings for tractors and automobile ancillaries (medium scale unit)
11. Uchagaonkar Ironworks, Kolhapur	Iron castings on jobbing basis.
12. Jay Bhavani Ironworks, Kolhapur	Iron castings on jobbing basis.
13. D... Foundry, Kolhapur	Iron castings on jobbing basis.
14. Hind Castings & Iron Works, Kolhapur	Heavy and light iron castings
15. Shri Dut Eng. Corp., Kolhapur	Centrifugally cast liners and sand cast pistons
16. Yeshwant Iron & Steel Works, Kolhapur	Mechanite castings

/ 17.

Name of unit	Line of manufacture
17. Pakco Engineering Pvt Ltd, Kolhapur	Iron castings on jobbing basis
18. R.C.G. Malleable Casting Industries, Miraj	Malleable iron pipe fittings and other castings
19. Kulkarni Engineering Associates Pvt Ltd, Sangli	Iron castings on jobbing basis
20. Salvi Superstructure, Bombay	CI and malleable castings
21. Bharatiya Foundries, Bombay	CI castings for flushing systems,
22. Kajeco Industries, Agra	CI pipes & fittings, man-hole cover
23. India Iron Foundry, Agra	CI weights, pump parts
24. Satya Industrial Corp, Agra	CI railway castings, man-hole covers, pipes
25. Diwan Chand S.P. Jain, Agra	Iron castings on jobbing basis
26. National Iron Foundry, Agra	Iron castings for own products and on jobbing basis
27. Kisan Industry & Foundry Works, Ludhiana	Heavy CI castings on jobbing basis
28. Modern Machine Tools and Engineering Works, Ludhiana	Heavy CI castings on jobbing basis
29. New India Foundry, Ludhiana	Heavy CI castings on jobbing basis
30. Bharat Jyoti Mechanicals, Ludhiana	CI castings for grinding & hosiery machines
31. Hindustan castings, Ludhiana	Heavy CI castings on jobbing basis
32. Ram Lal & Sons, Ludhiana	CI castings for sewing machines
33. Jodh Singh Sembi & Sons, Goraya	CI castings for chaff cutlers
34. Sadu Singh & Sons, Goraya	CI castings for chaff cutlers
35. J.M.P. Manufacturing Co, Jullunder	Malleable iron castings for automobile spare parts
36. Victor Tools, Jullunder	CI castings for hand tools
37. Sethi Industries, Jullunder	Malleable iron castings for industrial chains

/ 38.

Name of unit	Line of manufacture
38. Indian Machine Tools, Batala	CI castings for own machine tools
39. Deluxe Kuthali Works, Batala	CI castings on jobbing basis
40. Hero Engineering Works, Batala	Chilled CI rolls and machine tool parts
41. Batala Engineering Works, Batala	CI castings for machine tools and jobbing orders (large scale unit)
42. Sharda Foundry & Engineering Works, Batala	Heavy CI castings for own machine tools
43. Bombay Foundry & Machines, Amritsar	CI castings for printing presses

B. Non-Ferrous Foundries

1. Vulcan Engg. Works, Calcutta	Small non-ferrous castings for electrical, architectural and mechanical applications
2. Mascot Enterprises, Calcutta	Pressure die and sand mould castings
3. Super Electrical & Engg. Faridabad	Pressure die castings for scooters and autos
4. Non-ferrous Industries, Calcutta	Copper based alloys
5. Annapurna Cooker Co, Bangalore	Wide range of non-ferrous castings
6. Mysore Auto Service, Bangalore	Die casting of zinc alloys
7. Bangalore Engineering Industries, Bangalore	Shell-moulded castings of CI and non-ferrous
Mysore Foundries	CI castings on jobbing basis
8. Amin Patel & Co, Bombay	Aluminium castings by sand moulding
9. National Die Casting Co, Bombay	Alloy aluminium castings by gravity and pressure die casting
10. Sant Brass Metal Works, Jullunder	Brass castings for valve and pipe fittings

Name of unit	Line of manufacture
11. Leader Engineering Works, Jullunder	Brass castings for valves & pipe fittings (large scale unit)
12. Auto Piston Pvt Ltd, Amritsar	Aluminium alloy castings for auto pistons and iron castings for piston rings (medium scale unit)

C. Steel Foundries

1. Frontier Engineering Corp, Kanpur	Steel castings by thermit process and leaf springs
2. Kanpur Steel & Ferro-alloys, Lucknow	Alloy steel castings and ingots by induction furnace and indirect arc furnace
3. Precision tools & castings Pvt Ltd, Lucknow	Stainless steel castings
4. N.G. Chakravarti & Co, Howrah	Alloy steel and alloy iron castings
5. Tembe Industries, Kolhapur	MS steel, manganacese steel and alloy steel castings
6. Sarvodya Foundry and Engineers, Bombay	Alloy steel and cast iron castings

D. Re-rolling Mills

1. Agarwal Brothers Steel Rolling Mills, Bangalore	Bars from scrap
2. Bangalore Re-rolling Mill, Bangalore	Bars from billets
3. Bharath Steel Re-rolling Mill, Bangalore	Bars, flats, angles from billets and scrap
4. Krishna Steel Industry, Miraj	Bars from scrap
5. Eskay Steel Rolling Mills, Bombay	Bars from scrap
6. Agra Steel Corp, Agra	Bars from scrap
7. Jay Industries, M. Gobindgarh	Bars from scrap
8. Jai Bharat Rolling Mills, M. Gobindgarh	Bars, joists, flats, hexagonals from billets

Name of unit	Line of manufacture
9. Ajanta Steel Rolling Mills, M. Gobindgarh	Rods from light scrap
10. Surendra Steel Rolling Mills, M. Gobindgarh	Bars, joists and miscellaneous sections from billets and scrap
11. Pensla Industries (Rolling Mills), Jullunder	Bars from scrap
12. Gupta Steel Industries, Kanpur	Bars rolled from scrap
13. Singh Plate Mill Pvt Ltd, Kanpur	Steel bars and light sections, rolled from billets
14. Katia Steel Rolling Mills, Calcutta	Galvanised precision bars, gate rounds and drop bars from billets
15. We are Four, Calcutta	Cold rolling of box strapping

E. Others

1. Vijay Metal Works, Kanpur	Aluminium utensils
2. P.G. Karmarkar & Sons, Kanpur	Weighing scales and balances
3. Encardio-rite Electronics Pvt Ltd, Lucknow	Multi-channel recorders and other electronic measuring devices for medical and research purposes
4. Cintrex Company, Calcutta	Powder metallurgy bushes & components
5. Bhovuka Steel Ltd, Bangalore	Steel ingots by electric arc furnace (not small scale unit)
6. Versatile Engineers, Kolhapur	Foundry sand testing equipment manufacture, telescopes and planatarium equipment
7. Maharir Metal Industries, Kolhapur	Rolling of aluminium and utensil making
8. Sai Industries, Bombay	Extrusion of non-ferrous tubes

APPENDIX III

ITINERARY OF FIELD VISITS IN INDIA

April 1973

9	Calcutta
10 - 11	New Delhi
12 - 13	Kanpur
14	Lucknow
15 - 19	Calcutta
20 - 25	Bangalore
26 - 30	Kolhapur

May 1973

1	Sangli/Miraj
2 - 6	Bombay
7	New Delhi
8	Agra
9	Chandigarh/Gobindgarh
10	Ludhiana
11	Jullunder
12	Batala
13	Amritsar
14 - 18	New Delhi
19 - 22	Calcutta

APPENDIX IV

FOUNDRY MODERNISATION QUESTIONNAIRE

General

1.	Name & Address of the Unit:	Messrs. MYSORE FOUNDRIES 7th Block, Jayanagar West, Bangalore-560011
2.	Products:	
	(i) Types	Machine Tools, Pump, Electric Motor and General Castings.
	(ii) Maximum per piece weight	One ton per piece weight.
	(iii) Minimum weight/piece:	250 gms. per piece weight.
3.	Production:	
	(i) Quantity produced/month	70 tons.
	(ii) Average sales value	Rs. 1,25,000/mo (avg. Rs 1.75/kg)
	(iii) No. of shifts/month	One shift
4.	Yield (percentage of good castings to metal melted)	65% to 70% good castings (10-12% casting rejection for HMT orders, normal 5-8%)
5.	Total No. of employees	
	(i) on company's roll	90 Employees (incl. clerical, watch-keeping etc.)
	(ii) Contractor's labour	--
6.	No. of technically qualified Supervisory staff	Three
7.	Nature of company structure	Partnership
8.	Marketing channel & difficulties if any in selling products.	Working as sub-contractors to industries such as West & Company, H.M.T., Kirloskar.

/Plant & Equipment

Plant & Equipment

1.	Sand conditioning equipment/ Present practice of sand properties.	Pan Rotating type sand Mixer, Mechanical Siever. Facing sands are prepared and distributed to moulders.
2.	Moulding equipment/present moulding practice.	a) Two pneumatic mouldings machines one pinlift and one turnover type b) Machine moulding and hand moulding, green sand, dry sand, and loom moulding methods.
3.	Core making equipment/and present practice.	Core sand mixer. Oil sand cores, CO_2 Cores.
4.	Melting equipment with capacities/present practice.	Cupola melting 36" dia Cupola 3 to 3½ ton per hour. 24" dia Cupola (being removed) and replaced by 36" Cupola.
5.	Dressing and fettling equipment/present practice.	Tumbling barrel, grinders Fettling is mostly sub-contracted.
6.	Material handling equipment/ present practice.	3 ton capacity overhead cranes, Trolly lines provided for Trolleys.
7.	Testing equipment:	
	(i) For routine in-process shop control tests.	Chemical and Physical tests reporting received from C.M.T.I. and H.M.T.
	(ii) Tests on quality of finished castings	
8.	Instrumentation	Nil.
9.	Present quality control measures.	Routine visual inspection of castings.
10.	Whether product conforms to available standards.	Confirms I.S.S. 14 to 20.
11.	Record Keeping	Cupola Melt reports } Production reports } maintained

12.	Total investment in machine and equipment.	About Rs. 1,75,000/- (6-8 yrs. ago, today, 50% higher)
13.	Special problems, if any, reported by the management.	Material Handling problems are there. Irregular supplies of raw materials which forces the management to maintain heavy stocks of pig iron and coke.
14.	Opinion of the Management:	
	(i) On the need of modernisation of management;	"Management training courses would help a lot".
	(ii) On the need of modernisation of production equipment, tools and auxillaries;	"There is a need to modernise material handling and fettling equipment, and also to add two more moulding machines and to set up a testing laboratory".
	(iii) Any expansion plans	There is a proposal to manufacture Black Heart Malleable Castings.
15.	Remarks	Modernisation will help to manufacture automotive and other intricate castings. Finance is required with a nominal interest and on long term basis.

APPENDIX V

DESCRIPTION OF IRON FOUNDRIES VISITED

J.K. Foundry, Faridabad

This cast iron foundry was set up a year ago by a young "technocrat". The initial investment was Rs 1.2 lakhs, wholly financed by a bank at interest rate of 12 per cent per annum. The plant has already reached a turnover rate of Rs 4 lakhs per year and is expected to increase to Rs 5 lakhs next year.

The facilities are minimal - a single shed, no crane, one 24" cupola (1,5 tons/hour capacity) and hand moulding. Cupola is operated once in a week to give 10-13 tons of iron. Castings upto 1 ton weight have been attempted. Rejections were reported to be around 6 per cent and coke:iron ratio as 1:4. The plant employed 24 persons.

The cost of raw materials, delivered at works, was Rs 475/ton for foundry iron, Rs 210/ton for by-product coke (open market cost Rs 425/ton). Castings were sold at Rs 1 - 1.50 per kg.

The technocrat was confident, hard-working and progressive. Plant facilities were rapidly being augmented - CO_2 process was being used, a new compressor purchased and an overhead crane planned. He felt that the plant was now too small for him - he would like to sell it and build a larger unit if finance were available.

Cossul Foundries Pvt Ltd, Kanpur

This is a private limited company producing castings for agricultural implements to be used in their own products. The unit has two cupolas - 24" and 30" inside diameter. The latter one is not connected to the blower. In the sand preparation section, they had pan-roller type sand mixer but it was not in use. All processes of moulding, core making, fettling, etc. are carried out manually. They produce 12 tons of castings (C.I.) per month. About 20 to 30 labourers are on contract basis.

/ The total

The total investment in machinery and equipment in the foundry has been reported to be Rs 50,000. There is no technically qualified person employed. The special problems were reported to be procurement of pig iron and coke. As the unit has employed labourers on contract basis and is producing castings for their own use, it is not really interested in modernization.

New Gupta Foundries, Kanpur

This small scale foundry unit has 30" diameter cupola producing C.I. castings on job order basis. The furnace melts 1.25 tons/hour, and 12 tons of metals is cast once a week. The monthly production is reported to be about 30 tons. The unit employs 30 men.

Bharat Foundry (P) Ltd, Calcutta

This private limited company produces C.I. castings for Saxby & Farmer and other large-scale units. They also manufacture alloy cast iron. The maximum piece weight is 1.5 tons. The unit produces about 200 tons of castings p.m. on single shift basis, their maximum production having reached 350 tons. The average sales price is Rs 1,800/ton. The yield has been 65 to 70 per cent. The foundry employs 45 persons as regular employees and another 65 on contract labour. They have two technically qualified persons at the supervisory level.

Sand preparation is normally done by hand. No equipment is available in that section. Two coal-fired ovens are utilised for drying moulds and cores. The unit has two cupolas - one 36" dia. (2.75 tons/hr) and the other 34" dia (2 tons/hr). There is no equipment in the fettling section, except double-ended pedestal grinder. The only equipment for material handling is a chain pulley block. The unit is equipped with transverse testing equipment and a small chemical laboratory for testing of casting and metal composition. The tensile testing is normally done by SISI Calcutta. The unit is in a position to produce casting as per ISI specification, and has been making grade 20, 25 and 30 cast iron.

/ The total

The total investment in equipment is reported to be Rs 1 lakh. This unit has desired to modernize their plant by procuring a generator (25 kVA), skip for cupola charging, directly-coupled motor with blower, one sand mill, sand testing equipment, dry stove with temperature recorder, pneumatic chisels, shot blasting equipment, pin-lift type and turnover-type moulding machines, small analytical laboratory and some material handling equipment (like double-decker trolleys, etc.)

The main difficulty reported by the party was in the procurement of pig iron, hard coke, ferro-silicon and ferro-manganese.

Bangalee Silpi (P) Ltd, Calcutta

This is a private limited company producing mainly paper and jute mill plants and general C.I. casting on job order basis. The maximum piece weight is about 3.5 tons, monthly production 40 tons, and average sale value Rs 1,200 per ton. The unit reported no dearth of orders for C.I. casting. The unit employs 38 people on regular basis. Skilled workers earn Rs 8 per day while the others Rs 3. They have no technically qualified persons in the supervisory or managerial level.

There is no equipment for sand preparation, moulding or core making. The unit has two cupolas of 42" and 30" inside diameter, giving 3.25 tons and 2.50 tons per hour respectively. Excepting one double-ended pedestal grinder, there is no equipment in the fettling section. No testing facilities or instrumentation are available. Record keeping is poor.

The total investment in machinery and equipment has been reported to be Rs 50,000. Their main difficulties appear to be shortage of working capital and procurement of coke and pig iron in time. Pilferage during transit is reported to be a major problem. The management feels the need of modernization.

/ Ramkrishna

Ramkrishna Iron Foundry, Howrah

This is a partnership concern taken over in 1959 from an old factory started in 1901. It produces C.I. castings on job order and some special casting for General Electric Co, Hindusthan Steel, etc. on specific orders. Small exports have been made. The foundry has a small machine shop. The maximum piece weight cast is reported to be 3.5 tons. The monthly production is around 150 tons with average sales value of Rs 1.75 per kg. The unit normally runs on single shift. The yield has been reported at 70 per cent. They have 60 persons on regular roll and 18 on contract labour. The skilled worker gets Rs 8 to 10 per day whereas unskilled labour Rs 165 per month. There is no technically qualified person. The unit finds no difficulty in obtaining orders.

In the sand preparation section there is only a pan roller. The unit has six hand moulding machines (self made) but none of them are in operation at present. Oil and dry sand cores are made by hand. There are two cupolas - one 42" inside dia. giving about 3.5 tons/hour and the other 30" giving 2 tons/hour. They have two coal-fired core and mould drying ovens. In the fettling section, except for a flexible shaft grinder, there is no equipment. The unit has a mono rail of 6-ton capacity and no other material handling equipment. They operate the cupola two to three times in a week. The quality control is visual. The record keeping has been found to be at a minimum level.

The total investment in machinery and equipment has been reported as Rs 1,630,000 of which Rs 70,000 is for the foundry. The unit needs to renovate the foundry shed and also desires to go for a 10-ton overhead crane, etc. Their main current difficulties are in procurement of pig iron and coke.

P.V.S. & Company, Bangalore

This foundry has one 18" cupola melting about 1.75 tons/hour. They produce sewing machine frames and stands for USHA and miscellaneous C.I. castings on job orders. The maximum weight of casting made by the unit was 130 kg. The capacity of the foundry is about 30 tons of castings

/ per month

per month, but at present only 10 to 12 tons are produced because of the shortage of raw material. The average sale price varies from 1.28 to Rs 2 per kg. The yield is reported to be 60 per cent. The foundry employs 25 persons and has one B.E. Mechanical in the staff.

Some sand conditioning and fettling facilities are obtained from a sister concern located adjacent to the foundry. This concern has got pedestal grinders and flexible shaft grinder for cleaning the castings. The inspection of castings for supply to USHA is carried out by the USHA inspector.

The total investment on machinery and equipment in the foundry is reported to be Rs 60,000. Difficulty in procuring hard coke and pig iron is reported to be standing in the way of higher utilisation of the installed capacity. The foundry is likely to be extended by installing another cupola which is under erection.

V.R & Brothers, Bangalore

The unit was started in 1949 and installed a main frequency coreless induction furnace of 500 kg capacity in 1963. This was put into operation after the recession in 1965. The furnace, purchased through NSIC, cost Rs 485,000. They also have a 27" and a 37" cupola

The unit produces cast iron grinding medium for cement factories, heat resisting and high silicon iron castings (0.5 - 1.8 tons per piece). The unit also makes steel ingots in its induction furnace. The total present production is about 60-70 tons per month, though it can go upto 100-120 tons per month. It employs 150 persons.

In the sand conditioning section, the unit has two sand mullers, one power riddle and vibrators. Most of the cores are made by CO_2 process. Pedestal grinders, flexible shaft grinders and tumbling barrels are in use in the fettling section and there is one 3-ton overhead crane for material movement. The unit has a brinnel hardness testing machine and proposes to buy a physical and chemical testing laboratory in course of time. Investment in machinery and equipment is about Rs 5 lakhs.

/ The unit

The unit desires to expand by adding proper sand conditioning equipment, annealing furnace and shot blasting equipment in order to take up regular steel casting jobs. They also want to go for a carbon/ sulphur determinator in the laboratory. The management has a progressive line of thinking about its expansion and modernization programme.

Mysore Foundries, Bangalore

This foundry undertakes job orders and special supplies to Hindustan Machine Tools, BEST & Co, Kirloskar and other large firms. The unit has two cupolas - 36" dia. giving about 3 tons/hour and another 24" dia. as a stand-by. C.I. castings of all varieties are produced, the maximum piece weight being 250 grams. The unit produces about 70 tons castings per month on single shift basis. The average sales value is about Rs 1.25/kg. The yield is reported to be 65-70 per cent. The factory employs 90 persons and there are 3 technically qualified persons among the staff. This is a partnership concern and to some extent serves as an ancilliary unit to a number of large scale units.

In the sand conditioning section, they have a pan-roller type sand mixer and a mechanical sieve. The facing sand are prepared and distributed to moulders. For moulding, there are two machines - one pin-lift and other turnover type. They follow machine and moulding in green and dry sand. The unit has a core sand mixture. Oil sand cores and CO_2 coats are practised. In the fettling section, there is a tumbling barrel and few grinders. The fettling is mostly sub-contracted. Overhead crane (3-ton) and trolly lines have been provided for ease of material handling. Most of the chemical and physical tests are got done from C.M.T.I. and H.M.T. Most castings conform to ISS 14 to 20 grade.

The total investment in machinery and equipment has been reported to be Rs 175,000. As special problems the management mentioned irregular supply of raw materials which forces the management to maintain heavy stock of pig iron and coke.

/ The

The management is enlightened and seeks modernization of material handling equipment, fettling equipment, adding two more moulding machines, and setting up a testing laboratory. They felt that modernization will help them to manufacture automotive and other intricate castings competitively.

Bangalore Engineering Industries, Bangalore

This is a small scale foundry unit producing ferrous and non-ferrous castings by shell moulding methods. The unit has an imported shell moulding machine, a core shooter, electric core oven, and a shell fixing device, all from West Germany. The compressor is of indigenous made. The maximum part piece of casting has been reported to be 300 kg, the minimum being 0.025 kg.

The unit has a skelnar oil-fired, reverberatory 200 kg capacity furnace. About 1½ of cast iron is melted per day in 6 heats. Though the capacity of the unit is about 30 tons per month, the present level of production is 20 tons only. Castings are sold at an average rate of Rs 4 per kg. The foundry runs on single shift and employs 10 regular workers besides engineers. The yield is about 70 per cent.

All castings are produced on job order basis. At the moment they have no testing equipment and most of the inspection is visual. The castings conform to the standards prescribed by the users. They have sand mixer self-fabricated material handling equipment, and machine shop with lathe, drilling and grinding machines. This is a partnership concern and the investment in machinery and equipment is about Rs 1.12 lakhs.

The management has ambitious expansion plans of undertaking investment and die casting processing. They have also a plan for induction furnace for steel castings.

/ Menon

Menon & Menon Pvt Ltd, Kolhapur

This is a large scale unit producing graded C.I. castings, mostly grade 25. They supply to a number of large scale units like Escort and Kirloskar, and also produce their own oil engines. The unit has a 1-ton capacity oil-fired rotary furnace, and takes about 9-10 casts per day. The unit produces about 420 tons/month, with sales value of Rs 300,000. They run two shifts per day. The yield was reported to be from 60 to 70 per cent. The factory employs 70 persons on their regular roll and has 5 technically qualified persons.

The unit has two sand mullers, one power sieve, four jolt-squeeze pin-lift type moulding machines. Cores are made by CO_2 process. They have shot blasting equipment, pneumatic chippers, tumbling barrels, swing-frame grinders, double-ended pedestal grinders, flexible shaft grinder, and overhead crane of 2-ton capacity. They have a sand testing laboratory. The firm is in a position to produce cast iron as per ISS and customers specifications. The total investment of the unit in machinery and equipment is about Rs 17 lakhs, of which Rs 6 lakhs is in the foundry.

The management is very enlightened. They propose to go for another one-ton oil-fired rotary furnace and electric induction furnace, sand conditioning plant, more moulding machines and other supporting machines, with a view to enhance their production.

Uchagaonkar Iron Works, Kolhapur

This is a small scale partnership concern producing C.I. castings on job orders. The unit has a 30" inside dia. cupola giving about 2.25 tons per hour. About 70 tons of C.I. castings are produced per month, the maximum piece weight being about ½ ton. The unit's average sales of castings per month is about Rs 67,000. They run on single shift basis and yield is about 65 per cent. It employs 26 regular workers and has experienced persons at the supervisory and management level. No marketing difficulty has been reported by the concern.

/ They

They have a sand muller for preparation of moulding sands. Cores are made of oil sand. Most of the moulding, core-making and melting operations are done manually. For cleaning castings, the unit has pedestal and flexible shaft grinders and tumbling barrels. For charging the cupola they have a semi-automatic skip to the charging platform. No testing facilities are available. There is no quality control except normal visual inspection.

The total investment in machinery and equipment has been reported to be Rs 50,000. The procurement of raw materials such as pig iron, scrap, and hard coke have sometimes caused difficulties.

Jai Bhavani Iron Works, Kolhapur

This is small scale partnership concern producing oil engine parts and miscellaneous type of C.I. castings on job orders. The unit has a 28" cupola, giving about 2 tons per hour. The unit at present produces about 20 tons of good castings per month, with an average sales value of Rs 30,000. The unit runs on single shift basis and employs 16 people on regular roll and 12 contract labourers. The yield has been reported to be from 52 to 55 per cent. One of the partners is a diploma holder, but there is no other technically qualified person at the management level. They have an experienced foreman supervising the day-to-day work of the foundry.

For sand preparation, they have a sand muller, and for sand testing a permeability meter and compression testing machine. Moulding and core making are done manually. In the cleaning section, they have a pedestal grinder and tumbling barrel. A small chain pulley block of 2-ton capacity was the only material handling equipment in the foundry. They undertake wedge tests for the molten metal. Normally the unit produces castings as per ISS grade 14 to 18.

The total investment in machinery and equipment is reported to be about Rs 23,900. The management plans to have a 15-ton overhead crane, a centrifugal castings machine and a mechanical charging system for the cupola.

/ D.M. Foundries

D.M. Foundries, Kolhapur

This partnership concern produces castings on job orders. They have supplied C.I. castings to Cooper Engines and Shri Ram Refrigeration Industries, Hyderabad. The unit has a 24" dia. cupola, giving about 1.5 tons metal per hour. The unit employs 12 workers on a regular basis and produces about 25 tons of good castings per month though the installed capacity is about 50 tons. Due to shortage of working capital, the management was not in a position to increase production though it has no dearth of orders.

There is no technically qualified person on the management. Preparation of sands, moulds and cores are all made manully. For cleaning of castings they have double-ended pedestal grinder and portable hand grinders. The unit practises 'wedge tests' for control of chilling in the metal. They have also a hardness tester. The total investment on machinery and equipment has been reported to be Rs 20,000 approximately. The coke metal ratio was reported to be 1 : 10 and yield 75 per cent.

Hind Castings & Iron Works, Kolhapur

This is a small scale partnership concern producing light and heavy C.I. castings on job orders. The unit has a 30" cupola which is run on alternate days and produces about 200 ton castings per month, valued about Rs 150,000. The foundry runs on single shift and employs 28 persons on regular roll and 10 contract labour. The yield is reported to be 72-75 per cent. The unit employs two technically qualified persons at the supervisory level.

The foundry has sand mullers, hand moulding machine, core sand mixing muller, tumbling barrel, pedestal grinders, etc. They have two 3-ton cranes for material handling. The factory is equipped with a chemical testing laboratory and hardness tester. They have been making successfully the C.I. castings upto grade 17.

/ Shri Dut

Shri Dut Engineering Corporation, Kolhapur

This is a small scale partnership which produces sand cast liners and pistons and centrifugal cast liners to be used as original components by the large scale manufacturing concerns. The foundry is equipped with a 24" dia. cupola melting 1½ tons per hour. It has three sets of self-fabricated centrifugal casting machines independently run with three permanent moulds each. The unit produces monthly 40 tons of good castings from 60 tons of molten metal. The sales value of the castings is about Rs 100,000. The unit runs on a single shift basis, employing 24 persons. The yield is reported to be from 72 to 80 per cent. They have two qualified engineers on the management.

One sand mixing muller, one moulding machine (not in use) and tumbling barrels are found in the different sections of the foundry. Wedge and hardness tests, together with rigid inspection are carried out on the liners and the pistons which go as original components in the engines produced by Ruston & Co. Most of the castings conform to grade 17.

Total investment in machinery and equipment in this foundry is about Rs 80,000. The management was found to be quality conscious and was making efforts to maintain the quality of castings at a high level.

Yashwant Iron & Steel Works Ltd, Kolhapur

This is a small scale public limited company producing mechanite castings under licence from Cooper. They have two 28" dia. cupolas each producing about 2 tons/hour. Castings are made twice a week, and the foundry produces 70 tons of castings per month, which sell at Rs 2 to 3 per kg. Yield is about 55 per cent. The company employs 135 people, of which 90 work in the foundry. Three qualified engineers, two of them metallurgists, are among the staff. Their order books are full.

/ The unit

The unit has sand mullers, power sieves, two hand moulding machine, pneumatic rammers, etc. The cores are made manually with silica sand and synthetic bond. For fettling, they have pneumatic chippers, grinders and tumbling barrel. The unit has also two manually operated cranes, an electrically operated charging hoist for the cupola. Wedge tests are practised for control of chilling in the metal,and test bars for tensile strength are sent to outside laboratories. They have a hardness testing, chemical testing, and sand testing laboratory.

The total investment in machinery and foundry equipment is reported to be about Rs 197,852. The shortage of raw material is one of the difficulties the unit faces.

Pakco Engineering Pvt Ltd, Kolhapur

This is a private limited company manufacturing C.I. castings for oil engines hacksaw machines, grinding machines, etc. The piece weight of castings made has been 255 kg. The monthly production is reported to be 30 tons, monthly sales being Rs 2 lakhs approximately. The factory employs 20 persons and runs on single shift. The yield is reported to be about 70 per cent. They have regular distributors for their products and there appears to be no difficulty about marketing.

For preparation of sands, there is a sand muller and for moulding pneumatic moulding machines. Cores are prepared by hand. The unit has a 24" cupola giving about 1.5 tons of metal per hour. For dressing and fettling of castings, there are grinders and tumbling barrels. There is no facility for material handling and testing of the product. Wedge tests are carried out as a measure of control of quality of the molten metal.

The total investment in the machinery and equipment in the foundry is reported to be Rs 40,000 approximately. The unit has a proposal to install a hot blast cupola. The management plans to install a laboratory for chemical analysis, hardness testing machine, etc.

/ Kurlkarni

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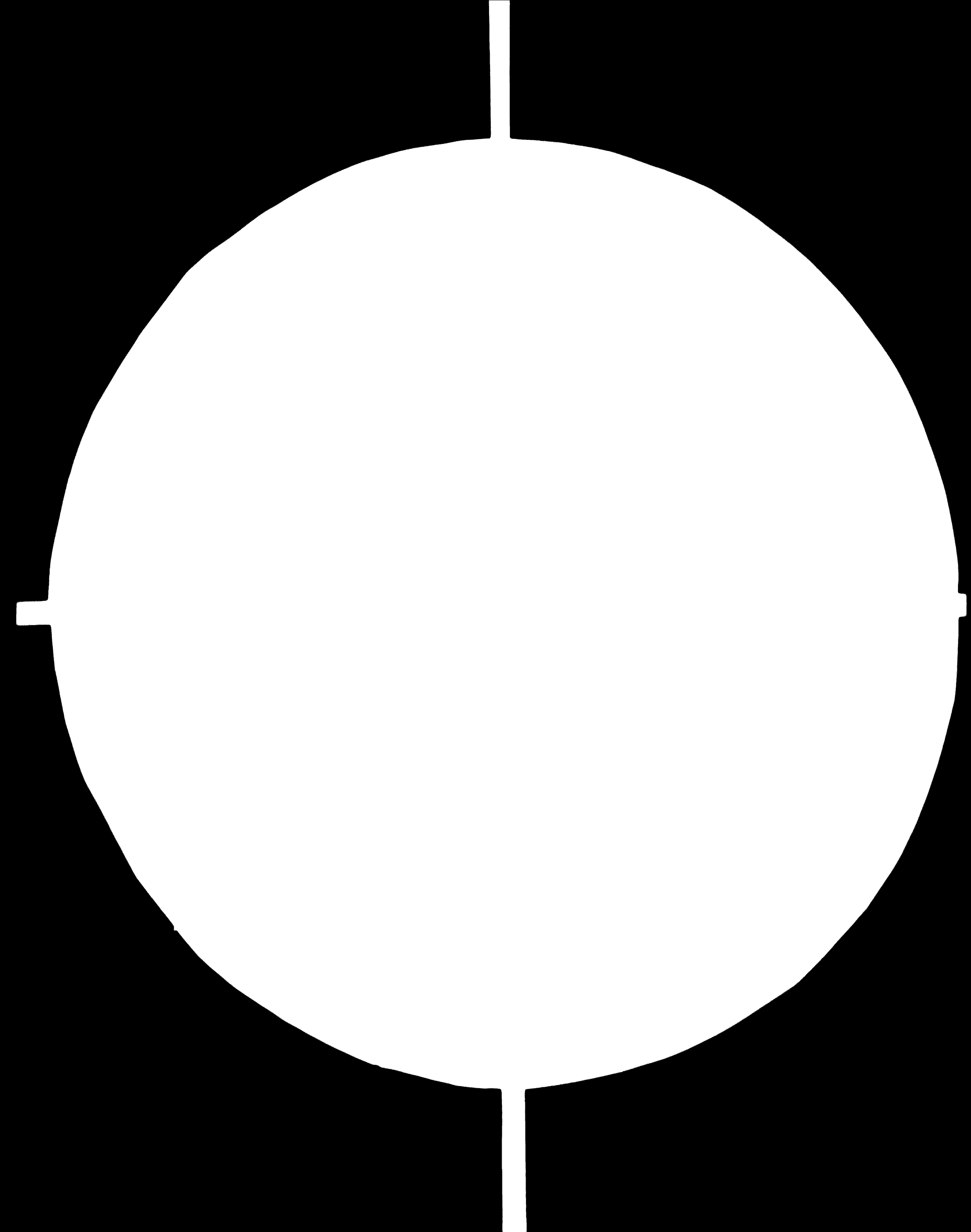

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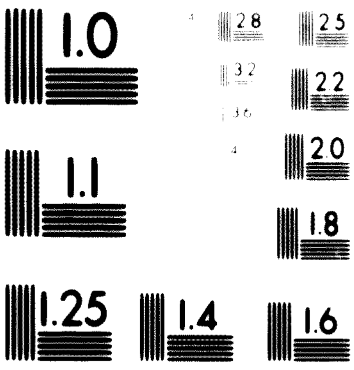

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Kurlkarni Engineering Associate Pvt Ltd, Sangli

This small scale unit produces grey iron castings mostly of grade 20. They have made castings weighing 700 kg. per piece. The capacity of the foundry is reported to be 150 tons p.m. though the present production was 120 tons p.m., sold at Rs. 2 per kg. The foundry has a yield of 50%. It works on single shift employing 120 people on regular roll out of which four are diploma holders. They supply castings against orders.

In addition to sand muller there are two hand operated moulding machines and two jolt squeeze type machines recently procured and yet to be installed. They have sand mixers for core sand and coal fired mould and core drying ovens. There are two cupolas — one 24" giving about 1.5 tons per hour and the other 28" yielding 2 tons per hour. There are two pedestal grinders and 2 portable hand grinders in addition to a tumbling barrel in fettling section. They have also sand blasting equipment and chain pulley blocks of 2 tons capacity. Normally wedge test is carried out to ascertain the quality of molten metal and other testing facilities - physical and chemical are availed from outside.

The total investment in equipment is reported to be Rs. 1 lakhs in foundry and another 50,000 in machineshop and other section. They have a small pattern shop for making simple patterns and repair of old ones. The management has programmes to improve their pattern shop, go for lab. equipment, pneumatic chippers and other fettling equipment.

Bharatiya Foundry, Bombay

This partnership concern manufactures cast iron machinery parts and flushing systems, man-hole covers and misc. C.I. castings on job orders. Maximum piece weight cast so far is about 500 kg, the minimum being ½ kg. The present production of the unit is about 30 tons per month, sold at the rate of Rs. 1,500 to 2,000 per ton. The unit employs 40 people of which 19 are contract labour. There is one technically qualified person in the staff. No dearth of work load has been reported by the unit.

/There is a

There is a muller for the preparation of moulding sand, four pneumatic moulding machines, three jolt squeeze type and one turn-over type. There is also a core blower for preparation of small cores. One 21" inside dia. cupola giving about 1 to 1½ tons of metal per hour is being used for melting cast iron. One cupola (2 to 2½ tons per hour cupola) was under construction. For non-ferrous melting the unit has a pit furnace (coke fired) for 150 no. crucibles. The fettling is done manually and with the help of pedestal and hand grinders. No material handling and testing equipment were found in the factory. The quality of casting is checked by visual inspection.

The total investment in machinery and equipment in the foundry is reported to be Rs. 60,000. The management appeared to be keenly interested in modernisation. The unit has an expansion programme for production of CI castings as per specifications and a lay-out for the new foundry was suggested.

Majeco Industries, Agra

This proprietorship concern produces cast iron pipes and pipe fittings, man-hole covers and other general CI castings as per buyers specifications. 75% of the castings are exported to USA and Middle-East. The monthly production is reported to be 600 tonnes, saleable at the rate of Rs 1000/- per tonne. The unit runs on single shift basis and employs 230 regular employees besides 3 technically qualified engineers in production as well as inspection departments. The yield is reported to be about 70%.

There is no equipment for preparation of moulding and core making sands nor for preparation of moulds. Orders have been placed for jolt-squeeze type moulding machines and a core shooter which are yet to be received. They have a 48" cupola giving about 5.5 tonne of metal per hour. For fettling they make use of double-ended pedestal grinders, tumbling barrels and other hand tools. There is no material handling equipment. The unit has set up a mechanical and chemical testing laboratory in sister concern. The exportable items are inspected by the appropriate authority. The products conform to specifications laid down by the foreign buyers.

/The total

The total investment in machinery and equipment is reported to be Rs 1.7 lakhs. Shortage of power, pig iron and hard coke were the main problems of this unit. The management took keen interest in modernisation and would like to go for mechanical charging of the cupola, shot blasting equipment and sand conditioning plant.

Indian Iron Foundry, Agra

This partnership concern produces CI castings, metric weights and other general castings on job orders. The maximum piece weight is reported to be 1.75 tonnes. The factory runs on single shift basis, producing about 200 tonnes casting per month saleable at the rate of Rs 900 per ton. The yield is reported to be 70%. The unit employs 100 persons, 50 on regular roll and 50 on contract. There is no technically qualified staff in the management.

There is no mechanical equipment available for the preparation of sand, moulds and cores. The unit has a 42" cupola giving about 4.5 tonnes per hour. In the fettling section there are a few pedestal and hand grinders. No testing facilities are available. The metric weights are produced under licence from the Government and as per ISI standards.

The total investment in machinery and equipment is reported to be Rs 1 lakh approximately. Procurement of pig iron and hard coke stated to be the main difficulties of the unit. They have a mind to go for moulding machines if finance is made available.

Satya Industrial Corporation, Agra

This partnership concern produces railway sleeper, brake blocks, bearing plates and other general CI castings on job orders. The factory employs 200 persons, 100 on regular roll and 100 on contract. It produces about 500 tonnes of castings per month on single shift basis, saleable at Rs 700 per tonne. The yield is reported to be 60 per cent. There is no technically qualified staff in the management.

/Excepting

Excepting sand muller and a pedestal grinder, there is no other equipment for sand conditioning, moulding, core making and cleaning of castings. The unit has a 48" cupola giving about 5 tonnes per hour. There is no mechanical equipment worth the name. Facilities for testing transverse and tensile strength, drop tests and hydraulic load tests are available in the foundry, as required for railway supplies. Inspection is carried out by the railway inspectors. The castings are produced as per IRS, ISS and P&T specifications.

The total investment in machinery and equipment is reported to Rs 1 lakh. The management is interested in modernisation and referred to some technical problems on which on spot advice was rendered. Because of acute power shortage they would like to go for a generating set, if funds are made available.

The National Iron Foundry, Agra

This unit produces automobile and tractor spares, bicycle parts, both in grey and malleable iron. The largest casting made is about 700 kg in grey iron and 30 kg in malleable. The monthly production is reported to be 40 tons saleable value being Rs 40,000. The unit employs 15 persons on regular roll and 10 as contract labour. The yield is reported to be 60%. Three engineering trainees are undergoing in-plant training in the factory.

There is a sand muller for preparation of moulding sands and moulds are made by hand-moulding machines, flour moulding, double box moulding and boxless stack moulding methods. Cores are made manually. Two cupolas of 28 and 30 inches diameter are available. The fettling of castings is carried out by hand chipping, rough grinding and wire-brushing. There is no material handling equipment excepting a chain pulley block and hoist for raising metal charges to the cupola platform. The tests carried out for quality control include hardness test, wedge test, tensile and transverse test etc. The unit also uses mould hardness tester and optical pyrometers.

The total investment in machinery and equipment in the foundry reported to be Rs 32,000. The unit is in a position to produce castings as per ISS/BSS specifications. They would like to go for pneumatic moulding machines, pneumatic chippers and mechanical charging equipment for the furnace as first step of modernisation.

Kishan Foundry, Ludhiana

Kishan Foundry produces C.I. castings for oil engines, power press, card board mills and other miscellaneous castings on job order basis. They have produced castings of five tons piece weight. The production is reported to be about 40 tons per month, sold at the rate of Rs. 1000 per ton. This is based on single shift working. The yield is reported to be 70% approximately. This is a proprietory concern employing 14 persons on regular roll. There is no technically qualified person among the staff.

In the sand preparation section, excepting a sand muller moulder there is no other equipment. Moulding and core making are done manually. The unit has two cupolas of 36" and 39" inside diametre, giving about 2.5 tons of molten metal per hour. Fettling and cleaning of castings are done manually with the help of hand tools and hand grinders. Inspection is done visually. Excepting a Poldi hardness tester, there is no testing equipment with the unit. The castings are of commercial quality and do not conform to any specific standard.

The total investment in machinery and equipment has been reported to be Rs. 50,000 approximately. The management would like to buy a 10 tons capacity overhead crane and mechanical charger for the cupola in case finance is made available to them.

/Modern Machine Tools

Modern Machine Tools & Engineering Works, Ludhiana

This foundry produces both light and heavy C.I. castings on job order basis. They have cast upto 5 ton castings. Though the production capacity is reported to be 100 tons per month, they have been producing approximately 30 tons per month, with average sales value of Rs. 35,000. The unit runs on single shift and employ 5 persons on regular roll and 15 on contract basis. There is no technically qualified person.

There is no machinery and equipment in the sand preparation, moulding and core making sections. The three cupolas of 14", 24" & 16" inside diametre, have melting rates from 0.75 tons to 2.25 tons per hour. Castings is done once in a fortnight. Fettling is manual with the help of hand tools. For material handling, there is a chain pully block available. The unit has a hardness tester; other physical testing facilities are availed of from outside. Castings are mostly of commercial standard. The total investment in machinery and equipment is reported to be Rs. 60,000 approximately.

New India Foundry, Ludhiana

The unit normally undertakes heavy weight machine tool castings on job order basis. They have made single pieces of upto 7.5 tons without having any mechanical lifting aids. The monthly production is about 40 tons, sold at the rate of Rs. 1000 per ton. The unit is run on a single shift basis. They employ 16 persons on regular wages. There is no technically qualified persons in this partnership concern.

Sand preparation, moulding and core making all are done manually. They have a cupola of 42" dia giving about 4 tons per hour, and 36" dia melting about 3 tons per hour. Fettling and cleaning are done manually.

/There is no

There is no testing facility in the foundry and all inspection is visual. They produce castings of commercial standard.

The total investment in machinery and equipment has been reported to be Rs. 50,000. The management and would like to go for equipment like overhead crane, mechanical charger, generator (due to power shortage), sand mixer and new foundry shed.

Bharat Jyoti Mechanicals, Ludhiana

This small scale unit produces castings mostly to be used for their own end products, which are crank shaft grinding machines and hosiery machines. The maximum piece is about 2.4 tons, the minimum being about 5 kg. The monthly production comes to about 10 tons, saleable at the rate of Rs 1.70 per kg. The yield of the foundry is reported to be about 60%. The unit runs on single shift basis and employs 8 persons. They have two technically qualified persons. This is a partnership concern.

No mechanical aids have been made use of for preparation of sands, making of moulds and cores, and fettling. They possess hardness testing equipment; other physical testings are got made outside. They come under the State Government Quality Marking scheme and are also trying to get I.S.I. mark.

The total investment in machinery and equipment is reported to be Rs 20,000 in Foundry. They have problems like blow-holes, gas-holes etc. on which technical advice was rendered on the spot.

Hindustan Castings, Ludhiana-A.

This is a jobing foundry undertaking heavy C.I. castings weighing upto 4.5 tons per piece. This includes lathe beds, power press bodies,

/diesel engines bodies

diesel engines bodies etc. The unit produces about 25 tons per month, saleable at the rate of Rs 1000 per ton. The yield of the foundry is reported to be 70%. They employ twelve persons on regular roll. This is a proprietory concern catering to the needs of local manufacturers. Most of the castings are made from dry sand moulds in the ground.

Sand preparation, moulding, core making, and cleaning of castings are all done manually. In the melting section there is a 30" cupola which is run only once or twice in a month. They undertake chill tests to ascertain the quality of the molten metal. They have also had a Poldi hardness tester. The castings are of commercial standard and at times they manufacture graded castings similar to I.S. 20 grade. The total investment in machinery and equipments is about Rs 35,000.

Indian Machine Tools, Batala

This proprietory foundry is engaged in the production of heavy machine tool castings and agriculture implements. The maximum piece weight of casting has been about 8 tons and monthly production 125 tons, saleable at the rate of Rs 800 per ton. The factory runs on double shift basis. Yield is reported to be about 80%. The unit employs 35 persons in the foundry and one technically qualified employee in the management. Most of the castings are made against orders.

Both dry sand and green sand practice of mould and core making are in use. Moulding and core making are done manually. There are two cupolas, 36" and 48", size giving 4 tons per hour and 6 tons per hour respectively. The castings are cleaned and handled manually. Only a hardness testing machine is available and other tests are availed of from the N.M.L. Foundry Station, Batala. The unit has a pyrometer for temperature measurement. The castings are of commercial quality. The total investment in machinery and equipment in the foundry is reported to be Rs 1 lakh.

/Delux Kuthali Works, Batala

Delux Kuthali Works, Batala

This partnership concern employs 34 persons on roll and 25 on contract basis. It produces cast iron pulleys, sewing machine parts, etc. The maximum casting has been about 400 kg. The monthly production is about 400 tons, saleable at Rs 900 per ton. The unit runs on single shift and its yield is reported to be 85%. There is no technically qualified person among the staff.

Sands are prepared manually and sieved by a mechanical sieve. Both cores and moulds are made manually. There is an oil-fired drying oven for drying them as and when necessary. There are two cupolas, 42" and 30" diameters. A mechanical skip is being used for charging materials into the cupola. The castings are made as per customer's requirement. Total investment in machinery and equipment is reported to be Rs 1.10 lakhs.

Hero Engineering Works, Batala.

This is a small partnership concern producing chilled rolls, agricultural parts, machine tools & other miscellaneous castings sold through their agents. The maximum weight of castings has been about 2 tonnes. The units employs 20 persons on the regular roll and 4 on contract. There are 3 technically qualified persons in the management. The yield is reported to be about 80 per cent. The average sale value per month has been given as Rs 25,000.

There is no equipment in the sand conditioning and core making section. Moulds are also made mannually. There is cupola of 33" diameter run by 12.5 HP blower. The fettling is done by hand tools and there is no material handling equipment excepting a chain pully block. The inspection and testing are done with the help of C.M.T. Foundry Station, Batala. The total investment in machinery & equipment is about Rs 20,000 in the foundry and Rs 1 lakh in the entire factory.

/Sarda Foundry Engineering

Sarada Foundry Engineering Works, Patiala, Punjab.

This partnership concern produces CI castings for use in their own machine tool production. The unit employs 15 persons on regular roll and 25 on contract. They work on single shift basis and produce about 80 tons of castings per month, valued at the rate of Rs 1,200 per tons. The yield of the foundry is reported to be 75 per cent. As the unit produces castings to be utilised for the manufacture of their own machine tools there is no marketing problem.

Sand muller is used but moulds are made manually. Larger moulds are made from dry sand. The unit has two cupolas, one 48" giving about [illegible] tons per hour and the other 30" giving about 3 tons per hour. The cleaning of castings is done manually. The unit has a crane for material handling. As there are no testing facilities available at the unit, these are obtained from the National Metallurgical Laboratory Testing Centre. Most of the inspection is done by the factory staff. For some machines, [illegible] inspectors carry out the inspection.

The total investment in land, buildings and equipment of the foundry is reported to be [illegible] approximately.

Bombay Foundry & Machinery, Amritsar

This is a partnership concern producing [illegible], [illegible] castings, [illegible]. The unit [illegible] for the [illegible] from outside. The foundry employs [illegible] contractors [illegible] for running the furnace and pouring the moulds on the shop floor. The monthly production is about [illegible] tons, valued at [illegible] to [illegible] per ton. The factory runs on single shift. The yield of the foundry is reported to be 65 per cent.

[illegible]

[illegible] Corporation, [illegible]

[illegible]

[illegible] Congress.

<u>APPENDIX [illegible]</u>

DESCRIPTION OF MALLEABLE IRON FOUNDRIES VISITED

<u>Metro Malleables Manufacturers Pvt Ltd, Bangalore</u>

This is a fairly modern foundry producing malleable cast iron castings, G.I. pipe fittings, sanitary fittings, oil engine spare parts, railway and electrical fittings of malleable iron, and other job orders. The unit has produced [illegible] kg piece weight castings. The monthly production is about 200 tons, of which 1/3 is malleable. The monthly sales value is Rs.2 lakhs. The factory runs on single-shift basis [illegible]. The yield is about 60 per cent. The unit employs 7 qualified engineers and is imparting training to 3 engineering apprentices.

In the sand conditioning section they have sand mullers, power riddles and aerator. In the moulding section there are four pneumatically-operated jolt-squeeze pin-lift type moulding machines, one turn over type machine, and eight hand-operated moulding machines. For making of cores there is one [illegible] core shooter and one sand [illegible] for oil sand cores. The two 30" dia cupolas give about 2.5 tons of metal per hour. For fettling and cleaning of castings, there are two pedestal grinders, one flexible shaft grinder, two swing grinders and one tumbling barrel. A 3-ton capacity mono-rail is utilised for pouring and carrying the metal. The unit has hydraulic pressure testing equipment for pipes, thermo-couple with pyrometer on the oil-fired annealing furnace. The unit is in a position to produce castings as per ISI standards.

The procurement of raw materials and consumables such as pig iron, hard coke, [illegible], ferro-silicon, ferro-manganese, steel scrap, C.I. scrap, etc. are reported to be the main problems of the unit. The management appears to be enlightened and interested in the modernization programme. They would like to go in for more moulding machines, a chemical and physical testing laboratory and [illegible] of the [illegible] electric melting unit. The management is technically efficient. The investment in machinery and equipment is reported to be within the limit of small scale industry.

/ [illegible].

R.C.G. Malleable Castings, Miraj, Maharashtra

This private limited company manufactures malleable pipe fittings, automobile malleable components, etc. The maximum per piece weight produced is about 10 kg. The unit employs 75 persons on regular basis and produces about 125 tons of castings per month, saleable at the rate of Rs 3,000 per tons (pipe fittings). The factory runs on single shift and the yield is reported to be between 40 to 50 per cent. There are two qualified engineers, one metallurgical and other mechanical, among the staff. The unit reported no marketing problems for their products.

For preparation of sands, there is a sand muller and power sieve. Four hand-operated moulding machines are used for moulding, but cores are made manually. There is a core and mould drawing oven as well. Melting is done in an 18" inside dia hot-blast cupola. The blast is heated to a temperature of about 250 degree centigrade before it is forced through the tuyeres. They have pedestal and hand grinders and two tumblers for fettling of castings. A galvanizing section is attached to the foundry for malleable castings. Most of the testing services are obtained from outside agencies. The castings are made as per customer's specifications. The total investment in machinery and equipment is reported to be Rs 4 lakhs approximately.

The unit has an expansion plan for adding an electric arc furnace of 1.5 tons capacity and go for the manufacture of steel castings. The management appears to be interested to avail of the facilities of the modernization programme of the Government.

J.M.P. Manufacturing Co. Jullunder

This small foundry produces castings of white heart malleable and cast iron. The maximum piece weight is about 60 kg. This is a partnership concern employing 50 persons in the foundry. There are three technically qualified employees among the staff. The yield is reported to be 67 per cent. The average monthly production of malleable castings is about 60 tons and that of cast iron 10 tons. The C.I. castings

/ are sold

are sold at the rate of Rs 1.70 per kg and malleable at Rs 3 per kg. The unit has been exporting castings to Afghanistan, Iran and other African countries. They manufacture spare parts of automobile components for the replacement market.

Sand mullers and power sieve are used for preparation of sands and two BMM moulding machines for moulds. The cores are made manually. There are coal fired drying ovens for drying of moulds and cores. The unit has a 700 kg capacity oil-fired rotary furnace as melting equipment. There are self-made 'wheelabraters' for cleaning of castings, a oil-fired annealing furnace (40 tons batch capacity) and a smaller one (30 tons capacity). The chemical and other testing facilities are availed of from the State Government Quality Marketing Centre. The products conform to ISI specifications. The total investment in machinery and equipment in the foundry is reported to be Rs [illegible].7 lakhs approximately. The unit reports difficulties in obtaining supply of furnace oil and control of sulpher in the metal composition. They have plans to go for an electric furnace.

<u>Salvi Super Structure, Bombay</u>

This is a proprietory concern manufacturing black heart malleable castings and C.I. castings on job order basis. The maximum weight per piece cast so far is 2 tons and the minimum 250 grams. At present, the unit produces 75 tons of C.I. castings per month, saleable at the average rate of Rs 2.25 per kg, and 45 tons of malleable castings saleable at Rs 4.25 per kg. The yield for C.I. castings is reported to be 60 per cent and that for malleable iron castings 50 per cent. The unit employs 150 people on regular roll and engages no contract labour. There are 8 engineers of which 6 are metallurgical engineers. The castings are made against negotiated orders.

There are two sand mullers - one for moulding sand and the other for core sand, seven jolt-squeeze pneumatic moulding machines, one turnover type moulding machine and a small core shooter. Melting is carried out in two oil-fired rotary furnaces of 2½ tons batch capacity

/ melting

melting about 1 ton per hour. Pedestal grinders and flexible shaft grinders are normally used for fettling the castings. For material handling there are two over-head cranes of 5 tons capacity. The unit has a lab equipped with chemical, physical and sand testing equipment. They use optical pyrometer for measuring the temperature of molten cast iron. They have two oil-fired annealing furnaces, one of about 8 tons and the other 5 tons batch capacity. The unit is in a position to manufacture castings as per specifications. The total investment in machinery and equipment is to the tune of Rs 5.8 lakhs.

The management appeared to be technically enlightened. They have an expansion proposal which was discussed at the time of visit and necessary suggestion made. The unit has recently entered into a joint venture with Kenya Government to set up a foundry plant in Nairobi on turn-key basis. Machinery valued at Rs 3 lakhs has already been exported and the plant is expected to go into production shortly.

Sathi Industries, Jullundur

This partnership concern produces industrial chains and malleable castings for their own use. The maximum piece weight has been 5 kg only. The unit employs 35 persons on regular roll, producing about 20 tons of castings per month, saleable at Rs 9,000 per ton. The unit runs on single shift basis and its yield is reported to be 70 per cent. There is no technically qualified person in the management.

No facilities other than manual are available for preparation of sands, moulds and cores. It has an oil-fired rotary furnace of 500 kg batch capacity. For cleaning of castings, grinders are used. There are no testing facilities available in the foundry. The castings are of commercial quality and do not conform to standards. The investment in the machinery and equipment in the foundry is reported to be about Rs 2 lakhs. The unit is interested to go for various types of testing equipment, if funds are made available under the modernization programme of the Government.

APPENDIX VII

DESCRIPTION OF NON-FERROUS FOUNDRIES VISITED

Vulcan Engineering Works, Calcutta

This is a partnership concern producing components and spare parts for electrical and mechanical engineering from gun metal, brass, aluminium and copper, on job order basis. Maximum weight per piece of casting has been 150 kg in aluminium alloys. Production is about 8 tons/month of copper-base alloy castings and the average selling price is about Rs. 20,000 per ton. The unit works on single shift basis. Casting yield is 65 %.

The unit employs 44 persons and has no contract labour. Two mechanical engineers have been engaged in supervising and management level. Sand preparation, moulding and core making are done manually; there is practically no equipment, apart from four pit-type crucible furnaces for melting non-ferrous metals, two pedestal grinders and two power saws. No material handling equipment is being used. As regards testing, the unit has hydraulic pressure testing, other testing facilities being available from outside agencies. Instrumentation is completely absent.

The total investment in machinery and equipment is reported to be Rs. 2 lakhs, of which Rs. 20,000 is in the foundry section. The paucity of working capital is a major problem, together with scarcity of raw materials. The unit finds no dearth of orders and has been able to export non-ferrous castings direct to U.S.A. The management has an open mind towards modernization and expressed a desire of going for an electrical melting furnace, sand preparation equipment and instrumentation. They expressed dissatisfaction over the financial assistance programmes of the nationalised banks.

/ Non-ferrous

Non-ferrous Industries, Calcutta

This proprietory concern produces copper base alloy castings and specializes in the manufacture of impellers, propellers and other complicated non-ferrous castings. The maximum weight per piece is about 200 kg.

The production capacity of the unit is reported to be 6 tons per month but present output is only 4 tons per month. The average selling price is around Rs. 22,000 per ton for gun metal casting and Rs. 25,000 per ton for phosphorus bronze casting. The yield in the foundry is about 60 %. The unit employs 18 regular employees and has no contract labour. A skilled moulder gets Rs. 7.50 per day and a un-skilled labour Rs. 4.00 per day. There is no technically qualified person engaged in the unit, but the proprietor himself has long experience in the field of non-ferrous castings. The unit produces castings on orders only.

The unit has two pit-type crucible furnaces for melting non-ferrous metals. There is no other equipment available. The preparation of sand moulds and cleaning of castings are done manually. However, the unit is preparing cores by CO_2 method. There is no testing equipment whatsoever and instrumentation is absent. At the same time, the unit is capable of producing non-ferrous casting of fair quality, as per specification.

The total investment in machinery and equipment has been reported to be about Rs. 40,000. The procurement of metal is reported to be the main problem of the unit. The management desires to modernize their factory by adding a chemical laboratory for analysis of non-ferrous metals and also hardness and tensile testing machine for physical tests. They intend to develop stainless steel castings in future.

/ Annapurna

Annapurna Cooker Co, Bangalore

This small non-ferrous foundry has modern equipment and enlightened staff in the management. It produces mostly copper base and aluminium base non-ferrous castings of quality. Maximum weight is 150 kg per piece. The capacity is about 2 tons/day, although present production is about half this rate. There are six oil-fired tilting crucible furnaces of 150 kg capacity. Yield is about 50 per cent. The company employs 96 people on regular basis and 20 on contract basis. Two of the partners are qualified engineers and take keen interest in the activities of the company. Almost 90 per cent of the product goes as ancillary supply to large scale units.

The plant has sand mullers and power riddles in the sand preparing section, six hand-made pin-lift type moulding machines, and small core blower for preparation of cores. Most of the cores are by CO_2 process. Both vertical and horizontal type of centrifugal methods are practised for the manufacture of worm wheels, bustings etc. The unit has pedestal grinders, abrasive cutters and bandsaws for fettling and cleaning of castings.

There is a chemical testing laboratory and brinnel hardness facility, and optical and immersion type pyrometers for temperature measurement.

The unit is in a position to manufacture non-ferrous castings to ISI or other specification. The total investment is about Rs. 7.5 lakhs. As an expansion programme, the unit plans to go for jolt-squeeze turn-over type moulding machine, gravity die casting machine, shot blasting equipment, shell moulding machine and core blower.

/ Bangalore

Bangalore Engineering Industries, Bangalore

This unit produces ferrous and non-ferrous castings by shell moulding method. It has an imported shell moulding machine, a core shooter, electric core oven, and a shell fixing divice, all from West Germany. The compressor is of indigenous made. The maximum piece weight has been reported to be 300 kg, the minimum being .025 kg. The unit has a 200 kg skelnar oil fired, rever bratory furnace, in which 6 heats of cast iron are melted per day giving 1.5 tons. Though the capacity of the unit is about 30 tons per month, the present level of production is 20 tons only. Castings have sold at an average rate of Rs. 4.00 per kg. The foundry runs on single shift and employs 10 regular workers besides engineers. The yield is about 70 per cent.

All castings are produced on job order basis. At the moment, they have no testing equipment and most of the inspection is visual. The castings conform to the standards prescribed by the users. They have sand mixer, self fabricated materials handling equipment, and machine shop with lathe, drilling and grinding machines. This is a partnership concern and the investment in machinery and equipment is about Rs. 1.12 lakhs.

The management appear to be enlightened and have an expansion programme for undertaking investment castings and also a plan for an electric induction furnace for steel castings.

Amin Patel & Co. Bombay

This small scale unit is a partnership concern manufacturing sand castings of aluminium and copper base alloys, both heat treatable and non-heat treatable varieties wherever applicable. Maximum piece weight of castings is 30 kg. Though the capacity of the company is about 20 tons/month, at present they produce about 4 tons only, saleable at the rate of Rs. 14/kg average. The yield is reported to be 60 per cent.

/ The

The company employs 35 persons and runs on single shift, including one engineer. They supply against negotiated orders. The quality of castings appear to be good.

While moulds are prepared manually, sands are mixed in a muller and cores made by CO_2 process. The unit has six bait out type oil-fired crucible furnaces of 300 kg, 200 kg, 500 kg and 90 kg capacities. For the purpose of fettling and cleaning, pedestal grinders, hand grinders and band saws are used. Some of the castings are supplied to one of their sister concerns having an end product, and the rest on job order basis. The total investment in equipment is reported to be about Rs. 1 lakh.

Sant Brass Metal Works, Jullunder

This partnership non-ferrous foundry produces castings of brass, gun metal and stainless steel. Their products include pipe fittings, gate valves, and other miscellaneous non-ferrous components against orders. Ten persons are employed in the foundry and 25 tons of castings produced per month, saleable at Rs. 15,000 per ton. The yield is reported to be 70 per cent. There is no technically qualified person among the staff.

No mechanical facilities are available for preparation of moulds, sands and cores. There are six pit-type oil-fired crucible furnaces for No. 40 crucibles. The unit has hydraulic pressure testing facility but no chemical laboratory. The product does not conform to specifications but satisfies commercial needs.

The total investment in machinery and equipment is reported to be about Rs. 1.6 lakhs. The unit has expressed their interest in modernization and would like to go for oil-fired tilting furnaces, moulding machines and for die casting.

/ Super

Super Electrical & Engineering Co, Faridabad

Starting in July 1958, this plant has developed rapidly into an efficient pressure die casting unit with its own design office and tool room. Its turnover in the last year was Rs. 50 lakhs and is planned to double to Rs. 1 crore by 1974.

At present the plant produces a variety of pressure die castings for scooters and automobile components. It proposes to manufacture petrol engines of its own design in future.

The main production facilities operate on 3 shifts. The plant has a force of 140 persons on roll and 60 on contract basis. Total labour cost (including wages and perquisites) is Rs. 150 per month for unskilled workers, rising to Rs. 250/- per month for skilled workers.

The plant's main problems were reported to be:

(i) No import licences for die steels. They had to pay Rs. 25 to Rs. 30 per kg against the controlled price of Rs. 10.

(ii) Uncertainty and fluctuating price for its raw materials - zinc and aluminium alloys.

(iii) Hard competition in selling: Their average selling price was Rs. 13/kg (incl. Rs. 8-9/kg materials cost).

(iv) Exhorbitant prices being now charged for new presses and machine tools by HMT and others.

Mascot Enterprises, Calcutta

This is a partnership concern for the manufacture of pressure die castings of zinc, aluminium and copper based alloys. The unit has three pollock cold chamber vertical pressure die casting machines of 40 and 100 tonnes capacity. The unit has been able to produce castings upto 2.5 kg piece-weight. The capacity is Rs. 1 lakh per month, but the average present production is about 40 per cent of this. The yield comes to about 85 per cent. They have 30 people on regular roll and 20 on contract basis.

/ There

There is no technically qualified person employed except the owner who has good experience in the line. The unit is in a position to produce castings as per ISI standard and has good die making experience. Some trials were made for brass pressure die castings, but there are some porosity defects.

Mysore Auto Service Pvt Ltd, Bangalore

This is a small-scale pressure die casting unit producing zinc alloy die cast components. The unit has three hand-operated hot chamber pressure die casting machines of which two were imported and the third made locally. The maximum weight of casting has been 336 grams, the minimum being 1 gram. At present the factory produces 7 tons of castings per month at sales turnover of Rs. 75,000. They run on 2-shift basis. Yield is reported to be 80 per cent. They employ 38 persons on regular basis and have 5 technical qualified persons on the staff.

The melting pot attached to the hot chamber pressure casting machine is of mechanite metal and gas-fired type. They have a number of hand grinders and tumbling barrels for dressing of castings. All inspection is visual. The main difficulty reported is making of dies and procurement of die steel and zinc alloys. The supply of raw material is quite inadequate and the unit has to make purchases from the open market at the very high prices. The total investment of machinery and equipment reported is Rs. 40,000/-.

National Die Casting Co, Bombay

This partnership manufactures gravity and pressure die cast components mostly out of aluminium-based alloys. The castings include both heat treatable and non-heat treatable varieties. The capacity of the unit is about 15 tons per month. At present, they produce about 7 tons per month valued at Rs. 1 lakh approximately on single shift basis. The yield is reported to be 60 per cent. In the management there is one agricultural engineer and one experienced supervisor. The unit employs

86 people. They supply against negotiated orders and some of the large scale units are obtaining castings from them.

The unit has a 60-ton capacity cold chamber pressure die casting machine imported from Germany. All gravity moulds are made in the factory itself which has a machine shop and tool room. There are nine bail-out type oil-fired furnaces for melting non-ferrous metal. For heat treatment of aluminium alloys, there is a bottom fired cylindrical type furnace, having a temperature range upto 800°C. For fettling of castings, they use double-ended belt grinders, drilling m/cs, and band saws. The unit has a laboratory for chemical analysis, hardness testing machine and air-operated pressure testing equipment of 100 lb/sq in capacity. The products are made in conformity to the specifications desired by the customers. The total investment in equipment was reported to be Rs. 3.5 lakhs approximately, of which for the foundry it was estimated to be Rs. 2.5 lakhs. The management appeared to be enlightened and has felt the need for modernization of their tool room for manufacture of die casting dies by themselves.

Bijaya Metal Works, Kanpur

This is a small aluminium rolling mill, with an utensil manufacturing unit. They produce aluminium sheets and circles from aluminium scrap for the production of utensils by spinning. They also add about 20 per cent virgin metal from HINDALCO into the scrap charge. There are 75 persons employed, mostly working on piece rate. They have sets of cold rolling mills, one oil-fired annealing furnace, oil-fired melting furnace and one pickling tank.

The annual turnover of the unit has been reported to be Rs. 8-10 lakhs. Procurement of virgin aluminium and furnace oil have been the major problem of the unit. The proprietor's son is an engineer.

/ Cintrex

Cintrex Products, Calcutta.

This is a small scale unit producing bushes for jute mills by powder metallurgy process. They procure non-ferrous powder (copper) from Mahindra Sintered Products and Assam Carbon, Gauhati. The unit has one mixer, one hand press and one Sinter electrical furnace. The monthly turnover is about Rs. 30,000. The management appears to be enlightened and the unit has good prospects.

APPENDIX III

DESCRIPTION OF STEEL FOUNDRIES VISITED

Frontier Engineering Corporation, Kanpur

This unit produces steel castings by using the [illegible] process, with oil-fired equipment. The proprietor is a qualified engineer. They take about 6 heats daily of 150 kg per heat. They mostly produce rim plates for [illegible] trucks which are supplied to [illegible] workshops as replacements. The rejections have been reported to be 7 to [illegible] per cent.

A 15 kg rim plate [illegible] is sold at the rate of Rs. 7 per kg. The monthly production of the unit is about [illegible] tonnes. The management appeared to be [illegible] of the [illegible] programmes of the Government.

Kanpur Steel & Ferro Alloys Pvt Ltd, Kanpur

This private limited company produces castings of various types on a small scale basis. They have a 1/2 ton induction furnace [illegible] on load cycle which [illegible]. They take [illegible] heats per shift. Re-lining of the induction furnace is done after about 120 heats. They are producing [illegible] nickel chrome steel.

The unit has also a 1 ton capacity induction arc furnace which is yet to be put into commission. They [illegible] of steel ingots, sold at the rate of Rs. [illegible]/kg. The [illegible] lasts about 350 [illegible]. The unit has experienced technical personnel.

Precision [illegible] Castings Pvt Ltd, Lucknow

This unit has been set up by an enthusiastic technically qualified technocrat. It produces about [illegible] tonnes/year of stainless and alloy steel castings for pumps and valves. The largest piece produced is 100 kg. The unit was started in the year 196[illegible].

/ They

They have a Plasma arc melting Furnace supplied by Union Carbide. This is of 15 kg capacity. There is also an indirect arc furnace of 50 [illegible] capacity fabricated locally. The factory employs 47 persons. They have no marketing problem as they are the only unit manufacturing stainless steel castings in the area. The present [illegible] is [illegible] 1 [illegible] Rs. 40-50/kg. They have adopted shell moulding method and investment casting (lost wax) is under trial. They have a sand muller for the preparation of [illegible] sand.

This is a unique unit of its type in the small scale sector, producing high quality [illegible] comparable to [illegible] manufacturers.

[illegible] Chakraborty [illegible], Calcutta

This factory with one half-ton induction furnace produces alloy steel castings and special alloy iron castings. The installed capacity is about [illegible] tons/month, whereas the present production is at the level of about [illegible] due to power shortage and other problems. Average sales price is from [illegible] per kg. The factory works in three shifts, [illegible] per shift. [illegible] per cent. There are [illegible] workers of which [illegible] are [illegible]. This is a private limited company being managed by experienced technical persons. [illegible] of the factory are supplied to [illegible], [illegible] D.G.S.&D. and [illegible] are exported.

In the sand preparation department, there [illegible]. [illegible] In addition to the induction furnace, there is [illegible] capacity [illegible] for production of special iron castings [illegible]. The fettling section has [illegible] cutter and [illegible]. There is also [illegible] fired [illegible] furnace.

The unit has a [illegible] testing laboratory. [illegible] the unit, they [illegible] for other physical testing. The unit is capable of producing castings [illegible] specification.

The total

The total investment in machinery and equipment is about Rs. 4 lakhs. The special problems were reported to be electric power, procurement of raw materials, lining material for the furnace. The unit plans to go for spectrography and metallography equipment, for which NSIC have already been approached. The plant has an expansion programme for setting up a small unit for the manufacture of centrifugal castings of stainless steel pipe (under a new name). The management is conscious of the need for modernization.

Sarvodaya Foundry & Engineers, Bombay

This is a proprietory concern for production of steel and cast iron castings of 50 kg maximum weight per piece. The production at present is about 12 tons per month of cast iron and 800 kg per month of steel castings. The CI castings are saleable at Rs 1.75 to Rs 2.00 per kg, and steel castings at Rs 10 per kg. The unit runs on single shift and supplies castings against negotiated orders. The company employs 15 persons on regular roll. The yield of the foundry is reported to be 60 per cent. Besides the proprietor who is experienced in the line of manufacture, there is no technically qualified person.

A sand muller is used but no equipment for machine moulding. Cores are made by CO_2 process. The unit has one indirect arc steel melting furnace with a 50 kVA transformer. There is also one Skelner furnace of 100 kg batch capacity. The fettling of castings is done by pedestal grinder, flexible shaft grinder, and manually. There is no testing facility available. The total investment in machinery and equipment is reported to be Rs 1.25 lakhs approx. The management appears to have little interest in improving facilities or raising quality.

/ Tembe

Tembe Industries, Kolhapur, Maharashtra

This is a steel foundry set-up by an experienced engineer who was working in TISCO. They produce both plain carbon and alloy steel castings. The maximum piece weight is reported to be about 150 to 200 kg. The unit employs 150 persons and produces about 25 to 30 tons of castings per month, saleable at the rate of Rs 6 to 7 per kg. The factory runs on three shifts and the yield is reported to be 40 per cent. There are two graduate engineers on the technical staff. There are five diploma holders undergoing training in the factory. The castings are produced on job orders. There appears to be good demand for their castings.

There is sand muller for preparation of sands, moulding machines and shell-moulding equipment for moulds. The melting unit is an electric resistance type melting furnace of 750 kg capacity. Swing frame and pedestal type grinders, pneumatic chippers are used for dressing and fettling of castings. There is chemical as well as physical testing laboratory for quality checks. There is also an oil-fired annelling furnace. The castings are as per ISI and commercial standards.

The total investment in machinery and equipment is reported to be about Rs 8 lakhs. The supply of raw material and power are reported to be the main problems of the unit. The unit appears to be competent to produce steel castings and is also attempting to manufacture electric arc furnaces on firm orders.

APPENDIX IX

INVESTMENT, MANPOWER & PRODUCTION
COSTS AT SMALL STEEL FOUNDRY
(capacity: 540 tons good castings/year)

A. CAPITAL COST ESTIMATE

Equipment	Rs
One 1-ton arc furnace, electricals, slag pot and misc. tools, refractories	5,10,000
5-ton E.O.T. Crane pendant push button	1,00,000
Ladles, ladle pre-heaters, weighing M/c.	35,700
Moulding shop	65,000
Core shop	48,000
Fettling shop	67,000
Chemical lab. & sand lab.	21,000
Electrical power equipment	90,000
Utilities, including water, compressed air & fuel oil	90,000
Maintenance & repair shop	10,000
Equipment cost:	10,36,700
Building 540 @ Rs 300 per sq m	1,71,000
Equipment erection	1,50,000
Engineering and contingencies	1,00,000
Total plant cost:	14,57,700

(say Rs 15 lakhs)

/ B.

B. MANPOWER ESTIMATE

	Number		Rs/month
Administrative			
Works manager	1		1,500
Accountant	1		500
Clerks	4		1,600
Peon	2		300
Total:	8		3,900
Production			
Steel melt shop			
Melters	4		2,000
Helpers to melters	6		1,200
Scrap preparation & charging	9		1,800
Pouring	6		1,800
Crane driver	4		1,000
Mason	2		500
Chemist	2		700
Total:	33		10,950
		Say	11,000
Moulding shop			
Sand preparation	2		600
Moulders	4		1,200
Core makers	4		1,200
Helpers	4		800
	14		3,800
Fettling shop			
Shot blast M/c	4		1,200
Swing frame grinder	4		1,200
Furnace operator	3		900
Helpers	3		600
Inspectors	2		800
Total:	16		4,700
Maintenance	6		1,400
Total:	67		24,800

/ C.

C. PRODUCTION COST ESTIMATE

(1) Cost of production of liquid steel: (1,200 tons of liquid steel/year)

	Cost per ton material Rs	Consumption per year ton	Cost per year Rs	Cost per ton Rs
Material cost				
Steel scrap	500	1,320	6,60,000	550
Ferro-manganese	1,300	15	19,500	16
Ferro-silicon	2,700	15	40,500	34
Aluminium	7,000	3	21,000	18
Lime	100	60	6,000	5
Fluorspar	2,000	6	12,000	10
Pit Coke	400	4	1,600	1
Total:				634
Cost above materials				
Electric power	13 p per kWh	8,40,000	1,09,200	91
Electrodes	Rs 8 per kg	8	64,000	53
Fuel oil			5,000	4
Refractories			80,000	66
Labour & supervision			1,55,400	130
Maintenance			5,000	4
Cost above materials:				348
Production cost of liquid steel:				982

(2) Cost of production of rough castings: (600 tons of castings/year)

	Cost per ton material Rs	Consumption per year ton	Cost per year Rs	Cost per ton Rs
Material cost				
Liquid steel	982	1,200	11,78,400	1,964
Sand	50	1,200	60,000	100
Clay	170	60	10,200	17
Linseed oil	5,200	15	78,000	130
Additives	2,500	6	15,000	25
Total:				2,236
Less credit for 1 ton of scrap @ Rs 500/ton				500
Net materials cost:				1,736
Cost above materials				
Electric power		1,00,000	13,000	22
Labour & supervision			66,000	110
Moulding boxes			20,000	33
Maintenance			2,000	3
Production cost of rough castings:				1,904

/ (3)

(3) <u>Cost of production of finished castings</u> (540 tons of good castings/year)

	Cost per ton material Rs	Consumption per year ton	Cost per year Rs	Cost per ton Rs
Material cost				
Castings	1,904	600	11,42,000	2,120
Less credit for 100 kg scrap at Rs 500 per ton				50
Net materials cost:				2,070
Cost above materials				
Electric power		1,50,000	19,500	36
Labour and supervision			76,400	142
Fuel oil			10,000	19
Oxygen/Acetelene			6,000	11
Consumables like grinding wheels, electrodes			6,000	11
Repair & maintenance			2,000	4
General plant expenses			15,000	28
Cost above materials:				251
Production cost of finished castings:				2,321

(4) <u>Fixed charges</u>

Depreciation on plant & equipment	72,600	134
Interest on capital investment @ 9 %	1,31,200	243
Interest on working capital of Rs 4,00,000 @ 10 %	40,000	74
Total fixed charges:		451
Total cost of finished castings:		2,772

APPENDIX X

DESCRIPTION OF REROLLING MILLS VISITED

Singh Plate Mills, Kanpur

This is a partnership concern. The managing partner, Sri Kripal Singh, is the President of Foundries & Engineering Works Association, Kanpur. His father, Sardar Inder Singh of Singh Engineering Works, is a pioneer in the rolling mill industry.

This unit comes under the category of billet re-rollers and is a member of S.R.M.A. Last month's production was 200 tons on single shift - size 10-12 mm, flats and other sections. Raw material to the extent of 27 % capacity is made available. Billets from Bhilai, Tata or Indian Iron cost Rs 1,069 per ton. Selling price is Rs 1,402 per ton for 12 mm rounds in standard lengths.

The plant has a pusher-type coal-fired furnace and a 5-stand 10" mill with 350 hp motor.

Gupta Steel Industries, Kanpur

This small scale re-rolling mill has 8" roll 3 high 4 stand mill. The mill runs about 10-12 hours/day to produce about 8 tons of rods from scrap, that is about 200 tons/month. It has a reduction gear and is driven by 200 hp electric motor. It employs 40 people. The split type gun metal bearings requires to be while metal lined very frequently. They have two coal-fired (batch type) heating furnaces.

Katia Steel Rolling Mill, Calcutta

This unit has two steel rolling mills - one with six 8" stands (500 tons/month capacity) and the other five 6" stands (150 tons/month). It rolls about 50 per cent of billet and 50 per cent scrap. Presently their monthly production is about 500 tons, sales prices being Rs 1,800 per ton. They run on single shift. The speciality of this unit is

/ that

that they export about 300 tons/month of tension bars, gate rounds and drop rods to USA and all these are galvanised in their own factory.

The yield (from starting material to finished rolled steel) is about 90 per cent with billets and 80 per cent with scrap. The unit employs 75 persons and has an experienced foreman in their mill.

The unit has pusher-type oil-furnace for heating of billets and scrap. The bearings used are split-type, while metal. They use high carbon rolls, alloy steel rolls and chilled rolls procured from local market. Galvanising is done by hot-dip method in three pots installed for this purpose. They do not have any testing facility, but inspection is done by the inspection authorities. No temperature control equipment was found.

The investment in machinery and equipment was reported to be Rs 6·8 lakhs. Their main difficulties were reported to be supply of power, billet, and furnace oil. They have a desire to go for looping system of work in the re-rolling mill and also a billet shear.

<u>"We Are Four", Calcutta</u>

This was the first plant under Government's scheme for entrepreneur . It was started by four young men and has been an outstanding success. The unit produces hoops and strips, as per ISI and other specification, in widths of 3/8", 1/2", 5/8", 3/4", 1", 1 1/4" and gauges 28, 26, 26, 26, 18, 18 respectively. The unit has a capacity to produce 40 tons per month and is at present producing 30 tons. The average selling price is about Rs 2,700 per ton.

There are 23 persons on regular roll of the company and they have no contract labour. The management is enlightened and capable of producing hoop iron and bailing hoop to any specification required by the customers. One of the partners is a diploma holder in mechanical engineer and the firm has itself fabricated its rolling and sliting mill. There is no dearth of orders for the products produced by them.

/ The unit

The unit has the following production equipment:

One 8" cold rolling mill (2-high) with 25 hp motor

One 10" cold rolling mill (2-high) with 25 hp motor

Two coilers driven by 7.5 hp motor, one for the rolling mill and another for sliting machine

One gang sliting machine driven by 10 hp motor, suitable for 10 gauge to 30 gauge

Pickling and blueing equipment

For maintenance workshop:

One 8" lathe

One 24" stroke shaping machine

One 10" capacity power hacksaw

One grinder wheel size 8"

One 1¼ piller type drilling machine

The unit has no annealing furnace and no facility for testing.

The total investment in machinery and equipment has been reported to be Rs 1.15 lakhs. The main difficulties of the unit have been in the procurement of raw material from Durgapur Skelp Mill and proper bearings from S.K.F.

Aggrawal Brothers Steel Rolling Mill, Bangalore

This small scale re-rolling mill manufactures M.S. rounds, squares and flats from scrap. It has a 8" 3-high 5-stand re-rolling mill driven by V-belt from a 150 hp electric motor. It has a 250 kVA L.T. transformer. The finishing rolls RMP is about 270. The heating furnace is of 18' x 6' x 2½' size oil fired. They have two shearing machines to cut upto ½" thick plate.

Though the mill has a monthly capacity of 300 tons, it is at present producing about 250 tons per month. The selling price is about Rs 1,700 to 1,800 per ton for the standard length. The factory runs on single shifts of 10 hours. The company employs 43 persons on regular roll and 11 contract labour. At the management level there is no technical qualified staff. The investment in machinery and equipment

/ is

is reported to be about Rs 2.5 lakhs.

At present, the unit is receiving about [illegible]3 tons of material per quarter from the Directorate of Industries allocation. Non-availability of raw material such as billets and re-rollable scrap have been the main problems of the unit. The unit would like to go for a 20-ton capacity pusher type furnace, 9" finishing stand and increase the present horse power of the rolling mill from 150 to 300 hp.

The Bangalore Rolling Mill Pvt Ltd, Bangalore

This steel re-rolling mill produces 10 mm to 15 mm M.S. rounds and 5 mm to 16 mm flats. They have an oil-fired pusher-type heating furnace of 5 tons per hour capacity. They have a 10" 5-stand re-rolling mill, powered with a 550 hp electric motor, and two shearing machines. They only roll from billets and sell through Government control.

The capacity of the mill is reported to be about [illegible]5 tons/day of 10 hours. At present they are producing about 1[illegible] tons daily. Investment on machinery and equipment is reported to be about 7,[illegible].

The Bharat Steel Re-rolling Mills, Bangalore

This is a good mill with investment of about Rs [illegible],00,[illegible] in machinery and equipment. They manufacture M.S. rounds from 10 to 32 mm, flats 25 to 75 mm wide, and angles up to 50 x 50 x 6 mm. The installed capacity is about 875 metric tons per month, but at present the unit is producing about 300 metric tons on average. The monthly sales come to about Rs 5,70,000. The unit rolls both from billets and re-rollable scrap. They run on single shift of 10 hours per day.

There are 63 persons on regular roll and 6 contract labour. There is no technically qualified person employed. The unit sells its product to the Government as well as the local market. They have 10" 6-stand re-rolling mill of Japanese type, powered with 500 hp electric motor. There is a pusher type and a batch type re-heating furnaces. The finished products are tested at G.M.T.I. They have gas-cutting equipment, arc welding transformer, pillar drilling machine, bending machine, shaping machine, 12" centre lathe, Bhadravati lathe, Shimoga No. 2 lathe, hacksaw cutting machine, etc.

/ The

The plant has [illegible] rolling [illegible] repairs. [illegible] production appears to be [illegible]. [illegible] special problems, the [illegible] mentioned procurement of raw material, furnace oil and [illegible]. At present production is interrupted by frequent [illegible] cuts which amount to about [illegible]. [illegible] roughing mill of 16" and [illegible] offered by Hindustan Steel.

Krishna Steel Industries, [illegible]

This is a scrap re-rolling mill [illegible] from re-rollable scrap. [illegible] 100 to 150 tons of rounds, [illegible] Rs 1,[illegible] per ton. [illegible] purchased scrap [illegible] Rs 1,1[illegible] per ton. [illegible] and is run by an experienced [illegible] man from [illegible]. [illegible] commercial quality rounds and [illegible] difficulties [illegible] products. The total investment [illegible] lakhs.

The heating furnace is [illegible] oil-fired, [illegible] x [illegible]', [illegible] capacity. The rolling mill is [illegible] motor through a V-belt drive. [illegible] carbon steel rollers of [illegible]. [illegible] testing facilities [illegible] available [illegible] unit, [illegible] from outside. [illegible] difficulty [illegible] re-rollable scrap and furnace oil.

[illegible] Steel Rolling Mills, [illegible]

This scrap re-rolling mill produces [illegible], flats, [illegible] and strips on single shift basis from re-rollable steel scrap. This is a partnership concern producing about [illegible] tons of [illegible] per month, saleable at Rs 1,750/ton. They reported to have an installed capacity of 300 tons p.m. on single shift basis though they are producing only [illegible] tons because of the shortage of raw material. [illegible]

/ [illegible]

[illegible]

[illegible] equipment [illegible] [illegible] of the difficulties [illegible]

[illegible]

[illegible]

[illegible]

[illegible] Industries, [illegible]

[illegible] shift basis. [illegible] contract. [illegible] manufacture [illegible] investment [illegible] equipment [illegible] lakhs approximately.

[illegible]

[illegible] (Rolling Mills) [illegible]

[illegible]

[illegible]

PART [illegible]

[illegible]

Mill Bearing

[illegible]

APPENDIX XII

INVESTMENT, MANPOWER, PRODUCTION COSTS AND PROFITABILITY AT MODERNIZED SCRAP REROLLING MILL
(Capacity: 400 tons/month of 3/8" rounds)

A. CAPITAL COST

	Rs
Original investment in 10" mill	250,000
Additional investment in improving bearing, adding scrap and billet shears, repeaters, re-heating furnace, cooling bed, etc.	450,000
Total investment:	700,000

B. LABOUR FORCE

	No. on roll	Monthly cost Rs
Administrative		
Manager	1	1,500
Accountant	1	800
Clerks/Stenographer	2	500
Peons/Watchmen	4	800
Production		
Foreman	1	1,000
Furnacemen	5	1,000
Mill operators	20	5,000
Helpers	10	1,500
Inspector	1	300
Maintenance		
Fitters	2	800
Electricians	2	800
Roll shop machinists	3	1,200
Total:	52	14,300
Add 20 % for PF etc.		2,860
Labour cost:		17,160
Contractor's labour (for preparing scrap etc.)	10	2,000
Total labour cost:		19,160
	(say	20,000)

/ C.

C. PRODUCTION COST

	Cost per ton material Rs	Consumption per month tons	Cost per month Rs	Cost per ton product Rs
Materials				
Re-rollable scrap	1,100	500	5,50,000	1,375.00
Less Credit for scrap	500	75	(-37,500)	(-93.75)
Net scrap materials cost:			5,12,500	1,281.25
Cost above materials				
Labour			20,000	50.00
Fuel oil, per litre	0.26	36,000	9,350	23.38
Power and water			6,000	15.00
Rolls, lubricants etc.			10,000	25.00
General plant overheads			6,400	16.00
Cost above materials:			5,64,250	129.38
Works cost:				1,410.63
Fixed charges				
Depreciation on plant & equipment @ 7 %			4,083	10.21
Interest on capital investment @ 9 %			5,250	13.13
Interest on Working Capital @ 10 % on Rs 17,00,000			14,165	35.25
			5,87,748	1,469.22

D. PROFITABILITY

Sales receipt on 400 tons @ Rs 1,800 per ton	7,20,000	1,800.00
Pre-tax profit	Rs 1,32,312	Rs 330.78
Annual pre-tax profit	Rs 15,87,744	
Profit: Sales	18.4 %	
Profit: Fixed capital	226.0 %	
Profit: Total capital employed	66.0 %	

APPENDIX XIII

SUGGESTED FOUNDRY TRAINING COURSES

Outline of subjects

Subject	No. of lectures
Foundry industry in India	1
Raw materials selection in ferrous & non-ferrous foundries	3
Melting processes	2
Cupola design	2
Cupola operating practice	2
Cast iron structure	1
Non-ferrous melting practice	3
Moulding materials	2
Moulding methods	2
Box vs Floor moulding	1
Foundry equipment	2
Foundry layout	2
Solidification principles	2
Gating, runnering & risering	3
Foundry maintenance	2
Pattern making	1
Quality control & inspection	3
Casting defects analysis	3
Work study in foundries	3
Production of malleable iron	2
Pressure & gravity die casting	2
Computation of cost factors	2
Marketing of castings	4
Role of supervisors	4
Incentive plans	2
Production planning & control	2
Environmental factors	2
Total	60

(about 3 months course)

APPENDIX XIV

PROPOSED MODERNISATION PROGRAMME
(as presently envisaged by SSIDO)

AN INTEGRATED APPROACH:

Tackling and solving individual modernisation aspects will not yield optimum results due to the presence of imbalance in the production set up. To give quick and optimum result, a time bound package programme has been planned. By this programme, all the inputs necessary for modernisation will be delivered to the small units within predetermined time limits. The whole programme involves an integrated approach.

PACKAGE ASSISTANCE:

1. **Supply of Raw Materials:**

For the optimum utilisation of the machine capacity of the selected industries which may be taken up for modernisation programme, it is necessary to arrange for the requirements of raw material on priority basis and the appropriate raw materials should be supplied on the basis of full requirements for two shifts. The centre and states should treat cases of modernising units on priority basis.

The nationalised banks may advance funds to modernising small scale units for the purchase of raw materials on priority basis and the formalities involved for the grant of advance should be reduced to a minimum.

The capacity of the small scale industries should be certified by DC(SSI) and this should be fully met. Industries selected for modernisation not covered under priority industries should be treated at par with priority industries. The requirements of steel for modernising small scale industries as certified by DC(SSI) should be supplied to them on priority basis. Raw material banks should ensure promptness in supplies of raw materials.

/2. Supply

2. Supply of Machinery & Equipment:

It is proposed to supply to small scale modernising units machinery and testing equipment of both imported and indigenous origin on a long term basis (10 years for imported and 7 years for indigenous machines) at a concessional rate of interest through hire purchase scheme of NSIC or by nationalised commercial banks. Necessary foreign exchange must be allocated to nationalised commercial banks for the purpose of importing machines.

3. Credit Facility:

The biggest implication of modernisation programme will be the additional requirement of finance to small scale units. The modernising units would require funds for the purchase of raw materials, machinery, testing equipment and for implementation of the modernisation programme. Nationalised Banks, State Financial Corporation and other financial institutions should provide credit facilities on easy terms on subsidised rate of interest and should simplify procedures to enable small units to effectively avail of their credit facility. The difference between the normal rate of interest and the concessional rate should be borne by the Government of India.

4. Financial Incentives:

(a) Special Modernisation Reserve Fund:

The same set of industries will not be taken up under the modernisation programme by the Government after five years. The Government would, therefore, like to enjoin upon the industries covered under the programme of modernisation to lay aside, out of their earnings every year, an amount equivalent to at least 10% of the value of the machines taken for modernisation for the purpose of "modernisation Reserve Fund" and this should be tax free. This is to ensure that the process of modernisation is carried on a perennial basis. This issue is under the consideration of the Government for finalisation.

(b) Development Rebate:

Ministry of Finance has decided to discontinue the provisions of the development rebate to the industrial sector from 1st June, 1974. The Government

/has under

has under the consideration, the provisions of similar nature as the development rebate, for the benefit of the modernising small scale industries.

(c) Depreciation Fund:

It has been given to understand that a new depreciation schedule for the machinery equipment etc. has been introduced by the Ministry of Finance, on the basis of different categories of the plant and machinery and the depreciation rates vary from 5% to 100% as the case may be. The Government has been approached emphasising that the case of accelerated depreciation to the S.S.I.'s is justified especially when the preventive maintenance is non-existent in the small scale sector. Small scale sector especially for modernisation should be allowed 15% to 25% extra benefits of the depreciation over and above the new schedule of depreciation allowances.

5. Techno Managerial Assistance:

Assistance in the following fields will be provided by experts from abroad, Public Sector Organisation, Industry, DCSSI' etc.

1. Product Design/Modification (including Package design wherever necessary).
2. Low cost production Technology.
3. Inspection and Testing.
4. Jigs, fixtures and Gauges.
5. Forging, Press Tool, Die Casting, Plastic, Extrusion and other Dies.
6. Factory Design, Lay-out, Machinery erection and preventive maintenance.
7. Financial Management (with special reference to Book-keeping, cost accounting and budgetary control).
8. Marketing Management (with special reference to sales including exports).
9. Personnel Management (with special reference to Labour Management).

/10. Inventry

10. Inventory Control.

11. Production, Planning and control.

12. Waste reduction, Cost reduction, Work study, etc.

13. Foundry, Metallurgy and Heat Treatment.

14. Metal Finishing.

15. Electrical Products - Design, Manufacture, Inspection & testing. (with special reference to Domestic Electric appliances)

16. Cutting Tool etc.

6. **Training and Visits:**

a) During the modernisation process if it is found that training is necessary for personnel at any level of a modernising unit, viz. Workers, Supervisors, Managers, etc., the same will be imparted with the help of training facilities available in various organisations in the country including S.S.I.D.O.

b) If at any time it is felt that one or more industrialists, where units are under modernisation programme, require/s first hand information about foreign products, their technology and method of working necessary arrangements will be made by the Government for their visits abroad.

7. **Visits of Foreign Experts:**

Efforts will be made to arrange for visits of foreign experts through UNIDO and other Aid giving organisations, so that modernising small units get the benefit of their expert advice. Particularly in some of the fields of specialisation, if know-how, is not available in India, the experts visit to these units needing such know-how will be arranged.

MODUS OPERANDI:

The following steps will be followed in conducting the Modernisation Programme:

/1. Selection

1. Selection of Members of Study Group:

This will not be applicable in the case of first group of industries already selected. This will be done for the selection of second and further groups of industries for modernisation. The study group will comprise of members from Small Scale Industry Associations, Small Industries, State Directorate, SSIDO, etc.

2. Guidelines to Study Group by Modernisation Cell of DCSSIDO:

Study Group will be intimated about the criteria for selection of Industries and the details of information it has to collect in respect of the selected industries.

3. Selection of Industry and Submission of Report by Study Group.

4. Issue of Government Notification in Respect of Industries Selected for Modernisation.

5. On intimation from Modernisation cell of DCSSIDO concerned State Director advertise inviting Volunteering Units to send their unit's names for registration for modernisation purposes. On receipt of this, pass on the same to DC SIO.

6. Representatives from SISI, Central Modernisation Cell, State Modernisation Cell, SISI, Select Suitable Units.

7. Central Cell Selects First Batch of Units for Registration

8. Central Cell Registers Such Units for Taking Up Modernisation Work in Respect of These Units.

9. Central Cell Selects Inplant Study Team and Gives the Guidelines:

For the first group of five industries, eight areas of Industry concentrations have been identified and eight inplant study teams will be selected to work in these eight places. The teams will be comprised of experts from Public/Private Sector Autonomous Bodies, SSIDO, etc. depending upon the require-

/ment. All

ment. All the eight teams put together are expected to complete inplant study in about 300 units in year. Every year three new Industries covering 300 units will be added. Units accepted for modernisation will be covered under the assistance programme for five years. The Government may enact legislation so that after five years of modernisation, the units will on their own continue modernisation programme by setting apart Modernisation Reserve Fund which will be tax free.

10. Inplant study is conducted and report submitted.

11. Central Cell sends the report to concerned SISI's for implementation giving guidelines and target dates for completion of the work.

12. Techno Managerial Assistance is provided by the implementation Team comprised of additional staff of SISI, a percentage of existing staff of SISI and some auxillary staff of SISI.

13. Central Cell arranges for foreign experts visits to modernising units as and when found necessary.

14. State and Central Cells take expedetious action for processing cases pertaining to Raw Materials, Equipment, Foreign Country Visit, etc. in respect of modernising units.

15. Central Cell coordinates with all the other agencies connected with Modernisation Programme for purpose of speedily implementing the same as per the schedule.

ORGANISATION/STAFF CREATED/TOBE CREATED FOR ORGANISING THE MODERNISATION PROGRAMME:

1. Central Government Organisation:

a) A modernisation Cell in the DC office at Delhi has been created. This cell will initiate, organise and coordinate all activities connected with the Modernisation Programme. This cell, if circumstances demand, may expand to cope up with the load of work. This Cell will also organise Seminars, main-

/tain list of

tain list of names of experts, publish Modernisation Bulletin (quarterly) and do publicity through AIR programmes/talks on modernisation. It will import large number of small samples from different countries for import substitution by modernising units.

b) Eight Implementation Teams each consisting of eight officers may be formed. Out of these eight officers in each team, six may be against fresh posts created and two earmarked from the existing staff of SISI for modernisation purpose. Workshop Drawing Office, Library and common facilities of SISI also may be provided on priority basis for modernisation purposes.

2. State Government Organisation:

a) A modernisation cell at State level has to be created for implementing the programme.

b) The Cell will give wide publicity to the programme within the State.

c) The Cell will initiate the units for modernisation to be selected by a Special Committee to be finally selected for registration by DCSSI in order to facilitate the coordination of the programme on all India basis.

d) It will process cases pertaining to raw materials, equipment, finance, etc. expeditiously.

e) The State will provide land on priority basis for expansion purposes.

f) The State will provide quality marketing facility to modernising units if required.

g) The State will provide testing, common and development centre facility to modernising units if required.

h) State will give preferential treatment to modernising units and will spell out its special assistance and incentives to such units.

i) State will effectively coordinate and pool the services of various organisations within the State for the benefit of modernising Small Scale Units.

/3.

8. <u>Small Industries Modernisation Centre:</u>

At the end of every year of modernisation, three new industries have to be selected and every year Inplant Study has to be conducted in 300 units. This means at the end of five years, there will be 15 industries covering 1500 units to be looked after. These units will be only a small fraction of the total number of them to be modernised. Undertaking modernisation work in respect of all such units will be, too huge and unwieldy to be managed by inplant and implementation teams as given above. This work can be streamlined and kept well under control if the same can be entrusted to an independent organisation working under Ministry of Industrial Development. In that case, the work of modernisation will be done by Central Cell, State Cell and the independent Organisation named as "Small Industries Modernisation Centre".

In addition to conducting inplant studies and effecting implementation, this Centre will also conduct training, Collect collate & disseminate information pertaining to modernisation to product design, develope low cost technology, conduct research on economic aspects, develope prototypes, publish journals, give sufficient publicity to the programme, etc.

The Centre will have a sample Room which will import latest models of machines and equipment for import substitution by the modernising small units.

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