

**BASIC DESIGN STUDY REPORT  
ON  
THE ESTABLISHMENT PROJECT  
OF  
THE METAL-WORKING AND MACHINERY  
INDUSTRIES DEVELOPMENT INSTITUTE  
IN  
THE KINGDOM OF THAILAND**

**JULY 1985**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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## PREFACE

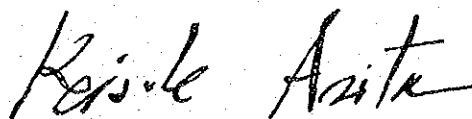
In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a Basic Design Study on the Establishment Project of the Metal-working and Machinery Industries Development Institute and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Thailand a study team headed by Mr. Kazutoshi Iwanami, Head, Basic Design Division, Grant Aid Department, JICA from January 14 to February 2, 1985.

The team had discussions on the project with the officials concerned of the Government of the Kingdom of Thailand and conducted a field survey in Bangkok area in Thailand. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between the two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

July 1985

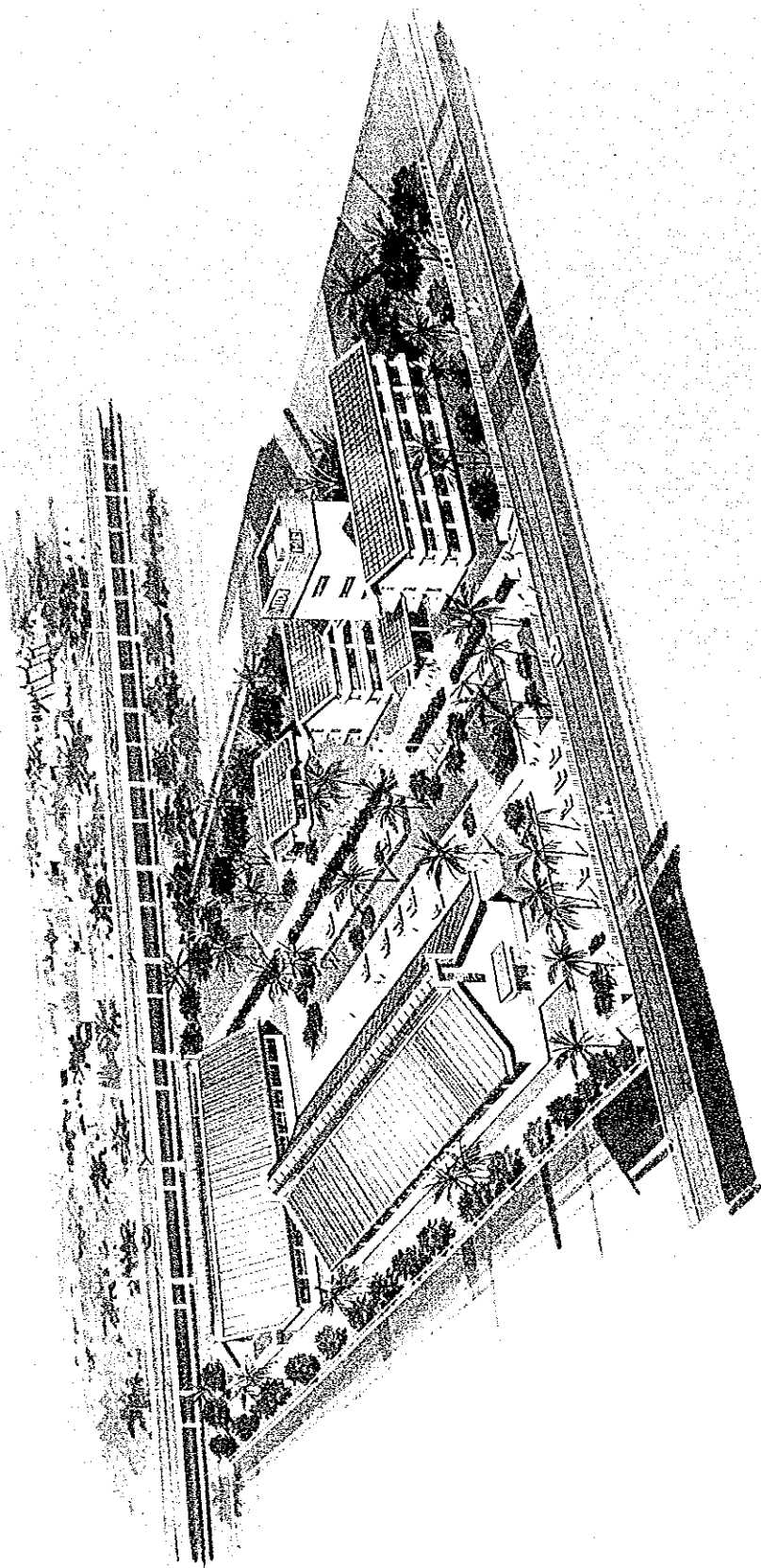


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Keisuke Arita  
President

Japan International Cooperation Agency

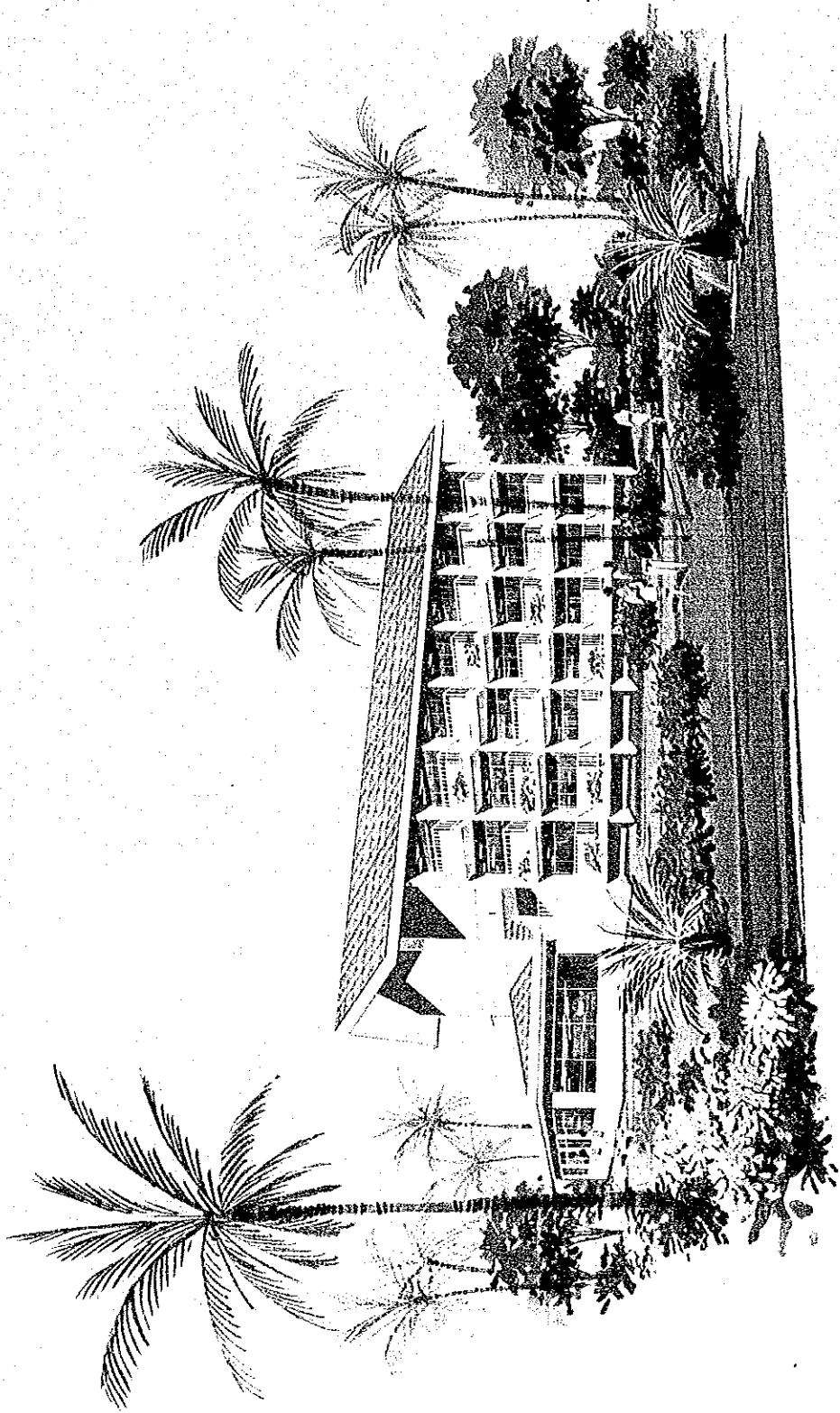




SITE A BIRDSEYE VIEWS

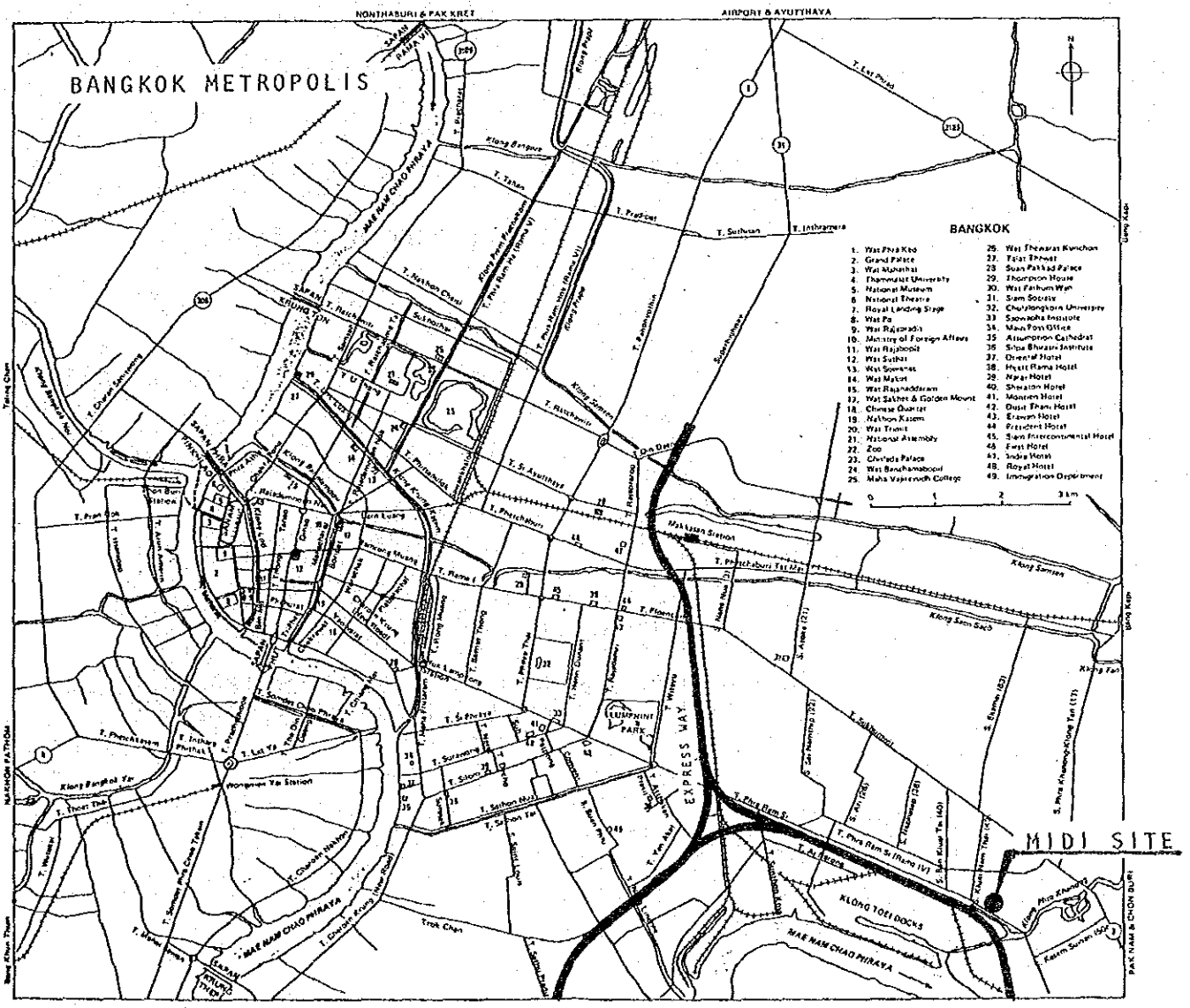
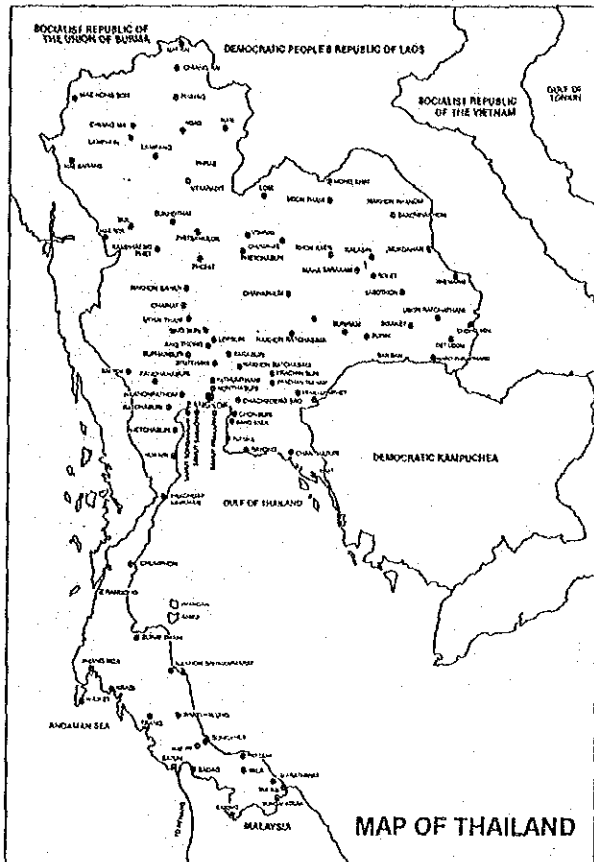






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## SUMMARY



## SUMMARY

### A. BACKGROUND

The Kingdom of Thailand, being endowed with fertile land and favorable climate, has originally been an agricultural country. The pattern of its economy has been exports of agricultural products and imports of industrial products. In recent years it has made remarkable efforts to advance industrialization to accelerate economic development. Its light industries, as a result, have developed remarkably, and the country is now relatively self-sufficient in regards to most consumer goods.

In order to establish a sound basis for economic development, the country has implemented four Five-Year National Economic and Social Development Plans since 1961 while adjusting its policy lines on each occasion. Its industrialization policy to promote import substitution, however, has had to rely on imports of capital goods, raw materials, intermediate goods and energy, etc., and because of these imports, a chronic trade deficit by an excess of imports over exports has prevailed.

Since the world-wide oil shock of 1973, capital investments in Thailand by foreign interests has decreased, and has been a cause of decreasing the speed of her development.

Concentration of import substitution industries into the metropolitan area has generated inequity in income distribution accompanied by an increase of unemployment in rural areas. Though a rapid economic growth of the metropolitan area has been achieved, the development of other regions of the nation is retarded.

The Government, as a result, is reorganizing its industrial sector to match the economic conditions of the country and the changes in the world economy.

In order to remedy these socio-economic imbalances, the Government of Thailand, in its Fifth Five Year Plan (1982 - 1986) places priority on the promotion of export industries with the aim to improve economic

efficiency. It has designated the key industries to be developed under these plans. It has also formulated plans to decentralize industries to rural areas to promote employment and living conditions in areas other than those of the cities.

The metal-working industries form the foundation of these key industries. They are composed mostly of medium and small scale enterprises which are still being run by pre-modern methods, using obsolete facilities and equipment. Their levels of production efficiency and product quality are not mostly well developed, while production costs are relatively high. Systematic subcontracting system with large scale enterprises has not yet been organized.

#### **B. ESTABLISHMENT OF AN INSTITUTION TO PROVIDE TECHNICAL GUIDANCE TO THE METAL-WORKING AND MACHINERY INDUSTRIES**

At present, there is no specialized institution dedicated to the promotion of the metal-working and machinery industries in Thailand. Since the establishment of such an institution is impossible without the assistance of the government, the Government of Thailand is planning to establish the Metal-working and Machinery Industries Development Institute (MIDI) under the jurisdiction of the Department of Industrial Promotion, Ministry of Industry.

MIDI is to be positioned between the academic institutions and the vocational training schools or technical colleges with the aim to offer practical technical guidance especially to technicians, craftsmen and entrepreneurs of medium and small scale metal-working industries. It is also to carry out researches and development of appropriate products, production technique, marketing and managerial technologies, etc. Entrusted jobs for private firms and trial productions will also be performed to support medium and small-scale enterprises.

### C. REQUEST TO JAPAN FOR ASSISTANCE AND COOPERATION

The Government of Thailand is requesting the grant aid and project type technical cooperation from the Government of Japan in establishing the MIDI. In response to this request, the Government of Japan decided to study the project, and the Japan International Cooperation Agency (JICA) dispatched a Study Team to Thailand in January 1985 to confirm the background and contents of the assistance requested, and conducted the necessary surveys for a basic design. After returning to Japan, the Team had a series of discussions with parties concerned on such items as viability, optimum scale and grade for the proposed project as well as its operation and management system, cooperation effect, etc. Then such results have been compiled into the Basic Design Study Report centering upon the machinery, equipment and buildings for the Institute.

### D. CONTENTS OF THE BASIC DESIGN

Major machinery and equipment proposed to be provided are as follows:

#### 1. MACHINERY AND EQUIPMENT

- a. Audio-visual educational equipment
- b. Materials testing and inspection equipment
- c. Equipment for information and data processing and for public relations activities
- d. Foundry equipment
- e. Machine working equipment
- f. Welding equipment
- g. Heat treatment equipment
- h. Low-cost automation equipment
- i. Forging equipment
- j. Plating and waste-water treatment equipment
- k. Die and mold testing equipment

## 2. BUILDINGS

### a. Main Building

RC construction, three-storied, one building, 2,944.4 m<sup>2</sup>

### b. Workshops

Steel construction, partially with mezzanine,  
two buildings, 3,937.0 m<sup>2</sup>

### c. Utility Building

RC construction, one story, four buildings, 92.0 m<sup>2</sup>

### d. Dormitory

RC construction, three-storied, one building, 815.0 m<sup>2</sup>

### e. Canteen

RC construction, one story, one building, 186.0 m<sup>2</sup>

Total 7,974.4 m<sup>2</sup>

## 3. PROPOSED SITE

The proposed site for this Institute is within the 25,000 m<sup>2</sup> of land under the possession of the Ministry of Industry, located south of Soi 42 (Kluaynamthai), Rama IV Avenue, Bangkok City.

Removal of existing obstacles on the site, and provision of earthfill to bring the level of the site to an appropriate height are to be executed by the Government of Thailand prior to the implementation of this project.

Such infrastructural facilities as electric power supply, water supply and drainage are already existing at the site.

## 4. EXECUTION SCHEDULE

The period required for executing the detail designs and to perform the construction and equipment work of this project is estimated as 21 months after Exchange of Notes between the two countries.



## 5. ADMINISTRATIVE AND OPERATIONAL EXPENSES

Expenses necessary for administration and operation of this Institute after its completion are estimated at approximately ¥104,512,000 or 11,360,000 Baht per year. These expenses are to be provided for by the budget of the Department of Industrial Promotion, Ministry of Industry.

## E. SIGNIFICANCE OF THIS PROJECT

When this project is implemented, it will become possible to provide technical and managerial training and guidance to nucleus technicians, craftsmen and entrepreneurs of medium and small scale enterprises of the metal-working and machinery industries.

Regional medium and small scale enterprises will also be able to send their representatives to attend courses offered by the Institute by virtue of the existence of a dormitory.

By development of technologies and managerial capabilities, the metal-working and machinery industries will be better prepared to serve other key industries. Production of metal products by improved technology and management, key industries will increase their competitive strength in international markets. This will help improve the present imbalance of trade which the country faces, and thus contribute to the fostering of the economy and welfare of Thailand.

## F. RECOMMENDATIONS

It is recommended that, after completing the physical aspects of this project, a follow-up by technical cooperation from Japan is most desirable for the operation of the Institute. Positive and continuous efforts of the Government of Thailand to secure and maintain qualified local staff, both qualitatively and quantitatively, will be most essential for the successful operation and utilization of the facilities. Needless to say, it will be necessary to continuously secure appropriate annual budgets for the administration and operation of this Institute.



**CHAPTER ONE**  
**INTRODUCTION**



## CHAPTER ONE INTRODUCTION

### A. BACKGROUND OF THE PROJECT

Thailand has been a typical agricultural country engaged primarily in the production of rice. It has, however, been the basic policy of the Government of the Kingdom of Thailand to steer the nation towards industrialization in order to promote its economic development. In 1953, it enacted the National Enterprise Establishment Law, and in the following year the Industrial Investment Promotion Law was adopted to promote its industrialization policy under government leadership. Many national enterprises were established during the following years under this law.

Needs for higher efficiency, however, were keenly felt in many of the national enterprises to alleviate financial burdens on the government.

In order to remedy this situation, the Government of Thailand, acting on the advice of the World Bank, established the National Economic and Social Development Board in 1959 with the objective of promoting industrialization under private leadership. The First Five-Year Economic and Social Development Plan (1961 - 1966) was formulated and implemented. Conditions necessary for the industrialization of the private sectors were steadily provided under this plan, and much improvement was made in the improvement of the infrastructure of the nation.

In the ensuing Second Five-Year Plan (1966 - 1971), priority was given to enlarging the productive capacity of the manufacturing sector. Emphasis was placed on the reformation of the economic structure, increase of national income, promotion of vocational training, promotion of the use of domestic raw materials, etc. The Industrial Investment Law was also amended to give priority to the private enterprises, to foster import substitution industries and to aggressively induce foreign capital, etc.

One of the consequences was an imbalance in trade accounts due to increased imports of capital goods, intermediate products and raw materials. Higher production costs when compared to international

prices except some of the competitive products, were also experienced due to the small scale of production which was oriented toward the domestic market. A decline in international competitive strength of these products exacerbated the economic conditions of the country.

In the Third-Five-Year Plan (1972 - 1976), industrial policy placed emphases on the improvement of the industrial structure, redressing of social distortions, redressing of unequal income distribution and improvement in the quality of labor in order to solve the various issues that had arisen from the industrial policy oriented toward import substitution.

Due to the impact of the oil crisis of 1973, however, investment from overseas decreased. This prevented the private sector from realizing its plans of establishing big businesses like petrochemicals, iron and steel, machine tool industries, etc. Economic growth and advances in industrial technology were stunted, and this condition can be said to be prevailing to this day.

The Fourth Five-Year Plan (1977 - 1981) attempted to raise the share of the industrial sector in the national GDP to the same level as that of the agricultural sector. This was necessary to emerge from an agricultural country into an industrial country. Various measures were taken to remedy the problems that had arisen so far, but due to the fact that the industrial structure was highly dependent on imports for raw materials, intermediate materials, capital goods and energy, and because of the relatively poor quality and high production cost of the industrial products made by inefficient methods in small quantities, their competition as export merchandise on the international market was weak. This brought about an excess of imports over exports for the nation, and the trade deficit due to unbalanced trade became chronic.

The immediate task was now, to take policy measures to rectify this problem by promoting the export industries.

The Government of Thailand, therefore, in its present Fifth Five-Year Plan (1982 - 1986) places emphasis on the promotion of export industries by adopting the following policies to develop her key industries:

- 1) fostering of export industries
- 2) promoting decentralization of industries and furthering employment
- 3) improving economic efficiency

The Government has placed priority on agro-industries, chemical industries, heavy industries and metal-working industries to be developed in accordance with the foregoing policy.

## B. ACTUAL SITUATION OF THE METAL-WORKING AND MACHINERY INDUSTRIES

Although the metal-working industry is a very basic industry indispensable to all other industries on which priority has been given in its Fifth Five-Year Plan, and in spite of its vital importance to the those industries, the state of the industry falls far short of what is required of in terms of its level of technology and productivity. The improvement of the metal-working industry is therefore most important and ranks top in priority.

Another fact is that ninety percent of the metal-working industries are medium or small scale enterprises. Furthermore, subcontracting of these medium or small scale enterprises by the large-scale enterprises is not yet systematized, and a large technological gap exists between the large-scale enterprises and these medium and small scale ones.

The level of medium and small scale metal-working industries must by all means be raised in all respects, such as their organization as an industry, individual management and technology. These industries, however, lack the strength and capabilities of their own, both collectively and individually, to develop to the extent required of by the nation.

The establishment by the government sector of an institution for metal-working and machinery where nucleus technicians, craftsmen and proprietors can be given technical and managerial guidance is, therefore, strongly sought for.



**C. ESTABLISHMENT OF THE METAL-WORKING AND MACHINERY INDUSTRIES DEVELOPMENT INSTITUTE**

In view of the very urgent need for a specialized organization for the promotion of the metal-working and machinery industries in Thailand, and since the establishment of such an organization would be impossible without government assistance, the Government of Thailand is planning to establish the Metal-working and Machinery Industries Development Institute (MIDI) under the jurisdiction of the Department of Industrial Promotion, Ministry of Industry.

It is envisioned that MIDI is positioned between academic educational institutions and vocational training institutes. Its objective is to carry out practical technical guidance, managerial guidance, technological research and development. Emphasis is to be placed on the training of nucleus technicians, craftsmen, managers and entrepreneurs of medium and small scale metal-working enterprises.

#### D. REQUEST TO JAPAN AND DISPATCHING OF BASIC DESIGN STUDY TEAM

The Government of Thailand has requested to the Government of Japan assistance in grant aid form and for project-type technical cooperation in establishing and operating the Metal-working and Machinery Industries Development Institute.

In response to the request of the Government of Thailand, the Government of Japan has decided to study the project, and the Japan International Cooperation Agency (JICA) has dispatched a basic design study team to Thailand.

The Basic Design Study Team was headed by Mr. Kazutoshi Iwanami, Head of the Basic Design Division, Grant Aid Department of JICA. The Team visited Thailand for a 20-day period from January 14, 1985. The members of the Study Team and its itinerary in Thailand was as set forth in Appendixes I and II.

Investigations were made by the Study Team with the cooperation and assistance of the Government of Thailand. Discussions were held with the authorities of the Government of Thailand whose names are as listed in Appendix III. Minutes of the Discussions (Appendix IV) were signed on January 24, 1985 between Mr. Kazutoshi Iwanami, Team Leader and Mr. Visith Noiphan, Director General, Department of Industrial Promotion, Ministry of Industry to confirm mutual understandings on the discussions and investigations.

The Study Team after return to Japan, held a series of discussions with parties concerned, and after a thorough and exhaustive study of the optimum scale and grade for the Institute, and after looking into the problems which would persist when this project is implemented under the grant aid program of Japan, a basic design and implementation schedule for machinery, equipment and buildings has been prepared in the form of this Report.

The Study Team has visited Thailand for seven days from July 3, 1985 to explain the draft of this Report, and the contents of the proposed basic design were confirmed by both the authorities concerned of the Government of Thailand and the Study Team.

**CHAPTER TWO**  
**BACKGROUND OF THE PROJECT**



## CHAPTER TWO BACKGROUND OF THE PROJECT

### A. GENERAL SOCIO-ECONOMIC CONDITIONS

#### 1. OUTLINE OF THE THAI ECONOMY

Thailand during the 19th century until World War II had grown as a typical agricultural country engaged primarily in the production of rice. By the end of the 1960s, however, the economy exhibited a remarkable growth as will be discussed later. This growth was attributable mainly to the following factors.

- a. Under the recommendation of the World Bank in 1959, efforts were made to expand and improve infrastructure facilities such as electric power and road networks which not only laid the foundation for industrial development but also resulted in contributing to increased agricultural production.
- b. Attempts were made to diversify agriculture from the conventional dependence on rice to cassava, hemp, maize, sugar cane, etc. which eventually became the nation's important products. They not only contributed to improving the farmers' income as cash crops but to foreign currency earnings as important export products.
- c. By the Industrial Investment Promotion Act of 1962, a departure was made from the industrialization policy under the leadership of state-owned enterprises. This was replaced by an aggressive foreign capital inducement policy under private leadership, by which various privileges were given to foreign enterprises coming into Thailand. As a result, foreign enterprises made spectacular entries into Thailand. Although the pace of industrialization which aimed for import substitution was moderate and centered mainly on the light industries, it is considered to have been a wise choice considering Thailand's technical level and capital resources.

The Thai economy which thus enjoyed steady growth during the 1960s, however, encountered considerable difficulties after the turn of the 1970s as a result of the oil crises that took place twice and the loss of the Indochinese market. Although it had somehow managed to tide over its international balance of payments crisis in the aftermath of the first oil crisis, thanks to the favorable international market prices of primary products including agricultural produce then current, the trading terms have since deteriorated due to the impact of the worldwide recession, softening of the prices of agricultural products and rising prices of industrial raw materials and supplies. The latter 1970s were difficult years for Thailand who was faced with a slowdown in economic growth rate, soaring inflation and a growing trade deficit. After the turn of the 1980s, however, it recovered its economic growth rate owing to years of good harvest in major agricultural products, a satisfactory growth of its processed agricultural products and a favorable market for transportation equipment, apparel and textiles.

The continuous years of good harvest however have brought about declines in farm income and domestic purchasing power due to excessive domestic supply of agricultural products coupled with a decline in international market prices for primary products. As a result, in spite of the fact that inflation is subsiding, a sense of recession prevails domestically, and the unemployment problem is beginning to assume serious proportions.

The Fifth Five-year Economic and Social Development Plan, which having made its start under such circumstances in October 1981, envisages Thailand as an industrial nation; that is, it aims for its conversion from an agricultural country to an industrial country and to enhance the ratio of industrial products in its export pattern. The plan basically aims at making its economy self-supporting in order to cope with the changes in the world economy and to convert its economic structure for that purpose.

The plan makes the following policy recommendations with respect to the manufacturing industry.

- (1) Implementation of an overall investment promotion measure
- (2) Reduction or exemption of import duties, etc. for specified industries
- (3) Export promotion measures
- (4) Fostering of small and medium scale industries
- (5) Foreign capital inducement
- (6) Development of basic industries in the eastern seaboard industrial zone

These recommendations for the most part are not new, having been proposed time and again before the Fifth Plan. The scheme for basic industries in the eastern seaboard industrial zone, however, is the Fifth Plan's new principal project. The plan attempts to decentralize the nation's economic activities, inclusive of this scheme, mainly to core provincial cities.

## 2. NATIONAL INCOME

Despite the difficulties encountered as above, the Thai economy has managed to achieve steady growth since the first economic development plan of 1961. This growth is well represented in its average annual growth rates of GDP, as follows:

1st Plan (Jan. 1961 - Sept. 1966)	7.3%
2nd Plan (Oct. 1966 - Sept. 1971)	7.2%
3rd Plan (Oct. 1971 - Sept. 1976)	6.2%
4th Plan (Oct. 1976 - Sept. 1981)	7.4%
5th Plan (Oct. 1981 - Sept. 1986)	6.6% (projected)

The factors which led to the steady growth are the relatively stable political situation that prevailed for an extended period, the diversification of agriculture, the increase in industrial production accompanying the progress of import substitution industries, free trade policy, etc.

On the other hand, there have been some adverse factors, too, such as the slump in agricultural production due to unseasonable weather, the softening in the prices of primary products, the growth of imports of raw materials and capital goods accompanying industrialization and the resultant increase in trade deficit, the inflation that rampaged in the aftermath of the oil crises and the reduction in investment due to high interest rate. But despite these, the Thai economy can claim to have followed a development process that compares favorably with other countries.

The per capita national income has increased steadily since the turn of the 1960s - doubled during the decade, trebled during the 1970s and reached about \$758 by 1981. The gap however is still large compared to the per capita national income in Singapore (\$5,118) and Malaysia (\$1,840). Despite the emphasis on the policy of redressing income disparity between provinces and cities, the disparity tends to expand rather than contract. When income in the Bangkok metropolitan area is considered as 100, it is a mere 13.4 in the northeastern region where the income is the lowest.

### 3. PRICES, EMPLOYMENT ENVIRONMENT AND WAGES

The consumer prices in Thailand prior to the 1st oil crisis had been stable enough, having been on a slowly rising trend. The first oil crisis, however, pushed the prices up by 15.6% in 1973 and by 24.3% in 1974, and the second oil crisis in 1979 caused a two-digit price inflation during 1980 and 1981. The rate of rise in most other years, however, has been contained within one digit.

As above, the price of oil has exerted a large impact on consumer prices which may be said to have manifested the nation's sore spot of having to rely on oil for most of its energy sources. Since 1982, however, partly owing to the stable price of food, the growth rate of consumer prices has sharply dropped.



The employed population in 1980 was approximately 22.7 million which accounted for 48% of the total population. The number of the fully unemployed was 210 thousand which represented an unemployment ratio of 0.9%. The percentage ratio of those engaged in agriculture, forestry and fisheries was overwhelmingly large at 70%, and the ratio of those engaged in each of commerce, services and manufacturing was relatively high on the 8% mark. The average annual growth rate of the employed population as a whole was 1.9% in the 1960s and 3.1% in the 1970s, but reflecting the impact of industrialization, the employed population in the manufacturing industry increased by 3.8% in the 1960s and by 10.1% in the 1970s, while those in agriculture, forestry and fisheries, mining and quarrying leveled off, then decreased. In terms of percentage composition by sex, the ratio of female workers was large, ranging between 47 to 48%.

Because an overwhelming number of people are engaged in agriculture, forestry and fisheries, proprietors and family workers account for a large proportion of the working population. Lately, however, the number of employed workers is increasing. In 1980, civil servants and state enterprise employees numbered 1.19 million. Private enterprises employed 3.73 million, most (81%) of them being unskilled labors with little education.

The rate of the totally unemployed is low at 0.9%, but the rate of the underemployed is high, and is developing into a serious social problem because of the inflow of these people from the rural areas into urban areas. The Fifth Five Year Plan estimates a growth of 2.7% a year on average in labor force during the 1982-1986 period which means that new employment opportunities must be created for 600 thousand to 700 thousand people a year. As measures for employment promotion, it emphasizes the increase in employment in the agricultural sector by its diversification, the promotion of labor intensive industries, the promotion of employment abroad, etc.

The wage level in Thailand is generally low since the employment demand in the modern industry sector is limited and most of the employed are unskilled workers. However, the sharp rise in consumer prices in 1973 led to a sharp rise in the cost of living followed by a progress in democratization and organization of labor unions, the adoption of the minimum wage system, etc. which resulted in a considerable improvement in the wages of particularly the modern sector.

#### 4. FOREIGN TRADE AND BALANCE OF INTERNATIONAL PAYMENTS

Thailand's foreign trade policy on exports and imports allows free transaction as a rule, but from the viewpoint of protecting domestic industry and maintaining domestic production, it requires that a permit be obtained from the Government for exports and imports of specified articles. It also enforces control on imports and exports by its tax system - by levying tariff and business tax on each merchandise. It has so far balanced its international payments account by making up for the chronic trade deficit with the surplus on capital account. The fact that its export merchandise have been mostly agricultural products and minerals which are susceptible to the depression in the international commodity market while its imports have mostly consisted of crude oil (which have accounted for around 30% of total imports), industrial raw materials and capital goods, the prices of which have sky rocketed since the soaring of crude oil prices, seemed to have been the cause of its trade deficit.

In contrast, its balance of invisible trade has been favorable with the ratio accounted for by the tourism income being particularly large. However, the burden of interest payments due to the increase in foreign debt tends to expand annually. The debt service ratio of foreign debts was still sound at around 15.5% as of 1981, but the foreign debts incurred by the government has since increased yearly, and as of April 1984 the ratio has risen to 54% and then further to 56% in October 1984. The Thai Government is therefore putting in much effort to curb imports and reduce the fiscal deficits.

As mentioned before, agricultural products (rice, cassava, raw rubber, sugar, maize) and tin still collectively account for more than 50% of total exports, but their combined weight has been on a consistently declining trend while the growth of industrial products such as textile goods has been remarkable, which is clearly an indication that diversification of export products is in progress.

As for export destinations, the shares of such neighboring countries as Singapore, Hong Kong, Malaysia and Indonesia are high next to those of the advanced countries such as Japan, the Netherlands and the United States.

As for imports, the weight of consumer goods is decreasing accompanying the growth of import substitution industries. The shares of raw materials, intermediate goods and capital goods, on the other hand, are rising. Particularly, the rise in the share of crude oil and petroleum products is spectacular, and although signs of a slight decrease has been witnessed since the commercialization of natural gas from the Bay of Siam, they still account for nearly 26% of total imports (in 1981). As import sources, the shares of Japan, the United States, West Germany and Saudi Arabia are high. Especially Japan accounts for a quarter of total imports.

## B. INDUSTRIAL PROMOTION POLICIES AND PREVALENT STATE

### 1. INDUSTRIAL POLICIES AND THE PROCESS OF INDUSTRIALIZATION

The process of industrialization in Thailand may be divided into the following five stages.

#### a. The First Stage (1945-1960)

The industrialization policy based on the National Enterprise Establishment Law (1953) and the Industrial Investment Promotion Law (1954) was adopted under government leadership, and by this policy more than 100 enterprises were established in the field of paper and pulp, spinning, cement, sugar, gunny bag, etc. mainly as national enterprises.

Also, despite the fact that various privileges, protection and other preferential measures were given to such industries as metal products, sugar manufacture, gunny bag, spinning, pharmaceuticals, ceramics, etc. so as to encourage industrial investment and induce foreign capital, no substantial results were achieved. Under such circumstances, an investigation of the economic situation in Thailand was carried out in 1959 by the World Bank Survey Mission. The Survey Mission's recommendation ruled out an industrialization process led mainly by the national enterprises and suggested instead that economic development be promoted according to the principle of competition led by private capital including foreign capital. In response to this, the government inaugurated the National Economic Development Board in 1959 and began mapping out its First Six Year Economic Development Plan and also established the Board of Investment.

#### b. The Second Stage (1961-1971)

The span of 11 years covering the First Economic Development Plan (1961-1966) and the Second Economic Development Plan (1966-1971) corresponds to this stage.

In response to the aforementioned recommendation of the World Bank, the First Economic Development Plan was formulated with emphasis placed on improving the productivity of the agricultural sector and on industrialization under private leadership. The government gave all its efforts to ready various conditions necessary for industrialization of the private sector and to improve the necessary infrastructure. As a result, the country was able to achieve an annual average growth in GDP of 8% against its initial target of 5.5%. The growth of its electric power and agricultural sector was also spectacular.

The ensuing Second Economic Development Plan maintained the same keynote of the First Plan but placed particular emphasis on expanding the production capacity of the manufacturing sector. Emphases were also placed on promoting changes in the industrial structure, creation of employment opportunities, increase in national income, reduction of income disparity among different regions, promotion of education and vocational training, promotion of the use of local raw materials, etc.

As the target values to be attained in the Second Plan were set too high in every aspect, many of them were not achieved. However, the target GDP growth rates of key industrial sectors such as agriculture, manufacturing, electric power, and water works were successfully achieved. The achieved growth rate of per capital national income however was 3.9% against the planned target of 5%.

In the meanwhile, the aforesaid Industrial Investment Promotion Law was amended drastically in 1962 which, in the years up to 1972, played the leading role in the industrialization of Thailand by establishing the priority of private enterprises, developing import substitution industries and actively inducing foreign capital.

The industrialization policy throughout this stage was, in short, aimed at mainly nurturing import substitution industries of consumer goods.

c. The Third Stage (1972-1976)

The period covered by the Third Social and Economic Development Plan corresponds to this stage. It is the period in which a shift of emphasis was made from economic development to social development - the period in which Thailand had hammered out its decision to switch from its policy which had been oriented toward high growth to a policy of stable growth in order to correct the various problems that had arisen under its industrial policy for import substitution of mainly consumer goods.

The industrialization policy up to this stage was not predicated on future exports but was mainly aimed at import substitution by promoting local production of consumer goods by inducing foreign capital.

Because of this, such evils as;

- (1) aggravation of the trade imbalance due to imports of capital goods, intermediate products and raw materials
- (2) decline in international competitive strength due to higher production cost by comparison to the international price as a result of production being oriented toward the domestic market by small-scale production facilities

were brought about, and these coupled with the depressed prices of primary products, the reduction of U.S. Army special procurement, etc. exacerbated the national economic environment.

In order to improve the situation, the Third Development Plan placed its priority on the improvement of production pattern and the correction of social distortions and income distribution through policy conversion from high economic growth to stable growth with emphasis on improvement of labor quality. The goals of its industrial policy were specifically:

- (1) Reduction of production cost of existing export products to acquire competitive strength in the international market
- (2) Promotion of labor intensive industries with low contents of imported input and high usage rate of local raw materials such as construction, agro-industry, food and processing.
- (3) Promotion and cost reduction of industrial products which are being produced in excess of domestic requirements and which are therefore available for exports: Gunny bag, cement, cotton thread, apparel, sugar, construction materials, tire, edible oil, etc.
- (4) Promotion of import substitution industries: Cotton, tobacco, pulp, iron ore, dairy products, etc.

The planned growth rates of the Third Plan were successfully achieved in almost all industrial sectors. Overall, the growth rate averaged 7.1% a year. The dwindling of foreign investment after the first oil crisis of 1973 however prevented the attainment of the policy goal of establishing big private enterprises in petrochemical, steel and machinery, and affected adversely the economic development of Thailand.

d. The Fourth Stage (1976-1981)

The targets of the Fourth Five Year Social and Economic Development Plan which corresponds to this period may be summarized as having been the acceleration of business recovery, correction of income disparity, a curb on population growth rate, development of human resources and expansion of employment opportunity, basic resources management and environmental conservation, national security management, etc.

In order to emerge from an agricultural country into an industrial one, the Plan's target was to raise the relative shares of the industrial sector versus the agricultural sector in GDP from 3:2 to about even.

The industrial policy during this period was to pick up the various problems that had arisen so far and to determine appropriate strategies to cope with them.

(1) Improvement of industrial structure

Promotion of basic industries, supporting industries and agro-industries; decentralization of factories into provinces and promotion of infrastructure facility improvement for this purpose.

(2) Promotion of export oriented industries

Market exploration and development, financial assistance, establishment of export processing zones, assistance for import substitution of intermediate goods and capital goods

(3) Government services for locating industries

Measures to accelerate decentralization of industries into provinces, granting of privileges in accordance with the Industrial Investment Promotion Law, construction of industrial estates in provinces, application of reduced power and freight rates, expansion of local credit services by financial institutions

(4) Enlargement of industrial development funds

Priority lending of funds to small scale industries and to industries located in the provinces, reorganization of the Small Industries Finance Office (SIFO) to expand its delegated authority and to improve its efficiency



(5) Industrial cooperation with ASEAN countries

Selective preferential trade agreements, joint investment for economic cooperation

(6) Acceleration of industrialization by means of government enterprise

Continued support to maintain tobacco monopoly, distillery and other state-run enterprises producing strategic goods; establishment of government enterprises in the fields that require huge investment, advanced technology or use of natural resources; improvement of efficiency of state-run enterprises

(7) Reconsideration of the government's industrial development monitoring system, etc.

In order to realize these diverse strategies, the following projects were formulated.

- (1) Infrastructure improvement
- (2) Technical training services
- (3) Technological services
- (4) Survey of investment environment
- (5) Promotion of quality control
- (6) Promotion of key industries

The real term economic growth rate during the period of the Fourth Plan slightly exceeded its target rate of 7%, but failed to attain the target average growth rates in both the agricultural and manufacturing sectors. Neither was the target ratio of shares between agriculture and industry in GDP attained, but it may be claimed that the industrial structure had undergone a slow but steady change.

e. The Fifth Stage (1982-Present)

The industrial structure up to this time was highly dependent on import of raw materials, intermediate goods, capital goods and energy. The international competitiveness of export products declined in the meantime due to the high cost of production, and thus a chronic trade deficit prevailed. The result was that the foreign currency earnings of the agricultural sector were always used up by the manufacturing sector.

In view of the foregoing, the following targets and policy measures were formulated in the Fifth Five Year Social and Economic Development Plan (1981-1986).

1) Fostering of export industries

The target average annual growth rate of the manufacturing industry as a whole was curbed to 7.6% (which was revised to 5.5%), while the target for export industries was set at 15%. In view of this, enactment of the Special Export Promotion Law, unification of agencies enforcing policy measures, expansion of credit ceilings for export industries, establishment of the export credit guaranty system, establishment of export processing zones and bonded warehouses, creation of new export promotion funds and other strategies were hammered out.

2) Decentralization of industries to provinces and creation of employment opportunities

In order to check the rapid population influx from provinces into big cities and to expand employment opportunities in the provinces, the following policy measures have been worked out: Improvement and expansion of local small scale industries and expansion of the credit system for this purpose, development of related facilities, improvement of production technologies and managerial techniques of small enterprises, promotion of the subcontracting system between big enterprises and small scale enterprises, promotion of industrial reorganization and

industrial estates, putting a check on industrial investment promotion measures in Bangkok and in surrounding areas (except for labor intensive export industries), improvement of incentives under the Investment Promotion Law, encouragement and assistance for training, etc.

3) Improvement of economic efficiency

Ten trades including chemical industry, iron and steel, ceramics, machinery, electrical machinery and automobile have been strengthened especially as designated industries.

Efforts have been made to gain competitive strength in both domestic and overseas markets by striving for quality improvement, reduction of production cost and realization of equitable prices. Assistance have been given to this end such as by reconsidering current import duty, business tax and excise tax, and also through investment promotion measures, technological development, accommodation of funds and tax system.

As above, the goals and policy measures of the Fifth Social and Economic Development Plan are many, and already three years have elapsed since its start, but the plan so far has not necessarily been carried out smoothly. The global recession of the early 1980s has naturally affected Thailand as well, and moreover, since it has been somewhat slow in recovering, the government has been compelled to revise its target economic growth rate substantially downward from its initial target. Its balance of trade shows a rising cumulative debt due to excess of imports over exports which keeps on increasing. Particularly its balance of trade with Japan which indicates a large excess of imports is generating a new trade friction between the two countries. Meanwhile, the rate of population growth in the metropolitan area of Bangkok shows no signs of decelerating, and unemployment is on the rising trend. Economic development in the metropolitan area however is quite spectacular, or even somewhat overheated with

new hotels and large department stores being constructed one after another by which the disparity between the outlying provinces is widening more than ever.

## 2. REAL STATE OF THE METAL-WORKING INDUSTRY

The definition of the metal-working industry is various depending on the purpose and application of the products, but here, metal products, general machinery, and transportation equipment are defined as the products of the metal-working industry. In terms of trade classification (working process), it comprises casting, forging, heat treatment, welding and sheet metal processing, surface treatment mostly plating, machining, machine assembling and press working.

### a. Value-added Productivity

A review of the changes in the ratio of value-added of the metal-working industries between 1969 and 1977 shows an increase from 19.2% to 49.9% in the metal product industry, a decrease from 28.5% to 20.1% in the machinery industry and an increase from 33.8% to 67.3% in the transportation equipment industry. The share of value-added of these metal-working industries as a whole in GDP, though still insignificant, rose from 0.2% in 1960 to 2.3% by 1982. Their share in the manufacturing industry rose from 3.8% in 1960 to 10.7% by 1982. Particularly, the share of the transportation equipment industry reached 8.6%, indicating a high degree of contribution associated with the growth of the automotive industry.

### b. Exports and Imports, Shares of Exports and Imports in Production Value, Self-Sufficiency Rate, etc.

Exports of machinery including transportation equipment, general machinery and electrical machinery according to the Standard International Trade Classification (SITC) increased at a high average annual rate of 75.4% at actual market rate between 1968 and 1980. Its ratio to total exports also rose from 0.1% in 1968 to 5.7% in 1980 to the amount of 7.6 billion baht. The average annual growth rate of machinery imports between 1968 and 1980 on

the other hand was 14.1%, but in terms of the ratio to total imports, it declined from 36.6% in 1968 to 22.8% by 1980 to a value of 43.1 billion baht.

The percentage of exports and imports of relevant industrial categories to the domestic production values were as follows:

<u>FY 1980</u>	<u>Exports</u>	<u>Imports</u>
Basic metals and metal products	32.8%	43.6%
Machinery and electrical machinery	33.1%	144.0%
Transportation equipment	0.9%	38.0%

The export ratio of machinery which is high next to rubber, plastics and food processing, indicates an increase of more than 5% a year on average. In imports, machinery commands the highest share, but it is declining at a rate of 12.4% a year on average from what had been 206% in 1975.

Domestic demand in 1975 and 1979 increased as follows:

2.8 times for basic metals (average annual growth of 29.1%), 3.1 times for basic metal products (32.5%), 2.7 times for electrical machinery (27.9%), 2.0 times for transportation equipment (18.2%) and 1.7 times for machinery (13.7%).

The ratio of production to domestic demand (self-sufficiency rate) is 87% in basic metal products, 75% in transportation equipment, 58% in electrical machinery, 37% in basic metals and 23% in machinery. The following offers further analyses on basic metal products, machinery and transportation equipment as metal-working industries.

Basic Metal Products: Includes hand tools, agricultural implements, cutlery, kitchen wares, etc. which use base metals for material. The combined output which was 2.38 billion baht in 1975 increased to 7.86 billion baht by 1979 at an average annual growth rate of 34.8%. Its self-sufficiency rate to domestic demand was 80.9% in 1975 but further rose to 86.5% by 1979, thus indicating a remarkable progress in local production. The import ratio fell from 21.7% in 1975 to 15.5% by 1979 whereas in value it increased from 640 million baht to 1,400 million baht. The export value grew from 78 million baht in 1975 to 180 million baht by 1979, but in terms of share it has remained level at 2 to 3% of domestic output. The domestic demand sharply rose from 2.94 billion baht in 1975 to 9.09 billion baht by 1979 at an average annual rate of 32.5%.

Machinery (excluding electrical machinery): Although the output grew from 2.34 billion baht in 1975 to 4.76 billion baht by 1979 at an average annual rate of 19.5%, the self-sufficiency rate is low at 22.5% in 1979. The ratio of imports is therefore high, having been 82.2% (10.43 billion baht) in 1975 and 79.1% (16.76 billion baht) in 1979. Both export ratio and export values are mediocre, having been only 0.3% and 340 million baht in 1979, respectively. The domestic demand grew at an average annual rate of 13.7% from 12.68 billion baht in 1975 to 21.18 billion baht by 1979, while production grew at a slightly faster pace of 19.5% a year on average. The self-sufficiency rate also rose, though only slightly.

Transportation Equipment: Includes automobile, aircraft, ship, rolling stock, tractor, etc., and the output grew from 13.34 billion baht in 1975 to 32.3 billion baht by 1979 at a high average annual rate of 24.7%. The self-sufficiency rate also rose from 60% in 1975 to 74.5% by 1979. Imports increased from 8.92 billion baht in 1975 (import ratio 40.1%) to 11.31 billion baht (import ratio 26.1%) by 1979, but the ratio of local production is rising yearly. This is because of the local content ratio which was imposed on passenger cars and commercial vehicles under the domestic automotive industry fostering policy adopted since 1978.

Exports are only a trifle yet, but the growth rate is a radical 73% a year on average. The domestic demand indicated a growth of 18.2% a year on average from 22.23 billion bahts in 1975 to 43.37 billion bahts by 1979, and the growth of its self-sufficiency rate was a high 3.6% a year on average.

c. Prevalent State of the Metal-working Industry by Type of Processes

In 2.a and 2.b above, we have macroscopically reviewed metal product manufacturing, general machinery and transportation equipment as metal-working industries. The actual state of these industries will be reviewed from the viewpoint of working process (type of industry).

The major types of industry (working process) in the metal-working industries are casting, forging, heat treatment, welding, press working, machining, machine assembling and surface treatment (painting, plating, coating). A number of integrated surveys on these working processes have been made in the past, but here. The reports of the following three survey projects will be quoted for review.

- (1) "Medium and Small Scale Metal-working Industries in Asia; Thailand and the Philippines Edition" by JICA, TECHNONENT ASIA, DIP, Thailand 1978.

This survey was conducted by JICA and TECHNONENT ASIA under cooperation of DIP, Thailand. It surveyed the medium and small scale metal-working industries in altogether seven countries - the five ASEAN countries excluding Brunei, but including Sri Lanka and Bangladesh - by quantitatively grasping the levels of their technology, control, management, market and of many other aspects and comparing them. The survey was conducted for three years from Phase I to Phase III, and Thailand was surveyed along with the Philippines in the initial year. About 350 medium and small scale metal-working industries were sampled and surveyed in Thailand.

- (2) "Feasibility Study on Sharing and Transfer of Technology Among ASEAN Countries", 1982 - 1984, by JICA/TECHNONET ASIA

This survey and study was also conducted by JICA and TECHNONET ASIA under the support of DIP, MOI Thailand for an extended period of about 27 months. It surveyed the medium and small scale industries mainly in Indonesia, the Philippines and Thailand in order to discover technologies which might be shared or transferred for producing the five target products selected as commanding large markets in the ASEAN countries, namely, medium and small size steel boats, simple machine tools, agricultural machinery, tools and metal mold. Although the number of enterprises surveyed was limited, the survey itself is fairly detailed.

- (3) "Study on the Promotion of the Metal-working Industry in the Kingdom of Thailand", 1983-1984, by JICA

This study was conducted by JICA and the Department of Industrial Promotion, Ministry of Industry (DIP/MOI) of the Royal Thai Government in search of measures to promote the medium and small scale metal-working industries of Thailand. It surveyed about 330 enterprises in the country's capital Bangkok Metropolitan areas and its surroundings, including prime (parent's) companies based on Japanese, indigenous and foreign capital especially with respect to the subcontracting systems being employed between the big companies and the medium and small scale companies.

The aspects which have been clarified by these three surveys are described below. Some 95% of the Thai medium and small scale metal-working firms are concentrated in the urban area, and more than 60% of them are within 10 years since their establishment and 25% between 11 to 20 years. The largest number of them are engaged in general machining (60.4%), sheet metal working and welding (58.2%), followed by press working (26.3%), casting(22.2%), machine assembling (22.2%) and a few in plating (11.4%) and forging (2.8%).



By type of product, the enterprises handling parts for industrial equipment account for the largest group of 25%, followed by automotive parts (22%) and parts for agricultural machinery (19%).

When seen by the number of employees, the enterprises with 11 to 30 employees account for the largest group of 43.7%. This is followed by 37.7% of enterprises with 5 to 10 employees and 7.3% of enterprises with 31 to 50 employees, which shows that the small scale enterprises with 5 to 50 employees account for about 90% of the total.

Enterprises whose employees are almost entirely or entirely male are as much as 95.3% of all enterprises, indicating that female workers have made very little inroads into the metal-working industry. As for monthly working hours, the majority of them (68.7%) work 201 to 250 hours, which indicates that many of the enterprises work overtime. Enterprises whose employees belong to the labor unions are low at 4.1%. The average monthly wages of the overwhelming majority of 95.9% range between 600 baht to 2000 baht. As for the average length of service, the largest group of 75.9% reported less than five years and a mere 12.7% between 6 to 10 years. These figures are in no way surprising considering that the enterprises are still relatively young and that employee turnover is quite high (45.8% of the firms reported an employee turnover rate of over 21%). As for the employees' level of education, most of them have either graduated only from primary school or below (30.4%) or finished the second year of middle school or below (56.6%).

The markets are mostly within the region (43.8%) or within the country (22.3%). The clients are mostly the users (61.1%) and dealers (30.4%). Most of the enterprises do not have any employees exclusively for sales (91.5%) while those which have one to three sales persons on their staff account for 6.7% of the total.

With respect to mechanization of the factory, 57.6% of the factories are partly mechanized. In terms of the total horsepower of production equipment, those in the range of 11 to 50 Hp account

for the largest group of 46.8%, but those in the range of 2 to 10 Hp are also comparatively many at 24.4% of the total. Their equipment are relatively new: Those between 2 to 5 years old account for 36.1% and those between 6 to 10 years, 37.7%, which is understandable considering that most of the enterprises are still relatively new. The operating rate of these production equipment differs by enterprise. Some are between 31 to 50% (25.9% of the total), some between 51 to 70% (26.6%) and some 71% or more (28.2%). Delays in delivery reportedly occur both "occasionally" (52.2%) and "rarely" (25.9%).

An overwhelming majority of the enterprises control their processing schedule based on a rough plan. The method of quality control of most enterprises is to check the product only when some problem has arisen or to apply the first product inspection. Enterprises that adopt any form of systematic quality control are very few. As for the frequency of complaints against defective products, an overwhelming majority (87%) of the enterprises surveyed answered that they range between 1 to 9%. Also, enterprises that engaged themselves in subcontracted jobs are around 10% of the total.

In the above paragraph we have introduced the actual status of the medium and small scale metal-working industries as revealed in Report (1). Reports (2) and (3) also report on the situation to approximately the same effect.

The following offers an outline of the prime (parent's) enterprises primarily based on the survey findings of Report (3).

Most of the prime (parent's) enterprises were established during the first and second stages between 1964 and 1978 when the industrialization policy of Thailand was in full swing and when a policy oriented toward import substitution was being adopted. Not all prime (parent's) enterprises are necessarily big, for medium and small scale enterprises account for 40% of them. As for type

of product, automobile-related products account for about a third while industrial equipment, agricultural machinery, electrical and communications equipment account for about 10% each.

An overwhelming majority of their sales outlets are in the domestic market, but 1/4 of them also sell to the developing countries while nearly 10% of them are even finding markets in the NICs and the advanced countries. In technical aspects, too, the differences between the previously described medium and small scale industries are quite distinctive. For instance, more than 2/3 of the prime (parent's) enterprises reported their rate of defective products to be 1% or less, and 40% of them claimed to have more than 10 employees who were capable of reading and understanding the drawings.

Regarding the type of processes subcontracted, casting is most frequent, followed by press working and machining. Many of the subcontracted items are standardized articles and parts with fixed forms. Many of the enterprises (40%), however, have no department to control the subcontractors (consignees). What the prime (parent's) companies strongly demand of their subcontractors (consignees) the needs to improve product quality, especially in casting, plating, machining and press work. And, many of the prime (parent's) companies hope to continue to strengthen their subcontracting relationship.

We will introduce here Report (3) which makes a comparative analysis of the prime joint venture companies with Japanese partners, the prime joint venture companies with foreign partners other than Japanese and the prime local capital companies.

The characteristics of these companies in terms of capital are that many (70%) of the "companies of Japanese origin" are the big businesses with a capital of 16 million bahts or more, and likewise 40% of the "companies of non-Japanese foreign origin", while half of the "local capital companies" are accounted for by the small and medium scale enterprises with a capital of four million bahts or less. Similarly, in the number of employees, too, many of the "companies of Japanese origin" have 200 or more employees while

many of the "local capital companies" have 200 or less. Frequency of subcontracting is also high with "companies of Japanese origin", with subcontracting being highly concentrated in automobile and automotive parts. As for the types of subcontracted process, casting is predominant with the "local capital companies". In contrast, the subcontracting work of the "companies of Japanese origin" and "companies of non-Japanese foreign origin" are widely distributed over casting, sheet metal working, press working, machining, etc. In their relationship with the subcontractors, the deep concern of the "companies of Japanese origin" is on quality and delivery control, and they tend to make severe demands on their subcontractors in these respect.

Report (3) also offers some interesting analysis such as a time series analysis of changes that occurred since the time of Survey (1) and an analysis of the salient features of the enterprises established during the last five years. Although the levels in general have been improved, such as a decrease in the fraction defective, almost no improvement is seen in their ability to interpret drawings and in the frequency of delays in delivery. Regarding the enterprises established recently, the report notes that machining accounts for the largest group, followed by sheet metal working and welding, press working and then machine assembling, but none in casting. When seen by types of product, the enterprises that manufacture automobile and related parts account for by far the largest number while a small number of them produce industrial equipment, agricultural machinery, civil engineering equipment or electrical and telecommunication equipment.

### 3. ORGANIZATIONS INVOLVED IN THE PROMOTION OF METAL-WORKING INDUSTRIES

There are many organizations that are directly or indirectly involved in, or technologically or financially related to the promotion of the metal-working industries. These organizations are as shown in Fig. 2-1. From among these, we will briefly describe the educational system relevant to technical education and a few of the public organizations that directly contribute to the promotion of the metal-working industries.

#### a. Educational System

The educational system of Thailand is as shown in Fig. 2-2. Compulsory education consists of six years of elementary education. As stated previously, the educational levels of the employees in the medium and small scale enterprises are mostly those who have completed this compulsory education and those with three more years of secondary education. In the latter half of the secondary education, the courses are divided for those who want to go on to universities, for those wishing to enter vocational schools or for those wishing to undergo technical training.

Under the Department of Vocational Education there are 11 polytechnics, 61 vocational and technical colleges and 44 vocational and technical schools.

Technologists are divided into four groups according to their level of education as follows:

- \* Technologist with degree ..... University graduates
- \* " " diploma Graduates of King Mongkut's
- \* " " certificate Institute of Technology,  
technical institutes and  
private colleges
- \* Craftsman ..... Graduates of National  
Institute for Skill  
Development (NISD)

Table 2-1 shows the number of university graduates in technical fields. As apparent from these tables, technologists in metal materials and related as well as in chemistry and electrochemistry are in short supply. Also, their lack of pertinent practical training at educational institutions is pointed out as a common shortcoming of these technologists. Most of the educational institutions offer one to four years of education for beginners but there are hardly any that offer short term courses for reeducation/retraining.

b. Organizations for Public Assistance

1) Department of Industrial Promotion (DIP)

DIP was established in 1941 as a suborganization of the Ministry of Industry (MOI) for the purpose of promoting and fostering local industries. Its staff size was 1,171 persons as of 1981. Six out of its eight divisions are primarily engaged in extension services and training services in their respective fields.

Details of the major divisions are as follows:

(1) Industrial Service Division (ISD)

Since its establishment in 1966 with the aid of UNDP, it is extensively engaged in various activities including technical training, consultation services, technical information service, offering of support for the establishment of various associations. Fig. 2-3 is its organization chart as of December, 1983. It is currently divided into five subdivisions, one of which is the Technical Operation Sub-Division consisting of two sections, namely the Metal Industry Development Section and the Industrial Technology Development Section. About 36 persons are assigned to these two sections. Tables 2-3 through 2-9 represent ISD's activities in numerical figures which show how active they are.

(2) Thai Management Development Productivity Center (TMDPC)

TMDPC was established in 1962 as a suborganization of DIP by the Royal Thai government and ILO. TMDPC is also a member of APO. Its activities are:

- Training of primarily managerial personnel of both the government and private sectors.
- Consultation services on managerial control
- Arrangements for consultation services by foreign experts of APO, JICA and others.
- Publication of monthly periodicals on managerial control and productivity

Table 2-10 shows the activities of TMDPC during the 1979-1982 period. In 1982, for example, it offered 60 training courses to 8,614 persons, consultation services to 36 firms, published 2,500 copies of "Productivity" every other month, and broadcasted over the state-run radio.

TMDPC has also extended its support in establishing various associations (such as the Thai Management Association, Marketing Association of Thailand, Government Enterprise Productivity Group, Export Instructors' Club, etc.)

(3) Small Industries Finance Office (SIFO)

SIFO was established in 1963 as a "loan project" for promoting small scale industries. It extends low interest loans to small entrepreneurs wanting to set up or expand their factories. SIFO has four divisions:

Administration, Loan Processing, Screening and Consulting, and Follow-up and Evaluation. Its funds for lending consist of the trust fund of MOF (Ministry of Finance) deposited with KTB (Krung Thai Bank) as SIFO's account and KTB's contribution.

2) Technical Transfer Center (TTC)

It is a function created within the Ministry of Science, Energy and Technology and its job is to coordinate technical organizations and promote technology transfer.

It maintains close linkage with the Ministry of Education, Ministry of Agriculture, Thai Institute of Science and Technology Research (TISTR) as well as with universities. It also maintains close contact with international organizations such as RCTT (Region Center of Technical Transfer) from which it obtains technical information in various fields.

3) Technological Promotion Association, Thailand-Japan (TPA)

TPA was established with the objective of promoting and improving science and technology of Thailand. It is engaged in:

- seminars and training projects
- industrial technology support projects
- industrial instrument projects

The duration of its seminars is mostly 1 to 6 days. In 1982 it offered 50 technical courses and 19 managerial courses, published science and technology textbooks, assisted the manufacturing industries in conducting surveys, and was also active in improving measuring instruments and measuring techniques.

4) Engineering Institute of Thailand (EIT)

EIT is a non-profitable organization founded on a personal membership system. The members as of 1984 was 24,000. It has set up committees on civil engineering, mechanical engineering, electrical engineering, mineral engineering and chemical engineering. It sponsors seminars (of 1 to 3 day duration) and lectures, publishes technical books and conducts examinations for applicants registering as consulting engineers.



5) Thai Institute of Science and Technology Research (TISTR)

Its predecessor is ASRCT (Applied Scientific Research Corporation of Thailand) created by the aid of UNDP in 1963 which had been engaged in promotion, support and practice of research and development of applied science relevant to national development, natural resources and industry. In 1979, it changed its form of organization and became a state-run organization placed under the Ministry of Science, Energy and Technology.

6) Thai Industrial Standard Institute (TISI)

The Industrial Products Standard Law was enacted in 1968 and TISI was established in 1979 under the Ministry of Industry. As of now, about 200 personnel are attached to TISI. It has so far promulgated close to 400 standards.

7) Industrial Estate Authority of Thailand (IEAT)

It was established in 1972 as a public enterprise and a division of the Ministry of Industry. It is responsible for construction planning, implementation, administration and operation of industrial estates. Its major duties consist of:

- securing of sites for industrial estates
- provision and improvement of infrastructure for operating industrial estates,
- leasing and selling of industrial estates
- implementation of feasibility studies, etc.

The activities of IEAT in the past had primarily catered to the big enterprises, but recently, the medium and small scale enterprises who were hardly aware of industrial estates have become enlightened, and new industrial estates are beginning to be constructed for them, too.

8) Association of Thai Industries (ATI)

It was established in 1962, and as of 1982 it has some 826 corporate members and 20 industrial clubs affiliated to it.

Its activities are:

- dispatching of missions to promote exports
- surveys and lecture classes on energy conservation
- fairs and exhibitions
- seminars
- dispatching of persons for education and training abroad

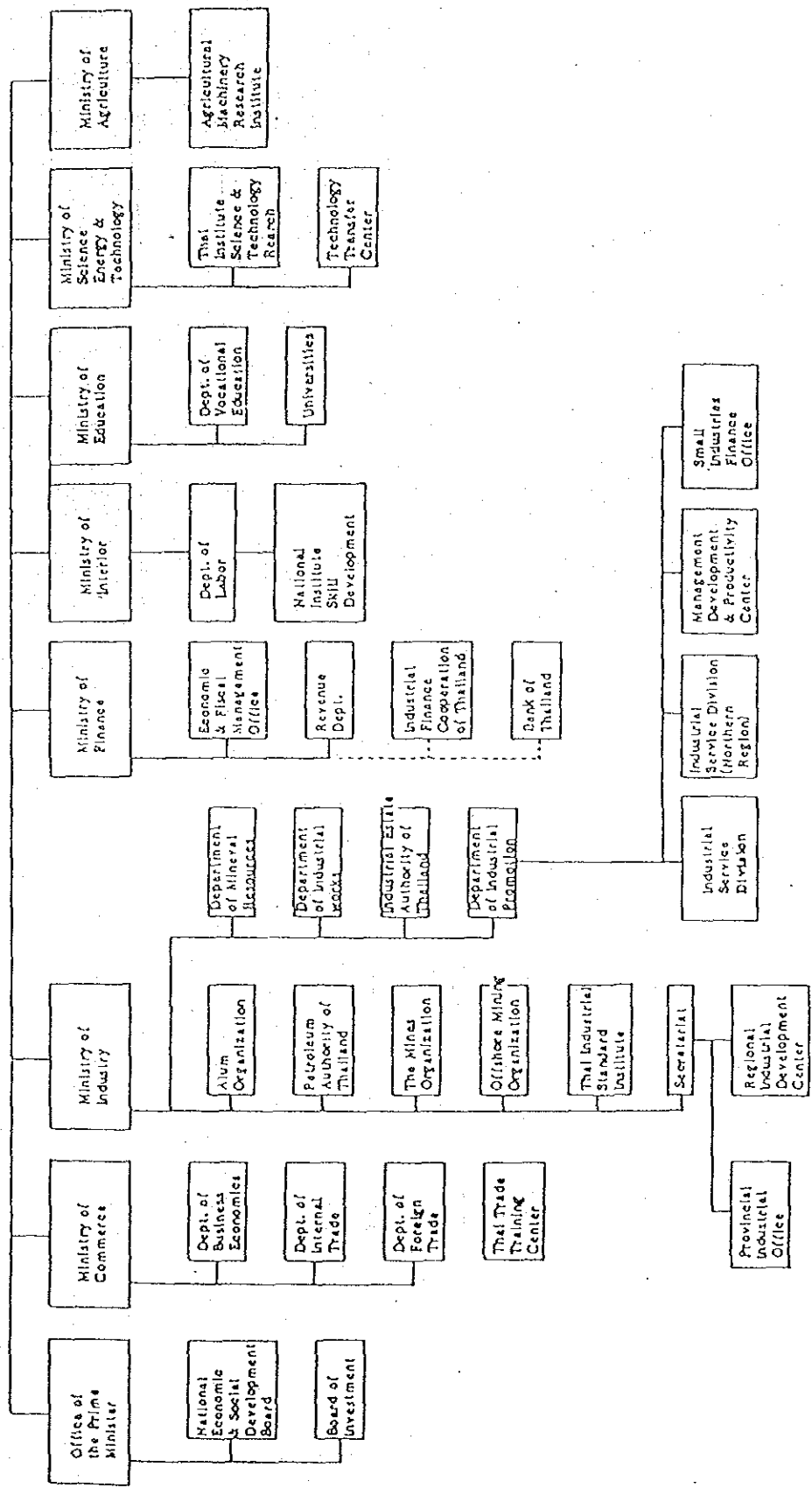


Figure 2-1 Organizations Related to Promotion of Metalworking Industries

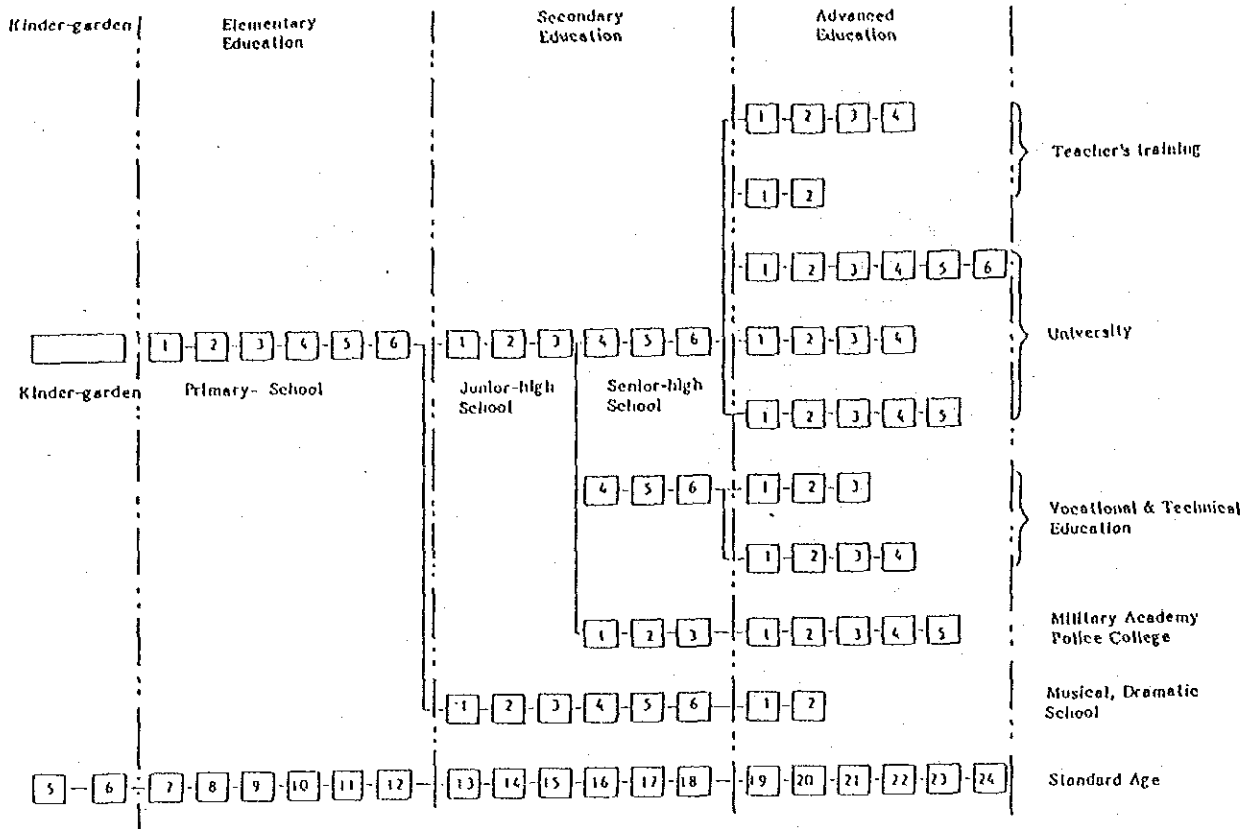


Figure 2-2 School System

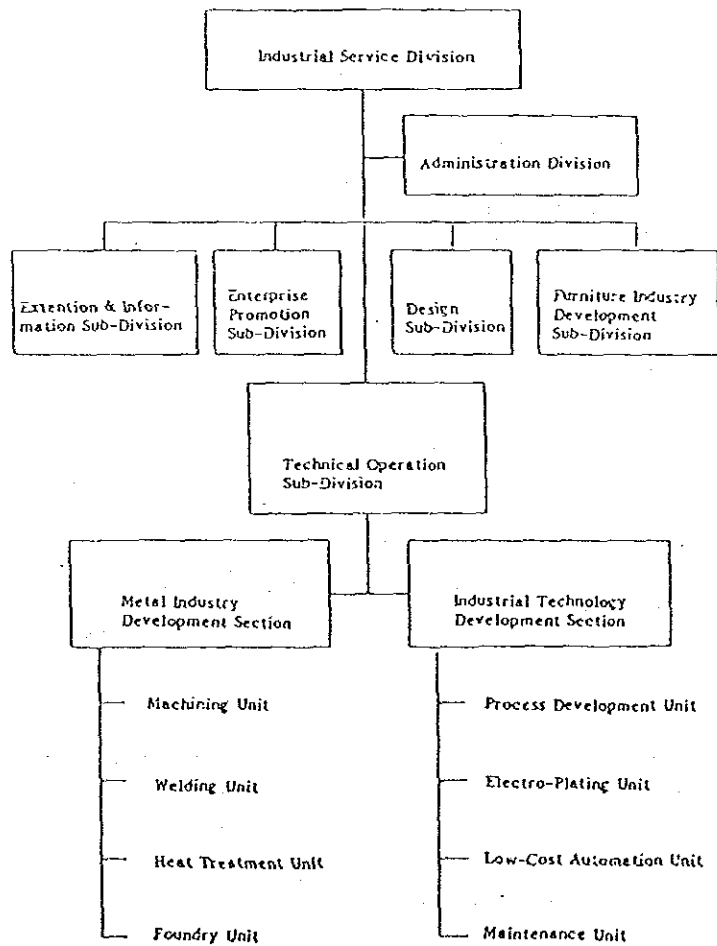


Figure 2-3 Organization of ISI

Table 2-1 Annual Manpower Output of Educational Institutions in Engineering

Level	1978			1979			1980			
	Total Engi- neering	Electri- cal Engi- neering	Indus- trial Engi- neering	Total Engi- neering	Electri- cal Engi- neering	Indus- trial Engi- neering	Total Engi- neering	Electri- cal Engi- neering	Indus- trial Engi- neering	
Master's Degree	69	6	7	3	83	20	10	85	17	10
Bachelor's Degree	1,376	373	142	254	1,069	327	127	1,428	363	116
Diploma Technician	6,483	1,566	359	1,975	567	1,478	457	7,276	1,787	494
Certificate Technician	12,482	4,044	4,029	5,796	22,206	5,236	4,657	21,895	5,830	3,828

- Sources: 1. Planning Division, Department of Vocational Education, Ministry of Education.  
 2. College of Technology and Vocational, Ministry of Education.  
 3. Office of the Private Education Commission, Ministry of Education.  
 4. Planning Division, Office of University Affairs.  
 5. Private College Division, Office of University Affairs.

Table 2-2 Number of Trainees Graduated from the Institute for Skill Development

	1979			1980			1981			1982		
	Total Engi- neering	Electri- cal Engi- neering	Mechani- cal Engi- neering	Total Engi- neering	Electri- cal Engi- neering	Mechani- cal Engi- neering	Total Engi- neering	Electri- cal Engi- neering	Mechani- cal Engi- neering	Total Engi- neering	Electri- cal Engi- neering	Mechani- cal Engi- neering
Preparatory Training (6-10 months)	2,057	408	648	780	2,003	433	732	2,513	481	760	944	2,882
Upgrading (40-70 hours)	2,457	949	416	796	2,188	773	356	3,017	1,253	478	930	3,493
Apprenticeship (2-3 months)	973	323	198	315	1,514	396	405	1,344	381	387	370	1,954
Training Promotion	823	-	36	836	735	-	-	788	-	496	109	750
Special Training	1,446	-	-	-	1,601	-	-	1,833	-	-	-	2,079
Total	7,756	1,680	1,298	2,500	8,341	1,602	1,493	9,475	2,115	2,121	2,353	11,168
												2,418
												2,622
												1,614

Source: National Institute for Skill Development, Department of Labour

Table 2-5 Contact with ISI (1975) ( ) : Percent

Number of employee	Number of firms ever have made contact with ISI		Number of firms never have made contact with ISI		Total
		(%)		(%)	
Less than 10	29	(16.8)	144	(83.2)	173 (100.0)
10 - 49	181	(29.6)	430	(70.4)	611 (100.0)
50 - 99	53	(39.0)	83	(61.0)	136 (100.0)
100 - 199	33	(47.1)	37	(52.9)	70 (100.0)
More than 200	15	(25.3)	22	(59.1)	37 (100.0)
TOTAL	311	(30.3)	716	(69.7)	1,027 (100.0)

Source: Seeng Sanguanruang, Somsak Tambonlertchai and Nit Summabhorn, A Study of Small and Medium Scale Industries in Thailand, 1978 (in Thai)

Table 2-6 Factory Surveys and Extension Services by ISI (1978-83)

Year	Factories	
1978	171	
1979	464	
1980	119	
1981	483	
1982	532	
1983	200	

Source: IDS, DIP, MOI

Table 2-7 Technical Information services by ISI (1978-83)

Year	Clients		Items	
1978	2071		4428	
1979	1503		4493	
1980	2781		5162	
1981	6055		7287	
1982	6767		7236	
1983	2902		6075	

Source: IDS, DIP, MOI

Table 2-3 Number of Trainees Graduated from the Industrial Service Division, Ministry of Industry

	1977		1980		1981		1982	
	Total	Engineering Industries	Total	Engineering Industries	Total	Engineering Industries	Total	Engineering Industries
Trainees	1,982	962	1,289	533	1,477	853	1,971	972
Number of course target	33	16	40	17	51	24	58	24
Man-days	8,463	2,585	10,291	2,678	8,154	2,505	10,58	2,387

Source: ISD, DIP, MOI

Table 2-4 Number of Attendants to the seminar of ISI in 1979

Year	Contents	Period (days)	Number of Attendants			
			Total	Public	firm individual	
1979	1. Packaging	21	1,091	391	611	89
	2. Product Advertizing	1	32	5	27	-
	3. Product Designing	2	58	19	37	2
	4. Arc & Mig Welding	3	139	88	31	20
	5. Car-body Assembly Meeting	2	148	51	73	24
	6. Water-pollution Control	3	102	-	102	-
	7. Sand-block Making	1	29	12	15	2
	8. Metal Plating	1	40	17	29	-
	9. Plastic Engineering	2	22	5	17	-
	10. Conservation Through Insulation	1	111	40	61	10
	11. Wooden Furniture Production	1	150	20	100	30
	12. Bottles and Other Containers	2	91	46	45	-
	13. Problems in Production & Marketing Products of Rattan	1	55	18	46	1
		1	98	70	28	-

Source: ISD, DIP, MOI

Table 2-8 Technical Inquiry and Consultancy Services by ISI

Year	Number of Technical Inquiry and Consultancy Services
1978	495
1979	192
1980	237
1981	598
1982	470
1983	591

Source: ISD, DIP, MOI

Table 2-9 Training and Seminar by ISI

Year	Number of Training Course and Seminars	Number of trainees
1978	36	1461
1979	46	2181
1980	40	1289
1981	51	1477
1982	71	3119
1983	82	3631

Source: ISD, DIP, MOI

Table 2-10 Number of Trainees Graduated from the Thailand Management Development and Productivity Centre

	1979		1980		1981		1982	
	Total	Engineer	Total	Engineer	Total	Engineer	Total	Engineer
Trainees	5,875	492	5,291	498	7,054	410	8,614	603
Number of course target	49	9	51	9	58	5	60	8
Man-days	14,688	1,230	13,228	1,245	17,635	1,025	212,535	1,508

Source: Thailand Management Development and Productivity Centre, Ministry of Industry





**CHAPTER THREE**  
**OUTLINE OF THE PROJECT**



## CHAPTER THREE     OUTLINE OF THE PROJECT

### A.   SIGNIFICANCE OF THIS PROJECT

In CHAPTER TWO we have briefly reviewed the socio-economic background, the actual state of the metal-working industries, the educational institutions and various organizations and their activities relevant to the metal-working industries in the Government of Thailand. The proportion of the metal-working industries to the Thai economy as a whole is extremely small yet, and the reasons why the Government of Thailand has decided to exert its efforts to promote the metal-working industries are considered to be as follows:

- (1) Because metal-working products can be efficiently produced even by the relatively small companies, namely the medium and small scale enterprises, it may be regarded as an appropriate industry for Thailand from the viewpoint of expanding employment opportunities.
- (2) The engineering industry inclusive of metal-working has a large repercussive effect on other industries and is therefore important for the development of the national economy.
- (3) For Thailand who is making an attempt to shift from industrialization for import substitution to export oriented industrialization, the fostering of the metal-working industries which support the basis of all industries is an urgent task.
- (4) The sound development of the medium and small scale industries which support the leading industries is indispensable in accelerating the nation's industrialization.

However, as apparent from the surveys conducted so far, the overt and covert problems of the Thai metal-working industries, particularly those of the medium and small scale enterprises are ubiquitous, being found in every aspect of their business from technology to equipment, managerial control, market and funds, all of which are hindering their sound development. Although some are problems that an enterprise can

solve by itself, most of them are beyond the efforts of any one enterprise to solve. Particularly for the medium and small scale enterprises which have limited manpower and financial resources, they are indeed difficult problems to solve.

As above, numerous problems must be solved in order to develop medium and small enterprises, some of which are as follows:

(1) Technical aspects

- \* Delay in modernizing equipment
- \* Lack of function to reeducate technical staff
- \* Disparity with big businesses in technical level
- \* Inadequacy of technical information

(2) Managerial aspects

- \* Pre-modern sense of management
- \* Delay in specializing in a particular trade
- \* Weak system of mutual interchange and mutual aid among the industry
- \* Small market and intense competition

(3) Funds and investment

- \* Poor financial resources and inability of modernizing equipment
- \* Inadequate funds for specializing in a particular trade

(4) Systems, promotion measures, organizations, etc.

- \* Absence of specialized promotion organization
- \* Inadequate planning and coordinating function for various policy measures
- \* Inadequate education and training systems
- \* Inadequate service functions for testing, inspection, trial fabrication and consignment processing
- \* Inadequate competence for extension service, business diagnosis and other services

(5) Relocation of industries

- \* Surfacing of public pollution problems
- \* Lack of industrial estate exclusively dedicated to metal-working industries
- \* Very few public industrial estates for the medium and small scale industries

It would be difficult to solve all of the diverse problems in one sweep, and it is quite significant that the Government of Thailand had formulated its plan to establish MIDI by focusing its attention particularly on the technical problems and that it has requested the Government of Japan for cooperation in this project.

Also, the fact that MIDI does not aim to educate the laymen like the technical schools and vocational training centers but to reeducate and train entrepreneurs, managerial staff, nucleus engineers and seasoned craftsmen and to function closely with daily business activities by offering extension services, trial fabrication, consignment processing, testing and research, technical information service would surely have a big impact on improving the technology of the medium and small scale Thai metal-working industries.

It is indeed of great significance for the Thai medium and small scale metal-working industries that the Government of Thailand has decided, against such a backdrop, to establish the Metal-working and Machinery Industries Development Institute under the Department of Industrial Promotion of the Ministry of Industry primarily intended for the medium and small scale industries and to put in greater efforts to promote the engineering industry inclusive of metal-working.

Also, the fact that this Institute's intent does not lie in training beginners by offering long term courses like at schools and vocational training centers but in technical improvement of nucleus engineers, skilled craftsmen, entrepreneurs and supervisory staff, each of whom assume an active part in the enterprise is indeed unique in that there has not been anything comparable to it in Thailand. In a country where rapid industrialization is in progress by the day, the mastery of new technologies and new knowledge by the nucleus people of the enterprises and to apply them in their daily jobs are just as essential as acquiring an elementary education.

## B. CONTENTS OF REQUEST

### 1. ESTABLISHMENT OF MIDI

The government institution to be established for the purpose of reeducating and retraining nucleus engineers, skilled craftsmen and management staff to foster medium and small scale engineering industries and to activate their linkage with big businesses so as to contribute to the industrial development and eventually to the social and economic development of the country was temporarily named the Engineering Industry Development Institute (EIDI), but as a result of consultation with the Basic Design Survey Team, was renamed as the "Metal-working and Machinery Industries Development Institute (MIDI).

#### a. Purpose of MIDI

To quote from the "Request for Project" submitted by the Government of Thailand to the Government of Japan, the purpose of establishing MIDI may be summarized as follows:

- 1) To help improve the industrial technology and managerial techniques of the medium and small scale enterprises which are to support the industrialization of Thailand along the policy of the National Social and Economic Development Plan. For this purpose, the Institute shall hold seminars and offer training courses for the nucleus engineers, skilled craftsmen and entrepreneurs to reeducate them, and also conduct extension services and business diagnosis mainly for the medium and small scale industries.
- 2) The Institute shall be equipped with facilities for casting, forging, heat treatment, plating and machining, and offer practical training for the above named participants and extend entrusted jobs, trial fabrication services, and inspection and testing services mainly to the medium and small scale industries.

- 3) The Institute shall not only extend the foregoing services but also conduct research and development on products, production technology, market research and managerial techniques suitable to the industrial environment of Thailand and disseminate the achieved results in the private sector.
- 4) In order to function as a technical information center of Thailand, the Institute shall collect technical research reports, literatures and books from sources in and out of the country and open them to the public.
- 5) The Institute shall perform the role of "cooperation center" for the government and relevant private organizations by maintaining two-way contacts with them, and shall strive for the development of the engineering industry.

b. Functions and Activities of MIDI

As an industrial technology promotion organization, MIDI is positioned between the academic education and research organizations - such as universities and research institutions - and the education and training organizations of elementary skill and techniques - such as technical training institutions/ vocational school and technical schools - and its purpose is to assist and promote the upgrading of technological levels by reeducating and retraining the engineers, skilled craftsmen and managerial personnel of particularly the medium and small scale enterprises as well as teachers and instructors of technical training institutions and technical schools. It shall also perform its own research and development and collect and disseminate technical information.



Its major functions and activities are as follows:

1) Assistance and Support Toward Improvement of Technology

- \* Holding of seminars and training courses on casting, forging, welding, heat treatment, electro-plating, machining, machine design, drafting, basic material technology and simple automation technology.
- \* Extension service activities outside the Institute, such as company patrol service, consultation and general publicity and enlightenment activities periodically or with appropriate timing

2) Assistance and Support for Improvement of Managerial Control Techniques

- \* Holding of seminars and training courses on production control, quality control, cost control and pollution prevention technologies, etc. particularly for business operators and managerial personnel in the metal-working and machinery industries with the cooperation of TMDPC (Thai Management Development and Productivity Center), TTC (Trade Training Center) and others.
- \* Extension services outside the Institute such as itinerant guidance and business diagnosis for the medium and small scale enterprises.

3) Support for Production Activities of Enterprises

- \* Consignment processing and inspection services

The Institute will provide processing, inspection and measurement services on consignment to the medium and small scale enterprises with or without fee and, at the same time, provide preliminary training to enterprises which plan to introduce similar equipment.

MIDI will therefore be equipped with high precision or special processing equipment, material testing and inspection equipment, and precision measuring instruments which the medium and small scale enterprises would not easily be able to install.

\* Consulting services on factory planning and layout, etc.

\* Advisory services on market research in and out of the country

#### 4) Applied Research and Development

Research, development and or trial production of appropriate products, jigs and tools suitable to the prevalent condition in Thailand.

#### 5) Information Services

\* Engineering and technical books, periodicals and audio-visual teaching aid will be made available to the public

\* Collection and translation of technical reports and literatures

\* Publication of periodicals

\* Publicity for MIDI and promoting its utilization

\* Drafting of industrial regulations and standards and proposals to relevant authorities

\* Interchange of technical information and personnel

## 2. ANTICIPATED EFFECTS

Once the Institute is completed and its activities are put on the right track, the following effects are expected.

- a. About 40 courses of lectures and training a year can be offered to educate and train about 1,200 persons. Also, enlightenment activities such as seminars and lectures on topics relevant to the engineering industries can be offered to the public at a frequency of once a month.

- b. Long-term extension services to 12 enterprises a year and 100 times or more of short-term itinerant guidance services and consulting services are being planned. Concentrated consulting services offered to a small number of enterprises are unique to ISD and are highly evaluated as being very effective.
- c. Testing, inspection, designing and experiment services can be offered, and such activities will lead to improvement in product quality and production efficiency.
- d. Research and development and trial fabrication of products, production technology will be conducted.
- e. It can function as the technical information center by exchanging information with research organizations and similar institutions inside and outside the country and disseminate such information, and also serve to strengthen the linkage between the big enterprises and the medium and small scale enterprises.

### 3. METHODS OF EDUCATION AND TRAINING

Education and training at this Institute will not be limited to classroom lectures but will stress practical training so that whatever has been learnt can be immediately applied to daily business activities. Also, the trainees will be able to master the techniques of production control and quality control by experiencing actual production as part of the training.

Education and training courses are divided into the following three courses.

#### a. Processing Technology Course

Training mainly by practical exercise in casting, forging, welding, electro-plating, heat treatment, machining, material testing and inspection and precision measurement, all of which constitute the basics of metal-working.

b. Engineering and Design Course

The subjects of study will be selected from among the products which are specified as the ones that need to be developed for the future of Thailand (simple machine tool, metal mold, agricultural machinery, hand tools, automotive parts, pump, valve, etc.) and used for education and training in design engineering, drawing, etc.

c. Administration and Management Technique Course

The participants will be taught the techniques in production control, quality control, market survey, personnel management, subcontractor management, etc. which are necessary in business.

The foregoing education and training are intended for the middle management class who are quite busy with much of their time being taken up in routine jobs. Maximum results, therefore, must be attained within a short period, which demands ingenuity in the method of education and training as well as in teaching material, one of which is the inducement of the audio-visual education system.

Besides the staff of this Institute, lecturers and competent instructors will be widely recruited from public and private sectors both at home and abroad.

4. OPERATING ORGANIZATION

This Institute shall be established under the Department of Industrial Promotion, Ministry of Industry and its operating organization shall consist of the following three divisions.

a. Administrative Division

- \* Coordination and control of overall plan and budget of the Institute
- \* Planning for the future, and project coordination
- \* Personnel planning and administration

- \* Overall planning and coordination of seminars, training courses and other activities
- \* Custody of books, literatures and teaching materials
- \* Various liaison with other relevant organizations
- \* Publication of organs and technical magazines
- \* Publicity and advertisements of the Institute
- \* Acceptance of application for seminars, training and consignment processing
- \* Other administrative and clerical job

b. Technical Division

- \* Preparation of seminars and training curricula and their execution
- \* Arrangement and administration of lecturers and instructors
- \* Research and development
- \* Drafting and proposing industrial standards
- \* Formulation of future plans
- \* Designing and fabrication of educational equipment and material
- \* Study and dissemination of technical information both at home and abroad

c. Workshop Division

- \* Instruction of trainees
- \* Consignment processing
- \* Development and trial fabrication of jigs, tools and fixtures
- \* Trial fabrication and testing of products developed
- \* Maintenance and custody of facilities and equipment
- \* Guidance on extension services
- \* Drafting of equipment inducement plan
- \* Machine scheduling and control

Also, in order to promote the metal-working industries in cooperation with other relevant government organizations, the private sector and research institutions, a "Committee" consisting of members representing various sectors should be established to discuss and decide, promotion programs, basic operational policy of the Institute and other important matters.

The Institute is planned to be built on the south side of the existing ISD in the southeastern part of Bangkok where it has secured 25,000 m<sup>2</sup> of land. The following principal facilities are planned to be built on this land.

#### 5. PRINCIPAL FACILITIES

(1) Main Building

Rooms for director and staff, lecture room, guest and conference rooms, library, metal material laboratory, audio-visual classroom, etc.

(2) Workshop A

Casting and forging shop, heat treatment shop

(3) Workshop B

Machine shop, welding shop, electro-plating shop, precision measurement room

(4) Canteen

(5) Dormitory

### C. ANALYSIS OF REQUESTS

The objective of this Institution is to perform the functions and activities requested by the Government of Thailand, i.e. to contribute to improving the level of industrial technology in Thailand, particularly with emphasis on upgrading the technological level and managerial technique of the medium and small scale metal-working industries which are the basis of all industries. This is in conformity with the national development plan of Thailand and it is quite opportune that its establishment should be proposed at this time.

The Institute which, unlike the vocational training institutes and schools that exist from the past, intends to reeducate and retrain nucleus engineers and skilled craftsmen as well as to upgrade managerial control techniques of business owners and managerial personnel. This will assist them in improving their organization, and this is exactly what the medium and small scale metal-working industries require and look forward to today.

Its scope of activities, however, is very extensive, ranging from market survey, feasibility study, business diagnosis to organization and reorganization of trade circles, all of which are difficult themes and which are besides its activities for improving technological levels in general. Every one of these activities are important and necessary, but in order to carry them out, it will be necessary to recruit a large number of personnel of considerable competence and develop their potential capabilities. The success or failure of operating this Institute depends solely on its personnel.

From this viewpoint, it is desirable that largest possible efforts be given to recruiting and developing the personnel of the Institute and expanding the scope of its activities, not all at one time, but slowly and steadily in the future.





**CHAPTER FOUR**  
**BASIC DESIGN**



## CHAPTER FOUR BASIC DESIGN

### A. BASIC DESIGN POLICY

This basic design was prepared after thoroughly reviewing the contents of the Request of the Government of Thailand to the Japanese Government, and also upon acquiring a grasp of its intent and closely examining the various survey reports of the past, the ongoing Thai Government industry promotion policies, the medium and small scale enterprise promotion programs, etc., and by having it reflect the various findings obtained through field survey and discussions made by the Basic Design Study Team. The following in particular were adopted as the basic policies of the designing.

#### (1) Review on the Justifiability of the Project

Firstly, the current socio-economic background in Thailand, its degree of progress in industrialization, the orientation of its industrialization policy, the actual state of the medium and small scale metal-working industries and other relevant factors were analyzed, then the role and position of the "Metal-working and Machinery Industries Development Institute" was reviewed and its justifiability examined.

#### (2) Review on the Optimum Scale and Grade

The optimum scale and the grade were determined upon a review of the prevalent technical level of the Thai industries, particularly that of the medium and small scale metal-working industries, the size of operating budget to be allocated from the Government of Thailand, MIDI's capability to develop competent personnel, its construction budget and other relevant conditions.

The advisability of expanding the Institute in steps was also examined from the viewpoint of effective utilization of the facilities and with due consideration to the preparedness (particularly in training and development of competent personnel) on the part of Thailand and to the question of priority.

(3) Review on the Proper Facilities and Equipment

Facilities and equipment which were considered optimum for this Institute to play the leading role in this field were selected with due consideration to the technical level of the metal-working industries of Thailand, particularly that of the medium and small scale enterprises, the nation's industrial promotion policies, probable sophistication and diversification of the industries in future years and other factors. And, since the target of this Institute is to reeducate and retrain mainly the nucleus engineers, skilled craftsmen and managerial class, it is necessary that the maximum results be achieved within the shortest possible period and that those results be practical and readily applicable to daily business activities. Accordingly, the methods and means of education were also taken up as important subject to be considered.

(4) Review on the Operating System and Maintenance and Control Systems

In this basic design, the operating method, organization, budget, proposed manning table, maintenance and control of facilities and equipment, method of education and curricula as of this stage were thoroughly reviewed, consistency between hardware and software was pursued, and an overall plan which Thailand would reasonably be able to cope with was developed and examined so that the Institute might long function as the nucleus in promoting industrial technology of Thailand.

## B. CONTENTS OF TECHNICAL EDUCATION AND CURRICULUM

Of MIDI's various activities, the human resources development function occupies an important position as touched on in Chapter 3.

Since the scope of what will be taught will be quite extensive as it will cover the technologies of the machinery and metal-working industries, and also as it is intended to educate and train primarily the already experienced middle management and leaders of medium and small scale enterprises, the contents, their level and the methods by which they will be taught must all be in conformity with the actual situation prevailing in Thailand.

A sufficient number of staff might be secured in the initial stage of its establishment to launch this sort of education, but whether or not they will be of appropriate quality will depend upon the efforts of the Thai side, and will be an important factor in foreseeing the future of MIDI.

Furthermore, standardized software as teaching aids will be quite important from the viewpoint of maintaining a certain operating level under conditions in which transfers or resignations of staff are likely to be inevitable. In this respect, Thailand has requested the transfer of Japan's experience in this field in condensed form as software, as part of Japan's grant aid program prior to operating MIDI.

In view of the above, the contents, methods and curricula of education will be discussed below. Details of the software which can be considered for provision will be discussed later.

- Contents
- (1) The contents should be practical and be directly applicable to daily production activities rather than theoretical or academic.
  - (2) Training shall not be in elementary skills like at the vocational training institutes, but shall consist of a balanced combination of lectures and practical exercise useful to improving the enterprise.

- Methods
- (1) The curriculum shall be prepared so that the courses can be completed in one to ten days.
  - (2) If the course mainly consists of practical exercise, the size of a class is to be limited to 5 to 15 persons to be effective. If the course mainly consists of lectures, the size of the class is to be 20 to 30 persons.
  - (3) The curriculum shall be designed in modules so that each process can be understood in its entirety, in spite of the shortness of the courses.
  - (4) Audio-visual educational materials are to be used as much as possible to enhance the effects.

## C. MACHINERY AND EQUIPMENT

### 1. GIVEN CONDITIONS IN SELECTING EQUIPMENT

#### Basic Policy in Basic Design

The given conditions for basic design are the following:

- 1) Various conditions enumerated in the request of the Thai Government
  - (1) Land area of the site
  - (2) Infrastructure
  - (3) Functions and assigned role
  - (4) Operation and organization, personnel plan
  - (5) Operating fund, budgeted plan
  - (6) Educational curriculum
  - (7) Positioning and character of the Institute
- 2) Various conditions agreed upon in the Minutes of Discussions of the Basic Design Study Team
  - (1) Order of priority of processes and products to be promoted
  - (2) Order of priority of buildings and utilities
- 3) Conditions imposed on account of being a project type technical cooperation
  - (1) Scope of technical cooperation (processes and products)
  - (2) Limitation on the number of Japanese experts dispatchable
  - (3) Limited number and qualification of Thai counterparts
  - (4) The Thai government's positioning of this project and its arrangements to support its operation
  - (5) Contents and objectives of technological cooperation
- 4) Others
  - (1) Current status and future prospects of Thai metal-working and machinery industries

- (2) Prevalent state of similar institutions in ASEAN countries
- (3) Desirable vision of Thailand and Japan in this field
- (4) Machinery, manpower and activity of existing ISD
- (5) Demonstration effect for technological improvement of enterprises
- (6) Capacity and growth potential as a new institution

Evaluation and review of these given conditions and planning of equipment were carried out according to the following processes.

#### Step 1

##### Scope of Necessary Equipment and Policy for Selecting Scale (Overall Framework)

Major conditions input:

- 1) (3)(5); 2) (1); 3) (1)(2); 4) (1)(2)(5)(6)

In Step 1, it was decided that in order to determine the scope of necessary equipment and overall framework of scale particularly in the light of condition 4) (1), namely, the current status and future prospect of the Thai metal-working and machinery industries, in view of the function and role of MIDI in forging where there are only a few enterprises in Thailand in modern operating form, rather than the installation of equipment, for the time being, support is to be mostly in software. Relocation of existing facilities of ISD and provision of some new complementary equipment is envisioned.

In electroplating, a certain level has been attained by self-exerted efforts of concerned enterprises and by technical guidance of ISD. Problem which is likely to be highlighted in the future will be the treatment technology of waste liquid. Accordingly, the plan for the electroplating shop, as in the case of forging, will mainly consist of relocating existing facilities of ISD, but providing a new small scale, general purpose waste liquid treatment system for pollution abatement. Its effects as a future countermeasure will be demonstrated, and it will enable the trainees to master its use and promote its diffusion.



In the plan for all other processes except forging and electroplating, considerations were given in particular to 1) (5) operating fund and budget plan and 4) (6) capability as a new institution and its growth potential, in addition to other given conditions. As a result, contents requested by the Thai Government were rather scaled down in determining the overall scope of equipment and selection of scale.

It would be ideal to determine the scope of equipment and scale to be at such a level that would adequately satisfy the contents requested by the Thai Government. At the same time it must be sure that MIDI's equipment will not become obsolete in the foreseeable future (in the next five to ten years) and that they are of a scope and scale that are in keeping with the times and will enable MIDI to assume the leading part in upgrading the Thai metal-working and machinery industries. Various constraints, however must also be taken into consideration.

Taking these conditions into account, the scope and scale were taken as follows:

Forging: Relocation of existing ISD facilities and the installation of some complementary equipment

Electroplating: Relocation of existing ISD facilities plus installation of a new waste liquid treating system

Other processes: Provision of the minimum scope and scale of equipment by which MIDI can take the leading role in improving the technical level of enterprises in the next three to five years. Whatever usable equipment in the possession of ISD to be relocated and used.

## Step 2

### Policy for Selecting Priority Needs for Necessary Functions

Main conditions input:

1) (3)(4)(5)(6); 2) (1); 4) (1)(4)(5)

While keeping in mind the policy on overall framework of the scope and scale of necessary equipment for the processes selected according to Step 1, the MIDI Function Matrix Table was prepared by plotting the functions of MIDI by arranging the processes mostly centered on hardware on the horizontal axis according to their priority, and by arranging the major products to be promoted on the vertical axis also in the order of their priority, and then by further dividing each of these large categories into intermediate categories according to the technical elements of each process by each product to obtain the matrix table (refer to Tables 1 and 2), and assigning priority to each of its column according to the following three ranking under the foregoing main conditions input.

- ⊙: Requested function with high priority (those for which necessary dimensions, accuracy and quantity are to be satisfied)
- : Requested function with medium priority (those for which restrictions will be imposed on necessary dimensions, accuracy and quality)
- △: Requested function with low priority (although necessary, bestowing with the function which will be foregone this time)

There are two matrix tables, one of which is the ideal plan which satisfies the contents of the request for Grant Aid of the Thai Government, and the other is the basic design plan which assigns priority in three grades to the foregoing requested functions based on the overall framework of the scope and scale of necessary equipment determined in Step 1 above. Audio-visual equipment and teaching materials as common facilities are the special cases handled as relevant to both the vertical and horizontal axes.

### Step 3

#### Policy for Selecting Necessary Equipment

Major conditions input:

1) (3)(5) (6) ; 2) (1) ; 3) (1)(2)(3)(5) ; 4) (1)(2)

Here, the application status of the necessary equipment selected through the foregoing steps (selection of the scope, scale, priority of necessary equipment) was plotted by arranging the machinery used for each working process by each equipment on the horizontal axis and the major products and their parts on the vertical axis, and the degree of application of each column was divided into the three ranks of:

- : necessary
- ⊗ : can be substituted with some other,
- △ : might be used sometimes

Which resulted in Table 3.

These application frequencies were tabulated for each equipment, and on the basis of these tabulated values, the equipment were classified into those which should be installed anew, those which can be substituted by existing ISD facilities to be relocated and those which installation should be foregone this time.

#### Step 4

##### Policy for Determining Capacity, Specification and Quantity of Necessary Equipment

Major conditions input:

1) (3)(4)(5)(6)(7); 4) (1)(2)(4)(5)(6)

The conditions which regulate the capacity is the size of products, processed parts, etc. For MIDI, the basic policy is to select an equipment capacity capable of fabricating, for example, a 3' simple lathe machine. This was chosen because it is the most frequently used in the Thai medium and small scale metal-working and machinery industries, and as the fabrication process of this product contains all of the processes and technical elements of the metalworking and machinery industries, it would have the largest linkage effects on improving technical competence; and also because it is the largest in size.

In selecting the specifications, the selection of equipment specifications that will allow the Thai medium and small scale metalworking industries to attain an average technical level in the short to intermediate range (within five to eight years) was set as the standard policy in view of the current status of the Thai medium and small scale metalworking and machinery industries.

The quantity was determined in consideration of various conditions such as the frequency of educational curricula offered, the total number of participating trainees in each course, number of staff, frequency of consignment processing anticipated, equipment characteristics, etc.

#### Step 5

Policy for Determining the Size of Building in which the Equipment are to be Installed, Number of Buildings, Specifications, Layout, etc.

Major conditions input:

- 1) (1)(3)(4)(5)(6);
- 2) (1)(2);
- 3) (2)(5)(6)

The workshops in which major equipment are to be installed will be divided into two groups, one for the group of processes that generates dust, heat, and vibration, and the other for the group that does not. Audio-visual equipment, precision material testing equipment and the like shall be installed in the main building. The workshop which particularly tends to generate dust and heat will be placed with adequate consideration to the direction of wind so as to prevent adverse effect on the other facilities and equipment.

Precision working machines and others which are particularly susceptible to vibration, etc. and which tend to be adversely affected by them will be placed as far away as possible. Special consideration will also be given to the foundations and structure of the floor so as to reduce the adverse effects of vibration, etc.

The equipment shall be arranged according to the sequence of the manufacturing process flow, and ample space will be secured around each equipment so that trainees and visitors can watch while the equipment is at work without being exposed to danger.

Also, countermeasures against rain and ventilation shall be included in the specifications for buildings in consideration of heavy rainfall and the tropical heat.

Especially, unless the engineering and the work for installation of equipment and buildings are carried out in an integrated manner, it may give rise to frequent occurrences of problems at some points of contact between the two. The policy for basic design is predicated on an implementation program that resolves this point in advance.











○ : Necessary  
 ⊗ : Can be substituted with some other  
 △ : Might be used sometimes

Table 3. Application Table of Equipment for Use by Product and by Working Process

Major category	Intermediate category	Equipment used		Marking off	Planer	Shaper	Radial drill	Drill	Milling	Fig milling	Profile milling	Designing machine	Table type boring	Machining center	Slotter	Lathe	NC lathe	Turning	Electrical discharge machine	Wire cut	Plane grinding	Outer cylindrical grinding	Inner cylindrical grinding	Tool grinding	Gear hobbing machine	Gear shaper	Gear grinding	Heat treatment	Hand finishing	Other	Approximate No. of processing steps	Characteristics and remark			
		Part name	Working method																														No. of units worked		
Machine tool	Small upright drill	Base	General purpose machinery	○	○																										4				
			Planomiler	△	○																												2	Template used for perforation	
		Column	General purpose machinery	○	○																													5	
			Machining center	○	○																													4	
		Table	General purpose machinery	○	○																													2	
			Machining center	○	○																													4	
		Drilling Head (Case)	General purpose machinery	○	○																													1	
			Machining center	△	○																													7	
		Drilling Head (Gear)	General purpose machinery	○	○																													6	
			Machining center	○	○																													5	
Spindle	General purpose machinery	○	○																													3	Simple shaped		
	Machining center	○	○																												5				
Casing	General purpose machinery	○	○																													4			
	Machining center	○	○																													3	Faster turning		
Impeller	General purpose machinery	○	○																													3	Facing necessary for boring		
	Machining center	○	○																												2	When small sized			
Shaft	General purpose machinery	○	○																													2			
	NC lathe	○	○																													2			
Body	General purpose machinery	○	○																													6			
	NC lathe	○	○																													7			
Valve	General purpose machinery	○	○																													11			
	NC lathe	○	○																													10			
Pump, valve	Valve	Frequency of use	General purpose machinery	○	6	7	9	21	23	11	1	1	14	17	9	17	8	2	2	2	2	12	10	1	5	5									
			NC lathe	○	○																														
		Ranking	General purpose machinery	○	11	10	8	2	1	1	6	14	14	4	3	8	3	9	13	13	13	13	5	7	14	12	12								
			NC lathe	○	○																														