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No. 4

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OF

THE PROJECT FOR CONSTRUCTION OF

THE INDUSTRIAL STANDARDIZATION TESTING AND TRAINING CENTER

AND

THE HOUSEHOLD METHODS IMPROVEMENT SERVICE CENTER

IN

THE KINGDOM OF [redacted]

DEC. 1986

[redacted]

JICA

[redacted]

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTING
THE INDUSTRIAL STANDARDIZATION, TESTING
AND TRAINING CENTRE
AND
THE INDUSTRIAL METROLOGY TESTING SERVICE CENTRE
IN
THE KINGDOM OF THAILAND

JULY, 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

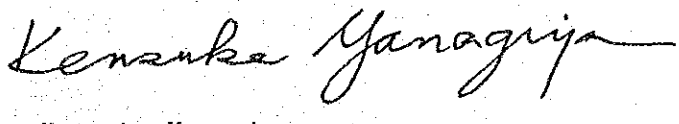
In response to the request of the Government of the Kingdom of Thailand, the Government of Japan has decided to conduct a basic design study on the Project for Constructing the Industrial Standardization, Testing and Training Centre and the Industrial Metrology Testing Service Centre and the Japan International Cooperation Agency (JICA) sent to Thailand a study team headed by Mr. Kiyoshi Isaka, Head of the Second Basic Design Study Division, Grant Aid Planning and Survey Department, JICA from March 29 to April 19, 1988.

The team had discussions on the project with the officials concerned of the Government of Thailand and conducted a field survey in the project site. After the team returned to Japan, further studies were made, a draft report was prepared and, for the explanation and discussion of it, a mission headed by Mr. Shigetaka Seki, Deputy Director, International Standards Office, Standards Department, Agency of Industrial Science and Technology, Ministry of International Trade and Industry was sent to Thailand from July 10 to July 16, 1988. As a result, the present report has been prepared.

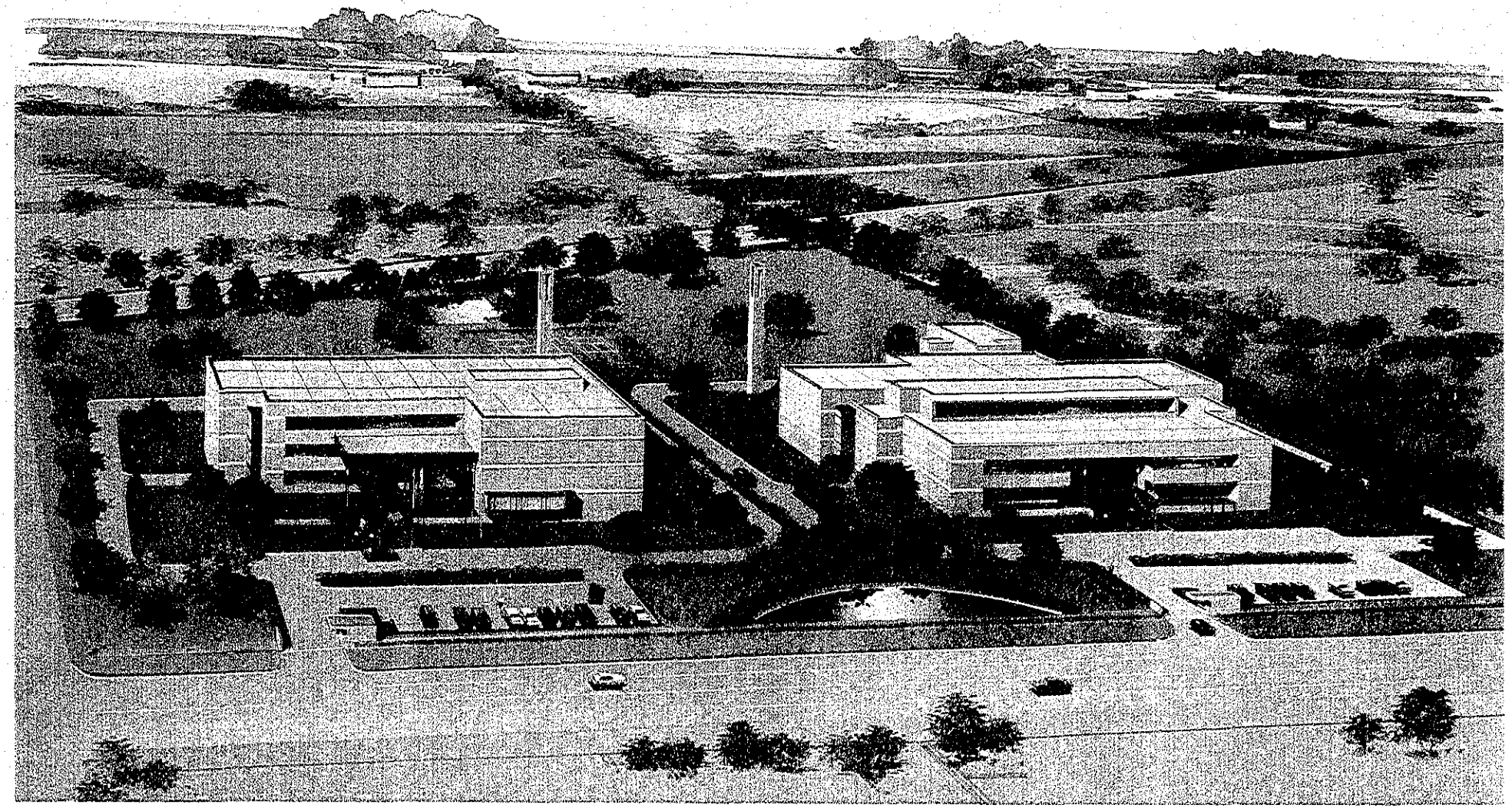
I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

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

July, 1988



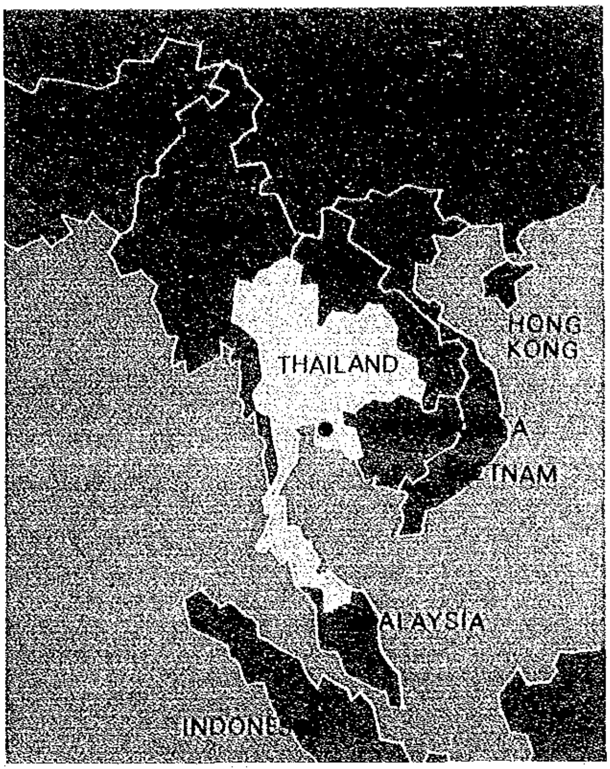
Kensuke Yanagiya
President
Japan International Cooperation Agency



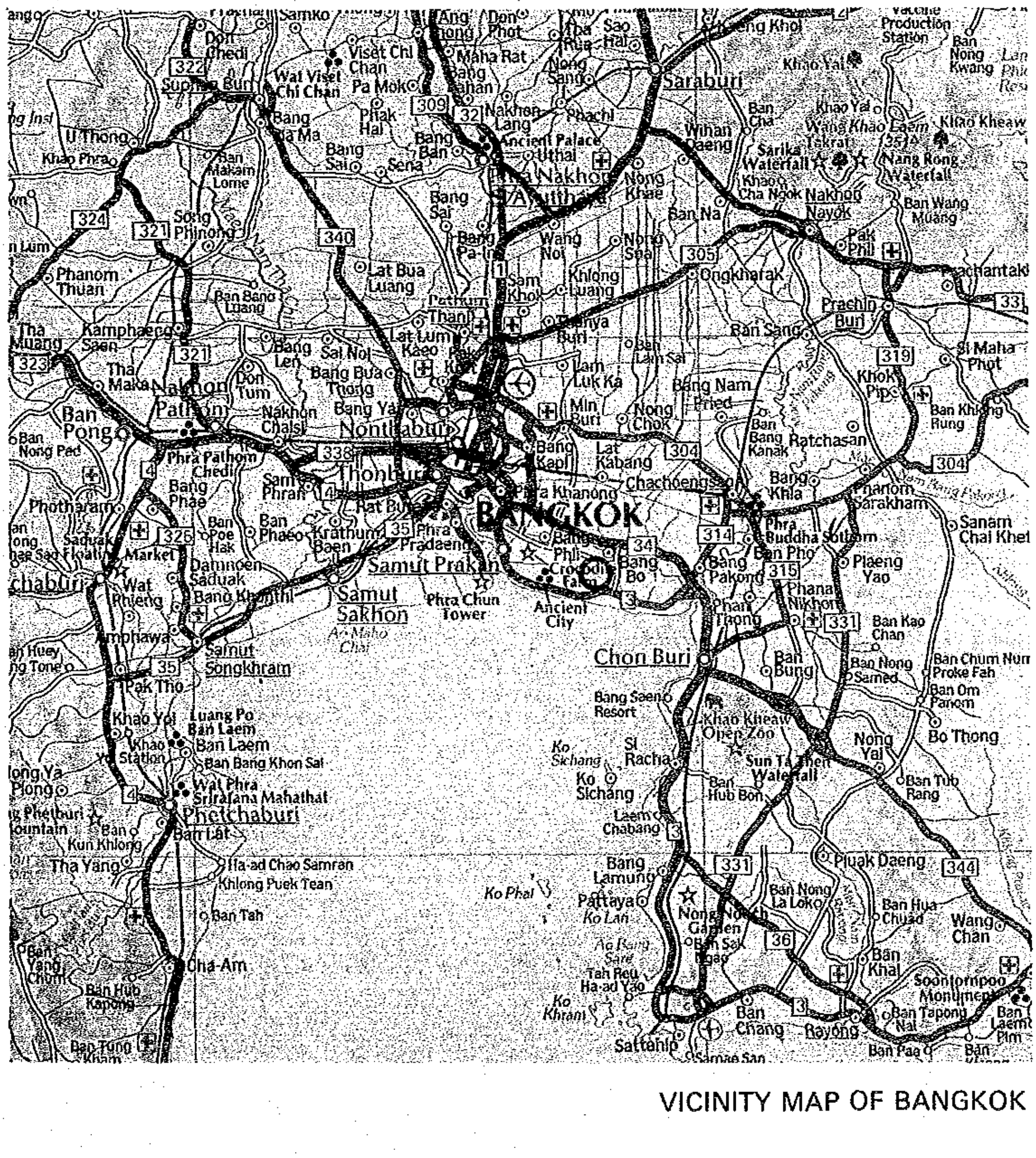
THE INDUSTRIAL STANDARDIZATION, TESTING AND TRAINING CENTRE

THE INDUSTRIAL METROLOGY TESTING SERVICE CENTRE

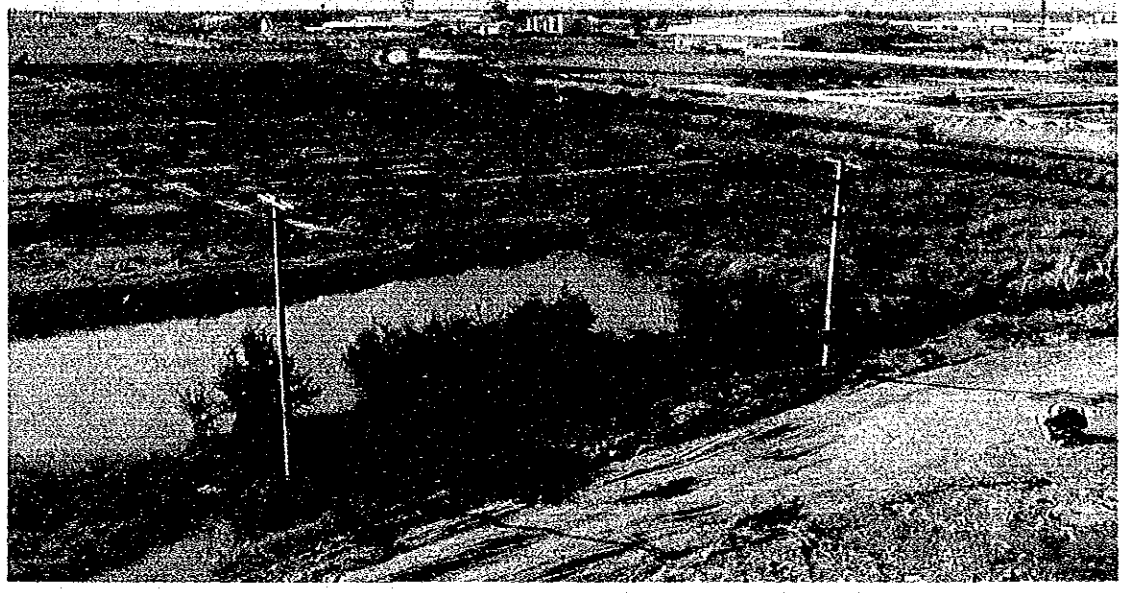
PERSPECTIVE

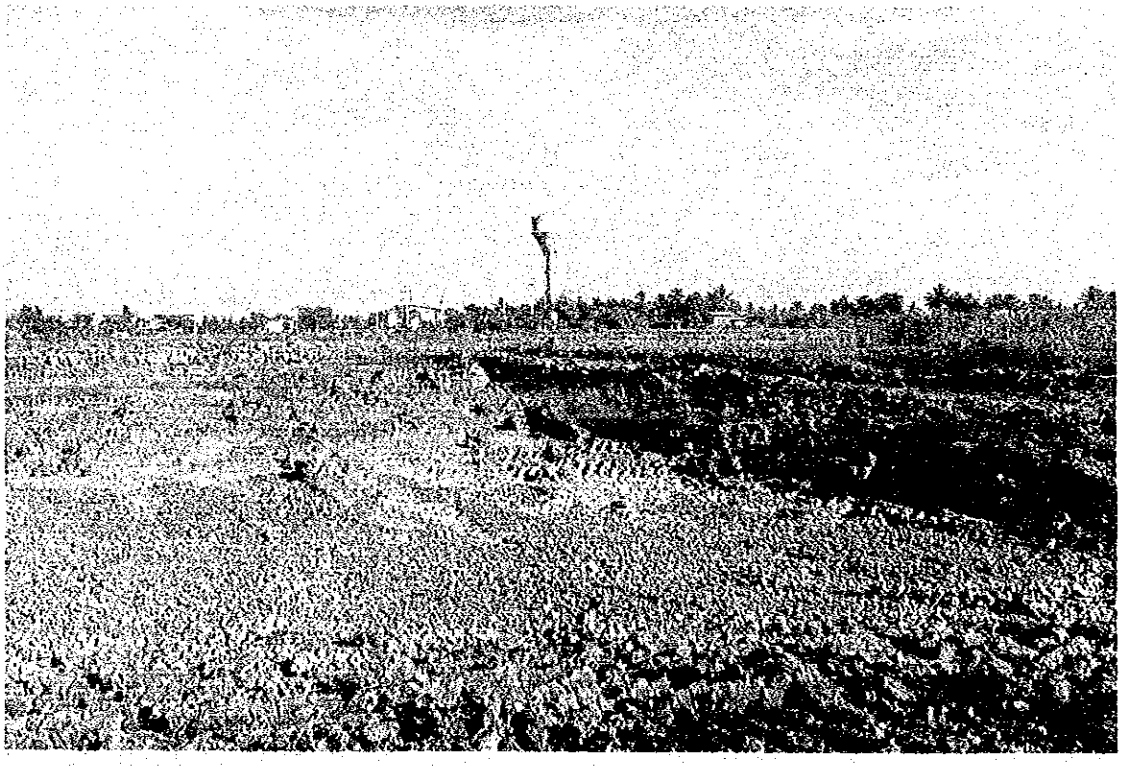


MAP OF THAILAND



VICINITY MAP OF BANGKOK





PROPOSED CONSTRUCTION SITE

SUMMARY

SUMMARY

Since 1961 when the First Five-Year Economic and Social Development Plan was initiated, the Thai economy has been growing steadily, with the nation's gross domestic product (GDP) maintaining high annual growth rates ranging from 6% to 8%. On the other hand, the ratio of industrial production to GDP has also been continuing to rise. It increased from 12% in 1960 to 20.8% in 1985. The manufacturing industry sector's growth rate has always exceeded that of the GDP. As is clear from the above figures, the growth of the Thai economy is largely attributable to the expansion of its manufacturing industry sector. The Thai Government is now in the process of implementing economic development policies centered around industrial development programme on the assumption that this trend will continue.

The present Thai trade position is characterized by chronic deficits, although both exports and imports are on the rise reflecting the expansion of industry and the increase in consumption demand. Improving the nation's trade balance is indispensable to the further growth of the Thai economy. It is essential, in this context, to increase the nation's exports by enhancing the quality of labour-intensive products and increasing international competitiveness of the nation's industry. To this purpose, there is a strong need to promote industrial product-centered export policy measures.

On the other hand, Thailand's basic industrial structure has as its main characteristics the following factors:

1. Factories are small in scale

2. A high percentage of the nation's labour force in the industrial sector is concentrated in medium and large-size factories.

3. Labour intensity of small industries is high.

4. Factories are concentrated in the metropolitan area and factories in rural areas are small in scale.

In Thailand, most of the manufacturing facilities are small underfinanced factories deficient in equipment, technology and skills. For Thailand's industry to continue to grow, it is essential to enhance the capabilities of these small factories in terms of product quality and delivery time, and to integrate them into the nation's modern industrial production system.

In light of the current situation for the nation's industry, the Thai Government has recognized the need to introduce a quality control system for the private sector, and is now actively promoting the expansion of the nation's current industrial standardization and setting up a metrological system.

With the background mentioned above, the Thai Government planned to establish the Development Centres for Industrial Standardization, Testing and Metrology with a view to developing the nation's industrial standardization, testing and metrology. Those would result in improving the nation's industrial base for further growth of its industry, grant aid for the project to be provided by the Japanese Government was, therefore, requested by the Thai Government.

In response to the above request, the Japanese Government conducted the development survey in February, 1987 through the Japan International Cooperation Agency (JICA) and drew up the master plan in regard to enhancement of industrial standardization, testing and metrology in Thailand. Based on the result of above survey, JICA confirmed the content of the request and examined the extent of the cooperation through the joint survey implemented in December, 1987 by the Preliminary Study Team which is concerned with the grant aid and the Contact Mission which is

concerned with the technical cooperation. As the result of the examinations, it was concluded that an early implementation of grant aid to the project was necessary. And the Japanese Government dispatched a Basic Design Study Team to Thailand from March 29 to April 19, 1988 through the Japan International Cooperation Agency (JICA) for the purpose of examining the feasibility of the project and of conducting basic design of the facilities and equipment necessary for the project.

This project consists of the "Industrial Standardization, Testing and Training Centre" and the "Industrial Metrology Testing Service Centre."

The major functions of the two Centres are as listed below.

The Industrial Standardization, Testing and Training Centre

1. Testings for developing of draft industrial standards and certification.

2. Conducting trainings in standardization, quality control and testing techniques.

3. Research and technical guidance on standardization, quality control and testing.

4. Dissemination of technical information and diffusion of technologies.

5. Implementation of testing on request.

The Industrial Metrology Testing Service Centre

(1) Metrology

1. Establishing a system for supplying industrial metrological standards.

2. Establishing, maintaining and supplying industrial metrological standards.

3. Increasing precision in calibration, expanding scope of calibration and development of new techniques.

4. Implementing metrological calibration services.

5. Technical guidance and diffusion of metrological techniques, and dissemination of information on metrological techniques.

(2) Testing

1. Implementation of testing for research and development.

2. Implementation of testing on request.

3. Training engineers in testing techniques.

4. Dissemination of technical information.

Taking into account the above-mentioned functions required of the two Centers and the contents of the request from the Thai Government, the survey of the local natural conditions, the project site, the local infrastructure and the local construction situation was conducted. Based on the analysis result of the data collected at the survey, the optimal contents and scales of the facilities were decided as shown below.

The Industrial Standardization, Testing and Training Centre

(1) Facilities

1. Testing facilities:

Mechanical testing laboratory, Environment testing laboratory, Air delivery room, Rainproof testing laboratory, Chemical testing laboratory, N.D.T. laboratory, Electrical testing laboratory, Electronics

testing laboratory, Anechoic room, Electronic auto-parts testing laboratory, Calorimeter room, etc.

2. Training and conference facilities:
   Seminar rooms (3 rooms with seating capacity of 50, 50 and 15 respectively), Conference room, Canteen, etc.

3. Administrative facilities:
   Director's room, Administration office, Staff room, Library, etc.

(2) Equipment

1. Equipment for standardization:
   Equipment for training and lecture,
   Equipment for training material production
   Vehicles for roving, etc.

2. Equipment for certification:
   Office machines such as copying machine, computer, etc.

3. Equipment for certification testing:
   Electrical and Electronics
   - Performance testing equipment
   - Safety testing equipment
   - Endurance testing equipment
   - Reliability testing equipment, etc.

   Mechanical
   - Material testing equipment
   - Non-Distructive-Testing equipment
   - Dimensional measurement equipment
   - Performance testing equipment, etc.

Chemical

- Analytical equipment for chemical products
- Analytical equipment for feed and consumer's products
- Analytical equipment for metallic elements

The Industrial Metrology Testing Service Centre

(1) Facilities

1. Testing facilities:

   Laboratories

   Length laboratory, Volume laboratory, Mass laboratory, Vibration laboratory, Pressure laboratory, Force laboratory, Temperature laboratory, Photometry and radiation laboratory, Electrical and Electronic laboratory, Anechoic room, etc.

   Testing laboratories

   Mechanical testing laboratory, Electrical testing laboratory, Environment testing laboratory, Chemical testing laboratory, Biochemical testing laboratory, N.D.T. laboratory, Flame testing laboratory, Precision measurement laboratory, etc.

2. Administrative facilities:

   Director's room, Administration office, Staff room, Library, Guest room, etc.

(2) Equipment

1. Equipment for Metrology:

   Metrological standard

   - Standards for electrical, thermometry, photometry and radiation
   - Equipment for the system of the maintenance and management on the mentioned quantities

Calibration

- Standards for length, mass, volume, force, pressure, thermometry, electrical, acoustic and photometry
- Equipment for the system of the maintenance and management on the mentioned quantities
- Vehicles, etc.

2. Equipment for testing:

Chemical and Biochemical

- Chemical substance composition testing equipment
- Analytical equipment for organic substance components and structure
- Contents analyzing equipment, etc.

Mechanical

- Testing equipment for metal structure
- Non-Destructive-Testing equipment
- Equipment for test specimen preparation, etc.

Electrical and Electronic

- Equipment for power supply
- Safety testing equipment
- Performance testing equipment
- Reliability testing equipment, etc.

An approximate 4.2ha of land is secured for the construction site located in the Bangpoo Industrial Estate in Samutprakarn Province, 34km south of Bangkok. It is about 50 minutes distance by car partially through expressway from the central part of Bangkok to the site. The site has no serious problems for the construction of the Centres in terms of ground conditions, area and environmental situations.

Implementation of the project will be divided into two phases, namely Phase 1 (construction of the buildings and procurement and installation of part of the equipment) and Phase 2 (procurement and installation of

equipment).
The total project implementation period is estimated to be about 23 months after the signing of Exchange of Note; 3 months will be required for the consultant contract, procedure of detail design, preparation of tender documents and tender, and another 20 months for tender evaluation, construction/equipment contracts and construction works and equipment works both of Phase 1 and Phase 2.

The estimated total project costs to be defrayed by the Thai Government is about 13.55 million baht.

As to the implementation of the project, the Thai Industrial Standards Institute (TISI) and the Thailand Institute of Scientific and Technological Research (TISTR) will be respectively responsible for operation and maintenance of the Industrial Standardization, Testing and Training Centre and the Industrial Metrology Testing Service Centre.
The organization and personnel assignment plan for the operation of both Centres have already been confirmed. It is scheduled that 107 staff will be assigned to the Industrial Standardization, Testing and Training Centre and 96 staff to the Industrial Metrology Testing Service Centre in the first five years.

The opening of the two Centres will contribute to the promotion of industrial standardization, more efficient certification testing and improvements in industrial metrological technique and testing technique, which in turn will enhance the level of Thai industry with the improvement of Thai-made products' quality and will eventually enhance and stabilize the socio-economic living standard of the Thai people. Therefore, this project has great significance and the grant aid to be provided by the Japanese Government for this project is judged to be sufficiently appropriate.

It should be added that utmost emphasis must be placed on recruiting and training the technical staff, as well as on securing a sufficient budget

for this project. Furthermore if the technical cooperation by the Japanese Government is implemented for the project, the effects of the grant aid will be maximized.

CONTENTS

CHAPTER 1 INTRODUCTOIN

CHAPTER 1 INTRODUCTION

For the purpose of improving the quality of the nation's industrial products, promoting exports of Thai-made products and increasing their competitiveness relative to imported ones, the Thai Government is currently in the process of working out and implementing various policy measures to promote the nation's industrial standardization and the certification scheme, promote the concept of quality control and improve the nation's testing and inspection capabilities as well as metrological system and calibration services. Promotion of industrial standardization, testing, inspection and metrological calibration systems, in particular, is positioned as a most important policy measure for promotion of industrial development and diversification of the nation's export goods in the Thai Government's 6th Five-Year National Economic and Social Development Plan (NESDP). That there is an urgent need to improve the capabilities of the nation's testing and inspecting function has been not only recognized by Thai industrial circles but also referred to in a resolution by the Industrial Restructuring Committee of the National Economic and Social Development Board (NESDB).
Regarding the promotion of the nation's industrial standardization, testing, inspection and metrological calibration systems, it was addressed by the Sub-Committee on the Restructuring of Economic Relations between Thailand and Japan which discussed problems of trade and economic cooperation between the two countries in 1985.

Against such a background, the Thailand Institute of Scientific and Technological Research (TISTR), an institution responsible for inspecting Thai-made industrial products, which is under the control of the Ministry of Science, Technology and Energy, requested the Japanese Government to conduct a survey which will be conducive to the improvement of industrial standardization and metrological techniques in Thailand. Later on, in

June 1986, the TISTR requested the Japanese Government to conduct a study on testing, metrological calibration and to provide a grant aid. In August 1986, on the other hand, the Thai Industrial Standards Institute (TISI) which is responsible for administrative affairs in industrial standardization in Thailand, made a request for a grant aid for constructing a testing centre aimed at improving the TISI's industrial standards testing capabilities and procuring the equipment to be installed in the testing centre in the course of an annual consultation session on technical cooperation between Thailand and Japan.

The contents of the above-mentioned requests from TISI and TISTR are as summarized below.

TISI

TISI, which is currently commissioning other public organizations to conduct many of the tests on certification, is experiencing great delays in certification test due to a shortage of testing equipment and preoccupation with their own research works. Furthermore, in the area of development of industrial standards, TISI is unable to keep pace with industrial advancement because of a lack of its own research facilities. Reaching the conclusion that it was necessary to construct a testing centre under its direct control and install necessary equipment in it in order to overcome these problems, the TISI asked for construction of such a testing centre and provision of the equipment to be installed in it. Furthermore, in order to obtain more effictive function of tests on certification, TISI, having a plan of increasing a large number of technical staff, asked the Japanese Government to offer a project-type technical cooperation to improve their technical capabilities.

TISTR

To promote exports of Thai-made goods, it is necessary to develop new industrial and processed agricultural products and at the same time

endeavor to comply with the technical regulations and performance requirements of destinations. In fact, there have been increasing demands for testing and evaluation of new products from the nation's other government organizations and private enterprises. Moreover, these demands have become more and more diversified and sophisticated. TISTR, reaching the conclusion that, to comply with this situation, it is necessary to construct a testing centre and procure the testing equipment including chemical analysis equipment to be installed in it, asked the Japanese Government to construct such a testing centre and provide the equipment to be installed in it.

For the quality of Thai-made goods to be upgraded so that they may be well competitive in international market, it is essential to establish viable metrological standard and improve the quality of the TISTR's own calibration services. For this purpose, it is necessary to construct additional metrological testing facilities and procure new and additional pieces of standard measuring and calibration equipment. For this reason, TISTR has asked the Japanese Government to provide such facilities and equipment.

TISTR, also having a plan of increasing a large number of testing and research personnel to meet the increasing demands for its testing and research work, asked the Japanese Government for a technical cooperation for improving their technical capabilities.

As a result of discussions on these requests from TISI and TISTR in the annual consultation session on technical cooperation between the two countries held in August 1986 and the subsequent administrative level discussion between both countries, these requests were combined into one. Japan International Cooperation Agency (JICA) dispatched the study team for the preparation of a master plan to promote industrial standardization, testing/inspection and metrological systems in February 1987 and the report on the survey was presented to both Governments of Japan and the Kingdom of Thailand in December 1987.

Furthermore, in December 1987 JICA sent a Japanese Preliminary Survey Team

to Thailand to discuss the details of the project to construct the Industrial Standardization, Testing and Training Centre and the Industrial Metrology Testing Service Center with representatives of the Thai Government, and a formal letter of request for a grant aid for this project, which was based on the results of the above-mentioned discussion, was submitted to the Japanese Government from the Thai Government.

For the purpose of confirming the background of this project and the details of the Thai request and investigating various factors likely to affect the implementation of this project, JICA dispatched a Basic Design Study Team headed by Kiyoshi Isaka, Head of Second Basic Design Study Devision, Grant Aid Planning and Survey Department, JICA, to Thailand. The Basic Design Study Team conducted the survey for 22 days starting March 29, 1988.

After returning to Japan, the Basic Design Study Team consulted repeatedly with representatives of all the organizations concerned with this project and at the same time carefully examined the propriety and optimal scale of this project, as well as a system for operating and maintaining the prospective facilities after studying and adjusting the contents of the prospective technical cooperation, and then drew up the equipment and facility plans and the basic design.

Upon completion of the above analysis, JICA summarized the results of the analysis work in a draft report and then dispatched a team headed by Shigetaka Seki, Deputy Director, International Standards Office, Standards Department, Agency of Industrial Science and Technology, Ministry of International Trade and Industry, to Thailand to explain the draft report to the Thai counterparts. For seven days starting July 10, 1988 the team explained the contents of the basic design to the Thai counterparts and obtained their consent to it. This report describes the results of the above-mentioned basic design study.

The list of the members of the Basic Design Study Team, the study schedule, the list of Thai counterparts and a copy of the minutes of meeting are included at the end of this report.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Current Status of the Thai Industry

2-1-1 Progress of Thai Industrialization in Terms of Gross Domestic Product (GDP)

The starting point of Thai industrialization was the 1st National Economic Development Plan (NEDP), drawn up by the National Economic Development Board (NEDB), based on a report entitled "A Public Development Programme for Thailand" issued in 1959, and in corporating the results of the survey of Thai economy, undertaken by a mission sent from the World Bank.

This 1st NEDP was followed in the ensuing years by succeeding National Economic and Social Development Plans (NESDP), and today, the 6th NESDP is under way. During the period covered by these Development Plans, Thai economy can be considered to have progressed smoothly, despite the series of economic upheavals that marked this period, notably the two oil crises of the 1970's, followed by the stagnation that is still affecting the world economy since the beginning of the 1980's. The country's economic progress is evidenced in the sustained growth recorded of gross domestic product (GDP) and of the manufacturing industry's production, as indicated in Fig.2.1-1 in terms of 3-year moving averages. It is revealed from this figure that the GDP has consistently increased by 6 to 8 percent per year from 1960 to date. The importance of the part played by industrialization is evinced by the fact that the manufacturing industries have steadily maintained a level of growth higher than that of the overall GDP, with only one exception for the early 1980's, which reflected the world wide business recession.

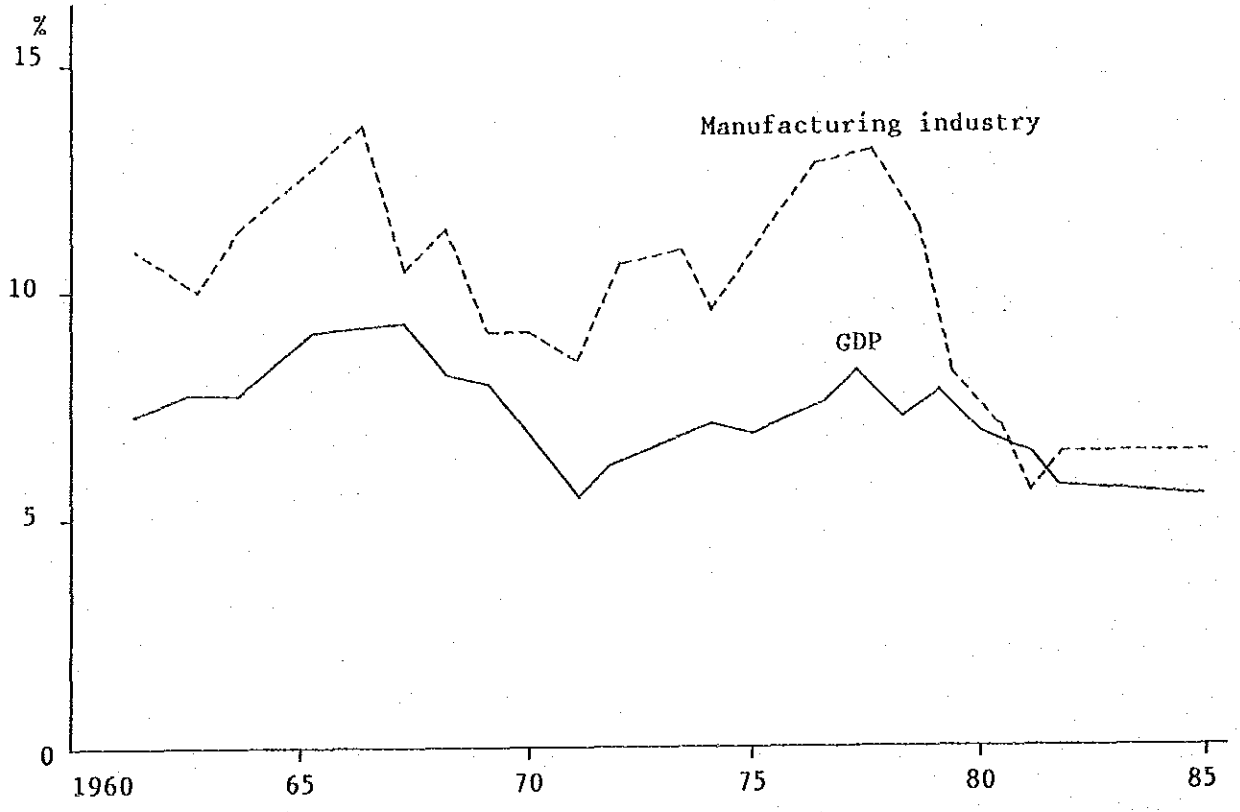

Fig. 2.1-1 Growth Rate of Thai Economy and Industry
(3-year moving average)

The progress of industrialization can also be considered in terms of the relative shares contributed by the agricultural and manufacturing sectors of industry, as represented in Table 2.1-1. It is seen that the share contributed by the agricultural sector which in the early 1950's had contributed roughly half of the GDP, marked a consistent decline from 40.2 percent in 1960 to 32.2 percent in 1970, and to 24.9 percent in 1980, and further to 23.2 percent in 1985. The converse growth of industry, particularly the manufacturing industry, is evidenced in the share of 12.0 percent of 1960 almost doubling by 1985 to 20.8 percent, to rank almost side by side with agriculture, and constitute the leading factor in the growth of Thai economy since the early 1960's.

Thus, while the importance of agriculture must never be neglected in considering the future of Thai economy, the contribution to be expected of industry, in particular, the manufacturing industry, requires to be accorded due attention. Current status of Thai industry will be treated in the following clauses.

Table 2.1-1 Shares Contributed to GDP by the Different Sectors of Economic Activity (Normalized to 1972 prices)

Sector	Share Percentage (%)					
	1960年	1965	1970	1975	1980	1985 *
Agriculture	40.2	36.1	32.2	30.4	24.9	23.2
Mining	1.2	1.7	1.7	1.2	1.6	1.6
Manufacturing	12.0	14.3	15.5	18.2	20.7	20.8
Construction	4.8	4.7	5.8	4.2	5.7	4.6
Services and others	41.8	42.2	44.8	46.0	47.1	49.8
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0

* : 1985 (Preliminary estimates)
Source: "National Income of Thailand", published by NESDB

2-1-2 Outline of Thai Export Industry

As regards Thai export industry, the ratio of export of industrial products to agricultural products has steadily been increasing. Following is the outline of her trade industry. Export trade has progressed as indicated in Table 2.1-2, which gives the data for staple export goods.
Six product categories, rice, rubber, maize, tapioca products, prawns, and sugar, occupied 6 of the 10 leading positions in Table 2.1-2 attest to the continuing prominence of agricultural products in the export trade. In 1985, the above 6 product categories still represented in value 35 percent of the total export.
It is notable, however, that rice which has traditionally been the outstanding staple article of export, is gradually decreasing its share,

with the rising weight of manufactured products, to reflect the effect of progressing industrialization. An illustrative instance is textile product which is rapidly raising its share, to contribute 12.2 percent of total in 1985. During the same year, integrated circuits also reached 4.3 percent share, and is continuing its rise.

According to "Trade of the world and Japan (1987)" published by Japan External Trade Organization (JETRO), export ratio of industrial products to total export has increased from 15.5% in 1970 to 54.9% in 1986.

Table 2.1-2 Progress of Staple Exports: Product Categories Exported

(Unit: B million)

Principal Exports	1980	1981	1982	1983	1984	1985
Rice	19,508	26,366	22,510	20,157	25,932	22,524
Rubber	12,351	10,841	9,490	11,787	13,004	13,567
Maize	7,299	8,349	8,330	8,468	10,147	7,700
Tapioca products	14,887	16,446	19,752	15,387	16,600	14,969
Prawns	1,961	2,136	2,764	3,164	2,799	3,439
Tin	11,347	9,091	7,773	5,265	5,280	5,647
Sugar	2,975	9,527	12,932	6,338	5,222	6,247
Integrated circuits	6,156	6,193	5,930	5,829	7,352	8,248
Textile products	9,643	12,570	14,005	14,351	19,155	23,578
Precious stones	3,240	4,486	4,671	6,214	6,129	6,350
Total principal exports	89,367	106,050	108,157	96,978	111,620	112,269
Others	43,830	46,951	51,571	49,497	63,617	81,097
Total	133,197	153,001	159,728	146,472	175,237	193,366

Source: Bank of Thailand, Quarterly Bulletin

2-1-3 Past Progress of Thai Industry and Changes in Industrial Structure

Thai industry has been achieving favourable development, and her industrial structure is changing in accordance with the development.

It is revealed from Table 2.1-3 that, in 1960, 60 percent of the total value added by all categories of industry was contributed by the 3 product

categories of foodstuffs, beverage, and tobacco manufacture, but that this share of the 3 categories had lowered to 44 percent in 1970, to 31.5 percent in 1980, and further to 29.6 percent in 1985. Of the foregoing product categories, foodstuffs alone, which used to be the staple national product, contributing 42 percent in 1960, dropped to 15 percent in 1985. In contrast, the share of textiles steadily rose during the same period from 4.6 to 15.1 percent, and electrical equipment from 0.6 to 2.0 percent.

Grouping the foregoing different product categories into product categories of consumer goods, intermediate goods, and capital goods, the total share of consumer goods production diminished from 72.4 in 1960 to 44.9 percent in 1985, and this was offset during the same period by an increase in share from 20.1 to 38.4 percent of intermediate goods, and from 6.7 to 13.7 percent of capital goods.

The foregoing observations well characterize the changes seen in the industrial structure which are changing from the food processing to the textile and machinery industry, and from consumer goods category to intermediate and capital goods categories accompanying the development of Thai industry.

Table 2.1-3 Progress of Shares Contributed by Different Categories of Industry

Unit: B million, normalized to 1972 prices

	1960		1970		1980		1985*	
I Consumer goods category	6,071	72.4%	12,384	53.1%	26,988	44.5%	35,425	44.9%
Foodstuffs	3,528	42.1	4,798	20.6	8,598	14.2	11,926	15.1
Beverage	654	7.8	3,035	13.0	5,890	9.7	7,044	8.9
Tobacco	849	10.1	2,401	10.3	4,601	7.6	4,438	5.6
Apparel	631	7.5	1,093	4.7	5,566	9.2	9,075	11.5
Leather goods/footwear	26	0.3	232	1.0	315	0.5	528	0.7
Furniture	100	1.2	308	1.3	353	0.6	548	0.7
Printing/ Publishing	283	3.4	517	2.2	1,665	2.7	1,866	2.4
II Intermediate goods category	1,689	20.1	7,506	32.2	23,768	39.2	30,315	38.4
Textile	386	4.6	2,157	9.2	8,839	14.6	11,931	15.1
Wooden products	338	4.0	735	3.2	928	1.4	1,024	1.3
Paper products	13	0.2	171	0.7	959	1.6	1,180	1.5
Chemical products	562	6.7	1,478	6.3	5,035	8.3	6,969	8.8
Petroleum products	1	0.0	1,414	6.1	3,108	5.1	3,112	3.9
Rubber products	67	0.8	372	1.6	1,611	2.7	1,407	1.8
Non-metallic/ mineral products	322	3.8	1,179	5.1	3,387	5.6	4,692	6.0
III Capital goods category	559	6.7	2,883	12.4	8,493	14.0	10,793	13.7
Base metals	29	0.3	392	1.7	710	1.2	673	0.9
Metal products	57	0.7	439	1.9	632	1.0	831	1.0
Machinery	38	0.5	534	2.3	1,102	1.8	1,550	2.0
Electric equipment	48	0.6	318	1.4	1,237	2.0	1,546	2.0
Transport equipment	387	4.6	1,200	5.1	4,812	7.9	6,193	7.8
IV Other categories	68	0.8	547	2.3	1,348	2.2	2,388	3.0
Total	8,389	100.0	23,320	100.0	60,597	100.0	78,921	100.0

*) 1985 : Preliminary estimates

Source : NESDB

2-1-4 Basic Structure of the Thai Industry

The basic structure of Thai industry which is changing as stated above will be treated in the following from the view point of numbers and content of factories.

The numbers of factories registered by Factory Control Division are reproduced in Fig. 2.1-2 for the period from 1950 to date. During this period, the total number of registered factories increased from 1,154 to 86,165 as of the end of 1984. Of this number, 39,626 factories in the manufacturing industry are taken up in Table 2.1-4, which reveals that small and medium factories number 38,985, representing an overwhelming portion of 98.4 percent, of which 25,342 are cottage factories, representating 64 percent of the total number, followed by small factories at 11,532 (29.1%), by medium factories numbering 2,111 (5.3%), and by large factories total 641 (1.6%). The predominant portion of petty industry factories is thus evident.

In respect of providing employment opportunities, however, the small and medium factories provide work for only 58.8 percent of the total employed labour force, whereas the 641 large factories employ 373,014, 41.2 percent of the total labour force. Regrouped into cottage/small and medium/large factories, the smaller group representing 93.1 percent in number of factories employs only 37.9 percent of the labour force, while the large group, representing 6.9 percent in number of factories, employs 62.1 percent of the working population. In terms of invested capital (fixed assets), the small group accounts for 24.0 percent, and the larger group 76.0 percent. The invested capital divided by the number of employees, or the capital-labour ratio, is seen to lower with diminishing size of factory, which is indicative of the labour-intensive character of the Thai manufacturing industry.

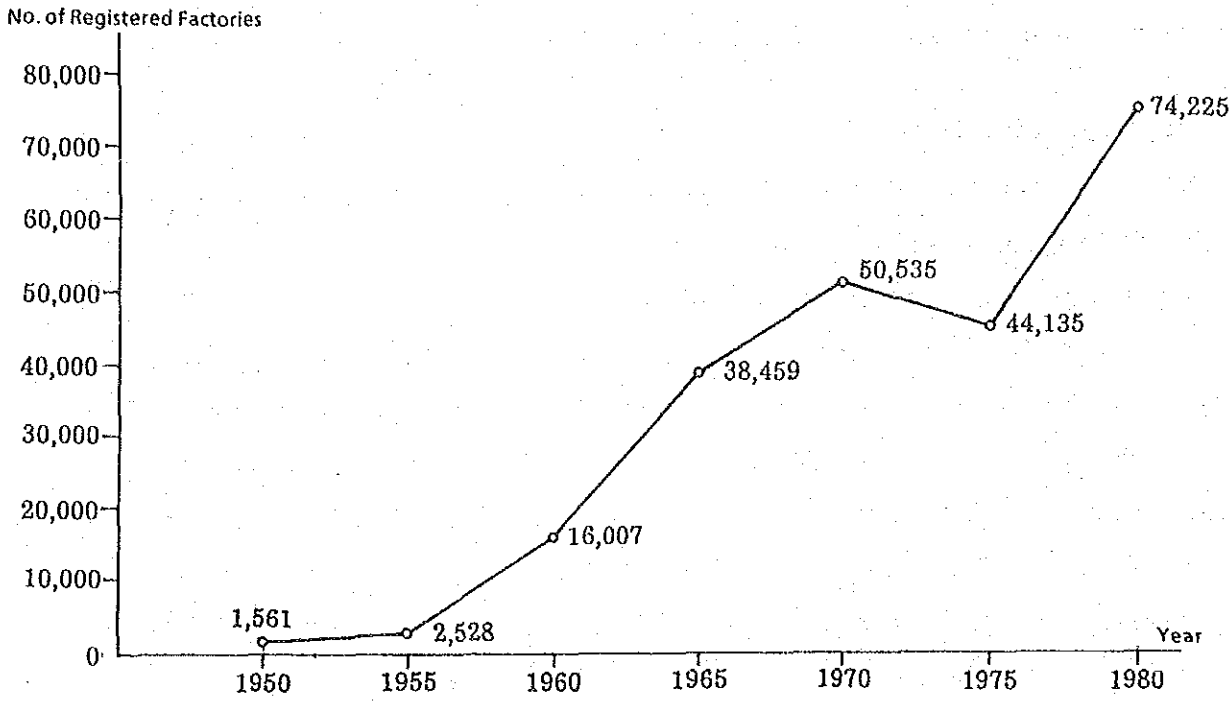

Fig. 2.1-2 Number of Registered Factories

Table 2.1-4 Structure of Thai Manufacturing Industry (1984)

Size Category (Number of employees)	Number of Factories (No.)	%	Number of Employees (No.)	%	Invested Capital (B million)	%
Small/medium	38,985	98.4	531,737	58.8	83,108	45.7
Cottage (9 and less)	25,342	64.0	122,726	13.6	12,837	7.0
Small (10 ~ 49)	11,532	29.1	219,969	24.3	30,895	17.0
Medium (50 ~ 199)	2,111	5.3	189,042	20.9	39,376	21.7
Large (200 and more)	641	1.6	373,014	41.2	98,553	54.3
Total	39,626	100	904,751	100	181,661	100

Source: Data on Registered Factories, Industrial Provincial Office, Ministry of Industry (MOI).

The 39,626 factories given in the foregoing are further classified into the 26 product categories according to the Thai Industrial Standard

Classification System. It is seen that, of the 38,985 factories in the small/medium group, the product category representing the highest number of factories is that of foodstuffs, followed by general machinery, metal products, wood and wooden products, transport machinery, motor repairing, printing and publishing, plastic products, non-metallic products, and clothing. The above 10 leading product categories account for roughly 80 percent of the number of factories. (Table 2.1-5) Classified by product categories, 13,517 factories (representing 34.7%) manufacture consumer goods, 9,543 (24.5%) intermediate goods, 13,361 (34.3%) capital goods, and 2,564 (6.6%) other products, of which 2,174 are motor repair shops. It is notable that approximately the same number of factories produce consumer and capital goods. It may also be noted that in the large size category, there are more than 100 factories producing textiles, other relatively well-represented product categories being clothing, tobacco, transport machinery, metal, chemical and rubber products, and electrical appliances.

The small/medium size category is characterized by an approximately 40 percent share of foodstuffs, wood/wooden products (largely sawmills), furniture, ceramic/non-metallic/mineral and rubber products, tobacco, and leather goods, most of which process materials produced domestically. Other product categories well represented include general machinery, metal products, transport machinery, and motor repair, product categories that are mostly associated with metalworking and machinery manufacture, and together they constitute roughly 40 percent of the number of factories.

The 8 product categories in metalworking and machinery manufacture (basic iron and steel, nonferrous metal products, general machinery, electrical equipment, transport machinery, precision/scientific equipment, motor repair) have 15,659 cottage and small factories which account for 96.3 percent, leaving only a small fraction contributed by the medium size and large factories. This small contribution by medium size factories calls for attention, since it should constitute a key category of enterprise in