The revenue in 1987/88 increased by 37% against the previous year. For reference, revenue to budget ratios were calculated:

	1986/87	1987/88
Revenue / Routine budget	46%	55%
Revenue / Total budget	35%	51%

(5) Land and buildings

B4T is located close to MIDC and near Bandung Institute of Technology. Many metalworking industries are located in the surrounding area. The size of the land occupied by B4T is 26,140 m^2. Office space occupies 1,000 m^2, and testing laboratories occupy 7,014 m^2.

6.3.2 Organization and Management of MIDC

(1) Function

The primary function of MIDC is "Quality Improvement" while that of B4T is "Quality Assurance". More specifically, the functions of MIDC are as follows:

(i) To carry our research activities for supporting the efforts to improve production capability as well as to formulate the conception of technological development in the metal and machinery industry.

(ii) To carry out development activities through dissemination of R & D results.

(iii) To carry out technical assistance as a tangible follow-up of the R & D results in the field of the metal and machinery industry.

The role of MIDC is to carry out the development for improving the productivity and quality of products through various activity programs, services to industry and job training for technicians for industry.

(2) Organization and personnel intructure

The organization of MIDC is described in Fig. 6.3-2

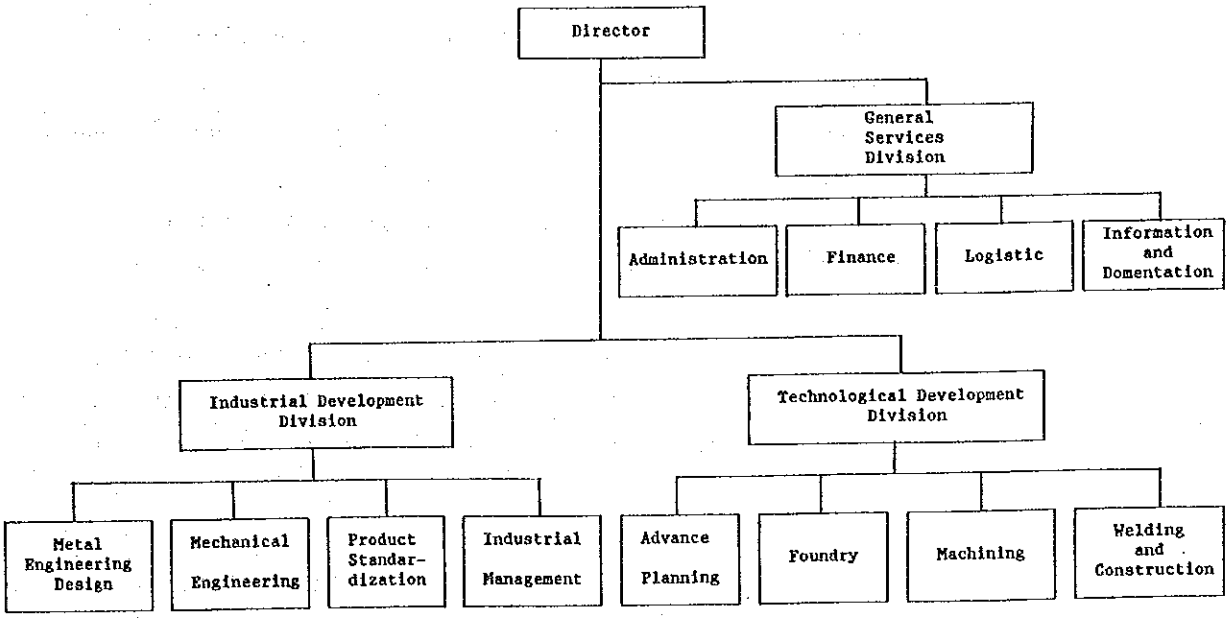


Fig. 6.3-2 Organization of MIDC

MIDC is headed by a director and its organization structure consists of three departments:

- General Services Division
- Industrial Development Division
- Technological Development Division

The personnel structure in 1988 of MIDC is as follows:

	Persons	Percentage	Engineers
Graduates of 5 year universities (S1)	35	(15.2)	(25)
Graduates of 3 year universities (D3)	30	(13.0)	(17)
Graduates of senior high school	115	(50.0)	(70)
Others	50	(21.8)	
Total	230	(100)	(112)

(3) MIDC is managed and operated through the following organs.

1) Executive Meeting
This meeting is a top executive meeting, held weekly, consisting of the Director and three Division Managers

2) Central Planning Board
This meeting is held monthly, and consists of the Director, three division Managers and Foreign Experts.
The purposes of the meeting are to evaluate program implementation and to check requests from private sectors.

3) Staff Meeting
This meeting is held monthly to coordinate the projects implemented in the different divisions. This meeting consists of the Director, three Division manager, and twelve heads of the sections.

4) Inter-Division Meeting
This meeting is held two or three times a month by the members consisting of the Division Manager, Heads of the section and sub-section heads.

(4) Budget and operation cost

The budget of MIDC is as follows:

(Unit: Rp. 1,000)

	1986/87	1987/88
Routine	542,790	542,500
Project	174,925	43,325
Total	717,715	585,825

While the routine budget in 1986/87 remained almost the same as the previous year, the project budget decreased to about one-fourth. As a consideration for the services of MIDC, about Rp. 250 million is expected as revenues from industries, which is remitted to the national treasury. The revenue to budget ratio in 1987/88 or MIDC is as follows:

	1987/88
Revenue / Routine budget	46%
Revenue / Total budget	42.7%

Training fees invoiced by MIDC are calculated in the following tariff:

Lecture by Senior Engineer ..... Rp. 10,000 per hour
Lecture by Technical Instructor .... Rp. 5,000 per hour
Lecture by Assistant ..... Rp. 2,000 per hour

Other expenses, such as materials, utility cost, and depreciation of the machinery, are charged separately.

Average training cost per man-month is, approximately, in the range of Rp. 2 million to 3 million including room and board.

The technical assistance fee of engineers is charged at a maximum of Rp. 60,000 per day.

(5) Facilities

MIDC is located on a site of approximately 24,000 m^2. The buildings consist of a main office building (2,600 m^2), a casting shop (1,730 m^2), a machining shop (1,050 m^2), a sheetworking & welding shop (1,020 m^2), a cafeteria (300 m^2), two lodging houses for trainees (800 m^2) and a guest house (120 m^2).

6.3.3 Organization and Management of the Other Central Research and Development Institutes Belonging to BPPI

(1) IRDCI (Chemical Institute)

1) The organization consists of five divisions: two research divisions, two development divisions and a general affairs division.

2) The personnel structure is as follows:

	Persons	Percentage
Graduates of 5 year universities (S1)	50	(18.3)
Graduates of 3 year universities (D3)	50	(18.3)
Graduates of senior high school	114	(41.8)
Others	59	(21.6)
Total	273	(100)

3) The budget in 1987/88 is as follows:

Routine budget	Rp. 400 million
Project budget	Rp. 76 million
Total	Rp. 476 million

Revenues for the services industries are not more than Rp. 10 million a year, which is remitted to the national treasury.

The revenue to budget ratio is 2.1 percent.

4) Site area occupied is 5.3 ha and the floor space of the buildings is about 15,000 m^2.

(2) CRDI (Ceramic Institute)

1) This organization has five divisions: two research divisions, two developments division and a general affairs division.

2) The personnel structure is as follows:

	Persons	Percentage
Graduates of 5 year universities (S1)	31	(11.3)
Graduates of 3 year universities (D3)	20	(7.2)
Graduates of senior high school	142	(51.8)
Others	81	(29.6)
Total	274	(100)

3) The budget in 1987/88 is as follows:

Routine budget	Rp. 400 million
Project budget	Rp. 30-40 million
Total	Rp. 430-440 million

4) Revenue for the services from industries is about Rp. 100 million a year, and the revenue to budget ratio is 22.7 percent. Average training cost per man-month is approximately Rp. 500,000.

5) The size of the land is 13,000 m^2, and the floor space of the buildings is 8,538 m^2.

(3) IRDTI (Textile Institute)

1) The organization consists of three research divisions and a general affairs division.

2) The personnel structure is as follows:

	Persons	Percentage
Master degree	1	(0.2)
Graduates of 5 year universities (S1)	52	(11.0)
Graduates of 3 year universities (D3)	28	(5.9)
Graduates of senior high school	208	(44.0)
Others	183	(38.7)
Total	472	(100)

3) Budget in 1987/88 is as follows:

Routine budget	Rp. 964 million
Project budget	Rp. 41 million
Total	Rp. 1,005 million

4) Revenue for the services from industries is Rp. 60 million. The revenue to budget ratio is about 5.9 percent. Average training cost per man-month is Rp. 1 million. Testing charges consist of actual expenses plus 10 to 15 percent of actual expenses as an honorarium. The size of the land is 37,000 m^2. The floor space of the buildings is 24,000 m^2.

(4) IRDCLI (Paper and Pulp Institute)

1) The organization is comprised of three research divisions, a technology transfer division and a general affairs division.

2) The personnel structure is as follows:

	Persons	Percentage
Ph. D	1	(0.3)
Graduates of 5 year universities (S1)	27	(8.7)
Graduates of 3 year universities (D3)	14	(4.5)
Graduates of senior high school	113	(36.4)
Others	155	(50)
Total	310	(100)

3) The budget in 1987/88 is as follows:

Routine budget	Rp. 900 million
Project budget	Rp. 50 million
Total	rp. 950 million

4) Revenue from industries is about Rp. 100 million, making the revenue to budget ratio 10.5 percent. Average training cost per man-month is Rp. 1 million or Rp. 50,000 per man-day, including room and board. The fee for engineers is Rp. 17,500 per hour plus Rp. 70,000 per lecture plus direct expenses. The floor space of the buildings is 10,000 m^2.

6.4 Outline of Similar Institutes in Japan

6.4.1 Research Institutes in Japan and Their Roles

(1) Research institutes in Japan are broadly divided into the following:

1) Research institutes operated by the national government
2) University laboratories
3) Private large company research centers
4) Industrial research institutes operated by local governments

Some of the national research institutes and university laboratories are located in Tokyo and its environs, and they are responsible for fundamental scientific and technological research for the development of Japanese industry.

The industrial research institutes operated by local governments and university laboratories in each prefecture are responsible for applied research and basic development studies. These studies are designed to promote the social and economic growth of local communities. The objectives of these institutes are to contribute to technological development, to increase productivity, and to add to the value of products of small- and medium-sized companies in the local prefectures.

The main purpose of the Center in Indonesia which was studied is to promote technological development of small- and medium-sized industries. In that context, the purpose of the Center in Indonesia is similar to that of industrial research institutes operated by local governments in Japan. Industrial research institutes in local prefectures are capable of extending technical assistance to and conducting joint studies with large industries in Indonesia.

6.4.2 Outline of Typical Industrial Research Institutes in Local Prefectures of Japan

There are 33 research institutes in Japan operated by the national government and 137 by local governments.

Kanagawa Prefecture has been the leader in Japan's industrialization since 1850. Today, Kanagawa's Keihin coastal industrial zone and inland industrial regions serve as models of Japan's energetic industry.

The Industrial Research Institute of Kanagawa Prefecture (IRIKP) in particular has contributed to the technological development of industry in the region.

An outline of the IRIKP is as follows:

(1) Organization structure

The IRIKP consists of 10 divisions and 30 sections, out of which one division and five sections are related to the machinery and metallurgy field. (Refer to Fig. 6.4-1)

The total number of personnel is 202, out of which 26 personnel belong to the Machinery and Metallurgy Division.

The total number of personnel is broken down as follows:

Administrative staff	:	36
Technical staff	:	156
Skilled workers	:	10

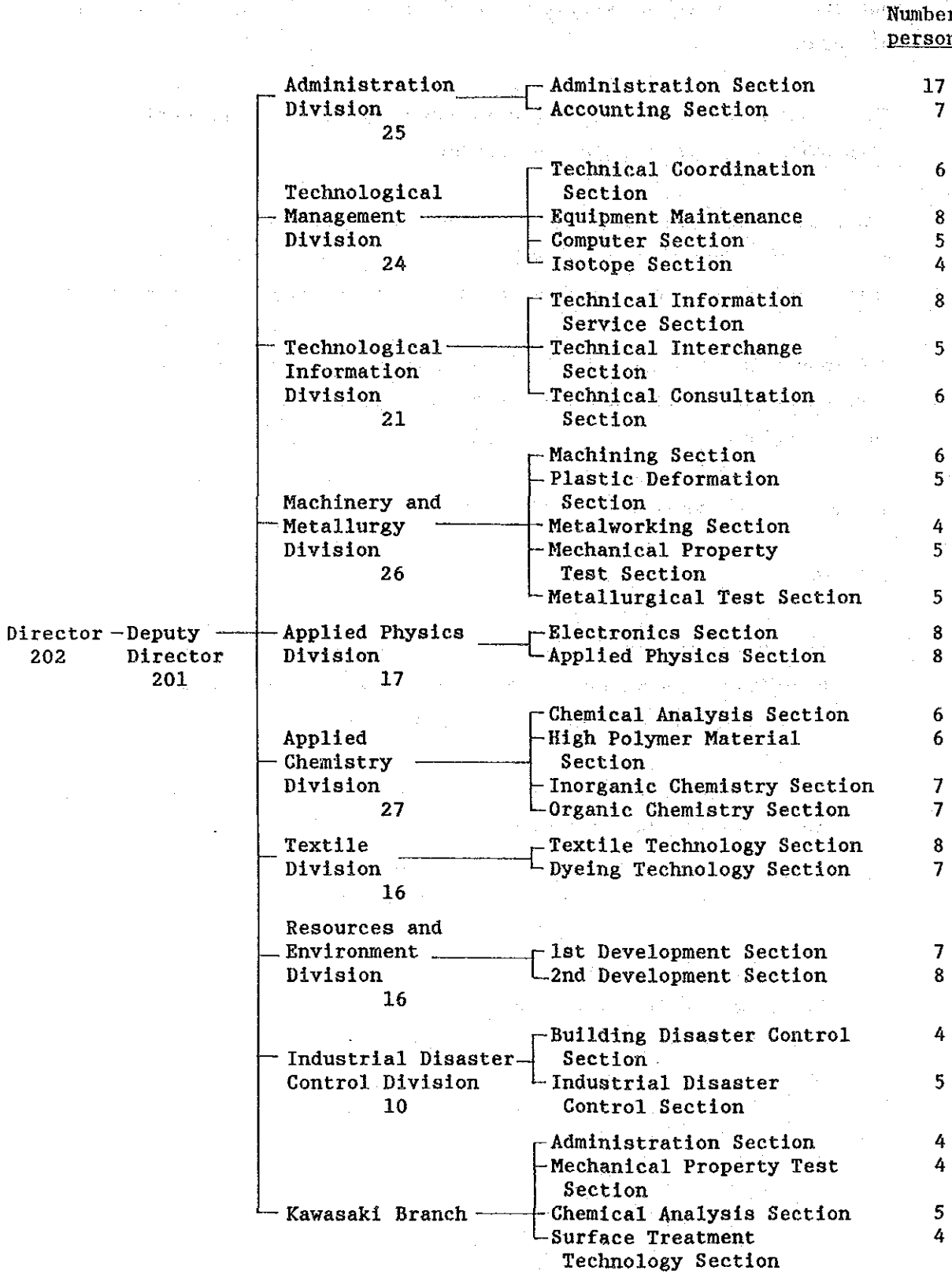


Fig. 6.4-1 Organization Chart of the Industrial Research Institute of Kanagawa Prefecture (IRIKP) (as of March 31, 1987)

(2) Function

The IRIKP performs many functions to help small business in the prefecture to develop their industrial and scientific technology. These functions include necessary experiments and research as well as providing consultation services.

Activities of the IRIKP are as follows:

1) Research and Development

The IRIKP performs various research and experiments in various fields of science and technology that correspond to technological innovations and upon request from private industry.

(i) Specific study
The IRIKP also performs research on specific subjects in the fields of science and technology. After choosing the subject, the IRIKP forms a project team of members from various fields of science and technology. The results are made available to small- and medium-sized companies and to other parties that have a particular interest in the study.

(ii) Development study for application of multi-functional thinner film
The ways to use the multi-functional thinner film which was developed at the institute are experimented with and examined.

(iii) Development study for the application of new materials
In cooperation with universities and private companies, the IRIKP studies the process and applied technology of newly developed ceramics materials.

(iv) Ordinary work study
The IRIKP carries out various ordinary studies for various businesses.

(v) Entrusted Study

The IRIKP undertakes the research and development of technology for small- and medium-sized businesses that do not have the facilities to do so themselves.

(vi) Joint Study

To solve important themes given from local governments, the IRIKP conducts joint research in cooperation with other industrial research institutes in local prefectures.

2) Experiments by Request

The IRIKP performs various experiments, provides analyses upon request, and issues test and inspection certificates related to product quality, product precision and product components. It has common service facilities such as machining, measurement and analysis apparatus for small- and medium-sized companies.

Items of analysis and testing

(i) Industrial material test
(tensile strength, hardness, bending, microstructure, electron microscope, fatigue, impact and torsion)

(ii) Manufacturing test of metal materials and industrial products
(cutting, grinding, plastic deformation, machinability, drawability, dies, tool, electro discharging machine, welding, pressure, lubricating oil, oil hydraulic, vibration, micro analysis of metal surface, plating thickness)

(iii) Precision measurement
(length, shape, and surface roughness)

(iv) Physical property test
(γ-ray irradiation, radiation measurement, application of radio isotope tracer, X-ray penetration, ultrasonic, magnetizing property and residual stress)

(v) Electrical and magnetic test and measurement

(vi) Chemical test
(Qualitative and quantitive analyses, petroleum products, synthetic resin, painting film thickness, plating, weather meter, accelerated exposure and potential measurement of metal)

(vii) Instrumentally chemical analysis
(Spectrometer, fluorescent X-ray, infrared spectrometer, atomic absorption sepctrometer, X-ray diffractometer, gas chromatograph spectrometer, X-ray microanalyzer, micro auger)

(viii) Texture test

(xi) Resources and environmental test

(x) Building material test

(xi) Industrial design

(xii) Copying service of technical literature

3) Technical Consultation and Instruction

The IRIKP offers technical consultation and instruction related to machining, presswork, welding, molten metal spraying, powder metallurgy, microstructure, heat treatment, precision measurement, and materials testing in the metalworking field.

(i) Consultation on technology
The IRIKP provides general consultation and advice on the first and third Wednesday of every month. Specialists from various fields are available to consult. The IRIKP also has specialists who can advise on patent laws.

(ii) Traveling technological instruction
Upon request, specialists and advisors from different fields visit small- and medium-sized companies and provide assistance in helping them to develop their own technology.

(iii) Dispatch of technical advisors

The IRIKP has many specialists who can provide assistance that will raise the level of technology in Kanagawa Prefecture. These advisors will be dispatched upon application.

(iv) Acceptance of Trainees

The IRIKP also has facilities and the experts to train groups of individuals through on-the-job training (OJT) and on-the research training (ORT).

(v) Visiting the Institute

It is possible to come and see the facilities and learn more about the IRIKP.

4) Technical Information Service

The IRIKP furnishes various kinds of information and technical literature through computer, and promotes technical interchange.

(i) Adjustment of data base for exchange of technological information

This system provides information about the special technology, product lines, main facilities, etc., of companies. The IRIKP has prepared data on five thousand companies and manufacturing plants. The data facilitates the exchange of technological information between companies and the promotion of company sales and advertisements.

(ii) Operation of a manpower bank for scientists and engineers

The IRIKP maintains a bank of trained specialists. The list includes 1,000 individuals and 26 research institutes in cooperation with scholars, researchers, and engineers living in the prefecture. It can help provide the right person to match users' needs.

(iii) Information transference through an on-line system

To allow their users access to the latest technical information quickly, the IRIKP has equipped their computer terminal with an on-line reference that is connected with a major commercial database.

(iv) Publications

The IRIKP publishes newsletters and leaflets that contain information about research studies and the introduction of new business, etc.

(v) Consultation of information and books

In its library, the IRIKP has nearly 1,600 technical and specialty journals and magazines published in Japan and overseas, and 11,000 books. The books include titles about standards such as the Japanese Industrial Standards (JIS), the Japanese Agricultural and Forestry Standard (JAS), the American Society for Testing Materials (ASTM), the American Society for Mechanical Engineering (ASME), etc.

(vi) Implementation of Technical Interchange

Technology information forum

Creative ideas come not only from documents and books but also directly from information exchange between individuals. The IRIKP provides a forum for information exchanges. The information covers a wide variety of fields such as automation, robotics, plastic, electric discharge process, structure, among many others.

(vii) Promotion of exchange among different types of businesses

As part of its efforts to encourage the development of new technology and new products, the IRIKP promotes the formation of groups consisting of different categories of business enterprises. In Kanagawa Prefecture, it has 60 groups of business enterprises.

(viii) Announcement of achievements

Once a year, the IRIKP announces the achievements of staff members who have completed studies and experiments.

(ix) Lectures

The IRIKP holds lectures to inform interested individuals about the results of studies done at the institute. It also hold courses on quality control as well as on technological innovations and on ways to save energy.

3) Budget

(i) Execution of the budget

(ii) Revenue

Revenue to total budget of ¥169,827,000 was ¥163,384,022. Out of this amount, technical service charge from companies was ¥108,069,350, and the IRIKP received national treasury of ¥25,568,000 as expenses necessary for specific studies. Revenue of entrusted work performed upon request was ¥12,000,000. It also received subsidy of ¥14,500,000 from the Japan Keirin Association to purchase testing and research facilities. Detailed statement of revenue is shown in Table 6.4-1

Table 6.4-1 Breakdown of Revenue in 1986

(Unit: ¥1,000)

Item			Revenue	
Service revenue from private companies and technical service				108,436
	Service revenue from private companies		367	
	Technical service charge		108,069	
		Test	105,884	
		Training	1,006	
		Technical assistance and information	800	
		Miscellaneous	379	
National treasury disbursements				25,568
Clearing out of property				68
Miscellaneous revenue				29,311
	Entrusted work		12,000	
	Subsidy		14,500	
	Other		2,811	
Total				163,383

(ii) Expenditure

Expenditure to total budget of ¥2,010,917 was ¥2,010,523. The execution rate of the budget was 99.9%. Detailed statement of expenditure is shown in Table 6.4-2

Table 6.4-2 Breakdown of Expenditures in 1986

(Unit: ¥1,000)

Item			Expenditure
Personnel expenses			1,393,748
	Salary		1,393,748
Project cost			616,775
	General administration		70,401
	International interchange		1,050
	Research on environmental protection		376
	Research on anti-pollution		864
	Industrial promotion		36,052
		Itinerant technical assistance	2,610
		Technical advisory service	32,042
		Subcontractors-upgrading	1,400
	Trade promotion		2,314
	Test, inspection and R & D		505,718
		Laboratories' operation	161,818
		Test and inspection	115,771
		R & D (effective use of of energy)	7,525
		R & D (new materials application)	96,491
		Technological information center operation	86,867
		Maintenance (facilities)	37,246
Total			2,010,523

CHAPTER 7

FUNCTIONS AND SERVICES REQUESTED FOR THE CENTER

CHAPTER 7 FUNCTIONS AND SERVICES OF THE CENTER

7.1 Outline

The flow of the Study which leads to the identification of the quantity and quality of services required for the Center is presented in Fig. 1.4-1. According to the study flow, functions required were studied and analyzed considering the following points.

(1) Contribution to the promotion of exports and the increase of employment opportunities as well as strengthening linkages between medium- and small-scale companies and large companies by focusing on development of the machinery industry, as indicated in Repelita IV (refer to 2.5)

(2) Present condition of the metalworking industry from a technical standpoint, particularly from problems in the metalworking industry in Indonesia (refer to 5.4)

(3) Problems in present condition and spread of industrial standards (refer to Chapter 4)

(4) Domestic production policy of industrial parts (refer to 3.2) and the policy to realize the promotion of medium- and small-scale industries (refer to 3.3)

(5) Present condition of similar related institutions (refer to Chapter 6) and their functional limitations.

7.2 Functions of the Center

The following were studied to select functions required for the Center.

(1) 466 parts were grouped according to kind of part manufacturing processes, and demand for parts to be developed were studied. The results thus studied are summarized in Table 7.2-1.

466 parts were nominated in the deletion program for the following eight groups of assembly-type industries.

1) two-wheeled motor vehicle
2) commercial car
3) power tiller
4) mini-tractor
5) automobile
6) machine tool
7) diesel engine (2 - 25 kW)
8) diesel engine (26 - 375 kW)

(2) Considering technical problems in the metalworking industry in Indonesia, the present condition of the existing related institutes and their functional limitations according to the questionnaire survey, new service items required for the Center (which can not be offered by the MIDC and B4T) were presumed below:

1) Casting

Technical problems in the casting industry are as follows:

(i) Ordinary cast iron products except key parts such as crank cases, cylinder heads, etc., can be produced. However, the scrapping rate of such products is in the range of 10 to 20%, which is extremely high.

(ii) Technology to produce special products such as cast steel, ductile cast iron, and alloy cast iron, is insufficient.

(iii) There are many factories that do not conduct preliminary chemical analysis during the melting process, nor product chemical analysis.

(iv) There are many factories that do not conduct sand tests.
(v) There are a few factories that examine and research the method of casting.

On the other hand, the present condition and functional limitations of similar institutions are as follows:

(i) The MIDC has sufficient technologies except in the fields of special alloy casting, steel casting and nonferrous casting to provide technical support to the general metalworking industry.
(ii) The MIDC offers good service to small companies in the Bandung area, but can not offer service to them in rural areas other than the Bandung area.

As a result, new items in the casting field required for the Center are as follows:

(i) Production of special cast iron such as cast steel, ductile cast iron, etc.
(ii) Quality control of manufacturing processes
(iii) Training of engineers in modern casting technology
(iv) Trial production of products having complicated shapes
(v) Control of raw materials and sub-raw materials

2) Forging

Technical problems in the forging industry are as follows:

(i) Blacksmiths making plows, hoes, etc., exist.
(ii) Some companies have air hammers, but do not use them.
(iii) Raw materials for forging are not domestically produced.
(iv) In spite of the above situation, there is a great demand for forged steel (e.g., gears, shafts, rotating members).

On the other hand, similar institutions do not have such facilities as presses and hammers, and modern forging technology is still backward in such institutions throughout the nation.

Therefore, the following new service items are required.

(i) Free forging and die forging technology of carbon steel and low alloy steel (e.g., shafts, gear blanks, arms and the like)
(ii) Method for selecting optimum materials

3) Heat treatment

Technical problems in the heat treatment industry are as follows:

(i) Some foreign affiliated companies have heat treatment facilities, while most factories do not have such facilities.
(ii) Demand for rotating members such as gears, shafts, etc., has been increasing.
(iii) Because products are manufactured without heat treatment, problems such as wear arise and such products' life shortens.
(iv) Demand for dies for presswork and sheetwork has been increasing, but there are very few factories that specialize in heat treatment and machining of the mold.

On the other hand, the ITB and MIDC, which are related similar institutions, launched a study of die making (design and machining), but the present technical level is not sufficient.

Particularly in the design of die, technical assistance from foreign affiliated companies is considered necessary.

Therefore, the following new service items are required.

(i) Annealing, quenching and tempering of carbon steel and low alloy steel
(ii) Carburizing

4) Presswork

Technical problems in the pressworking industry are as follows:

(i) Production of non-key parts for automobiles and motorcycles is possible. Workers mainly execute bending work using small presses, but rely on their personal experience and perception.

(ii) Assembling makers (in particular, foreign affiliated companies) are presently providing technical assistance including preparation and supply of drawings.

On the other hand, the ITB and MIDC launched a study of die making (design and machining), but such technology is still not enough to support small companies. Especially in the design of dies, technical assistance from foreign affiliated companies is inevitable.

Therefore, the following new service items in this field are required.

(i) Punching press technology (e.g., parts for agricultural machines, commercial cars and other machines)

(ii) Drawing work technology of small-sized parts

(iii) Production technology of dies to acquire fundamental knowledge

5) Sheetwork/welding

Technical problems in the sheetwork/welding industry are as follows:

(i) Production of non-key parts such as engine covers, exhaust pipes, etc., is possible.

(ii) Manual welding is used in many fields.

(iii) There are few skilled workers, and sheetworking/welding is performed according to their personal experience.

(iv) Visual inspection only is made.

On the other hand, the MIDC and B4T have sufficient technology and facilities, but can not offer service to small companies in local areas. Especially, welders should be trained and qualified.

New service items in this field are as follows:

(i) Adoption of various methods of welding
- Automatic welding technology (automatic submerged arc welding technology, etc. for manufacturing pressure vessels and steel structure)
- Acquisition of technology to weld alloy steel and nonferrous metal

(ii) Conduct of non-destructive inspection of welded portions

6) Machining

Technical problems in the machining industry are as follows:

(i) Parts having simple shapes can be machined and machines with simple mechanisms can be assembled.
(ii) Materials mostly include ordinary carbon steel and cast iron.
(iii) Most machining and assembling facilities have deteriorated, and NC machining facilities are not used.
(iv) Foreign affiliated companies or Persero possess testing and inspection facilities, while most private companies do not have them.
(v) Most private companies do not recognize the importance of testing and inspection.
(vi) In particular, linkage-type industries have a strong recognition that it is sufficient for them if parts are manufactured in accordance with drawings.

On the other hand, similar institutions do not have technology of precision machining and gear cutting. Those in local areas do not have sufficient machining facilities to assist and train small companies.

Derived from the above, the following new service items are required.

(i) Machining technology of parts having complicated shapes
(ii) Machining and assembling technology of components having complicated mechanisms

(iii) Recognition of the importance of testing, and inspection and conduct thereof

(iv) Production of dies and molds

(v) Technology related to precision machining and gear cutting

7) Plating

Technical problems in the plating industry are as follows:

(i) Plating of small parts is possible, but the quality of plated parts is inferior.

(ii) Sufficient plating facilities are not used.

(iii) There are few skilled workers, and plating work is conducted according to their personal experience.

(iv) Wastewater treatment facilities are not installed.

In addition, the MIDC does not have plating facilities.

Therefore, the following new service items are required.

(i) Plating technology of various metals such as Ni, Cr, Zn, Sn, Cd, Pb, etc. (establishment of plating conditions and inspection methods)

(ii) Higher efficiency work of plating work (high speed plating)

(iii) Conduct of wastewater treatment

8) Testing and inspection

The following problems in the testing and inspection in the metalworking industry are pointed out.

(i) Tests such as chemical composition and mechanical properties of materials are mostly not conducted.

(ii) Non-destructive tests of parts after machining are usually not performed.

(iii) Failure analysis of broken parts is not conducted.

On the other hand, the MIDC and B4T have enough facilities and technology for test and inspection, but can not offer service to small companies in local areas. Failure analysis technology of parts is still backward.

Therefore, the following new service items are required.

(i) Expansion of capabilities for analyzing chemical composition and mechanical properties of materials
(ii) Conduct of non-destructive tests of parts
(iii) Service of precision measurement
(iv) Service of environmental test
(v) Service of failure analysis of broken parts

Technical problems in the metalworking industry and new service items required for the Center are summarized in Table 7.2-2.

As can be seen from the table, the B4T and MIDC in the Bandung area have sufficient facilities and technologies in the fields of testing/ inspection, casting, presswork, sheetwork/welding and machining to provide technical assistance to medium and small companies, but do not have technologies in fields of forging, plating, precision machining and failure analysis of parts necessary for the implementation of the deletion program.

In spite of existence of numerous companies in other areas such as the Jakarta, Surabaya and so on, there are not sufficient number of government-owned technical assistance institutions to promote the deletion program of small companies, as described in Chapter 6. Therefore, functions required for the Center should consist both of those of the B4T and MIDC, and of newly required functions (e.g., forging, plating and precision machining and failure analysis of broken parts). In view of this situation, functions required for the Center were studied with reference to service functions of similar institutions in Japan. Results thus studied are as follows:

1) Testing and inspection

(i) Industrial material test
- Quality assurance of industrial materials by mechanical test

(ii) Physical property test
- Failure analysis of damaged parts and physical property test

(iii) Precision measurement
- Dimensional measurement and surface roughness measurement of parts

(iv) Non-destructive test
- Quality assurance of industrial materials by non-destructive test

2) Technical assistance (T/A) and training

(i) Technical assistance
- Technical consultation
  General consultation and advice by specialists from various fields
- Itinerant technical instruction
  Specialists and advisors from different fields will visit small- and medium-sized companies and, provide assistance in helping them to develop their own technology.
- Dispatch of technical advisors
  Specialists will provide assistance to raise the level of technology in local prefectures. These advisors will be dispatched upon application.

(ii) Training
Advisors will conduct training of production technology using facilities in the Center for engineers and workers of small-and-medium companies.

3) Research and development (R&D)

Following functions are required in order to develop parts and components which are not presently produced in Indonesia.

(i) Specific study
Engineers in the Center will conduct specific studies by choosing special themes which are strongly requested by domestic industries and then results studied will be published.

(ii) Entrusted study
Engineers in the Center will undertake the research and development of technology for small- and medium-sized businesses that do not have the facilities to do so themselves.

4) Category of industry to be covered

Casting, forging, heat treatment, pressworking/sheetworking, welding, plating, machining and testing and inspection.

Table 7.2-1 Breakdown of Kinds of Parts and Manufacturing Processes for Deletion Program

	Name of products	Number of kinds of parts for deletion program	Breakdown by year								Kind of manufacturing processes*	Breakdown by kind of manufacturing process								
			'83	'84	'85	'86	'87	'88	'89	'90		'83	'84	'85	'86	'87	'88	'89	'90	Sub Total
1	Two-wheeled motor vehicle	42	-	-	-	-	9	9	7	17	①	-	-	-	-	-	8	1	3	11
											②	-	-	-	-	4	1	5	6	16
											③	-	-	-	-	1	-	-	1	2
											④	-	-	-	-	1	-	-	1	2
											⑤	-	-	-	-	4	1	5	10	20
											⑥	-	-	-	-	1	-	-	1	2
											(Sub total)					(11)	(9)	(11)	(22)	(53)
2	Commercial car	88	-	-	-	-	21	36	11	20	①	-	-	-	-	1	2	-	-	3
											②	-	-	-	-	-	-	-	-	-
											③	-	-	-	-	-	-	-	-	-
											④	-	-	-	-	-	-	-	-	-
											⑤	-	-	-	-	19	35	18	20	92
											⑥	-	-	-	-	1	3	3	-	7
											(Sub total)					(21)	(40)	(21)	(20)	(102)
3	Power tiller (Single axle hand tractor)	16	-	-	-	-	13	3			①	-	-	-	-	3	2			5
											②	-	-	-	-	1	1			2
											③	-	-	-	-	2	-			2
											④	-	-	-	-	-	-			-
											⑤	-	-	-	-	10	3			13
											⑥	-	-	-	-	2	-			2
											(Sub total)					(18)	(6)			(24)
4	Mini tractor	13	-	-	-	-	8	2	3		①	-	-	-	-	-	4	2		6
											②	-	-	-	-	2	3	1		6
											③	-	-	-	-	1	-	-		1
											④	-	-	-	-	-	-	-		-
											⑤	-	-	-	-	3	7	3		13
											⑥	-	-	-	-	2	-	-		2
											(Sub total)	-	-	-	-	(8)	(14)	(6)		(28)
5	Automobile	35		-	-	-	-	30	5		①	-	-	-	-	-	-			-
											②	-	-	-	-	2	2			4
											③	-	-	-	-	12	1			13
											④	-	-	-	-	1	1			2
											⑤	-	-	-	-	21	5			26
											⑥	-	-	-	-	18	2			20
											(Sub total)					(54)	(11)			(65)
6	Machine tool	89	-	-	27	25	37				①	-	-	14	7	6				27
											②	-	-	4	19	29				52
											③	-	-	11	1	3				15
											④	-	-	1	-	-				1
											⑤	-	-	21	25	36				82
											⑥	-	-	-	1	-				1
											(Sub total)			(51)	(53)	(74)				(178)
7	Diesel engine (2-25 kW)	121	93	14	14						①	11	1	4						16
											②	21	9	3						33
											③	29	2	2						33
											④	5	-	1						6
											⑤	29	13	14						56
											⑥	24	1	-						25
											(Sub total)	(119)	(26)	(24)						(169)
8	Diesel engine (26-375 kW)	62	15	22	15	8	2				①	-	5	4	-	-				9
											②	-	9	8	6	1				24
											③	12	3	2	-	1				18
											④	2	2	-	-	-				4
											⑤	12	18	13	7	2				52
											⑥	8	5	4	1	1				19
											(Sub total)	(34)	(42)	(31)	(14)	(5)				(126)
9	Total	466	108	36	56	33	120	55	21	37	①	11	6	22	7	10	15	3	3	77
											②	21	18	15	25	39	7	6	6	137
											③	41	5	15	1	20	1	-	1	84
											④	7	2	2	-	2	1	-	1	15
											⑤	41	31	48	32	95	51	26	30	354
											⑥	32	6	4	2	24	5	3	1	77
											Total	153	68	106	67	190	80	38	42	744

*① = Casting ② = Forging/H. treat. ③ = Sheetwork/welding ④ = Plating ⑤ = Machining ⑥ = Presswork

Table 7.2-2 Technical Problems in Metalworking Industry and New Service Items Required for the Center (1/2)

	Number of parts to be domestically manufactured according to the deletion program	Technical problems in metalworking industry	Technical problems in similar institutions	New service items required for the Center
Casting	77	1) Ordinary cast iron products except key parts such as crank cases, cylinder heads, etc., can be produced. However, the scrapping rate of such products is in the range of 10 to 20%, which is extremely high. 2) Technology to produce special products such as cast steel, ductile cast iron, and alloy cast iron, is insufficient. 3) There are many factories that do not conduct preliminary chemical analyses during melting, nor product chemical analyses. 4) There are many factories that do not conduct sand tests. 5) There are a few factories that examine and research the method of casting.	The MIDC has sufficient facilities and technology in the casting field, but does not have sufficient ones in the field of special alloy cast, steel cast and nonferrous cast. The MIDC offers good service to small companies in Bandung area, but can not offer service to them in other rural areas except Bandung area.	1) Production of special cast iron such as cast steel, ductile cast iron, etc. 2) Quality control of manufacturing processes 3) Training of engineers in modern casting technology 4) Trial production of products having complicated shapes 5) Control of raw materials and sub-raw materials
Forging	137	1) Blacksmiths making plows, hoes, etc., exist. 2) Some companies have air hammers, but do not use them. 3) Raw materials for forging are not domestically produced. 4) There is a great demand for forging steel (e.g., gears, shafts, rotating members).	Similar institutions do not have such facilities as presses and hammers, and modern forging technology is still backward in similar institutions throughout the nation.	1) Free forging and die forging technology of carbon steel and low alloy steel (e.g., shafts, gear blanks, arms and the like) 2) Method for selecting optimum materials Equipment to be installed: 1) Batch type heating furnace 2) Drop hammer 3) Thermometer 4) Trimming press
Heat treatment		1) Some foreign affiliated companies have heat treatment facilities, while most factories do not have such facilities. 2) Demand for rotating members such as gears, shafts, etc., has been increasing. 3) Because products are manufactured without heat treatment problems such as wear, arise and such products' life shortens. 4) Demand for dies for presswork and sheetwork has been increasing, but there are very few factories that specialize in heat treating and machining the mold.	The MIDC has some kinds of heat treatment facilities, while similar institutions in provices do not have heat treatment facility, and modern technology is still backward in similar institutions throughout the nation.	1) Annealing, quenching and tempering of carbon steel and low alloy steel 2) Carburizing Equipment to be installed: 1) Heating furnace 2) Tempering furnace 3) Quenching oil bath 4) Quenching water bath 5) Gas atmosphere furnace

Table 7.2-2 Technical Problems in Metalworking Industry and New Service Items Required for the Center (2/2)

	Number of parts to be domestically manufactured according to the deletion program	Technical problems in metalworking industry	Technical problems in similar institutions	New service items required for the Center
Pressworking	77	1) Production of non-key parts for automobiles and motorcycles is possible. Workers mainly execute benching work using small presses, but rely on their personal experience and perception. 2) Assembling makers (in particular, foreign affiliated companies) are presently providing the technical assistance including preparation and supply of drawings.	The ITB and MIDC launched study of die making (design and machining), but such technology is not still enough to support small companies. Especially in the design of dies, technical assistance from foreign affiliated companies is inevitable.	1) Punching press technology 2) Drawing work technology of small-sized parts 3) Production technology of dies to acquire fundamental knowledge
Sheetworking/ Welding	84	1) Production of non-key parts such as engine covers, exhaust pipes, etc., is possible. 2) Manual welding is used in many fields. 3) There are a few skilled workers, and sheetworking/ welding is performed according to their personal experience. 4) Visual inspection only is made.	The MIDC and B4T have sufficient technology and facilities, but can not offer service to small companies in local areas. Especially, welders should be trained and qualified.	1) Adoption of various methods of welding - Automatic welding technology (e.g., automatic submerged arc welding, etc.) - Acquisition of technology to weld alloy steel and nonferrous metal 2) Conduct of non-destructive inspection of welded portion
Machining	354	1) Parts having simple shapes can be machined and machines with simple mechaNisms can be assembled. 2) Materials parts mostly include ordinary carbon steel and cast iron. 3) Most machining and assembling facilities have deteriorated, and NC machining facilities are not used. 4) Foreign affiliated companies or Persero posses testing and inspection facilities, while most private companies do not have them. 5) Most private companies do not recognize the importance of testing and inspection. 6) In particular, linkage-type industries have a strong recognition that it is sufficient for them if parts are manufactured in accordance with drawings.	Similar institutions do not have technology of precision machining and gear cutting. Those in local areas have not sufficient machining facilities to assist and train small companies.	1) Machining technology of parts having complicated shapes 2) Machining and assembling technology of components having complicated mechanism 3) Recognition of the importance of testing and inspection and conduct thereof 4) Production of dies and molds 5) Technology related to precision machining and gear cutting
Plating	15	1) Plating of small parts is possible, and the quality of plated parts is inferior. 2) Sufficient plating facilities are not used. 3) There are a few skilled workers, and plating work is conducted according to their personal experience. 4) Wastewater treatment facilities are not installed.	The MIDC does not have plating facilities.	1) Plating technology of various metals such as Ni, Cr, Zn, Sn, Cd, Pb, etc. (establishment of plating conditions and inspection methods) 2) Higher efficiency work of plating work (high speed plating) 3) Conduct of wastewater treatment
Test/Inspection		1) Tests such as chemical composition and mechanical properties of materials are mostly not conducted. 2) Non-destructive test of parts after machining is mostly not performed. 3) Failure analysis of broken parts is not conducted.	The MIDC and B4T have enough facilities and technology for test and inspection, but can not offer service to small companies in local areas. Failure analysis technology of parts is still backward.	1) Expansion of capabilities for analyzing chemical composition and mechanical properties of materials 2) Conduct of non-destructive tests of parts 3) Service of precision measurement 4) Service of environmental test 5) Service of failure analysis of broken parts

7.3 Types of services to be offered by the Center

7.3.1 Testing and inspection

The following 33 items are proposed as tests and inspections to be performed by the Center. Items from (1) to (26) are intended for the improvement of the basic technological level of the metalworking industries in order to comply with the requirements of the deletion program. More specifically, items from (1) to (13) are general tests and inspections conducted frequently, while items from (14) to (26) will be conducted, as required, as part of technical assistance or R & D. The remaining items from (27) to (33) could be conducted in the future.

(1) Brinell hardness test
(2) Vickers hardness test
(3) Tensile strength test
(4) Impact test
(5) Visual and microscopical inspection using projector
(6) Micro structure
(7) Chemical analysis
(8) Surface roughness measurement
(9) Three-dimensional measurement
(10) Gear tooth dimensional measurement
(11) Magnetic particle inspection
(12) Ultrasonic inspection
(13) X-ray inspection
(14) Micro vickers test
(15) Fatigue test
(16) Scanning electron microscope test
(17) Sulphur print test
(18) Penetrant test
(19) Fluorescent magnetic particle test
(20) Sand test for iron cast mold
(21) Plating film test
(22) Pressure test (air tightness and water pressure)
(23) Length measurement
(24) Angle measurement
(25) Gear rolling test

(26) X-ray diffractor analysis
(27) Electron probe micro analyzer test
(28) Electron microscope test
(29) Auger electron microscope test
(30) Drawability test using universal tester
(Conical cup, reduction, etc.)
(31) Hardenability test
(32) Corrosion Test
(33) Dynamic balancing test

7.3.2 Technical assistance (T/A), Training (TR) and R & D

As T/A is aimed at solving problems to which each company is confronted and TR is aimed at training of engineers of different companies, it is impossible to predetermine those definite items, because program should be selected according to the specific needs of the companies.
There is a method for selecting programs of R & D, T/A and TR according to the deletion program. The detailed programs of R & D, T/A and TR were studied as follows:

(1) 92 metal parts as nominated in the deletion program for commercial car and diesel engine were selected.
(2) Then, details of R & D, T/A and TR for promotion of domestic production of those parts were studied.

Major items and their details are summarized in Table 7.3-1.
The purpose of R & D to be provided by the Center is not to develop high technology but is to develop manufacturing technology of parts that are not domestically manufactured at present.

In particular, themes related to development of manufacturing technology, that is impossible for medium- and small-scale companies by themselves, are selected to conduct joint studies. The aim of this joint studies is to transfer manufacturing technology of developed products in the course of their joint development.

Table 7.3-1 Major Items for R&D, T/A and TR

	R & D	T/A	TR
Casting	- Complicated shape casting technology (e.g., engine blocks) - Special cast iron technology (e.g., ductile cast iron, malleable cast iron) - Cast steel technology technology - Alloy cast iron and alloy cast steel	- Technology in manufacturing parts as nominated in the deletion program	- Green sand mold technology - CO_2 mold technology - Shell mold - Self-hardening sand mold (Fran type resin) - Melting technology
Forging	- Die forging of connecting rods - Die forging of gears - Free forging of shafts	- T/A related to manufacturing technology of various parts as nominated in the deletion program	- Free forging technology - Die forging technology
Heat treatment	- Carburizing and nitriding of gears and shafts - Heat treatment technology of die	- Manufacturing technology of parts as nominated in the deletion program	- Heat treatment technology of die - Heat treatment technology of carbon steel
Sheet-working	- Technology for welding different metals	- Automation of thick plate welding (to be appliable to shipbuilding and pressure vessel)	- Acquisition of technology to conduct non-destructive inspection of welded portion
Presswork	- Deep drawing work technology (for automotive parts) - Die making technology	- Improvement of improper process resulting from defective parts (e.g., improvement of die)	- Working condition and maintenance of press
Plating	- Determination of plating condition for automotive parts (e.g., plating thickness and plating condition)	- Prevention of defect in plating layer (pre-treatment and plating conditions)	- Acquisition of electroplating, chemical plating, and hot dipping techniques
Machining	- It is difficult to specify this item at the present stage, because R & D themes are discovered during the promotion of the deletion program	- Finishing of high alloy steel by grinding work - Gear cutting technology (bevel gears and so on) - Jigs and fixtures machining technology	- Acquisition of technology to operate NC machine - Acquisition of technology to operate grinding machine

7.4 Selection of Machinery and Equipment to be Installed in the Center

In order to perform the function required for the Center (testing and inspection, R & D, T/A and TR) as described in 7.2, there are the following methods for selecting machinery and equipment to be installed in the Center.

(1) To solve the present problems with which industries face
(2) To solve the present problems with which existing similar institutions are confronted
(3) To achieve themes on R & D necessary for future development of industries other than items (1) and (2) above
(4) To achieve the targets of deletion program

Results studied for the selection of them from the viewpoint of items (1), (2) and (3) above are shown in Table 7.4-1 and the above results from the viewpoint of item (4) above are shown in Table 7.4-2.

- First selection (refer to Table 7.4-1)

  Machinery and equipment were selected from the viewpoint of solving present problems, with which metalworking industry and existing similar institutions are facing, as Phase I, so that the requirements (1) and (2) mentioned above are satisfied.
  In Phase II, machinery and equipment would be selected in order to meet the requirements arising out of future industrial development, corresponding to requirement (3) mentioned above.

- Second selection (refer to Table 7.4-2)

  Machinery and equipment were selected to satisfy requirements arising in the course of deletion program corresponding to requirement (4) mentioned above.

Selected machinery and equipment by product category, by processing category and by planned completion time of the deletion program are summarized and shown in Table 7.4-2.

It is clear that kinds of machinery and equipment according to the first selection are almost same as those according to the second selection, and forging, heat treatment and plating which are not presently available in Indonesia are necessary both for solving the present problems with which industries are confronted and for accomplishing the deletion program.

Conceptual design of machinery and equipment should be conducted on the basis of the above results.

Table 7.4-1 Present Condition of Metalworking Industry and Required Equipment for the Center

(1) Casting

Present condition	1) Ordinary cast iron products except for key parts such as crank cases, cylinder heads, etc., can be produced. However, the scrapping rate of such products is in the range of 10 to 20%, which is extremely high. 2) Technology to produce special products such as cast steel, ductile cast iron, and alloy cast iron, is insufficient. 3) There are many factories that do not conduct preliminary chemical analyses during melting, nor product chemical analyses. 4) There are many factories that do not conduct sand tests. 5) There are a few factories that examine and research the method of casting.
Phase I Requirements	1) Production of special cast iron such as cast steel, ductile cast iron, etc. 2) Quality control of manufacturing processes 3) Training of engineers in modern casting technology 4) Trial production of products having complicated shapes 5) Control of raw materials and sub-raw materials
Equipment to be installed	1) H.F induction furnace for iron & steel casting 2) Crucible furnace for nonferrous metals 3) Green sand molding unit 4) CO_2 sand molding unit 5) Chemical binder sand molding unit 6) Shell molding unit 7) Sand test equipment 8) Wooden pattern making equipment
Phase II Requirements	1) Cost reductions through improved productivity and quality. 2) Precision casting (lost wax)
Equipment to be installed	1) Finishing process equipment 2) Heat treatment furnace 3) Precision casting equipment

(2) Forging

Present condition	1) Blacksmiths making plows, hoes, etc., exist. 2) Some companies have air hammers, but do not use them. 3) Raw materials for forging are not domestically produced. 4) There is a great demand for forging steel (e.g., gears, shafts, rotating members).
Phase I	
Require-ments	1) Free forging and die forging technology of carbon steel and low alloy steel (e.g., shafts, gear blanks, arms and the like) 2) Method for selecting optimum materials
Equipment to be installed	1) Batch type heating furnace 2) Drop hammer 3) Temperature measuring and recording instruments 4) Trimming press
Phase II	
Require-ments	1) Production of high grade steel such as steel for dies, stainless, bearing steel, etc. 2) Cost reductions through improved productivity and quality 3) Cold forging
Equipment to be installed	1) Rotary heating furnace 2) Conveying system 3) Cold forging press

(3) Heat treatment

Present condition	1) Some foreign affiliated companies have dedicated heat treatment facilities, while most factories do not have such facilities. 2) Demand for rotating members such as gears, shafts, etc., has been increasing. 3) Because products are manufactured without heat treatment, problems such as wear, arise and such products' life shortens. 4) Demand for molds for presswork and sheetwork has been increasing, but there are very few factories that specialize in heat treating and machining the mold.
Phase I	
Requirements	1) Annealing, quenching and tempering of carbon steel and low alloy steel 2) Carburizing
Equipment to be installed	1) Heating furnace 2) Tempering furnace 3) Quenching oil bath 4) Quenching water bath 5) Gas atmosphere furnace
Phase II	
Requirements	1) Heat treatment of molds 2) Bright quenching, and soft nitriding treatment 3) High frequency induction hardening
Equipment to be installed	1) Wash cleaning bath 2) Salt bath, high & medium 3) Soft nitriding furnace 4) High frequency induction hardening equipment

(4) Presswork

Present condition	1) Production of non-key parts for automobiles and motorcycles is possible. 2) Bending work is mainly done using small presses. 3) Assembling makers (in particular, foreign affiliated companies) are presently providing the technical assistance including preparation and supply of drawings.
Phase I	
Require-ments	1) Punching press technology 2) Drawing work technology of small-sized parts 3) Production technology of molds to acquire fundamental knowledge
Equipment to be installed	1) Press brake 2) Mechanical press 3) Hydraulic press 4) Shearing machine 5) Surface plate
Phase II	
Require-ments	1) Deep drawing work of large-sized parts and presswork of parts having complicated shapes 2) Automation of presswork 3) Production of molds for practical use 4) Introduction of robots for material handling
Equipment to be installed	1) Transfer press

(5) Sheetworking/welding

Present condition	1) Production of non-key parts such as engine covers, exhaust pipes, etc., is possible. 2) Manual welding is used in many fields. 3) There are a few skilled workers, and sheetworking/welding is performed according to their personal experience. 4) Visual inspection only is made.
Phase I	
Require-ments	1) Adoption of various methods of welding - Automatic welding technology (e.g., automatic submerged arc welding and so on) - Acquisition of technology to weld alloy steel and nonferrous metal 2) Conduct of non-destructive inspection of welded portion
Equipment to be installed	1) 3-roll bending machine 2) AC arc welder 3) CO_2 gas shielded arc welder 4) Submerged arc welder 5) MIG welder 6) TIG welder 7) Arc air gauging machine 8) Band arc overlay welding machine 9) Engine welder 10) Plasma arc cutting machine 11) Manual and automatic gas cutting machine 12) Flux dryer and collector 13) Tool cabinet and rack
Phase II	
Require-ments	1) Welding of different metals 2) Welding after machining 3) Simultaneous welding of members at several locations 4) Attempt unmanned operation (i.e., introduction of robots)
Equipment to be installed	1) Electroslag welding machine 2) Electron beam welding machine 3) Laser beam welding machine 4) Seam welding machine 5) Automatic gas cutting machine (shape) 6) Automatic gas cutting machine (flame planer)

(6) Machining and assembling

Present condition	1) Parts having simple shapes can be machined and machines with simple mechanisms can be assembled. 2) Materials parts mostly include ordinary carbon steel and cast iron. 3) Most machining and assembling facilities have deteriorated, and NC machining facilities are not used. 4) Foreign affiliated companies or Persero possess testing and inspection facilities, while most private companies do not have them. 5) Most private companies do not recognize the importance of testing and inspection. 6) In particular, linkage-type industries have a strong recognition that it is sufficient for them if parts are manufactured in accordance with drawings.
Phase I Requirements	1) Necessity for machining parts having complicated shapes 2) Machining and assembling of components having complicated mechanism 3) Recognition of the importance of testing and inspection and conduct thereof 4) Production of dies and molds 5) Technology related to precision machining and gear cutting
Equipment to be installed	1) Engine lathe 2) Precision high speed lathe 3) Radial drilling machine 4) Bench drilling machine 5) Jig boring machine 6) Universal milling machine 7) Shaping machine 8) Sloting machine 9) Full broaching machine 10) Hack sawing machine 11) Band sawing machine 12) Abrasive cutoff machine 13) Universal grinding machine 14) Universal tool & cutter grinding machine 15) Gear hobbing machine 16) Cylindrical gear grinding machine 17) Gear boring machine 18) Thread chasing machine 19) Bench tapping machine 20) Universal machine 21) Copy milling machine 22) Boring machine 23) Superfinishing machine 24) Rock cutting machine 25) Straight bevel gear cutting machine 26) Straight bevel gear grinding machine 27) CNC machining center

(cont'd)

Phase II	
Require-ments	1) Machining of precision parts 2) Automation of machining 3) Machining of alloy steel and special steel 4) Improved precision of testing and inspection 5) Production of precision dies and molds
Equipment to be installed	1) Electric discharging machine 2) Electro-chemical machine 3) Electrolytic grinding machine 4) Ultrasonic machine 5) CNC lathe 6) CNC milling machine 7) CNC gear cutting machine 8) Computer aided design (CAD) system

(7) Plating

Present condition	1) Plating of small parts is possible. 2) Sufficient plating facilities are not used. 3) There are a few skilled workers, and plating work is conducted according to their personal experience. 4) Wastewater treatment facilities are not installed.
<u>Phase I</u> Require-ments	1) Plating technology of various metals such as Ni, Cr, Zn, Sn, Cd, Pb, etc. (establishment of plating conditions and inspection methods) 2) Higher efficiency plating work (high speed plating) 3) Conduct of wastewater treatment
Facilities to be installed	1) Electroplating facility 2) Chemical plating facility 3) Chromium coating facility 4) Hot dipping facility 5) Sand & shot blast machine 6) Polishing machine 7) Ultrasonic washing machine 8) Wastewater treatment system 9) Ion deioniser 10) Hull cell tester 11) pH meter thickness measuring equipment and pinhole tester 12) BOD tester and COD tester
<u>Phase II</u> Require-ments	1) Local coating (plasma spraying, etc.) 2) Application of surface treatment (hardening, anti-corrosion, etc.) of parts to plating 3) Unmanned operation (introduction of robots)
Equipment to be installed	1) Plasma spraying equipment

(8) Testing and inspection

Present condition	1) Tests such as chemical composition and mechanical properties of materials are mostly not conducted. 2) Dimensional measurement of parts after they are machined is not sufficiently performed.
Phase I	
Requirements	1) Expansion of capabilities for analyzing chemical composition and mechanical properties of materials 2) Conduct of non-destructive tests 3) Service of precision measurement 4) Service of environmental test 5) Service of failure analysis of broken parts
Equipment to be provided	1) Material test 1 Universal tester 2) Chemical analysis 1 Direct reading spectrometer 3) Non-destructive test 1 X-ray radiography 4) Measuring equipment 1 Hob tester 2 Universal gear tester 3 Three dimensional measuring device 5) Environmental test 1 Industrial wastewater analysis 2 Vibrometer 3 Sound level meter 6) Performance test of machinery and equipment
Phase II	
Requirements	1) Alignment measurement of assembled large structures 2) Dynamic balancing test of assembled large structures 3) Large structure testing 4) Drawability test of steel plate 5) Special tests of alloy steel 6) Ultra thin surface layer analysis of metal and non-metal during the conduct of failure analysis
Equipment to be provided	1) Dynamic balancing machine 2) Micro alignment telescope 3) Universal tester (capacity 300T, horizontal type) 4) Universal tester (conical cup, reduction, etc.) 5) Hardenability test 6) Corrosion test 7) Electron probe micro analyzer 8) Electron microscope 9) Auger electron microscope

Table 7.4-2 Kind of manufacturing processes of main parts and facilities required based on deletion program (1/3)

Kind of Manufacturing Processes	Year / * Contents	1983 Diesel Engine, 2-25 kW	1983 Diesel Engine, 26-375 kW	1983 Machine Tool	1984 Diesel Engine, 2-25 kW	1984 Diesel Engine, 26-375 kW	1984 Machine Tool	1985 Diesel Engine, 2-25 kW	1985 Diesel Engine, 26-375 kW	1985 Machine Tool	1986 Diesel Engine, 2-25 kW	1986 Diesel Engine, 26-375 kW	1986 Machine Tool	1987 Machine Tool
Casting	Green sand mould	Cylinder head Fly wheel				Fly wheel		Crank case Cylinder liner Gear case	Fly wheel housing Counter weight Cylinder head	Cabinet leg Rear leg Front leg		Crank case	Bed Frame Table	Case Saddle Cross slide
	CO_2 mould	Fly wheel				Fly wheel				Cabinet leg Rear leg Front leg			Bed Frame Table	Case Saddle Cross slide
	Self-hardening mould Shell mould	Cylinder head Cylinder head (Core)						Crank case Cylinder liner Gear case Crank case (Core)	Fly wheel housing Counter weight Cylinder head Cylinder head (Core)			Crank case		
Forging					Crank gear	Connecting rod		Connecting rod Crank shaft Cam shaft	Cam shaft			Crank shaft Cam shaft gear Crank shaft gear	Lead screw Feed rod Packs	Speed gear Reverser gear
Machining	Precision high speed lathe	Crank shaft patty fly wheels				Fly wheel patty				Legs of lathe			Screw shaft lead screw	
	Jig boring machine	Crack case stud				Connecting rod		Gear case connecting rod		Freis base tables		Crank case	Knee guide off freis	Guide slide of freis
	Gear hobbing machine				Crank gear shaft gear							Gears		Gears
	Universal Grinding M/C	Piston ring piston				Piston piston ring		Crank shaft				Crank shaft	Cross guide/ guide slide	
	Super finishing machine							Cylinder liner	Cylinder liner					Bearings
	CNC machining counter							Cylinder head cam shaft	Cylinder head					
Sheetwork/ welding		Oil filter cap upper cover Breather cover oil return pipe Oil filter cap upper cover	Brocket waterpipe Fuel pipe Waterpipe			Intakes exhaust pipe Intakes exhaust pipe			Cover cooling pipe Cover cooling pipe	Chip pan sheet cover Coolant tank panel box Chip pan sheet cover			Column case Column case	Cooling system Cooling system
Presswork		Breather cover oil return pipe	Fuel pipe							Coolant tank panel box				

Note : *Contents may comprise of materials, methods and equipment

Table 7.4-2 Kind of manufacturing processes of main parts and facilities required based on deletion program (2/3)

Kind of Manufacturing Processes	Year / * Contents	1987 Commercial Car	1987 Two-wheel Motor Vehicles	1988 Commercial Car	1988 Two-wheel Motor Vehicles	1989 Commercial Car	1989 Two-wheel Motor Vehicles	1990 Commercial Car	1990 Two-wheel Motor Vehicles
Casting	Green sand mould	Disc plate Caliper Brake drum		Exhaust manifold	Cylinder head Cylinder block Fly wheel		Cylinder sleeve		Disc brake Caliper
	CO_2 mould								
	Self-hardening mould	Disc plate Caliper Brake drum Fly wheel			Cylinder head Cylinder block		Cylinder sleeve		Disc brake Caliper
	Shell mould	Disc plate Caliper (Core) (core)		Exhaust manifold		Cylinder head (Core) Cylinder block (Core)			
Forging			Bearing Spring Sprocket rear				Cam shaft Sprocket drive		Crank shaft Connecting rod Main gear
Machining	Precision high speed lathe	Intake/exhaust manifold cylinder head cover	Bearing	Steering shaft, rear axle shaft pinion shaft, gear shaft	Fly wheel piston	Cam shaft holder, sleeve yoke tie rod end, cylinder wheel	Piston pin	Connecting rod main shaft	connecting rod
	Universal grinding M/C	Brake sleeve, guide pin backing plate, brake disc	Spring	Clutch-dies plate, brake lining spindle hub brake shoe		Differential case	Cam shaft	Synchronizer hub	Crank shaft
	Universal milling machine				Cylinder head Cylinder block Crank case	Cylinder head	Cylinder sleeve	Differential drive pinion	Clutch
	Gear hobbing M/C	Speedmeter gear		Steering gear Reverse gear				Speed gear Input shaft counter gear Differential gear	Gear
	Super-finishing M/C					Piston		Differential drive pinion counter gear	Gears
Sheetwork/welding		Backing plate Cover strap	Cover Cover	Disc plate Spined hub				Synchronizer hub Synchronizer sleeve	Name plate Name plate
Presswork				Friction plate washer				Synchronizer ring	

Note : *Contents may comprise of materials, methods and equipment

Table 7.4-2 Kind of manufacturing processes of main parts and facilities required based on deletion program (3/3)

Kind of Manufacturing Processes	Year	1987				1988				1989			
				Automobile				Automobile				Automobile	
	* Contents	Power Tillers	Mini Tractor	Shock Absorber	Radiator & Plug	Power Tillers	Mini Tractor	Shock Absorber	Radiator & Plug	Power Tillers	Mini Tractor	Shock Absorber	Radiator & Plug
Casting	Green sand mould	Cylinder head Gear case				Crank case Transmission case	Transmission case Cylinder liner				Crank case Cylinder head		
	CO_2 mould												
	Self-hardening mould	Cylinder head Gear case				Crank case Transmission case	Cylinder liner				Crank case Cylinder head		
	Shell mould	Cylinder head (Core) Gear case (Core)				Crank case (Core) Transmission case (Core)	Transmission case (Core)				Crank case (Core) Cylinder head (Core)		
Forging		Connecting rod Crank shaft Cam shaft				Cam shaft gear Ring gear	Crank shaft gear				Crank shaft		
Machining	Precision high speed lathe	Sprocket	Sprocket shaft					Piston rod					
	Jig boring machine	Fork	Fork	Damper cover	Frame blacket								
	Universal milling machine	Arm	Arm				Transmission case						
Machining	Gear hobbing M/C					Staged gear	Shaft gear						
	Universal machining counter	Cylinder liner/ head									Cylinder head		
	Universal grinding M/C	Crank shaft									Crank shaft		
Sheetwork/ welding		Forks Arm Forks	Forks Arm Forks	Damper case & damper cap Cylinder tube & upper cap Damper cap upper cap	Filler pipe Inlet pipe Overflow pipe				Upper tank Upper tank				
Presswork				Outer cover	Outlet pipe								

Note : *Contents may comprise of materials, methods and equipment

CHAPTER 8

ESTIMATIONS OF DEMAND FOR THE SERVICES OF THE CENTER

CHAPTER 8 ESTIMATION OF DEMAND FOR THE SERVICES OF THE CENTER

8.1 Overview of the Estimation

The Center is designed to provide three kinds of services to metalworking industries in Indonesia. These are 1 testing & inspections, 2 research & development (R & D), and 3 technical assistance and training. The volume of the three services of the Center was estimated in this chapter so that (1) the size of the Center, (2) the location of the Center, and (3) the financial analysis of the Center can be determined or conducted in the following chapters.

The estimation was made mainly by analyzing the following data and information:

(1) forecasting of volume of metalworking by type of work in Indonesia shown in the M/P,
(2) regional distribution of metalworking industries in Indonesia compiled by the JICA study team from governmental production license statistics,
(3) activity records of B4T and MIDC, and
(4) information obtained through interviews and the questionnaire survey

It was made clear through the past activities of B4T that there is considerable difference in demand for 1 testing and inspections (one of the three services of the Center) among regions. The questionnaire survey showed similar results: many firms are not willing to use an outside testing/inspection center which is located far from them, unless the testing/inspections are mandatory. Aggregate demand for testing and inspections in Indonesia was estimated taking this regional factor into consideration.

For the other two services of the Center, which are 2 R & D, and 3 technical assistance and training, the past activities of MIDC show similar regional characteristics as those of B4T. Approximate estimation of demand for the services of the Center was made through quantitative analysis of the questionnaire survey and macro data related to metalworking industries.

8.2 Aggregate Demand for Tests and Inspections

The outline of the technical approach, which was used to estimate total volume of potential needs for testing and inspection services, is shown in Fig. 8.2-1.

(1) Forecasting of metalworking industries in Indonesia

M/P, on which this project is based, has forecast the volume of metalworking in terms of tonnage in the years 1985, 1990 and 1995 for 10 industries, such as machine tool or agricultural machines. The estimation mainly has its base on the progress of localization of metal industries in Indonesia, which was guided by the deletion program. The progress, however, has not been achieved as planned, as being exemplified by the three-year postponement of the localization program for automobiles. In consideration of that situation, two of the upcoming standard years of the M/P have been changed to 1993 and 1998, from 1990 and 1995, respectively. (see Table 8.2-1)

(2) Estimation of the number of recommendable tests and inspections

The number of recommendable tests and inspections per ton or unit was considered for each of 13 tests and inspections by type of work. The estimation was made for each of 10 metal relating industries. (see ANNEX IV-8-1 through IV-8-9) These recommendable numbers of tests and inspections were multiplied by the forecast volume of metalworking, which is made by sub-assemblers, to obtain the volume of recommendable tests and inspections in 1985, 1993 and 1998. The results of the estimation are shown in Table 8.2-2.

(3) Regional distribution of metalworking industries

The regional distribution of metalworking industries was estimated through two steps. As the first step, representative commodities were chosen for each of 9 metalworking industries. The electric machine industry and electric appliance industry were combined here. As the second step, production quotas given to the manufacturers of these commodities by the Indonesian Government were summed up in each of the 6 regions in Indonesia. Comparing aggregate production quotas in each region, a regional distribution of the industries was determined. The number of the quota does not necessarily match the number of actual production volume as the manufacturers are allowed to apply a quota bigger than their actual production capacity corresponding to their future production plans. For that reason, it is considered that this approach may be much better than using the actual production volume in order to estimate the regional distribution of the industries in 1992, when the Center is planned to start operation.

For the purpose of the study, Indonesia was divided into 6 regions from an economic point of view rather than a geographical one. These are JABOTABEK (Jakarta, Bogor, Tangerang, Bekasi), Jawa Barat (except BOTABEK), Jawa Tengah (including Yogyakarta), Jawa Timur, Sumatera, and all the other regions combined. The result of the regional distribution is shown in Table 8.2-3.

(4) Recommendable number of tests and inspections by region

By multiplying the recommendable number of tests and inspections in Indonesia, which was shown in Table 8.2-2, by the regional distribution of industries as shown in Table 8.2-3, the recommendable number of tests and inspections by region in the years 1985, 1993 and 1998 was calculated (see Table 8.2-4). Table 8.2-5 shows the flow of the tests and inspections between 1985 and 1993, assuming that the rate of annual increase of the tests and inspections is equal for each year of the period.

(5) Activities of B4T by region, 1987

The total number of tests and inspections conducted by B4T was 6,467 in 1987. Its regional distribution is shown in Table 8.2-6. The cover ratio of B4T services in each region was calculated by dividing the above regional distribution by the recommendable number of tests and inspections, which is shown in Table 8.2-4. (see Table 8.2-7) It was revealed in Table 8.2-7 that Jawa Barat, where the B4T is located, shows by far the highest cover ratio, 39.3 percent, followed by the neighboring region, JABOTABEK, with a cover ratio of 14.5 percent.

The direct distance between Bandung, where B4T is located, and Jakarta, the center of JABOTABEK, is about 180 km, and it was observed that the number of tests and inspections brought to the B4T from JABOTABEK was bigger than that from the other regions except Jawa Barat due to the shorter distance. The distances from Bandung to Semarang, the center of Jawa Tengah, Surabaya, the center of Jawa Timur, and Medan, the center of north Sumatera, are 290, 540 and 1,500 km, respectively. As shown in Table 8.2-6, no significant differences in cover ratio among these regions was observed. It is assumed that, for distances beyond at least 290 km, distance does not affect the volume of the tests and inspections brought to the B4T.

(6) Estimation of potential needs for tests and inspections in Indonesia

It is necessary to eliminate the bias coming from distance when the aggregate potential needs for tests and inspections in Indonesia are estimated. For this purpose, the cover ratio of B4T activities to Jawa Barat, which is 39.3 percent, was applied to all the regions assuming the ratio to be a neutral one with no bias toward distance. In other words, the cover ratio of B4T activity in a region would be 39.3 percent if B4T were located in all other regions than Jawa Barat. The flow of potential needs for tests and inspections was so estimated for the period between 1985 and 2002, and combining all the regions together, Table 8.2-8 shows the flow of the potential needs for tests and inspections in the whole of Indonesia.

It is shown in the table that the potential needs for tests and inspections in JABOTABEK are substantially higher than in the other regions through the period. In 1987, for instance, 55 percent of the total potential needs for tests and inspections is in that region. This is understandable from the fact that almost all of the electric appliance/machine industry and transportation industry, which jointly occupy more than 60 percent of total value added in Indonesia, have factories in the region.

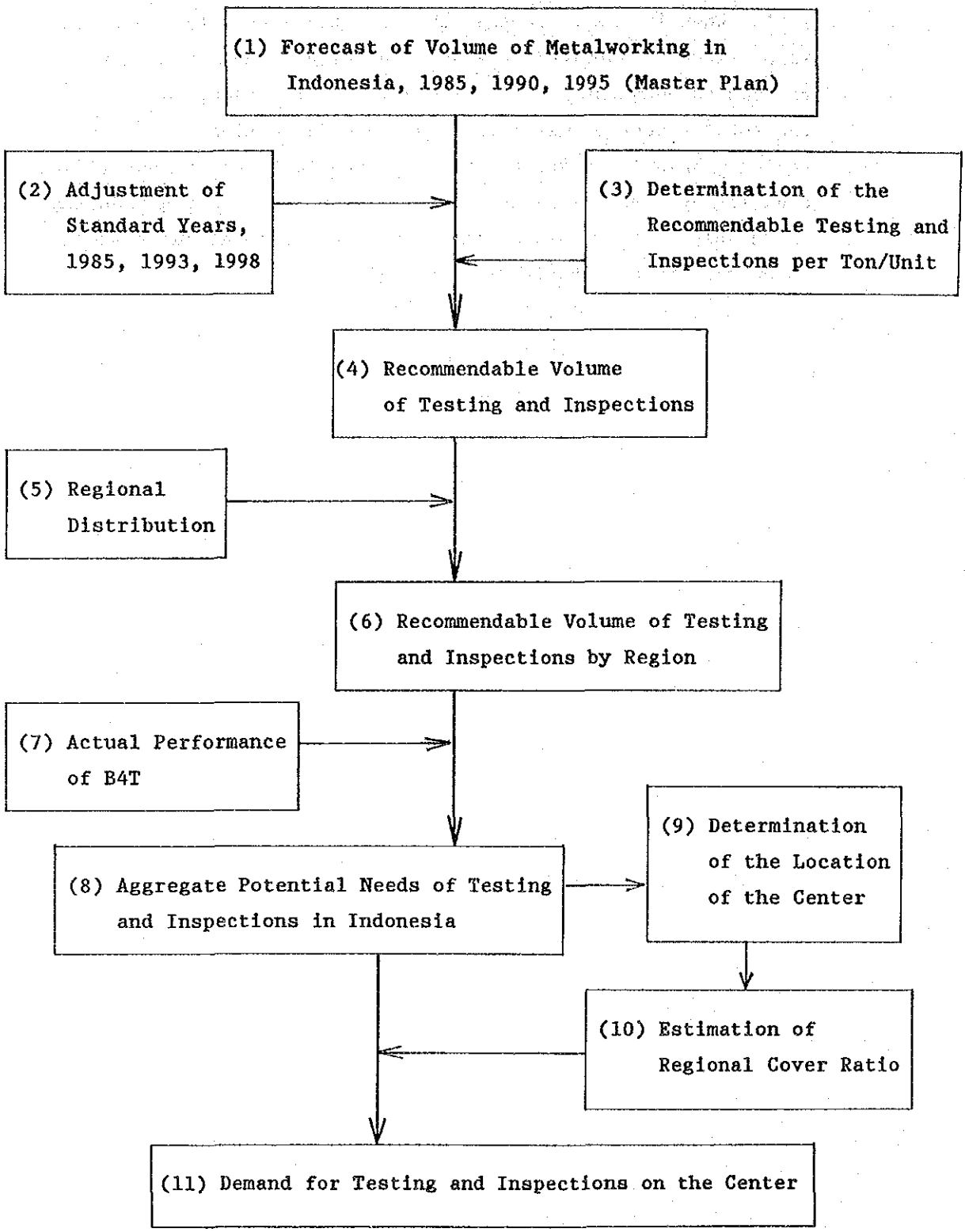


Fig. 8.2-1 Estimation of Flow of Demand for Testing and Inspection on the Center

Table 8.2-1 (1) Volume of Metalworking by Type of Work, 1985

(Unit: Ton)

Item \ Type of work	Casting	Forging, Heat Treat.	Machining	Sheetwork, Welding	Press-working	Hull Steel	Equipment & Outfit	Structure Work	Plate Work	Machine Work
1) Machine Tool	142	0	485	223	55	-	-	-	-	-
2) Agri. Machine	903	45	2,138	2,203	585	-	-	-	-	
3) Const. Equip.	110	62	1,020	2,852	188	-	-	-	-	
4) Elec. Machine	1,008	252	0	2,156	2,536	-	-	-	-	-
5) Elec. Appli.	112	126	-	4,352	4,408	-	-	-	-	
6) Automobile	0	0	0	-	73,008	-	-	-	-	
7) Motorcycle	794	0	2,827	-	13,194	-	-	-	-	
8) Diesel Engine	0	0	2,592	480	768	-	-	-	-	
9) Shipbuilding	-	-	-	-	-	31,181	4,090	-	-	-
10) Process Equip	-	-	-	-	-	-		80,667	20,500	5,500
T o t a l	3,069	485	9,062	12,266	94,742	31,181	4,090	80,667	20,500	5,500

Source: Master Plan

Table 8.2-1 (2) Volume of Metalworking by Type of Work, 1993

(Unit: Ton)

Item \ Type of work	Casting	Forging, Heat Treat.	Machining	Sheetwork, Welding	Press-working	Hull Steel	Equipment & Outfit	Structure Work	Plate Work	Machine Work
1) Machine Tool	4,830	221	8,004	2,374	455	-	-	-	-	-
2) Agri. Machine	3,561	397	7,565	7,009	2,142	-	-	-	-	
3) Const. Equip.	3,139	1,784	5,878	29,202	1,935	-	-	-	-	
4) Elec. Machine	1,583	791	352	3,834	6,525	-	-	-	-	-
5) Elec. Appli.	143	325	-	5,571	9,546	-	-	-	-	
6) Automobile	22,065	15,276	39,037	-	99,291	-	-	-	-	
7) Motorcycle	9,466	7,249	15,304	-	28,193	-	-	-	-	
8) Diesel Engine	7,385	1,130	12,208	754	1,507	-	-	-	-	
9) Shipbuilding	-	-	-	-	-	58,096	7,620	-	-	-
10) Process Equip	-	-	-	-	-	-		110,000	38,000	8,000
T o t a l	52,172	27,173	88,348	48,744	149,594	58,096	7,620	110,000	38,000	8,000

Source: Master Plan

Table 8.2-1 (3) Volume of Metalworking by Type of Work, 1998

(Unit: Ton)

Item \ Type of work	Casting	Forging, Heat Treat.	Machining	Sheetwork, Welding	Press-working	Hull Steel	Equipment & Outfit	Structure Work	Plate Work	Machine Work
1) Machine Tool	19,095	1,076	27,104	5,140	986	-	-	-	-	-
2) Agri. Machine	9,929	1,706	20,382	17,960	5,633	-	-	-	-	
3) Const. Equip.	8,430	4,799	15,804	46,481	3,077	-	-	-	-	
4) Elec. Machine	2,500	1,250	556	6,056	10,307	-	-	-	-	-
5) Elec. Appli.	183	414	-	7,094	13,434	-	-	-	-	
6) Automobile	43,557	30,277	73,303	-	45,414	-	-	-	-	
7) Motorcycle	15,572	14,597	27,736	-	45,414	-	-	-	-	
8) Diesel Engine	16,666	3,571	28,927	1,190	2,381	-	-	-	-	
9) Shipbuilding	-	-	-	-	-	84,404	11,070	-	-	-
10) Process Equip	-	-	-	-	-	-		137,000	51,700	11,500
T o t a l	115,932	57,690	193,812	83,921	246,960	84,404	11,070	137,000	51,700	11,500

Source: Master Plan

Table 8.2-2 Recommendable Tests and Inspections in Indonesia

Tests & Inspections	Region / Year	Indonesia Total 1985	1993	1998
[Category A]				
1) Brinell Hardness		397	6,701	14,793
2) Vickers Hardness		200	3,443	8,849
3) Tensile		3,982	67,004	147,955
4) Impact		1,193	20,101	44,384
5) Projector		1,193	20,101	44,384
6) Micro Structure		208	52,586	137,047
7) Chemical Analysis		3,982	67,004	147,955
[Category B]				
8) Surface Roughness		3,264	9,894	22,527
9) 3-Dim. Measurement		401	4,256	11,957
10) Gear Tooth Dim.		3,264	9,894	22,527
[Category C1]				
11) Magnetic Particle		598	2,711	6,022
[Category C2]				
12) Ultrasonic		2,023	3,700	5,661
13) X-ray		2,023	4,000	6,261
Total		22,728	271,395	620,322

Source: ANX IV-8-10 - 19

Table 8.2-3 Regional Distribution of Metalworking Industries

Item \ Area	JABOTABEK	Jawa Barat*	Jawa Tengah	Jawa Timur	Sumatera	Others	Total
Machine Tool	0.67	0.33	-	-	-	-	1.00
Agri. Machine	0.53	-	0.28	0.12	0.07	-	1.00
Const. Machine	1.00	-	-	-	-	-	1.00
Elec. M/C & Appli.	0.97	-	-	0.02	0.01	-	1.00
Automobile	0.80	-	-	0.20	-	-	1.00
Motorcycle	1.00	-	-	-	-	-	1.00
Diesel Engine	0.46	-	0.27	0.27	-	-	1.00
Shipbuilding	0.43	-	0.10	0.21	0.19	0.07	1.00
Process Equipment	0.40	0.23	0.06	0.23	0.07	0.01	1.00

* Note: Excluding Bogor, Tanggerang, & Bekashi

Source: ANX IV-8-20 - 28

Table 8.2-4 Recommendable Tests and Inspections by Region, 1985, 1993, 1998

Tests & Inspections	Region / Year	JABOTABEK			Jawa Barat-Ex.JABOTABEK			Jawa Tengah			Jawa Timur			Sumatera			Others			Total		
		1985	1993	1998	1985	1993	1998	1985	1993	1998	1985	1993	1998	1985	1993	1998	1985	1993	1998	1985	1993	1998
[Category A]																						
1) Brinell Hardness		177	5,417	11,828	75	197	508	34	140	456	80	876	1,860	27	63	128	3	8	12	397	6,701	14,793
2) Vickers Hardness		89	2,779	6,982	38	114	559	18	72	258	40	442	983	13	31	64	2	4	6	200	3,443	8,849
3) Tensile		1,777	54,168	118,284	758	1,962	5,088	346	1,403	4,571	807	8,766	18,607	264	629	1,284	32	76	124	3,982	67,004	147,955
4) Impact		533	16,250	35,483	227	589	1,525	103	421	1,371	242	2,830	5,582	79	189	385	10	23	37	1,193	20,101	44,384
5) Projector		533	16,250	35,483	227	589	1,525	103	421	1,371	242	2,830	5,582	79	189	385	10	23	37	1,193	20,101	44,384
6) Micro Structure		168	45,252	113,419	0	469	8,752	25	386	2,273	11	6,418	14,356	6	82	247	0	0	0	208	52,586	137,047
7) Chemical Analysis		1,777	54,168	118,284	756	1,962	5,086	346	1,403	4,571	807	8,766	18,607	264	629	1,284	32	76	124	3,982	67,004	147,955
[Category B]																						
8) Surface Roughness		1,790	6,119	14,007	566	1,745	4,447	183	479	1,152	543	1,202	2,264	160	309	587	22	40	69	3,264	9,894	22,527
9) 3-Dim. Measurement		289	3,077	8,277	60	825	2,860	26	122	321	26	232	498	0	0	0	0	0	0	401	4,256	11,957
10) Gear Tooth Dim.		1,790	6,119	14,007	566	1,745	4,447	183	479	1,152	543	1,202	2,284	160	309	587	22	40	69	3,264	9,894	22,527
[Category C1]																						
11) Magnetic Particle		302	2,027	4,589	94	189	328	53	165	456	111	238	454	33	83	179	4	10	16	598	2,711	6,022
[Category C2]																						
12) Ultrasonic		809	1,480	2,264	465	851	1,302	121	222	340	465	851	1,302	142	259	398	20	37	57	2,023	3,700	5,661
13) X-ray		809	1,609	2,522	465	851	1,302	121	252	400	465	914	1,428	142	316	510	20	58	99	2,023	4,000	6,261
Sub Total		10,843	214,717	485,429	4,298	12,087	35,727	1,662	5,963	18,690	4,383	35,168	73,788	1,368	3,067	6,037	177	394	650	22,728	271,395	620,322

Source: ANX IV-8-29 - 38

Table 8.2-5 Flow of Recommendable Tests and Inspections by Region, 1985 - 1993

Region \ Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
JABOTABEK	10,843	14,527	19,937	28,021	40,308	59,297	89,147	136,899	214,717
Jawa Barat-Ex. JABOTA	4,296	4,838	5,455	6,162	6,978	7,926	9,046	10,397	12,087
Jawa Tengah	1,662	1,935	2,258	2,640	3,093	3,631	4,273	5,041	5,963
Jawa Timur	4,383	5,377	6,677	8,400	10,716	13,897	18,390	24,987	35,168
Sumatera	1,368	1,510	1,669	1,844	2,039	2,256	2,498	2,767	3,067
Others	177	196	216	238	263	291	322	356	394
Total	22,729	28,383	36,212	47,305	63,397	87,298	123,676	180,447	271,396

Source: ANX IV-8-39 - 44

Table 8.2-6 Regional Distribution of B4T Services, 1987

Item \ Area	JABOTABEK	Jawa Barat	Jawa Tengah	Jawa Timur	Sumatera	Others	Total
Number of Services	2,897	2,143	296	883	219	29	6,467

Source: ANX IV-8-45

Table 8.2-7 Regional Cover Ratios of B4T, 1987

Item \ Area	JABOTABEK	Jawa Barat	Jawa Tengah	Jawa Timur	Sumatera	Others	Total
Recomm. Services	19,937	5,455	2,258	6,677	1,669	216	36,212
Number of Services	2,897	2,143	296	883	219	29	6,467
Cover Ratio	0.145	0.393	0.131	0.132	0.131	0.134	0.179

Source: Tables 8.2-5 and 8.2-6

Table 8.2-8 Flow of Potentail Needs for Tests and Inspections in Indonesia, 1985 - 2002

Region \ Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
JABOTABEK	4,260	5,707	7,832	11,008	15,835	23,295	35,021	53,781	84,352	99,255	116,818	137,519	161,924	190,701	224,641	264,677	311,915	367,660
Jawa Barat Ex. JABOTABEK	1,688	1,901	2,143	2,421	2,741	3,114	3,554	4,085	4,748	5,773	7,078	8,767	11,003	14,035	18,260	24,317	33,253	46,797
Jawa Tengah	653	760	887	1,037	1,215	1,426	1,679	1,980	2,342	2,926	3,666	4,607	5,807	7,342	9,312	11,848	15,123	19,367
Jawa Timur	1,722	2,112	2,623	3,300	4,210	5,459	7,225	9,816	13,816	16,015	18,570	21,537	24,983	28,988	33,641	39,049	45,334	52,641
Sumatera	537	593	656	725	801	886	981	1,087	1,205	1,377	1,575	1,804	2,067	2,372	2,724	3,133	3,608	4,162
Others	70	77	85	94	103	114	126	140	155	171	189	209	231	255	283	312	346	382
Total	8,930	11,150	14,226	18,585	24,905	34,294	48,586	70,889	106,618	125,517	147,896	174,443	206,015	243,693	288,861	343,336	409,579	491,009

Source: ANX IV-8-46 - 51

8.3 Demand for R & D

The technical approach used to estimate the potential needs for R & D is shown in Fig. 8.3-1.

(1) Forecasting of metalworking industries in Indonesia

The numbers of establishments in the metalworking industries, which include the industries categorized in commodity numbers 381, 382, 383 and 384, were drawn from industrial statistics in 1980 and 1986. Assuming the same annual increase ratio for each industry between 1980 and 1986 to last till the year of 2002, the flow of the number of establishments of metalworking industries in Indonesia between 1986 and 2002 was calculated. The resulting flow is shown in Table 8.3-1.

(2) Estimation of the number of establishments in Indonesia which intend to use the R & D services of the Center

From the questionnaire survey, 18 out of 30 firms showed their intention to use the Center if it were established within the region where the firm is located, as described in Table 8.3-2. The number of establishments which are willing to use the Center for R & D activities was estimated by multiplying the number of establishments in Indonesia by the ratio, 18/30. Table 8.3-3 summarizes the calculation.

(3) Estimation of total volume of potential needs for R & D per year

In Table 8.3-3, the number of firms which intend to use the Center is shown. The estimation of total volume of potential needs in Indonesia for R & D per year was made by multiplying the number of firms by the frequency of R & D activities (the number of R & D activities per year per firm). To find the frequency of R & D activities, the past record of MIDC activities was reviewed.

The total number of R & D activities entrusted to MIDC out of Jawa Barat (excluding Bogor, Tanggerang and Bekasi) between 1984 and 1986 was 37. (see ANNEX IV-8-52) On the other hand, from Table 8.2-8, the volume of potential needs for tests and inspections in Jawa Barat accounted for 19 percent of the total demand in Indonesia in 1985. The activities of MIDC show similar regional characteristics as those of B4T where a substantial portion of the activities is dependent on the Jawa Barat area. Assuming that the activities of MIDC have the same regional cover ratio as those of B4T, the total potential needs for R & D in Indonesia was estimated by dividing 37 by 19 percent. The resulting estimation of the potential needs is 195 R & D activities in all of Indonesia between 1984 and 1986. It is assumed that 65 potential needs for R & D existed in 737 firms in 1986. The same ratio (65/737) was applied to forecast the flow of the number of potential needs for R & D activities in Indonesia up to the year 2002.

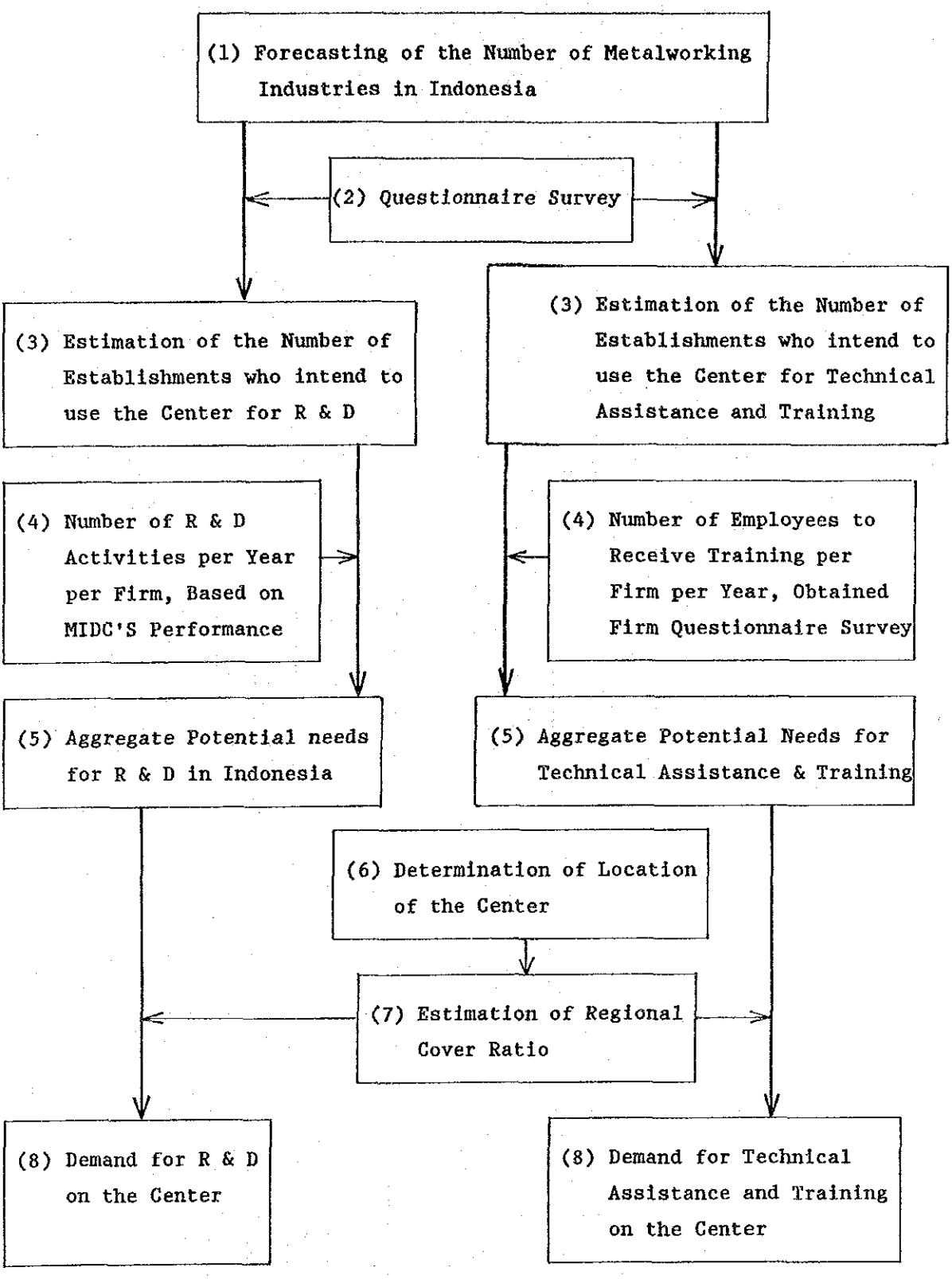


Fig. 8.3-1 Estimation of Flow of Demand for R & D, Technical Assistance and Training on the Center

Table 8.3-1 Flow of Metalworking Industries (Number of Establishments), 1980, 1986 - 2002

Year / ISIC Nbr	1980	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
381	363	556	597	641	688	739	793	852	914	982	1,054	1,132	1,215	1,304	1,400	1,504	1,614	1,733
382	132	180	190	200	210	221	233	245	258	272	287	302	318	335	352	371	391	412
383	113	186	202	220	239	259	282	306	333	361	393	427	464	504	548	595	647	703
384	178	307	336	368	403	442	484	529	580	635	695	761	834	913	1,000	1,095	1,199	1,313
Total	786	1,229	1,325	1,428	1,540	1,661	1,792	1,933	2,085	2,250	2,429	2,622	2,830	3,056	3,301	3,565	3,851	4,161

Source : BPS

Table 8.3-2 Intention to use the Center for R & D, Training and Technical Assistance

	Yes		No		
	Number	%	Number	%	Total
R & D	18	60	12	40	30
TR. T/A	32	71	13	29	45

Source : ANX II (Questionnaire Survey)

Table 8.3-3 Flow of Potential Establishments for Tests and Inspections in Indonesia, 1980, 1986 - 2002

Year / ISIC Nbr	1980	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
381	363	556	597	641	688	739	793	852	914	982	1,054	1,132	1,215	1,304	1,400	1,504	1,614	1,733
382	132	180	190	200	210	221	233	245	258	272	287	302	318	335	352	371	391	412
383	113	186	202	220	239	259	282	306	333	361	393	427	464	504	548	595	647	703
384	178	307	336	368	403	442	484	529	580	635	695	761	834	913	1,000	1,095	1,199	1,313
Total Establishment	786	1,229	1,325	1,428	1,540	1,661	1,792	1,933	2,085	2,250	2,429	2,622	2,830	3,056	3,301	3,565	3,851	4,161
Potent. Establishment	472	737	795	857	924	997	1,075	1,160	1,251	1,350	1,457	1,573	1,698	1,834	1,980	2,139	2,311	2,496

Source: Tables 8.3-1 and 8.3-2

Table 8.3-4 Flow of Potential Needs for Tests and Inspectonns in Indonesia, 1980, 1986 - 2002

Year / ISIC Nbr	1980	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
381	363	556	597	641	688	739	793	852	914	982	1,054	1,132	1,215	1,304	1,400	1,504	1,614	1,733
382	132	180	190	200	210	221	233	245	258	272	287	302	318	335	352	371	391	412
383	113	186	202	220	239	259	282	306	333	361	393	427	464	504	548	595	647	703
384	178	307	338	368	403	442	484	529	580	635	695	761	834	913	1,000	1,095	1,199	1,313
Total	786	1,229	1,325	1,428	1,540	1,661	1,792	1,933	2,085	2,250	2,429	2,622	2,830	3,056	3,301	3,565	3,851	4,161
Potent. Establishment	472	737	795	857	924	997	1,075	1,160	1,251	1,350	1,457	1,573	1,698	1,834	1,980	2,139	2,311	2,496
Potent. Needs	42	65	70	76	81	88	95	102	110	119	129	139	150	162	175	189	204	220

Source: Tables 8.3-3

8.4 Demand for Technical Assistance and Training

Table 8.3-1 shows the technical approach used to estimate the aggregate demand for technical assistance and training in Indonesia.

(1) Forecasting of metalworking industries in Indonesia

Forecasting of the number of firms engaged in metalworking industries shown in Table 8.3-1 was used here as one of the data bases.

(2) Estimation of the potential needs for technical assistance and training in Indonesia

Technical assistance and training, generally, have an educational function in common. The technical assistance service provided by the Center puts significant importance on the educational effect rather than mere problem solving. Thus, the estimation for each service was made in parallel here.

From the questionnaire survey, it was revealed that 71 percent of the firms (32 out of 45 firms) showed an interest in using the Center for technical assistance and training purposes, as shown in Table 8.3-2. These firms were categorized by size, as summarized in Table 8.4-1. The number of employees sent to outside training institutions per firm is, from interviews with them, approximately estimated as two persons for a large-size firm, 100 or more employees, and one person for a medium-size firm, with fewer than 100 employees. The average number of employees to be sent to outside institutions is, therefore, calculated as 1.53 (= 14 x 1 + 16 x 2) ÷ 30). By multiplying the total number of establishments engaged in metalworking in Indonesia by the ratio of firms which are interested in using the Center, the number of firms which are interested in using the Center is obtained. Then, the aggregate potential needs for technical assistance and training provided by the Center is estimated by multiplying the number of firms interested in the services by the average number of employees sent to the Center. (see Table 8.4-2)

Table 8.4-1 Number of Establishments by size which wish to use The Center for Technical Assistance and Training

Size of Employees	Number of Firms		Total
	Wish to use the Center	Not wish to use the Center	
1 - 19	0	4	4
20 - 49	9	0	9
50 - 99	5	2	7
100 - 199	5	1	6
200 - 499	7	3	10
500 -	4	2	6
No answer	2	1	3
Total	32	13	45

Source: ANX II (Questionnaire Survey)

Table 8.4-2 Flow of Potential Needs for Technical Assistance and Training in Indonesia, 1980, 1986 - 2002

Year / ISIC Nbr	1980	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
381	363	556	597	641	688	739	793	852	914	982	1,054	1,132	1,215	1,304	1,400	1,504	1,614	1,733
382	132	180	190	200	210	221	233	245	258	272	287	302	318	335	352	371	391	412
383	113	186	202	220	239	259	282	306	333	361	393	427	464	504	548	595	647	703
384	178	307	336	368	403	442	484	529	580	635	695	761	834	913	1,000	1,095	1,199	1,313
Total	786	1,229	1,325	1,428	1,540	1,661	1,792	1,933	2,085	2,250	2,429	2,622	2,830	3,056	3,301	3,565	3,851	4,161
Potential Firms	559	874	942	1,016	1,095	1,181	1,274	1,374	1,483	1,600	1,727	1,864	2,013	2,173	2,347	2,535	2,739	2,959
T/A.TR per Firm	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53
Potential Needs	885	1,337	1,441	1,554	1,676	1,807	1,949	2,103	2,269	2,448	2,642	2,852	3,080	3,325	3,591	3,879	4,190	4,527

Source: Tables 8.3-1 and 8.4-1

8.5 Determination of the Location of and the Demand on the Center

8.5.1 Determination of the Location of the Center

It is assumed that the Center would start operation in 1992. Table 8.2-8 shows that more than 75 percent of the total potential needs for tests and inspections, which amounts to 70,889, in Indonesia in 1992 will be created out of the JABOTABEK area, followed by Jawa Timur, which accounts for 14 percent of the total Indonesian needs. The two regions together account for 90 percent of total Indonesian potential needs in 1992. In 1995, the degree of concentration in the JABOTABEK area is estimated to increase to 79 percent of the total Indonesian needs. Although the degree of concentration is forecast to decline in 1998, it will still account for 75 percent of the total Indonesian needs. This may stem from the fact that the area is by far the most industrialized area in Indonesia. Especially, most of the automotive and electric machine/appliance manufacturers, who are assumed to create more needs for tests/inspections than any other industries, have their production facilities there.

On the other hand, the share of Jawa Timur, which would account for 14 percent of total Indonesian potential needs in 1992, will decrease to 13 percent in 1993 and 11 percent in 1998. In terms of the number of needs, that of Jawa Timur in 1992 will be 9,816, which would amount to less than 2/3 of the total number of tests and inspections including those in non-metal-related fields which B4T conducted in 1986. Also, the analysis of past performance of B4T reveals that only about 40 percent of the potential needs in Jawa Barat, where B4T is located, were brought to B4T, while the other regions showed a much smaller rate. This limited percentage would also hold true for Jawa Timur. Accordingly, it is reasonably assumed that Jawa Timur would not be a good site for the Center to secure sufficient demand until the region attracts more metalworking industries. From the viewpoint of the macro demand forecasting on tests and inspections, technical assistance, training and R & D, which have been discussed in this chapter, it would be said that there is no better place than JABOTABEK for the Center to be established.

If the largest three industries are selected in each region in terms of the volume of value-added, those of JABOTABEK are automotive, detergent and metalworking industries. The combined share of the three leading industries of the total industry value-added in the region is a little more than 20 percent, which is the smallest amount of any of the other regions. This means that the industries in JABOTABEK are widely diversified. The other significance of the three largest industries in the region is that all three are among chemical or heavy industries, which would involve metalworking to some extent. Compared to JABOTABEK, the three largest industries in Jawa Barat are textiles, primary metal and cement, all of which are among resource of agriculture-related-industries. The three leading industries in Jawa Timur are the labor intensive tobacco industry, and sugar processing and daily products, which are among agriculture industries. These three leading industries account for about 70 percent of the total value-added in the region, which means that the industries in Jawa Timur are not well diversified.

8.5.2 Role sharing of the Center with B4T and MIDC

It is foreseen that a part of the services which would be conducted by B4T or MIDC, especially for those of advanced technology, will be brought to the Center. The effect of the decrease in service demand on the existing institutions would be, however, marginal, if the rapid increase of the potential needs of the services in Indonesia, specially in the Jawa Barat and JABOTABEK areas, is taken into account. For instance, the volume of the potential needs for tests and inspections in JABOTABEK alone in 1992 is 53,781, which is about 8 times the service performed by B4T in 1987. Since the demand for services is expected to increase annually which would well surpass the capacity of the existing institutions even if they were reinforced, the establishment of the Center in the JABOTABEK area is regarded as necessary.

8.6 Estimation of Demand on the Center

8.6.1 Estimation of demand for tests and inspections on the Center

Regional cover ratios of the services of the Center are calculated applying the same correlation as with B4T between distance and the number of services coming from the region. The calculated regional cover ratios are further adjusted by reducing the part of the services to be handled by B4T. The summarized regional cover ratios of the Center and B4T are shown in Table 8.6-1. The next step in estimating the demand for tests and inspections on the Center is to multiply the regional potential needs shown in Table 8.2-9 by the regional cover ratios. Table 8.6-2 shows the flow of the tests and inspections expected to be brought to the Center between 1990 and 2002.

8.6.2 Estimation of demand for R & D, and technical assistance and training on the Center

Services provided by B4T show similar regional distribution as those of MIDC, stemming from the distance between the institutions and each region as well as from the industrial concentration of each region. Table 8.6-3 shows the ratio of the tests and inspections expected to be brought to the Center over the aggregate potential needs in Indonesia. Assuming that the same ratio is applied to R & D, and technical assistance and training, the demand for R & D, and technical assistance and training on the Center is estimated by multiplying the aggregate demand for R & D, and technical assistance and training by the ratios. The estimated demand for each service which is expected to be brought to the Center is shown in Tables 8.6-4 and 8.6-5.

Table 8.6-1 Regional Cover Ratios of the Center and B4T for Tests and Inspections

Region \ Area	JABOTABEK	Jawa Barat (Ex. BOTABEK)	Jawa Tengah	Jawa Timur	Sumatera	Others
The Center	0.287	0.104	0.068	0.064	0.066	0.067
B4T	0.106	0.289	0.066	0.068	0.066	0.067
Total	0.393	0.393	0.134	0.132	0.132	0.134

Source : ANX IV-8-45

Table 8.6-2 Flow of Tests and Inspections Expected to be Brought to the Center, 1990 - 2002

Tests & Inspections \ Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
[Category A]													
1) Brinell Hardness	477	718	1,085	1,645	1,924	2,251	2,632	3,080	3,604	4,217	4,936	5,777	6,762
2) Vickers Hardness	244	368	556	844	1,015	1,224	1,475	1,778	2,144	2,588	3,127	3,778	4,566
3) Tensile	4,776	7,185	10,854	16,441	19,236	22,503	28,329	30,805	36,046	42,182	49,366	57,780	67,631
4) Impact	1,433	2,155	3,255	4,932	5,770	6,752	7,898	9,241	10,812	12,654	14,809	17,331	20,289
5) Projector	1,433	2,155	3,255	4,932	5,770	6,752	7,898	9,241	10,812	12,654	14,809	17,331	20,289
6) Micro Structure	1,638	3,304	6,668	13,468	16,204	19,511	23,516	28,381	34,318	41,607	50,628	61,907	76,214
7) Chemical Analysis	4,776	7,185	10,854	16,441	19,236	22,503	26,329	30,805	36,046	42,182	49,366	57,780	67,631
[Category B]													
8) Surface Roughness	1,324	1,536	1,783	2,070	2,442	2,882	3,404	4,020	4,747	5,606	6,622	7,823	9,241
9) 3-Dim. Measurement	408	549	737	991	1,213	1,484	1,817	2,225	2,726	3,339	4,092	5,015	6,150
10) Gear Tooth Dim.	1,324	1,536	1,783	2,070	2,442	2,882	3,404	4,020	4,747	5,606	6,622	7,823	9,241
[Category C1]													
11) Magnetic Particle	322	404	506	633	744	876	1,029	1,211	1,423	1,674	1,970	2,316	2,726
[Category C2]													
12) Ultrasonic	480	518	559	601	655	714	776	852	921	1,003	1,092	1,190	1,294
13) X-ray	504	548	597	651	711	778	850	900	1,018	1,113	1,218	1,332	1,456
Total	19,139	28,161	42,492	65,719	77,362	91,112	107,357	126,559	149,364	176,425	208,657	247,183	293,490

Source : Tables 8.2-8 and 8.6-1

Table 8.6-3 Ratio of Tests and Inspections on the Center over the Total Potential Needs, 1990 - 2002

Item \ Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Demand to the Center	19,139	28,161	42,492	65,719	77,362	91,112	107,357	126,559	149,364	176,425	208,657	247,183	293,490
Potential Needs	34,294	48,586	70,889	106,618	125,517	147,896	174,443	206,015	243,693	288,861	343,336	409,579	491,009
Ratio to the Cneter	0.56	0.58	0.60	0.62	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.60	0.60

Source: Tables 8.2-8 and 8.6-2

Table 8.6-4 Estimated Demand for Technical Assistance and Training on the Center, 1990 - 2002

Item \ Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Demand to the Center	1,807	1,949	2,103	2,269	2,448	2,642	2,852	3,080	3,325	3,591	3,879	4,190	4,527
Ratio to the Center	0.56	0.58	0.60	0.62	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.60	0.60
Ratio to the Cneter	1,012	1,131	1,262	1,407	1,518	1,638	1,769	1,879	2,028	2,191	2,366	2,514	2,716

Source: Tables 8.4-2 and 8.6-3

Table 8.6-5 Estimated Demand for R & D on the Center, 1990 - 2002

Item \ Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Potential needs	88	95	102	110	119	129	139	150	162	175	189	204	220
Ratio to the Center	0.56	0.58	0.60	0.62	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.60	0.60
Demand to the Center	49	55	61	68	74	80	86	92	99	107	115	122	132

Source: Tables 8.3-4 and 8.6-3

CHAPTER 9

CONCEPTUAL DESIGN OF THE CENTER

CHAPTER 9 CONCEPTUAL DESIGN OF THE CENTER

9.1 Operation and Management of the Center

9.1.1 Objective and Function of the Center

(1) Objective

The objective of the Center is to support the metalworking industries owned both by private sector and by the public sector in the improvement of the basic technology and the quality of the products, thus contributing to the modernization of the metalworking industries as a whole.

(2) Function

The major functions of the Center are as follows:

1) Testing and inspection to identify the quality of the products made by the linkage-type industries to determine if they meet the requirements of the assembly type industries.
2) Implementing technical assistance services to the linkage type industries in the manufacturing process and operation and maintenance of the equipment in order to most effectively achieve the localization program of the fabricated metal components demanded by the Indonesian Government. Training of the workforce in the acquisition of the necessary technical skills is also conducted.
3) Implementing R & D activities in the technological areas which are not yet completely practiced in Indonesia. Such areas include:
   - improvement of casting technology to produce metallic material for fabricated metal products.
   - improvement of forging and pressworking technology to attain better forming.

- improvement of plating, sheetworking, welding and machining technologies to attain improvement in quality and reduction of the manufacturing cost of the product.

4) Providing technical assistance and training of manufacturing processes by using facilities in the Center and holding seminars.
5) Providing technical advisory services including visits to factories.
6) Providing market and technical information to the industries.

9.1.2 Major Activities of the Center

(1) Testing and inspection

The Center will conduct entrusted tests of items numbered 1) and 13) below at all times for quality assurance of industrial materials and issue inspection record. There are following items from 14) to 26) to be performed, as required, as a part of T/A or R & D.

1) Brinell hardness
2) Vickers hardness
3) Tensile
4) Impact
5) Visual and microscopical inspection using projector
6) Micro structure
7) Chemical analysis
8) Surface roughness measurement
9) Three-dimensional measurement
10) Gear tooth dimension
11) Magnetic particle inspection
12) Ultrasonic inspection
13) X-ray inspection
14) Micro vickers test
15) Fatigue test
16) Scanning electron microscope test
17) Sulphur print
18) Penetrant test
19) Fluorescent magnetic particle test
20) Sand test for iron cast mold
21) Plating film test
22) Pressure test (air tightness and water pressure)
23) Length measurement test
24) Angle measurement test
25) Gear rolling test
26) X-ray diffractor analysis

(2) R & D, T/A and T/R

R & D of new products and new manufacturing process will be carried out using facilities to be installed in the Center under instructions of engineers. Each technology thus developed will be transferred to companies in Indonesia. Engineers will give instructions of R & D until Indonesian companies could manufacture new products by themselves.
Technical assistance (T/A) will be divided into long-term T/A to be provided within the Center and short-term T/A to be performed at factory sites.

1) Long-term T/A

- Quality improvement of products and suggestion thereof
- Improvement of productivity and suggestion thereof
- Improvement for shortening delivery time and suggestion therefor

2) Short-term T/A

- Solution of present problems and suggestion thereof
- Suggestion for factory layout improvement

Regarding TR, practical training related to handling and maintenance method of machinery and equipment will be conducted using machinery and equipment to be installed in the Center.
Expected effects induced from R & D, T/A and TR activities are summarized in Table 9.1-1

Table 9.1-1 Expected Effects from R & D, T/A and TR (1/2)

	Expected effects	R & D				T/A			TR			
		Item	Duration (months)	Times per year	Number of engineers	Item (Duration)	Times per year	Number of engineers	Course (Duration)	Times per year	Number of trainees	Number of engineers
Casting	1) Transfer of technology related to manufacturing process of cast steel and special cast iron (ductile and malleable cast iron) 2) Transfer of technology related to complicated shape casting 3) Transfer of technology related to forging (die and free forging) 4) Transfer of heat treatment technology	- Manufacturing process of complicated shape casting (e.g., engine blocks) - Manufacturing process of special cast iron (e.g., ductile and malleable cast iron) - Manufacturing process of cast steel - Manufacturing process of alloy cast iron and cast steel - Five other items	6-8 3 3 3	9	3	- Manufacturing technology of various parts nominated in the deletion program (1 day)	300	1 (4 assistant engineers)	- Green sand mold - CO_2 mold technology (6 days) - Shell mold (6 days) - Self-hardening sand mold (Fran type resin) (6 days) - Melting technology (6 days) Breakdown of Course: Lecture for 2 days Test and inspection for 1 day Practice for 3 days	12	5-25	1
Forging		- Die forging of connecting rods - Die forging of gears - Free forging of shafts	3 3 3	3	3	- Manufacturing technology of various parts nominated in the deletion program (1 day)	20	1	- Free forging technology (6 days) - Die forging technology (6 days) Breakdown of Course: Lecture for 2 days Practice for 3 days Test and inspection for 1 day	4	5-25	1
Heat treatment		- Carburizing and nitriding of gears and shafts - Heat treatment of dies - One other item	3 3	3	1	- Manufacturing technology of various parts nominated in the deletion program (1 day)	50	1	- Heat treatment technology of die (6 days) - Heat treatment technology of carbon steel (6 days) Breakdown of Course: Lecture for 2 days Practice for 3 days Test and inspection for 1 day	4	5-25	1

Table 9.1-1 Expected Effects from R & D, T/A and TR (2/2)

	Expected effects	R & D				T/A			TR			
		Item	Duration (months)	Times per year	Number of engineers	Item (Duration)	Times per year	Number of engineers	Course (Duration)	Times per year	Number of trainees	Number of engineers
Sheet-working / welding	1) Acquisition of manufacutring process technology and transfer of technology - Increased quality - Increased productivity - Reduced manufacturing cost 2) Acquisition and transfer of technology to conduct non-destructive inspection 3) Acquisition and transfer of machining technology - Acquisition of precision machining and inspection of dimensional accuracy	- Welding technology of different metals - One other item	6	2	2	- Automation of thick plate welding (to be applicable to shipbuilding and pressure vessels) (1 month/item) - Seven other items	8	1	- Acquisition of technology to conduct non-destructive inspection of welded portions (2.5 months/course) - Four other courses	5	8-10	3
Press-work		- Deep drawing work technology (for automotive parts) - One other item	6	2	1	- Improvement of improper process resulting from defective parts (e.g., improvement of dies) (1 month/item) - Seven other items	8	1	- Working conditions and maintenance of process (1 month/course) - Seven other courses	8	3-5	2
Plating		- Determination of plating condition for automotive parts (e.g., plating thickness, plating condition) - Two other items	3	3	1	- Prevention of defect in plating layer (pre-treatment and plating condition) (1 month/item) - Seven other items	8	1	- Acquisition of electroplating and chemical plating, and hot dipping techniques (2 months/course) - Three other courses	4	4-6	1
- Machining		It is difficult to specify this item at the present stage, because R & D themes are discovered during the promotion of the deletion program				- Finishing of high alloy steel by grinding work (1 month/item) - Seven other items	8	2	- Acquisition of technology to operate NC machine (3 months/course) - Two other courses	3	3-5	2
						- Gear cutting technology (bevel gears and so on) (1 month/item) - Seven other items	8		- Acquisition of technology to operate grinding machine (1 month/course) - Seven other courses	8	3-5	

9.1.3 Organization and Personnel of the Center

(1) Organization of the Center

1) Basic concepts in formulating the organizational structure of the Center

The Center could be established as a governmental organization or semi-governmental organization jointly funded by the Indonesian Government and private sector. The supervising agency of the Center could be either BPPI or the other governmental agency. In the course of the field survey, industrial federation such as KADIN expressed a strong interest in establishment of the high-level testing institute for export products, and its readiness for the capital contribution. However, the basic character of such institute does not necessarily coincide with that of the Center, because the Center intended to be established in the JABOTABEK area, aims to comply with the needs of metalworking industries which have not been fully covered by the existing governmental institutes such as B4T and MIDC. Primary objectives of the Center are to enhance the technological level of the linkage type industries, thus contributing to the effective and urgent materialization of the deletion program. This means that the role of the Center is to complement and extend the roles of B4T and MIDC for the metalworking industries. In view of these functions of the Center, it is expected that the organization of the Center should be flexible enough to allow frequent exchange of the information and staff personnel with B4T and MIDC, in order to avoid unnecessary duplication of activities.
Furthermore, it is generally considered that the establishment of the new governmental organization under totally new concept takes long time, which does not contribute to the solution of the current issues such as the materialization of the deletion programs.

On the other hand, it is absolutely necessary that the Center should be so managed to comply with the requirements of the industries, and be open to the opinions of the universities and specialists engaged in the metalworking field. Above are the basic conceptual framework in formulating the organizational structures of the Center as mentioned below.

2) Organization of the Center

As proposed, the Center to be established is to be an organization under the control of BPPI of the MOI, and to have the following organization as described in Fig. 9.1-1.

(i) Management board

Management board consisting of the representative of BPPI, the Director of the Center, the Director of B4T and the Director of MIDC, is the highest decision making organ of the Center. The powers of the board are:

- approval of the basic activity plan of the Center.
- discussion of subject matters proposed by the Advisory Committee, and
- coordination of projects relating to B4T or to MIDC or to both.

The board is expected to meet at least once a month.

(ii) Communication forum with industries and scientist

As the relationship with the industries is very important, communication between the Center and the industries (includes the Association of Producers), scientists and specialists should be conducted regularly.

A forum for communication is necessary to be established in order to supply the Center with inputs on current requirements of the metalworking industries and the opinions of the scientists and specialists in the mechanical engineering field. The candidates of the industry representatives could be selected from the member firms belonging to:

- GAMMA
- GIAMM
- GAIKINDO

The candidates for the scientist and specialist representatives could be appointed from the following universities and organizations:

- Mechanical Engineering Department, ITB
- Mechanical Engineering Department, ITS
- Directorate of other similar institutes in the metalworking field such as LUK.

(iii) Director

The Director is the top executive of the Center, whose power would be:

- formulation and decision of the implementation plan of the Center,
- management of personnel affairs and activities, and
- evaluation of the activities.

(iv) Implementating organ

For the implementation of the function of the Center, three departments consisting of a Testing & Inspection Department, Technical Service Department and Administration Department under the control of the Director of the Center are to be organized.

a) Testing & Inspection Department
This department consists of three sections:

- mechanical testing section
- nondestructive inspection section
- metallurgical testing section

Total number of staff members is 36 including the manager of the department. The role of the department is to perform testing and inspection and its related activities.

b) Technical Service Department
This department consists of six sections:

- casting section
- forging and heating treatment section
- pressworking section
- welding section
- plating section
- machining section

The total size of the staff is 70 including the manager. The role of the department is to provide technical assistance to the industries and governmental organization through counseling, training and direct visits to the factories. The department also undertakes contract research projects as well as voluntary research projects.

c) Administration Department
This department consists of seven sections:

- general affairs section
- personnel affairs section
- finance and accounting section
- information management section

- promotion and public relations section
- technical coordination section
- maintenance of equipment section

The total number of staff persons is 30 including the manager. The role of each section is as follows:

- the general affairs section is to take care of keeping official documents, of maintaining the property, of managing the canteen, and of other affairs which do not belong to the other section.
- the personnel section handles personnel affairs.
- the finance and accounting section is engaged in bookkeeping, accounting and financing work.
- the information management section is engaged in the maintenance of the library and related information materials, and also is responsible for keeping the reports of the research work of the Center.
- the promotion and public relations section is mainly responsible for the publicity of the Center through the publication of brochures and other materials to arouse the awareness of the industries of the activities of the Center.
- the technical coordination section is engaged in the coordination of inter-divisional technical matters.
- the maintenance of equipment section is responsible for the maintenance of the machinery and equipment of the Center.

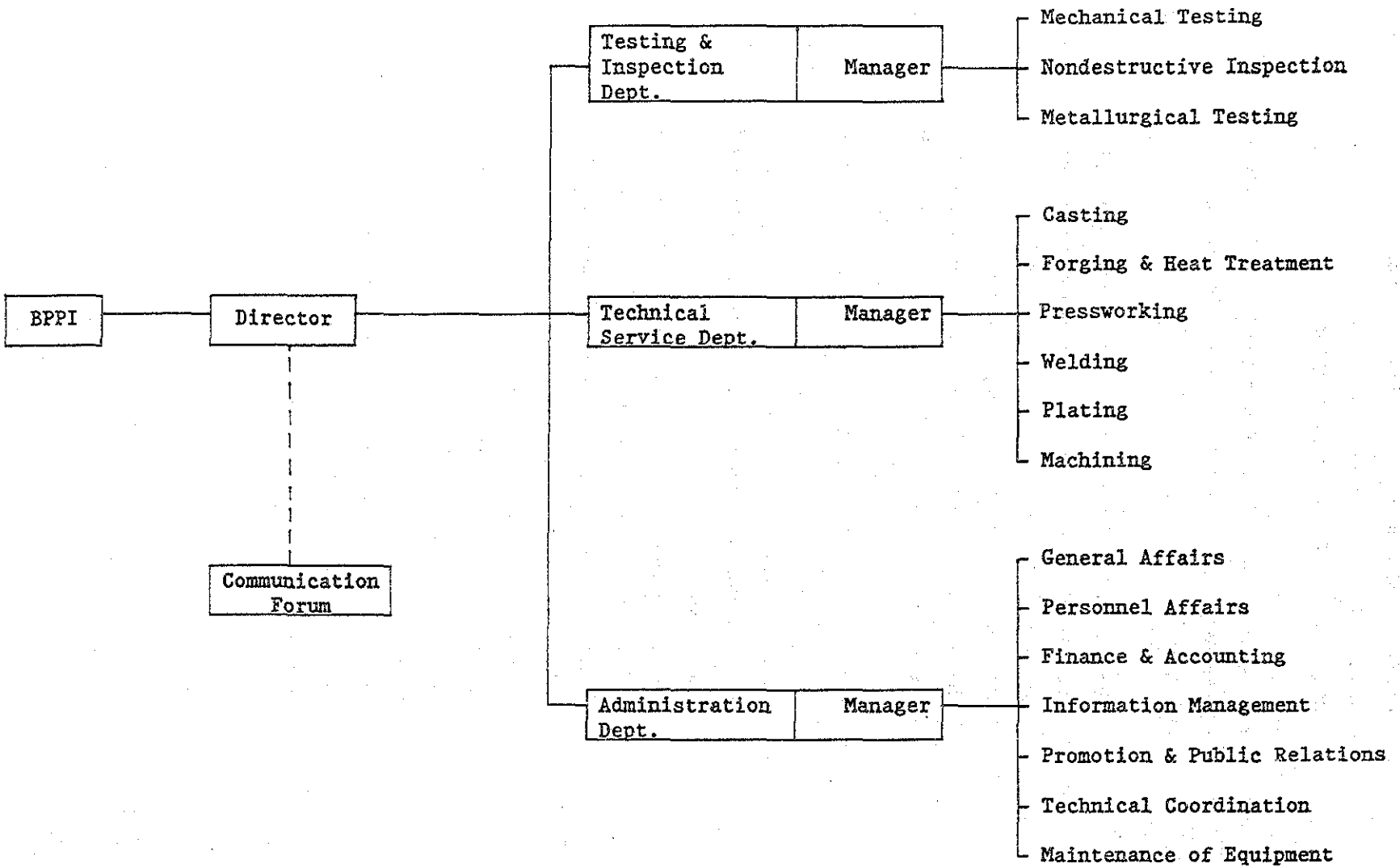


Fig. 9.1-1 Organization Chart

3) Alternative organization structure of the Center

The Center is proposed to be operated as a governmental organization in the interests of financial viability. However, the establishment of a new institute with a relatively similar character as such existing organizations as MIDC or B4T would possibly not welcomed by the Indonesian Government.

In light of the above, the following alternative organization structure of the Center is suggested:

(i) MIDC would be reorganized as an organization which controls two major centers, one located in Bandung and the other in the JABOTABEK area;

(ii) Through the establishment of a close information network among the two major centers of MIDC and local R & D laboratories related to metalworking industries such as those located in Surabaya, Medan or Semarang, and by transferring a part of the authorized testing and inspection function related to metalworking from B4T, MIDC would become a concentrated national center for the metalworking industry in Indonesia;

(iii) The reorganized MIDC would be managed by a director and two vice-directors. One vice-director would be in charge of the daily operations of the Bandung center and the other would be in charge of the daily operation of the new Center in the JABOTABEK area; and

(iv) Most of the functions and organization sections proposed in the original organization plan for the Center would be realized with the organization of the new Center of MIDC in the JABOTABEK area including the proposed communication forum. However, a part of such key functions as personnel management or annual operation planning would be transferred to the central administration section which would control both of the two major centers of the new MIDC.

Because the alternative organization structure involves the reorganization of an existing one, the suggestion of any more concrete picture of the new organizaion would be beyond the scope of this study. However, a tentatively suggested alternative organization structure is summarized and shown in Fig 9.1-2.

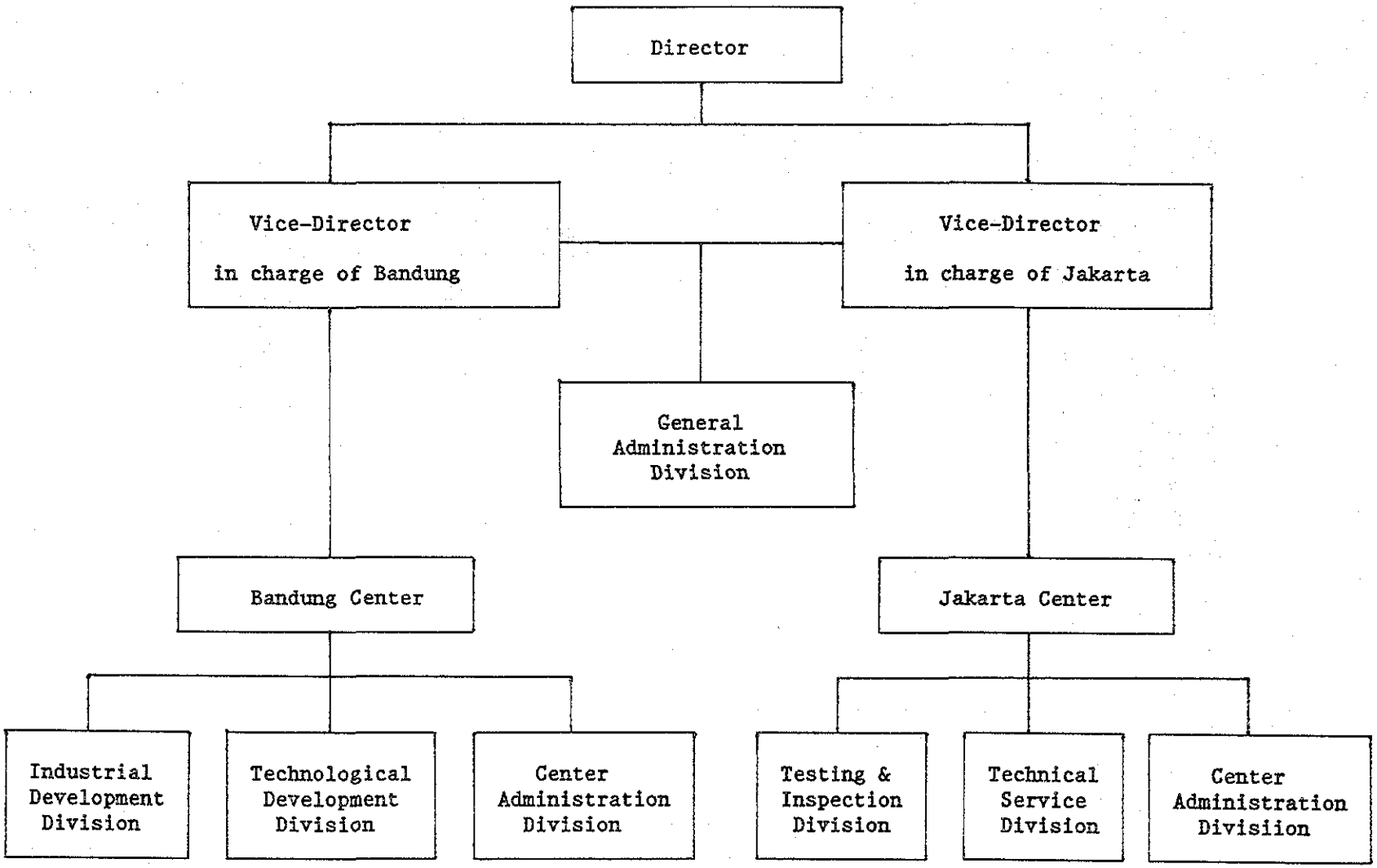


Fig. 9.1-2 Alternative Organization Chart

(2) Personnel required for the Center

1) Basic concept

In designing the personnel structure of the Center, the current conditions of B4T and MIDC have been referred to and analyzed. The current personnel structures of B4T and MIDC classified by educational background, and by technical staff or non-technical staff are summarized as follows:

Table 9.1-2 Number of Staff

	B4T		MIDC	
	Technical staff	Non-technical staff	Technical staff	Non-technical staff
- Graduates of 5 year universities (S1)	18	4	25	10
- Graduates of 3 year universities (D3)	28	0	17	13
- Graduates of senior high school	38	76	70	45
- Others	68		50	
Total	232		230	

The percentages of the staff combined, divided by educational background, and by technical staff or non-technical staff are as follows:

Table 9.1-3 Percentage of Staff

	Technical staff	Non-technical staff
- Graduates of 5 year universities (S1)	9.3%	3.0%
- Graduates of 3 year universities (D3)	9.7%	2.8%
- Graduates of senior high school	23.4%	26.2%
- Sub-total	(42.4%)	(32%)
- Other staff	25.6%	
Total	100.0%	

The percentage composition structure of the technical staff classified by educational background is as follows:

- Graduates of 5 year universities (S1) 22%
- Graduates of 3 year universities (D3) 23%
- Graduates of senior high school 55%

The percentage structure of the non-technical staff classified by educational background is as follows:

- Graduates of 5 year universities (S1) 9.4%
- Graduates of 3 year universities (D3) 8.8%
- Graduates of senior high school 81.8%

The personnel structure of the Center should be similar to the structure of B4T and MIDC so that the exchange and communication of the staff between the Center and existing institutions could be attained.

2) Personnel staffing plan of the Center

In consideration of the above situation as well as of the experiences in Japan, the personnel structure at first year is proposed as follows:

- Director 1
- Managers of the departments 3
- Staff persons of each department 133

Table 9.1-4 Number of Personnel Staff

	Number of Engineers		Assistant	Total
	Graduates of 5 year universities (S1)	Graduates of 3 year universities (D3)	Engineers graduates of senior high school or more	
Testing & Inspection Department				
- Mechanical testing	1	1	7	9
- Nondestructive inspection	1	2	6	9
- Metallurgical testing	1	5	6	12
- Workforce				5
Total (excl. manager)				35
Technical Service Department				
- Casting	1	3	8	12
- Forging & heat treatment	1	2	6	9
- Pressworking	1	2	6	9
- Welding	1	2	3	7
- Plating	1	1	4	6
- Machining	1	5	6	12
- Workforce				15
Total (excl. manager)				69

General Affairs Department	University graduates 5 year or 3 year course (S1) (D3)	Graduates of senior high school	Total
General Affairs	2	4	6
Personnel Affairs	1	1	2
Finance & Accounting	1	1	2
Information Management	1	2	3
Promotion & Public Relations	1	1	2
Technical Coordination	1	1	2
Maintenance of Equipment	1	1	2
Workforce			10
Total (excl. manager)			29
Grand Total			133

The details of the personnel structure of the Center classified by educational background are summarized as follows:

	Number of persons
- University graduate, S1	13
- Polytechnic graduate, D3	31
- Graduates of senior high school	63
- Others	30
Total	137

(3) Personnel training

During the establishment of the Center, training in such foreign countries as Japan and other countries for approximately five engineers per year would be required for testing and inspection, R&D and training instructor in metalworking.

(4) Foreign experts

For the purpose of providing supervisory and advisory services to the Indonesian personnel, it is required that foreign experts specializing in the various branches of metalworking technologies be stationed at the Center. While the number of such experts needed would decline year by year, more experts are required especially at the start-up of the Center in order to implement the technology transfer to the Indonesian personnel smoothly and intensively. The numbers of foreign experts by branches are described in Table 9.1-5.

Table 9.1-5 Number of Foreign Experts

Area of expertise	First year after start-up of the Center	Second year	Third year	Fourth year
Casting	2	1	1	1
Forging Heattreatment	1	1	1	1
Sheetworking Pressworking	1	1	1	1
Welding	1	1	1	
Plating	1	1		
Machining	2	1	1	
Mechanical testing Metallurgical testing	1	1		
Nondestructive testing	1	1		
Total	10	8	5	3

(5) Management organ of the Center

Regarding the internal management organs, the following are proposed:

1) Management board

As described in 9.3.1, (2), the Management Board is the highest decision-making organ of the Center.

2) Executive organ

The Director of the Center is the top executive of the Center in the implementation of the daily activities.

3) Executive meeting

It is proposed that the executive meeting consisting of the director and three managers of the departments would be held once a week. However, this meeting is not a decision-making organ. The purpose of the meeting is to discuss matters proposed by the Director, and the meeting is expected to contribute to better internal communications.

4) Staff meeting

For the purpose of the coordination of inter-departmental activities, it is proposed that Staff Meetings consisting of the Director, Manager(s) and Heads of the relevant sections be held monthly.

5) Foreign experts advisory committee

From time to time at the discretion of the Director of the Center, it is proposed that the Foreign Experts Advisory Committee consisting of the Director, and Manager(s) hold meetings to discuss and supervise the implementations of the projects undertaken by the Center.

9.2 Conceptual Design of the Facilities and Buildings for the Center

9.2.1 Outline

Based on services and functions required for the Center as analyzed in Chapter 7 and estimation of demand for services of the Center as analyzed in Chapter 8, area of the highest potential needs for services required for the Center was JABOTABEK. On assumption that a candidate site was JABOTABEK, a conceptual design of the Center was conducted as follows:

(1) Candidate construction site: JABOTABEK area

(2) Functions of the Center:
   1) Test and inspection,
   2) T/A and TR, and
   3) R & D for cultivating the metalworking industry

(3) Selection of machinery and equipment:
Machinery and equipment targeted at accomplishing the purpose of policies for domestic production of industrial products in Indonesia should be selected. (machinery and equipment necessary for Phase I as described later should be selected.)

(4) Design for civil and building works:
Design for civil and building works was conducted to make functions and selected machinery and equipment for the Center effective. Civil and building facilities should include necessary auxiliary facilities such as canteen, dormitory and the like. Space for machinery and equipment to be installed in the future should be considered.

(5) Construction schedule: Construction schedule necessary for the construction of the Center should be prepared on the basis of the existing state of the construction industry in Indonesia.
Conceptual design of the Center based on the design conception as mentioned above was as follows:

9.2.2 Candidate Site for the Center

The conclusion was reached that the construction of a new Center in the JABOTABEK area is the top priority, considering the total demand on the Center, as described in Chapter 8. However, because the JABOTABEK area is very expansive and the MOI does not have a site for construction of the Center, the JICA study team evaluated through field survey the National Center for Research, Science and Technology (PUSPIPTEK) located in Serpong City in the outskirts of Jakarta as the most suitable and favourable location for the Center, and selected it as the candidate site for construction of the Center.

(1) Location

PUSPIPTEK is situated in Serpong City, east Jawa area, about 27 km southwest of Jakarta. The Serpong area was selected as a candidate site for a commuters' town in Jakarta covering new city planning by BKSP JABOTABEK. The housing complex, which is under development along the Tangerang and Bogor Road linking Tangerang in the north and Bogor in the south, is scattered.
The distance from the heart of Jakarta to the candidate site is approx. 40 km. The shortest way to go to the candidate site from Jakarta is to go along the Jakarta-Merak Tollroad, exit at Tangerang Interchange, go south on Tangerang-Bogor Arterial Road, pass through the built-up area of Serpong and thus reach the candidate site.

Regarding transportation in the surrounding area, a few buses shuttle between Tangerang and Bogor, but there is no means of public transportation directly linking Jakarta. Merak Line in the JABOTABEK Railway System under the control of PJKA connecting Merak in the west coast of Jakarta runs through Serpong. This railway line is single-track, but a double-track line between Tanah Abang in Jakarta and Serpong is planned in parallel with the future city planning. This planned line is expected to be ready as a commuter train line in the early months of 1990.

There are seven airport facilities including the Soekarno Hatta International Airport within the 40 km radius from Jakarta, and a heliport is provided in the PUSPIPTEK complex.

(2) Outline of PUSPIPTEK

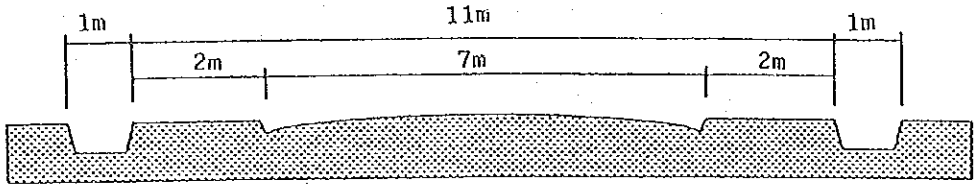
According to Presidential Decree No. 43, PUSPIPTEK was developed with a view to carrying out research and development on high technology modelled on the Tsukuba Academic City in Ibaraki Pref., Japan. Presently, a site area of 350 ha has been prepared, and further development of 150 ha is expected. An academic city will be developed in the future on the total site area of 500 ha, out of which 350 ha are the site for R & D in high technology industries, and the remaining 150 ha are the site for educational and training facilities. (Refer to Fig. 9.2-1.)
Laboratories within PUSPIPTEK established so far are as follows:

1) Aerodynamics, Gasdynamics and Vibration Laboratory (LAGG) (a BPPT facility)
2) Strength of Materials, Components and Structure Laboratory (LUK) (a BPPT facility)
3) Thermodynamics, Engine and Propulsion System Laboratory (LTMP) a BPPT facility)
4) Applied Electronics Laboratory (LET) (a LIPI facility)
5) Applied Chemistry Laboratory (LKT) (a LIPI facility)
6) Applied Physics Laboratory (LFT) (a LIPI facility)
7) Calibration, Instrumentation and Metrology Laboratory (LKIM) (a LIPI Facility)
8) Applied Metallurgy Laboratory (LMT) (a LIPI Facility)
9) Processing Technology Laboratory (LTP) (a BPPT Facility)
10) Multipurpose Reactor and its Supporting Laboratory (RSG-LP) (Batan Facility)

(3) Present condition of infrastructure improvement and future plan

1) Road

Roads indicated in solid lines, as shown in Fig. 9.2-1, show the existing roads. The sub loop in the northwest part of the existing ring road encompassing LKT, LFT and LKIM indicated by broken lines is the proposed road for the candidate site. The proposed road will have the following structure and will be constructed by PUSPIPTEK.



Road Profile

2) Water supply

Water of the Cisadane River flowing through the west part of the PUSPIPTEK complex from south to north is used as a source of water supply. After purification of the water (capacity: 100 ℓ/sec.), purified water is pumped up to an elevated water tank (height: 40 m, capacity: 600 m^3) in the central part of the complex.
The water quality conforms to the standards of WHO, meaning that the water in the area can be used as drinking water. As shown in Fig. 9.2-2, the water is distributed via a looping system of 200 mm dia. main water pipes from the elevated water tank, and water is stably supplied to each facility.
The main water pipe network is also used for fire fighting, and hydrants are installed at regular intervals.

3) Drainage

A communal wastewater treatment facility is not thoroughly constructed. After experimental drainage is treated in such a way to meet the standards of water quality for the Cisadane River, it is discharged from PUSPIPTEK to drainage water (open road ditch).

4) Gas

LPG is generally used in the PUSPIPTEK complex. The use of town gas is planned for the future, but its realization is a remote possibility.

5) Waste disposal

Papers, cloth and refuse are disposed of and incinerated at an incinerating facility within the PUSPIPTEK complex, and incombustibles are buried for disposal.

6) Electricity

As shown in Fig. 9.2-3, electrical power is supplied to each facility from a substation constructed by Perusahaan Umum Listrik Negara (PLN) within the PUSPIPTEK complex via embedded cables. It is possible to supply electrical power necessary for the Center through expansion from the existing distribution line.

Distribution system: 3-phase, 3-wire, 20 kV, 50 Hz, 2 loop lines

An outline of PLN's substation is as follows:

- Transformer capacity: 60,000 kVA x 2 Total 120,000 kVA
- Primary voltage : 500 kVA
- Secondary voltage : 20 kV

7) Telephone

A large-capacity private branch exchange (PBX) is installed within a telephone center in the PUSPIPTEK complex, and telephone lines are connected to each facility via embedded cables. Ten lines are provided for the new center's facilities. It is possible to extend the subscriber lines in and after 1990, as required.

The capacity of the PBX is as follows:

- Number of trunks : 360 (max.)
- Number of subscriber lines: 3,500 (max.)

(4) Reasons for selection of this candidate site

1) It was confirmed during the field survey that quite a few areas remained unused within the PUSPIPTEK complex site. PUSPIPTEK agrees to construct the Center in its unused area.

2) This candidate site is within the JABOTABEK area and within easy reach of Jakarta. If the transportation network is improved, it will be convenient for companies to utilize this Center.

3) Infrastructure is improved and the necessity of new public investment is small.

4) Related research facilities are so well-equipped as to facilitate joint R & D activities.

The selection of PUSPIPTEK as the candidate site for construction of the Center is recommended because there are many advantages as mentioned above.

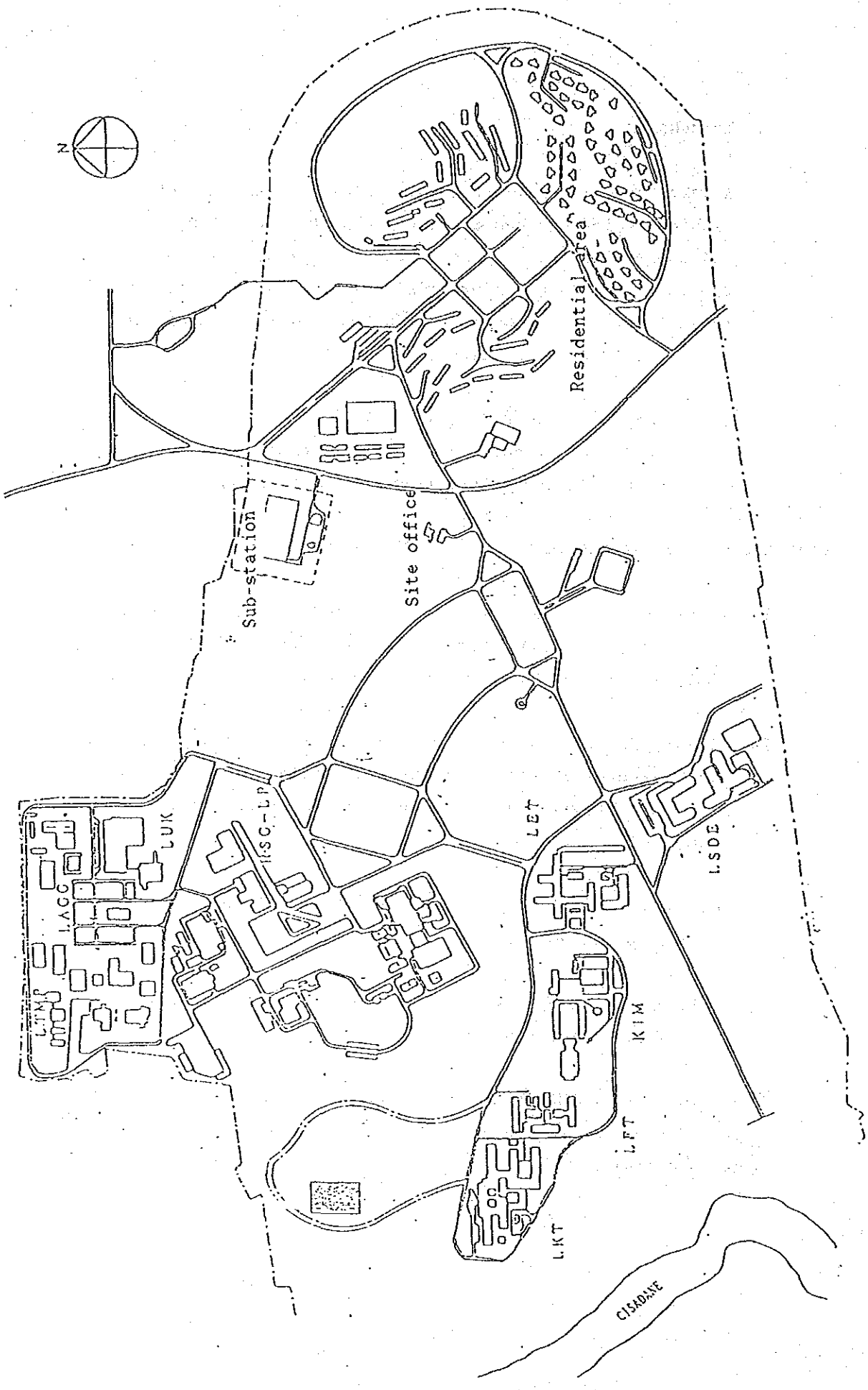


Fig. 9.2-1 PLOT PLAN OF PUSPIPTEK

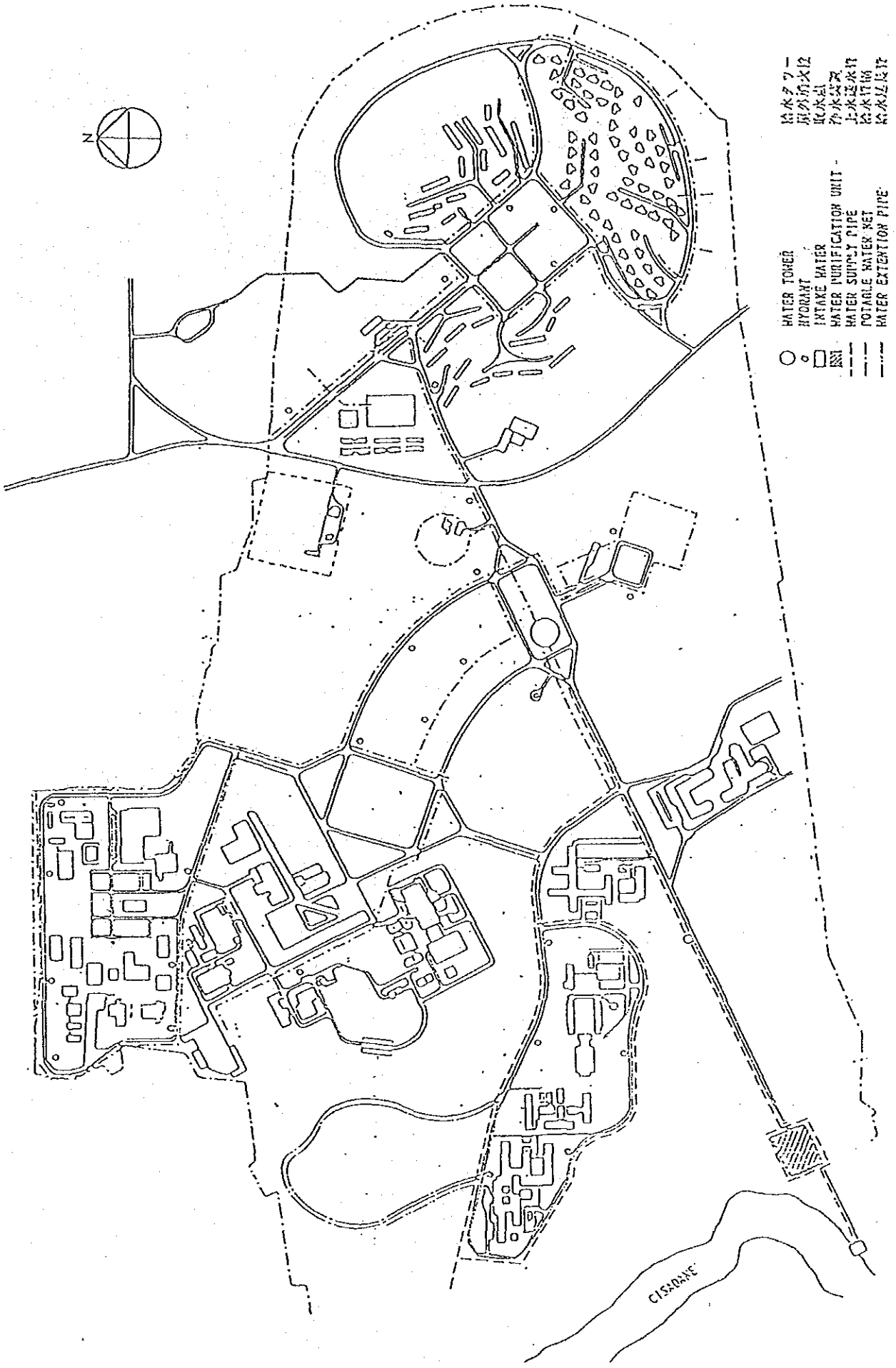


Fig. 9.2-2 MAIN WATER SUPPLY LINE

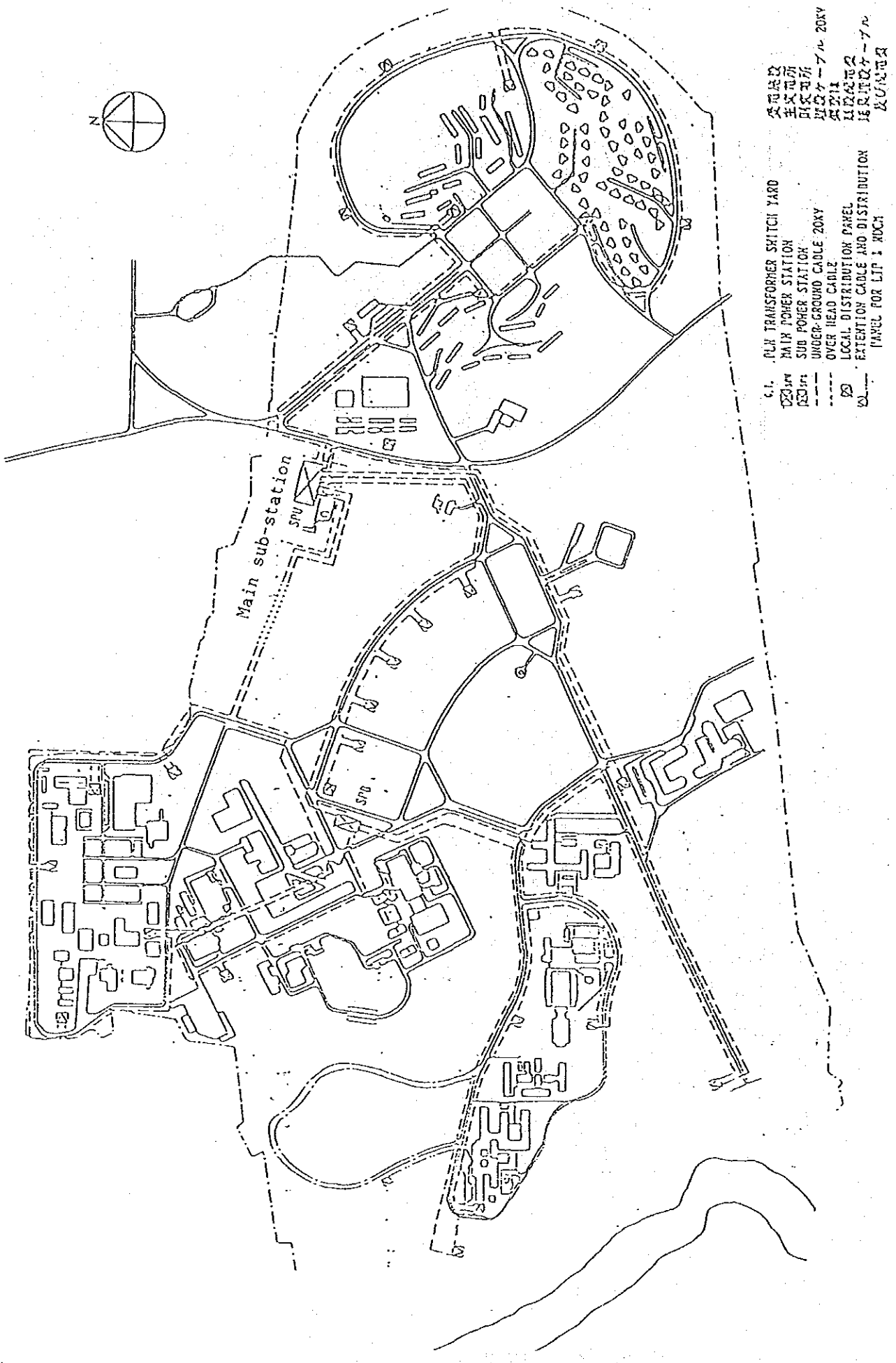


Fig. 9.2-3 MAIN ELECTRIC FEEDER LINE

9.2.3 Machinery and Equipment to be Installed in the Center

Functions required for the Center as described in Chapter 7 were studied, and kinds of main facilities to be installed in the Center were selected based on the following two criteria.

(1) Selection of newly required facilities

Considering the present technical problems in metalworking industry and the functional limitation of existing similar institutions, machinery and equipment are selected dividing into two phases, (Phase I is the first stage that basic facilities are to be installed. Phase II is the future stage that advanced facilities are to be installed.)

(2) Selection of facilities for accomplishing the deletion program

Facilities selected in Phase I were roughly identical with those selected in (1) and (2) as mentioned above. Therefore, detailed facilities to be installed in the Center were selected according to Phase I and also considering present technical level in Indonesia and future technological advance. Facilities thus selected are presented in Tables 9.2-1 (1) through 9.2-1 (11). Details of facilities to be installed are shown in Tables 9.2-1. Basic conceptions in each facility are described below:

1) Casting facilities

(i) Melting facility

i) High frequency induction furnace
(capacity: 200 kg)
Crucible furnace (capacity: 50 kg)
A high frequency induction furnace for melting cast iron and cast steel products and crucible furnace for melting aluminum and bronze will be installed to use for training melting technology and preparing molten iron for casting.

ii) Sand molding facility

Green sand molding machine
(flask size: 500 x 500 x 150 mm)
Sand mixer for CO_2 sand (capacity: 50 kg)
Shell molding machine
(flask size: 500 x 500 x 150 mm)
Self-hardening sand mixer (capacity: 1 ton/hour)
The above machines will be installed to make green sand mold and CO_2 sand mold used in Indonesia and to make shell mold and self-hardening mold that would popularize for the future, as the sand mold for cast steel, cast iron and nonferrous metal. Namely, training of casting technology and tests of prototype products related to new products as well as products nominated in the deletion program will be conducted.

(ii) Typical products (as an example)

Cylinder head, crank case, gear case, various frames, various parts for machine tools, fly wheel housing and fly wheel

2) Forging facilities

(i) Main facilities

i) Drop hammer (capacity: 2 ton)
A drop hammer will be installed to enable free forging and die forging.
A precision forging press that would be required for the future will be installed in Phase II.

ii) Trimming press (capacity: 200 ton)
A trimming press will be installed to conduct various tests and make experiments for various presswork.

iii) Heating furnace

A heating furnace will be installed to produce free forging products (200 O.D. x 1000 mm long).

(ii) Typical products (as an example)

Crank gear, connecting rod, crank shaft, cam shaft, various gears and shafts

3) Heat treatment facilities

(i) Main facilities

i) Quenching and tempering furnace, oil bath and water tank

These will be provided to conduct annealing and tempering of shafts having the size of 200 O.D. x 1000 mm long.

ii) Gas atmosphere furnace

This furnace will be installed to conduct carburizing and nitriding of products up to 200 x 200 mm.

(ii) Typical products (as an example)

Various cast steel, cast iron, forging products, and die

4) Sheetworking facilities

(i) Main facilities

i) 3-roll pyramid type plate bending machine

This machine for bending and forming the steel plate into cyllindrical shape (20 mm thick x 1,500 mm long) will be installed to conduct training and make prototype products related to bending and forming of parts for carbon steel, low alloy steel and stainless steel pressure vessels

ii) Press brake and shearing machine

These will be installed to bend the steel plate (13 mm thick x 3,000 mm long)

(ii) Typical products (as an example)

Parts for various pressure vessels, structural steel and various machines

5) Welding facilities

(i) Main facilities

i) Automatic submerged arc welder
(secondary output: 300 to 1,250 A)
This welder will be provided to conduct training of high efficiency welding of structural steel and pressure vessel.

ii) Automatic band arc overlay welding machine
(secondary output: 100 to 1,000 A)
To conduct training of high efficiency overlay welding such as stainless steel, etc.

iii) Automatic gas cutting machine
(max. 100 mm thick x 1,500 mm long)
This machine will be installed to conduct training of high efficiency cutting of steel plate.

iv) TIG and MIG welders
(secondary output: 20 to 30 A)
To conduct training of special welding such aluminum, titanium, etc.

v) Plasma arc cutting machine
(secondary output: 20 to 300 A)
To conduct training related to high speed cutting of iron and nonferrous metal.

(ii) Typical products (as an example)

Various pressure vessel, structural steel, exhaust pipe, fork, arm, fuel tank, etc.

6) Plating facilities

(i) Main facilities

i) Electroplating facility (FRP tank; 1,200 mm long x 600 mm wide x 600 mm high, control system with silicon rectifier 10 V/100 A and necessary accessories)
To conduct training of metal plating technology and testing of prototype products.

ii) Chemical plating facility (FRP tank; 1,200 mm long x 600 mm wide x 600 mm high temperature control system; heater power 8 kW x 2)
To conduct training of non-electroplating (nickel, etc.)

(ii) Typical products (as an example)
Various cover plates, pipes, ornaments, plastic parts, zinc-plated parts for corrosion protection

7) Machine tools

(i) Main machine tools

i) CNC machining center (table size: 900 x 400 mm)
This machining center will be installed to conduct training of automatic machining technology of parts having complicated shapes such as crank cases, etc.

ii) Gear hobbing machine (table size: 400 mm)
Rack cutting machine (table size: 300 x 1,120 mm)
Straight bevel gear grinding machine (table size: 146 mm)
These machine will be installed to conduct training of gear cutting technology.

iii) Universal grinding machine
(max. size of workpiece: 270 O.D. x 1,000 mm long)
Surface grinding machine (table size: 500 x 1,500 mm)

Superfinishing machine (max. size of workpiece: 60 x 1,000 mm long)
Honing machine (max. size of workpiece: 250 I.D. x 1,000 mm long)
These machines will be installed to conduct training of grinding, superfinishing and honing technology.

iv) Copy milling machine (table size: 400 x 1,400 mm)
Universal milling machine (table size: 350 x 400 mm)
These machines will be installed to conduct training of die making technology. However, electric discharge machine, electro-chemical machine and electrolytic grinding machine will be installed in Phase II.

(ii) Typical products
Crank case, gear case, cylinder head, various gears, connecting rod, die, etc.

8) Pressworking facilities

(i) Main facilities

i) Mechanical press (crank press) (capacity: 200 ton)
This press will be installed to conduct training of punching and bending and various tests.

ii) Hydraulic press (capacity: 500 ton)
This press will be installed to conduct training of drawing work technology and various tests.

(ii) Typical products
Various cover plates, panel box, fuel tank, oil filter, exhaust pipe, radiator parts and press drawing products

9) Testing and inspection facilities

(i) Main facilities

i) Mechanical property test

- Universal tester (capacity: 100 ton)
- Rotation bending fatigue tester (Ono type)

Various testing equipment of ordinary metal materials except for special tests such as K1C value measurement, creep and the like will be installed to conduct tests and issue inspection records.

ii) Physical and chemical property tests

- Scanning electron microscope (100,000 magnifications)
- Optical microscope (800 magnifications)
- X-ray diffractmeter (X-ray tube power: 2 kW)
- Direct reading spectrometer (simultaneous measurement of 32 elements)

These apparatuses will be installed to conduct analyses of chemical composition of various metal materials, issue inspection records, failure analyses of broken metal materials and test for improvement of production process.

iii) Non-destructive test

- Radiographic testing unit (output power: 1.8 kVA)
- Ultrasonic testing unit (portable type)
- Magnetic particle testing unit (yoke type)
- Penetration testing unit

The above ordinary non-destructive testing apparatuses will be provided to conduct training of inspection, testing of products and issue inspection records.

iv) Measurement

- Universal surface profile instrument (measuring accuracy: 10 μ to 600 μ)
- Universal gear tester (max. size of workpiece: 300 mm O.D.)
- Profile projector (10 to 100 magnifications, table size: 290 x 610 mm)
- Block gauge (accuracy: zero class, 103 pieces per set)

Dimensional measurement apparatuses will be provided to make measurement of products and issue inspection records. Block gauges and test bars will be provided to calibrate.

(ii) Typical products

All products produced in the Center and products requested by the outside companies

10) Audio visual facilities

(i) Main facilities

i) Seminar room system

Video display system (PAL, SECAH, NTSC), 16 mm film projector, 35 mm slide projector and overhead projector will be provided to conduct training and seminars.

ii) Potable video recording unit for producing video tapes for education

(ii) Typical services

Various education, training and seminars

Table 9.2-1 (1) Casting facilities

No.	Item	Q'ty	Installation purpose
C-1	Induction furnace	1	For melting cast iron, cast steel, alloy steel, etc.
C-2	Crucible furnace	1	For melting nonferrous alloy metal such as aluminum and bronze
C-3	Ladle	1 set	For conveying molten metal
C-4	CE meter	1	For carrying out simplified chemical for chemical composition analysis during the melting process
C-5	Pyrometer	1	For measuring temperature of molten metal
C-6	Ladle dryer	1	For drying ladles
C-7	Balance	1 set	For measurement of material weight
C-8	Tools, jigs, etc.	1 set	
C-9	Green sand molding machine	1	For molding green sand
C-10	Sand mixer for CO_2 sand	1	For mixing silica sand and water glass binder
C-11	CO_2 gas economizer	1	For supplying CO_2 in the sand mold
C-12	Shell molding machine	1	For molding shell mold sand
C-13	Sand conditioning unit	1	For supplying conditioned self-hardening sand
C-14	Sand reclamation equipment	1 set	For reclaiming used sand
C-15	Flask, etc.	1 set	

No.	Item	Q'ty	Installation purpose
C-16	Sand testing apparatus		
	Sand rammer	1	For making sand mold test pieces
	Permeability tester	1	For measurement of permeability of sand molds
	Ro-tap sieve shaker	1	For measurement of sand grain distribution
	Moisture indicator	1	For measurement of water content in the sand mold
	Universal sand tester	1	For measurement of compression of the sand mold
	Mold hardness tester	1	For measurement of surface hardness of the sand mold
	Others	1 set	
C-17	Shot blast machine	1	For cleaning the surface of the casting by spraying a fine metal grit and removing the scale
C-18	Wood lathe	1	For making a wood pattern for the casting
C-19	Planer	1	For cutting the surface of the wood
C-20	Band saw	1	For cutting the wood
C-21	Router machine	1	For shaping the surface of the mold
C-22	Surface plate	1	For determining the standard level for machining parts
Phase II			
C2-1	Sand blasting		For cleaning the surface of the non ferrous casting by spraying a fine sand
C2-2	Grinder	1	For surface finishing
C2-3	Heat treatment furnace	1	For heat treatment of casting
C2-4	Precision casting equipment	1 set	For study of precision casting

Table 9.2-1 (2) Forging facilities

No.	Item	Q'ty	Installation purpose
F-1	Batch type heating furnace	1	For heating the material for softening before forging
F-2	Drop hammer	1	For forming the heated and softened material
F-3	Trimming press	1	For punching out the flash generated by die forging
F-4	Thermometer	1	For measuring temperature of the material
F-5	Others (tools and jigs)	1 set	Tools for fixing the material when forging, and jigs for forming
Phase II			
F2-1	Conveying system	1 set	For transporting materials
F2-2	Rotary heating furnace	1	Automatic heating furnace
F2-3	Cold forging press	1	For forging of room temperature mild steel