Fig.I-5-2 Plant Layout of Existing Pinjore Foundry

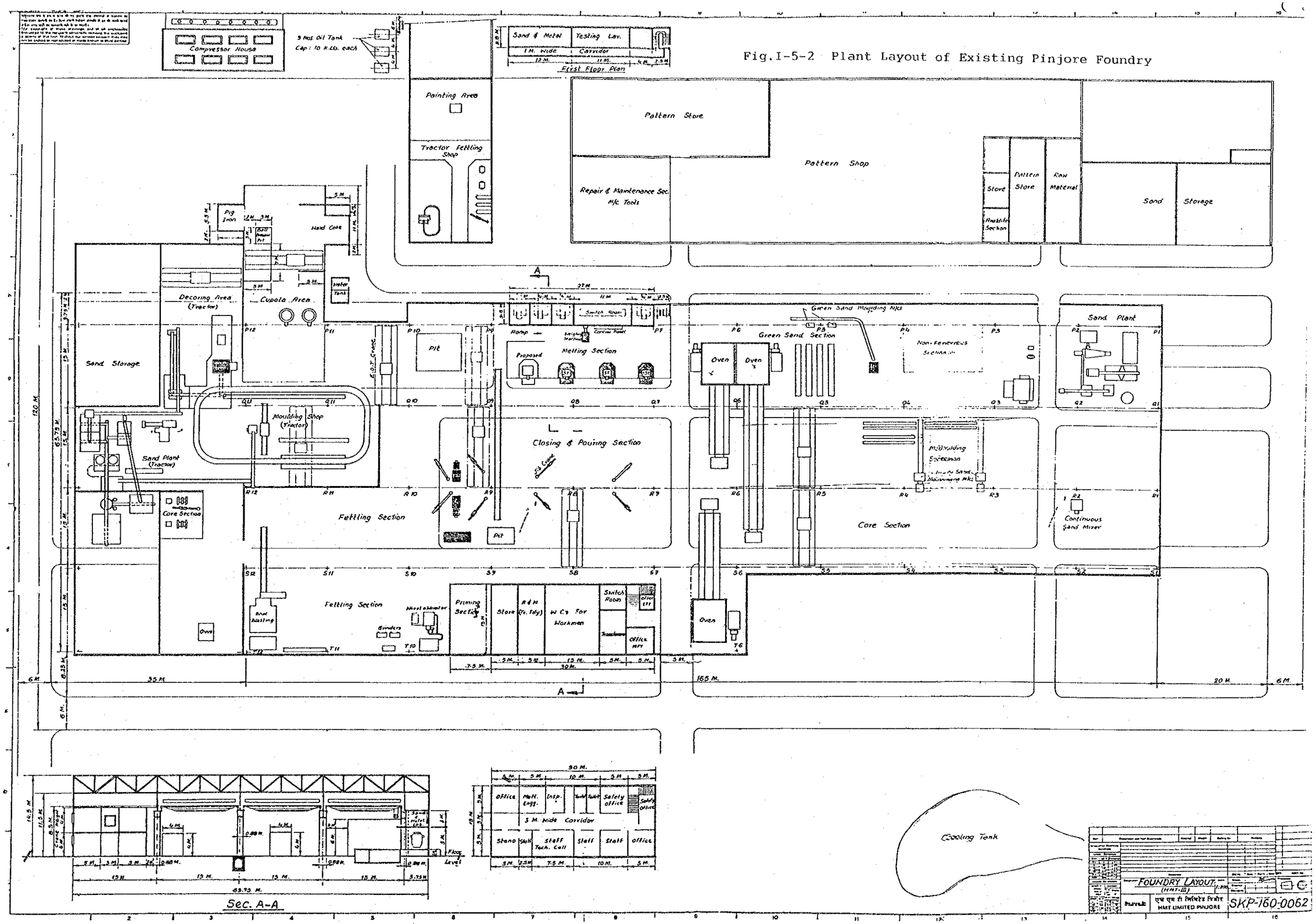


Table I-5-1 Outline of Bangalore and Pinjore Foundries

(Production record as of 1991/1992)

	ITEM				
1	FOUNDRY	HMT-BANGALORE FOUNDRY	HMT - PINJORE FOUNDRY		
2	LOCATION	BANGALORE 560031	PINJORE 134101 DISTT : AMBALA HARJANA		
3	OPERATION START	1961	1963		
		MTB	MTP	TRP	TOTAL
4	BUILD. AREA	21,097 m²	13,057.5 m²	2,025 m²	
5	NO. OF EMPLOYEES TOTAL	421 persons	292 persons	101 persons	393 persons
	(INCL) PATTERN	39	36		
	SAND	13	11	55	
	MOLD	189	110		
	MELT.	22	17	2	
	FETTL.	72	42	10	
	NON FERR.		5		
	MAINTEN.CRANE	72	32	19	
	STORE		10	1	
	QC. INSP.	7			
	MANAGE. ENG.	7	29	14	
6	PROD. AMOUNT	3,149 T/Yr.	2,301 T/Yr.	1,101 T/Yr.	3,402 T/Yr.
	(INCL) GREY IRON	2,909 T/Yr.	2,301 T/Yr.	1,101 T/Yr.	
	DUCTILE	65 T/Yr.	—	—	
	ALLOY	175 T/Yr.	—	—	
	MACHINE MOLD	568 T/Yr.	1,941 T/Yr.	1,101 T/Yr.	
	HAND MOLD	2,581 T/Yr.	360 T/Yr.		

	ITEM	M T B	M T P	T R P	TOTAL
7	PROD. SIZE & WEIGHT	HAND MOLD	HAND MOLD		
		GREY IRON:AVE.500KG MAX.5,200KG	GREY IRON		
		DUCTILE: AVE. 20KG MAX. 110KG	AVE.1,500KG:1,880x540x930		
		ALLOY: AVE.300KG MAX.4,000KG	MAX.4,000KG:2,740x1,270x1,420		
		MACHINE MOLD	MACHINE MOLD	MACHINE MOLD	
		GREY IRON:AVE.100KG MAX.1,600KG	GREEN SAND AVE.10KG 100x100x100	G.B.HOUSING 98KG	
		DUCTILE: AVE. 1KG MAX. 50KG	MAX.40KG 330x320x220	911x494x477	
		ALLOY: AVE. 40KG MAX. 110KG	MEDIUM AVE.50KG 400x400x250	CYL.HEAD 12KG	
			MAX.215KG 520x520x110	102x136x201	
			HEAVY AVE.320KG 720x540x670		
			MAX.1,200KG 1,450x540x670		
8	MOLDING SAND	1. Green Sand Mould	1. Green Sand Mould	1. Green Sand Mould	
		2. Dry Sand Mould	2. Dry Sand Mould	2. Shell Mould (core)	
		3. Oil Sand Mould (core)	3. Oil Sand Mould (core)		
		4. Alkyde No-Bake Sand Mould	4. Alkyde No-Bake Sand Mould		
9	SAND/METAL RATIO	Green Sand AVE. 5 : 1	AVE. 4.3 : 1	AVE. 14 : 1	
		Dry Sand			
		HAND MOULD, ALKYDE SAND			
		AVE. 3 : 1			
10	POURING YIELD	68.0 %	63.2 %	62.2 %	
11	MAIN PRODUCT	MT COMPONENT	MT COMPONENT	TRACTOR COMPONENT	
12	DELIVERY	88.7 % MTB 2,794 T	100 % MTB	100 % TRP	
		11.3 % OUTSIDE 355 T			
13	PROD. COST Rs./TON	22,566	25,886	26,026	

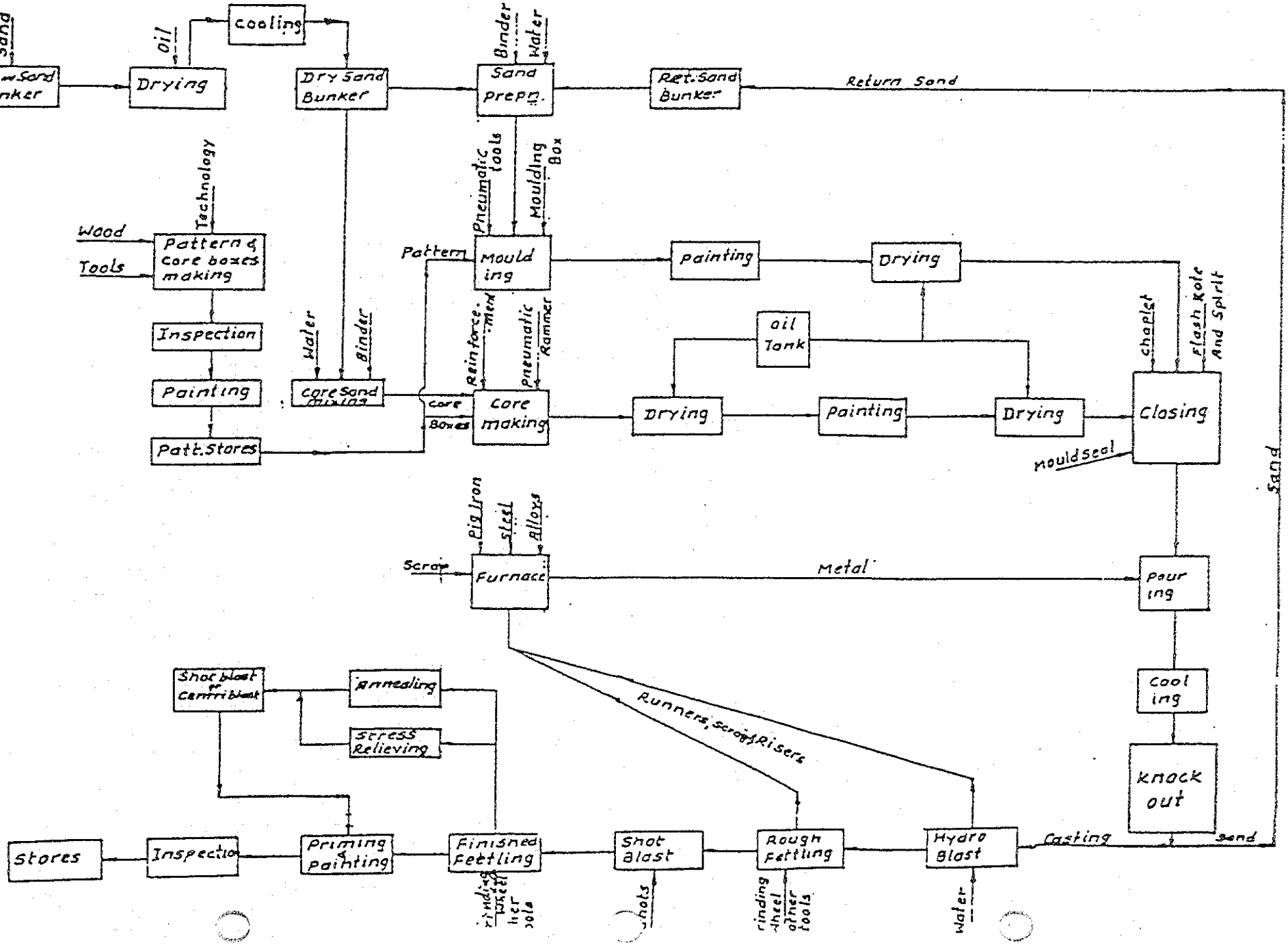
	ITEM	M T B	M T P	R P	TOTAL
14	MAIN FACILITY				
	SAND PLANT	1. Sand Drier 2T/H 1 set	1. Sand Drier 2T/H 1 set	1. Sand Drier 2T/H 1 set	
		2. Mullers 500KG 2 set	2. Mixer 800KG/Back 2 set	2. Mixer 800KG/Back 2 set	
		3. Mixers 250KG 1 set			
		4. Sand Bunkers 16 set			
	MOLDING	1. Jolt Squeeze Pinlift M/c	1. W3 Jolt Squeeze Turnover M/c	1. Jolt Squeezer Pattern	
		WHPL-3 2 set Green Sand	2 set Green Sand	Draw Automatic Moulding	
		2. Jolt Rollover Draw M/c BMD	2. SRW I Jolt Squeeze Pattern	M/c 1 set Green Sand	
		2 set Dry sand	Draw M/c 1 set Dry Sand	Box 1,400 x 800 x 400	
		3. Jolt Turnover Draw M/c RD5	3. SRW II Jolt Squeeze Pattern	10 Moulds/H	
		1 set Dry Sand	Draw M/c 1 set Dry Sand	2. Shell Core Making M/c	
		4. Mobile Sand Slinger 6 T/H	4. Continuous Sand Mixer	Type L180 2 set	
		1 set Dry Sand	1 set 4 T/H	3. Vertical Oven 1 set	
		5. Sand Mixers 250KG cap.	5. Drying Oven 3 set	(Oil Sand)	
		6 set Alkyde Sand	6. Oil Fired Vertical Oven		
		6. Drying Oven Trolley Type	1 set		
		4 set			
		7. Vertical Oven 1 set			
		8. Core Shooters H25 1 set			
		9. Core Shooters H12 1 set			
	MELTING	1. Main Frequency Induction	1. Main Frequency Induction Furnace		
		Furnace 1.5 T 1 set	1.5 T 1 set		
		3.0 T 2 set	3.0 T 2 set 1-sourse/2-furnace		
		2. Cupola 36" Dia 3 T/H 2 set	2. Cupola 36" Dia 3 T/H 2 set		
		3. Mixer 250KG cap. 1 set	(Furnace in common use)		
		4. Ramming Mass Mixer 100KG cap.			
		1 set			

	ITEM	M T B	M T P	T R P	TOTAL
	FETTLING	1. Padestal Grinding M/c	1. Airless Wheelabrator	1. Shot Blasting M/c	
		Double End 2 set	Tumblast 1 set	Monorail	
		Single End 2 set	2. Shot Blast Chamber Type M/c	Chamber type 1T 1 set	
		2. Swing Frame Grinding M/c	5T 1 set		
		3 set			
		3. Centri Blast M/c 1 set			
		4. Wheel Abrator Tumblast M/c			
		1 set			
		5. Rotary Blast M/c 1 set			
		6. Shot Blast M/c 1 set			
		7. Shot Blast Chamber Type M/c			
		1 set			
		8. Muffle Furnace 1 set			
		9. Russ Annealing Furnace 1 set			
		10. Welding Transformers			
		Twin Set 1 set			
		Single Set 7 set			
	TRANSPORTATION	1. E.O.T. Cranes	1. E.O.T. Cranes	1. E.O.T. Crane	
		10T 3 set	10T 3 set	5T 1 set	
		5T 11 set	5T 2 set		
		3T 2 set	3T 3 set		
		2. Jib Cranes	2. Jib Cranes		
		2T 2 set	2T 6 set		
		1T 4 set	1T 5 set		
		1/2T 4 set			

	ITEM	M T B	M T P	T	
	OTHERS	1. Knock Out M/c	1. Knock Out M/c	1. Knock Out M/c	
		6T 3 set	Heavy Knock Out 1 set	2T 1 set	
		3T 3 set	2T 2 set		
		2. Pattern Machine Tool	2. Pattern Machine Tool		
		Milling, Drilling, Sander,	Milling, Planing, Turning Lathe, Band Saw,		
		Band Saw, Turning Lathe,	Circular Saw Sander, Drilling M/c, etc.		
		Planing M/c, etc.	Total 13 set		
		Total 25 set			

Note: Most of facilities of Bangalore foundry were installed in 1960/61 and those of Pinjore foundry for machine tool production in 1963/64 and for tractor production in 1981.

Fig.I-5-3 Present Production Process



B. Basic Concept of the Action Program

It is determined that the foundry renovation shall be indivisible with the renovation of the existing principal business cores and the Bangalore and Pinjore foundries have been selected as the subjects of the urgent modernization investment implementations.

1. Problems at Present

(a) Production Facility

In the foundries in both Bangalore and Pinjore, almost all of the principal facilities such as the sand plant, melting, molding, finishing and the heat treatment installations are outdated and superannuated. Bangalore foundry, built in 1961, is 30 years old. Pinjore foundry dates from 1964, except for the facility for tractor components which was built in 1981.

Compared with current modern facilities, technologically as well as in terms of mechanization, they are obsolete and inferior in efficiency, which also leads to frequent troubles and repairs.

The productivity deficiency is considerable and an excessive maintenance crew is required.

(b) Mold Sand

In the long history of the operation, various kinds of sand systems have been used, including green sand, clay dry sand, oil sand, alkyd binder-self-hardening molds and CO2 molds.

The technology management, measuring control (sand composition adjustment) and production control are very complicated and require the utmost care. There are, of course, quality problems inherent in these systems, such as controlling the dryness of the sand , or contamination by sand at the knock-out stage.

In addition, the used alkyd sand is disposed of because there is no reclamation/re-conditioning process, which

affects the productivity and the economy of the operation seriously.

(c) Productivity

The above mentioned superannuation, absolance, low efficiency and mold sand treatments affect productivity adversely, and also lower the morale and the motivation of the employees.

The productivity level of two foundries is as follows.

	No. of Employees	Annual Production	Production per Employee
Bangalore	421 persons	3,149 T/Yr	7.5 ton/man/Yr
Pinjore	393 persons	3,402 T/Yr	8.7 ton/man/Yr

(d) Quality

The current defect ratios of the foundries are excessively inferior, as indicated on a weight basis in the following:

Bangalore Foundry	12.5%
Pinjore Foundry (machine tool)	13.9%
Pinjore Tractor	7.5%

The defects include blow holes, sand burns, porosity, shrinkage cavity and cold shut. Also there are dimensional dispersions, deformation, and mis-alignment of the core mold, and the surfaces are affected by sand burns, and roughness.

It is of the utmost necessity that there be improvement of the foundry technology, quality management and the product inspection systems.

Present HMT foundry production is almost all for in-house consumption (100% in Pinjore). Quality management is lax, but it must be made much stricter regarding production for outside sales in the future.

(e) Technology

There is much room for improvement both in production and manufacturing technology.

Foundry quality is determined by the casting technology, melting technology, molding techniques, flask joining and sand control.

The foundry engineers, therefore, need to have a higher level of expertise. Also, much more emphasis has to be paid to up-grading the qualifications of the workers as a whole. Therefore, an integral training curriculum has to be developed and implemented.

As for the quality level of castings, Pinjore foundry handles only gray iron casting and Bangalore foundry engages in the production of gray iron casting, low alloy iron casting and spheroidal graphite iron casting.

To increase the production volume and enlarged outside sales, they have to start the production of more value-added, higher quality, and sophisticated castings.

The studies in such areas as heat-resistant, wear-resistant, corrosion resistant and high alloy iron castings are necessary. It is required to master the production technology of these castings and add the necessary facilities for the production.

(f) Environment

Both foundries are very disorganized, with materials placed at random in the shop. Dust and fumes contaminate the shop and the working environment is very inferior from the viewpoint of safety and hygiene.

Particularly, the sand transportation, mold-knock-out and sand preparation systems are all open which cause dust; there is a tremendous difference in working conditions, as compared with the machine tool factory.

Problems in workers' safety and hygiene cause poor

motivation. Thus, it is quite hard to recruit new employment in the foundry.

2. Objectives

(a) Bangalore Foundry

To separate the foundry division from Machine Tool Factory Bangalore, MTB, and give it the status of an independent profit center.

To improve the productivity and the quality level of products by modernizing production facilities and by improving the production process.

To start the sales to outside including overseas markets by expanding the production capacity.

(b) Pinjore Foundry

To expand the production capacity through the introduction of efficient facilities and modernize the production process for the purpose of securing higher in-house procurement of castings for tractor production along with the expansion program of the tractor division.

It is of importance to hold the bargaining power against outside casting suppliers.

To improve the productivity and the quality level.

3. Approach

(a) Bangalore Foundry

A new foundry of 1,000 ton/month capability at Bangalore will be built. Operation will start in Apr., 1995. The production capacity will be more than 550 tons/month (7,000 tons/year) at first and gradually increase to 1,000 tons/month by 1999/2000.

Proposed production features are as follows:

(1) Melting

2 sets of 10 tons induction furnace.
3 sets of 5 tons induction furnace.

2 sets of 1.5 tons induction furnace.

Total melting capacity will be approximately 18,000 tons per year.

(2) Sand System

The Furan sand molding system will be introduced and continuous sand mixers will be used.

Sand will be transported with the enclosed flow system using compressed air. Sand reclamation/re-conditioning facility will be installed.

(3) Molding

(3)-1 Machine Mold Line of 600 tons/month capacity
The machine mold line with 2 x 3 m bottom plate, on which the flasks and the patterns are set, will be introduced. Combined with the vibration table and 20 tons/Hr. continuous sand mixer, the production will be mechanically driven through the pattern draw, surface painting, drying, core setting, joining, finally to the pouring of the molten metal, for the medium-sized casting products.

(3)-2 Hand Mold Line of 300 tons/month Capacity

A self-moving continuous sand mixer of 20 tons capacity per hour will be used for large-sized casting products. Maximum weight will be 15 tons.

A 20-ton overhead crane is to be installed.

(3)-3 Small-size molding of 100 tons/month capacity

A continuous sand mixer of 4 tons capacity per hour and a vibration table will be installed for the production.

(4) Fettling

20-tons crane-type shot blaster and

5-tons hanger-type continuous shot blaster

are to be provided for efficient fettling operation.

(b) Pinjore Foundry

To correspond the enlargement of the tractor production, a highly efficient automatic green sand molding line is to be provided in 1994. The Furan sand molding line is to be introduced for the production of machine tool castings in 1993.

The production will gradually increase from 7,000 tons/year in 1995 to 12,000 tons/year by 1999/2000.

Existing two management organizations for machine tool castings and for tractor castings, are to be unified at the implementation of the project.

Production features are as follows:

(1) Melting

2 sets of 2-tons - induction furnace installed in addition to existing 2 set of 3-tons induction furnace.
Total melting capacity will be 19,500 tons/year.

(2) Sand system

A hand molding line with the Furan system and continuous sand mixer will be installed. Sand transportation by the compressed air flow will be adopted. Sand reclamation/re-conditioning facility will be installed.

The automatic molding line with the green sand reclamation and re-conditioning facility is to be installed.

The capacity of the sand system will be reinforced to meet the scheduled automated operation.

(3) Molding

(3)-1 Impact Mold System

An impact automatic molding line with the flask size of 1,200 x 800 x 350/350 mm is to be introduced. The mold capacity will be 54 mold/Hr. The capacity increase 5.4 times of the existing tractor casting line.

The molding machine with the sand consumption of 60 tons/Hr. is to be added along with the existing jolt/squeeze machine.

Production volume of castings for tractors will be 9,000 tons per year.

(3)-2 Hand molding

A 20-tons/Hr. continuous sand mixer and a 10-tons/Hr. continuous sand mixer will be installed.

The vibration table, roller conveyor, pattern draw, and the flask reverser are to be installed for the main and the core molding.

Total machine tool casting production capacity will be 3,000-tons/Yr. including the existing green sand jolt/squeeze machine for the smaller size.

(4) Fettling

A 5-tons crane type shot blaster and a 1-ton mono-rail chamber type shot blaster are to be installed with the existing conventional turn table/gun-type shot blaster.

C. Sales Plan

1. General

HMT foundry activity is mainly for in-house production; noticeably the output of the Pinjore foundry is 100% for the in-house machine tool and tractor production. However, the current in-house tractor casting production only covers 13 - 15% of the total requirement; the rest is supplied from outside subcontractors.

To enable increased tractor production, the foundry capacity has to be expanded to maintain the principal casting components in-house and also to keep price control power over the subcontractors.

At Pinjore, the in-house production ratio would remain about 39% of the total. Therefore, there is no room for outside sales at the Pinjore foundry.

The Bangalore foundry, on the other hand, which is to be renovated corresponding with the complete renewal of the Bangalore machine tool production complex, shall be expanded to have the capacity for optimum operation. Although the machine tool production turn-over is increasing greatly due to higher value-added sophisticated products, the in-house foundry consumption for machine tools would not increase so much; about a 72% increase by 1999/2000. As a result, about 60% of the annual production, about 7,200 tons/Yr., must be diverted for outside sales, or for centralized production to meet the entire machine tool foundry demand concentrated at Bangalore (refer to Chapter D in the Production Plan)

The Pinjore tractor casting demand for boughtout goods would reach about 14,000 tons/Yr. in 1999. However, the size and weight range of the tractor components do not meet the Bangalore production system. Also, the distance, the transport infrastructure, and the regional problems would not permit substitute production at the Bangalore foundry.

Thus, the outside sales program for the Bangalore foundry is to be strongly emphasized.

2. Marketing Plan

(a) Extension of the existing outside sales connection.

The Bangalore foundry has been supplying about 400 tons/Yr. of products to outside customers as indicated below. It is recommended that existing customer channels be reinforced to enlarge sales volume, up to 10 times by 2000.

List of Existing Customers

Existing Customers	Main Products	Production, tons/Yr.
Bharath Earth Movers Ltd.	Brake Drums	100
Gujoraj M/C Tools	Lathe Beds	150
Chamundi M/C Tools	Lathe Beds	20
Hindustan Motors	Oil Pans	
	Covers	20
	Retard Housings	
Ingersoll Rand Ltd.	I:R Frame Heads	100
	I:R Cylinders, etc.	
G:D Weiler Ltd.	Lathe Beds	20
A.C.E. Designers	Beds	15
Total		425

(b) Exploitation of new customers in Indian domestic market

The projected domestic consumption of foundry products is estimated to increase 8 - 12%. This would mean that prospects are quite good for increased production. Accordingly, endeavors should be made to acquire domestic market information and knowledge of user activity, and an aggressive approach to the customer is suggested.

(c) Exploitation of the international market

The supply of foundry products, in the advanced countries including Japan is declining due to the lack of workers, the high rise in man-power cost, and the resulting decrease in profitability. Many casting enter-

prises are closing down this factories; this trend surely would continue.

In light of this, there are tremendous and immediate prospects for the export of foundry products from India. Perhaps, the best prospects for export in this country lie in the foundry areas among all the activities of HMT.

HMT should promote foundry marketing to acquire stable customers in the international field and also to coordinate with the major international trading houses.

3. Premises for the outside sales of the foundry products.

There are three primary factors with regard to products for outside sales: (1) international level quality, (2) punctual delivery, and (3) stable price.

Among these three factors, quality is particularly important, and it is governed by production technology.

HMT, at present, should be well aware that it would not be easy for them to explore outside sales at the current quality level. Emphasis must be laid on improving production engineering, upgrading production technology and minimizing defects and mis-alignments.

The introduction of Proof Cutting is vitally important to confirm the product quality in-house, in order to establish the quality reputation of the HMT foundry.

The QA/QC systems and organization are also to be concretely established with the modernized technology with the precise equipment.

The reliable reputation from the customers is indispensable for the outside sales promotion.

D. Production Plan

1. Production Volume

The projected production schedules in the Bangalore and Pinjore foundries are indicated in Table I-5-2 & I-5-3.

Table I-5-2 Annual Production of Castings by Bangalore Foundry

Unit: Tons

	Item / Year	1990～1991	1995～1996	1999～2000
Production	For MTB	2,794	3,600	4,800
	Outside sales	355	3,400	7,200
	Sum	3,149	7,000	12,000
	Outside sales (%)	11.3	48.6	60.0

Table I-5-3 Annual Production of Castings by Pinjore Foundry

Unit: Tons

	Item / Year	1990～1991	1995～1996	1999～2000
Production	For MTP	2,301	2,750	3,000
	For TRP	1,101	4,250	9,000
	Sum	3,402	7,000	12,000

Table I-5-4 Estimated Demand of Castings by TRP

Unit: Ton

Item / Year	1990～1991	1995～1996	1999～2000
Tractor Production (set)	17,414	27,850	44,400
Foundry Demand Total (t)	8,508	14,482	23,196
Supply by In-house Foundry (%)	12.9	29.3	38.8

The large portion of the tractor castings are supplied from outside.
In-house production to be 39% at 1999～2000.

E. Facility & Technology Improvement Plan

1. Facility Renovation Plan

(a) Facility Renovation Plan at Bangalore Foundry

i. Location

A new foundry will be established at north-west direction of the existing foundry shop, as indicated in the factory layout: W-10-0379 (see Fig.I-5-4.)

The space is to be 152 m x 91 m.

The facility and the equipment are indicated in the attached drawing MTDFY015 (Fig.I-5-5.)

ii. Foundry space

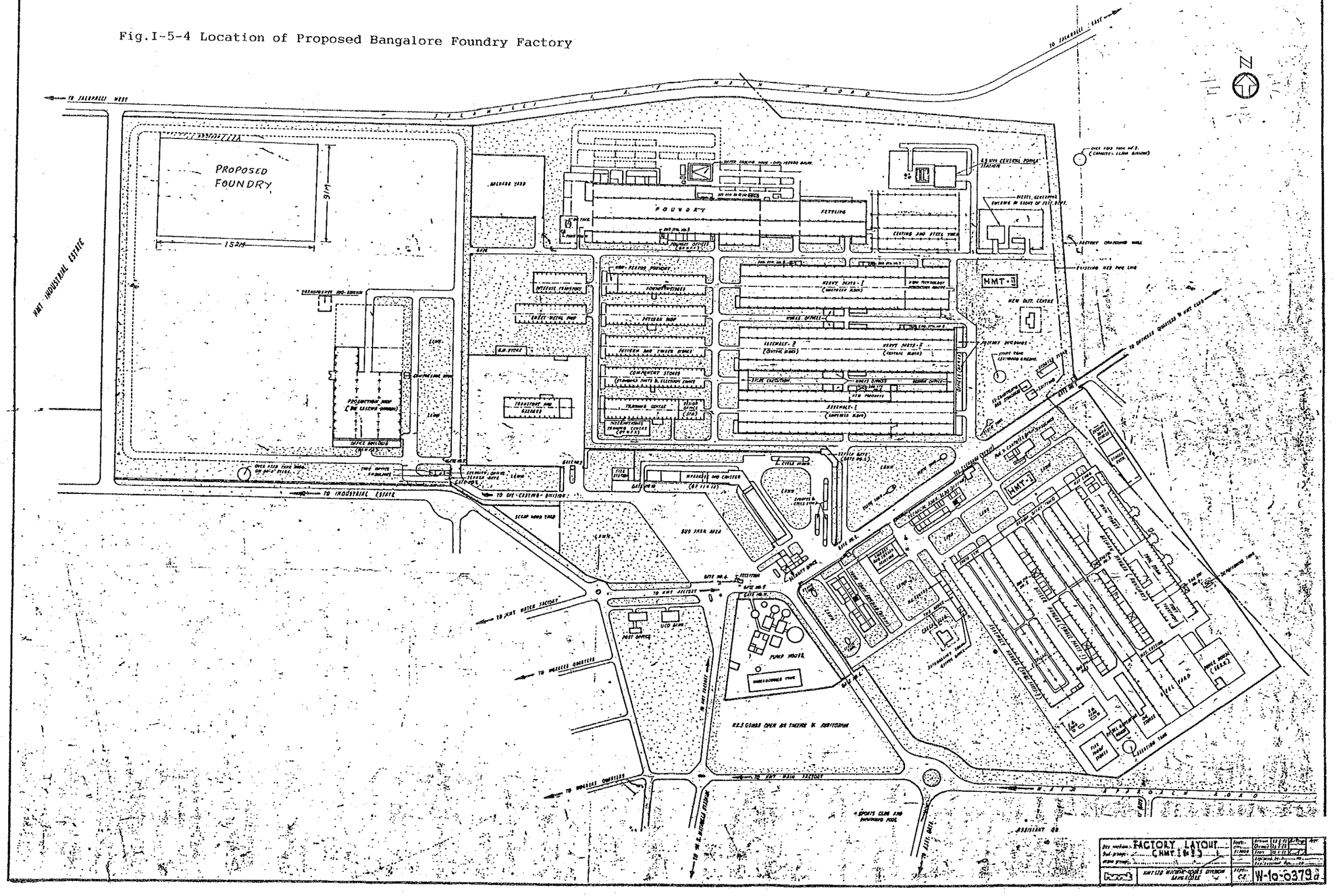
Total plant area is 12,954.15 m^2.

Details of space by division are shown in Table I-5-5.

iii. Facility

The newly installed facility in the Bangalore foundry is to be as shown in Table I-5-6.

Fig.I-5-4 Location of Proposed Bangalore Foundry Factory



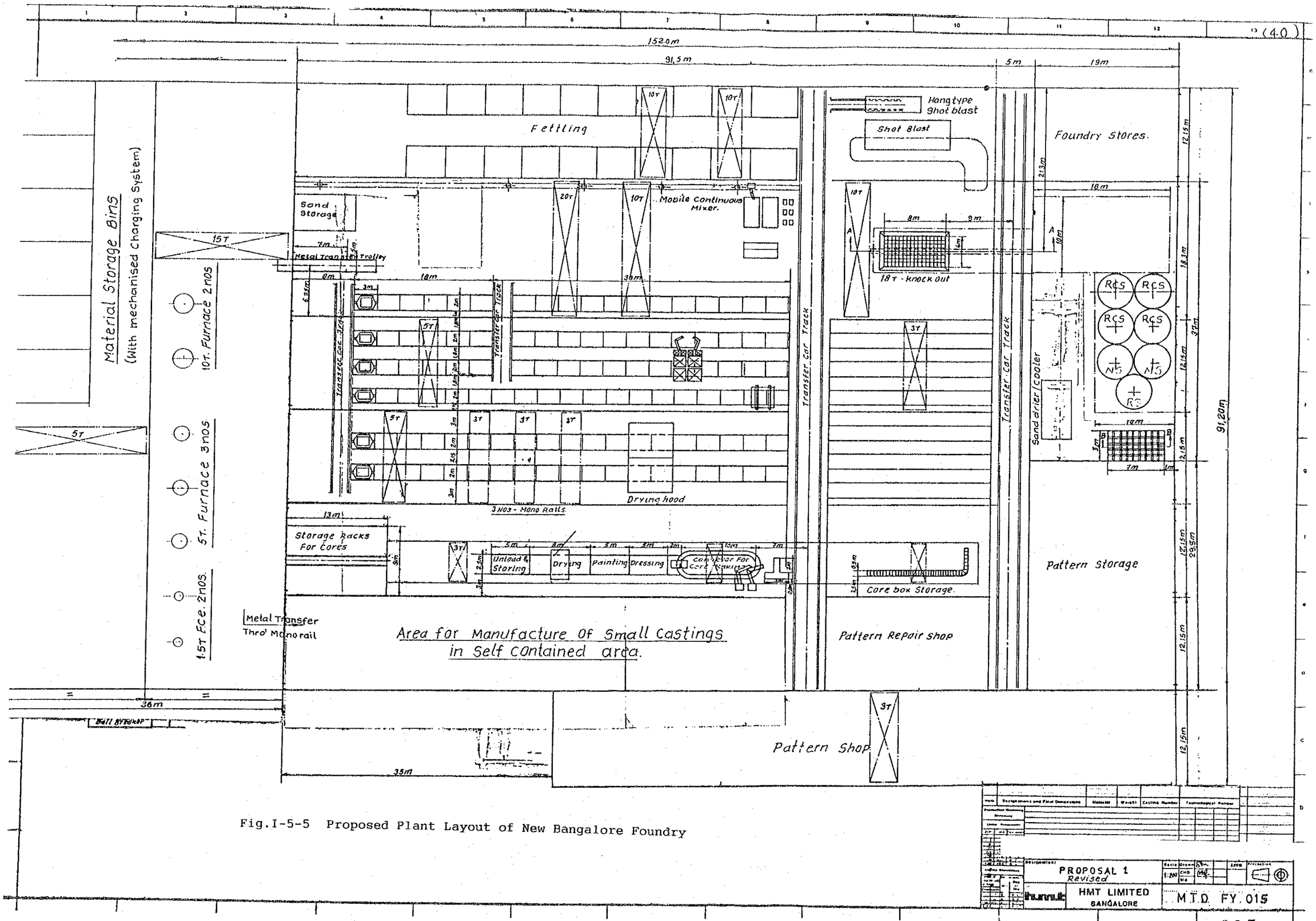


Fig.I-5-5 Proposed Plant Layout of New Bangalore Foundry

PROPOSAL 1
Revised
HMT LIMITED
BANGALORE
M.T.D. FY. 015

Table I-5-5 Factory Area by Division of Bangalore Foundry

ITEM	Length x Width (m)	Area (m^2)	%
PATTERN SHOP	80.50 x 12.15	978.075	7.6
PATTERN REPAIR SPACE	21.00 x 12.15	255.15	2.0
PATTERN STORAGE	19.00 x 29.90	568.10	4.4
SAND MOLD	19.00 x 37.00	703.00	5.4
MOLDING MECHANIZED LINE	65.50 x 24.30		
(INCL. FALSK/PATTERN STORE)	21.00 x 24.30	2,101.95	16.2
HAND MOLDING (INCL. POURING SPACE)	65.50 x 18.30	1,198.65	9.3
SMALL CASTING	65.50 x 12.15	795.825	6.1
CORE SHOP	65.50 x 12.15		
(CORE BOX STORE)	21.00 x 12.15	1,050.975	8.1
MELTING SECTION	36.00 x 79.05	2,845.80	22.0
FETTLING SECTION	65.50 x 12.15		
	21.00 x 30.45	1,435.295	11.1
FOUNDRY STORE	19.00 x 12.15	230.85	1.8
TRAVERSER AREA	2 x 5.00 x 79.05	790.50	6.1
TOTAL		12,954.15	100.0

Table I-5-6 List of Facility to Be Installed at Bangalore Foundry

(1) Pattern shop	
Modern milling machine	2 nos.
Araldite	1 no.
Spark erosion machine	1 no.
3 tons crane	1 no.
Inspection gauges	1 set
(2) Sand plant	
(2)-1. Fresh sand plant	
Hopper, 10 tons	1 no.
Compressed air flow system, 6 tons/Hr.	1 no.
Sand silo, 150 tons	3 nos.
Sand Dryer & Cooler, 6 tons/Hr.	1 no.
(2)-2. Furan sand reclamation/re-conditioning	
Knock-out apparatus, 20 tons	1 no.
Shaking trough, conveyor	1 no.
Magnetic separator	1 no.
Sand breaker	1 no.
Reclamation apparatus with cooler, 12 tons/Hr.	1 no.
Compressed air flow system, 9 tons/Hr.	1 no.
(2)-3. Others	
Dust collector	1 no.
Sand transport mechanism	1 unit
Sand silo, 150 tons each	4 nos.
(3) Molding	
(3)-1. Machine mold line	
Continuous sand mixer, 20 tons/Hr.	2 nos.
Flask driving trolley	112 nos.
Vibration table, 2 x 2.5 m, 5 tons	1 nos.
Pattern drawer, 5 tons	1 nos.
Paint dryer	2 nos.
Flask transporter	5 nos.
Overhead hoist crane, 3 tons	3 nos.
Bottom plate	150 nos.
(3)-2. Hand mold line	
Self-moving continuous sand mixer, 20 tons/Hr.	1 no.
Overhead crane, 20 tons	1 no.
Sand hopper tank, 45 tons	1 no.
(3)-3. Small size mold system	
Continuous sand mixer, 4 tons/hr.	1 no.
Vibration table	1 no.

	Sand reclamation, 2 tons/hr. (including shake-out, cooler)	1 no.
	Paint dryer	1 no.
(3)-4.	Core molding	
	Continuous sand mixer, 6 tons/Hr.	2 nos.
	Compaction table	2 nos.
	Roller conveyor, pattern drawer	1 unit
	Paint dryer	1 no.
	Overhead hoist crane, 3 tons	3 nos.
(4)	Melting	
	10 tons induction furnace (1-source/2-furnace)	2 nos.
	5 tons induction furnace (2-source/3-furnace)	3 nos.
	1.5 t. induction furnace (1-source/2-furnace)	2 nos.
	Material hoper, 10 tons	8 nos.
	Vibrated conveyor	8 nos.
	Material transporter	1 unit
	Charging bucket	3 nos.
	Material preheating apparatus	1 unit
	Mono-rail pouring system for small casting	1 no.
	Dust collector	1 unit
	Ladle	6 nos.
	Overhead crane, 15 tons	1 no.
	Overhead crane, 5 tons	1 no.
(5)	Fettling	
	Hanger type continuous shot blaster, 5 tons	1 no.
	Crane type shot blaster, 20 tons	1 no.
	High speed cutter	1 no.
	Tum blaster	1 no.
	Annealing furnace	1 no.
	Muffle furnace	1 no.
	Overhead crane, 10 tons	2 nos.
(6)	Testing, Inspection	
	Metallurgy inspection (microscope, CE meter)	
	Sand analysis	
(7)	Utility	
	Compressor	6 nos.
	Fork lift	2 nos.

(b) Facility Renovation at Pinjore Foundry

i. Location

An automatic impact mold line with green sand system is to be installed at the northern half of Bay B. Furan sand hand molding in Bay C.

ii. Layout

The equipment layout to be indicated in SKP-160-1 (see Fig.I-5-6).

iii. Facilities

Facilities to be installed at the Pinjore foundry are as shown in Table I-5-7.

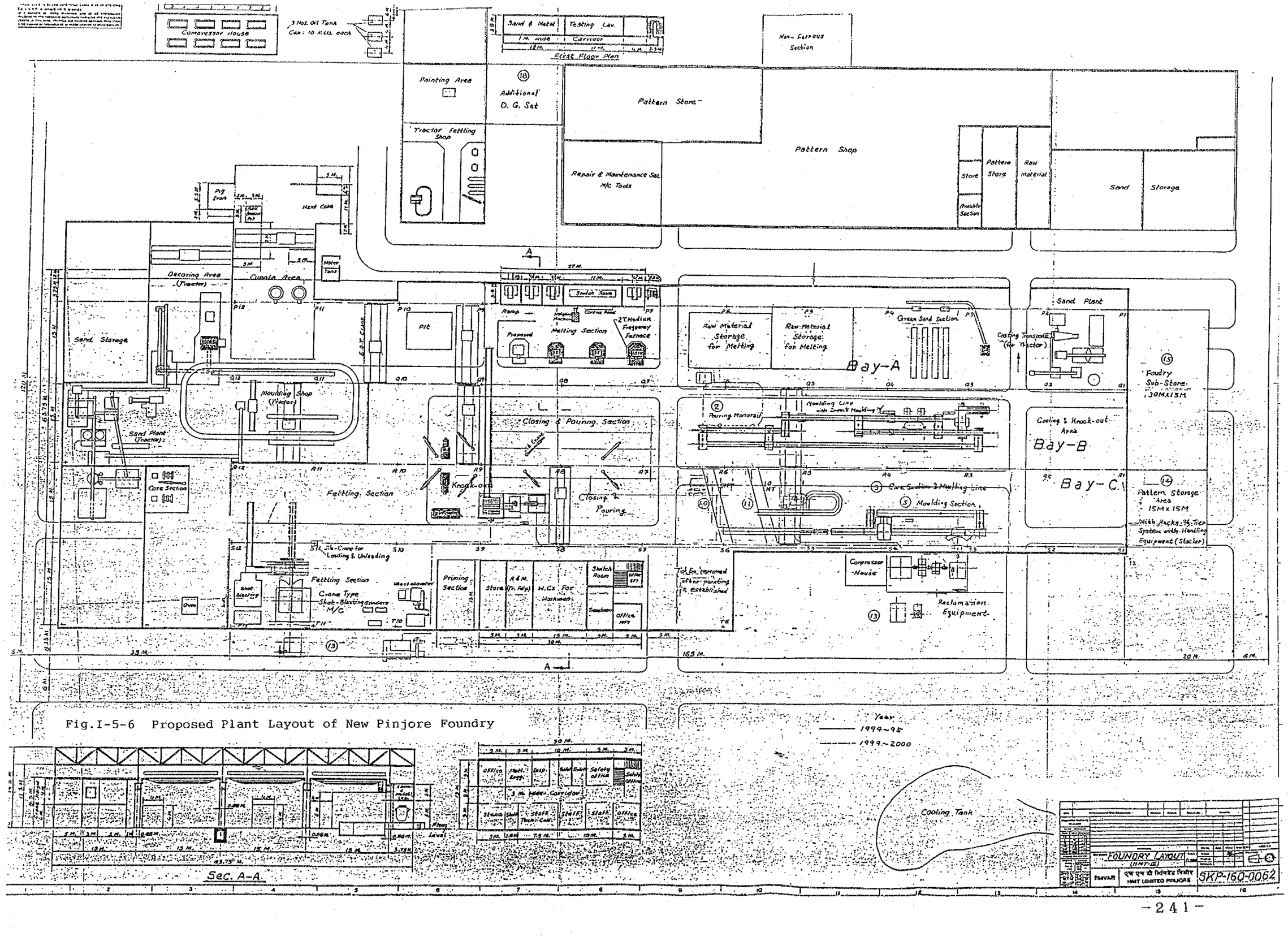


Fig.I-5-6 Proposed Plant Layout of New Pinjore Foundry

Table I-5-7 List of Facilities to Be Installed at Pinjore Foundry

(1) Sand Plant	
(1)-1. Impact mold line with green sand system, 80 tons/Hr.	
Sand cooler	1 no.
Hopper, with measuring appliances	1 no.
Turbine mixer	1 no.
Moldability controller	1 no.
Electric control system	1 unit
Bucket elevator, hopper, motor, etc.	1 unit
(1)-2. Furan sand reclamation/re-conditioning	
Sake-out machine, 10 tons	1 no.
Oscillating conveyor	1 no.
Magnetic separator	1 no.
Sand breaker, 10 tons/Hr.	1 no.
Sand reclamation/re-conditioning (including cooler, bucket elevator)	1 unit
Compressed air flow system for sand transport	1 no.
Dust collector	1 unit
Bucket elevator, hopper, conveyor, control panel	1 set
(2) Molding	
(2)-1. Impact mold line	
Impact mold system	1 no.
Automatic flask transport system 1,200 x 800 x 350/350 mm, 54 molds/Hr.	1 unit
Drilling machine for pouring inlet	1 no.
Flask reverser	2 nos.
Punch-out machine	1 no.
Transport system	1 no.
(2)-2. Furan sand system	
Continuous sand mixer (long arm mixer), 20 tons/Hr.	1 no.
Compressed air flow system	1 unit
Continuous sand mixer (high speed), 10 tons/Hr.	1 no.
Vibration table, 2 tons	1 no.
Pattern drawer	1 no.
Flask reverser	1 no.
Painting machine	1 no.
Roller conveyor	1 no.
Dust collector	1 unit
Overhead crane, 10 tons	1 no.
Overhead crane, 5 tons	2 nos.

(2)-3. Shell core making machine	1 no.
(3) Melting	
2 tons induction furnace	2 nos.
Mono-rail type continuous pouring system	2 units
Overhead crane	1 no.
Material charging system	1 unit
(4) Fettling	
Hanger type shot blaster, 5 tons	1 no.
Dust collector	1 unit
Monorail type chamber shot blasting machine, 1 ton	1 no.
(5) Testing, Inspection	
Spectro-meter	1 no.
Sand tester	1 no.
(6) Utility and others	
Emergency diesel generator, 1,500 kVA	1 no.
Compressor	4 nos.
Pattern storage space, 15 x 15 m	
Raw material store, 30 x 15 m	
Melting raw material storage area	
Non-ferrous casting removal	

2. Production Technology Improvement

(a) Production engineering and production technology improvement

i. Introduction of the Furan Sand Molding system at Bangalore & Pinjore Foundries

The furan sand molding system has the following advantages:

(1) The mold drying process is eliminated.

(2) Unified application of the casting sand simplifies the sand treatment control.

(3) The sand can be reclaimed and reconditioned for more economical operation. (Alkyd sand can not be re-used economically, hence it is discarded.)

(4) Compared with other organic self-hardening compositions, such as Alkyd Resin Coated Sand (Oil-Urethane Sand), the quality, economy and productivity of the furan sand is much higher for the following reasons.

* Higher compression strength at high temperature.
* Higher destructive resistance of the mold at high temperature, thus reducing sand inclusion, scabs, and pull down defects.
* Smaller residual compression strength in 200 - 600 °C range, therefore, better disintegration ability, resulting in easy knock-out operation.
* Less gas evolution at casting and also the timing of the gas evolution delays, thus, reducing the porosity defects such as pin holes.
* Cost of the added chemicals for the binder and for the hardening are cheaper per ton compared to Alkyd sand.
* Higher separation speed from the pattern, better utilization of the patterns.

ii. Introduction of the Impact Mold at Pinjore Foundry

Extremely high speed, continuous molding can be achieved for higher productivity and better quality. The impact mold has the following advantages.

(1) High molding speed.

(2) High packing density to attain a smooth casting surface.

(3) Higher molding strength at the parting line and the permeability corresponds to increase accordingly with the distance from the parting line, therefore, minimizing defects due to gas evolutions.

(4) Sharp corner edges can be obtained, reducing the fins, thus decreasing fettling work.

(5) Uniform mold strength in the horizontal section, which contributes to the stability of the mold and reduces deformations. Higher accuracy at as-cast condition, thus reducing the cutting margins.

(6) High density of the mold sand at the wall of the flask can be obtained thus increasing the versatility of the pattern size.

iii. Introduction of the Crane type Shot Blaster at Bangalore & Pinjore Foundries

Three-dimensional shooting of the shot grid can be obtained by way of the rotation of the work in an enclosed chamber, enabling efficient dismantling of the sand.

(b) Quality Control and Quality Assurance Improvement

Improvement in QC and QA is necessary to bring HMT's products to the internationally acceptable level of quality. The following measures should be taken.

(1) Establishment of QA/QC system

(2) Prevention of Defects

Non-conformity control by the precise analysis of the defects and the subsequent preventive measures are to be incorporated immediately.

(3) Improvement of Testing and Inspection Facility

Judgment based on the actual data to be applied with various inspection equipment covering the sand characteristics, material properties and the chemical composition check; the dimensional accuracy control, hardness and non-destructive testing are to be incorporated for the improvement action of the daily operation.

(4) Establishment of Experiment and Inspection Technology

Knowledge and technology of QA/QC are to be accumulated and implemented as the normal activity of the foundry operation.

3. Environment

The existing HMT foundries use open-type sand transportation (with a belt conveyor) and the shake-out and knock-out processes are also in an exposed condition; it is inevitable that a considerable amount of dust is always in the shop.

Although the larger shot blasters are enclosed in chambers, the worker still has to enter into the booth, directly exposed to the shot blast shooting.

In the renovated foundry, the improvements will be as follows:

* The sand transportation will be enclosed in a compressed air flow line or contained in an underground pit conveyor line.

* The continuous sand mixer will stop the floating dust of the intermittent operations of the conventional batch work.

* Dust collectors are to be installed at each point of the sand operation.

* Dust hoods and dust collectors are to be installed at the core knock-out, and the shake-out machines.

* the shot blast machines are to be of an enclosed type with automatic operation. Also, dust collectors are provided.

F. Management Improvement Plan

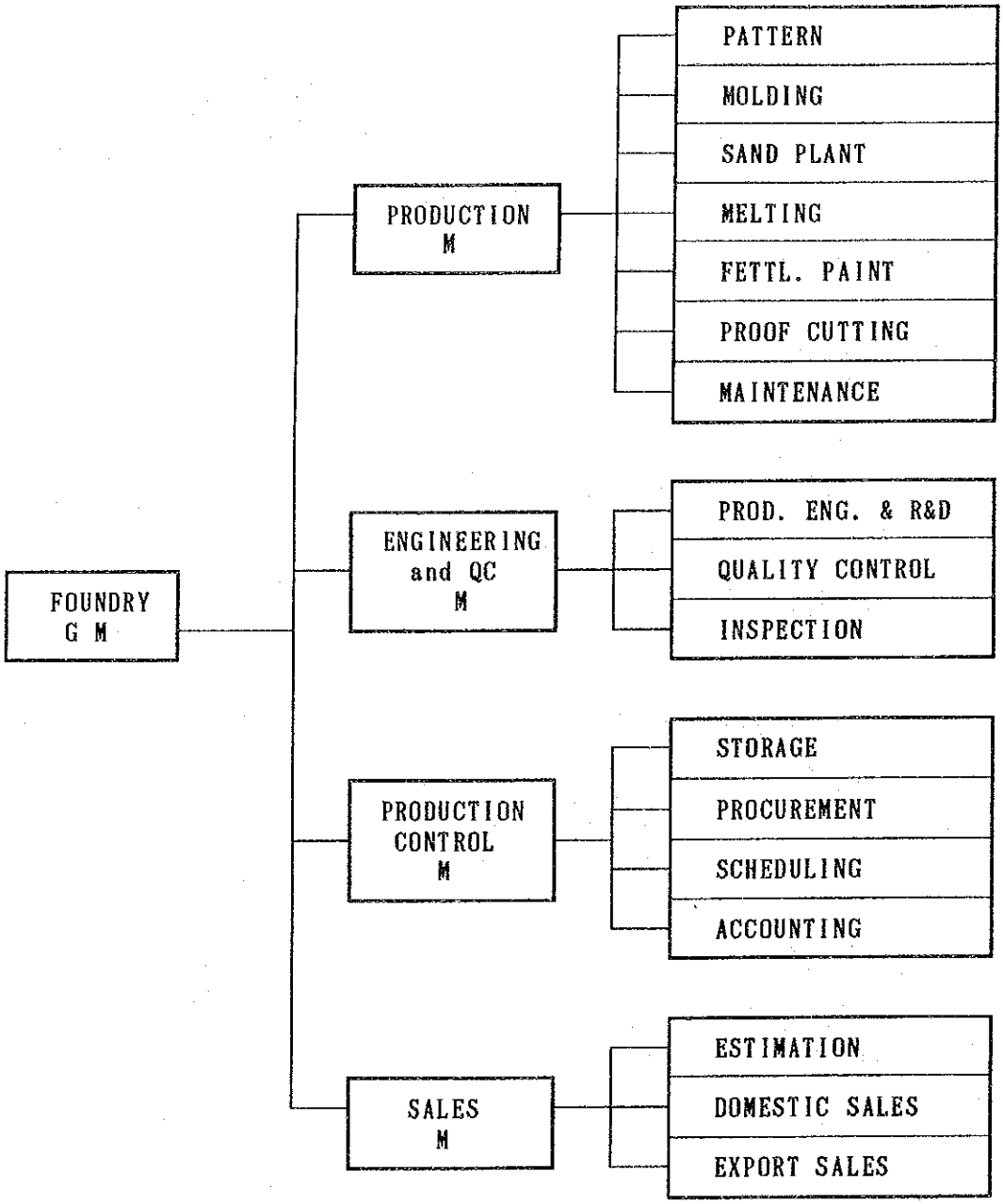
1. Organization Structure

Proposed organization structure of foundries is illustrated in Fig. I-5-8.

2. Manning Schedule

The proposed manning schedule both in the Bangalore and Pinjore foundries as shown in Table I-5-8.

Fig. I-5-8 Proposed Organization Chart of Foundries



Note: A sales section is not required for Pinjore Foundry.

Table I-5-8 Manpower Plan

1. Bangalore Foundry

Section	1991/92	1995/96	1999/2000
Managers, Engineers and Staff	7	15	15
Pattern	39	47	47
Sand Plant	13	4	4
Molding	189	120	120
Melting	22	22	22
Fettling	72	16	16
Non Ferrous			
Maintenance, Crane	72	20	20
Store		4	4
QC, Inspection	7	10	10
Proof Cutting		8	8
Painting		4	4
Total	421	270	270

2. Pinjore Foundry

	1991/92	1995/96	1999/2000
Direct	138	198	121
Indirect	188	145	108
Administration	43	45	40
Pattern Shop	45	40	35
Repair & Maintenance	35	47	50
Total	449	474	354

G. Training Schedule

An integral training program shall be organized and be implemented along with the renovation of the foundry.

While confined so long only in the experience of the conventional production technology, the sudden exposure to high technologies in the foundry process, may induce a risk of confusion or even worsen the quality for the starting few years of the renewed operation.

The principal introductions are the Furan sand mold system, the impact molding and the sand recycling system. The introduction, training, diffusion of above technologies are to be carried out systematically.

The proposed training schedules for both Bangalore and Pinjore are shown in Table I-5-9.

Table I-5-9 Training Schedule or Bangalore and Pinjore Foundries

JOB CURRICULUM	TRAINED PERSONNEL						
	1993	1994	1995	1996	1997	1998	1999
BANGALORE FOUNDRY							
ENGINEER : Overall tech., management	5	5	5	5	5	5	5
PATTERN : Operation of new machines			5	5	5	5	5
SAND : Furan sand system, reclamation-reconditioning			5	5	5	5	5
MOLD : Furan sand, operation of the system			20	20	20	20	20
MELT : Furnace operation			5	5	5	5	5
FETTL : Sand reclamation, shot blast oper.			5	5	5	5	5
MAINT : Preventive maintenance			20	10	10	10	10
TEST : QA/QC procedures, measuring tech.			5	5	5	5	5
PINJORE FOUNDRY							
ENGINEER : Overall tech., management	5	5	5	5	5	5	5
SAND : Green sand, Furan sand operation, recycl.		5	10	10	10	10	10
IMPACT MOLD : Operation			10	10	10	10	10
FURAN MOLD : Operation		10	10	10	10	10	10
MELT : Furnace operation							5
FETTL : Sand reclamation, shot blast oper.		5	5	5	5	5	5
MAINT : Preventive maintenance		10	10	10	10	10	10
TEST : QA/QC procedures, measuring tech.		5	5	5	5	5	5

I-6. MECHATRONICS CENTER

A. Current R&D Structure

HMT has several R&D Centers in its business groups, to carry out the improvement, modification and expansion of the present product mix. Also, each unit has a tactical R&D team, responding immediately to current production requests. These are performed as the normal activity of the enterprise in close cooperation with the design and production stages.

On the other hand, in parallel with the recent rapid advancement of the technology, the new product mix should always be studied. There are excellent companies who add new product lines for diversification and even change their corporate image because of successful diversification into exotic fields.

It seems to be the right time for HMT to analyze the future creation of a new product mix for its survival and for the continuation of the enterprise into the 21st century.

B. The Basic Concept of the Action Programs

1. Problems

A fresh start for new diversification requires technology imported from outside; some time has to be spent for the negotiation of the technical transfer agreements and also for governmental clearance.

In this time span, the outside technology is still advancing further and when everything is ready, the said new technology might be obsolete; again the new import of technology must be sought. The repetitive import of technology, as experienced by HMT in the past, is not only expensive but also it makes it difficult to catch up to the top level of international competition.

Also as for the exploitation of exotic fields, while the current R&D structure is subject to each business group, there exists an unavoidable tendency to attach heavy importance on immediate profit, so that it is difficult to pay attention to long term R&D and to the advanced investment for new exotic business diversifications. HMT, as its corporate mission, hoisting the target to be "The leading Industry in the High-Tech Field", should establish a propagating base to generate core technology for the future.

2. Proposed Functions of the Mechatronics Center in the Action Program

To come out from the above-mentioned unavoidable trough, HMT should have its own capability for the continuous creation of competitive technology. It is necessary to establish an organization where the future R&D assessments will always be carried out to determine the integral, the long range R&D targets for at least a ten year span.

Future targets for diversification should be selected from the present technology cores (seeds) in HMT as indicated in Table V-4-1, and their feasibility should be studied. When the inhouse technology core is not

available, in exotic fields or in fields where the potential market is foreseeable (such as Textiles, Apparel and Food Processing), appropriate outside consultants might be utilized.

A technology situation appraisal should be conducted. The technology potential, which would be the seed for the future, would be compiled against the market potential, which would represent market needs. The analysis should be conducted from the perspectives of marketing, cost, finance and HRD. These activities shall be impartial, independent of the existing business groups, and directly connected to the technical director.

Also, the license possibilities, joint venture schemes, M&A, and OEM production are to be studied and evaluated. HRD is indivisible from the R&D plan; the proposed Mechatronics Center is just responding to the above-mentioned requirement, in which the future core technology of "Mechatronics" will serve to breed inhouse and to bring up young engineers to move HMT into the future.

3. Kinds of Service to be implemented

1) A comprehensive diffusion of Mechatronics Technology to entire HMT, not only to Machine Tools but also to Printing Machines, Press Machines, and to expected future products such as the Food-Processing Machines.

2) Compose a wide-range curriculum for new-comers, active engineers, supervisors, and also for management, to upgrade the inhouse technology level. The training cost shall be borne by each business group, but the fee should not exceed that of outside commercial seminar training.

3) Accept Customer Engineer Training, and assist sales promotion. The Center provides the most modern products of HMT, which can act as the show room for HMT's advanced technology.

4) Join in the trouble-shooting and in the after-sales service for customers, to maintain close contacts with

the present sales activities, and also to be flexible in response to current market requirements.

5) Add the mechatronics R&D function (mainly Design Capability) in the near future, and to become R&D point of the new products.

C. Needs Estimation for the Services proposed by the Center

According to the long range HMT Corporate Plan (see Part I of the Report), the total employment varies from the current 30,000 to 28,000 at the year 2000. The current mean age of employees is about 45 years old and the retirement ratio is considered to be around 3% in the past few years.

To give vitality to the enterprise, to make aggressive entry into new business territory and to expand corporate activity, it is essential to inject younger power, urgently reducing the mean age to around 30 years old: so that at least 200 technical young employees per year are to be recruited.

The Mechatronics Center shall have the orientation training of the newcomers and also have 1st-year/2nd-year training for the rapid diffusion of the core technology of HMT.

In parallel with the above, mechatronics training for management is to be carried out. Also, a concentrated mechatronics special course shall be provided for the engineers who would be the future leaders of the HMT technology, preparing the inhouse technology accumulation and the diffusion to new fields.

The service needs are to be tabulated as follows.

Orientation Training for New recruits	200p. 5-day Course
1st Year Training	160p. 10-day Course
2nd Year Training	130p. 10-day Course
Supervisor Training	100p. 10-day Course
Middle Management Training	50p. 10-day Course
Engineer Training	50p. 10-day Course
Design Engineer Concentrated Training	20p. 20-day Course
TOTAL	600p/yr. (in terms of 10-day Course)

In addition to the above, the Center accepts Customer Engineer Training along with product sales, to contribute to sales and after-sales service promotions, starting with 30 persons/year, gradually increasing to 100 persons/year. in the year 2000, in accordance with the expansion of the business.

The curriculum would be a 5-day course, in which the first two days are for lectures, and the other three days are for the actual program input, the actual operations and the instructive remarks.

D. Equipment of the Facility of the Mechatronics Center

1. Location, Geography

The Mechatronics Center is to be located inside the HMT compound in the city of Bangalore (Machine Tool Div., Bangalore 560031), utilizing the existing Machine Tool R&D Cutting Center, extending the 1st floor.

The existing R&D Cutting Center is built as a ground floor configuration but the expected extension to be envisaged at the construction; the pillars, walls and ceilings are reinforced accordingly, and the ends of the pillars are exposed to facilitate the future extension.

2. Layout Plan

Fig. I-6-1 shows the floor plan for the proposed Mechatronics Center at Bangalore.

The dormitory, canteen and other amenity facilities for the trainees are not considered; existing HMT facilities art to be utilized. However, a mini-bus is to be provided to facilitate the transportation to the factories and for the commuting of the customer engineers.

3. Indication of the Equipment and Facilities

The list of the equipment for the Mechatronics Center is indicated in Table I-6-1.

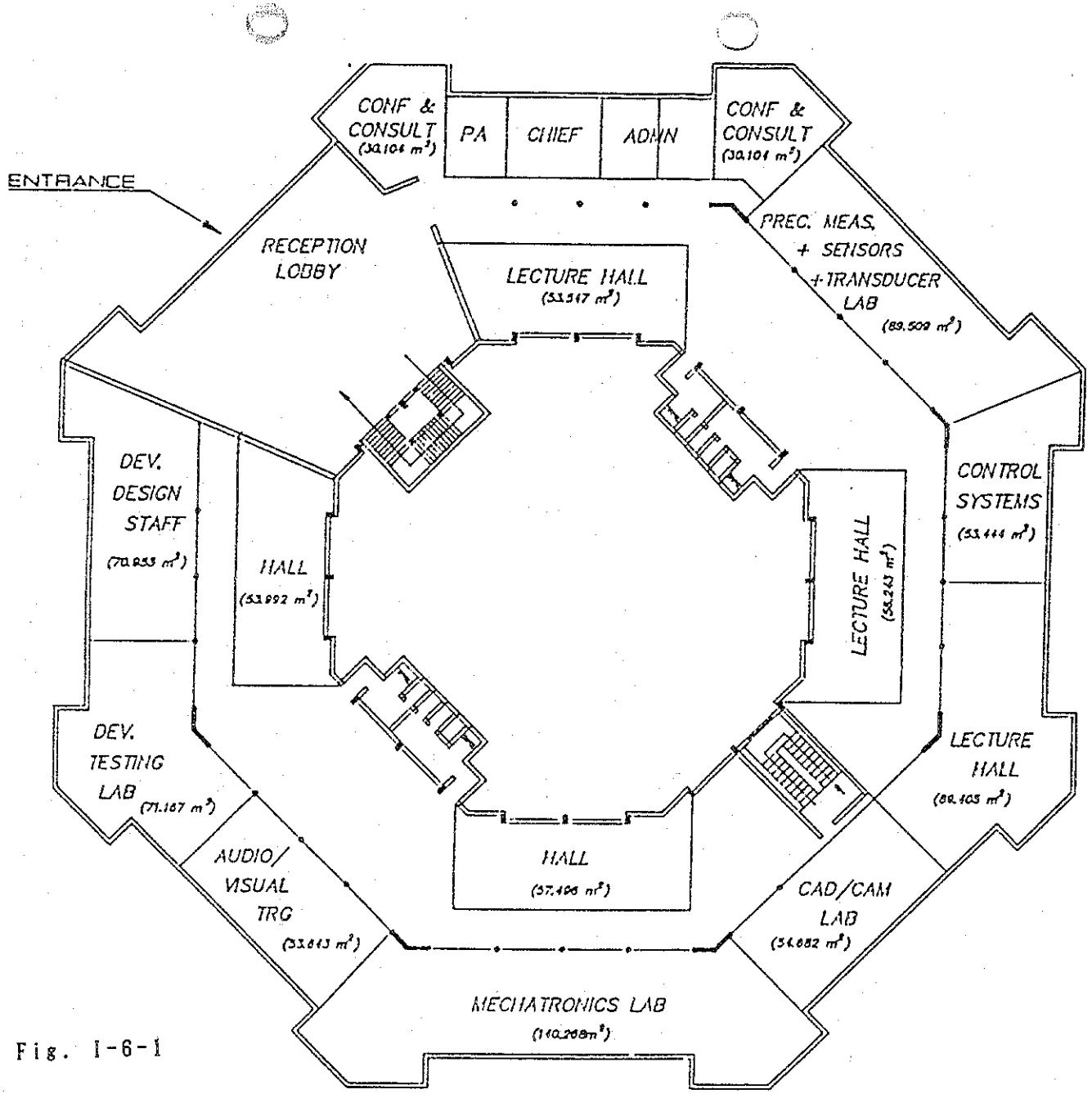


Fig. I-6-1

FLOOR PLAN FOR THE PROPOSED MECHATRONICS CENTRE AT BANGALORE

AREA STATEMENT :

Ground floor : 2,088.62 sq.metres
(Existing R&D building)

First floor : 2.057.62 sq.metres
(Proposed for Mechatronics centre)

Total : 4,146.24 sq.metres

Scale : approx : 1 mm = 0.218 m

Note : All areas are approximated

Table I-6-1 List of Equipment for the Mechatronics Center

(1/4)

Sl.No.	Description	Quantity	Price Rs. Million	
			Domestic	Foreign
I.	Precision Measurement Lab:			
1.	Small CMM	1	2.0	-
2.	Laser Measurement System	1	-	1.0
3.	Digital Measuring Instruments	1 set	-	1.0
4.	Storage, Furniture & Others	-	0.5	-
5.	PC	1	0.1	-
II.	Control System Lab:			
1.	Power Supply etc. Facilities	1	0.1	-
2.	CNC System (HMT Make)	1	0.8	-
3.	CNC System (Imported)	1	-	1.5
4.	PLC	1	-	0.4
5.	PC	1	0.1	-
6.	Simulation Equipment	1 set	0.1	-
7.	Other Controls (2 types)		2.0	-
8.	DC Servomotor and Drive	1 set	-	0.1
9.	AC Servomotor and Drive	1 set	-	0.1
10.	Storage, Furniture and Facilities	1 set	0.1	-
11.	PC	1	0.1	-

Sl.No.	Description	Quantity	Price Rs. Million	
			Domestic	Foreign
III.	Transductor & Sensors Lab:			
1.	Encoders/Linear Scales/Tacho Inductosyn	1 each	-	0.2
2.	Pressure Transducers/Sensors, Force Sensors	set	-	0.1
3.	Temperature Transducers/Sensors	set	-	0.1
4.	Velocity/Acceleration/Vibration pickups & Probes	set	-	0.2
5.	Touch Trigger Probes	set	-	0.2
6.	CCD Camera/Vision System	set	-	0.5
7.	Other Types of Probes and Transducers	set	-	0.5
8.	Furniture, Storage & Facilities	-	0.1	-
9.	PC	-	0.1	-
IV.	CAD/CAM Computer Lab:			
1.	Engineering Work Station	1	2.0	-
2.	PCs and Printers	4	0.4	-
3.	Plotters and Digitizers	1 each	1.2	-
4.	LAN etc.	set	0.1	-
5.	Software Additional	set	-	2.0
6.	UPS	set	0.2	-
7.	Furniture, Storage, Facilities	-	0.1	-

Sl.No.	Description	Quantity	Price Rs. Million	
			Domestic	Foreign
V.	Mechatronics Lab:			
1.	Trainer FMS with CNC trainer lathe CNC Machining Center, Robot, CMM etc.	set	-	6.5
2.	Training Robot	1	-	0.3
3.	Assembly Robot with Vision System	set	-	2.0
4.	HMT Trainer CNC Machines	2	0.5	-
5.	HMT CNC Production Machines (STC 15, VMC 800, SNC H)	1 each	13.0	-
6.	Power Supply, UPS etc.	set	0.4	-
7.	Other Mechatronic Items	set	0.5	-
8.	Furniture, Storage and Facilities	-	0.2	-
9.	PC	1	0.1	-
VI.	Development and Testing Lab:			
1.	Oscilloscope	1	0.1	-
2.	UV/Other Type Recorders	1	-	0.2
3.	Electronic Measuring Equipment	set	0.1	-
4.	Power Supplies, etc.	set	0.2	-
5.	Multimeters, Ammeters, Volt Meters, Hand Held Instruments	set	0.1	-
6.	PLC Programming Unit	1	-	0.5
7.	Microprocessor Development System	1	-	2.0
8.	Other Equipment, Logic Analysers	set	-	1.0
9.	PC	1	0.1	-

Sl.No.	Description	Quantity	Price Rs. Million	
			Domestic	Foreign
VII.	Audio Visual and Training Lab:			
1.	TV + VCR + Projection TV	set	0.2	-
2.	Video Cameras and Equipment	set	-	0.1
3.	Slide Projector + OHP + Audio + Offset m/c	set	0.1	-
4.	PC + DTP	2	0.4	-
5.	Board Copier	1	-	0.2
6.	Furniture S.torage etc.	-	0.1	-
	TOTAL		26.2	20.7

Less 8% for freight, handling and insurance Rs. 1,407,000.
Less 5% for installation and commissioning Rs. 2,345,000.

Value for equipment Rs. 24,104,000. Domestic
Rs. 19,044,000. Foreign

E. Operation of the Mechatronics Center

1. Objective and Functions

The objective of the Mechatronics Center is as follows.

"To breed the HMT core technology of Mechatronics in-house and to diffuse it to the entire HMT activities."

Its functions are:

1) To promote, bring-up and diffuse the mechatronics technology to the entire HMT, regardless of the current business domains.

2) Train the inhouse human resources at all employee levels, providing a wide range curriculum. Trainees consist of the newly recruited personnel, active workers and staff, supervisors, middle management, engineers and the design personnel. The cost of the operation shall be borne by each business group that dispatches the trainees. However, the fee should not exceed that of an outside commercial seminar.

3) Accept Customer Engineer Training free of charge and assist the sales promotion. The Center demonstrates the newest product lines of HMT, which can act as a show room for HMT's advanced technology.

4) Join in trouble-shooting and in after-sales service for the customers, to maintain close contacts with the present sales activities and also to be flexible to reflect current market demands in the curriculum.

5) Add the mechatronics R&D function (mainly the Design Capability) in the near future, and become the R&D point of the new products.

2. Major Activity

The Centralized Technical Training in Mechatronics:

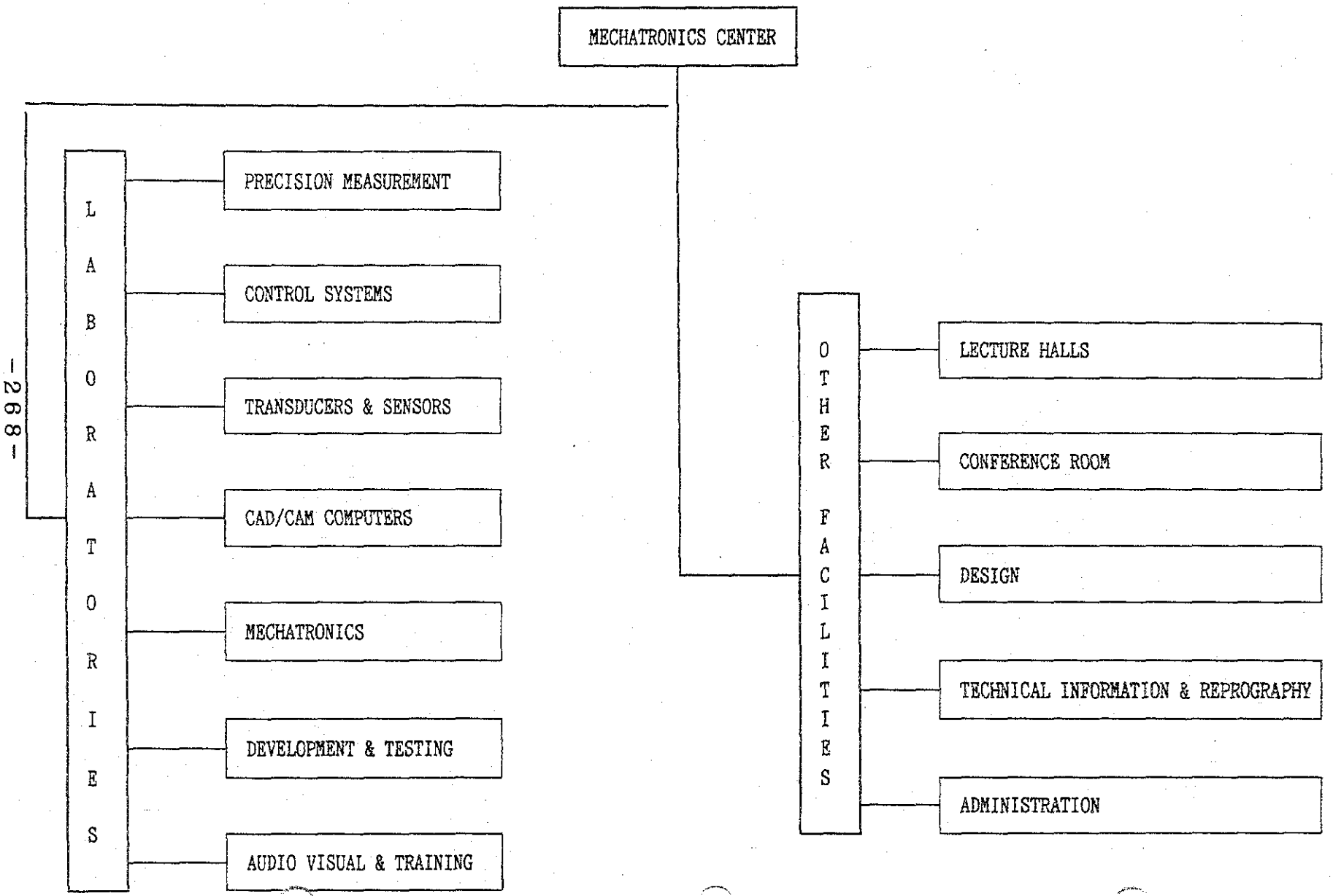
1) Orientation Training for the newly recruited personnel

2) 1st Year Training
3) 2nd Year Training
4) Supervisor Training
5) Middle Management Training
6) Engineer Training
7) Design Engineer Concentrated Training
8) Customer Engineer Training

3. Organization, Manpower Requirement

Fig. I-6-2 shows the organization (facilities) at the proposed Mechatronics Center and Table I-6-2 shows the manpower requirement and personnel costs for the operation of the Center.

Fig. I-6-2 Organization (Facilities) at the Proposed Mechatronics Center at Bangalore



Facilities at the proposed Mechatronics Center at Bangalore

Table I-6-2 Manpower Requirement and Personnel Cost

Sl. No.	Category	Officers/ Engineers	Supervisors/Technicians/Clerical
1.	Chief of Mechatronics Center	1	1
2.	Precision Measurement Lab	1	1
3.	Control System Lab	1	1
4.	Transducers and Sensors	-	1
5.	CAD/CAM Computers	1	1
6.	Mechatronics Lab	1	2
7.	Design, Development & testing	6	1
8.	Audio Visual & Training	1	1
9.	Tech. Information and Reprography	-	1
10.	Administration (Personnel, Finance, Purchase & Typing)	3	2
11.	Driver	-	1
		15	13
	TOTAL	28	

Anticipated personnel cost/year:

- Officers/Engineers 15 x Rs.6,000/M = Rs.1,080,000.
- Supervisors, etc. 13 x Rs.4,000/M = Rs. 624,000.

Rs.1,704,000.

F. Center Operations

1. Service Income

The inhouse training cost shall be borne by each business group who dispatches the trainees to the Center. However, the fees shall not exceed those of outside commercial seminar training. The target cost would be 4,500 Rs for a 10-day course. The business group shall bear additional hotel, or transportation charges related to the Bangalore training. The customer engineer training is to be free of charge, and is stipulated as a service of HMT.

2. Operating Cost

Fixed fees (depreciation cost of the building, equipment, their interest, insurance and fees) are to be absorbed in the HMT overhead, and therefore are to be excluded from the operating cost calculation. The variable cost is to be the operating cost, which is transferred to the training cost of each business group, according to the numbers of trainees accepted. The calculated details are indicated in Table I-6-3.

Other useful data, elaborated for the establishment of the Mechatronics Center with the collaboration of the HMT counterparts, are attached.

Table I-6-4: Investment Cost Estimation
Table I-6-5: Requirement of Training of Staff
Fig. I-6-3: Schedule for Establishing the Mechatronics Center

Table I-6-3 Operating Cost & Training Cost

Operating Cost:

Fixed Cost

- New Investment Depreciation with Interest (10 year return with 7.25% interest = 15% of Investment)	9,000,000 Rs/Yr
- Insurance, Tax, Fees, Other Fixed Cost (0.35% of the Building Cost)	31,500 Rs/Yr

Variable Cost

Maintenance Cost (1% of Equipment Cost)	475,000 Rs/Yr
Utility	
- Electricity : 50,000 Kwh/Yr x 1.5 Rs/Kwh	75,000 Rs/Yr
- Water : 2,000 m^3/Yr x 3 Rs/m^3	6,000 Rs/Yr
- Fuel Oil : 10 Kl/Yr x 7,000 Rs/Kl	70,000 Rs/Yr
Wages (incl. Insurance, Social Benefit, Bonus etc)	1,704,000 Rs/Yr
Indirectly Cost (10% of above)	233,000 Rs/Yr
Contingency (7% of above)	163,000 Rs/Yr
HMT Overhead (16% of above)	372,800 Rs/Yr
Variable Cost Total	3,098,800 Rs/Yr

(Operating Cost: excluding Mechatronics Center Fixed Cost, which is assumed to be absorbed in HMT Overhead)

Numbers of Trainees:

- HMT Personnel: 20 p. x 30-Course (10 days each) - 600 p./Yr
- Customer Training - 30 p./Yr
  to be gradually increased to 100 p./Yr

Training Cost:

For 10 day Course About 4,500 Rs/Trainee

Table I-6-4 Investment Cost Estimation of Mechatronics Center

Initial Investment Cost:

	Domestic Currency Rs.	Foreign Currency Rs.
Mechatronic Center Building**		
- Existing R&D Center to be extended (1st floor to be added) 2,000 m^2 x 04,000 Rs/m^2	9,000,000	
Equipment as per attached list	24,104,000	19,044,000
Freight, Handling & Insurance (3%)	1,407,000	
Installation & Commissioning (5%)	2,345,000	
Vehicle (Mini-bus)	600,000	
Sub-Total	37,456,000	19,044,000

Pre-Production Capital Expenditure:

Pre-Investment Studies & Preparatory Investigation Management of Project Implementation Detail Planning & Tendering Supervision, Coordination, Test-Run & Take-over of Civil Works, Equipment & Plant		
Training of Staff & Labor	1,750,000	1,750,000
Arrangement for Supplies		
Arrangement for Marketing		
Preliminary & Capital Issue Expenditure		
Technology Cost: Lump-Sum Payments (to be included in the Equipment Cost)		
Technology Cost: Royalty Payments		
Utility Cost (to be covered by Existing R&D Cost)		
Sub-Total	1,750,000	1,750,000
Grand Total	39,206,000	20,794,000
		60,000,000

About Rs.60,000,000 (300,000,000 Yen)

** Civil, Electrification & Sanitation: Internal partitions, fittings, A.C. Furniture & Office Equipment.

Table I-6-5 Requirement of Training of Staff

I. Training/Consultancy by International Specialists

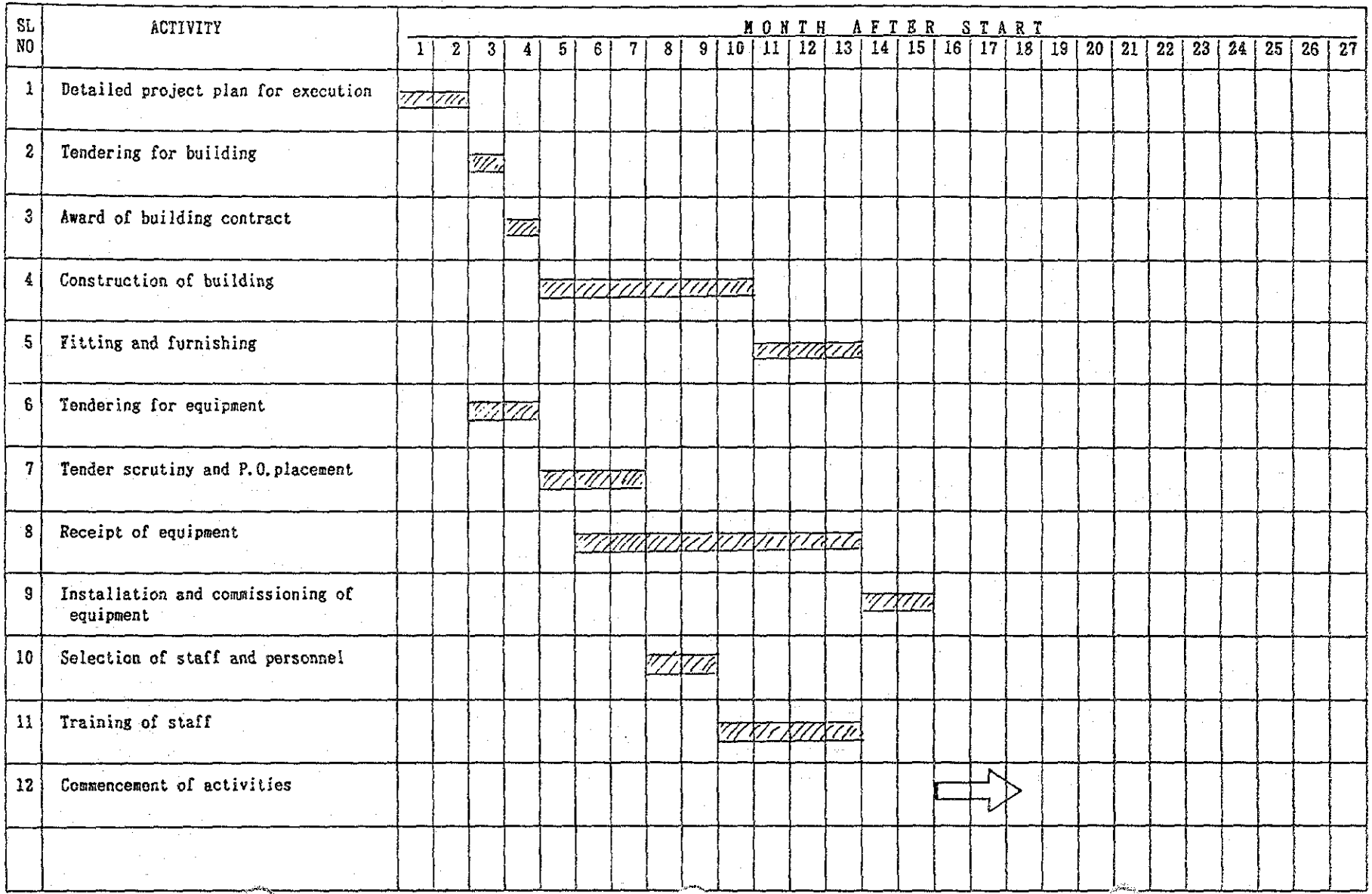
Field	Duration (Man Months)
1. Control System Specialist	: 1
2. CAD/CAM Specialists	: 1
3. Mechatronic Specialists	: 1 (0.5m/m at detailing
4. JICA Specialists	: 1 stage and 0.5 after functioning of the Center)
TOTAL MAN-MONTHS	: 4
Anticipated expenditure at 45,000 Yen/day and other contingencies	: Rs. 1,750,000

II. Training/Visits for engineers of Mechatronic Center

Field	Duration (Man Months)
1. Precision Measurements	: 0.75
2. Control System	: 0.75
3. CAD/CAM	: 0.75
4. Mechatronics	: 0.75
5. Design, Development, Testing	: 1.50
TOTAL MAN-MONTHS	: 4.50
Deputation cost	:Rs. 1,750,000

TOTAL FOR I & II = Rs. 3,500,000
DOMESTIC = Rs. 1,750,000
FOREIGN = Rs. 1,750,000

Fig. I-6-3 Schedule for Establishing the Mechatronics Center



I-7. Development of Management Information System

A. Current situation of HMT's Management Information System

Until the middle 1980s, each unit and each factory of HMT had its owned computers and developed its EDP system independently of each other. Taking the opportunity of the installation of the UNISIS A3K in 1986, HMT has established the Computer Service Department, Bangalore (CSB), applied EDP in factories and marketing departments in the Bangalore area, and tried to have a MIS connected with its headquarters. Since then, HMT has been aiming at setting up a network which will connect the whole of HMT in the future.

Only five years have passed since HMT started its substantial utilization of computers, so the installation of MIS is still in the planning stage. In reality, each of HMT's policies for an information system, planning, organization, and personnel is not good enough. There is a vast amount of problems to be solved in the future. This situation is just as was mentioned in the Interim Report in detail.

As a result, it must be pointed out that there are serious defects in the current computerization of HMT. The followings are the major problems:

a) Computers are not useful at all for "production control" at such production sites as machine tool factories;

b) In the areas of the financial and accounting systems, there is no "total system." The cost accounting system and financial accounting system are not integrated yet and the cost accounting system is not good satisfactory.

As mentioned above, non of the production management, inventory management, purchasing management, cost management, etc. is good enough in the current EDP system. This means that each individual EDP system which is needed as an information source to become the foundation of MIS does not function. Therefore, a total re-design of the application

systems is necessary for developing the information systems in the future.

However, investment for computers in India is financially a heavy burden compared with that in Japan, North America or Western European countries. Moreover, coupled with the incomple nature of the infrastructure such as domestic information transmission and the under-development of domestic computerization in India, it may not be possible to expect good results of computerization so soon.

Accordingly, while exerting HMT's best efforts to control the investments for hardware in line with downsizing concept, construction of long-term information systems to conform to the actual situation of HMT should be planned.

B. Basic Concept of Action Program

1. Problems

Not only is the newest information technology of HMT not used effectively for its computerization, but also the information system is separated from the actual business work. Accordingly, it must be said in principle that the computerized management information system in HMT can be constructed only after establishing computerization in each section of the company.

The main problems in such situation are as follows.

a) Lack of fundamental conception for computerization

Fundamental concepts such as answering the question "Why and for what should the computer be used" are missing. There was a concept to reduce personnel expenses at first in the earlier stage of computerization in European countries, North America and Japan, but it is not realistic to expect the same in India. Improvement of business work and usage of information by utilizing computers should be considered most important in India.

b) Lack of the planning divisions for information system construction

There are CSB and various levels of the computer divisions and sections in HMT that are engaging in the development and operation of individual systems, but there is no organization to promote an entirely integrated information system, especially the planning function. There is no control or adjustment of various projects and planning which each individual department or section now carries out at random under the pressure of actual business activity.

c) Insufficient systems and lack of unification among the current individual businesses

The lack of integration between hardware and software is remarkable, and most of the running systems are

incomplete. There is no conformity between and among the systems of departments and sections, and many instances of money waste due to duplicated developments can be pointed out. Moreover, the lack of unity in software and code systems which are now in use may cause very serious obstacles in the future to the concentrated management of technology, sales, purchasing, etc.; exchanges of information among each division; and, finally to the construction of a substantial MIS.

d) Lack of systemized business operations and procedures before the computerized system applied

Because the existing manual ways and procedures of business operations were converted to the computerized system as they were, good results were not obtained in spite of so much manpower and expense having been spent to develop the system. The most typical examples are that, as there is no concept of the reduction of lead times in production or the collective cost reduction or improvement of productivity or the like, the most important production management system hardly has any correlation with the relevant materials, the inventory control of semi-processed products, purchasing system, cost estimating, invoicing, etc. The re-design of working processes to permit the computerization of business operations is imperative.

e) Insufficient talents for information systematization

It is pointed out that there is insufficient talent in quality and quantity for promoting information systematization and that the information system department is evaluated too low. This stems from a lack of fundamental education about the information system having been given to the employees who were involved with the computerization in the company. Because the system was built by information engineers having insufficient knowledge of business duties and, on the other hand, by employees in charge of business with little knowledge about the information system, the fundamental business opera-

tion system is incomplete and therefore may prevent the use of computers in the future. It will be necessary to train the persons who are to be in charge of SE and informationalization from among employees who have developed a career in HMT.

2. Functions of the Proposed Management Information System

The major functions to be expected from the proposed MIS are as follows.

a) Constructing an on-line real-time production system and cost accounting system as well as re-constructing the inventory and purchase control system with the following aims:

- Reduction of the inventory of materials and semi-products;
- Maintenance of products' quality by precise production process management;
- Shortening the production lead time and achieving earlier money collection; and
- Increase of new product development.

b) Strengthening and maintaining of the development force and rationalization and economization of the new technology developments accompanied by the standardization of code, database and system development.

c) Optimizing inventory, production and sales information control, reduction of inventory in distribution and earlier money collection based on the establishment of an information network which connects factories and sales bases.

d) Establishing precise and waste free production and sales systems along with the promotion of power and energy saving and an integrated production system.

e) Supplying management information to each level of the company management according to unification and commonality of information based on standardization and system integration.

f) Reducing communication costs, optimizing selection of business chances and winning in competition through the construction of an information system which responds to customers with the information network connecting the company and outside customers.

3. Approach for the Reform of MIS

The current computer system in HMT is very far from being a complete MIS. Therefore, the proposal in the action program will range from the re-construction of the individual departmental work system in the prior stage of the management information system to a complete MIS considered from the long-term viewpoint.

a) Establishment of an individual work EDPS (Electronics Data Processing System) which is the information source of the management information system and making its database while attaining system downsizing as well as reviewing the work flow and rationalization and advancing the efficiency of the work through computerization. The fundamental policy is to achieve the followings:

- A system which aims at on-line, real-time data processing;
- Downsizing to medium and small computers; and
- Application of LAN to the production management system.

b) Standardization of the computer operation system, coding system and development processes

Rather than developing an information system for each individual department or section independently of each other, an exchangeable system should be developed from the entire company viewpoint. Especially, it is imperative to standardize the database and the coding system for the future MIS. Moreover, it is also important to standardize the development processes and therefore it will be necessary to form a library of various kinds of manuals and information systems.

c) Integration of system and database

When the above mentioned items a) and b) have been completed, the system and the database are to be integrated from the viewpoint of the entire company. Especially, the unified system of production management and marketing is to be realized and further correlated to the accounting information system. Thus, the unification of information sources is promoted and the commonality of information allowing everybody to use the same information is realized. At the same time, by connecting all the factories, the sales bases and the head office in the center with an on-line system, the speed of information transmission is increased and decision making at each level of management is supported.

d) Construction of information network inside and outside the company (EDI)

By realizing the on-line capability for order receiving and placement between the company and outside, the speed of such work will be increased and at the same time, rationalization across fences between different companies is realized. Such a system is the integrated management strategic support system which is useful for supporting sales, obtaining information about competitors, reinforcing the sales force, product development, and so on. ANSI 12 is to be applied as the standard.

C. Forecast of Needs for Host Computer Service in HMT

The following table shows the working hours of the A3K host computer up to now.

Table I-7-1 Working Hours of the HMT Host Computer

(Unit:Hours)

	1988-89	1989-90	1990-91 up to Jan. 91	Per day
CPU	1,688	2,471	2,772	11.1
		46.3%	34.6%	
I/O	2,939	4,603	6,009	24.0
		56.6%	20.0%	
Terminal	32,341	45,067	73,273	293.1
		39.3%	95.1%	

Note : 300 working days per year for the above calculation

The above table shows that the A3K machine hours are almost full and the disk capacity and the number of terminals have reached the upper limits. Moreover, there are problems at this time such as slow response time and lack of room in the magnetic disk capacity. As mentioned in the Interim Report, it has reached a limit and no more expansion of business can be expected. The requirement of computer capacity is assessed on global basis and, thereafter, suggested as the needs of Host Computer, Factory LAN, and OA LAN for CHQ and mini system for MTB.

There are the following needs at least as for the utilization of computers in the future.

First, in line with the advancement of restructuring of HMT, a natural increment in demand for computers of about 10% is foreseen every year.

Second, there will be the following needs for computerization just in the area of Bangalore regarding the information system in the future, and a 50% increase of CPU capacity in 5 years and a 100% increase of terminal hours are estimated:

- Real time processing of production management, inventory management, purchasing management, etc., in each factory;
- Re-construction of cost management system and financial accounting system integrated with business operation systems;
- Building the engineering database; and
- Construction of MIS by each unit.

Third, in order to expand the information system relative to the following functions of HMT's head office, a 120% increase of CPU base and about 200% increase of terminal hours are estimated. In addition, a 150% increase for development is estimated:

- Expansion of marketing system; and
- Construction of the corporate MIS.

Fourth, construction of a system database for office automation in favor of users in the company will also require computer capacity.

If each of the above-mentioned items is to be reached in 5 years, in March, 1998, there will be the following estimate at least, on the actual results in 1990-1991. This means almost double the current capacity will be required.

Table I-7-2 Estimated CPU hours in 1998

(Unit : Hours)

	1991-91 results up to Jan.,'91	Natural increment	Factory basis needs	Head office needs
Production/Inventory	978	906	587	
Finance & Accounting	382		229	
Payroll & Personnel	579			
MIS & Marketing	112			161
CHO/CSB	725			1,450
	2,772(3,326)	906	816	1,611

3,326 + 906 + 816 + 1,611 = 6,559 hours

Two possible ways of coping with the situation noted above are:

- Raise the level of the host computer; and
- Solve problems by downsizing to decentralized mini-computers and the application of PCLAN.

In order to meet the information system needs in the future, downsizing should be realized by reinforcing the technology enough to cope with downsizing and then the investment for computer hardware would be minimized.

D. Investment Plan

1. Outline of the Equipment and Facility Plan

The current buildings and facilities of CSB are good enough. However, marginal augmentation towards infrastructural facility establishment, comprising of Information Center library, UPSS, environmental facilities are required. In the future, the size of the host computer itself will get much smaller and, moreover, the expansion of the host computer should be kept to the minimum by all means. The new Host computer should be mainly used for meeting on-line systems requirements for machine tools, watches and marketing needs of Bangalore-based Units, along with a mini computer and factory LAN for meeting local requirements of MTB.

The current computers installed in CSB are designed with a view forward upsizing and common use among units in the area and not forward down-sizing. In order to optimize investments in hardware, applications currently running on mainframe may be down-sized. Down-sizing of applications requires considerable expertise and therefore should be attempted only by CSB. After down-sizing, the mini system for MTB is to be installed. While procuring the mini-system, the database management software should be compatible among mini and mainframe for Bangalore-based units, whereas it has to be upward compatible for out-lying units. This approach will ensure standardization of databases and also protection of investments.

The major equipment and facilities to be installed are as follows.

a) Host computer
   - Main memory : in the level of 48M byte
   - Disc capacity : 15 gigabyte
   - Printers : 2 sets
   - Communication facilities
   - Basic software

b) LAN and bar code technologies
   - Local area network : 1 system
   - Bar code terminal : 10 units
   - Bar code printer : 1 unit

c) Educational and training equipment and software

2. Schedule of Investments

The establishment of the complete Management Information System is to proceed in stages as per the following 3 steps.

1st Stage (1992/93 - 1996/97)

In this stage, development capabilities and skills of HMT for computerization should be strengthened with minimum hardware investments.

- To establish communication network connectivity of manufacturing units with those of marketing offices and CHQ, the facilities available through I-NET, RABMN, INMARSAT, etc. are to be made use of.
- While developing production and other systems, connectivity and/or compatibility among POPLAN, MINI SYSTEM AND MAINFRAME systems are to be ensured.
- To establish standardized and integrated data-bases on a new host computer in CSB by utilizing updated information technologies. These databases are the foundations of future integrated MIS for all of HMT.
- To realize reduction of inventories and speedy money collection by establishing a total factory database and factory MIS which is integrated with the production system, inventory control system, accounting and finance system ,etc. This will contribute to increased factory profits. The present A3K Host computer should be mainly for batch-oriented applications for Bangalore-based units.
- To shorten the total lead time from orders received to dispatch and to meet customers' needs by using single resource information systems. In order to establish this system, the linkage of production systems with marketing systems should be established as well as the establishment of integrated databases and the MIS.
- To customize the model system developed for MTB to other machine tool factories.

- To promote user-oriented Office Automation (OA).
- To train and educate information engineers. For the time being, outside information engineers should be used for system developments.

2nd Stage (1997/98 - 2001/2002)

The information systems developed in the first stage should be advanced in the following areas.

- To enclose customers in the information network system by connecting outside companies such as dealers, suppliers, sub-contractors, etc. in order to achieve superiority over competitors. HMT could achieve increased market shares and cost reduction.
- To train end users and to promote user-oriented OA systems.
- To increase investments for OA equipment.
- To sell software and services developed for internal use to outside companies.

3rd Stage (2002/03 - 2006/07)

AT this stage, almost all the systems will have been completed. But reconstruction and increasing the level of information systems will be required because of the changes in environment. Activities in this stage are as follows.

- To raise the level of information equipment and information technologies.
- To train and educate users according to the changes in environment.

3. Estimates of Initial Investment Amount

The total initial investment costs up to the year 1996/97 are estimated to be about Rs. 129.7 million in base cost (excluding price escalation and physical contingency costs) using 1992/93 prices as a base. The details of the estimation are shown in Table I-7-3.

Table I-7-3 Estimates of MIS Investment Amount

Use of Funds	Number	Amounts
1. Equipments Host Computer (equivalent to Unisys A16) Hardware - CPU - 48 MB Memory - 15 GB Disk - Tape Drive - Datacomm - Printer Software - System Software - Network Software - Data Management - Language US$.3,468,800.	(sets) 1	(Rs.Lakhs) 867.2
Mini Computer	1	65.0
Barcode Printers/Software @JYE.4,500,000.	6	49.0
Factory LAN @JYE.7,410,000.	6	81.0
Software @JYE.11,200,000.	1	20.0
2. Training & Education of LAN Engineers 2 men 2 months US$.(16,000)		4.0
3. R & D System Development by Outsourcing		45.0
4. Development of Communication Network Software		32.0
5. Training Education & Facility		134.0
GRAND TOTAL		1,297.2

Assumptions : 60% Customs Duty on discounted prince.
40% Discount on Listed price of Host Computer

Exchange Rate : US$. 1 = Rs. 25.-

D. Administration Plan

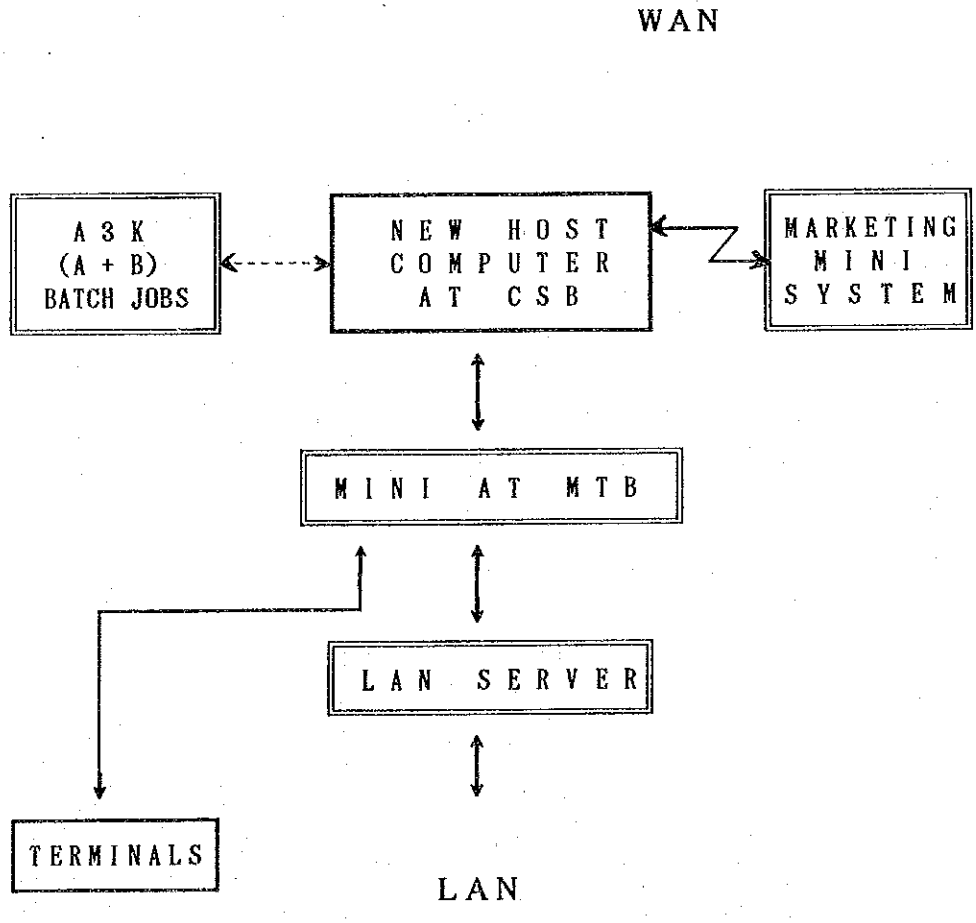
1. Objectives and Functions

Under the strong control and leadership of the central planning section, led by the Central Information Officer (CIO), an integrated information system is to be developed.

The major objectives and the functions of the proposed system are briefly illustrated in the following charts.

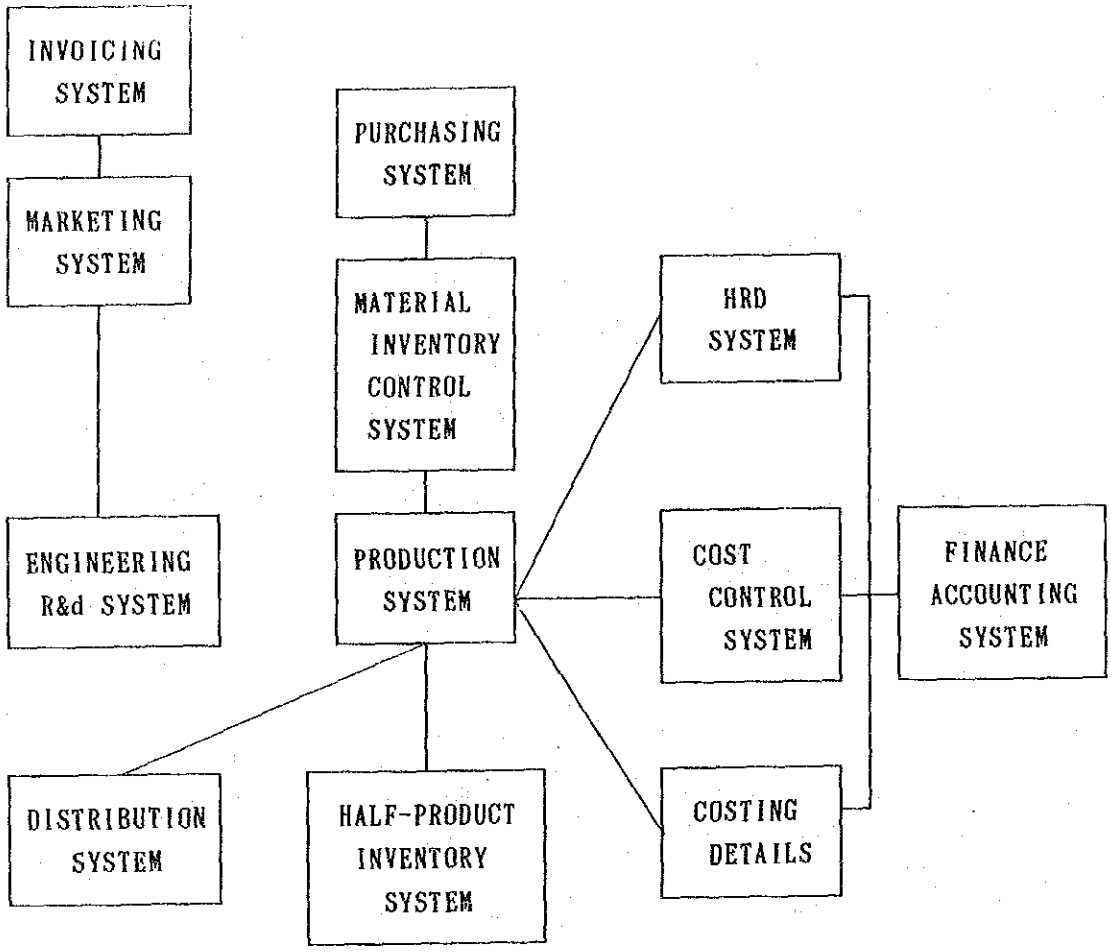
a) To establish both the centralization and the decentralization of the information network system

PROPOSED COMPUTER SYSTEMS DEVELOPMENT FOR BANGALORE BASED UNITS



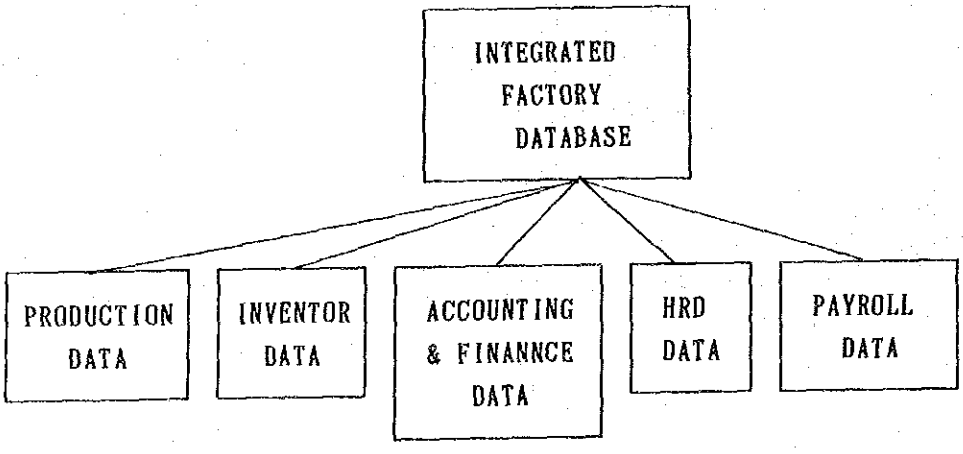
b) To establish EDP systems which fit well with each business system.

EDP systems based on factory



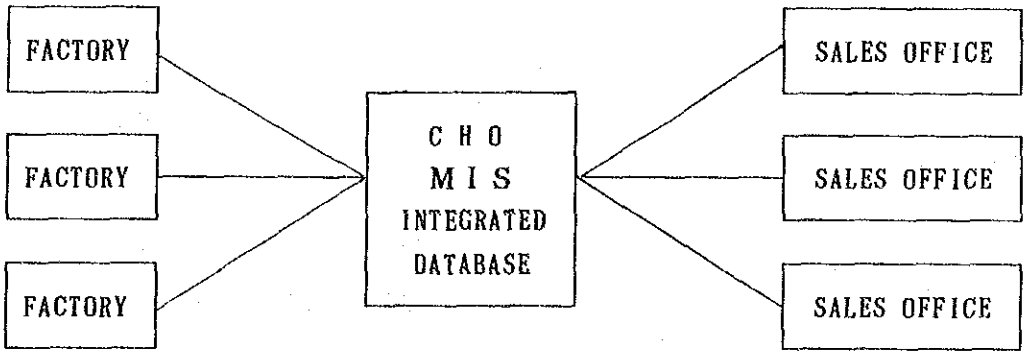
c) To supply useful factory management information from single sources of information based on an integrated database.

Integrated database in factory

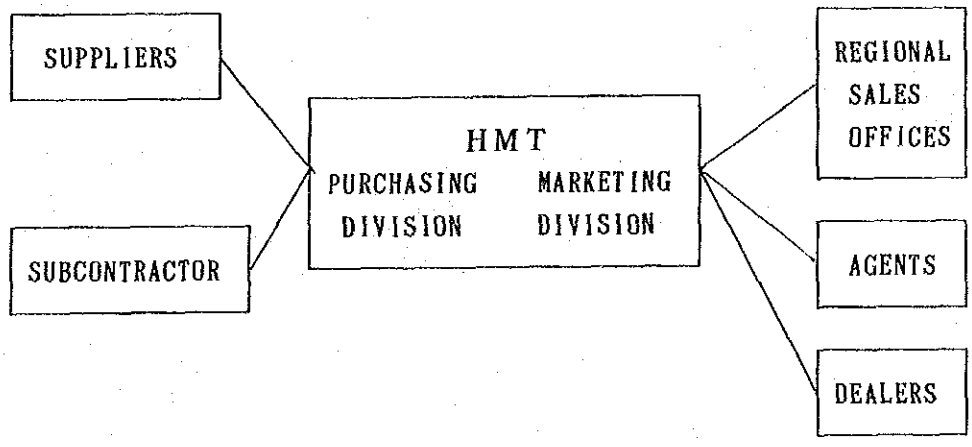


d) To promote rationalization, efficiency and cost reduction in both production and sales activities by a database covering entire HMT.

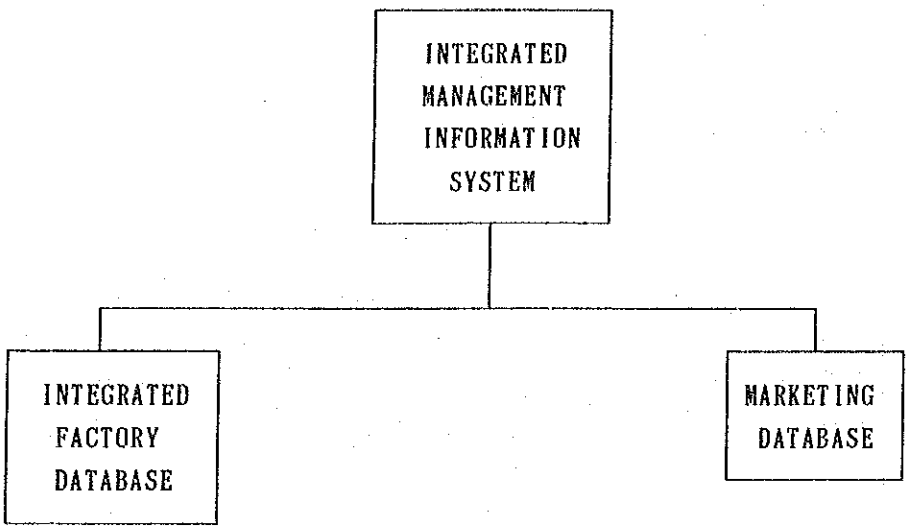
Network Information System Connecting All HMT Units



e) To promote intercompany rationalization, efficiency and cost reduction in both production and sales activities by data interchange on an information network system expanded to connect outside companies.



f) To build up integrated MIS.



2. Major Activities

In HMT there are no division or staff members in charge of planning and establishing the MIS from the viewpoint of top management. With the full support of top management, it is necessary to organize a section to promote the computerization of HMT. It is necessary to identify the key person representing the user interest at each factory to co-ordinate with Unit EDP and Information planning. The strategies of top management are to be directly reflected in the established new management information system. The major activities required in each step are as follows.

1st Step : Establishment of a foundation for MIS and promotion of standardization.
The KEY WORD at this step is "STANDARDIZATION"

This step is the most effective and basic action for the future development of the information system although it does not necessitate a huge amount of investment. If these actions are not carried out, the MIS will be in vain. In the meantime, a model system is to be constructed in MTB. The major actions to be taken in this step

are as follows.

a) To establish a central information library.

To establish a system which would collect documents from all EDP sections into a central information library and to make it easy to analyze problems with information from company-wide bases. Implementing the above suggestion would contribute to the establishment of a future information system and become the starting point of "standardization".

b) To design the whole picture of the future MIS for HMT

This makes it clear and precise as to what kind of system is required by management, and what kinds of basic policies are to be taken for the future computerization of HMT.

c) Redesign of production system and related systems

The production control system, which must be the base for the computerization of HMT operations, should be redesigned. The system should be redesigned to such a degree that the following requirements can be achieved.

- To grasp each production process on a real time bases.
- To grasp the situation relative to inventories for both raw materials and semi-finished products.
- To grasp the actual cost of each product on a real time basis.
- To provide sufficient information to meet the needs of personnel management, accounting and finance, marketing, distribution sections, etc.

d) To promote standardization

Establishing an effective and efficient standard coding system, standard database format and standard procedures and documentation of the system for development should be promoted totally in the company. The importance of "standardization" can not be overemphasized throughout HMT. It is essential for the future MIS.

2nd Step : Construction of HMT's corporate MIS
The KEY WORD at this step is the "SYSTEM INTEGRATION"

The major activities in this step are as follows.

a) To expand the model system

The model system developed in MTB is to be transplanted to other units to promote "standardization"

b) To complete the internal information network system

Make use of the communication network using I-NET, RABMN and INMARSAT, etc., towards systems integration and for dependents on single source for data computing and retrieval. At the completion of this, everybody in HMT will be able to get the same and updated information from any terminal in HMT, and the first stage of MIS have been completed.

c) System Integration

Such EDP systems as the production system, accounting and finance system, marketing information system,etc., are all to be integrated in the corporate MIS. This integrated information system would also contribute to that of the factory MIS.

d) Integrated system of production and marketing system.

As a result of system integration of both production and marketing, each department can get sufficient and updated information from other departments. Therefore, quick and effective production and sales activities can be realized.

3rd Step : Expansion of information network to outside establishments.
The KEY WORD is "EDI" (Electronic Data Interchange)

a) The order and order-receipt network system

The development of the social infrastructure such as transportation or telecommunication networks will bring about speedy movement of products and the rationalization of intercompany transactions. In order to meet these changes, the information network should be extended to outside establishments for the exchange of orders and order receipt data. Thereafter, HMT could play a leading role and reap huge profits by the early establishment of such an information network. These types of network systems are called "SIS" in Japan and "EDI" in the US and Western Europe.

b) The collection of outside information

The establishment of an intercompany network system contributes not only to cost reduction through the rationalization of production activities but also is effective in collecting information on competitors' activities and strengthening marketing competitiveness. With this stage the establishment of the corporate MIS would complete.

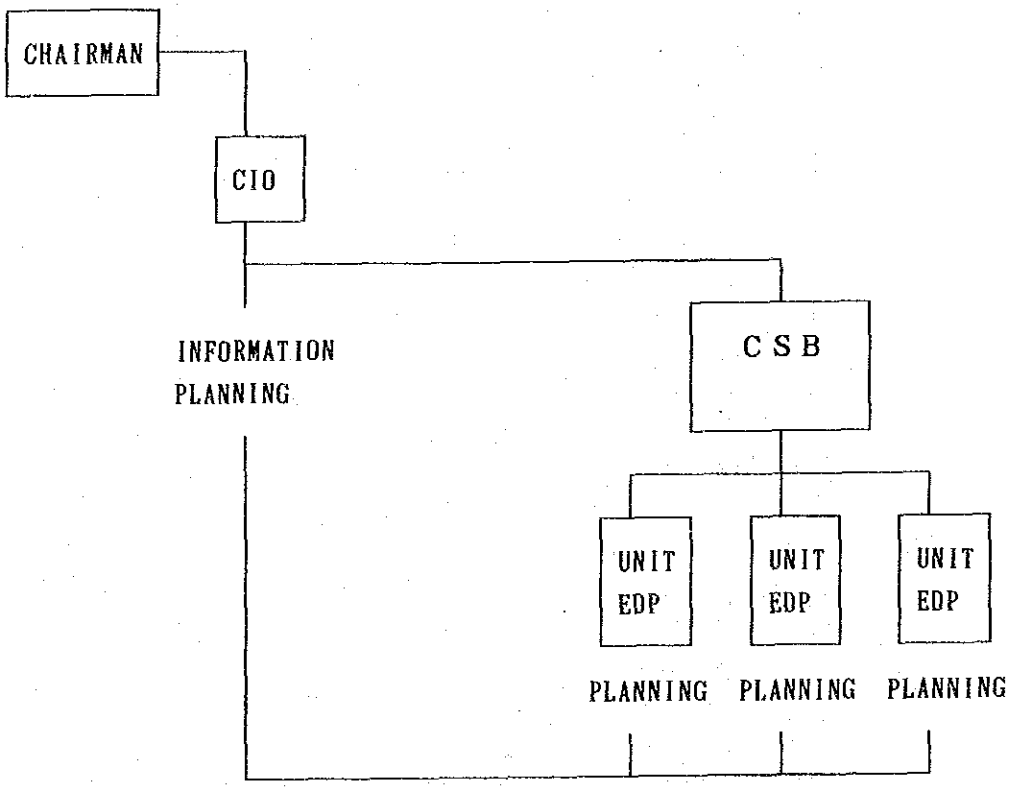
In line with all the above activities, the promotion of education of information engineers, and of OA equipment operators is required.

3. Organization and Manpower Plan

a) Organization Structure for the Promotion of MIS

Fig. I-7-1 shows the proposed organization structure for the promotion of MIS in HMT.

Fig.I-7-1 Organization Structure for MIS



a. The Central Information Officer (CIO) and the central information system planning section should perform the following functions.

- To plan and design the company-wide information system to reflect the company's strategy by keeping in close communication with top management.
- To make middle-term and long-term information system plans.

- To evaluate the information system plans presented from each unit.
- To audit all HMT computer systems, from PC-base systems to main frame systems.

b. CSB's main activities are to be the following.

- To be responsible for system developments, maintenance and operations of all units located in the Bangalore area, and for company-wide system developments.
- To develop and maintain the information network system.
- To investigate, plan and educate the workers and staff regarding the introduction of updated information technologies.
- To advise and give consulting services for the units located outside the Bangalore area, and give support in the development, operation and maintenance of information technologies of both hardware and software.
- To train and educate information engineers and end users.
- To prepare and promote various levels of "standardization".
- To undertake training of HMT's systems personnel. CSB to advise on development and implementation of Office Automation.

c. EDP section of each unit and each department should be divided into two sections by function. One is the system planning section which proposes to CIO on new information plans depending on the needs of users, and the other is the system development and operation section. As for the development of main information systems, it should be promoted under the close cooperation of CSB. The small system, ie., to meet the requirements of Section/Department, without having any bearing to the system of other Section/Department/Unit/Office could be developed by the Unit EDP. However, such developments should be brought to the notice of CSB/CIO. Data entry and accuracy should be the responsi-

bility of the users.

b) Manpower Plan

HMT is still lacking in information engineers in terms of both quantity and quality. System engineers (SEs) who can design information systems, and experts in database, LAN and data communications are essential for establishing total information systems for HMT. For the time being, HMT should put high emphasis on training and educating its in-house SEs, and the current shortage of SEs and experts would have to be covered by the use of outside experts.

a. Needs for information engineers

Considering the size of future HMT information systems, about 100 information engineers (SEs and programmers) in Bangalore and another 100 information engineers in the units located out side of the Bangalore area are needed.
The number of these necessary personnel is shown in Table I-7-4. In addition, marginal inductance of systems personnel at senior level is required for manning software projects at Units & CSB and also for managing the computer centers.

Table I-7-4 Manpower Increase Plan

(Unit : Number)

	Bangalore based			outside Bangalore			all HMT		
	SE	Pgmr	Total	SE	Pgmr	Total	SE	Pgmr	Total
Present	20	24	44	31	9	40	51	33	84
increase	+5	+6		+2	+5		+7	+11	
1992/93	25	30	55	33	14	48	58	44	103
increase	+10	+6		+3	+9		+13	+15	
1993/94	35	36	71	36	23	56	71	59	127
increase	+5	+6		+4	+9		+9	+15	
1994/95	40	42	82	40	32	70	80	74	152
increase	+5	+6		+2	+9		+7	+15	
1995/96	45	48	93	42	41	83	87	89	176
increase	+5	+7		+3	+9		+8	+16	
1996/97	50	55	105	45	50	95	95	105	200

b) Policies to secure enough information engineers

As explained in the Interim Report, it is very difficult for HMT to get enough information engineers. Therefore the following measures should be taken.

- Establishment of a job-rotation system

  SEs are to be the problem solvers who understand the whole range of HMT business operations covering such wide areas as production control, marketing, accounting and finance, etc., and who also can design the new job procedures and computer systems using updated information technologies.

  For the establishment of well designed information systems which fit the actual work of HMT and its business operation procedures, it is important to introduce an aggressive job-rotation system in which bright, young people who have enough knowledge and experience in each field are transferred to the EDP departments as SEs for a period of 3 to 5 years. Such a job rotation system has the following advantages. For one, there would be fewer possibilities for them to be head-hunted. For another, they will become the promoters of the future OA system or FA system in each of their specialized areas.

- Establishment of career-path plan

  In India, there is strong demand for information engineers, especially for experts. However, in HMT, the status of the staff of the EDP departments and the system engineers are low. In order for HMT to secure a sufficient number of information engineers, the incentive provided by showing a clear future career path plan is essential.

F. Business Operation Plan

1. Results of the Evaluation of Investment Viability

At present the Computer Service Department (CSB) attached to the headquarters of HMT is not an independent profit center. Their expenditures are basically covered by the in-house transfer revenue which is borne by each unit according to the hours that they utilize the host computer. In the near future, it is expected that CSB is to be an independent profit center with the start of outside sales of the software developed by HMT and other services.

In spite of the above, the viability of the proposed investments was examined without taking outside sales into consideration. The results of the examination are summarized and shown in Table I-7-5. Other major assumptions posed for financial viability are as follows:

- Utilization of the host computers would increase at an average annual rate of 10% in real terms;
- The number of workers would increase from the current 44 to 105 over the coming 5 years;
- The average unit personnel expenses and other costs would increase at an annual rate of 10% which would surpass the expected price increase; and
- The annual price increase rates applied for the estimation of transfer revenue after 1992/93 were 8.3% for 1993/94, 6.6% for 1994/95, 6.5% for both 1995/96 and 1996/97 and 6.2% after 1997/98.

Table I-7-5 Summary of the Financial Evaluation of MIS

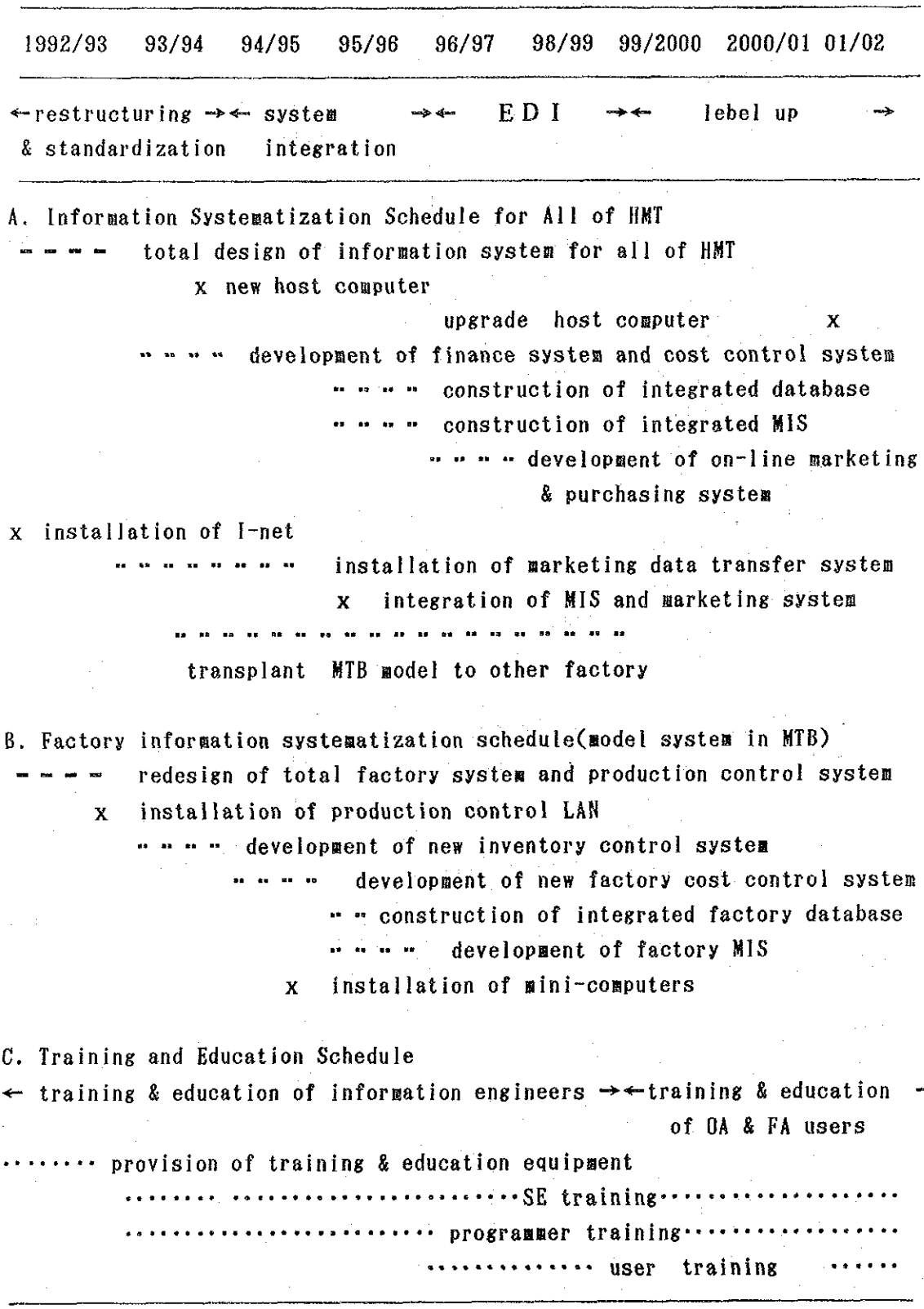
(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Revenue	21.7	51.6	81.5
- Service Revenue	21.2	50.4	80.3
- Other Revenue	0.5	1.2	1.2
2. Expenditure	21.6	67.9	58.3
- Personnel Expenses	3.2	13.1	17.4
- Leasing Fee	8.8	0	0
- Depreciation	1.4	18.8	19.3
- Other Expenses	4.9	8.8	11.7
- Interest	3.3	27.2	10.0
3. Balance	0.1	-16.3	23.2

2. Implementation Schedule

The implementation schedule for the establishment of MIS in HMT is summarized and shown in Fig. I-7-2.

Fig. I-7-2 Implementation Schedule of MIS Establishment



I-8. PRODUCTIVITY IMPROVEMENT PROGRAM

A. Background

Most of the units of HMT have a long history of manufacturing. In spite of this long experience, the technical level of each unit is not necessarily high from an international standard. One of the major reasons for this is considered to be the lack of an established system in HMT to improve the manufacturing processes step by step. In Japan, the productivity improvement activities are considered to be an integral part of the daily operations of factories, and various kinds of measures are developed to give shopfloor workmen such training in identifying problems from daily operations and in proposing improvement measures to solve these problems.

In consideration of the above, the Study Team positioned the introduction of a productivity improvement scheme in HMT as one of the integral parts of the restructuring study. Along with the implementation of the study, the experimental introduction of a productivity improvement scheme, which had been successfully implemented in Japan, to two selected factories in HMT was initiated.

B. Objective

The major objectives of the proposed Productivity Improvement Program (PIP) are as follows:

1) Building up a positive work culture in HMT;

2) Building up the foundation for continuous productivity improvement activities throughout the company; and

3) Realizing a certain level of tangible results in productivity improvement.

C. Procedures of the introduction of PIP in HMT

1. 1st Phase (Experimental Introduction of Basic PIP)

The experimental introduction of the basic productivity improvement program has been conducted under the guidance of a JICA expert in the two selected units of HMT. The remarkable results have been identified, and a model program which should be applied in all units of HMT has been established.

2. 2nd Phase (Implementation of Basic PIP)

Based on the established model, the Basic Productivity Improvement Program should be expanded to all units of HMT.

Without continuous efforts, the building up of the work culture and the formation of the foundation for the continuous productivity improvement could not be achieved.

Further, Basic PIP is not enough to reach the higher targets of productivity. Together with the implementation of Basic PIP, organizational restructuring, including the revision of incentive schemes or personnel evaluation/promotion systems, and also improvement of production scheduling and control system, is to be implemented, and should be coordinated with PIP.

For the above purposes, the use of outside consultants would still be need in Phase 2 of the program.

3. 3rd Phase (Further Expansion of PIP)

After the implementation of the 2nd step PIP, it is expected that HMT would develop the whole concept of PIP best fit for HMT. However, the management of HMT would still be required to make every effort to sustain and encourage PIP efforts until the productivity improvement activity has become routine and customary behavior throughout the organization of HMT.

In the 3rd step, priority will be accorded to the PIP target to obtain higher productivity through incorporating technological aspects. All PIP schemes, such as 5S (Good house keeping in the workplace), and employee participation in the "Kaizen" (continuous improvement) activities, are to be integrated, as well as technological development which includes improving production methods and systems through process engineering and introducing FMS lines, etc.

D. Organization

1. PIP Cell

A separate group shall be formed at 2 levels: one at Corporate Headquarters and one at each business group.

Because the major emphasis is given on the voluntary participation of each work group in PIP, the functions of the PIP Cell are such supporting services as (1) coordination of PIP activities among work groups, (2) preparation of common materials for activities such as instruction manuals, or (3) organization of common events.

The head of the PIP Cell at Corporate Head Quarters shall be a Director, and that at each business group shall be the General Manager of each group. In case outside consultants are involved in the program, they shall work in close connection with these PIP Cells.

2. Executive Team

At each unit of HMT, an Executive Team for PIP shall be formed under the chairmanship of the unit General Manager and Heads of departments and the leaders of work groups as members. The major functions of Executive Teams are as follows:

a) Assessment of the present level at each participating section.

b) Setting Step-by-Step targets or deciding improvement schemes.

c) Identifying problems and developing action plans for solving problems or improvements.

d) Monitoring the progress of implementation.

3. Work Groups

At each shopfloor section participating in the program, a Work Group consisting of 5 - 15 shopfloor workers and supervisors shall be formed, and one leader would be selected. In this Work Group, the supervisors who maintain good relations with shopfloor workers would play a key role.

E. Outline of basic PIP (2nd Phase)

1. Scope of Basic PIP

From the results of experimental introduction of PIP in HMT, it is recommendable to start Basic PIP in all shopfloor operations of each unit of HMT.

Among many factors for productivity improvement, only a few basic factors such as 5S (Good house keeping in the workplace), elimination of operators' waste time, etc., should be selected as the targets of implementation. The major criteria for the selection of targets in each unit would be as follows:

a) Conformity with total productivity improvement schemes.

b) Ease of implementation.

c) Relationship with daily operations.

d) Possibility of attaining tangible effects.

2. Process of Implementation of Basic PIP at each Unit

The process of the implementation of Basic PIP at each unit would be as follows:

Step 1: Formation of an Executive Team

Step 2: Organization of Work Groups

Step 3: Convincing all people involved of the importance of PIP.

The Executive Team, with the assistance of the staff members of PIP Cells and external consultants, will conduct the introductory lectures to Work Groups for understanding the needs and benefits of implementing PIP. The training wing of the HRD Section of HMT will also provide necessary assistance in conducting and co-ordinating the above training programs.

Step 4: Assessment of the Present Level of Workfloor Operations.

The members of the Executive Team will observe every shopfloor section, and assess the present levels of operations. According to the needs, pictures of the spots to be improved would be taken for comparison with those after improvement.

Step 5: Setting up of Step by Step Targets

After the assessment of the present level of operation, each Work Group should establish immediate targets which could be attainable within the set short period. Immediately following the attainment of the initial targets, a little higher levels of next targets would be set.

Step 6: Determination of Action Plans

The action plans for attaining targets are to be established by each Work Group, which have to be authorized by the Executive Team. A certain amount of budget should be allocated for providing necessary tools and equipment for implementing action plans.

Step 7: Physical Implementation

Once the action plans have been decided, the implementation should be performed by each Work Group.

Step 8: Monitoring the Progress of Implementation

According to the master schedule, the progress of the implementation of respective stages of Basic PIP should be monitored and assessed by the Executive Team in order to up-grade the program.

F. Implementation Costs

From the experience of the 1st Phase of the program, the implementation costs of PIP could be covered by the general administration costs of each unit, and no specific fund allocation would be needed except for the costs for expert services of outside consultants which would be needed at the 2nd Phase of the program.

The work scope and costs for the above expert services would be as follows:

1. No. of experts : 2

2. Period of service: 2 years, 3 to 4 weeks every quarter.

3. Terms of reference:

   a. Advice on planning of development of PIP to all Units.
   b. Promotion for awareness of PIP and review of action plans.
   c. Advice on organization of implementing function and review of action plans.
   d. Training of managers and supervisors.
   e. Coordination and advice on systems improvement.
   f. Monitoring of results of PIP.
   g. Guidance and coordination of HMT staff in charge of PIP.
   h. Advice on development of the 3rd stage PIP.
   i. Advice on sustenance of PIP.

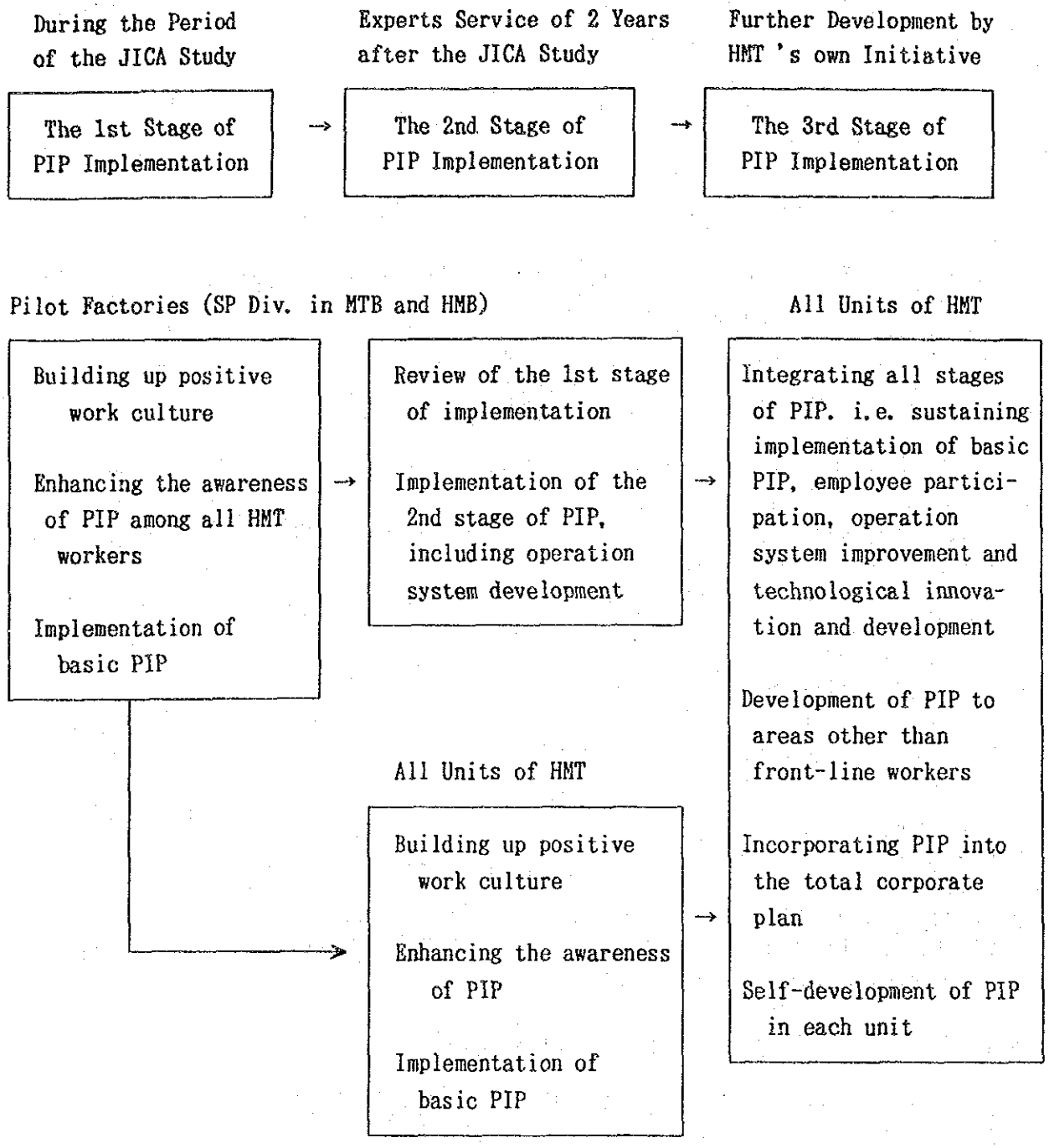
4. Requirements to HMT:

   a. Appointment of Director in charge of PIP.
   b. Determination of Corporate level organization for PIP, and appointment of staff.

5. Estimation of expenses: (for 2 experts per year)

a. Consulting fee	US$ 100,000 x 2 =	200,000.-
b. Air fare	4,000 x 4 x 2 =	32,000.-
c. Accommodation & per diem	200 x 120 x 2 =	48,000.-
d. Other expenses		20,000.-
	TOTAL	US$300,000.-

Fig. I-8-1 The Implementation Steps and the Major Targets by Step in PIP



I-9. Other Investment Programs

A. General

There are some other programs which are equally important for the achievement of corporate targets of HMT but which were not included in the above strategic action programs due to the limited capabilities of the Study Team. For those programs, separate studies have been made by each unit of HMT keeping the Basic Unit-based long-term strategies in mind. The results of these studies have been reviewed by the Study Team, and the necessary adjustments were made from the view of the overall growth targets of HMT, limited resource allocations within HMT and their financial soundness.

Thus, each of these investment programs is not the result of detailed feasibility studies, but is regarded as one of the indicative figures for future actions of each unit which have to be upgraded by further detailed studies.

The major programs of these are the following:

1) Modernization of the machine tool units of HMT other than MTB;
2) Modernization of Praga Tools;
3) Modernization and expansion of the Watch Business Group;
4) Modernization and expansion of the Lamp Division;
5) Modernization and expansion of the Die Casting and Plastic Machinery unit (DCB);
6) Modernization and expansion of the Dairy Machinery Unit (DMU);
7) Modernization and expansion of the Bearing Factory;
8) Expansion of the Ball Screw Section; and
9) Diversification projects for new areas.

B. Expected Financial Results

The expected financial results of these other investment programs were conducted making use of a simple financial model, which is based on the following assumptions.

1) All of the capital expenditure costs are financed by the external sources by long-term borrowings;
2) All of the operating costs exceeding the internal fund availability are financed by short-term borrowings;
3) The lending therms applied for external borrowings are:
   Long-term borrowings
   - Interest rates of 18.5% per annum
   - Repayment in 5 years after the grace period of one year
   Short-term borrowings
   - Interest rates of 21.0% per annum
   - Repayment within one year;
4) The effective tax rates are posed as 10% of the net profit of the year; and
5) The effective dividend payment rates are 15% of the net profit of the year.

C. Investments and Expected Financial Results

1. Modernization of the Machine Tool Units of HMT Other than MTB

a) Background and Objectives

The machine tool business units are considered to be the largest beneficiaries of the implementation of the strategic and other investment programs of HMT, because the majority of the machinery needed for plant modernization is considered to be supplied by these units. Further, the successful implementation of the modernization of MTB would also need the modernization of other machine tool units of HMT because many of the module machines for new manufacturing systems developed by MTB would have to be supplied from the other units.

Under the above circumstances, the modernization of each machine tool unit of MTP, MTK, MTH, MTA and HMB was planned basically with the following objectives.

- To modify the product mix putting emphasis on the integration of the number of models and the increase of CNC and other high value-added items;
- To increase the production capacity by productivity improvements in order to meet the market demand projected to grow at about 10% per annum;
- To achieve the reduction targets of inventory costs; and
- To reduce the total number of workers by replacing obsolete machines with modernized machines.

b) Investment Costs

The total modernization costs of other machine tool factories except for MTB are estimated at Rs. 2,228.2 million, of which Rs. 1,223.6 million is the local currency and Rs. 1,004.7 million is the foreign currency portion.

The cost breakdown by unit is shown in Table I-9-1.

Table I-9-1 Other Machine Tool Units - Summary of Investment Costs

(Unit: Rs. million)

	MTP	MTK	MTH	MTA	HMB	Total
1. Land & Building	9.0					9.0
2. Plant & Equipment	352.5	555.4	357.5	252.2	123.6	1,641.2
3. Technology Acquisition		20.0			10.0	30.0
4. Initial Training		6.0			1.5	7.5
5. Physical Contingency	36.2	58.1	35.8	25.2	13.5	168.8
6. Price Escalation	61.0	134.6	67.6	78.8	29.8	371.8
Total Investment Costs	458.6	774.2	460.8	356.2	178.4	2,228.2
of which						
Local Currency	188.9	442.2	214.6	296.6	81.3	1,223.6
Foreign Exchange	269.7	332.0	246.3	59.6	97.1	1,004.7

c) Expected Financial Results

Table I-9-2 Other Machine Tool Units - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	1,907	4,396	6,904
2. Materials	924	2,341	3,658
3. Value-Added	983	2,054	3,246
4. Personnel Expenses	587	757	866
5. Depreciation	42	122	153
6. Other Expenses	331	653	1,039
7. Operating Profit/Loss	24	522	1,188
8. Interest	126	465	386
9. Non-Operating Expenses/Revenue	-69	-39	-39
10. Profit before Tax	-33	97	841
Number of Employees	9,201	7,351	6,317
Production/Employee (Rs. thousand)	207	598	1,093
Profit/Sales (%)	-1.7	2.2	12.2

2. Modernization of Praga Tools

a) Background and Objectives

Although it is desirable that the current subsidiary company, Praga Tools, be integrated into the total operation of HMT's machine tool business in the near future, the modernization of the production facility in advance of the integration is also important.

The major objectives of the modernization are as follows:

- To increase the production capacity by productivity improvements in order to meet the market demand projected to grow at about 10% per annum;
- To achieve the reduction targets of inventory costs; and
- To reduce the total number of workers by replacing obsolete machines with modernized machines.

b) Investment Costs

Table I-9-3 Praga Tools - Summary of Investment Costs

(Unit: Rs. million)

	Local Currency	Foreign Exchange	Total
1. Land & Building	20.0		20.0
2. Plant & Machinery	154.5	154.5	309.0
3. Technology Acquisition		33.0	33.0
4. Initial Training	1.5	6.5	8.0
5. Physical Contingency	17.6	19.4	37.0
6. Price Escalation	64.9	37.9	102.9
Total Investment Costs	258.5	251.3	509.9

c) Expected Financial Results

Table I-9-4 Praga Tools - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	506	1,111	1,771
2. Materials	234	514	820
3. Value-Added	272	596	951
4. Personnel Expenses	114	156	178
5. Depreciation	24	28	48
6. Other Expenses	125	302	482
7. Operating Profit/Loss	9	110	243
8. Interest	46	146	199
9. Non-Operating Expenses/Revenue	-20	-20	-20
10. Profit before Tax	17	16	63
Number of Employees	2,249	1,740	1,492
Production/Employee (Rs. thousand)	225	639	1,187
Profit/Sales (%)	3.4	1.4	3.6

3. Modernization and Expansion of the Watch Business Group

a) Objectives

The capital expenditure in the Watch Business Group would be conducted with the following main objectives:

- To modernize the existing production facilities in order to both increase production capacity and increase the ratio of quartz analog and digital watches;

- To increase the Inter-Unit Transfer of components by modernization of existing facilities for components;

- To augment the watch case manufacturing capabilities from current 4.2 million to 9.8 million per annum; and

- To start the non-watch product production, such as timing systems or mini DC motors.

b) Investment Costs

Table I-9-5 Watch B.G.- Summary of Investment Costs

(Unit: Rs. million)

	Local	Foreign	Total
1. Land & Building	250.0	0	250.0
2. Plant & Equipment	1,028.5	638.2	1,666.7
3. Technology Acquisition	0	50.0	50.0
4. Initial Training	8.5	5.0	13.5
5. Physical Contingency	128.7	69.3	198.0
6. Price Escalation	318.3	80.7	389.0
Total Investment Costs	1,734.0	843.2	2,577.2

c) Expected Financial Results

Table I-9-6 Watch B.G. - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	2,478	5,276	6,921
2. Materials	1,155	2,638	3,461
3. Value-Added	1,323	2,638	3,461
4. Personnel Expenses	413	623	850
5. Depreciation	109	185	216
6. Other Expenses	641	1,319	1,730
7. Operating Profit/Loss	160	512	665
8. Interest	183	459	577
9. Non-Operating Expenses/Revenue	-96	-96	-96
10. Profit before Tax	73	148	184
Number of Employee	7,300	6,210	6,370
Production/Employee (Rs. thousand)	339	850	1,086
Profit/Sales (%)	2.9	2.8	2.7

4. Modernization and Expansion of the Lamp Division

a) Objectives

The modernization and expansion of lamp manufacturing facilities would be conducted with the following objectives:

- To rehabilitate the obsolete existing facilities and improve productivity with the aim of reducing manufacturing costs both by reducing the number of workers and cycle times and by reducing the inventory costs;

- To establish a new plant having two modernized FTL assembly lines with total production capacity of 10.8 million pieces of FTLs; and

- To install new production facilities for the manufacture of 3.0 million pieces of Compact FTLs.

b) Investment Costs

Table I-9-7 Lamp Division - Summary of Investment Costs

(Unit: Rs. million)

	Existing	FTL/Expansion	Compact FTL	Total
1. Land & Building		24.0	24.0	48.0
2. Plant & Equipment	88.5	132.0	120.0	340.5
3. Technology Acquisition		15.0	20.0	35.0
4. Initial Training		1.5	2.5	4.0
5. Physical Contingency	8.9	17.3	16.7	42.8
6. Price Escalation	17.1	10.7	10.0	37.6
Total Investment Costs	114.4	200.4	193.1	507.9
of which				
Local Currency	88.0	56.9	54.4	199.3
Foreign Exchange	26.4	143.5	138.7	308.5

c) Expected Financial Results

Table I-9-8 Lamp Division - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	237	991	1,217
2. Materials	101	415	510
3. Value-Added	136	576	707
4. Personnel Expenses	102	110	112
5. Depreciation	10	39	33
6. Other Expenses	73	304	374
7. Operating Profit/Loss	-49	122	189
8. Interest	14	160	149
9. Non-Operating Expenses/Revenue	1	1	1
10. Profit before Tax	-64	-39	39
Number of Employees	1,949	1,186	905
Production/Employee (Rs. thousand)	122	836	1,345
Profit/Sales (%)	-27.0	-3.9	3.2

5. Modernization and Expansion of the Die Casting and Plastic Machinery Unit

a) Objectives

In DCB, the capital investments are needed with the following objectives in mind:

- To modernize the existing facilities with the aim of expanding production capacity, and reducing cycle times, inventory costs, and the number of workers; and

- To diversify the product range, especially in the plastic machinery area, and introduce new products with high competitiveness both in cost and quality.

b) Investment Costs

Table I-9-9 DCB - Summary of Investment Costs

(Unit: Rs. million)

	Existing	New Products	Total
1. Land & Building	12.0	22.0	34.0
2. Plant & Equipment	136.0	251.0	387.0
3. Technology Acquisition		5.5	5.5
4. Initial Training		1.0	1.0
5. Physical Contingency	14.8	27.9	42.7
6. Price Escalation	39.5	76.2	115.7
Total Investment Costs	202.3	383.6	585.9
of which			
Local Currency	169.9	328.2	498.1
Foreign Exchange	32.4	55.4	87.8

c) Expected Financial Results

Table I-9-10 DCB - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	96	376	672
2. Materials	48	215	384
3. Value-Added	48	161	288
4. Personnel Expenses	12	28	42
5. Depreciation	1	24	35
6. Other Expenses	13	51	91
7. Operating Profit/Loss	22	59	121
8. Interest	1	53	73
9. Non-Operating Expenses/Revenue	-2	-2	-2
10. Profit before Tax	22	8	50
Number of Employees	208	280	315
Production/Employee (Rs. thousand)	462	1,343	2,133
Profit/Sales (%)	22.9	2.1	7.4

6. Modernization and Expansion of the Dairy Machinery Unit

a) Objectives

In DMU, the capital investments are needed to achieve the following primary objectives:

- To modernize the existing facilities with the goal of improving the existing products and shifting the product mix in response to the change of market demand, the expanding production capacity, and reducing cycle times, inventory costs, and the number of workers; and

- To diversify the product range, and introduce such new products as ice cream making machines, homogenizers or packaging machinery.

b) Investment Costs

Table I-9-11 Dairy Machinery Unit - Summary of Investment Costs

(Unit: Rs. million)

	Existing	New Products	Total
1. Land & Building		20.0	20.0
2. Plant & Equipment	35.0	80.0	115.0
3. Technology Acquisition		20.0	20.0
4. Initial Training		8.0	8.0
5. Physical Contingency	3.5	12.9	16.3
6. Price Escalation	6.3	17.5	23.8
Total Investment Costs	44.8	158.3	203.1
of which			
Local Currency	20.1	51.4	71.5
Foreign Exchange	24.7	106.9	131.5

c) Expected Financial Results

Table I-9-12 Dairy Machinery Unit - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	35	111	249
2. Materials	17	54	122
3. Value-Added	18	56	127
4. Personnel Expenses	7	17	20
5. Depreciation	3	12	14
6. Other Expenses	8	22	50
7. Operating Profit/Loss	-	6	44
8. Interest	4	41	56
9. Non-Operating Expenses/Revenue	-3	-3	-3
10. Profit before Tax	-	-30	-7
Number of Employees	151	197	180
Production/Employee (Rs. thousand)	232	563	1,383
Profit/Sales (%)	-0.	-27.0	-2.8

7. Modernization and Expansion of the Bearing Factory

a) Objectives

The major objectives of the investment project are as follows:

- To modernize the equipment of the existing factory with the aim of expanding the production capacity, and reducing cycle times, inventory costs and the number of workers;

- To establish new modernized production lines in order to penetrate into the field of small-size ball bearings; and

- To diversify into the production of a variety of small-batch production items, such as higher-size cylindrical roller bearings; single, two and four row tapered roller bearings; tractor motor bearings; spherical roller bearings; slowing rims, etc.

b) Investment Costs

Table I-9-13 Bearings - Summary of Investment Costs

(Unit: Rs. million)

	Domestic	Foreign	Total
1. Land & Building	64.9		64.9
2. Plant & Equipment	567.0	1,400.0	1,967.0
3. Technology Acquisition		90.0	90.0
4. Initial Training		10.0	10.0
Base Cost Estimate	631.9	1,500.0	2,131.9
5. Physical Contingency	63.2	150.0	213.2
6. Price Escalation	202.8	242.3	445.1
Total Investment Costs	897.9	1,892.3	2,790.2

c) Expected Financial Results

Table I-9-14 Bearings - Summary of Financial Results

(Unit: Rs. million)

	1990/91	1996/97	1999/2000
1. Sales Value of Production	305	1,539	3,320
2. Materials	140	708	1,527
3. Value-Added	164	831	1,793
4. Personnel Expenses	57	107	143
5. Depreciation	7	104	175
6. Other Expenses	73	369	796
7. Operating Profit/Loss	27	251	679
8. Interest	21	386	629
9. Non-Operating Expenses/Revenue	-10	-10	-10
10. Profit before Tax	16	-125	60
Number of Employees	917	970	970
Production/Employee (Rs. thousand)	333	1,587	3,423
Profit/Sales (%)	5.2	-8.1	1.8

8. Expansion of the Ball Screw Section

a) Objective

In order to meet the growing demand, the production capacity of the Ball Screw Section in MTB would be increased from the current about 500 pieces to 5,500 pieces per annum.

b) Investment Costs

Table I-9-15 Ball Screws - Summary of Investment Costs

(Unit:Rs.million)

	Domestic	Foreign	Total
1. Land & Building	6.0		6.0
2. Plant & Equipment	32.6	67.5	100.1
Base Cost Estimate	38.6	67.5	106.1
3. Physical Contingency	3.9	6.8	10.6
4. Price Escalation	5.0	5.0	9.9
Total Investment Costs	47.5	79.1	126.6

8. Expansion of the Ball Screw Section

a) Objective

In order to meet the growing demand, the production capacity of the Ball Screw Section in MTB would be increased from the current about 500 pieces to 5,500 pieces per annum.

b) Investment Costs

Table I-9-15 Ball Screws - Summary of Investment Costs

(Unit: Rs. million)

	Domestic	Foreign	Total
1. Land & Building	6.0		6.0
2. Plant & Equipment	32.6	67.5	100.1
Base Cost Estimate	38.6	67.5	106.1
3. Physical Contingency	3.9	6.8	10.6
4. Price Escalation	5.0	5.0	9.9
Total Investment Costs	47.5	79.1	126.6

c) Expected Financial Results

Table I-9-16 Ball Screws - Summary of Financial Results

(Unit: Rs. million)

	1991/92	1996/97	1999/2000
1. Sales Value of Production	15	80	109
2. Materials	1	7	9
3. Value-Added	14	73	100
4. Personnel Expenses	2	8	11
5. Depreciation	4	14	11
6. Other Expenses	5	9	12
7. Operating Profit/Loss	3	42	66
8. Interest	18	48	31
9. Non-Operating Expenses/Revenue	0	0	0
10. Profit before Tax	-15	-5	35
Number of Employees	24	84	84
Production/Employee (Rs. thousand)	604	949	1,299
Profit/Sales (%)	-101.4	-6.3	32.1

9. Diversification Projects for New Areas

a) Background and Objectives

In order for HMT to keep growing, very aggressive policies should be taken for the diversification into new areas. From its existing internal resources, HMT has a vast potential to penetrate into a vast range of new areas, especially in the field of industrial machinery. Some examples of these areas are listed as follows.

- Food processing machines
  drying, freezing, pulverizing, mixing, packing, sterilizing equipment, etc.
- Factory Automation (FA) related machinery
  unattached vehicles, CNC storage, material handling equipment, etc.
- Office Automation (OA) related equipment
  copying machines, facsimiles, printers, etc.
- Specialized printing machines
  web offset printing machines, form printing machines, desk top publishing equipment, etc.
- Construction machinery and equipment
- Textile and apparel machinery
  CNC cutting or sewing machines

For the purpose of financial projections, an assumptive project was posited and its investment costs and financial results were projected.

The objectives of the assumed project are as follows.

- To construct a new factory to assemble 120,000 sets of copying machines per annum, mainly for export to the overseas market; and

- To construct a new factory to assemble 120,000 sets of facsimiles per annum, also mainly for export to the overseas market.

b) Investment Costs

Table I-9-17 New Areas - Summary of Investment Costs

(Unit: Rs. million)

	Copying Machines	Facsimiles	Total
1. Land & Building	41.1	41.2	82.3
2. Plant & Equipment	593.6	215.1	808.7
3. Technology Acquisition	75.0	45.0	120.0
4. Initial Training	8.0	6.4	14.4
Base Cost Estimate	717.7	307.7	1,025.4
5. Physical Contingency	71.8	30.8	102.5
6. Price Escalation	106.5	53.3	159.8
Total Investment Costs	896.0	391.8	1,287.7
of which			
Local Currency	363.3	226.8	590.0
Foreign Exchange	532.7	165.0	697.7

c) Expected Financial Results

Table I-9-18 New Areas - Summary of Financial Results

(Unit: Rs. million)

	1991/92	1996/97	1999/2000
1. Sales Value of Production	0	2,013	4,823
2. Materials	0	1,651	3,955
3. Value-Added	0	362	868
4. Personnel Expenses	0	44	59
5. Depreciation	0	95	103
6. Other Expenses	0	60	145
7. Operating Profit/Loss	0	163	561
8. Interest	0	356	320
9. Non-Operating Expenses/Revenue	0	0	0
10. Profit before Tax	0	-194	242
Number of Employees	0	420	420
Production/Employee (Rs. thousand)	0	4,793	11,483
Profit/Sales (%)	0	-9.6	5.0

II. INVESTMENT PLAN

The investment plans have been formulated according to the proposed Action Programs. The investment plans comprise the investments necessary to attain the targets of the Action Programs in such areas as sales, production, and technological improvement. In the investment plans, the production facilities and technologies have been primarily selected and designed to satisfy the 1999/2000 targets of the Action Programs. However, the future growth possibilities after 2000 have also been considered in the formulation of the investment plans.

The following assumptions have been set for the formulation of the investment plans.

Premises of the Investment Plans

(1) The base projections have been prepared in Rupees at FY1992/93 prices.

(2) The exchange rate of Rs. 25.872 per US$, the period average of October, 1991, has been used.

(3) The following price escalation rates have been used.

Year	Escalation Domestic	Foreign
1992/93	8.5%	1.8%
1993/94	8.3%	1.9%
1994/95	6.6%	3.9%
1995/96	6.5%	4.9%
1996/97	6.5%	4.2%
1997/98	6.2%	3.6%
1998/99	6.2%	4.6%
1999/2000	6.2%	4.4%
After 2000/01	6.2%	4.4%

(4) A 15-year project life has been assumed after the completion of the investment.

(5) A straight line method is used for depreciation. The depreciation period is 25 years for factory buildings and 15 years for machinery and equipment.

(6) The expenditures related to the implementation of the project and to technology acquisition are debited to deferred assets and amortized through 5 years after the payment.

(7) The lending terms applied for the external borrowing are as follows:

(a) Repayment

Term loans (Foreign currency)
-Repayment of 9 years after the grace period of 3 years

Term loans (Domestic currency)
-Repayment of 9 years after the grace period of 3 years

Short-term loans (Domestic currency)
-Repayment within one year

(b) Interest rates

	Term Loans (Foreign Currency)	Term Loans (Domestic Currency)	Short-term Loans (Domestic Currency)
Interest Rates in Real Term	14.27%	7.57%	9.25%
Interest Rates in Nominal Term			
1992/93	22.77%	16.07%	17.75%
1993/94	22.27%	15.87%	17.55%
1994/95	16.87%	14.17%	15.85%
1995/96	15.67%	14.07%	15.75%
1996/97	16.37%	14.07%	15.75%
1997/98	16.37%	13.77%	15.45%
1998/99	15.37%	13.77%	15.45%
1999/2000	15.57%	13.77%	15.45%

II-1. Bangalore Machine Tool Factory (MTB)

A. Outline of the Investment Plan

1. The Investment Plan

The investment plan of MTB consists of the following two investments.

(1) Investment for the factory modernization

The existing production facility is mainly composed of general purpose machines and is quite aged. To solve this problem, the factory modernization will be implemented in three steps.

Step 1: Installment of 29 CNC machines
(1992/3 - 1994/95)
Step 2: Installment of 6 sets of FMC
(1995/96 - 1997/98)
Step 3: Installment of 3 sets of FMS
(1998/99 - 1999/2000)

One of the major purposes of the introduction of FMS in Step 3 is the acquisition of the technologies required for MTB's production of FMS as well as the acquisition of highly efficient production systems. It is after 2000 that the benefits of the investments of Step 3 will fully appear.

Therefore, the investments in Step 1 and Step 2 are positioned as strategic investments requiring immediate implementation while the Action Program of MTB envisages investments for all three steps.

(2) Acquisition of new technologies for product technology improvement

The development of the following 4 products will be carried out.

(a) Development of FMC and FMS
(b) Development of special turning machines

(c) Development of CNC gear cutting machines
(d) Development of high-grade CNC machines

As with the factory modernization, the development of FMS is primarily aimed at responding to future market needs after 2000. The development of FMS is planned to be carried out through the Step 3 investment. As for other developments are to be carried out in the strategic investment project.

Considering the present situation of R&D capability at MTB, the technical collaboration with leading international manufacturers is essential for the development of the products mentioned above.

2. The Strategic Investment Project

The investment plan (Step 1 to 3) is formulated so that it incorporates all the investments required in the 1990s for attaining the sales target in 2000 and securing the technologies which would enable the further growth of MTB in the 21th century.

It is, however, considered that a significant importance should be placed on the Step 1 and 2 investments when the emerging problems of MTB in present technologies, products, production system, and financial position are considered. Thus, the Step 1 and 2 investments have been given the status of the strategic investment project in this survey.

There exists a high uncertainty in the viability of the Step 3 investment. The viability of the investment in Step 3 will be vulnerable to the progress of the strategic investment project in addition to the uncertainty in market, economic and technological factors.

The most realistic approach at the present stage to the investments in MTB is to propose the mid-term investment plan targeting the coming five years. The major thrust areas are the modernization of production system and the acquisition of priority technologies with which rather immediate results can be expected.

It is recommended that financial and economic evaluation shall be conducted for the Step 3 investment after the implementation of the strategic investment project gets off the ground.

Under this context, the strategic investment project has been highlighted in the evaluation.

B. Implementation Schedule

The investment plan is expected to be implemented over a period of eight years, from 1992/93 to 1999/2000. The strategic investment is to be implemented over a period of six years up to 1997/98. The investment implementation schedule is shown in Fig. II-1-1.

In order to minimize interruptions in production, the investment will be implemented with a phasing system by replacing existing machines with new machines step by step.

C. Project Cost Estimate

1. Plant Cost

(a) Factory Building Construction Cost

MTB will continue to use the existing factory building through the project period. No expansion or renovation of the factory building is expected.

(b) Machinery and Equipment Cost

The machinery and equipment to be newly installed have been divided into three categories, i.e., (1) machinery and equipment to be procured within HMT, (2) machinery and equipment to be procured from domestic suppliers, and (3) machinery and equipment to be imported.

For item (1), item (2) and imports from countries other than Japan, HMT has estimated the cost and for machinery