The foregoing national organization for the advancement of foundry technology and management can be expected to bear fruit in further development of this industry in Thailand.

c) Malaysia

In 1976, Malaysia produced 30,000 tons/year of castings, from foundries numbering roughly 150, according to figures published by the Federal Industrial Development Agency.

Industrial estates have been created in various parts of the country, to promote spread of industry in outgoing regions. The establishment of modern foundries is being actively pursued by firms of foreign affiliation. These foundries produce 100 - 150 tons/month, and those equipped with high-performance centrifugal casting 300 - 350 tons/month. Many of them are also equipped with low-frequency induction furnace for melting. Other foundries, however, are generally of more modest size, with a work force of 30 or 40, and producing far less than 150 tons/month. Melting is by small cupola, and molding by hand.

The production figures published in 1981 (likely for 1980) were 86,000 tons/year, indicating a rate of development to rank with Thailand.

Table 3.4-16 Malaysian Casting Production and Foundries

	1976	1980	
Produciton (tons/year)	30,000		86,000
Number of foundries	150	Iron	205
		Steel	6
		Nonferrous	12

The branches of industry served by the foundries were those related to manufacture of equipment for tin mining/refining, palm oil processing, and other machinery; manhole covers were also manufactured.

The Malaysian Industrial Technology Center (MITEC) is playing a guiding role in the dissemination and enhancement of foundry techniques and skills.

Another notable characteristic of the Malaysian foundry industry is its effective dispersion in the regional industrial estates. Apart from the urbanized areas in Selangore around Kuala Lumpur and in Penang/Butterworth, a prominent number of foundries have been established in the Ipoh State in the north.

d) Singapore

Singapore manufactured 25,000 tons/year of foundry products in 1976. According to the journal "Modern Casting", the figure for 1978 was 40,000 tons/year, of which 21,000 tons/year of iron, 2,800 tons/year of steel, 8,000 tons/year of copper alloy, and 6,000 tons/year of aluminum alloy castings. The Japanese journal "SOGO IMONO" (All Castings) of August 1980 cites for 1979, 33,100 tons/year produced, of which 24,000 tons/year of iron, 6,000 tons/year of steel, and 3,100 tons/year of other castings, together with work force figures of 1,073 engaged in iron, 344 in steel, 120 in nonferrous, 200 in die casting and 40 in precision casting.

The figures reported in 1981 (likely for 1980) were 30,000 tons/year, from 42 foundries producing iron, 7 foundries for steel, 15 foundries for nonferrous, 7 foundries for die casting, and 2 foundries for precision castings.

Table 3.4-18 Singaporean Casting Production and Foundries

	1976	1979	1980	
Production (tons/year)	25,000	33,100	30,000	
Number of foundries			Iron	42
			Steel	7
			Nonferrous	15
			Die cast	7
			Precision	2

Foundries in Singapore distinctly separate into those of foreign and domestic affiliation, the former mostly located in the Jurong District, and well equipped with modern facilities, in contrast to domestic foundries, scattered within the city, of small scale and modestly equipped. The products also serve different categories of market: The foreign foundries produce iron and steel castings for industries manufacturing household electric appliances, marine machinery, machine tools, industrial machinery, oil refinery, and mining equipment; the domestic foundries cater for local small industries, as well as produce manhole covers, piping and other simple iron castings.

e) Hong Kong

In 1978 Hong Kong produced 20,000 to 30,000 tons/year of castings in 270 very small foundries employing around 4,500 workers in all. The products served branches of industry associated with mechanical equipment, public works, building construction, shipbuilding and shiprepair, as well as toy makers and locksmiths, while die-cast precision products were supplied to the optical instrument manufacturers.

The Hong Kong Productivity Center reported in July 1978 that most Hong Kong foundries operated with cupola - in large part of 1 - 2 t/h capacity - which numbered in all 136. Other melting equipment included 4 low-frequency induction, 1 arc, and 3 rotary furnaces, while 144 crucible furnaces equipped the nonferrous foundries.

Die casting is active: There are almost 200 die-casting machines operating in Hong Kong, though mostly with machines of clamping force below 140t. For hand molding, most foundries use green sand. Molding with CO_2 and with self-hardening sand has been introduced in some of the advanced foundries.

In 1980, aggregate production amounted to 51,000 tons/year. Statistics for 1978 count 134 foundries mainly operating in ferrous, 101 similarly in nonferrous, and 35 in die casting.

Hong Kong foundries are mostly located in the Kowloon Peninsula, and close to the Chinese border. Statistics on foundries classified by size are available for 1978, which is reproduced in Table 3.4-19.

Table 3.4-19 Hong Kong Foundry Statistics for 1978

PRODUCTS / WORK FORCE	FERROUS	NONFERROUS	DIE CASTING	TOTAL
1 - 9	94	85	11	190
10 - 19	26	7	5	38
20 - 49	11	9	10	30
50 - 99	3	-	3	6
100 - 199	-	-	4	4
200 - 499	-	-	2	2
Total	134	101	35	270
Aggregate work force	Approx. 4,500			
Aggregate production (t/year)	20,000 - 25,000			

NOTES: Source: Hong Kong Productivity Center, July 1978

Numbers of foundries: Foundries are classified by main product, to avoid duplicate counting.

f) Comparison between Indonesian and neighboring countries in respect of foundry industry

The per capita domestic production of castings and per capita GNP is correlated in Fig. 3.4.1 for Indonesia and neighboring countries. What is notable is that, comparing between Indonesia and Thailand, for instance, the ratio of per capita GNP is above 1 : 2, whereas that of per capita casting production is below 1 : 6. This disparity, even taking account of differences in various circumstances particular to each country, should still be considered to leave room for improvement in the case of Indonesia. The further fact that a considerable portion of the domestic demand for foundry products is being met by imports into Indonesia attests to the existence of a sizable potential domestic market for foundry products in this country.

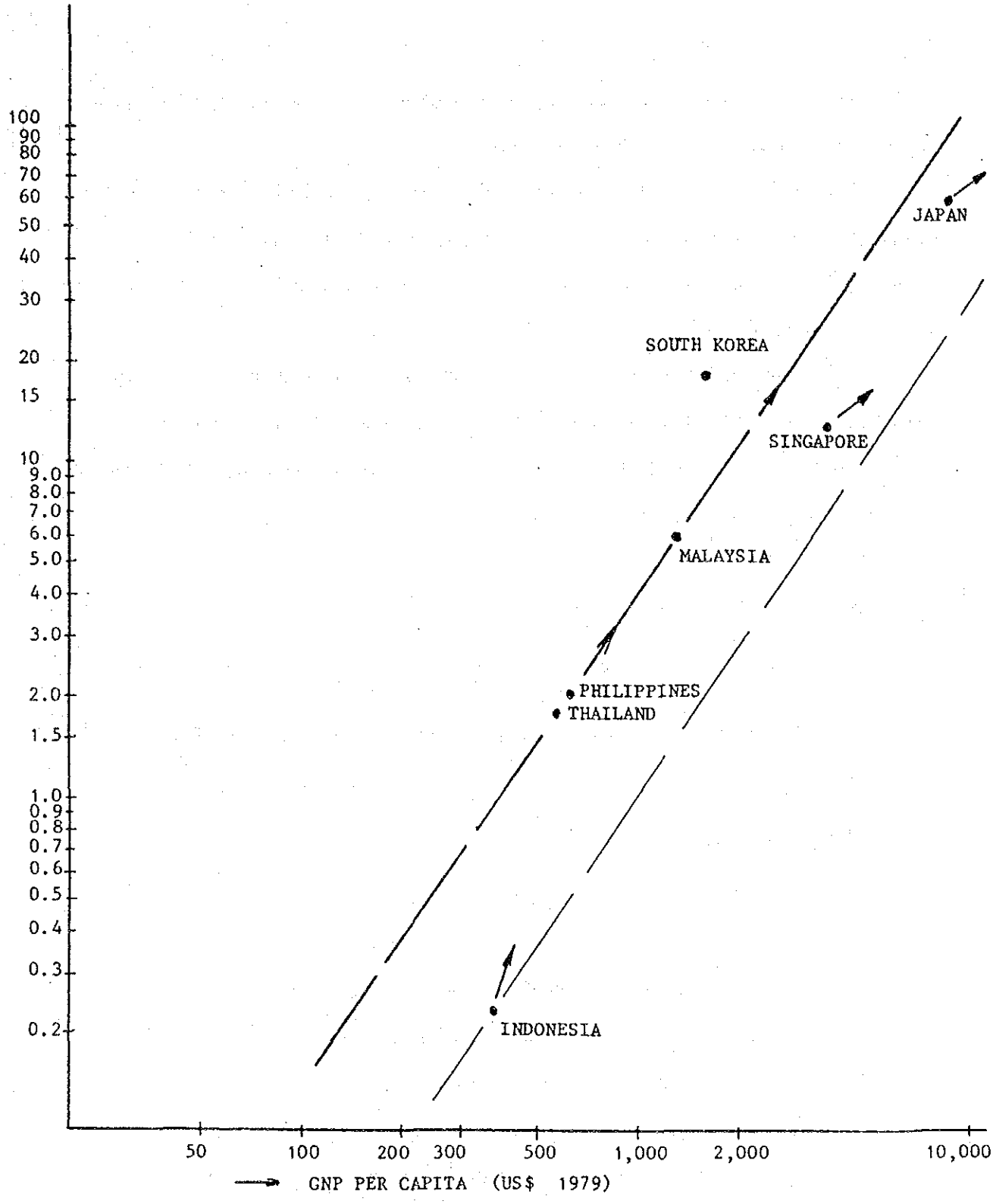


Fig. 3.4.1 Comparison between Indonesian and neighboring Countries in respect of foundry industry

These circumstances call for opportunate and apposite measures to be taken for promoting the development of Indonesian foundries.

A leading role could well be played by the Jakarta Foundry Center in enhancing the level of the Indonesian foundry industry, through improved product quality, lowered product price and shortened delivery, to gain on the rapid advances marked by the neighboring countries in this domain.

The Renovation Project should constitute an opportune occasion for enabling the Jakarta Foundry Center to equip itself for assuming the role of leading enterprise, through enhancement of its technical level and in meeting the challenge for producing components to replace imported products.

3.5 Future demand forecast from semi-individual approach

Overview of REPELITA IV relevant to demand forecast for foundry products.

1) Government policy and administrative measures adopted in REPELITA IV

To summarize the Government policy adopted in REPELITA IV for promoting industrial development:

(1) To aim at developing the national economic structure in balanced progress of industrial and other sectors of economic activity

(2) To enhance the nation's industrial independence, for which purpose, to maintain the current rational protectionist system

(3) To promote modernization of the smaller industries, to enhance employment opportunities

(4) To promote enhancement of technical capability and development of industry, through encouragement of domestic technical consultants and through strengthening of their capabilities for development and planning

(5) To enhance exportation of manufactured products, through powerful assistance provided for transportation, financing, productive capacity expansion

(6) To convert the economy from one of agriculture-based to industry-based structure, while ensuring the realization of a progressive and equitable welfare society.

2) Economic sectors accorded priority

The development of manufacturing industries is accorded highest priority in REPELITA IV for enhancing the economic structure, with consequent benefits expected to ensue in such forms as increased employment opportunities, exportation of manufactured products and replacement of imported by domestically manufactured products.

The order of priority among the different types of manufacturing industries is: Machinery manufacture - heavy industries - light industries.

3) Branches of industry accorded priority within the manufacturing sector

Whereas the overall economic growth is envisaged in REPELITA IV to average 5%/year, a target of 9.5%/year is set for the manufacturing industries, among which the strategic branch of machinery manufacture is expected to mark 17%, and basic chemical production 17.2% annual growth, in contrast to the non-strategic branches that will average 6.5%/year. The market for the manufactured products is envisaged to grow at an average rate of 8.5%/year, and products manufactured in excess of demand are to be exported.

Priorities within the machinery manufacture and basic metal branches

The priority activities within the machinery manufacture and basic metal branches of industry envisaged in REPELITA IV are:

a) Palm oil/sugar/wood/food processing, textiles, basic chemicals/basic metal processing

b) Machine tools for grinding, pressing, drilling, sawing, cutting, turning

c) Agricultural/harvesting machinery

d) Heavy construction equipment

e) Heavy machinery

f) Electric/electronic equipment - including computers

g) Automobiles

h) Railroad equipment

i) Aircraft

j) Marine machinery/fittings

k) Iron and steel manufacture, water supply facilities

l) Nonferrous (including copper, aluminum) materials.

NOTE: Priority is also accorded to industrial manufacture of equipment for maintaining peace and order.

4) Provisions in REPELITA IV for specific industries of relevance to foundry products

(1) Machinery manufacture

a) Products and production facilities

The products include equipment and machinery most commonly used in industry - boilers, heat exchangers, compressors/blowers/pumps, material handling equipment. In terms of specific industries, they are those associated with palm oil, sugar, rubber, coffee, tea, lumbering/plywood, cement, pulp/paper, fertilizer, metalworking.

Production facilities for industrial machinery manufacture are to be encouraged to establishment in East, Central and West Java, as well as around Jakarta and in north Sumatra. Facilities to serve maintenance of cement, fertilizer and liquefied natural gas plants will be established in the region. West Sumatra is designated for installing the maintenance facility for a cement plant, East Kalimantan for that of a fertilizer plant, and the Maruk region for a similar facility for plywood plant. These facilities will also undertake manufacture of certain replacement and spare parts for the relevant equipment.

In this connection, the nationalized P.T. Barata and P.T. Bomo Bisma Indra will be rehabilitated as a full-scale machinery factory, to produce in total 85,000 tons/year of machinery, employing a work force of 9,000.

Such developments will enhance the role to be played by the Bandung Metal and Machinery Manufacture Development Center.

b) Machine tool industry

Machine tools - typical capital goods - are demanded by key industries as welll as by small factories, and also used for training. Their importation will be reduced, to restructure the Indonesian industry.

Machine tool factories are currently located in East and West Java, as well as in Jakarta and in Chiregon.

REPELITA IV provides for increasing the aggregate production equipment from a capacity of 100 to 300 playner, from 300 to 1,000 lathes, from 250 to 1,000 milling machines, and from 1,000 to 1,500 drilling machines.

c) Agricultural machinery

Priority is accorded in REPELITA IV to realizing a target of 2,000 large trucks a year to be manufactured, together with increased production of rice mill units, as well as of small and hand tractors, tillers, irrigation pumps, and sprinklers.

East/Central Java and north Sumatra are to be the centers of rice mill and agricultural tractor manufacture.

d) Heavy/construction machinery

The use of domestically manufactured components is to be encouraged in the production of road rollers, bulldozers, stone crushers, concrete mixer trucks. Plans also envisage the manufacture of 50,000 diesel engines of up to 30 HP output. Heavy machinery manufacture is to be located in East/West Java and in Sumatra.

e) Electrical equipment

Electrical equipment manufacture will be developed to serve in extending the power supply network and industry in general. The demand for generators, transformers, circuit breakers and motors will increase, and will be manufactured in facilities to be established in West Java, Jakarta and North Sumatra.

f) Electronics

The electronics industry will support the development of the telecommunication network and of the radio/television broadcasting systems, as well as contribute to information processing and to educational aids. There is also a potential export market.

Centers of production are located in East/West Java, Jakarta and North Sumatra.

Products include telephone sets, telex/teleprinter sets, tranceivers, broadcasting installations, radars, micro-computers, radio/television sets, taperecorders. Most production is based on foreign design. Development efforts will be directed first at assimilaion of assembly techniques.

g) Automobiles

The first measures adopted were for enhancing the portion of domestically manufactured components incorporated in the assembled vehicles. Manufacture with 100% domestic components is to be realized in 1986/87. Plans provide for engines (both gasoline and diesel) to be manufactured in domestic factories for 7 brands of automobiles. Paint shops and factories for automobile component manufacture are also planned.

These components are:

Cabin, Rea body, chassis, frame, fuel tank, wheel, muffler tail lamp radiater.

h) Railroad rolling stock

This industry is developing in the Madewin region.

Products cover passenger cars and steam/diesel/electric locomotives. Starting with maintenance/repair and assembly operations, productive capability is envisaged to be gradually extended to production of replacements for imported components, until the products come to be made largely of domestically manufactured components.

i) Aircraft

Efforts are concentrated in themanufacture of C-212 aircraft and BO-105, Puma and BK-117 helicopters. They are assembled in Bundung, with components manufactured in Jakarta, and in West Java.

License production is undertaken by a joint venture enterprise with Spanish partnership, and with technical assistance obtained from Germany, France and U.S. Components are 80% domestically manufactured in the case of the C-212 and BO-105, 50% for the CN-235, and 20% for the Puma.

j) Shipbuilding/shiprepairing

The policy is to enhance the shiprepairing capability, with ultimate aim of acquiring capability for constructing new ships. The newest dock has a capability of 10,000 tons.

Plans are for installing:

1 dock below 2,000t capacity

9 docks from 2,000 to 5,000t capacity

4 docks from 5,000 to 10,000t capacity

Repairs can be effected on ships up to 30,000 tons.

The shipyards are located in Wjumpandun Jakarta, Surabaya and Palembang.

(2) Basic metal industries

a) Iron and steel

The aim is to promote the development of a sound steel industry, that will satisfy the domestic demand for iron and steel, and lower the dependence on imports. To this end, new investment will be encouraged, to maximize the productive capacity.

Plans provide for the installation of a 850,000 tons/year hot rolling mill, a 130,000 tons/year galvanizing line, and installations for producing 160,000 tons/year of transport piping, and 100,000 tons/year of section steel.

Production centers are projected in East/West Java, North/South Sumatra, and South Sulawesi.

b) Nonferrous metals

Meeting domestic demand, reducing imports, and improving the national industrial structure - similarly to the case of the steel industry - are the aims envisaged also for the nonferrous industries.

Priority is accorded to the project for an electrolytic copper plant to produce 100,000 tons/year of wire and billet. The targets for aluminum are 40,000 tons/year of raw aluminum, 15,000 tons/year of wire, 15,000 tons/year of billet, and 6,000 tons/year of casting.

Production will be centered in North Sumatra and Jakarta.

5) Current status and forecasts of supply and demand of industries of relevance to foundry products

The Ministry of Industry has published the estimate for production capacity, actual production and demand for the years to come, of which those relevant to the machinery and basic metal industries are cited in Table 3.5-1.

The demands of interest to the Jakarta Foundry Center would be those of:-

- Metal processing/machinery
- Heavy equipment
- Diesel engines
- Agricultural engines

Table 3.5-1 Economic Indicators

1. Estimates of Capacity, Real Production and Market Demand in Basic Metal Industries, 1984/85 - 1987/88

Commodity	Unit	1984/85 Capacity Production Consumption	1985/86 Capacity Production Consumption	1986/87 Capacity Production Consumption	1987/88 Capacity Production Consumption
BASIC METAL SECTOR					
- P e l l e t	'000	-	-	-	-
	tons	-	-	-	-
		924	1,320	1,510	1,760
- Sponge iron	'000	2,200	2,200	2,200	2,200
	tons	912	1,200	1,400	1,600
- Steel slab	'000	1,100	1,100	1,100	1,100
	tons	342	460	560	620
		292	400	460	529
- Ingot/Billet	'000	1,175	1,175	2,000	2,000
	tons	1,014	1,170	1,340	1,800
		1,130	1,360	1,500	1,800
MELTING INDUSTRY					
- Iron melting	'000	71	71	260	260
	tons	71	71	150	200
		140	170	200	200
- Steel melting	'000	13	13	13	13
	tons	3.23	3.72	6.62	7.3
		4.25	5.3	6.62	7.3
ROLLING MILL					
- Hot coil	'000	1,100	1,100	1,100	1,100
	tons	326	407	470	815
		356	407	470	815
- Cold rolled sheet	'000	-	-	850	850
	tons	-	-	225	425
		912	1,000	1,157	1,248
- Tin plate	'000	-	130	130	130
	tons	-	-	78	86.8
		192	210	225	247.5
- Concrete reinforcing bar	'000	1,200	1,200	2,000	2,000
	tons	832.9	958	1,200	1,350
		832.9	958	1,200	1,350
- Wire rod	'000	416	416	416	600
	tons	340	384	416	450
		353	384	434	477.4

Cont'd table

Commodity	Unit	1984/85 Capacity Production Consumption	1985/86 Capacity Production Consumption	1986/87 Capacity Production Consumption	1987/88 Capacity Production Consumption
- Galvanized steel sheet	1000 tons	490.8 474 474	490.8 490.8 535	650 530 604	650 560 664.4
NONFERROUS INDUSTRY					
- Aluminum ingot	1000 tons	225 175 20	225 175 30	225 225 36.5	225 225 45
- Copper rod	1000 tons	51 33 30	51 40 35	51 47 39	51 51 42
- Aluminum sheet	1000 tons	34.3 17 32.3	34.3 21 34	36 36 36	38.2 38.2 38.2
- Aluminum rod	1000 tons	34.8 8.6 8.6	34.8 11 9.2	34.8 17 17	34.8 21 21
BOLT & NUT INDUSTRY					
- Bolt & nut for steel contruction	1000 tons	1,500 350 4,700	1,500 860 5,600	2,500 1,500 6,300	2,500 1,760 6,400
STEEL WIRE					
- Welding wire	Tons	38,020 14,000 50,000	38,020 25,000 70,000	40,000 37,000 70,000	40,000 38,000 80,000
P I P E					
- Welding pipe	1000 tons	407 216 216	487 260 260	407 311 311	407 360 360
- Spiral welding pipe	1000 tons	60 60 85	60 60 115	100 90 140	120 120 154
- Seamless pipe	1000	- 150	- - 175	160 53 200	160 160 299
OTHER METAL INDUSTRY					
- Valves, Globes, Gates, etc.	Unit	150,000 60,000 340,000	150,000 108,000 360,000	150,000 130,000 330,000	150,000 150,000 412,000

Cont'd table

Comodity	Unit	1984/85 Capacity Production Consumption	1985/86 Capacity Production Consumption	1986/87 Capacity Production Consumption	1987/88 Capacity Production Consumption
- Water meters	Units	150,000	150,000	150,000	150,000
		63,000	85,000	150,000	250,000
		300,000	410,000	460,000	500,000
ENGINES & TURBINES					
- Water turbines		400	400	400	400
	Tons	40	80	114	180
		30	51	160	300
DIESEL ENGINE INDUSTRY					
- Stationary diesel		93,400	93,400	93,400	93,400
engines up to 30HP	Units	63,000	72,000	83,000	93,000
		161,000	170,000	184,000	193,000
- Ditto		6,500	6,500	6,500	6,500
up to 500HP	Units	1,500	2,500	4,000	6,500
		14,000	18,000	25,000	27,000
- Ditto		-	-	150	150
500 HP and abve	Units	-	-	125	150
		200	200	200	200
AGRICULTURAL ENGINES INDUSTRY					
- Mini tractors		200	200	200	200
(12 - 22.5 KW)	Units	125	150	175	200
		3,000	3,500	4,000	5,000
- Hand tractor		2,150	2,150	2,150	2,150
(3 up to 11 KW)	Units	1,500	1,700	1,900	2,150
		8,000	15,000	20,000	33,000
- Large tractor	Units	5,250	5,250	5,250	5,250
		10	500	520	550
		2,000	2,200	2,500	2,900
- Thresher	Units	2,500	2,500	2,500	2,500
		1,500	1,700	2,000	2,500
		10,000	20,000	40,000	70,000
- Huller	Units	6,100	6,100	6,100	6,100
		2,000	3,000	4,000	6,000
		39,000	46,000	54,000	72,000
- Polisher	Units	3,500	3,500	3,500	3,500
		1,000	1,500	2,500	3,500
		39,000	46,000	54,000	72,000
- Rice milling unit	Units	1,570	1,570	1,570	1,570
		1,000	1,250	1,500	1,570
		3,500	5,000	7,000	11,500

Cont'd table

Commodity	Unit	1984/85 Capacity Production Consumption	1985/86 Capacity Production Consumption	1986/87 Capacity Production Consumption	1987/88 Capacity Production Consumption
- Irrigation pumps	Unit	7,200	7,200	7,200	7,200
		5,000	5,500	6,000	7,200
		6,000	8,000	9,500	11,000
MACHINERY INDUSTRY					
- L a t h e s	Unit	700	700	700	1,200
		250	300	450	700
		3,700	4,200	4,500	5,250
- Drilling machines	Unit	550	550	550	2,000
		225	350	550	1,500
		2,500	3,600	4,400	5,600
- Sawing machines	Unit	100	100	100	100
		50	75	100	100
		8,960	9,120	9,200	9,440
- Milling machines	Unit	250	250	250	550
		50	100	250	400
		650	700	800	800
- Bending machines	Unit	100	100	100	100
		25	50	75	100
		700	1,000	1,500	2,000
- Scrapping machines	Unit	100	100	100	100
		20	40	60	75
		75	100	100	150
- Grinding machines	Unit	25	25	50	50
		25	25	50	50
		25	30	50	70
- Rolling machines	Unit	100	100	100	100
		25	35	50	75
		1,520	1,630	1,740	1,850
- Table drills	Unit	150	150	150	150
		50	75	100	150
		750	1,000	1,500	2,000
- Shearing machines	Unit	100	100	100	100
		50	60	75	100
		360	430	490	750
- Dies, Mold, Jigs		11,500	11,500	11,500	11,500
and Fixtures	Ton	1,000	3,000	4,500	6,500
		11,800	12,200	12,400	12,700
- Special machine	Unit	250	250	250	250
tools		20	60	80	135
		124	132	160	200

Cont'd table

Commodity	Unit	1984/1985 -Capacity -Production -Demand	1985/1986 -Capacity -Production -Demand	1986/1987 -Capacity -Production -Demand
Heavy equipment industry: - Road/vibro rollers	Unit	1,140 424 525	1,140 445 551	1,140 467 579
- Stone crushers	Unit	590 20 110	590 22 122	590 25 134
- Concrete mixers	Unit	2,000 1,300 1,650	2,000 1,430 1,800	2,000 1,570 1,900
- Compactor plates	Unit	500 440 550	500 480 600	500 520 660
- Wheel loaders	Unit	335 134 335	335 201 360	335 300 400
- Motor graders	Unit	265 106 188	265 159 234	265 239 293
- Excavators	Unit	450 180 579	450 279 683	450 405 806
- Buldozers	Unit	1,240 496 2,140	1,240 744 2,280	1,240 1,116 2,420

From Table 3.5-1, the data concerning products of direct interest to JFC are picked out in Table 3.5-2.

Table 3.5-2 Excerpts from Table 3.5-1 of Data on Branches of Direct Interest to JFC

Commodity	Unit	1984/85 Capacity Production Consumption	1985/86 Capacity Production Consumption	1986/87 Capacity Production Consumption	1987/88 Capacity Production Consumption
MACHINERY INDUSTRY					
- Lathes	Units	700	700	700	1,200
		250	300	450	700
		3,700	4,200	4,500	5,250
- Milling machines	Units	250	250	250	550
		50	100	250	400
		650	700	800	800
AGRICULTURAL ENGINE INDUSTRY					
- Mini tractors (12 - 22.5 KW)	Units	200	200	200	200
		125	150	175	200
		3,000	3,500	4,000	5,000
- Hand tractors (3 up to 11 kW)	Units	2,150	2,150	2,150	2,150
		1,500	1,700	1,900	2,150
		8,000	15,000	20,000	33,000
- Large tractors	Units	5,250	5,250	5,250	5,250
		10	500	520	550
		2,000	2,200	2,500	2,900
DIESEL ENGINE INDUSRY					
- Stationary diesel engines up to 30HP	Units	93,400	93,400	93,400	93,400
		63,000	72,000	83,000	93,000
		161,000	170,000	184,000	193,000
- Ditto up to 500HP	Units	6,500	6,500	6,500	6,500
		1,500	2,500	4,000	6,500
		14,000	18,000	25,000	27,000
- Ditto of 500 and above	Units	-	-	150	150
		-	-	125	150
		200	200	200	200

Commodity	Unit	1984/85 Capacity Production Consumption	1985/86 Capacity Production Consumption	1986/87 Capacity Production Consumption
Heavy equipment industry:				
- Wheel loaders	Units	335 134 335	335 201 360	335 300 400
- Motor graders	Units	265 106 188	265 159 234	265 239 293
- Excavators	Units	450 180 579	450 279 683	450 406 806
- Bulldozers	Units	1,240 496 2,140	1,240 744 2,280	1,240 1,116 2,420

Castings of importance in machine tools include:-

- Lathe beds
- Milling machine columns

In construction (heavy) equipment:-

- Counterweights

for wheel loaders, motor graders, excavators and bulldozers, which are envisaged for replacement of imported with domestically manufactured components

In agricultural tractor engines:-

- Cylinder blocks
- Cylinder heads/liners
- Pistons,

which constitute the principal engine components.

6) Current status and forecasts of supply and demand of mahcine tools

(1) Current status

Currently, 9 establishments produce machine tools, among which P.T. Industri Mesin Perkakas Indonesia (P.T. IMPI) is exceptionally well-equipped with the latest facilities. It was recently established by the Ministry of Industry, with the collaboration of a Belgian machine tool manufacturer. Current production capacity is for 300 lathes/year; extension is planned, which will bring the annual capacity to 650 lathes, 600 drilling machines and 600 milling machines.

Currently, however, the range of products is limited, and the only market served is restricted to the Department of Education and Culture, as well as other small customers. Sales in the open market is for the future.

Other machine tool manufacturers are as listed in Table 3.5-3.

Table 3.5-3 Indonesian Machine Tool Manufacturers and Their Production

Name of company	Type of product	Total production	Use of product
PT. I M P I	- L a t h e s	150	S o l d
PT. P I M S F	- L a t h e s	2	For company's own use
	- Combination freis and drills	100	S o l d
	- Grinding and cutting machines	1	S o l d For company's own use
	- S a w s	1	For company's own use
	- Bending machines	-	and for sole
	- Rolling machines	-	S o l d
	- Hydraulic presses	-	For company's own use
	- Hand presses	-	For company's own use
	- Hand cutting machines	-	For company's own use and for sole
	- Line drills	2	For company's own use
PT. SUMBER BAHAGIA	- Simple lathes	12	For company's own use
	- Simple freis	2	For company's own use
	- Table drills	25	S o l d
	- Bending machines	10	S o l d
	- Hand rolling machines	-	S o l d
	- Hydraulic presses	50	S o l d
	- Press brakes	1	For company's own use
PT. SHOW GROUP	- Simple lathes	3	For company's own use
	- Flat grinders	3	For company's own use
PT. CANDI NAGA	- Universal lathes	250	S o l d
	- Hand rolling machines	-	S o l d
	- Mechanical presses	2	For company's own use
	- Hand cutting machines	15	S o l d
PT. BINTANG MAS INDUSTRI	- Simple lathes machines	1	Prototype
	- Pipe-bending machines	1	Prototype
	- Hydraulic presses	60	S o l d
	- Press brakes	1	Prototype
PT. TEXMACO	- Simple lathes	1	Prototype
	- Table drills	1	Prototype
	- Hand clamping machines	200	S o l d
PT. MEDAN GERAK JAYA	- Freis machines	1	For company's own use
	- Mechanical presses	20	For company's own use
	- Hydraulic presses	1	For company's own use
	- Press brakes	1	For company's own use
CV. CIPTA KARYA	- Table drills	250	S o l d
	- Hydraulic presses	10	S o l d
	- Spindle lathes	7	For company's own use
	- Cutting machine	2	For company's own use
	- Threading machine	3	For company's own use

Source : Directorate-General of Basic Metal Industries

(2) Companies chosen by the Indonesian Government to produce machine tools

(a) The 11 companies listed in Table 3.5-3 have been chosen by the Indonesian Government to produce machine tools, by license issued with the Ministry of Industry Decree 1/SK/1/1985 of January 4, 1985. The companies include some that have been engaged in machine tool manufacture from the past, and others that have so far only served as importing agents.

- o PT. Pindad
- o PT. Impi
- o PT. Pimsf
- o PT. Sarana Idea Utama
- o PT. Sumber Bahagia
- o PT. Cipta Karya
- o PT. Medan Gerak Jaya
- o PT. Bintang Mas Industri
- o PT. Oyama
- o PT. Tools Indonesia
- o PT. Karya Prima

(b) The companies chosen have been required to start production of the respectively prescribed machines by July 1985. In actuality, however, 3 to 4 years is expected to pass before full production is attained by all these companies, and in the mean time, the balance of demand will have to be imported.

Table 3.5-4 List of Companies Chosen to Produce Machine tools

Name of company	Type of machine	Specifications of maximum	Total production (Units)
PT. (Persero) I M P I	- L a t h e s	Centre span 1500 mm, centre height 200 mm	400
PT. P I M S F	- Freis combination drills	Size of table 240 x 600 mm diameter of drill 32 mm	500
	- Table drill	Diameter of drill 13 mm	2,100
	- Rolling machines	Plate dimen ion 2500 x 3 mm	500
	- Bending machines	Plate dimension 2500 x 2mm	400
	- Cutting machines	Plate dimension 1270 x 2mm	400
	- Punching machines	Pressure 3 ton, thickness of plate 3mm	200
	- Bending presses	Operational pressures 80 ton	100
	- Column-drilling machines	Diameter of drill Ø 30 mm	200
PT. SARANA IDEA UTAMA	- Lather machines	Centre span 1500 mm, centre height 180 mm	300
	- Cutting machines	Plate dimension 1270 x 2mm	400
	- Plate rolling machines	Plate dimension 2500 x 3mm	400
	- Bending machines	Plate dimension 2500 x 2mm	400
	- Pipe-bending machines	Pipe diameter 50 mm	400
PT. SUMBER BAHAGIA	- L a t h e s	Centre span 1500 mm, centre height 180 mm	300
	- Table drills	Diameter of drill 13 mm	600
	- Presses	Operational pressure 30 ton	100
	- Punching	Operational pressure 3 ton, thickness of plate 3mm	300
PT. CIPTA KARYA	- Table drills	Diameter of drill 13 mm	400
PT. MEDAN GERAK JAYA	- Presses	Operational pressure 250 ton	150
	- Cutting machines	Plate dimension 2500 x 5mm	150
	- Table drills	Drill diameter 13 mm	500
	- Presses machines	Operational pressure 80 ton	150
	- Freise type knee	250 x 1200 mm	100
PT. BINTANG MAS INDUSTRI	- Presses	Operational pressure 250 ton	1,000
	- L a t h e s	Centre span 1500 mm, Centre height 180 mm	300

Cont'd table

Name of company	Type of machine	Specifications of maximum	Total production (units)
PT. OYAMA	- S a w s	Diameter 180 mm	750
	- Surface grinding machines	Table dimension 220 x 500mm	50
	- Column drilling machines	Drill diameter Ø 30 mm	75
PT. TOOL INDO-NESIA	- L a t h e s	Centre span 150 mm, Centre height 180 mm	300
	- Cutting machines	Plate dimension 1270x2mm	300
	- Table drills	Drill diameter 13 mm	1,200
	- Bending machines	Plate dimensions 2500 x 2mm	200
	- Rolling machines	Plate dimensions 2500 x 3mm	200
	- Freis type knee	Table dimension 250x1200mm	200
	- Surface grinding machines	Table dimension 220x500 mm	200
PT. KARYA PRIMA	- Sawing machines	Diameter 180 mm	100
	- Table drills	Drill diameter 13 mm	200
	- Presses	Operational pressure 150 ton	100
PT. (PERSERO) PINDAD	- L a t h e s	Centre span 1500 mm; centre height 180 mm	320
	- Freis type knee	Table dimensions 2500x120mm	250
	- Column drilling machines	Drill diameter 30 mm	100
	- Presses	Operational pressure 150 ton	200

Source : Department of Industry

Table 3.5-5 Planned Machine Tool Production Capacity

T y p e	Production capacity (Units)
- L a t h e s	1,920
- Freis machine	1,050
- Table drills machine	4,600
- Column drilling machines	375
- Rolling machine	1,100
- Bending machines	1,000
- Bending	250
- Pipe-bending machines	400
- P r e s s e s	1,550
- Cutting machines	1,250
- Punching machines	500
- S a w s	850
- G r i n d e r s	250
T o t a l	15,095

c) Demand

(a) Demand in the past

Demand for machine tools have progressed during the past few years as given in Table 3.5-6.

Table 3.5-6 Average Demand for Machine Tools over 1981 - 1983

T y p e	Units	Tons
- L a t h e s	2,133	2,444
- Freis machine	551	372
- Drills machine	4,829	717
- S a w s	2,169	223
- Planing machine	163	82
- Gear cutting machine	59	42
- Tapping or screw cutting machine	229	79
- Sharpening, triming, trueling, grinding polishing, etc.	-	931
- Machine tools operating by electric, ultrasonic	1,053	750
- Other metal working presses, grinding, polishing machines	-	3,721
- Forging machines, stamping machines	-	36
- Bending, forming, folding or flattening machines	-	833
- Shearing, punching, notching machines	-	644
- Other machine tools	-	5,783
T o t a l		16,664

Processed by Data Consult.

b) Demand forecast

The Directorate-General of Basic Metal Industries has published a forecast of demand for machine tools in 1989, which is cited in Table 3.5-7. It envisages for that year a demand for 5,950 lathes and 1,000 milling machines.

Table 3.5-7 Projected Demand for Machine Tools, 1989

Type of machine	S i z e	Projected consumption (Units)
- L a t h e s	Total demand : - Measuring less than 1600mm/200mm	5,950 1,800
- Freis machine	Total demand : - Combination drill - Type knee	1,000 500 150
- D r i l l s	Total demand : - Table drill Ø 13 mm - Column drill	6,250 1,000 300
- P r e s s e s	Total demand : - Measuring less than 2500 x 2 mm	350 250
- Cutting machines	Total demand : - Measuring less than 1270 x 2 mm	500 265
- Hydraulic presses	Total demand : - Pressure of no less than 250 tons	2,500 200
- Rolling machines	Total demand : - No less than 2500 x 3 mm	450 250
- S a w s	Total demand : - No less than Ø 180 mm	9,600 300
- Surface grinders polishes	Total demand : - No more than 220 x 500 mm	850 500
- Punching machines	Total demand : - Pressure and thickness of the plate no more than 3 tons and 3 mm	750 300
- Pipe-benders	Total demand - Ø no more than 50 mm	675 300
- Presses	Total demand : - Pressure no more than 80 tons	500 225

Source : Directorate-General of Basic Metal Industries.

7) Heavy (construction) equipment

Government policy

The Indonesian Government is attaching importance to developing the heavy (construction) equipment industry, with highest priority accorded to domestic production of:-

- Crawler bulldozers (100 to 300 HP)
- Hydraulic excavators (100 to 300 HP)
- Wheel loaders (60 to 150 HP)
- Motor graders (100 to 150 HP)

In 1982, tree(s) firms were authorized to establish their production facilities in Indonesia, and will be the subject of strong protective government measures to facilitate their operation.

a) past imports

The 4 types of equipment envisaged in the preceding Section constituted the bulk of the imports cited in Table 3.5-8.

Of the 4 types, crawler bulldozers are seen to have been by far the most important.

Table 3.5-8 Imports of 4 Types of Heavy Equipment

Type	1981		1982	
	Units	US$'000	Units	US$'000
Crawler bulldozers	961	55,393	1,068	61,020
Hyd. excavators	688	18,920	655	19,103
Wheel loaders	140	8,820	182	10,356
Motor graders	183	10,162	182	7,299
Total	1,972	93,295	2,087	107,778

Source : Survey on heavy equipment.

b) Current production

The current nominal production capacities of the existing facilities for manufacturing the 4 types of equipment in question are as given in Table 3.5-9.

Table 3.5-9 Production Capacity of the 4 Heavy Equipment Assembing Plants

(Units)

T y p e	Caterpillar	Komatsu	Mitsubishi	Total
- Crawler bulldozers	510	660	-	1,170
- Wheel loaders	265	70	-	335
- Motor graders	165	100	-	265
- Hyd. Excavators	-	100	350	450
T o t a l	940	930	350	2,220

Processed from BKPM (Investmenr Coordinating Board) data.

however, have counted, as of March 1985, only 392 units in all, as cited in Table 3.5.3.2-3.

Table 3.5-10 Actual Production of the 4 Types of Heavy Equipment

(Units)

T y p e	Caterpillar (4/84-3/85)	Komatsu (8/83-3/85)	Mitsubishi (1/84-3/85)	Total
- Crawler bulldozers	103	119 *)	-	222
- Wheel loaders	15	13	-	28
- Motor graders	10	5	-	15
- Hyd. Excavators	-	75	52	127
T o t a l	128	212	52	392

*) Includes 6 units Dozel shovels

This poor performance is due mainly to shortage of components manufactured domestically - particularly those ordered out-house. This betokens the fact that the components envisaged for replacement of imported products are not being supplied in quality and in time to meet the requirements of the customers needing the product for their manufacturing operations.

c) Demand

(a) Current situation

The current worldwide slackness of demand and restriction of imports into Indonesia have generated a cut-throat competition for importation of construciton machinery: 25 sole agents from 9 countries such as Japan, USA, England, West Germany, Italy, Poland, France, Russia, Yugoslavia are promoting 38 brands of construction machinery. Among these 25, only 3 are considered to be viable in the future:-

(b) Expected trend of demand

The market demand is constituted of replacements and fresh purchases for new projects and extensions.

There should exist a sizable latent demand for replacements, considerring the fact that many existing units have served over 10 years, but owners are showing little interest in replacing their equipment: They are likely to retain their present equipment for further 2 or 3 years.

The existing fleet of these machines has been estimated by an Indonesian consultant to have counted in 1983:

10,849 crawler bulldozers

3,391 wheel loaders

1,845 motor graders

2,338 hydraulic excavators

The aggregate demand including both replacements and fresh purchases is estimated to be as given in Table 3.5-11.

Table 3.5-11 Demand Forecast for 4 Types of Heavy Equipment

(1984 - 1988)

Year	No. of units at beginning of year	Units bought to replace old units	New units bought	Total Market	No. of units at end of year
1984	18,423	1,105	250	1,355	18,673
1985	18,673	1,307	262	1,569	18,935
1986	18,935	1,514	275	1,789	19,210
1987	19,210	1,729	289	2,018	19,499
1988	19,499	1,950	304	2,253	19,803

Processed by Data Consult.

It is seen that the total demand in 1984 of 1,355 units, of which 1,105 replacements, will grow in 1988 to 2,253 units with 1,950 replacements.

c) Expected trend of supply

The three establishments authorized to manufature construction equipment have drawn up programs for future production as cited in Table 3.5.12.

Table 3.5-12 Planned Production of 4 Types of Heavy Equipment by 3 Assembling Companies

(Units)

Type of heavy equipment	Year				
	I	II	III	IV	V
A-company					
- Crawler bulldozers D. 60E (155 HP)	80	120	140	190	225
- Crawler bulldozers D85E (220 HP)	120	180	220	290	330
- Crawler bulldozers D75S (200 HP)	20	30	35	50	57
- Motor graders GD 600 R (145 H)	30	45	55	72	82
- Hydraulic Excavators PC 120 (90 HP)	30	45	55	72	82
- Wheel loaders W70 (105 HP)	20	30	35	55	57
Total	300	450	540	724	833
B-company					
- Hydraulic Excavators MS 110	125	125	150	150	150
- Hydraulic Excavators MS 180	-	50	50	50	50
Total	125	175	200	200	200
C-company					
- Crawler bulldozer D7G (200 HP)	91	119	210	233	243
- Crawler bulldozers D6G (140 HP)	47	100	106	112	116
- Wheel loaders 980C (270 HP)	25	52	57	59	62
- Wheel loaders 930 (100 HP)	46	97	105	108	114
- Motor Graders 120 B (125 HP)	27	79	85	92	95
Total	246	447	563	604	630

Source: Department of Industry.

3.6 Future demand forecast from individual-level approach

Market research based on the sample survey of users.

1. Before implementing a sample survey,the target market for JFC has been made clear. Taking account of the tentative plan (by the Ministry of Industry, P.T. Barata, JFC) presented to the first survey team of the Renovation, the JICA has narrowed down the target industries as follows:

   a) Sugar industry
   b) Cement industry
   c) Agro-based machine and equipment
   d) Paper industry
   e) Steel making industry
   f) Transportation industry
   g) Electric equipments
   h) Civil and construction
   i) Machinery industry
   j) Mining and energy

2. Ranking of the target industries according to priority

   Table 3.6-1 is the JFC's tentative plan (with additional product items envisaged by JICA). The Ministry of Industry (MOI), P.T. Barata, JFC and JICA reviewed this plan and ranked the above-mentioned target industries according to priority as follows:

   The first group:
   1. Agro-based machine and equipment
   2. Transportation
   3. Civil and construction
   4. Machinery industry
   5. Mining and energy

The second group :
1. Steelmaking
2. Electrical equipments

The third group :
1. Sugar industry
2. Cement industry
3. Paper industry

The first group has already deals with JFC and is expected to grow further, thus increasing the demand of materials. Form this group JFC can select customers suitable to its capacity.

Since the second group includes the steelmaking industry which produces chilled rolls, the quantity of potential demand is fairly large. However, JFC might have a great deal of technical difficulties in this field, even if investment is made for appropriate equipment. In our opinion, it would be better to leave this group over until the second phase of the development and concentrate on other fields.

The third group comes at the end of the priority, not because they are unattractive to JFC, but because they belong to the domain of other national enterprises, Gresik and Surabaya Foundry Centers.

Table 3.6-1 Tentative production plan by JFC

	Organization / Target industry	Ministry of Industry	P.T. Barata (M.Q)	JFC	JICA Additional Products
1	Sugar Industry				Sugar roll (FC) Press (FC)
2	Cement industry				Liner (FC) ball (FC)
3	Agro-based machine and equipment	Cylinder bead Gear box Flywheel 120t/y			Pump (FC) Valve (FC)
4	Paper industry				
5	Steelmaking industry	Chilled roll Coupling Spindle 600t/y	(Demand of chilled roll 10,000t)	Chilled roll 2,000t Coupling 200t	Shoes for drawing (FC)
6	Transportation industry	Shoulder Press die Anchor 500t/y	(Shoulder; 1000 pcs per year	Shoulder 300t/y	Cylinder head (FC) Gear box (FC) Cylinder liner (FC) Flywheel
7	Electrical equipment				Counter weight for elevator (FC)
8	Civil and construction	Counter weight Manhole cover	Manhole cover	Counter weight 200t Manhole cover 300t	Shoes for constraction machine (FC) Sprocket (SC) Guide roller (SC)
9	Machinery industry	Machine tool parts 100t/y			Sheave (FC) Reduction gear (FC) Wheel for O.H.crane (FC) Gear for O.H.crane (FC)
10	Mining and energy	Slurry pump Ingot mold 400 t/y		(Bubble cap) (Wheel head) and Xmas tree	
	Total	2,420 tons		3,000 t	

3. The JICA team carried out a sample survey of present and potential customers of P.T. Barata

Jakarta Foundry Center. Moreover, to supplement this survey, Indonesian consultants were hired to conduct the survey based on a questionnaire prepared by JICA. The number of the survey samples is as follows:

- Companies that the JICA team visited 7
- Answers to the questionnaire (sent to 33 companies) 20

Total 27

Altogether 27 answers were received out of 40 questionnaires. The results of this is shown in Table 3.6-2.

Surveyed companies are, as explained above, all present and future customers of JFC, which include:

Transportation industry

Agro-based machinery industry

Civil and construction industry

Machining industry

and others.

a) Amount of foundry products purchased by the surveyed customers.

Out of 27 customers, 14 gave answers about the purchase of foundry, the total of which amounted to 1,546 tons in 1984. This means 110 tons per company and the simple addition shows there would be about 3,000 tons of demand from 27 companies.

b) Purchase plans by the surveyed customers.

It is difficult to analyze future plans of companies, because, in addition to the difficulty of forecasting future, companies are not willing to make their plans open. Nonetheless, general trend is promising, judging from the fact that the Indonesian government has an unambiguous plan for industrial development and some of the surveyed companies has not yet either purchased home-produced foundry products or are at the stage of trial manufacturing.

The promising fields include automobile, construction and transportation, agro-engine, diesel engine and machine tool industries, all of which but automobile industry could be JFC's customers. The estimated demand for some of the surveyed companies is as follows:

	1990	1995
Forklift (1 company)	1,000 units	1,600 units
Agro-Engine (ditto)	530 tons	570 tons
Diesel Engine (ditto)	6,000 units	6,000 units
Machine Tool (ditto)	130 units	150 units

This will be only tiny part of the whole demand. The amount of foundry necessary to meet above-mentioned demand is:

	1990	1995
Forklift (1 company)	1,600 tons	2,560 tons
Agro-Engine (ditto)	530 tons	570 tons
Diesel Engine (ditto)	2,256 tons	2,256 tons
Machine Tool (ditto)	130 tons	150 tons
Total	4,516 tons	5,536 tons

If JFC supplies 50% of this amount, it will be 2,216 tons. The total demand for foundry products will not be insufficient.

c) Possibility of ordering to JFC

Some of the survey companies which have had no contact with JFC are considering to purchase from JFC, if certain conditions are met. Out of the 27, 18 companies (67%) expressed their interest in buying from JFC. This fact shows that users are keen to find a manufacturer which can supply high quality foundry at reasonable prices without any delivery delays.

The total of the demand for each type of foundry products is shown below.

	FC	FCD	SC	Others
	ton	ton	ton	ton
Transportation	871.5	320	320	
Agro-Machine	120			
Civil/Construction	96	11.5	5	
Machine-Tool	385			
Pump	24		0.2	
Ship	6.5		3	1
Steel	694			
	ton	ton	ton	ton
Total	2,197	331.5	328.2	1

Among these, the products dealt with by JFC are as follows:

Counter weight (FC)	522.5	tons
Flywheel (FC)	120	tons
Anchorage (FC)	69	tons
Pump (FC)	24	tons
Lathe	60	tons
Shield	300	tons
Machine tool and parts	84	tons
Total	1,179.5	tons

These figures make up a part of the whole market, and JFC could capture it with proper efforts. Furthermore, in addition to digging up existing demand, JFC should try to substitute import castings as well.

Taking these potentialities into consideration, JFC's future is widely open. However, it is indispensable for JFC to acquire necessary production/management technique in order to secure increasing demand.

Table 3.6-2 Sample Survey of Customers of Castings

ENTER-PRISE	KNOWING OF JFC	EXPERIENCE OF ORDER TO JFC	POSSIBILITY OF ORDER TO JFC	PRICE RP/KG	PRIORITY OF PROCUREMENT	CONSUMPTION OF CASTINGS 1982	1983	1984	(1990)	(1995)	NAME OF CASTING	MATERIAL	SIZE	UNIT WEIGHT (KG)	QUANTITY	TOTAL WEIGHT (T)
A	not	not	FC: 48 T/Y	3,500	Quality			10	288		Drum	FC	ϕ1300x150	20		
B	yes	not	FC: 300T/Y FCD: 300 SC: 300		Quality price Delivery Material				FC: 300T SC: 300	350 300	Brocket Rear spring Stop: Sub spring Brake drum	SC SC FC23	100x70x50 70x40x20 ϕ350x20	4 3.4 20		
C	yes		FC: 60T/Y FCD: 20 SC: 10 Alloy-SC: 10	FC: 700	Quality price Delivery						Counter weight	FC		1,800	14	25.2TON
D	yes		FC: 462.5						760		Counter weight	FC		1,300		
E			FC: 1T/Y	FC:2500				FC: 1			Counter weight		300x400x 2,000	1,000		
F	yes	yes			Quality Dimensions						Press die					
G											Die mold					
H	yes	yes									Diesel engine Parts					
I	not	not	FC: 120T/Y	as-cast: 1050 Finished 2500	Quality price Delivery	437	369	350	530	570	Fly wheel	FC	ϕ400x45	20	6,000	120 TON
J	yes	yes									Fly wheel					

	ENTER-PRISE	Number of ENTERPRISE	Products of Enterprise	Production Amounts 1982	1983	1984	(1990)	(1995)	Customers	Remarks
Transportation Industry	A	150	Automobile Cement Bulk Carrier							
	B	283	Automobile KD51 TLD56 JCR 360/420	4,271 898	3,596 311 689	283 311 676	2,000 2,000 1,400	2,200 2,200 1,500	SASAMI GAPURA INTRA MOTOR CAHAYA SURYA BALI MOBIL INTAN	
	C	75	Fork lift Farm Tractors Trailers/implements			50 20 21	1,000 800 1,000	1,600 1,600 2,000	PT. UNITED TRACTORS	
	D	300	Heavy Equipments Agri-Tractor Material Handling							
	E	170	General Steel Fabrication Component for Heavy Equip. Pressure Vessel							
	F	500	Automobile parts			40,000				
	G	120	Die Mold Jig							
	H	200	Diesel Engine (2 cyl - 12 cyl)			1,000	6,000	6,000		
Agro-Machine	I	250	Diesel Engine	22,991	20,872	18,431	28,000	30,000	Farmers Fishermen	
	J	200	Diesel generator Pump Compressor		▼ 35,000	▼ 25,000				

Sample Survey of Customers of Castings

ENTER-PRISE	KNOWING OF JFC	EXPERIENCE OF ORDER TO JFC	POSSIBILITY OF ORDER TO JFC	PRICE RP/KG	PRIORITY OF PROCUREMENT	CONSUMPTION OF CASTINGS					NAME OF CASTING	MATERIAL	SIZE	UNIT WEIGHT (KG)	QUANTITY	TOTAL WEIGHT (T)
						1982	1983	1984	(1990)	(1995)						
K	yes	yes	FC: 2T/Y SC: 1.5T/Y	FC: 150 FCD:250		FC: 1.5 SC: 2	2 2.5	2.5 3	5 5	7 8	construction machine parts	FC20 FC25 FCD SC				1.5T 1.5 2.0 0.5
L	yes	yes	FC: 25T/Y FCD: 10 SC: 5	FC: as-cast 600 Finishe FCD:120 SC: 1400	Price Quality	FC: 35 SC: 5	30 5	40 8			casting coupling FUNDO FUHRUNG	FC FC/FCD	ø315x380 115x110 x260	120 kg		
M	not	not	FC: 61T/Y	FC: 90	Quality Price		64	61			Type VSL-19SC 12SC 7SC 4SC					
N	not	not	FC: 8T/Y	FC: 2000	Price Quality		3	6	20	30	Anchorage Guide 19K13 12K13 7K13	FC FC FC	270x270x2 210x210x1 160x160x1	90 17.5 25 8.5 03 2.5		3.5 3.4 1.0
O	not	not	FC: 24T/Y	FC: 90	Quality	FC:155	222				Various kinds of machinery and engine parts	FC	2Mx2Mx4M	2 ton	12	24 ton
P	not	not	FC: 60T/Y	FC: 100			15	20	30		Bed for Lathe Body for milling machine	FC25 FC25	200x300 x400 00x600x 800	1 ton 2.5ton		
Q	yes	yes	FC: 1T/Y	FC: 160	Delivery											
R	not	not	SC FC FCD Alloy-SC 300T/Y					300			Large shield AS BS	GC-20 GC-20		119 111.5		59 55
S	yes	yes									Leth-leg					
T	yes	yes	Alloy-SC 0.2T/Y		Quality	FC:0.2T SC:0.22	0.2 0.22	0.2 0.22								

	ENTER-PRISE	Number of ENTERPRISE	Products of Enterprise	Production Amounts					Customers	Remarks
				1982	1983	1984	(1990)	(1995)		
CIVIL AND CONSTRUCTION	K	96	Road construction machine : Road Roller Ston-crusher, Asphalt mixing plant	134	46	68			General : 70% Public : 30%	Competitor PT.BARATA PT.PUTRA KALIMANTAN KYC PRODUCT
	L	200	Building, High-way Bridge	81,000T	84,500T	99,500T				
	M	73	Casting VSL - 19SC 12SC 7SC		Set 1,885 3,083 1,677	1,214 3,768 1,798				
	N	15	PRESTRESSED Concrete for Bridge, Buildings							
MACHINERY INDUSTRY	O	350	Machinery parts Gear Spare parts	170 19,753 28,245	347 25,358 34,621				PT.TRIANTO DIESEL PT.YANMAR DIESEL PT.YAMINDO MINISTRY OF EDUCATION	
	P	25	General machine Agricultural machine Lathe Milling machine			30 -	100 30	110 40		PURCHASE from: PT.SIDE MAJU
	Q	300	General machine							
	R	50	General machine Industrial machine Electro machinery Iron and Steel Making			700				
	S	32	Machine tool : Lathe							
PAPER	T	-	Cigarette paper Writings & printings	1,523,941 4,172,055	3,464,300 4,617,592	3,426,893 4,565,635				

Sample Survey of Customers of Castings

	ENTER-PRISE	KNOWING OF JFC	EXPERIENCE OF ORDER TO JFC	POSSIBILITY OF ORDER TO JFC	PRICE RP/KG	PRIORITY OF PROCUREMENT	CONSUMPTION OF CASTINGS 1982	1983	1984	(1990)	(1995)	NAME OF CASTING	MATERIAL	SIZE	UNIT WEIGHT (KG)	QUANTITY	TOTAL WEIGHT (T)
Pump	U	not	not	FC: 24T/Y	1000	Price	18	20	24			Pump					
	V	yes	not			Price Delivery			21			Discharge case Suction case Impeller			10 10		1T 1T
Ship	W	yes	yes	FC: 6.5T/Y SC: 3 BC: 1	SC:1,800	Quality Price Delivery	SC: 3	4	5	FC: 5 SC: 10	10 15	Pully & Block Bearing Roller wheel	SC BC FC	ϕ600x7.5 ϕ 75x75 ϕ100x75		11 112 56	2.2T 0.5 6.25
	X	not	not														
Iron/Steel	Y	yes	yes	FC: 694		Quality Price Delivery	694	694	694			Ingot case Pouring cup Casting bed	FC15-20 FC20 FC20	1,680x448x448 2,200x535x535 1,860x2,050x250	640 1400 11400		640 8.4 45
Electricity	Z	not	not														
Rail Way	A-1									1600 200-300		Solid Wheel Brake block Spike Shoulder					1600T 200-300

	ENTER-PRISE	Number of ENTERPRISE	Products of Enterprise	Production Amounts 1982	1983	1984	(1990)	(1995)	Customers	Remarks
Pump	U	56	Centrifugal pump Hand pump	8 590	6 480	6 400				
Pump	V	49	Turbine pump Centrifugal pump Sanitary pump Axial flow pump			100 200 600 150				
Ship	W	498	Ship building & Ship Repairing						General : 100%	Procurement from P.T. wajaco
Ship	X	1025	Ship building, and Repaire — Tongan Minyak Tag boat Doton Kapal patroli	1 18	2 1 3 23				Public : 75% General : 25%	
Electricicy Iro/Steel	Y	700	Iron and Steel making	98,000	95,000	85,000			Public : 40% General : 60%	
Electricicy Iro/Steel	Z	111	Generator Welder						General : 100%	
Electricicy Iro/Steel	A-1	50,000	Railway							
Electricicy Iro/Steel										
Electricicy Iro/Steel										
Electricicy Iro/Steel										

4) Sample survey of foundry : Companies (foundries) outside JFC Survey of the foundry industry was carried out, taking samples from foundries which are similar to JFC in scale. The JICA team visited 7 foundries and sent questionnaires to 8 foundries.

a) Trend of product items

Main products (FC, SC, Malleable iron) of the surveyed foundries are:

- Pipe fitting (Malleable)
- Flywheel (FC)
- Brake drum (FC)
- Counter weight (FC)
- Anchorage (FC)
- Valve (FC)
- Pump (FC)
- Gear for tea machine (FC)
- Frame of textile machine (FC)
- Rice mill parts (FC)
- Rice polisher parts (FC)
- Ingot (FC)
- Cylinder liner (FC)
- Sugar mill roll (FC) (SC)
- Sugar mill frame (SC)
- Bogie (SC)
- Side frame (SC)
- Ball (SC)

Among these products, flywheel, counter weights, anchorages, pumps and cylinder liners are produced also by JFC, thus competition being expected.

b) Productivity

It is through excellent technology and productivity that a company captures the large share of demand. The productivity of each surveyed foundry is shown below:

Company	Production (per year)	Employee	Productivity	
			ton/manyear	ton/manmonth
A.	2,502 tons	470	5.32	0.44
B.	70	60	1.17	0.10
C.	140	37	3.78	0.31
D.	40	35	1.14	0.10
E.	120	85	1.14	0.12
F.	21	40	0.52	0.04
G.	324	74	4.38	0.36
H.	450	106	4.24	0.35
I.	1,630	96	16.98	1.41
J.	720	210	3.43	0.26
K.	325	84	3.86	0.32
L.	1,440	200	7.20	0.60
M.	880	200	4.4	0.37
Total	8,662	1,697	5.10	0.42

Productivity of the surveyed foundries is rather low - less than one tenth of that in advanced countries. JFC's productivity is at present 4.45 tons/man·year, which is lower than the average of surveyed foundries. To compete with them effectively, JFC should improve its technology and productivity.

c) Price

Examples of prices below are taken from 10 surveyed foundries.

	FC	Product items
600 RP/kg	1 foundry	Sugar mill
950 RP/kg	2 foundries	Tea machine parts
1,000 RPkg	2 foundries	Flywheel, pump
1,200 RP/kg	1 foundry	Pipe fittings
	SC	Product items
1,500 RP/kg	1 foundry	Sugar roll
2,500 RP/kg	.....	Shoe of track

To compete with them, the reasonable price for JFC castings will be about 950 to 1,000 RP/kg (FC). This range of grades being a base load, JFC should have its eye on more sophisticated products with greater added value.

d) Fraction defective of products

The following is the fraction defective of products in 9 surveyed foundries:

Foundry	Product defective rate
A	1%
B	2%
C	6 - 8%
D	11.4%
E	10 - 14%
F	10 - 15%
G	13 - 15%
H	15 - 20%
I	20%

Almost all 9 foundries have high fraction defective of products. The average seems to be 10 to 15%. JFC's rate is 18%, which is fairly high even compared with surveyed ones.

Without lowering it down to 6%, JFC could not survive the competition. The products with greater added value will require more sophisticated specifications for product inspection and, if production control remains as it is, give rise to even higher fraction defective of products.

So, the first priority is to acquire basic technique. It is only through basic technique that the required product quality is satisfied and the fraction defective of products is decreaased.

e) Equipment

(1) Melting equipment

Electric furnaces - low frequency furnace (LF), high frequency furnace (HF), Heroult furnace (HEF) - are used by 7 foundries.

LF + HF	2 foundries
LF	2 foundires
HF	1 foundry
HEF + HF	1 foundry

The number of foundries which use cupolas is also 7. The table below shows the production amount and product items according to the type of melting furnaces.

Although the electric furnace group and cupola group have the same number of foundries, the former produces about three times as much as the latter. Moreover, the electric group produces higher grade products than the cupola group.

	Electric furnance group	Cupola group
Production amt	9,050 tons	2,410 tons
Product item	Pipe fittings Flywheel Brake drum Counter weight Cylinder liner Rice mill parts Ingot Bogie/frame Sugar mill roll	Anchorage Flywheel Dump Counter weight Tea machine gear Textile machine frame Sugar mill roll

It is difficult to say which is better between electric furnace and cupola.

In general, electric furnaces are preferable for FCD, but in case of FC in large quantity, cupolas have an advantage. In deciding which to employ, various factors - costs of electricity and coke, characeristics of a foundry, etc. - should be taken into account.

(2) Molding equipment

Molding machines are used by 9 foundries out of 13.

Foundry	Number of molding machines
A	11 units
B	2 units
C	7 units
D	8 units
E	2 units
F	15 units
G	17 units
H	2 units
I	4 units
Total	68 units

The average is 5.2 units/foundry.

It seems that relatively small types of castings are being produced with these machines.

Table 3.6-3 Sample Survey of Foundry Shop

ENTER-PRISE	EMPLO-YEES	PRODUCTION (TON/Y)			Price (RP/Kg)	Reject (%)	Future Plan	Casting Name	Mate-rial	Size	Unit Weight (Kg/piece)	Max Size/ Weight	Facilities			
		1982	1983	1984									Melting	Molding	Others	Building
A	470	1,884	2,718	2,502	FC: 1,200	11.4%	3300T/Y (FC:455T/Y) ((750T/Y)	Pipe fitting (1/2"-3") Fly wheel Bearing housing Balance weight	FCMB28 FC25 FC20 FC20	1/2"-3"	0.1-2.3 16-22 6.3 1.0	409x404 x79. 52kg	LHF... 3Tx2 HFF... 3Tx1	FDC-1... 7 FDC-2... 2 2MM-AR.. 1 2ML-AR.. 1	Shot blast ..... 1 Cleaning Drum.... 1 Leakage Tester.. 1	7,300 m2
B	60			70	FC: 1700-2500 SC: 2500		Brake Drum 1000 piece/M 5000	Brake-Drum Track shoe Counter weight Jaw crusher Gear					HFF...0.4Tx1 LFF... 2Tx1	FD-3B-2	Emission spectrometer 1	
C	45			trial	Simple 1500-1700		At present time..Trial 200 T/M	Brake-Drum Cylinder liner Fly Wheel Motor cover	FC FC FC FC				LFF... 1Tx2	FD-1... 5 FD-4... 2	Microscope ..... 1 Brinell 1	
D	37			140	FC: 1000	6-8%	INDESTMENT RD500,000,000.- 100 T/Y	Anchorage Fitting	FC25 FC20		10-20 0.5-5		Cupola... 1T/Mx2 CE-meter-1	F2A.... 2 Shell,M..2	Shot blast .... 2 Lathe...10 Hardness T..... 1	2,000
E	35			FC: 20 Al-C:20	FC: 950 Al: 4000		Water Valve : (2"-8") Textile Parts	Water Valve Furnace Cover Counter Weight Ornamental Bracket Tension Cable Suspension	FC20 FC20 FC20 Al Al Al	4" ø300 600x400 x250	30 30 130 0.3 0.3 0.3	FC: 600kg Al: 300	Cupola ...2T/Mx1 Crucible(Oil) ...0.5Tx1	MM...450x450 x50...1 IMM..450x750 ... 1		1,300
F	85			120	1000	1%		Pump Flywheel	FC FC				Cupola ... 2Tx1	CO2 Greensand Handmolding		
G	40		FC: 10 BC: 3 Al: 2	15 3 3		FC: 20% BC&Al: 5%		Water meter Tea machinery gear Shaft blacket Cooler Fan Bearing Shaft	BC FC20 FC Al BC	ø150x100 ø400x50 40x60x115 ø2000 ø400	10 40 30 65 30	FC: 2000x500 x150...1.5T Al: ø2000..150kg BC1200x 400x150..150kg	Cupola: 2T/Hx1 Crucible: 0.2T/Hx2	Hand Molding		1,500
H	74 (Total) (350)	FC: 200 BC: 10 Al: 1	250 15 2	300 20 4	FC: 950 BC: 4500 Al: 2500	FC:10-14 BC:15-5		Textile Machine .... Frame Tea Factory .... Gear Water meter Bearing Gears	FC20 FC20 BC BC BC	2x0.7x0.9M ø3x0.1M ø200 ø400 ø500	65 500 10 30 65	FC: 2x0.5x0.4 ...1.5T BC: 1.2x0.5 ..650kg Al: ø2x0.2 ..40K	Cupola: 7T/Hx1 Crucible: 0.5T/Hx2	Greensand CO2 Hand Molding		10,000

Sample Survey of Foundry Shop

ENTER-PRISE	EMPLO-YEES	PRODUCTION (TON/Y)			Price (RP/Kg)	Reject (%)	Future Plan	Casting Name	Mate-rial	Size	Unit Weight (Kg/piece)	Max Size/ Weight	Facilities			
		1982	1983	1984									Melting	Molding	Others	Building
I	106 (Total) (630)	500	270	450		15-13%		Meter pump unit Rice Milling unit Rice Polisher unit Fly wheel	FC20 FC20 FC20 FC25	Bar Bar Bar ø450x70	115 95 93 60	600x400x 150 ø450x70 ±60kg	LFT..1.5T..1 2.0T..2	FIA..... 2 F2A..... 4 KHFO.... 2 FD2A.... 4 FO3B.... 2 T3..... 1	Laboratory ..... 1 Hardness.T ..... 1 Tensile Strength Test M.. 1	17,000
J	96			FC: 324 SC: 960 Others: 346		FC: 2% SC: 3% Others: 2%	Mass production	Iron and Steel Castings				FC: 2.5x2.5x2M ...4 Ton SC: 1x1x1M ...2.5Ton	HFT... 2Tx1	F-1A/2A..12 Shell M.. 5		4,320
K				FC:2000 SC:1500	FC: 200 SC: 300			Ingot Round Bar	FC25 SC	140x90x90 ø8x12,000 ø9x " ø10x "	:90 4.74 6.7 7.0	140x90x90 ø10x12,000	Induction:1	Ingot mold 35		10,000
L	210			720				Piston ling Cylinder liner								
M	84	FC: 300 Non-Ferrous 25	300 25	300 25	FC: 600	FC: 10-15% Others: 7-10%	1990 year Investment U$1,250,000 FC:1000T/Y SC:1000T/Y	Sugar mill spare parts			3 Ton		Cupola.. 2	MM..... 2	Lathe Radial boring Shaperi etc. 30	7,000
N	200			FC 1440				Sugar Roll mill Castings for Tin Mining			14 Ton		Cupola:10T/Hx2 5T/Hx1 2T/Hx1 Rotary 4Tx2 BC:Rotary 1Tx1 Tilting 2Tx1 1Tx2	Pit Hand molding		10,000
O	200			SC 880	SC: 1500	15-20%	FCD:50T/M	Sugar Roll mill Frame Bogey Side Frame ball					Electric F: 6T/Bx1 HFF: 2Tx2 0.5Tx1	UG4... 2 UG5... 2	Spectrometer ..... 1 Shot blast.. Hunger..1 Drum....2 Heat treatment..1	8,000

3.7 Sales strategy and production policy

1. Basic strategy

As a nationalized enterprise, JFC's target should be the following types of products:

(1) Some of the products that JFC is now manufacturing and could be JFC's base load.

(2) Those products which are being tentatively manufactured under the home production plan.

(3) Those products which are to substitute imported ones in the long run.

Through fair competition with the private enterprises, JFC should enhance its competitive position in the world market. On the other hand, JFC could give a positive impact on the private sector by acquiring high technology for home production.

2. Target market

At the present stage, it would not be wise for JFC to expand too rapidly even after the renovation. The first priority is to produce reliable products at low cost and go on step by step. Instead of putting a finger in every pie, the target fields should be narrowed down to a certain extent.

From this point of view, special emphasis is put on the above-mentioned first group.

Accordingly, JFC's market consist of :

(1) Agro-based machine and equipment

(2) Transportation

(3) Civil and construction

(4) Machinery industry

(5) Mining and energy

(6) Others - public sector

3. Criterion of production

Considering the characteristics of JFC, it should be decided what items of product in the target fields are suitable for it. From the managing point of view, producing a limited number of product in a large quantity is most effective, though the products sizes suitable to JFC's equipment should also be taken into account.

The types of castings should be narrowed down, too. If many types of castings such as FC, SC, BC, Al were all dealt with, technical and managerial losses would be significant.

In view of the products of other state foundry factories, FC and FCD are the most suitable types of castings for JFC.

Consequently, the products which satisfy the following conditions may be selected.

(1) Possibility of mass-production for small number of product items.

(2) FC and FCD

(3) The sizes of products are:

a) 600 mm x 560 mm flask for machine molding

b) 1,500 mm x 1,500 mm flask for hand molding

c) Below 3 tons per product

4. Demand for each item of products

JFC should, freed from the past manners, search customers through consultation with the private sector. Besides, JFC, a member of the state enterprise Barata group, has special duties to supply foundry products to the other members and to become a vehicle for realizing the home production program.

These considerations lead to the following estimation of demand for JFC with regard to each item of product (see Table 3.7-1):

Table 3.7-1 Estimation of demand for JFC (1)

Target industry	Target products	Total demand	
		1st year	10th year
1. Agro-based machine and equipment	1) Flywheel	260t/y	814t/y
	2) Cylinder block	455	1,432
2. Transportation	1) Shoulder	250t/y	———
	2) Press die	40	80t/y
Diesel engine for general use	3) Flywheel	20	120
	4) Cylinder liner	16	96
	5) Cylinder head	40	240
	6) Cylinder block	300	1,800
Diesel engine for generator use	7) Flywheel		240
	8) Cylinder liner		90
	9) Cylinder head		144
	10) Piston		45
3. Civil and construction	1) Counter weight	1,640t/y	4,100t/y
4. Machine industry	1) Lathe	2,133t/y	5,960t/y
	2) Milling machine	551t/y	1,000t/y
	Total	6,505T	17,371T

Table 3.7-1 Estimation of demand for JFC (2)

Target industry	Target products	Total demand	
		1st year	10th year
5. Mining and energy	1) Pump 2) Bubble cap	300t/y 300t/y	420t/y 600t/y
6. Public sector	1) Pipe fitting 2) Manhole cover	200t/y ———	200t/y ———

5. Sales strategy - Customers

Present and future customers for JFC are as follows:

(1) Agro-based machinery and equipment

JFC has already manufactured agro-diesel engine-flywheel- for R.T. Yammar. Other customers include Kubota and Mitsubishi.

(2) Transportation

a) The main customer for railway equipment would be the Ministry of Railway and Perusahan Jawatan Kereta Api. If quality, cost and delivery time are satisfied, the orders will be likely to come from them.

b) Automobile press die

This is used for the pressing of automobile sheet metal. Some dies have been already delivered to Mitsubishi, but complaints over the quality, cost and delivery time have been made. An order has also come from P.T. Materindo. Potential customers

are car makers such as Toyota, Daihatsu, Suzuki, Honda nad Isuzu.

(3) Diesel engine parts

Diesel engine parts either for general use or for generators. In both cases the main customer is BBI of Barata group. B.B.I should be a main target in the future, too.

(4) Civil and construction

In this field JFC produces only counter weights for construction machine/forklift. A present customer is P.T. Tractor Nusantara. Other potential customers are P.T. Trakindo Utama (Caterpillar), P.T. United Tractor (Komatsu), P.T. Triguna Utama (Mitsubishi) and so on.

(5) Machining industry

Some orders have been received from P.T. Industry Mesin Perkakas Indonesia. There are 11 companies having licences to manufacture machine tools. Among them, lathes and milling machines are produced by the following companies:

1)	IMPI	Lathe
2)	P.T. SARANA IDEA UTAMA	Lathe
3)	P.T. SUMBER BAHAGIA	Lathe
4)	P.T. BINTANG INDUSTRY	Lathe
5)	P.T. TOOL INDONESIA	Lathe and milling machine
6)	P.T. (PERSERO) PINDAD	Lathe and milling machine
7)	P.T. PIMSF	Milling machine
8)	P.T. MEDAN GERAK JAYA	Milling machine

(6) Mining and energy

The orders of mining pumps have been received from the state tin mining corporation, P.T. Tambang Timar. This corporation and its 3 contractors (private companies) engage in the whole process of tin mining from exploration to refining. They will be the main customers in this field.

Bubble caps are used in petroleum refining. There are 9 major petroleum refineries in Indonesia. They are Calacap, Balikpapan, Putri, Tuguh, Sugai (Sei), Pakning, Plagn, Sugai and Gorong.

(7) Public sector

It is difficult to get constant orders from the public sector. However, Kubota, which supplies pipe fittings to the public sector, is intending to use JFC as a base for exporting and could be a stable customer.

6. The estimation of demand for JFC is based on the following calculations

(1) Agro-based machine and equipment

The Ministry of Industry estimates the demand of tractors as shown below:

	1984/85	85/86	86/87	87/88
	unit	unit	unit	unit
Mini tractor	3,000	3,500	4,000	5,000
Hand tractor	8,000	15,000	20,000	33,000
Large tractor	2,000	2,200	2,500	2,900
	13,000	20,700	26,500	40,900

From this estimation, the demand for flywheels and cylinder blocks is calculated in the following way (The first year is 1984/85 and 10th year is 187/88) :

Flywheel : The weight is supposed to be 20 kg/pc

1st year ... 20 kg x 13,000 = 260t/yr

10th year ... 20 kg x 40,900 = 818t/yr

Cylinder block : The weight is supposed to be 35 kg/pc

1st year ... 35 kg x 13,000 = 455t/yr

10th year ... 35 kg x 40,900 = 1,432t/yr

(2) Transportation

1) Shoulder

According to the field survey, the demand will continue for 5 years at the rate of 250 tons per year. The weight is supposed to be 1 kg per piece.

2) Press die

The estimation is based on the types that JFC can produce. For the first 3 years, the average weight is supposed to be 1.5 ton per unit. After 3 years, it is supposed to be 3 tons per unit. The demand is estimated to be 3 times as much as that of present orders to JFC.

1st year ... 8 set/yr x 100/30 x 1.5 ton/set = 40t/yr

10th year ... 8 set/yr x 100/30 x 3 tons/set = 80t/yr

(3) Diesel engine

As to diesel engines for general use, B.B.I plans to produce 1,000 units per year for 5 years, and 6,000 units per year after that. Products have a range of cylinders, from 2 to 12, 4-cylinder being taken at the average here. The supposed weight per piece is shown in each formulas below.

a) Flywheel

1st year ... 20 kg/pc x 1,000 = 20t/yr

10th year ... 20 kg/pc x 6,000 = 120t/yr

b) Cylinder (liner)

1st year ... 4 kg/pc x 4cyl x 1,000 = 16t/yr

10th year ... 4 kg/pc x 4cyl x 6,000 = 96t/yr

c) Cylinder head

1st year ... 10 kg/pc x 4cyl x 1,000 = 40t/yr

10th year ... 10 kg/pc x 4cyl x 6,000 = 240t/yr

d) Cylinder block

1st year ... 300 kg/unit x 1,000 = 300t/yr

10th year ... 300 kg/unit x 6,000 = 1,800t/yr

As to diesel engines for generator, it is planned to start manufacturing in 2 year's time by introducing foreign technology. Thus demand will occur in 3 years' time. The production amount will be 200 to 300 units per year (200 units for the 3rd year, 300 units for the 10th year)

- Flywheel

  3rd year ... 800 kg/pc x 200 = 160t/yr

  10th year ... 800 kg/pc x 300 = 240t/yr

- Cylinder liner

  3rd year ... 50 kg/pc x 6cyl x 200 = 60t/yr

  10th year ... 50 kg/pc x 6cyl x 300 = 90t/yr

- Cylinder head

  3rd year ... 80 kg/pc x 6cyl x 200 = 96t/yr

  10th year ... 80 kg/pc x 6cyl x 300 = 144t/yr

- Piston

  3rd year ... 25 kg/pc x 6cyl x 200 = 30t/yr

  10th year ... 25 kg/pc x 6cyl x 300 - 45t/yr

(3) Civil and construction

The demand for forklifts is estimated by United Tractors as in the table below :

	I		II		III		IV		V	
	unit	ton	unit	ton	unit	ton	unit	ton	unit	ton
TOYOTA	350	462	380	508	450	605	520	698	570	760
United Tractor	675	1191	760	1341	850	1490	940	1640	1035	1803
Total	1025	1653	1140	1849	1300	2095	1460	2338	1605	2503

Phase I of this table is taken as the 1st year and Phase V is taken as the 10th year.

The weight is supposed to be 1.6 tons per piece.

1st year

1.6 t/pc x 1,025 = 1,640t/y

10th year

1.6 t/pc x 2,563 = 4,100 t/y

(4) Machinery industry

The demand estimation is :

	1983	1989
Lathe	2,133 units	5,950 units
Milling machine	551 units	1,000 units

The weight of lathe parts and milling machine parts are supposed to be 1 ton per unit. The 1st year is 1983 and the 10th year is 1989.

a) Lathe

1st year ... 1t/unit x 2,133 = 2,133t/yr

10th year ... 1t/unit x 5,950 = 5,950t/yr

b) Milling machine

1st year ... 1t/unit x 551 = 551t/yr

10th year ... 1t/unit x 1,000 = 1,000t/yr

(5) Mining and energy

a) Pump

The present demand for pumps is supposed to be 300 tons per year, which will rise by 40% in 5 years' time and then become stable.

1 st year ... 300t/yr

10th year ... 420t/yr

B) Public sector

The demand for pipe fittings is estimated to be 200 tons per year (domestic and abroad).

CHAPTER 4

BASIC PROGRAM FOR DEVELOPMENT OF INDONESIAN FOUNDRY INDUSTRY

CHAPTER 4 BASIC PROGRAM FOR DEVELOPMENT OF INDONESIAN FOUNDRY INDUSTRY

4.1 present situation of Indonesian foundry industry

The demand for foundry products in Indonesia is said to be 70,000 to 100,000 tons a year. Among them, 30,000 to 35,000 tons are domestically produced and 40,000 to 65,000 tons are imported. At the Third Training Conference held by JICA in Bangkok in August 1981, the participant from the Indonesian Ministry of Industry informed that Indonesian foundry production amounted to about 35,000 tons a year with 157 iron casting factories and 218 nonferrous metal casting factories, most of which are concentrated in Java. Table 4.4-1 shows the data presented to this Conference by the various participants, including Asean countries.

At this Conference, the Indonesian delegate pointed out that their foundry industry was facing the quality problem caused by the shortage of skilled workers, inferior materials and poor technology, and thus in need of technical aides from the advanced countries.

Table 4.1-1 The present situation of the foundry industry in Asian Countries
(As of August 1981)

Item / Country	Type of factory	No. of fact'y	Prod'n Amt(t)	Type of products	Pop. (mil)
Nepal	Iron casting	6	500	Farming appliances, Machine repair tools	14
Sri Lanka	Iron casting	36	10,000	Construction tools, Household utensils	15
	Nonferrous metal	200		Machine repair tools	
Fiji	Foundry (Iron & non-ferrous metal)	3	——	Sugar refining machines Ship parts, Manhole, Repairs tools	0.6
Bangladesh	Iron casting	210	25,000	Hand pumps, Motor dr. pumps, Repair tools	86
	Nonferrous metal	40			
Indonesia	Iron casting	157	35,000	Pumps, Household utensils, Repair tools	148
	Nonferrous metal	218			
Malaysia	Iron casting	205	80,000	Tin processing machines, Palm oil processing machines, Manhole parts	13
	Steel casting	6			
	Nonferrous metal	12			
Thailand	Iron casting	200	86,000	Tin mining machines Sugar refining machines Automobile components Construction machines	46
	Steel casting	12			
	Malleable iron casting	5			
	Die casting	30			
Philippines	Iron casting	85	100,000	Mining & earth-moving machines, Ship machine parts, Sugar refining machines, Agricultural machines, Timbering machines	48
	Steel casting	11			
	Nonferrous metal	49			
Singapore	Iron casting	42	30,000	Mining machines, General machines, Ship machines, Pumps	2.3
	Steel casting	7			
	Nonferrous metal	15			
	Die casting	7			
	Precision casting	2			
Korea	Iron casting	278	700,000	Automobile components, General machines	38
	Malleable iron casting	15			
	Steel casting	51			
Taiwan	Iron casting	392	550,000	General machines, Automobile components, Precision machines	17
	Steel casting	21			
	Malleable iron casting	16			
	Nonferrous metal	32			
	Precision casting	20			
Hong Kong	Iron casting	134	51,000	Ship repair tools	6.5
	Nonferrous metal	101			
	Die casting	35			

Table 4.1-2 shows the present situation of small foundry factories in Indonesia. This is the result of the survey carried out by Japan External Trade Organization (JETRO) in August 1984, with the help of the Small Industry Dept. of the Indonesian Ministry of Industry.

JETRO team surveyed altogether 7 factories, 2 (A, E in the Table) in Jakarta, 1 (B in the Table) in Bandung 3 (C and D in the table, and another) in Tegal and 1 in Semarang. They are all small factories employing less than 30 workers and producing around 20 tons a month.

A, B, D and E factories are manufacturing industrial products, while C factory is specialized in producing hand pumps. To be more precise, A's products are brake drums for automobiles (cast iron), B's are small road rollers and water gate parts (cast iron), D's are general machine parts (cast iron) and E's are liners for automobiles and bicycles, piston rings and brake drums (cast iron).

Their main equipment, molding methods, raw materials and problems are also shown in the Table.

A and E factories employ high frequency induction furnaces, while B and D use the normal type of cupola. On the other hand, C uses old-type tilting china furnace without wind box. Although induction furnaces can be recommended as far as the product quality is concerned, they tend to push up the production cost through high installation cost, large consumption and high contract cost of electricity. Owing to low installation and operation costs, cupolas are the most widely used furnaces in the world but the china furnaces are still used everywhere in this country. In Japan, too, cupolas dominate in pig casting factories.

As to molding equipment, only E factory has an old-type molding machine, the rest using a hand molding method. Most factories have sand mills, though not sand reclaiming equipment.

Table 4.1-2 List of the surveyed factories (Aug. 1984)

Item \ Factory	A	B	C	D	E
1. Employees	30	16	15	16	20
2. Type of products	Construction machines, Automobile components	Road rollers, Water gates	Hand pumps	General machine parts	Automobile and motorcycle components, Liners, Brake drums
3. Type of castings	Cast iron Cast steel	Cast iron	Cast iron	Cast iron	Cast iron
4. Production amount (ton/month)	20	8	15	20	25
5. Melting furnance	High frequency furnance (0.4 t)	Cupola (1.5 t/h)	China furnance (0.5 t/h)	Cupola (2 t/h)	High frequency furnance (1 t)
6. Molding equipment	Nil	Nil	Nil	Nil	Sand molding machine, 6 units Large molding machine, 2 units
7. Sand milling equipment	Sand mill, 1 unit	Sand mill, 1 unit	Nil	Sand mill, 1 unit	Sand mill, 3 units
8. Molding method	Hand molding (Co_2 method)	Hond molding (Natural silica, Sand + clay, Dry sand molding)	Hand molding (River sand + clay Green sand molding)	Hand molding (Silica sand + molasses + starch CO_2 method, Green sand molding)	Machine molding (Synthetic sand, CO_2 method, Green sand molding)
9. Raw materials					
①Main materials for melting	Fine	Normal	Lot of rust and foreign substances	Irregular forms & dimensions, Foreign substances	Lots of rust, Foreign substances
Coke	———	Irregular lumps	Iregular lumps	Irregular lumps	———
②Sand	Quartz sand	Natural quartz sand	River sand	Quartz sand	Quartz sand
10. Problems	Inferior cast surfaces	Many flaws (Blow, Sand inclusion, Penetration)	Many flaws (blow, Sand inclusion, Misrun)	Many flaws (blow hole, Misrun)	Many flaws (Pin hole, Sand inclusion)

A, D and E factories use silica sand for moulding. E is the only factory that uses synthetic sand - or semi-synthetic sand to be exact.

From the point of raw materials for melting, only A is up to the standard, C, D and E being blemish.

The main problem of these factories lies in faulty products. With the exception of A factory, all of them produce such flaws as blow holes, sand inclusions, penetrations, misruns and pin holes.

From this survey it is reasonable to conclude that most of the factories are facing rudimentary and un-solved problems.

Indoensian government has just set about the fourth 5 year plan "REPELITA IV" (1985 - 1989). In the second and third 5 year plans (REPELITA II, III: 1975 - 1979, 1980 -1984), the emphasis was put on the domestic manufacturing of car and diesel components. This policy has been carried over into the REPELITA IV, and it is expected that the industries encouraged in the plan (car, agriculture, oil, cement, construction, etc.) will need much more foundry products than the traditional ones (tin, palm oil, sugar, forestry etc.). That is the reason why officials of the Ministry of Industry are so eager to develop the foundry industry.

Unfortunately, notwithstanding their eagerness, the achievement has not been satisfactory so far. In other words, the Indonesian industrialists are facing lots of difficulties caused by the poor state of their management and technology.

The essential points in overcoming these difficulties are:

(1) On the manager's side, increase of experience and new attitudes toward production management.

(2) On the production side, improvement of skills and full installation of necessary equipment.

Most users we surveyed expressed strong complaints about the quality, delivery and price of foundry products.

For instance, a Japanese joint venture pointed out that the average rate of defective products from its subcontracted factory reached 15% even though the production process was very simple. In the worst case, one lot included 71% of defective products.

Those defective products should have been disposed of by proper check before delivery. Frequently quality specifications are not observed strictly.

Also, delivery dates are likely to be ignored, which may cause the suspension of assembly work.

As for the costs, the products of subcontracted factories are more expensive than those of a parent company. Taking account of transportation, quality check, travel expenses for technical guidance, the former would be three times as expensive as the latter.

These problems are not restricted to Indonesia alone, but common to most of the developing countries. To cope with this difficult situation, one need accumulate knowledge and experience about management, production control, manufacturing technique and the like. More specifically, the following points are essential to develop enterprises.

a. Deep knowledge about qualities.

b. Positive attitude toward quality control.

c. Acquirement of proper technique.

d. Establishment of material and operation standards.

e. Training of workers.

f. Managers' experience

g. Competitive spirit.

Above-mentioned points are very important for Indonesia, and there are a great deal of things to do, ranging from development of key industries and proper financial policies to the training of personnel for enterprises. Since all of these measures require lots of time and money, they should be implemented step by step according to plan.

In many cases, governmental aids is indispensable for solving the problems. Personnel training is a case in point. MIDC in Bandung should play a crucial role in this. Yet, it seems that MIDC's training does not work well on the production line. For example, the lathe legs, which are being manufactured experimentaly, are based on MIDC's method, but it is hard to keep dimensional precision by this method. We think the leaders of MIDC need much more understanding of production techniques than they have now.

It seems also important to set up vocational training institutions for metal work at the expense of the state. At present the skills of foundry workers are so poor that requirements of users can not be met without taking some measures to improve them.

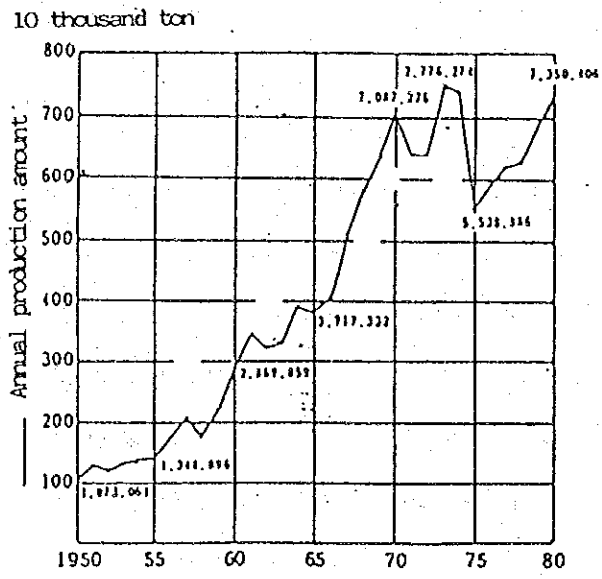
In these training institutions, it would be most effective to teach basic knowledge and technique by practice. Although it is desirable to set up several of such institutions throughout Indonesia, there might a bottleneck in fund and instructors. Therefore, our opinion is that initially a training institution should be established within Jakarta Foundry Center to give opportunities of acquiring basic knowledge and skills for foundry and machine work.

4.2 Development of the Japanese foundry industry

The followings are the chronological outline of the development of the Japanese foundry industry.

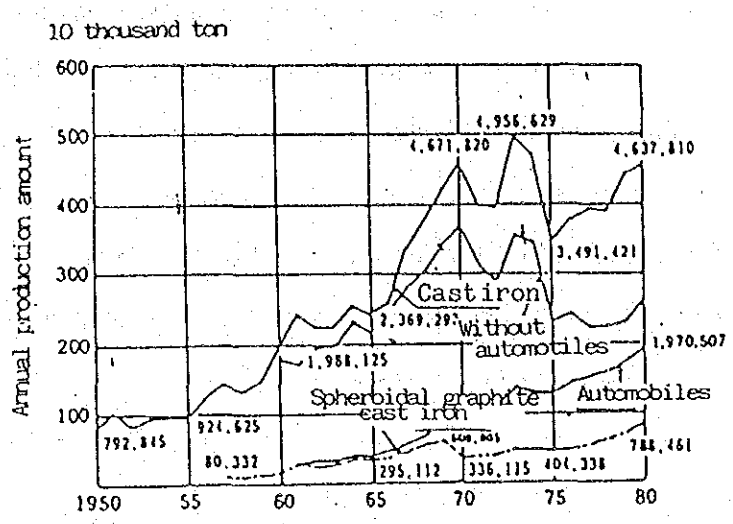
4.2.1 Production amount

Table 4.2.1-1 shows the chronological change of production amount of each casting since 1950. In Fig. 4.2.1-1 and -2, this change is shown in graphs.



Source: Japan Foundrymen Society

Fig. 4.2.1-1 Total Amount of Foundry Production in Japan



Note: Spheroidal graphite cast iron makes a part of cast iron
Up to 1969,

Source: Japan Foundrymen Society

Fig. 4.2.1-2 Amount of gray & sheroidal graphite cast iron production (cast-iron pipes excluded)

According to Table 4.2.1-1, the amount of foundry products in Japan was 7,776,274 tons in 1973, the year of the oil crisis. Since then the product amount, reflecting the world recession, had been continiously decreased until 1980, when the economic recovery caused its rapid increase up to 7,350,406 tons.

Let us see the production amount individually casting by casting.

The production of cast iron was 891,199 tons in 1950, 2,012,325 tons in 1960, 5,248,501 tons in 1970 and reached the peak, 5,765,271 tons, in 1973. The share of cast iron in the whole foundry demand is around 75%.

The production of malleable cast iron also reached the peak in 1973 with 486,495 tons. Since then it has gradualy decreased and 1983's production was only 280,122 tons - 57.6% of that of 1973. This resulted from the fact that spheroidal graphite cast iron has replaced malleable cast iron as materials of pipe joints and car components which provided major demand for the latter.

The production of cast steel showed the same pattern, the peak being 907,222 tons in 1973, followed by the gradual decrease (518,815 tons in 1983 - 57.2% of that of 1973). This was also caused by the replacement of cast steel with spheroidal graphite cast iron in shipbuilding, steelmaking and power plants.

The production of light alloy castings and die castings has increased because of the boom in the car industry. In 1983, the amount was 268,620 tons for light alloy castings and 445,293 tons for die castings.

The production of copper alloy castings remains almost unchanged over the period - about 90,000 to 120,000 tons a year.

Precision castings are mainly used for car components, industrial machines and precision machines. The production amount was 6,124 tons in 1983, which was, however 25 billion yen, a big increase in terms of pecuniary amount.

Table 4.2.1-2 shows the chronological change of cast iron production classified by its uses.

According to this table, cast iron for car components amounted to 1,891,700 tons in 1983, occupying 40.1% of the whole. This was followed by cast iron pipes (915,100 tons, 19.4%) and industrial machines and tools (688,200 tons, 14.6%).

Table 4.2.1-3 shows the uses of castings for various types of industries. In 1983, almost half of foundry products (2,891,000 tons, 45.7%) were used for transporting equipment and machinery (automobiles, industrial vehicles, bicycles, harbor and railway, ships). General machinery (industrial, civil engineering and construction, mining, metal work, textile, agricultural, fishing, etc.) occupied the second position with 1,376,200 tons (21.5%), and electrical machinery (electronics, electric,communication, etc.) the third position with 190,600 tons (3.0%). "Others" in the table includes a wide variety of machines and tools, e.g. rolls, casting molds and molding plates, pipe joints, valve and cocks, cast iron pipes and so on.

Table 4.2.1-1 Production Amount of Each Type of Foundry

(Unit: ton)

Yr. \ Mat.	Cast iron	Malleable iron	Cast steel	Light alloy	Copper alloy	Die casting	Precision casting	Total
1950	891,199	28,785	114,141	6,698	31,014	1,224	—	1,073,061
55	1,092,742	58,200	144,390	11,627	35,802	6,137	—	1,348,898
60	2,012,325	129,053	352,528	34,874	72,571	40,308	—	2,859,859
65	2,861,658	200,895	423,578	59,396	83,226	88,579	—	3,717,332
70	5,248,501	426,440	896,771	178,088	117,005	220,421	—	7,087,226
73	5,765,271	486,495	907,222	183,797	122,933	309,215	1,341	7,776,274
74	5,508,933	444,945	890,380	172,982	117,274	286,821	1,764	7,423,099
75	4,060,094	323,489	644,590	163,620	87,573	252,328	1,192	5,538,886
76	4,459,865	331,352	621,291	192,510	89,147	303,818	1,727	5,979,710
77	4,649,693	353,958	611,752	206,147	85,502	332,251	2,254	6,241,557
78	4,641,131	345,015	623,087	229,102	81,464	351,530	2,262	6,273,591
79	5,229,065	348,306	682,296	243,555	87,669	374,820	2,686	6,968,397
80	5,482,301	332,249	732,605	269,980	95,445	433,910	2,599	7,349,089
81	5,043,385	299,299	682,657	277,087	95,470	450,212	4,494	6,852,604
82	4,823,757	284,190	612,931	264,341	91,725	428,730	4,918	6,510,592
83	4,719,554	280,122	518,815	268,620	86,325	445,293	6,124	6,324,849

Source : Annual & monthly reports of machine statistics published by the Ministry of International Trade and Industry

Table 4.2.1-2 Chronological Change of the Use of Cast Iron

(Unit: Thousand ton, %)

Use \ Year / Vol. Pct.	1965		1970		1975		1980		1983	
	Volume	Pct.	Volume	Pct.	Volume	Pct.	Volume	Pct.	Volume	Pct.
Industrial machine & tool	740.7	25.9	1,168.6	22.3	554.0	13.6	836.8	15.3	688.2	14.6
Civil engineering & mining machine	24.0	0.8	53.1	1.0	55.9	1.4	113.4	2.1	100.6	2.1
Metal processing machine	56.8	2.0	230.8	4.4	92.6	2.3	177.6	3.2	149.5	3.2
Roll	86.2	3.0	122.6	2.3	76.3	1.9	83.2	1.5	72.7	1.5
Textile machine & tool	96.6	3.4	129.4	2.5	46.8	1.1	62.0	1.1	41.6	0.9
Mold & molding plate	568.1	19.9	1,365.6	26.0	872.0	21.4	534.8	9.8	140.0	3.0
Agricultural & finishing tools	57.4	2.0	67.8	1.3	64.2	1.6	93.7	1.7	96.2	2.0
Electrical & communication equipment	85.4	3.0	150.5	2.9	87.0	2.1	132.7	2.4	115.4	2.4
Automobile	295.1	10.3	898.0	17.1	1,215.5	29.9	1,970.5	35.9	1,891.7	40.1
Industrial vehicle, bicycle & railway	36.2	1.3	70.5	1.3	59.3	1.5	146.3	2.7	107.5	2.3
Harbor & ship	83.0	2.9	121.6	2.3	121.1	3.0	116.1	2.1	96.7	2.0
General goods	87.5	3.0	92.8	1.8	61.5	1.5	69.8	1.3	51.4	1.1
Cast iron pipe	492.4	17.2	576.7	11.0	574.7	14.1	844.8	15.4	915.1	19.4
Others	152.4	5.3	200.6	3.8	185.4	4.6	300.8	5.5	253.0	5.4
Total	2861.8	100	5,248.6	100	4,066.3	100	5,482.5	100	4,719.6	100

Source : "Foundry Yearbook 1983" published by General Foundry Center

Table 4.2.1-3 Uses of Foundry Products in the Major Machine Industries

(Unit: Thousand ton, %)

Type of Ind. \ Year \ Mat.		Cast iron	Malleable iron	Steel	Copper alloy	Light alloy	Die casting	Precision casting	Total
General machine	1981	1,202.3 (23.8)	18.4 (6.2)	271.2 (39.7)	16.4 (17.2)	22.3 (8.1)	38.5 (8.5)	1.3 (28.9)	1,570.4 (22.9)
	82	1,127.5 (23.4)	13.5 (4.8)	257.0 (41.9)	14.9 (16.3)	21.0 (7.9)	37.0 (8.6)	1.4 (28.6)	1,472.3 (22.6)
	83	1,076.1 (22.8)	13.6 (4.8)	212.1 (40.9)	14.3 (16.6)	20.6 (7.7)	38.2 (8.5)	1.3 (21.3)	1,376.2 (21.8)
Electric machine	1981	127.4 (2.5)	9.9 (3.3)	21.7 (3.2)	4.7 (4.9)	8.3 (3.0)	40.5 (9.0)	0.3 (6.7)	212.8 (3.1)
	82	119.8 (2.5)	13.7 (4.8)	18.7 (3.1)	3.8 (4.1)	7.8 (3.0)	36.1 (8.4)	0.3 (6.1)	200.2 (3.1)
	83	115.4 (2.4)	13.9 (5.0)	15.1 (2.9)	3.3 (3.8)	8.4 (3.1)	34.2 (7.7)	0.3 (4.9)	190.6 (3.0)
Transportation machine	1981	2,162.6 (42.9)	113.7 (38.0)	138.1 (20.2)	18.1 (19.0)	232.7 (84.0)	333.5 (74.1)	1.5 (33.3)	3,000.2 (43.8)
	82	2,027.9 (42.0)	103.0 (36.2)	110.9 (18.1)	16.5 (18.0)	222.8 (84.3)	318.4 (74.3)	1.6 (32.7)	2,501.1 (43.0)
	83	2,095.9 (44.4)	106.1 (37.9)	106.8 (20.6)	15.6 (18.1)	227.7 (84.8)	336.4 (75.4)	2.5 (41.0)	2,891.0 (45.7)
Others	1981	1,551.1 (30.8)	157.2 (52.5)	251.7 (36.9)	56.3 (58.9)	13.7 (4.9)	37.7 (8.4)	1.4 (31.1)	2,069.1 (30.2)
	82	1,548.6 (32.1)	154.0 (54.2)	226.3 (36.9)	56.5 (61.6)	12.6 (4.8)	37.2 (8.7)	1.6 (32.7)	2,036.8 (31.3)
	83	1,432.2 (30.4)	146.5 (52.3)	184.9 (35.6)	53.1 (61.5)	11.9 (4.4)	37.5 (8.4)	2.0 (32.8)	1,868.1 (29.5)
Total	1981	5,043.4 (100)	299.2 (100)	682.7 (100)	95.5 (100)	277.0 (100)	450.2 (100)	4.5 (100)	6,852.5 (100)
	82	4,823.8 (100)	284.2 (100)	612.9 (100)	91.7 (100)	264.2 (100)	428.7 (100)	4.9 (100)	6,510.4 (100)
	83	4,719.6 (100)	280.1 (100)	518.9 (100)	86.3 (100)	268.6 (100)	446.3 (100)	6.1 (100)	6,325.9 (100)

Source : Annual & monthly reports of machine & steel statistics published by the Ministry of InternationalTrade and Industry

4.2.2 Chronological change of the numbers of factories and employees in the foundry industry

Since the end of the World War II, Japanese foundry industry had grown rapidly until the oil crisis triggered production fall in 1973. The production has been declining since then and so has the numbers of factories and employees.

1) Number of factories

Table 4.2.2-1 and Fig. 4.2.2-1 show the change of the number of foundry factories in Japan.

Table 4.2.2-1 Chronological Change of the Number of Factories Classified by the Type of Castings (At the end of March)

Castings \ Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Cast iron	1,198	1,174	1,146	1,098	1,045	1,013	1,003	971	935	923
Cast iron pipe	23	24	23	23	23	25	24	25	25	25
Malleable cast iron	62	59	58	57	51	50	46	41	47	41
Cast steel	178	175	174	174	161	157	152	152	150	148
Nonferrous metal casting	515	500	482	463	438	427	415	406	388	379
Die casting	146	149	146	152	153	155	154	152	154	154
Precision casting	23	24	22	19	19	19	19	29	29	29
Total	2,145	2,105	2,051	1,986	1,890	1,849	1,813	1,775	1,728	1,698

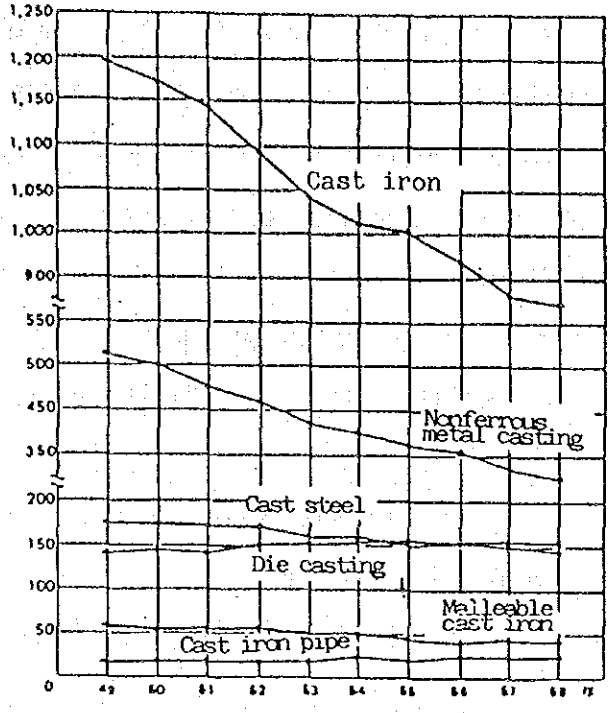


Fig. 4.2.2-1 Number of Factories Classified by the Type of Castings

In 1983, the number of factories was 1,198 — 30 less than the previous year. Compared to 1981 (38 less than 1980) and 1982 (47 less than 1981), this decrease appears to be relatively small. Considering the fact that the production had falled in three consecutive years, the efforts of the management seem to have been great. Over the period of 10 years since 1974, the factories has lowered its number from 2,145 down to 1,698 — a decrease of 447 (20.8%).

Let us see the change. Cast iron factories have reduced their number from 1,198 to 922 (decrease of 276, 23.0%) over past 10 years. The rate of decrease varies from year to year, being rather rapid in the years of recession. The number of cast iron pipe factories, although gradually increasing, remains unchanged at 25 in those 3 years. The fall of malleable cast iron factories is significant - from 62 to 41 (decrease of 21,

33.9%).

Needless to say, the decrease of demand is the most important cause of this fall. Cast steel factories have been reduced from 178 to 148 (decrease of 30, 16.8%) during these 10 years. The demand for cast steel falled greatly in 1983 and the management is facing the difficult situation. The number of nonferrous metal casting factories has decreased from 515 to 379 (decrease of 136, 26.4%), but that of die casting factories has increased from 146 to 154 (+8, 5.5%) over the same period.

In Table 4.2.2-2 each type of foundry is classified according to the number of employees.

From this Table it is clear that factories are generally small, nonferrous metal casting and cast iron factories being particularly so.

Table 4.2.2-3 shows the change of cast iron factories classified by the number of employees. Small factories with less than 29 employees have been reduced from 581 to 535 (-46, 7.9%) over 10 years, while factories of 30 to 49 employees have reduced their number from 295 to 195 (-97, 33.2%). For those of 50 to 99 employees, the reduction was from 187 to 115 (-72, 38.5%). Decrease of larger factories is as follows: For 100 to 299 employees, from 108 to 58 (-50, 46.3%); for 300 to 499 employees, from 15 to 10; for 500 to 999 employees, from 13 to 7. The number of factories of more than 1,000 employees have remained 2 without change. From these figures it can be concluded that on the whole Japanese foundry factories are getting smaller.

Table 4.2.2-2 Classification of Factories by the Number of Employees and Type of Castings

1983. 3.

Casting / Employees	Cast iron		Cast iron pipe		Mal.iron		Steel		Nonf.metal		Die	
	Fac.	Pct.	Fac.	Pct.	Fac.	Pct.	Fac.	Pct.	Fac	Pct.	Fac.	Pct.
29 or less	535	58.0	14	56.0	16	39.0	64	43.2	274	72.3	88	57.1
30 ~ 49	195	21.1							40	10.5		
50 ~ 99	115	12.5	3	12.0	15	36.6	44	29.7	31	8.2	31	20.1
100 ~ 299	58	6.3	2	8.0	5	12.2	35	23.6	29	7.7	28	18.2
300 ~ 499	10	1.1	4	16.0	3	7.3	4	2.7	4	1.0	6	3.9
500 ~ 999	7	0.8	2	8.0	2	4.9	1	0.7	1	0.3	—	—
1,000 or more	2	0.2			—	—	—	—	—	—	1	0.7
Total	922	100	25	100	41	100	148	100	379	100	154	100

Table 4.2.2-3 Chronological Change of the Cast iron g Factories Classifed by the Number of Employees

Employees / Year	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
29 or less	581 (48.7)	615 (52.4)	667 (58.2)	631 (57.5)	586 (56.1)	541 (53.4)	556 (56.4)	529 (54.5)	515 (55.1)	535 (58.0)
30 ~ 49	292 (24.1)	246 (21.0)	217 (18.9)	214 (19.5)	221 (21.2)	233 (23.0)	222 (22.1)	219 (22.6)	210 (22.5)	195 (21.1)
50 ~ 99	187 (15.6)	179 (15.2)	144 (12.6)	134 (12.2)	131 (12.5)	134 (13.2)	130 (13.0)	122 (12.6)	126 (13.5)	115 (12.5)
100 ~ 299	108 (9.0)	106 (9.0)	96 (8.4)	100 (9.1)	89 (8.4)	84 (8.3)	75 (7.5)	71 (7.3)	67 (7.2)	58 (6.3)
300 ~ 499	15 (1.3)	16 (1.3)	12 (1.1)	9 (0.8)	8 (0.8)	9 (0.9)	11 (1.1)	11 (1.1)	9 (0.9)	10 (1.1)
500 ~ 999	13 (1.1)	9 (0.8)	7 (0.6)	7 (0.6)	8 (0.8)	10 (1.0)	7 (0.7)	7 (0.7)	6 (0.6)	7 (0.8)
1,000 or more	2 (0.2)	3 (0.3)	3 (0.3)	3 (0.3)	3 (0.3)	2 (0.2)	2 (0.2)	2 (0.2)	2 (0.2)	2 (0.2)
Total	1,198 (100)	1,174 (100)	1,146 (100)	1,098 (100)	1,045 (100)	1,013 (100)	1,003 (100)	971 (100)	935 (100)	922 (100)

2) Number of employees

Table 4.2.2-4 and Fig. 4.2.2-2 show the change of the number of employees in Japanese foundry factories.

According to Table 4.2.2-4, the total employees in Japanese foundry factories were 93,579 in 1983, which is 2,170 (2.3%) less than the previous year. Over the period of 10 years, the total decrease is 44,793 (32.4%) from 138,172 in 1974. In cast iron factories, the number of employees fell from 46,032 to 44,457 (-1,573, 3.4%) in 1984. In cast iron pipe factories, it increased from 4,852 to 5.079 (+857). The total balance of both was a decrease of 718. In above-mentioned tow types of factory, the employees have been reduced from 76,751 to 50,166 (-26,585, 34.6%) over these 10 years. Malleable cast iron factories have seen the biggest reduction of employees in the industry — from 4,555 to 4,225 (-330, 7.2%) in 1983 and from 8,946 to 4,225 (-4,721, 52.8%) over 10 years. Cast steel factories also reduced their employees from 12,038 to 11,791 (-247, 20%) in 1983 and from 20,856 to 11,791 (-9,065, 43.5%) over 10 years. For nonferrous metal casting factories, the reduction ws 731 in 1983 (5.2% as compared to the previous year) and 3,922 (22.6%) over 10 years. On the other hand, die casting factories had gradually increased their employees since 1981 thanks to the rise of demand, but have been sluggish recently. Over ten years it has reduced its employees from 13,099 to 12,042 (-1,057, 8.1%). Precision casting factories, although declined temporarily, has increased their employees from 1,151 to 1,708 (+551, 48.4%). Precision casting is enjoying brisk

Table 4.2.2-4 Chronological Change of the Number of Employees Classified by the Type of Castings

(At the end of December)

Year \ Castings	Cast iron	Cast iron pipe	Mal. c. iron	Cast Steel	Nonf. Metal	Die casting	Precision casting	Total
1974	71.111	5.640	8.946	20.856	17.369	13.099	1.151	138.172
1975	61.960	5.301	7.836	19.825	15.414	12.124	1.013	123.476
1976	57.745	5.158	6.830	18.968	15.369	11.983	973	117.026
1977	55.285	5.100	6.337	15.634	14.955	11.873	855	110.039
1978	51.884	6.993	6.096	15.267	14.443	11.589	919	107.191
1979	52.000	6.944	5.592	14.448	14.530	11.763	949	106.226
1980	51.060	4.588	5.081	13.238	15.019	12.107	1.431	102.524
1981	48.910	4.536	4.820	12.779	14.894	12.620	1.487	100.046
1982	46.032	4.852	4.555	12.038	14.178	12.317	1.577	95.549
1983	44.457	5.709	4.225	11.791	13.447	12.042	1.708	93.379

Source: Annual & monthly reports of machine statistics published by MITI

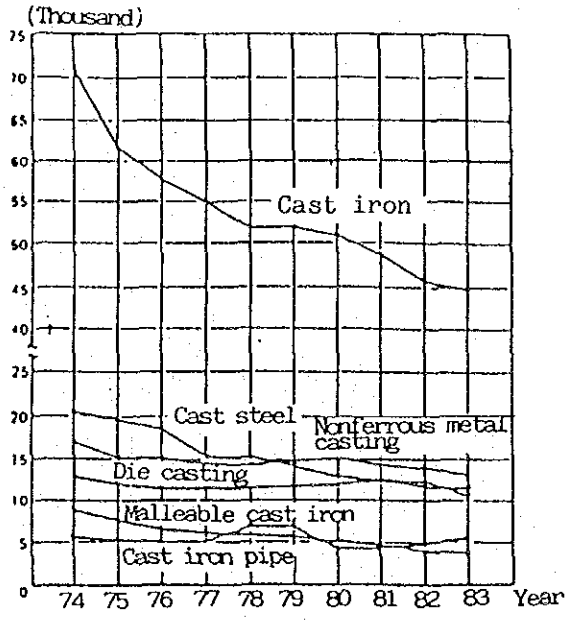


Fig. 4.2.2-2 Chronological Change of the Number of Employees Classified by the Type of Castings

3) Productivity and production amount per factory

Table 4.2.2-5 and Fig. 4.2.2-3 show annual production amount per employee since 1974.

According to Table 4.2.2-5, in 1983, the annual productions per employee were 85.6 tons for cast iron, 160.3 tons for cast iron pipes, 66.0 tons for malleable cast iron, 37.0 tons for die castings and 3.6 tons for precision castings. In spite of the recession, all castings except cast iron pipes and cast steel have raised their productivity, which is now much higher than the American foundry industry.

Table 4.2.2-5 Chronological Change of Productivity

(Unit: Ton, at the end of December)

Year \ Castings	Cast iron	Cast iron pipe	Malleable cast iron	Cast steel	Die casting	Precision casting
1974	65.2	146.3	49.7	42.7	21.9	1.5
1975	56.3	108.5	41.3	32.6	20.8	1.2
1976	65.5	126.9	48.5	32.8	25.3	1.8
1977	71.3	138.9	55.9	39.1	27.9	2.6
1978	74.7	109.5	56.6	40.8	30.3	2.5
1979	84.0	123.7	62.3	47.2	31.9	2.8
1980	90.8	184.1	65.4	55.3	35.8	2.5
1981	86.8	175.5	62.1	53.4	35.7	3.0
1982	85.3	187.7	62.4	50.9	34.8	3.1
1983	85.6	160.3	66.3	44.0	37.0	3.6

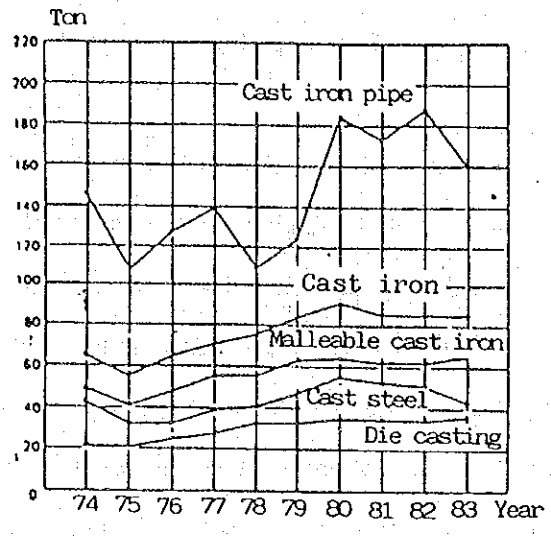


Fig. 4.2.2-3 Chronological Change of Productivity (per head/year)

Table 4.2.2-6 shows annual production amount per factory. In 1983, it decreased in cast iron and cast steel.

Over these 10 years, all but cast steel have increased the production per factory.

Table 4.2.2-6 Annual Production of Castings per Factory

(Unit: Ton)

Year \ Cast	Cast iron	Casting pipe	Mal. cast iron	Cast steel	Nonf. metal c.	Die casting	Prec. casting
1975	2,974	23,945	5,483	3,683	502	1,694	50
1976	3,303	28,476	5,713	3,571	584	2,081	79
1977	3,589	30,813	6,210	3,516	630	2,186	119
1978	3,709	33,283	6,765	3,870	709	2,296	119
1979	4,314	34,364	6,966	4,346	776	2,418	141
1980	4,624	35,200	7,223	4,820	881	2,818	189
1981	4,374	31,834	7,300	4,491	920	2,962	155
1982	4,199	30,434	6,047	4,086	918	2,784	169
1983	4,126	30,603	6,832	3,506	937	2,892	211

4) Price of foundry products

Prices of foundry products in Japan are listed in Tables 4.2.2-7, 4.2.2-8 and 4.2.2-9.

Price of a foundry product is determined on the basis of its shape, size, difficulty in manufacturing, quantity, yield, quality of the material, production method and other factors. In setting up prices, therefore, certain profit should be added to the calculated costs. The constant efforts to make a certain profit should be made, even though it is not easy when we are competing with others.

The lists below only indicate average prices for reference. Table 4.2.2-7 shows average prices of each type foundry products. Table 4.2.2-8 shows average prices of foundry products for industrial machines and tools. Table 4.2.2-9 shows average prices of automobile products. Products for industrial machines and tools in 4.2.2-8 are not mass-produced in most cases, whereas those for automobiles are usually mass-produced. Therefore the former is higher than the latter in prices.

Yen/kg is taken as the unit in these Tables.

In past years prices of foundry products have increased greatly. For example, the price of grey cast iron was 130.6 yen/kg in 1974, then it rose up to 184.6 yen/kg in 1984. The rate of increase was 141.3%. Among the various products, those for automobiles increased their price most rapidly. This can be seen in Tables 4.2.2-8 and 4.2.2-9.

The prices increases peaked in 1981 as can be seen in Table 4.2.2-7. Since then the price increase has lost its impetus because of the general recession. The fall of the process of non-mass-produced products for industrial machines and tools is especially significant. Therefore, foundries in this field are having a difficult time. The prices of nonferrous foundry products, that is, bronze castings, light alloy aluminum castings and die castings have changed drastically, depending on the change of material pieces.

Table 4.2.2-7 Chronological Changes of Foundry Products Prices by Material (per kg)

(Unit: Yen)

Material / Year	Gray iron castings	Sphere. gra. iron casting	Malleable iron cast.	Bronze castings	Lt. alloy alum. cast.	Alum.die castings
1974	130.6	190.1	245.6	886.0	657.1	593.3
75	137.2	190.4	264.8	856.1	645.5	597.2
76	139.5	199.3	260.3	870.9	669.3	626.8
77	143.7	209.2	269.6	872.0	718.0	666.8
78	152.2	207.4	267.6	857.3	710.4	658.3
79	156.7	209.5	269.6	883.5	730.2	689.1
80	169.6	223.3	296.8	971.9	835.5	752.1
81	179.8	229.7	307.8	924.3	860.1	712.2
82	183.0	230.1	321.2	915.4	828.5	683.9
83	184.6	230.8	331.4	895.4	818.9	689.3

Source: Annual report of machinery statistics by MITI

Table 4.2.2-8 Chronological Changes of Foundry Products Prices for Industrial Machines and Equipment (per kg)

(Unit: Yen)

Material / Year	Gray iron castings	Sphere.gra. iron casting	Malleable iron cast.	Bronze castings	Lt.alloy alum. cast.	Alum.die castings
1974	178.6	222.2	267.1	1,085.1	714.4	621.6
75	185.8	219.3	285.6	972.2	704.2	613.1
76	178.5	222.6	274.7	938.7	740.1	645.4
77	183.9	223.4	288.4	973.6	839.8	703.0
78	184.8	219.5	292.4	968.2	837.9	701.2
79	186.0	213.4	307.9	988.9	842.9	729.2
80	201.9	233.0	342.5	1,149.1	1,005.1	850.9
81	207.2	245.0	373.2	1,162.1	1,012.3	860.5
82	206.4	240.5	384.6	1,088.9	992.9	819.5
83	202.9	236.5	365.5	1,002.9	983.8	850.2

Source: Annual report of machinery statistics by MITI

Table 4.2.2-9 Chronological Changes of Foundry Products Prices by Material for Automobiles (per kg)

(Unit: Yen)

Material / Year	Gray iron castings	Sphere.gra. iron casting	Malleable iron cast.	Bronze castings	Lt. alloy alum.cast.	Alum. die castings
1974	121.7	173.0	223.3	748.5	596.4	553.3
75	136.3	173.7	251.0	889.7	596.2	562.0
76	136.9	186.5	240.1	926.6	604.4	583.6
77	138.1	204.5	241.3	976.0	652.1	618.8
78	148.1	200.8	231.0	910.2	649.4	613.7
79	155.4	202.9	231.9	938.6	672.7	644.6
80	162.9	210.8	250.7	1,107.7	771.3	697.8
81	167.3	212.9	252.6	1,114.5	806.2	650.4
82	170.7	214.6	264.1	1,110.4	775.4	635.2
83	170.5	216.7	264.9	1,006.5	767.3	631.1

Source: The same as Table 4.2.2-2

4.2.3 Present situation of small and medium-sized foundries in Japan

Table 4.2.3-1 shows samples from small and medium-sized foundries in Kawaguchi city. These listed employees, production volumes, monthly production, product items, materials (cast iron), melting equipment and molding sand for each of them.

From the Table, it is clear that there are big differences among foundries in production volume per worker, ranging from 2.0 tons to 10.0 tons per month. The same can be said in monthly production volume per worker. In the case of A factory which specializes in cast iron pipes of 100 - 250 kg class, hand molding is employed. Mass-production is not adopted. Its production efficiency is low, because of dry sand molding with clay. This dry sand molding method is seldom used in Japan nowadays. This factory is characterized by its manufacturing of spheroidal graphite cast iron in a small cupola.

B factory is a small foundry with only 10 employees. It mainly produces hydraulic parts and pipes. FC 35 and FCD (spheroidal graphite cast iron) are major materials. Its melting equipment is a 4.5 tons low frequency induction furnace. It adopts self-hardening molding which mixes resin binder with molding sand. Molding is done by hand.

C factory is an excellent foundry with 30 employees, manufacturing 300 tons/month of foundry products. The average weight of products is 3 kg. The products are mosty brake drums of small cars and motorcycles. Machine and green sand molding is employed. 4 units of high pressure high speed molding machines are used. The melting equipment is low frequency induction furnaces for 3.5 tons and 0.8 tons.

D factory enjoys the best productivity among the five. Its main products are for machine tools, the largest one weighing 5 tons and the average weight being 1.6 tons. The materials are cast irons only. The melting equipment is a low frequency induction furnace for 5 tons whose running water is 41 tons under 10 hour operation per day. It

consumes electric power of 56 kwh/ton. The self-hardening molding with furan resin is employed.

E factory produces machine tools and large-sized pumps. The materials are cast irons. The product weight ranges from 500 to 3,500 kg. The melting equipment is cupola of 5 tons/hour. 1 - 2% oxygen is mixed into the cupola during air blasting so that the temperature of molten metal can be kept high. Like other factories, self-hardening furan resin is used for foundry sand.

Table 4.2.3-1 An Example of Small-and Medium-sized Cast iron Foundries in Kawaguchi City

Item \ Foundry	A	B	C	D	E
Employee	25	10	30	55	21
Output(ton/month)	50	55	300	450	100
Production amount (Million yen/month)	21.3	8.6	44.4	94.5	22.5
Product	Cast ironpipe (bend pipe)	Valve hydral.parts	Auto-parts	Mach. tool parts	Mach. tool pump, etc.
Material	FC10, FCD 90 %	FC35, FCD 65 %	FC50, FCD 50 %	FC100 %	FC100 %
Melting furnace	2 ton/hr. cupola	Low freq.furn. 4.5 ton	Low freq.furn. 3.5, 0.8 ton	Low freq.furn. 5 ton	4 ton/hr. cupola
Molding sand	Dry sand mold	Furan sand	Grn.sand mold high/pre.mold	Furan sand	Furan sand

Note: These figures are as of September 1983

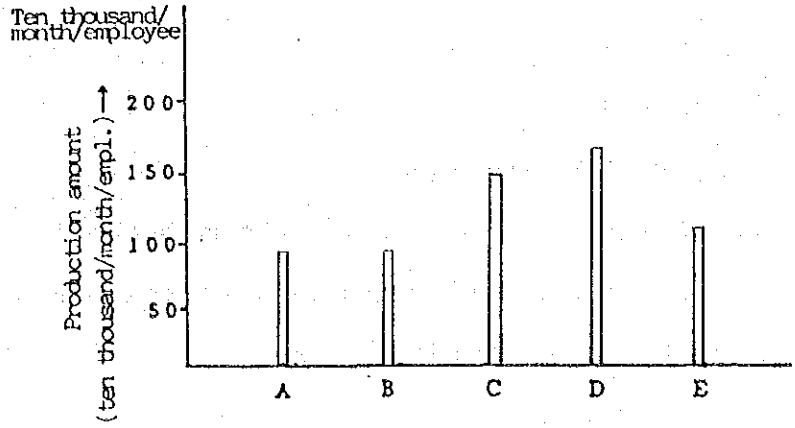


Fig. 4.2.3-1 Productivity value of each factory

All the floors of these 5 factories are concreted, and all have good working environment and their workers are well-trained. Since they receive regular check-ups by official casting instructors, they produce few defective products (unusable product) —the rate of defective products is about 2 - 3%.

These factories are imposed severe conditions over quality, delivery and prices by their users when receiving orders. The Table 4.2.3-2 shows an example of inspection standards of acceptance adopted by a certain user.

Table 4.2.3-2 An example of inspection standards of acceptance adopted by a machine tool maker

Foundry products are checked with regard to the following items.

1. Check items

(1) General check items

1) Material

a. Appearance

b. Dimensional accuracy

c. Mechanical properties

2) In-process check item

a. Appearance

(2) Specified check items

1) Cast iron products with sliding faces

2) Cast iron products used after being quenched and hardened

3) Cast iron products used as hydraulic parts or air-pressure parts

4) Specified deformation tempering castings

5) Attaching of checking data

6) Cast emblem of manufacturers

(3) Reference standard

1) Chemical constituent

2) Particles and structure

3) Dealing with defective products

2. Checking standards

(1) General checking standards

1) Material

a. Appearance

a) Appearance check at the delivery shall be done after shot or sandblasting.

b) Burrs and sand on castings shall be removed.

c) Scars of riser, ingate and so on shall be finished as cast surface or within 2/3 of finish allowance.

d) No defects such as cracks, drawhole, sand inclusion and pinhole should be on mill scale. However, on working surfaces, these are allowed in the limit of the finish allowance.

e) Roughness and unevenness of casting surfaces shall be mentioned in another specification.

2) Dimensional accuracy

a. Draft shall conform to JIS.

b. Tolerance of length shall conform to JIS.

c. Tolerance of thickness shall conform to JIS.

d. Tolerance of nonconformity due to the mold setting be within 0.5 mm.

e. Finish allowances are as follows:

Foundry size	Surface (top, bottom, side)
200 mm or less	3 mm
201 to 500 mm	4 mm
501 to 800 mm	5 mm

However, for upper molds, 2 mm of tolerance can be added.

3. Mechanical properties

(omitted)

However, only tensile strength and hardness are measured here.

4. Inspection after working

(1) No defect on working surface is allowed.

(2) No large particle due to the quality of material is allowed on working surface.

(3) No chapret on working surface is allowed.

(Other items are omitted)

For reference, we will mention below about the foundry in Kawaguchi, Japan.

Kawaguchi is located 25 km north of Tokyo. Its population is 400,000. Kawaguchi has been well known as a city of foundry and also called the "City of Cupola". There are 270 small sized foundries in the city. As shown in Table 4.2.3-3, the average output of pig iron and castings of 27,000 to 28,000 tons per month and of 300,000 tons per year, being the largest foundry manufacturing city of Japan. It forms 6.0% of 4,719,600 tons, the total foundry output in Japan (Table 4.2.1-2) in 1983.

Table 4.2.3-3 Breakdown of Cast Iron and Its Amount of Production in Kawaguchi District (as of May 1984)

(Unit: Ton, %)

Use	1984				1983	
	May		April		May	
Industrial machine&tool	9,991	121	10,403	126	8,234	100
Civil eng.&mining mach.	597	114	559	107	522	100
Metal proc.machine	1,762	142	1,859	150	1,243	100
Roll	19	90	32	152	21	100
Textile machine & tool	22	138	22	138	16	100
Mold & molding plate	606	90	631	94	673	100
Agriculture&fin.tools	635	69	794	86	926	100
Elec.&com. equipment	1,244	197	1,154	183	630	100
Automobile	5,605	122	5,901	128	4,613	100
Ind. vehicle,bicy&rlwy	2,388	201	2,196	185	1,190	100
Harbor & ship	379	117	401	123	325	100
General goods	377	93	439	108	406	100
Others	3,465	114	3,715	122	3,037	100
Total	27,090	124	28,106	129	21,836	100
No. of surveyed fact.	271		273		285	

Note: Includes ductile cast iron. May 1983 represents 100%
Source: Kawaguchi Foundry Association

The breakdown of cast iron and castings output in Kawaguchi is: 9,991 tons for industrial machines and tools forming 36.9% of the total; 5,605 tons for automobiles forming 20.7%, 2,388 tons for industrial vehicle; bicycle and railroad forming 8.9%, 1,762 tons for metal working machines forming 6.5%; and 3,465 tons for others forming 12.8%. The breakdown of these products classified by use is as follows. 10,870 tons for automobile, industrial vehicle, bicycle, railroad, agricultural machinery and implement, finishing implement, civil engineering and construction machine, mining machine, harbor and shipping, textile machine and implement, and electric and communication equipment. These are mass-produced forming 40.1% of the total. In addition, 16,220 tons for non-mass produced products such as industrial machine and tool, metal working machine, mold, mold stool, commodity, roller and other products forming 59.9% of the total. The foundries in Kawaguchi are characterized by manufacturing of non-mass produced products rather than mass-produced ones. Therefore, foundries for hand molding occupy the most part of all and those for machine molding comparatively a small portion. Every foundry in Kawaguchi, as exemplified by above mentioned 5 foundries, is mechanized with molding, melting and finishing equipments as well as working environment. The 1983's output of cast iron in Kawaguchi classified by use is shown in Table 4.2.3-4.

Table 4.2.3-4 Breakdown of Cast Iron and Casings Production in Kawaguchi District (1983)

(Unit: Ton)

Use	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Industrial machine&tool	7,601	8,361	8,716	8,812	8,234	9,257	8,807	8,309	9,011	9,709	9,834	10,108	106,759
Civil eng.&mining mach.	456	540	604	622	522	598	568	430	548	538	533	562	6,521
Metal proc. machine	1,095	1,197	1,233	1,341	1,243	1,405	1,403	1,290	1,403	1,702	1,679	1,662	16,653
Roll	10	25	22	16	21	22	36	23	21	29	21	21	267
Textile machine & tool	9	20	43	14	16	15	15	12	11	11	14	15	195
Mold & molding plate	627	734	517	648	673	533	530	409	465	648	775	662	7,221
Agriculture&fin.tools	525	545	556	626	926	615	622	627	708	764	787	791	8,092
Elec.&com. equipment	893	839	1,024	1,071	630	993	876	1,049	913	1,035	993	1,084	11,400
Automobile	4,398	4,659	5,071	5,208	4,613	5,142	5,215	4,543	5,322	5,310	5,124	5,046	59,651
Ind. vehicle,bicy&rlwy	1,103	1,486	825	1,328	1,190	1,301	1,621	1,246	1,593	1,661	1,581	1,774	16,709
Harbor & ship	280	357	369	344	325	383	371	335	340	354	438	428	4,324
General goods	390	484	430	428	406	425	429	424	398	374	435	427	5,050
Others	3,316	3,667	3,381	3,416	3,037	3,347	3,318	2,976	3,121	3,484	3,593	3,752	40,408
Total	20,703	22,914	22,791	23,874	21,836	24,036	23,811	21,673	23,854	25,619	25,807	26,332	283,250
No. of surveyed fac.	289	289	289	286	285	284	283	282	281	278	276	276	3,398

Compared to 1982 98%

Source: Kawaguchi Foundry Association

4.3 Measure for Radical Reform of Indonesian Foundry Industry

To succeed in manufacturing modern industrial products such as automobile, farm machine and implement, home electric appliance, first of all, Indonesia could produce quality castings as a basic material for them, especially cast iron products. This has already been pointed out by local Japanese copmanies. It has also been mentioned that customers' requirements should be fully satisfied, such as delivery time and prices.

To realize them, the production system for castings should be modernized, that is, the existing foundry technique should be replaced with a modern one. To be concrete, the manufacturing of products should be done sufficiently taking into consideration and understanding the conditions of customer's order. Consequently, "Plan, Do, See" activity should be, first at all, done repeatedly, carefully and enthusiastically.

In advanced countries, the modernization of management and technology is commonly considered as a key method to succeed in production, in detail later. The management, including president, department manager, section chief, supervisor should bear it in mind. Measures to succeed in implementing actions of "Plan, Do, See", the basics of production management for foundry will be mentioned below.

4.3.1 Review of production process

Table 4.3.1-1 indicates typical production processes of castings. These processes, essential to manufacture castings, include pattern making, sand preparation, molding, core making, mold setting, melting, pouring, shakeout, fettling and testing and inspection.

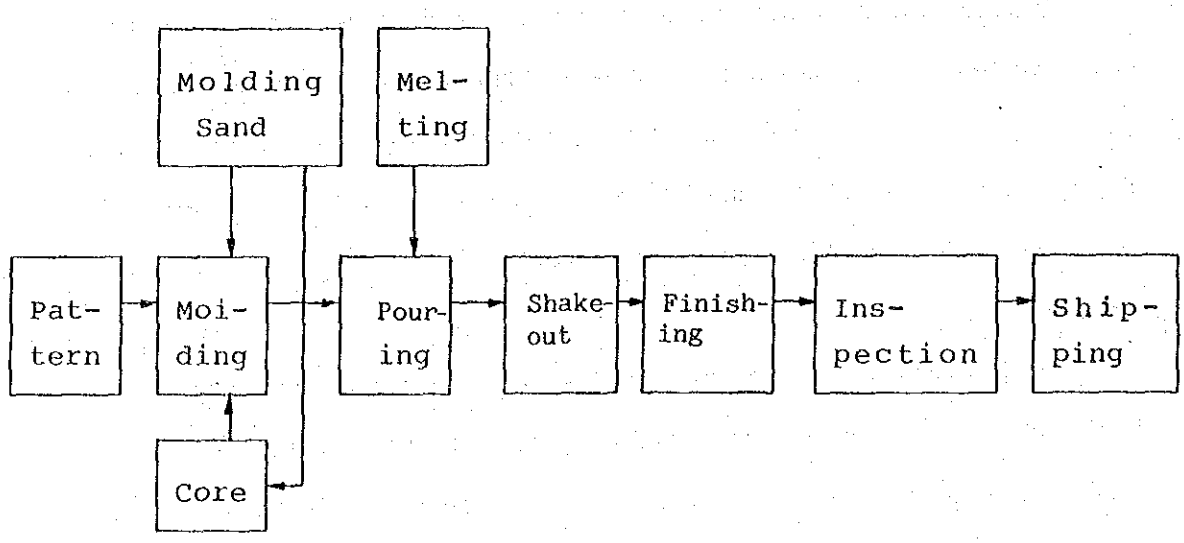


Fig. 4.3.1-1 Production process for castings

These processes are commonly adopted in Japan and Indonesia. However there is a big difference between these two countries in product quality and accuracy. This difference is caused by different levels of technique, material, equipment and so forth in each process. In addition to these differences in production process, the ability or skill of the workers also makes a remarkable difference in results. Therefore, management and control plays an important role.

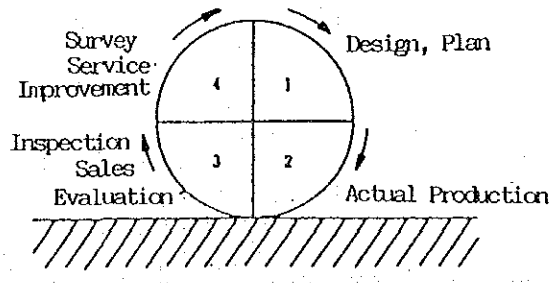
Without improvement, any company will not be able to compete with other companies due to a lot of loss works. In every Indonesian foundries, it shall be pointed out that there are a number of defects on products.

Table 4.3.1-1 shows the defects in each process. This Table clearly indicate the mutual relation of process and defect. The reduction of these defects depends on the ability of personnel to casting, and the responsibility of it shall be beared by upper-class managers. These shall be well understood. Above mentioned activities, "Plan, Do, See" shall be adopted as a management and control method against those defects. This method shall be applied to all operations such as order receiving, material preparation, personnel administration, production, finance, costing, etc.

Table 4.3.1-1 Production process and appeared process of castings

Process	Appeared defects
Pattern	dimensional deviation, deformation, wall thickness inequality, burr
Molding sand	sand inclusion, scab, blow hole, penetration, sand drop, etc.
Molding	sand inclusion, scab, blow, misrun, push up, mismatch, run-out, rough surface, etc.
Melting	blow, shrink, crack, chill, misrun, lack of strength, lack of hardness, coarse grain, kish graphite, slag inclusion
Pouring	misrun, blow, slag inclusion
Shakeout	crack, deformation, change of hardness
Finishing	breakage, defective finishing
Inspection	(Visual observation and using apparatus, inspect so as to meet the user's specification.)

The activity program of "Plan, Do, See" (which is called Deming Circle in Japan) shall be conducted as indicated in Table 4.3.1-2. Then it becomes the activity called "Plan, Do, See, Replan" which will produce good results.



Concept of attaching importance to quality control
Sense of responsibility in quality control

Fig. 4.3.1-2 Principle of quality control (Deming Circle)

4.3.2 Standardization

The production activity can be enhanced effectively by standardizing in-house operations. The standardization plays an important role in "Plan, Do, See" activity.

Here the standardization in casting technique is described as an example.

Melting, sand preparation and molding processes were found as factors which influence the product quality. Therefore once these three processes are standardized and employees have learned and understood the standards, the casting operation can be greatly improved.

To define technical standards, following items shall be included: design, operation, material, equipment, and in process inspection. Design standard here corresponds to the basic design concerning the selection of casting molds, in other words, that of: green sand mold or dry mold, resin self-hardening molding or CO_2 molding and so forth. In these standards, each property value shall be listed as mentioned in basic measures in Chapter 4. This property value is also called control property. Based upon this control property value, operation, material, equipment, and in-process inspection standards shall be decided. This is also called the decision of work property value.

In the tour of foundries in Indonesia, it can be pointed out that many defects as follows are seen.

(1) Blow

(2) Sand inclusion

(3) Misrun

(4) Rough surface of casting surface due to sand penetration

(5) Low quality of material

The processes through which defects appear and measures against defects are as follows:

1) Melting operation

Present condition:

Low temperature melting of 1,350 - 1,400C and oxide melting cause such defects as blow hole, misrun, shrinkage, lack of hardness, coarse grain, and so on. Since castings of below FC20 are manufactured, there are relatively fewer troubles, however, in cases of FC25, FC30, the manufacturing might be almost impossible with the present melting technique.

Countermeasures:

The selection and use of materials shall be standardized. The equipment shall be improved, a high temperature melting shall be introduced, and clean and quality melting water with good circulation shall be obtained. Then almost all defects due to melting will disappear.

2) Molding sand

a) Green sand mold or floor mold

Present condition:

Since river sand and natural sand are used for green sand mold and floor mold, many defects such as, sand inclusion, penetration, blow, and improper dimensions appear on casting.

Countermeasures:

River sand and natural sand shall not be used as molding sand. Because these are main causes of above-mentioned defects. These sands are not fire-resistant enough to be used as molding sand, and difficult to handle requiring many experiences. The molding sand now used shall be replaced by silica, binding agent, bentonite, dextrin, coal powder and proper amount of water (3.5 - 4.5%)

shall be well mixed in a sandmill and then used. Molding sand shall have following properties.

(1) Compression strength (in molding)

(2) Moldability (in molding)

(3) Toughness (in molding)

(4) Flowability (in molding)

(5) Permeability (in pouring)

(6) Collapsibility (after pouring)

(7) Easy shakeout (after pouring)

These shall be taken into consideration to define the mixture standard of synthetic sand.

b) CO_2 mold

Present condition:

During the instruction tour in Indonesia, it was found out that CO_2 molding method has been used without correct understanding. In general the amount of sodium silicate mixed with silica (river sand) shall be 5-6% of the whole sand, however, some foundries are still using 8-9% of it, and reversely some are using only 3-4%. The reason for this excessive amount or deficient amount is not clear. Due to this improper quantity of sodium silicate, mold surface after casting tend to be rough enhancing the penetration of sand into the surface.

Countermeasures:

The average grain size of river sand or silica shall be of 40-50 mesh. And this sand and sodium silicate which are 5-6% of the total sand shall be mixed for 3-5 minutes in the mixer. In this process a clean sand mixer shall be used. It is important to select the proper sand and mixer, and them to standardize the

operation. And if pebble pitch which forms 0.5-1.0% of the total sand is added to the mixed sand, sand shakeout will be improved, easy to remove sand from castings.

3) Molding

Present condition:

In the present molding with natural sand or river sand, molding sand is apt to be less strength. The operators, therefore, are using excessive amount of water to enhance their workability and to prevent a lot of breakage of molds. Since in most cases floor molds are used there, therefore moisture of drag mold is increased, causing such defects as blow, sand inclusion, mold drop, penetration. This type of molding is less efficient and an urgent improvement required.

Countermeasures:

First molding sand used shall be replaced by synthetic sand. Then instead of floor mold, metal flask and wooden flask shall be used. For synthetic sand, the specified molding sand mixer shall be used, and it is necessary to take care that strength, permeability and moisture of molding sand could meet the definite standard. This controlled sand shall be carefully molded, and especially molding for sprue, runner bar and ingate and also around pattern shall be rammed hard. If the pouring speed is too slow, such defects as scab, blow casting and sand inclusion will appear. Therefore, in case of products with weight less than 30 kg, a proper dimension of sprue shall be decided to finish the pouring within 15 seconds. Molding operation and pouring speed shall be standardized and a ratio in each size of sprue, runner bar and ingate shall be determined at 1:09:08. Such standardization in molding will contribute to reduce casting defects as mentioned above. Operation standards of melting, molding sand and molding practice are listed in Tables 4.3.2-1, 4.3.2-2 and 4.3.2-3.

Table 4.3.2-1 List of Operation Control of Cupola Melting

Process \ Standard	Operation Design	Operation Method	Materials	Equipment	In-Process Inspection
1. Furnace Repair	1-1 Designed dimension of furnace 1-2 Selection of repair materials 1-3 Mixture ratio of materials	1-1 Procedure of dimension measuring 1-2 Procedure of repair operation 1-3 Procedure of mixing of repair materials	1-1 Quality of mortar 1-2 Quality of fire brick	1-1 Procedure of repair tools 1-2 Procedure of patching machine operation	1-1 Examination of inside shape of furnace
2. Pig Iron, Return Scrap, Steel Scrap	2-1 Selection of metallic materials 2-2 Mixture ratio of materials	2-1 Procedure of metal measuring	2-1 Quality of metals 2-2 Quality of ferro-alloys	2-1 Procedure of examination of material measuring equipment	2-1 Examination of rusty or mixed materials
3. Coke	3-1 Selection of coke 3-2 Coke ratio	3-1 Procedure of coke measuring 3-2 Procedure of coke charging	3-1 Quality of coke	3-1 Ditto	3-1 Examination of coke size
4. Lime Stone	4-1 Selection of lime stone 4-2 Ratio of lime stone	4-1 Procedure of lime stone measuring	4-1 Quality of lime stone	4-1 Ditto	4-1 Examination of lime stone size
5. Furnace Operation	5-1 Decision of height of bed coke 5-2 Pressure & volume of blast 5-3 Instruction of melting temperature 5-4 Chemical composition of melten metal	5-1 Procedure of furnace operation		5-1 Procedure of examination of charging machine	5-1 Examination of tuyer condition 5-2 Examination of flame color at charging door 5-3 Examination of slag color
6. Tapping-out	6-1 Instruction of addition of CaSi 6-2 Instruction of front test of furnace 6-3 Decision of tapping temperature	6-1 Procedure of addition of CaSi 6-2 Procedure of furnace front test 6-3 Procedure of optical pyrometer operation	6-1 Quality of CaSi 6-2 Quality of chill test material	6-1 Procedure of CE-meter operation 6-2 Procedure of preparation of optical pyrometer 6-3 Procedure of preparation of chill test	6-1 Examination of CE-value 6-2 Examination of tapping temperature 6-3 Examination of chill value 6-4 Examination of pressure volume of blast
7. Ladle	7-1 Decision of designed dimension of ladle 7-2 Selection of repair materials 7-3 Mixture ratio of repair materials 7-4 Instruction of preheat of ladle 7-5 Drying of ladle	7-1 Dimension measuring 7-2 Procedure of repair operation 7-3 Procedure of mixing of repair materials 7-4 Procedure of preheating 7-5 Procedure of drying	7-1 Quality of fire brick 7-2 Quality of mortar	7-1 Procedure of examination of ladles condition	7-1 Examination of ladle lining condition

Table 4.3.2-2 List of Operation Control of Molding Sand Mixture

Process \ Standard	Operation Design	Operation Method	Materials	Equipment	In-Process Inspection
1. Preparation for Producing Moulding Sand	1-1 Selection of mixer 1-2 Selection of sand 1-3 Selection of additives 1-4 Selection of binders 1-5 Selection of moisture 1-6 Selection of mixing ratio of materials	1-1 Procedure of measuring of materials	1-1 Quality of new sand 1-2 Quality of reclaimed sand 1-3 Quality of binders a. Clay b. Bentonite c. Sodium silicate d. Organic chemical resin 1-4 Quality of ingredients a. Cereal b. Sea coal, Pitch c. Dextrin d. Starch	1-1 Procedure of managing of mixers a. Simpson type b. Screw type c. Other type 1-2 Procedure of managing of measuring apparatus	1-1 Examination of mixer condition 1-2 Examination of quality of new & reclaimed sand
2. Mixing of Moulding Sand	2-1 Decision of quality characteristic of mixed sand 2-2 Decision of mixing condition & method	2-1 Procedure of mixing operation of sands and other ingredients			2-1 Examination of quality characteristic of mixed sand
3. Transportation of Sand	3-1 Decision of transportation condition & method	3-1 Procedure of transportation of moulding sand		3-1 Procedure of examination of transportation equipment	3-1 Examination of transportation condition of sand

Table 4.3.2-3 List of Operation Control of Molding

Process \ Standard	Operation Design	Operation Method	Materials	Equipment	In-Process Inspection
1. Moulding	1-1 Selection of moulding flask 1-2 Selection of moulding sand a. Green sand b. Dry sand c. Organic & inorganic sand 1-3 Selection of moulding form a. Machine moulding b. Hand moulding c. Flask moulding d. No-flask moulding e. Pit moulding 1-4 Decision of dimensions of gating & risering system	1-1 Procedure of moulding operation a. Machine moulding b. Hand moulding c. Flask moulding d. No-flask moulding e. Pit moulding (incl. green, dry, organic, inorganic sand moulding)		1-1 Procedure of managing of moulding machine 1-2 Procedure of managing of moulding flask 1-3 Procedure of managing of drying oven 1-4 Procedure of hardness tester 1-5 Procedure of measuring of surface stabilized index (SSI)	1-1 Check of air pressure of moulding machine 1-2 Check of accuracy of flask dimension 1-3 Check of mould hardness 1-4 Check of toughness of mould sand by grasping (green sand) 1-5 Check of surface stabilized index (SSI)
2. Core Making	2-1 Decision of items of vent process 2-2 Selection of core rods 2-3 Selection of core paste	2-1 Procedure of core making 2-2 Procedure of core paste	2-1 Quality of core rod 2-2 Quality of core paste		2-1 Check of taking into corner 2-2 Check of mould paste
3. Coatings	3-1 Coating materials a. Watery b. Flash-off	3-1 Procedure of coating of mould in a. Watery coat b. Flash-off coat	3-1 Quality of coating materials		3-1 Check of condition of mould & core "Baume" (specific gravity of coating)
4. Assembling	4-1 Decision of venting method from mould & core 4-2 Selection of mould seals 4-3 Selection of vent chiller & chaplet	4-1 Procedure of venting from mould & core 4-2 Procedure of mould seals 4-3 Procedure of chiller & chaplets	4-1 Quality of mould vents 4-2 Quality of mould seals 4-3 Quality of chiller & chaplet		4-1 Check of condition of moulds & cores 4-2 Check of vents clear 4-3 Check of mould seal

4.4 Practical Program for Development of Indonesian Foundry Industry

4.4.1 Personnel Training and Establishment of Training Center

Appropriate production facilities and excellent technology are required in any production activity. And these two factors can be well utilized only by human beings to attain a certain goal.

That is, the Education/Training of personnel will play a vital role in the industrialization in Indonesia.

This is a reason why personnel training is included in this program. One of main causes by which Indonesia is late in industrialization lies in the inefficiency in production line. It is due to the lack of awareness about production and that of responsibility of persons concerned as already stated. That is, the education/training is urgently required.

To improve this situation, their attitude should be changed.

To satisfy user's wishes in this competitive society, the education/training of personnel is the most important aspect so that they are able to grasp and deal with users' wishes.

The proper training center for such qualified personnel should by all means be established. It should have two objects, one for managers and engineers, another for technicians. For the former, as the most typical training center, there is the Metal Industry Development Center (MIDC) in Bandung. It is necessary to review the roles and functions which MIDC has played up to now in terms of the results, especially in the practical aspect. The roles and functions of MIDC should be extended and strengthened. Then to solve the problems in workshops,experienced personnel who are versed in production technology should be assigned there. Naturally, it is necessary to conduct the personnel training at specified institutions on the basis of prescribed training procedure, system, curriculum for a certain period.

4.4.2 Introduction of TQC concept and its system

The management of business always requires results which have great influences on the evaluation on quality, prices and product accuracy. Results will also decide the fate of the company.

The business activity should be conducted under well thought program covering all aspects of business always having an advantage over competitors. That is, in every field such as finance, material, sale, production, equipment and personnel, a well considered plan and control should be practiced. And the results of practical activities should be quickly estimated and reflected in the next plan as much as possible.

Thus, the management of business should be conducted in all departments and sections within the company in plan, practice and estimation to improve the results. What is most important here is the attitude of the management. They have to understand that the business activity is conducted by all employees participation. Based upon this idea, the TQC activity, "Total Quality Control" has been implemented in Japanese enterprises up to now. This activity includes SQC (Statistical Quality Control) which had already been used for many years.

The TQC covers all aspects of a company. The management policy taken up by the top management is transferred to each department and section in charge. Given this policy, all personnel will do their best on their own will to achieve the result. Morale of the employees are enhanced in this way to produce the improvement of results. Those are the purposes of the TQC activity.

To achieve good results in the TQC activity, a department in charge of the planning and promotion of this activity shall be established. Then it is important that in regular meetings of each group these results shall be made public.

4.4.3 Establishment of Foundry Technology

We have often stated that Indonesian foundries have low quality products problems and also pointed out the causes in detail in 4.1 "The Present Situation of Indonesian Foundry Industry".

Here, we describe about the establishment of foundry technology. Why have foundry defects been left unsolved? Especially a lack of management ability to solve the problems is in question.

In general, the production technology is categorized into two, one belonging to engineers and other to technicians. Cooperation of both is necessary to have good results. There are two kinds of technologies. One consists of basic knowledge and technique. The other is composed of highly advanced applied knowledge and technique. Foundry technology rather belongs to the former category. Thus it is important to establish the foundry technology by a complete acquirement of the former technology. This means that basic technique and basic knowledge shall be mastered and then put into practice in each process of foundry manufacturing, especially in such processes as melting. Production of molding sand and molding, as described in 4.3.2 "Standardization".

As shown in Table 4.3.2-1, Table 4.3.2-2, Table 4.3.2-3, operation standards consist of the contents of Table 4.4.3-1.

Among standardization, items in Table 4.4.3-1, operation standards shall be determined by laying stress on basic quality characteristics and those of other operation, materials, facilities and in-process inspection, shall be defined by laying importance on characteristics of production control. Examples of these values are shown in this table. It is recommended that each value shall be standardized by referring to Fig. 4.4.3-1, Fig. 4.4.3-2 and Table 4.4.3-2 to Table 4.4.3-7.

Standardization of operation shall be initiated by grasping correctly what the present operation is, and taking its factors for a temporary standard. Persons in charge of standardization shall be those who know the present situation best. First of all, first edition of standard shall be made, and observed in operation, then sequently revised.

This operation standard book shall be kept in a secured place.

Table 4.4.3-1 Operation Standard

Name of Operation Standard	Detail of Operation Standard		
	Process	Standardized Item	Ex.of property values for production control
Operation Standard for Melting	1.Furnace repair 2.Main materials 3.Sub materials 4.Operation 5.Tapping-out 6.Ladles	a.Operation Design b.Operation c.Materials d.Equipment e.In-process Inspection	*Bed coke height see Fig.4.4.3-1 *Coke ratio: see Table 4.4.3-2 *Charged metal size: 1/3 of cupola diameter *Coke size: 1/6-1/10 of cupola diameter
Operation Standard for Producing Molding Sand	1.Mixer 2.Materials 3.Mixing 4.Transportation & storing of molding sand	Ditto	*Purity of raw material sand: see Table 4.4.3-3 *Type of Bentonite see Table 4.4.3-4 *Mixing of molding sand:see Table4.4.3-5 for green sand and Table 4.4.3-6 for CO_2 sand
Operation Standard for Molding	1.Molding 2.Core making 3.Coating 4.Sealing	Ditto	*Spine diameter see Table 4.4.3-7 *Pouring time: see Fig.4.4.3-2

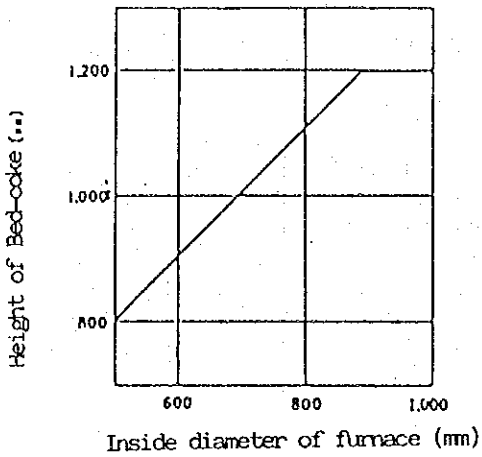


Fig. 4.4.3-1 Height of Bed-coke

Table 4.4.3-2 Standard Value of Coke Ratio

Class	Exp. tap temp. (C)	Steel scrap comp. ratio (%)	Coke ash cont. (%)	Coke ratio (%)
FC15	1,440 ~ 1,470	0	≒10	9 ~ 11
FC20	1,460 ~ 1,490	15 ~ 30	< 10	11 ~ 13
FC25	1,480 ~ 1,510	30 ~ 50	< 10	13 ~ 15
FC30	1,510 ~ 1,540	40 ~ 60	< 8	14 ~ 16
FC35	1,520 ~ 1,550	50 ~ 60	< 8	15 ~ 18

Table 4.4.3-3 Purity of Molding Sand (JIS G 5901-1974)

Grade	SiO_2	Fe_2O_3	Al_2O_3	CaO+MgO
1	98.0<	0.5>	1.0>	1.0>
2	96~98	1.0>	2.0>	1.5>
3	93~96	1.5>	4.5>	2.0>
4	90~93	2.0>	6.0>	2.5>
5	85~90	3.0>	8.0>	3.0>
6	70~85	5.0>	15.0>	5.0>

Source: "Casting Iron Melting Handbook"
by Japan Foundrymen Society

Table 4.4.3-4 Chemical Composition and Property of Bentonite

Class	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Ignition loss
1	79.30	11.25	1.61	0.73	0.60	5.76
2	75.00	13.62	2.02	0.96	2.11	5.41
3	60.18	12.91	6.09	4.16	2.39	11.26

Properties:

1. Particle-size mainly composed of montmorillonite shall be below 200 mesh.
2. Na ion system is resistant to high-temperature, and Ca ion system accelerate the breaking of sand.

Table 4.4.3-5 Mixture and Physical Property of Synthetic Sand

Unit: weight %

Mixture of synthetic sand			Physical property		
New silica sand	(%)	5-20	Compression strength of green sand mold	:	0.7-1.20 kg/cm^2
Reclaimed sand	(%)	80-95	Permeability	:	80-150
Bentonite	(%)	1.0-5.0	Active clay (%)	:	7-8
Dextrin	(%)	0.3-1.5	Volatile matter (%)	:	2-3
Coal powder	(%)	0.5-0.8	Ignition loss(%)	:	6-9
Moisture	(%)	3.5-4.5	P.H. value	:	8-10

Remarks:

1. Bentonite : below 200 mesh and Na system is better.
2. Dextrin : 80% of it is below 250 mesh, and it's -grade shall be more than 90%.

Table 4.4.3-6 Example of Mixture and Compression Strength of CO_2 Sand

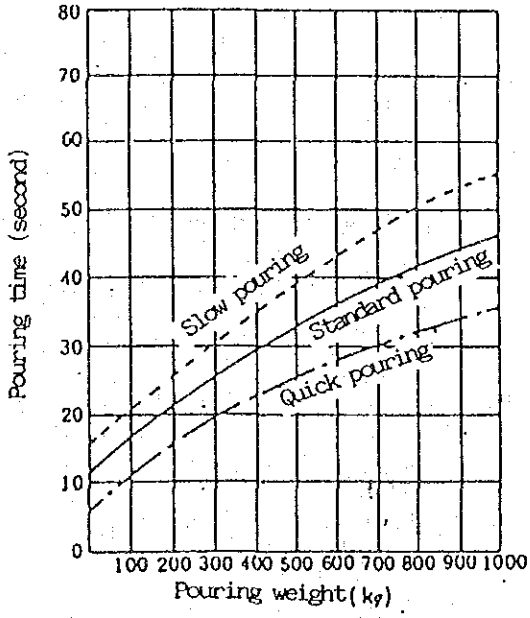
Mixture (%)		Compression strength (kg/cm^2)		
Shore sand	100	Just after Mixing		1.17
Water glass	5-6	1 hour	"	1.73
Pitch particle	1.0-2.0	2 hours	"	2.70
Wood flour	0.1-0.5	3 hours	"	5.64
		24 hours	"	21.4

Note: Composition is percentage of weight.

Tble 4.4.3-7 Pouring Weight and Pouring Sprue Diameter

Pouring weight (kg)	Pouring sprue dia. (ømm)
<25	25 × 1
<50	35 × 1
<75	45 × 1
<100	55 × 1
100～300	60 × 1
300～500	50 × 2
600～750	55 × 2
750～1.000	60 × 2

Note: For castings of complicated shape and under low pouring temperature, pouring sprue diameter shall be a little larger.



Source: "Worksite Technique for Foundry" by the Nikkan Kogyo Shimbun

Fig. 4.4.3-2 Pouring weight and pouring time

4.4.4 Foundry equipment

Generally speaking, the foundry equipment in Indonesia are old, and it is necessary to replaced them with new ones for the development of the foundry industry in Indonesia.

It is necessary that the Indonesian foundries are to manufacture wide ranging products for limited mass production such as compact car, agricultural machinery, small size marine machine and household appliances which may be the future leading industries of Indonesia, as well as for non-mass production such as tin mining pump, sugar refining machine, machine tool, general industrial machine and so on. If the domestic production is promoted instead of the importation of such products, the amount of demand will be enormous.

In this sense, the modernizations of foundry is essential. That is, the modernization of production measures must be urgently carried out to lower the cost through stabilizating the quality.

1) Building structure and floor

Considering ventilation, natural lighting and draft, the building height shall be 7,000 mm under the runway guarder if overhead travelling cranes are installed.

Natural lighting from every direction shall be considered.

The floor surface shall be finished with concrete.

Molding sand is the most important material requiring floor surface to be kept always clean. For this reason, floor surface shall be finished with concrete, and to do so, the working environment can be remarkably improved.

2) Equipment

As shown in Table 4.1-2, the modernization of foundry equipment in Indonesia is lagging. Therefore, we will refer to the main equipment to be modernized for

each process.

(1) Melting equipment

a) As existing china furnaces are unsuitable, these shall be replaced with generally used cupolas. Proper design of cupolas are recommended because improper designs are often seen.

b) Induction furnace

The melting operation of this furnace is simple requiring a small number of operators. It can be recommended for these reasons, however, as its installation cost and power (contract) fee may put the pressure on the price of castings, the furnace shall be fully operated under a production plan with 2 or 3 shifts.

c) CE meter

This is essential for quality inspection and shall be equipped without fail.

d) Ladles

Each ladle, especially with about 200 kg capacity shall be mounted with a cover.

e) Thermometer

An emission pyrometer to measure tapping-out and pouring temperatures shall be equipped.

(2) Green sand molding equipment

Green sand reclaiming system:

In order to stabilize, as much as possible, the physical property of the molding sand for greens sand molding, this system shall be operated.

This system is composed of sand mill, belt conveyor, bucket elevator, sand chute hopper, molding machine, roller conveyor, shakeout machine, sand return conveyor, sand blender, magnetic separator, sand cooler, sand

storage and so on.

This equipment is used for manufacturing of small size and mass-produced parts, and for green sand molding.

(3) CO_2 equipment

This shall be prepared to be used for core making of green sand mold.

(4) Shell molding equipment

This is used for core making of green sand mold, mainly for cylinder liner, automobile, motorcycle, agricultural machinery and marine engine.

(5) Equipment for organic chemical binder system (no-brake)

For every product of more than 50 kg of weight, which can not be casted, the organic chemical binder process shall be adopted. The equipment for this process system is required.

This equipment is composed of organic chemical binder mixer and binder, sand reclaimer, sand crusher, bucket elevator and sand cooler.

(6) Finishing equipment

a) Shot blasting machine

Either table type or tumbling type, which is suitable for your own products, shall be installed.

b) Grinder

Among various types of grinders such as hand, table, bench and hanger grinders, the most suitable one for your own products shall be equipped.

c) Inspection equipment

i) Sand tester

This tester is used to check strength, permeability and grain size.

ii) Board and tools for inspection

These tools are used to measure dimensions of castings.

iii) Metallurgical microscope

This microscope is used to examine the metallic structure of castings.

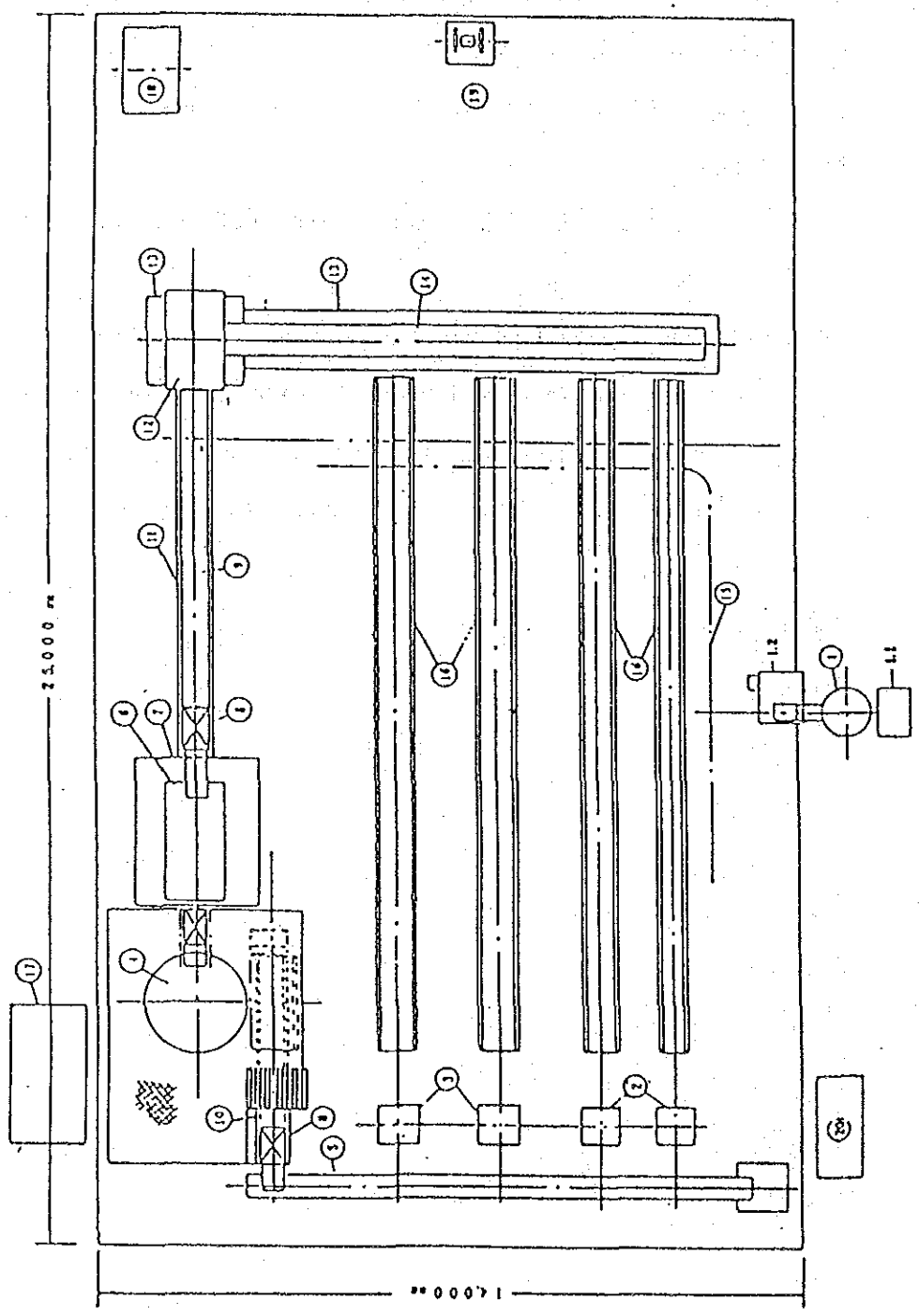
iv) Materials for liquid penetrant inspection

These materials are used to inspect surface flaws and their sizes.

The above mentioned equipments are the minimum requirement. Fig. 4.4.4-1 shows an example of layout for a model cast iron foundry of 50 tons/month capacity and duty list of employees is as follows;

Management	:	1
Engineer	:	1
Technician	:	1
Clerk	:	1
Melting	:	2
Sand	:	1
Moulding	:	6
Coremaking	:	2
Finishing	:	3
Inspection	:	1
Total	:	19

Table 4.4.4-1 Layout for a Model Cast Iron Foundry - 50 tons/month Capacity



Main Equipments of Foundry Model Shop

(Monthly production 50 ton)

1. 2 ton/hour Cupola
   - 1.1 Skip hoist
   - 1.2 Rotary front hearth
2. Moulding machines FD-2 2
3. Moulding machines FD-3B 2
4. Sand mill 200 kg/batch
5. Belt conveyor 400 mm width 10,000 mm length
6. Rotary braker screen 40 m^3/hour
7. Sand bin 20 m^3 with cooler
8. Bucket elevator
9. Belt conveyor 400 mm x 8,500 mm
10. Belt conveyor
11. Pit for belt conveyor
12. Shaker max. load 700 kg
13. Pit for oscillating conveyor
14. Oscillating conveyor 500 mm x 10,500 mm
15. Monorail hoist capacity 1 ton 15,000 mm rail length
16. Angle rail for mould traverser 60 mm angle x 14,000 mm x 4
17. Dust collector 150 m^3/hour
18. Shot tumblast 200 kg/batch 15 min. (max.)
19. Table grinder
20. Air compressor 22 kW

4.5 Roles and functions of JFC

1) Historical Verification and Scenario for the Future

(1) Verification of the Past

In 1971, the project was started under the yen loan from the Japanese Government. And in 1975, JFC started its operations as the first modern foundry in Indonesia. Since then, JFC has been playing a leading role in the Indonesian casting industry as its founder. Those foundries under a traditional technical system existed like specialized villages at Ceper, Tegar, etc. in Central Java. And they met the demand for castings in Indonesia for a long time.

It was difficult, however, for the traditional casting industry to meet the currently enlarged demand of substantial consumption type. This was the significant motive to establish JFC.

JFC burdened with the role as a technical leader has been continuously striving to meet a wide variety of demand and an excessive level of expectation. Until it has satisfactorily met every customer's demand and expectation, however, JFC is not in a position to reach an international level in implanting the technology and in self-supporting. In the meantime, the existing foundry companies have used exertions to modernize their facilities in the private sector, too. More recently, an epoch-making increase in effective demand has been expected, being backed up with the domestic production promoting policy taken by the Indonesian Government, in particular. And modern private foundry companies have been really founded. As a result, the market is now entering into those environments

under which the market competition may be changed from the orderly one to a fair market. At Gresik, moreover, a new cast steel works has been additionally founded under an aid of West Germany. Under the wing of P.T. Barata, a government-owned company, three foundries have been operating together with Surabaya Foundry having the longest history.

Under the circumstances so changed, JFC is expected to review its new roles and functions. Over the 15 years' history of JFC, it has been passing a long time of pregnancy to be technically independent. These facts permit us to expect that JFC will not fail to achieve its technical and managerial independency in the near future while contributing not only to P.T. Barata as a whole but also increasingly to the entire Indonesian economy.

(2) Verification of the Present

With the above-mentioned flow in the past, JFC is now being asked "What is your new function and role?" At present or in 1985, JFC is proceeding with the JFC Renovation Plan decided of its own will. From the viewpoint of compatibility with the entirety, the plan may be deemed operating in a desirable direction, considering that it has been taken as JFC's role and function in the entire Barata Renovation Project.

Coupled with the new participation of the private sector into this filed, on the other hand, JFC is inevitably increasing the importance of its role as a manpower source. For competition in the market under the present circumstances, JFC is tending to compete with the private sector in an increasingly collaborative manner from now on. As compared with the role and function of the private sector, JFC's roles and functions are likely to be more and more ambiguous in the future. With these trends taken into

consideration, the current roles and functions of JFC should be positioned as the starting line of a renovated JFC so that it can take off for a new development, outlooking a change or changes over a long period of 10 thru 20 years to come. The present is a transition period to that end. Now, it is important to accumulate energies in terms of both management/technology and facilities/equipment for the new development.

(3) Scenario for the Future

Based on the results of verifying the JFC's roles and functions in the past and at present as referred to above, a scenario for the future of JFC is to be discussed below.

For the future, 10 years are to be taken as a delimit, which is in turn divided into the following three stages:

Short term (1 thru 3 years)
Medium term (4 thru 6 year)
Long term (7 thru 10 years)

And how JFC should exist for each term would like to be discussed below.

As already referred to, JFC has been assuming heavy responsibilities as a leading company in the Indonesian modern casting industry. From now on, these roles and functions would never be lightened but enhanced, to the contrary.

To cope with the rapidly increasing demand, however, JFC is inevitably introducing the principle of collaborative competition with the private sector. There has been a difference in product price and quality levels between the castings offered by private foundry companies and by JFC in

the past. This difference, however, has now almost disappeared or could be supported by no means with the mere founder's way of thinking and pride as a government-owned company. As a leading company in the past, the JFC's roles and functions of:

- o Maintaining a high level of technical capabilities,
- o Producing qualified castings with high efficiency and
- o Transferring accumulated production technology to the private sector

were permitted at the level within the territory of Indonesia. From now on, however, it is necessary to heighten the level to that internationally comparable. To this end, the first step is:

Short Term (1 thru 3 years) during which JFC should carry out all preparations and implementations, recognizing that JFC is to accumulate the energies enough to achieve an independence of technological capabilities so that JFC may technologically lead the private sector to the international level.

Medium Term (4 thru 6 years) during which castings at a high level of technology internationally comparable can be offered to users. This term should be positioned as a period in preparation for a subsequent growth.

Long Term (7 thru 10 years) during which JFC should make inroads into a new high added-value market and establish a stable supply system. In addition, JFC should secure the allowance enough to meet the needs of the times and should use that allowance to plan and prepare for the new growth plan.

Such a way of heightening stages step by step as mentioned above is an approach to which patience is essential in contradiction to the pursuit for a rapid development. To foster such a skill incentive industry as foundries, however, the objective could not be achieved without growing and storing competent labor. These facts have been best understood by those concerned whom JFC has brought up so far. Over an outlook of the coming ten years, therefore, the subjects for JFC to tackle with are to reach a time of its take-off for independence and an international level of its medium-class product manufacturing system and to establish a higher added-value production setup.

2) Objective-oriented Roles and Functions

From an objective-oriented point of view, JFC's functions and roles may be summarized into the following three:

(1) Social roles as a government-owned company,

(2) Function of establishing a healthy management as an enterprise and

(3) Function of forming a market of fair competition collaborative with the private sector.

From an achievement priority point of view, (2) should be given priority in terms of urgent necessity under the present circumstances, followed by (1) and (3).

As far as (2) "Function of Establishing a Healthy Management" is concerned, in particular, the basic trends of deficit have continued, arising from a certain viscious circle of failure to sufficiently pick up the potential demand as the result of not fully satisfying the expectations of customers in terms of quality, price and delivery period.

To turn the viscious circle over to a favorable one, it is necessary that the proposed Renovation Project be used as an opportunity to steadily advance the exertions to improve operations in a combination of management and labor and that the technological potential available in JFC be made to satisfy customers within the territory of Indonesia as soon as possible. To this end, concrete improvement measures involved should be implemented steadily one by one.

For the social role referred to in (1), Indonesia will continue on having a potential demand for castings in far excess of the supply capacity for the time being from a macroscopic point of view. Despite the political incentives taken by the Government, it is necessary to fully recognize that a significant time will be required to foster and strengthen foundries as one of the skill-incentive industries.

While such circumstances are continuing for a while, JFC's roles, especially in the field of cast iron, will be:

- To absorb, implant, improve and popularize the advanced technologies available overseas,
- To rationally link with the policies taken by the Government (to promote an import substitute policy),
- To serve as a leading arranger among other casting firms and demonstrate its operations on a show-window basis as a model shop or leading enterprise and
- To constantly foster and supply the manpower as a solution to the increasing difficulties for the private sector to secure the manpower.

These roles and functions of JFC will be in higher need than ever in the future.

For the necessity of introducing the principle of collaborative competition with the private sector as referred to in (3), JFC has conventionally had a monopolic

constitution under the protection by the Government against the competition with the private sector while establishing a government-led market order. From now on, however, this constitution should be internally renovated into the form in which emphasis is placed to the principle of collaborative competition with the private sector. To strengthen its own entrepreneurial constitution further, JFC should start to renovate itself to perfectly overcome the competition in the international market near at hand.