BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
PROVIDING THE EQUIPMENT
FOR
PATHUMWAN TECHNICAL COLLEGE
IN
THE KINGDOM OF THAILAND

August 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a basic design study on the Project for Providing the Equipment for Pathumwan Technical College and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Dr. Katsumi Ishihara, Professor, Department of Mechanical Engineering, Gifu National College of Technology, from March 11 to March 30, 1991.

The team held discussions with the officials concerned of the Government of Thailand, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Thailand in order to discuss a draft report and the present report was prepared.

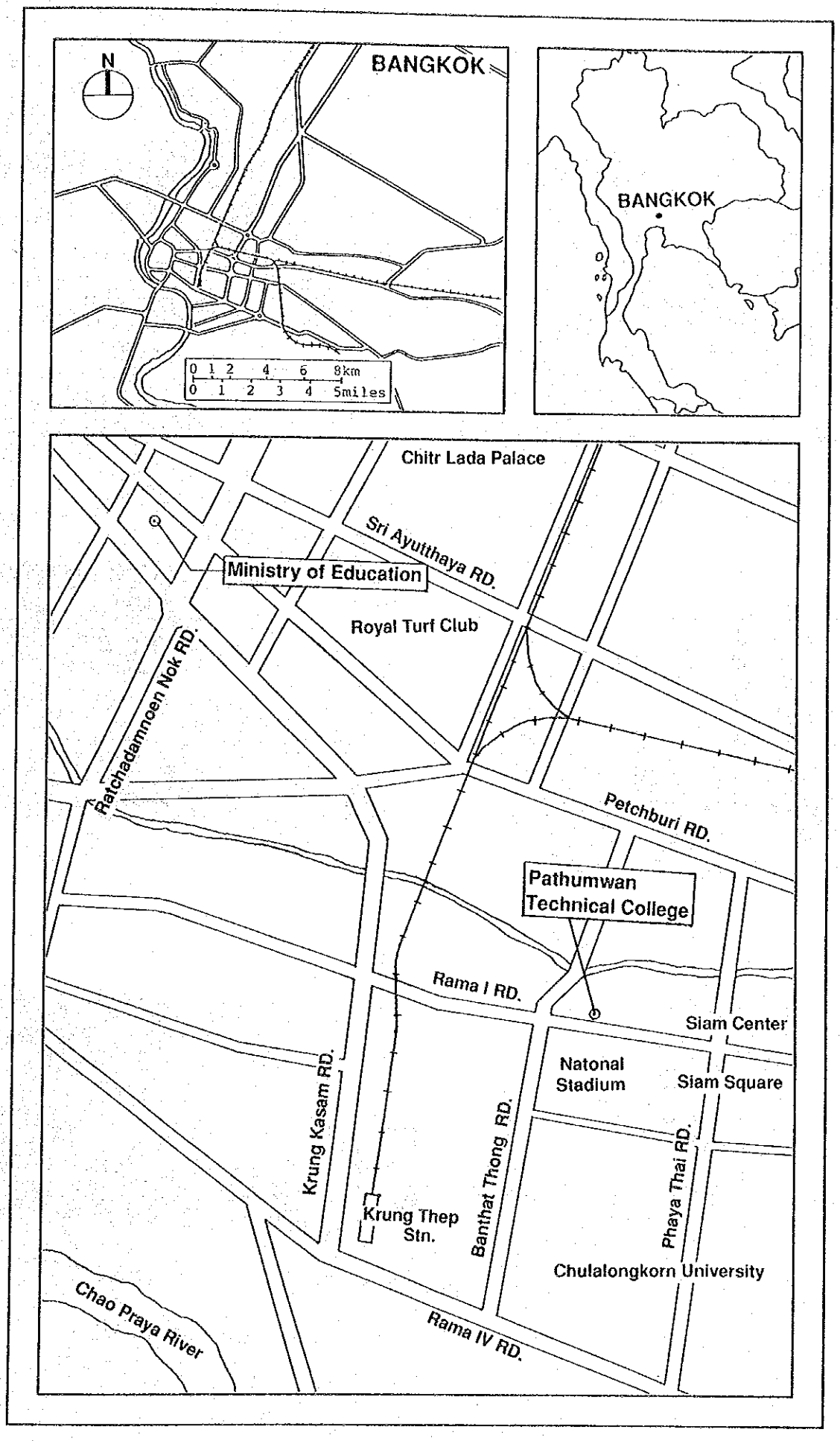
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

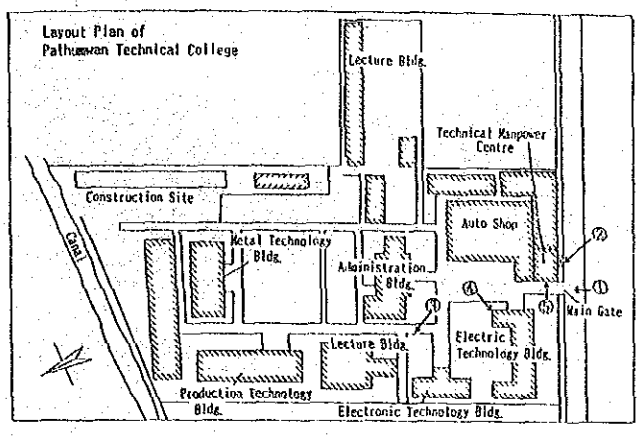
August 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

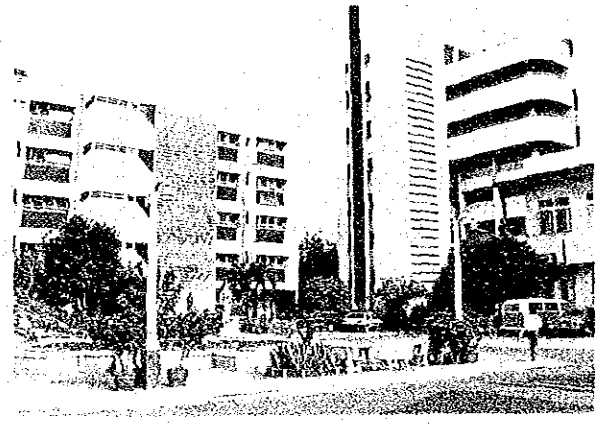


LOCATION OF THE PROJECT SITE



①Main Gate and Administration Bldg.

②Name Plate of PTC



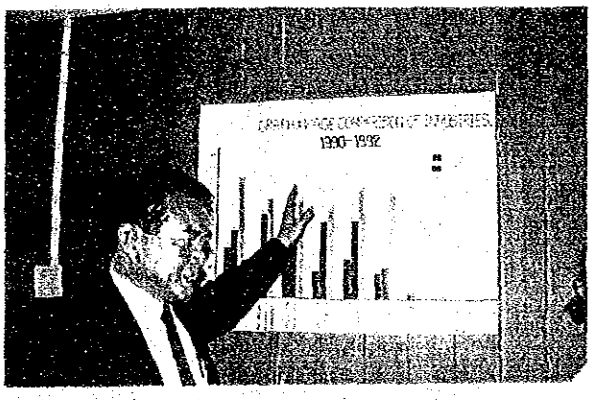
③Electronic Technology Bldg. (left)
& Lecture Bldg. (right)

④Electric Technology Bldg.

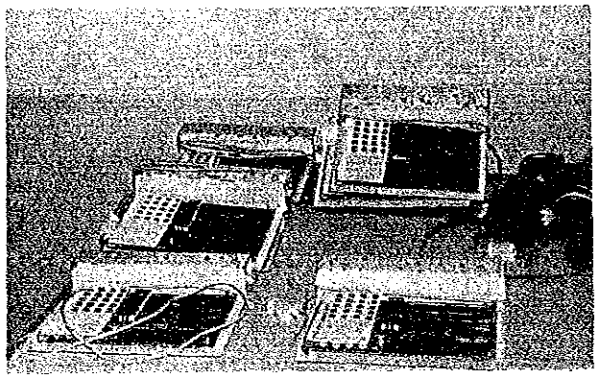
⑤Technical Manpower Centre

Signining of the Minutes (Basic Design Study)

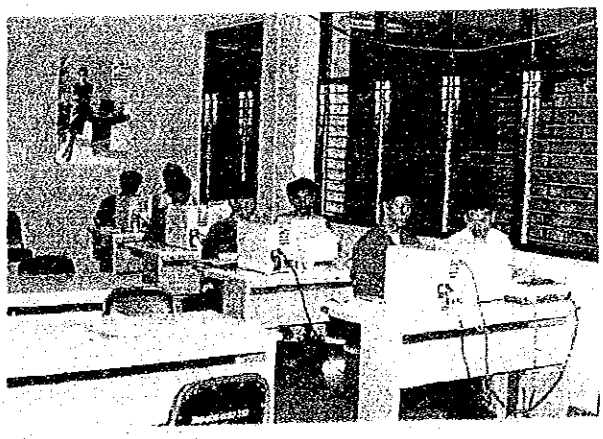
Signing of the Minutes (Draft Report Explanation)



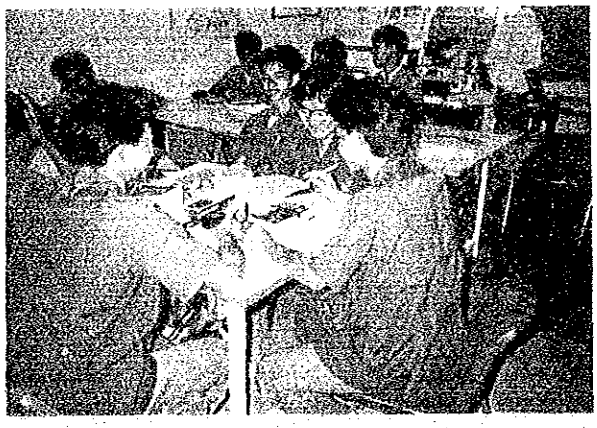
Director of PTC explaining
its graduates' follow-up



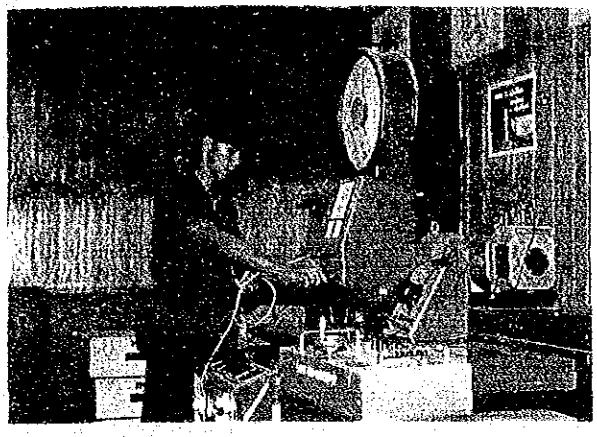
Electronic Technology Dept.,
Existing Micro-computer



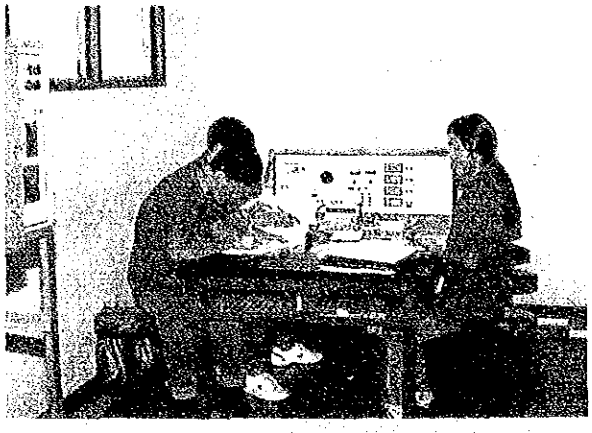
Electronic Technology Dept.,
Training of computer operation



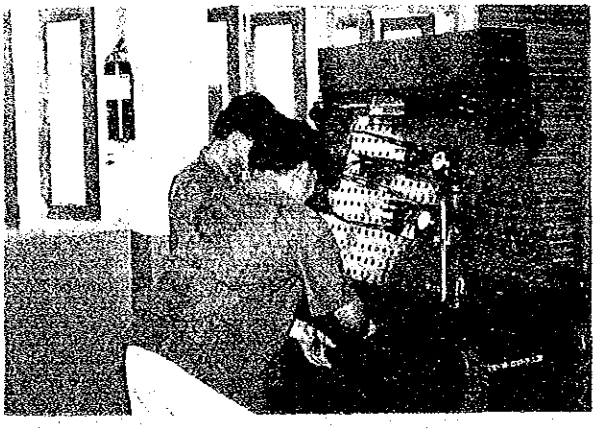
Electronic Technology Dept.,
Experiment of measuring electronic ciruit



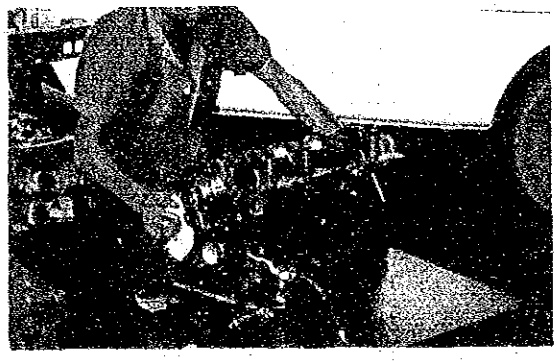
Instrumentation & Process Control Dept.,
Experiment of measuring small motor torque



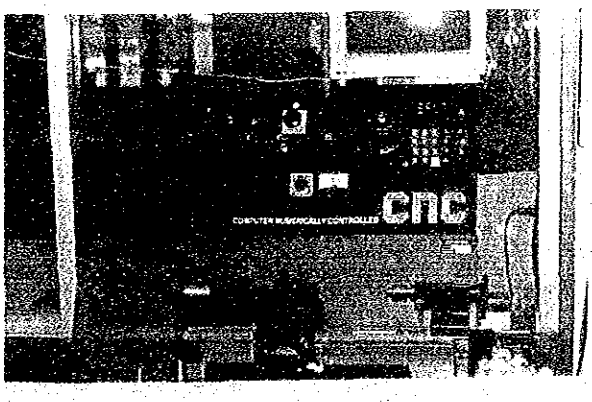
Instrumentation & Process Control Dept.,
Experiment of measuring electric circuit



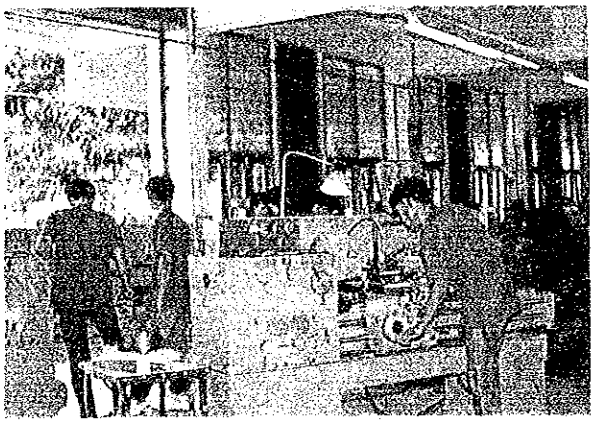
Instrumentation & Process Control Dept.,
Experiment using Hydraulic Control Training Unit



Automechanics Technology Dept.,
Training of repairing engine



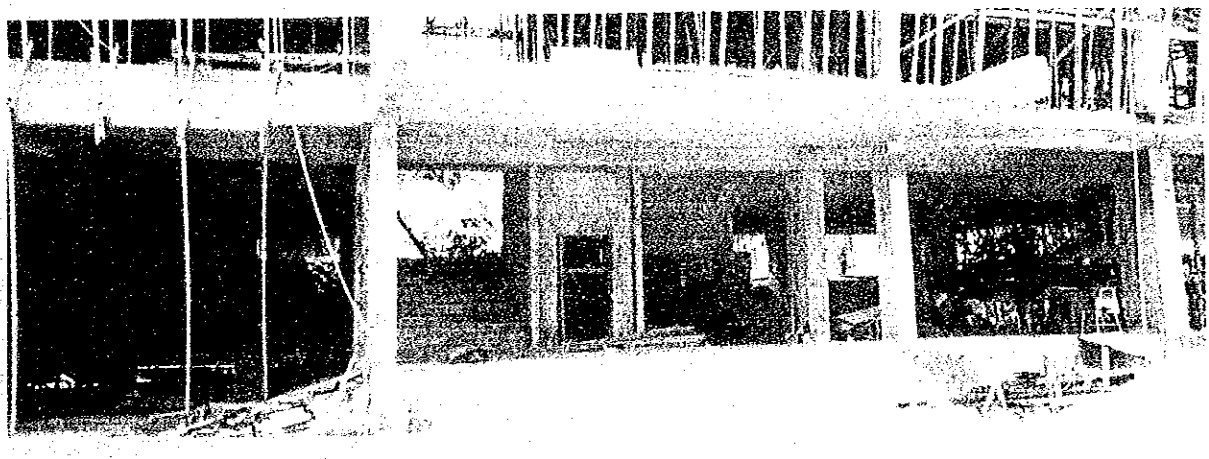
Production Technology Dept., Existing CNC Lathe



Production Technology Dept.,
Training of lathe operation

New School Bldg. Construction Site

New School Bldg. Construction Site



New School Bldg. Construction Site

SUMMARY

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Primary industry including agriculture has been the traditional mainstay of the economy in Thailand. However, in the 1960s the agri based economic structure began to shift towards diversified industrialization.

Industrialization and economic growth in Thailand in the latter half of the 1980s has been conspicuous and agriculture comprised only 15.1 percent of the total domestic production in 1989 in contrast to 25.4 percent of the industrial sector. Agricultural products were 23 percent of the total export volume in sharp contrast to 68.6 percent of industrial products. The national economic structure rapidly shifted from agriculture to industry.

In conjunction with rapid economic development, social problems such as social and economic differences between urban and rural areas, infrastructure, and environmental issues began to surface, and it has become a major task to solve these situation. Domestically, the level of science and technology has been unable to keep abreast of the rapid changes in the industrial structure; and particularly conspicuous is the severe labor shortage in the industrial fields. It is vitally important that qualified engineers are fostered in order to ensure continued economic growth and development.

Under these circumstances, the Government of Thailand instituted policies under the Sixth National Economic and Social Development Plan (1987-1991, revised in 1988) to cope with the socio-economic transitions brought about by rapid economic growth. The Seventh National Economic and Social Development Plan (1992-1996) which will come into effect in October 1991 will continue the reforms instituted by the Revised Sixth Development Plan. The basic guidelines for the Seventh Development Plan were approved by the Cabinet and its major objectives are as follows:

(1) Maintain stability in the economic and financial sectors and preserve a steady economic growth rate.

(2) Distribute the revenue and other benefits reaped by economic growth to the rural areas.

(3) Further improve and develop human resources and the standard of living.

Development of human resources in above (3) means to foster people who are necessary to cope with the rapid changes in the industrial structure. In order to achieve this objective, major goals have been targeted in the area of educational policy. Educational policies promoting development in science and technology and curriculum

content reflecting the demands of the labor market must be pursued. This Project is placed as part of the educational policy to produce engineers to achieve these goals.

Thai institutions which are responsible for fostering skilled labor, technicians, and engineers are the universities and technical colleges. There are 43 universities, both public and private in Thailand. Of these universities, only seven public universities maintain faculties in the engineering fields; and these faculties produce only 3,000 graduates annually. Although the Thai government is boosting plans to open additional faculties of engineering, there is a shortage of faculty teachers and instructors which has made immediate implementation difficult.

There are 211 technical colleges (upper level secondary education, junior college and college combined), both public and private, which are responsible for producing skilled labor and technicians. The annual number of skilled labor, technicians and engineers who graduate from these institutions is approximately 56,000, 24,000, and 1,200, respectively. Graduates of technical colleges are far greater in number than university graduates.

In this respect, namely the shortage of engineers who are the university graduate, the graduates of technical colleges comprise a far larger engineering related labor pool for the private industrial sector. Unfortunately, the educational content of these technical colleges has been unable to keep abreast of the high technological standards of Thai industries due to insufficient educational equipment and the lack of advanced technological knowledge on the part of teachers; therefore, there has been a strong request by the industrial sector to upgrade the technical skills of their graduates and the quality of the teachers.

Pathumwan Technical College (PTC) which is the implementing agency of this Project, has been providing the Vocational Educational Diploma Level (PWS), the equivalent of junior college, in production technology and electronic engineering fields. Recently, the Ministry of Education has planned for PTC to offer more advanced and practical vocational education and the Technician Educational Higher Diploma Level (PTS) curriculum (equivalent to the third and fourth year of university education); thereby making it the foremost central technical college in Thailand. The Ministry of Education has initiated a government approved project to construct a new PTC building as part of its plan and 32 million bahts were appropriated for the construction project. This construction project began in June 1990 and is expected to be completed on April 30, 1992. In addition, PTC has future plans to institute one new department at the vocational diploma level and three additional departments at the Higher Diploma level.

There are plans to increase the student body to 2,200 members in 1993, a 38 percent increase from a student population of 1,593 in 1990, to 2,420 members or a 52 percent increase by 1996. Furthermore, PTC is planning to begin re-education programs for the faculty members of other technical colleges, in order to allow them to keep up with the newest technology.

However, despite these endeavors to improve PTC, basic educational and training equipment equivalent to the high technological levels of the industrial sector is deficient. Hampered by a limited budget, the Ministry of Education has found it difficult to correct this situation.

Under these circumstances, the Government of Thailand has officially requested the Government of Japan, an advanced nation in the industrial field, to provide educational equipment mainly in the electronic engineering fields under the auspices of the Japanese grant aid program.

Lab equipment for two existing departments and one new department and supplementary equipment have been requested.

Table of Field Requested

Existing Dept.	New Dept.	Supplementary Equipment
Industrial Electronics Technology	Mechatronics	Video Program Production & Display
		Text Printing
Instrumentation and Process Control		Audio Visual for LL

In response to this request, the Government of Japan decided to carry out a basic design study for the "Project for Providing the Equipment for Pathumwan Technical College in the Kingdom of Thailand" (hereinafter called as "the Project"). The Japan International Cooperation Agency (JICA) dispatched a basic design study team from March 11, 1991 to March 30, 1991 to Thailand. During this period the study team held discussions with the relevant Thai Government and PTC personnel, surveyed the present situation of the technical education in Thailand, the implementation structure of the Project and its effects and the appropriateness of the Project under grant aid, and confirmed the undertakings of the both Governments. After returning to Japan the study team analyzed and evaluated the most appropriate equipment, estimated the cost of the Project, and formulated the implementation plan. Then JICA dispatched a study team to explain the draft of the final report on the basic design study of the Project from June 12, 1991 to June 21, 1991.

An outline of major planned equipment selected based on the survey and domestic

analysis of the survey results is shown below.

Major Planned Equipment

Laboratory	Major Equipment
1. Instrumentation Lab	Electric Measurement Trainer, Oscilloscope Trainer, DC/AC Bridge,LCR Meter, Other Electric Instrument
2. Electric Device and Circuit Lab	Electric Circuit Trainer, Storage Oscilloscope, Thyristor Trainer,LCR Meter, Semiconductor Characteristic Curve Tracer, Other Electric Instrument
3. Digital Electronics and Microprocessor Lab	Logic Circuit Trainer, Single Board Microcomputer Trainer,Digital Circuit Trainer, Oscilloscope, Other Electric Instrument
4. Microcomputer lab	Logic Analyzer, Single Board Microcomputer, Personal Computer,Emulator, Stepping Motor Control Board
5. Personal Computer Lab	Personal Computer, Printer, Software
6. Computer Aided Design Lab	CAD/CAM Training Computer, Software, Printer, X-Y Plotter,Uninterrupt Power Switch
7. Power Electronics and Electric Drive Lab	DC Servomotor Trainer, Stepping Motor Trainer, Positioning Control Trainer, Oscilloscope, Universal Counter
8. Automatic Control Lab	AD/DA Converter, Temperature Servo Control, Servo-Feedback Control Trainer, Sequence Control Experiment Equipment
9. Computer Aided Measurement Lab	Personal Computer, Printer, X-Y Plotter, GP-IB Board, FM/AM Standard Signal Generator, Audio Analyzer, FFT Analyzer, Spectrum Analyzer, Micro-torquemeter
10. Industrial Electronics Lab	Transistor Inverter Training Unit, Robot Model, Flexible Manufacturing System
11. Hydraulics and Pneumatics Lab	Basic Hydraulic Training Unit, Electrohydraulic Training Unit, Proportional Hydraulic Training Accessory, Electric Pneumatic Training Unit, Programmable Controller
12. Transducer Lab	Instrumentation Transducer Unit, Orifice Plate with Ring, Diaphram Seal
13. Industrial Instrumentation Lab	Pneumatic Recorder, Pneumatic Controller, Electronic Controller,Thermocouple with EME/RTD-EMF, Vortex Flowmeter

Laboratory	Major Equipment
14. Process Control Lab	Distributed Control Trainer 1) Highway Gateway 2) Application Module 3) Advanced Multifunction Controller 4) Logic Controller system
15. CNC Machining Workshop	CNC Wire-cut Discharge Machine, CNC Milling Machine, CNC Precision Surface Grinding Machine, CAD/CAM Computer
16. Metrology Lab	Coordinate Measuring Machine, Roundness Tester, Surface Roughness Tester, Microscope, Micrometer, Granite Surface Plate
17. Telecommunication Lab	Optical Fiber Communication Training Set, Microwave Link Demonstration and Training Set
18. Video Program Production Studio	3-CCD Color Video Camera, S-VHS Portable Video Cassette Recorder, Video Monitor, Microphone, Lighting Kit, S-VHS Editing video Cassette Recorder, Editing Controller, Dubbing VTR, Installation Materials
19. Auditorium	Video Projector, Motor-drive Screen, Speaker, Microphone, Installation Materials
20. Audio/Visual Room	Video Projector, Motor-drive Screen, Speaker, Installation Materials
21. Text Printing Room	Duplicator, Bookbinding Machine, Word Processor, Printer,Copying Machine
22. Language lab.	Master Console, Booth Section, Headset, Tape Recorder, Speaker, Video Projector, Motor-drive Screen, Installation Materials

PTC educational content and curriculum were analyzed, the operation and maintenance system, the technical levels, and coordination with construction plans of the new PTC building were taken into consideration in formulating a suitable basic design of the Project. The three departments relevant to the Project are all closely related in educational content and often share the same lab. Therefore, it was decided that equipment will be selected and furnished according to the curriculum of each lab rather than department, in order to avoid overlapping the equipment.

The executing agency of the Project is the Department of Vocational Education, Ministry of Education (DOVE) and the implementing agency is the PTC. DOVE will be responsible for all the administrative tasks to be fulfilled by the Government of Thailand

such as construction of the new building, operation and maintenance, budget formulation, etc., pertaining to the Project. The new building and installation of facilities and equipment will be utilized in the educational activities of PTC. PTC will be responsible for building and equipment maintenance, procurement of teaching staff, and the budget management.

Project implementation is expected to take 12 months, four months for detailed design, eight months for equipment procurement and installation.

Provision of educational training equipment by the Project is anticipated to enable comprehensive experiment and training curriculum, to improve technical skills of students, and to foster competent technicians with the capability to put their skills to immediate practical application who are required for the present Thai industry. Furthermore, effective improvements and reforms in vocational education in Thailand through re-education of instructors of other technical colleges are expected.

The Project will not only upgrade education in the fields of science and technology as targeted by the Seventh National Development Plan and fulfill the demands of the labor market for qualified personnel, but will contribute to Thailand's continuous economic growth. Therefore, it has been concluded that the Project is meaningful and appropriate to be implemented under the auspices of the grant aid program of the Government of Japan.

It is recommended that the following measures be taken by the Government of Thailand for smooth and effective implementation and operation of the Project.

1) The Government of Thailand will endeavor to see that construction of the new building progresses on schedule, in order to avoid delays in equipment delivery and installation.

2) It is necessary to make every effort for maintenance of the equipment provided in the Project in order to utilize them effectively.

3) It is necessary that measures be taken to secure a budget that will adequately cover operation and maintenance expenses.

4) In order to effectively utilize the equipment to be provided in the Project and to further enhance its educational effect, it is necessary to seek for technical cooperation such as dispatching experts in related fields to Thailand and providing training courses to Thai teachers in the country from advanced industrialized countries including Japan.

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1. INTRODUCTION

1. INTRODUCTION

The economy of Thailand has in recent years developed steadily due to remarkable increase in investment from abroad. In 1989 the nation's economy registered a 12.3 percent growth rate; and it has rapidly shifted from an agricultural to industrial base. The industrial sector of the GDP for 1989 rose to 25.4 percent and the agricultural sector fell to 15.1 percent. In addition, export headed by that of industrial goods has grown steadily. However, the economy is plagued by such woes as an increasing trade deficit due to a higher import volume than export volume and spiraling inflation.

Moreover, in conjunction with rapid economic development, various social problems such as social and economic differences between urban and rural areas, infrastructural and environmental issues began to surface and it has become a major task to solve these situation. Domestically, the level of science and technology has been unable to keep abreast of the rapid changes of the industrial structure; and particularly conspicuous is the severe labor shortage in the industrial sector. It is vitally important that qualified engineers who can practically apply their skills in the work force immediately, are fostered in order to ensure continued economic growth and development.

Institutions which are capable of producing middle level engineers immediately capable of entering the work force, are the technical colleges under the jurisdiction of the Ministry of Education. However, these institutions lack basic training equipment and equipment for practical application suited to the high levels of industrial technology in Thailand. Consequently, it has been difficult to carry out thorough training and education in these areas.

Under these circumstances, the Government of Thailand instituted a project to construct a new building for the Pathumwan Technical College (PTC), which is the foremost technical college in Thailand, with the aim of expanding education in engineering and technology. Subsequently, it submitted an official request to the Government of Japan for grant aid to provide the necessary educational equipment for the new building.

In response to the request, the Government of Japan decided to conduct a basic design study on the Project for Providing the Equipment for Pathumwan Technical College (hereinafter called "the Project"). The Japan International Cooperation Agency (JICA) dispatched a basic design study team headed by Dr. Katsumi Ishihara, Professor, Applied Physics Department of Mechanical Engineering, Gifu National College of Technology, from March 11 to March 30, 1991 to Thailand. During this period, the study team deliberated with pertinent Thai government officials and the PTC, carried out a field survey to identify the present situation of technical education and the industrial sector in

Thailand, evaluated the implementation structure of the Project, the effects of Project implementation, the appropriateness of the Project under grant aid, and confirmed the undertaking by both governments. After returning to Japan, the study team analyzed and selected appropriate equipment, Project cost estimation, and formulated the implementation plan of the Project. JICA dispatched a study team headed by Dr. Masazumi Kumagai, Professor, Department of Electronic Engineering, Sendai National College of Technology to Thailand from June 12 to June 21, 1991 to explain the final draft report to Thailand.

This report is a summation of the results of the aforementioned study. Members of the study team, the survey itinerary, the list of members interviewed, and the Minutes of the Discussions are shown in Appendix 1.1 to 1.4.

2. BACKGROUND OF THE PROJECT

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2.1 Outline of Thailand

2.1.1 Socio-economic Conditions in Thailand

Traditionally, Thailand has been an agro-based society and the role of the agricultural sector within the domestic socio-economic structure should not be underestimated. Although farmland decreases yearly, it still comprises 46 percent of the nation's entire land area and supports a farming population which is 59 percent of the total national population. In addition to the staple crop, rice, the six traditional principal crops are tapioca, sugar cane, tobacco, corn, and rubber. Recently, vegetables, fruits, and flowers are the flourishing new farm products. Rice has traditionally been Thailand's most important export item, but the shift to greater added value export items can be seen in recent years.

In the 1960s the trend to industrialize became prominent in Thailand, as well as in neighboring developing countries. The economic structure of Thailand which has traditionally been centered on agriculture, shifted to diversified industrialization. Although this policy was temporarily set back twice, due to the oil shocks in the 1970s, industrialization of the Thai economy has continued steadily. In the 1980's the results of introducing foreign currency began to be seen, and export of manufactured products began to grow at an accelerated rate. Agriculture which had always ranked first in the nation's GDP was replaced by the industrial sector in the latter half of the 1980s.
In 1989 the industrial sector comprised 25.4 percent of its GDP, followed by agriculture at 15.1 percent. Industrial products comprised 68.6 percent of the nation's total export volume, in sharp contrast to agricultural products at 23.0 percent. Particularly noteworthy, is the fact that industrial products including television sets, IC, metal manufactured products, and textiles replaced rice as the top export item after 1985, and has continued to do so to the present.

Supported by an established agro-based economy and burgeoning industries, the growth of the Thai economy has been remarkable. The GDP growth rate was 4.9 percent, 9.5 percent, 13.2 percent, and 12.3 percent in 1986, 1987, 1988, and 1989, respectively. Moreover, per capita income reached US$1,076 in 1988 and US$1,225 in 1989.

However, society has not been able to keep abreast with the changes brought by rapid industrialization, and the need for competent personnel in the areas of research and technology development, distribution and marketing, management, and planning is a major issue. Moreover, fostering of competent personnel in a short period of time is quite

difficult. However, it is essential that Thailand overcome the situation if it is to catch up with neighboring NIES countries.

In addition, social problems created by the large economic gap between the rural and urban areas such as Bangkok, destruction of the environment due to rapid industrialization and unplanned agricultural development, the severe concentration of population in Bangkok, the economic center of the nation, and skyrocketing urban land costs, poor infrastructure and public services, and fears of an ever rising cost of living have become reality. The future task of the Government of Thailand will be to resolve these issues.

2.1.2 Related Programs

(1) The Sixth National Economic and Social Development Plan (1987-1991)

The socio-economic development in Thailand for the past 30 years was directed and implemented under the First National Economic and Social Development Plan put into effect in 1961, followed by six successive national development plans since that time. The Sixth National Economic and Social Development Plan, instituted in 1987, targeted an average annual economic growth rate of 5 percent. However, the transition to a rapidly expanding economy during this period is anticipated to achieve an annual growth rate of more than 10 percent, which greatly surpasses the original target. On the other hand, many problems stemming from rapid economic growth such as the lack of qualitative and quantitative infrastructure, the lack of experienced engineers, technicians and skilled labor, uneven income distribution due to differing levels of economic development in different areas, and issues related to natural resources and environmental protection have become a by-product of this growth. In order to cope with these socio-economic issues, the Government of Thailand was forced to revise their policy in September 1988; and the Revised Sixth National Development plan was put into effect from 1989-1991.

(2) The Seventh National Economic and Social Development Plan (1992-1996)

The year 1991 marks the end of the Sixth Development Plan and from October 1991 the Seventh National Economic and Social Development Plan (1992-1996) will be implemented for the next five years. Although the plan is currently being formulated by the National Economic Social Development Bureau (NESDB), the basic framework of the plan was approved by the Cabinet in May 1990. The following are the major development objectives.

1) Maintain optimum level of economic growth rate, as well as economic and monetary stability.
2) Distribute income and the success of economic development to the rural areas.

3) Promote development of human resources, quality of life.

To achieve the three aforementioned objectives, the following concrete goals are targeted:

1) Economic Growth
   Actual annual economic growth rate is targeted at 9 percent.
2) Economic Stability
   Annual inflation rate will be kept below 5.5 percent and the trade deficit will be maintained under 7 percent of GDP.
3) Income Distribution
   Income discrepancies according to area or occupation will be lessened and the percentage of the population below the poverty line will be decreased to under 20 percent by the final year of the plan.
4) Development of Human Resources, Quality of Life.
   By intermittently organizing formal and non-formal educational systems for lifelong education, the health and the skills of the population will be fostered to produce ethical and moral citizens.

Although a variety of policies has been devised in order to achieve the aforementioned goals, stable economic growth has been recognized as the foremost condition to successfully attain these goals. Implementing educational policies, especially for science and technology has been recognized as indispensable for economic growth. Other educational policies are concerned with promotion of participation in educational project by private sector, cooperation from private and public institutions to promote vocational education, incorporation of educational methods that reflect the needs and conditions of the labor market and to establish a system of information exchange, the creation of a learning network, and improving the knowledge and skills of educators and educational administrators. Furthermore, based on the recognition that human resources are the most important asset of any society, the need to create a lifelong educational system that produces moral and educated citizens has been pointed out.

The tendency to place priority on economic development rather than social development cannot be denied. However, it is desirable that the Seventh Development Plan returns to its original goal of creating a balance between the industrialized urban areas and the agricultural rural areas in the nation's progress toward development.

2.2 Current State of Education in Thailand

2.2.1 Educational Administration

The major organization responsible for educational administration is the Office of the National Education Commission (ONEC) under the Prime Minister's Office, the Ministry of Education, and the Ministry of University Affairs. ONEC is responsible for formulating national educational policies and fulfilling intrinsic roles such as educational planning, survey, statistics, analysis, promotion and dissemination.

National and private universities are under the administration of the Ministry of University Affairs. Institutions not under the Ministry of University Affairs are under the administration of the Ministry of Education, with the exception of army or police schools. Non-formal educational institutions are also under the jurisdiction of the Ministry of Education.

Department of Vocational Education related to this Project is under the Ministry of Education. Organization Structure of Ministry of Education is shown in Appendix 2.4.

2.2.2 Educational System

(1) An Outline of the Educational System

Education in Thailand can be divided into formal and non-formal educational systems. The formal educational system consists of compulsory primary and secondary schools, and upper level educational institutions. Prior to primary school, there is pre-school education or the equivalent of kindergarten. The non-formal educational system is oriented for adults who did not have the opportunity to enter the formal educational system. The school system composed of the primary and secondary schools, with the exception of a segment of the vocational schools, are all under the administration of the Ministry of Education. In addition, the upper level educational institutions such as universities, fall under the jurisdiction of the Ministry of University Affairs. An outline of the educational system in Thailand has been shown below in Table 2.1 and Fig. 2.1.

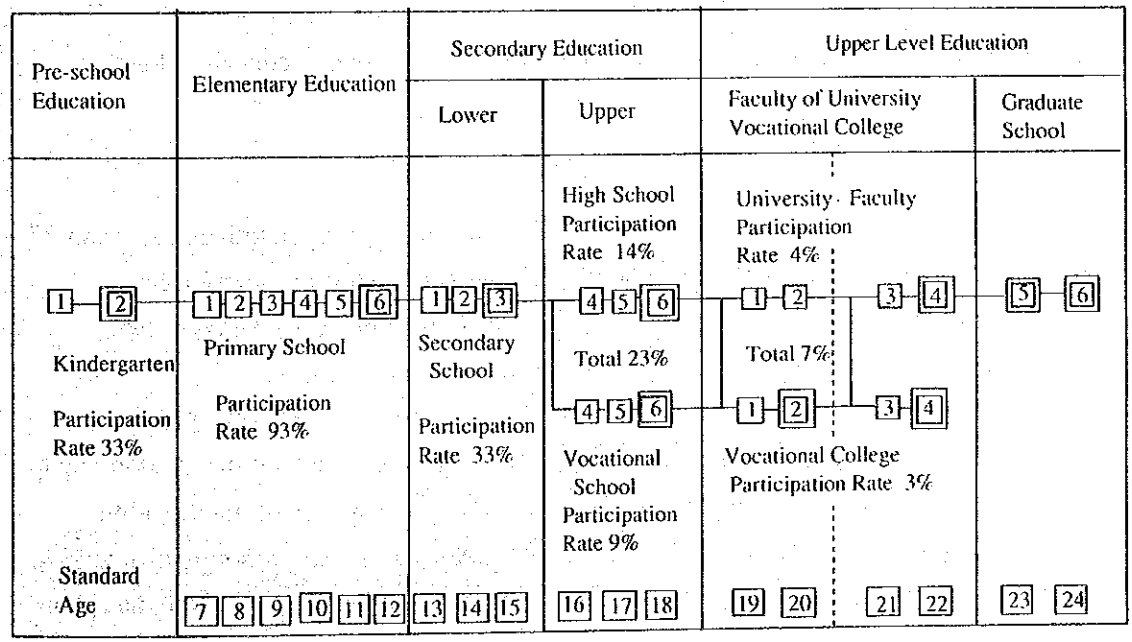
Table 2.1 Educational System in Thailand

Type of Education		School Age/Duration
Formal Educational System		
Pre-school	Kindergarten	up to 6 years/1-2 years
Elementary education	Primary school	7-12 years/6 years
Secondary education		
(lower level)	Secondary school	13-15 years/3 years
(upper level)	Secondary school	
	Academic course	16-18 years/3 years
	Vocational course (PWC)	16-18 years/3 years
Upper level education		
	Vocational college (PWS,PWT)	19-20 years/2 years
	Vocational college (PTS,FDVTE)	21-22 years/2 years
	University (Bachelor Degree)	19-22 years/4 years
	Graduate school (Masters, Ph.D)	23-24 years/1-2 years
Non-formal Educational System		
Non-formal Education	Non-formal schools	No age limit/no set term

Remarks: Education was compulsory only through primary school until 1990, when it was extended by a Cabinet decision to include lower level secondary school. It is currently being implemented on an experimental basis.

PWC = Paw Paw Chaw=Vocational Educational Certificate Level
PWS = Paw Paw Saw =Vocational Educational Diploma Level
PWT= Paw Paw Taw =Technician Educational Diploma Level
PTS = Paw Taw Saw =Technician Educational Higher Diploma Level
FDVTE = First Degree in Vocational Technological Education

Fig. 2.1 Education System of Thailand



Source: Ministry of Education

(2) Elementary Education

Elementary Education in Thailand is compulsory and enrollment rate is approximately 93 percent or 7 million primary school students in 1988. This figure shows that elementary education is almost completely disseminated in Thailand. However, there are problems such as dropout students, regional differences and insufficient facilities and instructional materials, besides the remaining 7 percent non-enrollment.

Improvement of science and mathematics ability in elementary education level is indispensable for upgrading of science/engineering level in secondary and higher education. Therefore, the Seventh National Plan puts emphasis on the strengthening of science and mathematics education in elementary level.

(3) Secondary Education

The secondary education in Thailand consists of lower and upper levels. Upper level is divided into academic course and vocational course. The participation rate for lower level in 1988 is only 33% or 122 million. Among the 23% participation rate for upper level, 14% enrolled in academic course and remaining 9 % in vocational course. (Refer to article 2.2.3 for upper level secondary vocational education.)

The problems pertaining to secondary education include low participation rate and low ratio of students continuing on to higher degree program. In 1990, the Thai government decided to extend the compulsory education term up to lower level secondary education to solve the problem and implementing tentatively on experimental basis. The Seventh National Plan also emphasizes the importance to enrich the science and mathematics education in secondary education level as in elementary education level.

(4) University Education

Currently, there are 14 national universities, two national open universities, and 27 private universities in Thailand. There are about 180,000 students enrolled in the conventional universities and about 520,000 students in national open Universities. These figures reflect the nation's enthusiasm for upper level education.

Geographically, nine out of 14 national universities and 13 out of 24 private universities are concentrated in Bangkok. This situation is detrimental if the economic gap between different geographical areas is to be eliminated. In support of the Seventh National Economic and Social Development Plan to reduce regional economic differences, education has assumed a significant role; and the Ministry of University Affairs has plans to construct several more universities in the rural areas.

(5) Private Schools

The percentage of students who enroll in private schools and institutions at primary school levels is 10 percent and 12 percent for lower level secondary school. The percentage of students who enroll in public institutions is overwhelmingly high. Although the percentage of students who enroll in private upper level secondary schools in the academic course is only 8 percent, enrollment jumps to 45 percent for the vocational course. Subsequently, private schools play a significant role in vocational education at the upper secondary school level. In addition, 35 percent of the university student populace except for those of National Open Universities, is enrolled in private universities; and they fulfill the same important role as the private upper level secondary schools in vocational education.

(6) Non-formal Education

Non-formal education, mainly carried out under the auspices of the Ministry of Education, offers adults who did not have the opportunity to pursue their education under the formal system, to complete their basic education. It also provides knowledge, information, and short-term technical training to those who have completed the basic education course. Non-formal educational institutions are located throughout the nation and their students totaled more than 540,000 in 1988.

(7) Teacher Training

Teacher training programs for primary and secondary school teachers are conducted by the teachers college; and lecturers and instructors for upper level institutions receive their education or training at the universities or the institute of technology. A problem endemic to all levels of the educational system is the difference in teachers' salaries between the public and private sector. Particularly conspicuous is the exodus of instructors. The major issue for the future is how to stop this flow.

2.2.3 *Vocational Education*

On completing their lower level secondary education, students have the option to proceed to an academic or vocational course for upper level secondary education, depending on their aptitude and abilities. Vocational course is composed of three years course (technical high school level), two years course as higher education level (college level) and four years course (university level).

The vocational education program in Thailand is diverse; and it is composed

of the following four systems of vocational colleges under government jurisdiction. (Refer to Table 2.2)

(1) Authorities in Charge of Vocational Education and the Number of Schools

The Department of Vocational Education (DOVE)

The Department of Vocational Education oversees 165 vocational colleges in the fields of technology (industry), commerce, agriculture, art/craft, and home economics. Each of these colleges is located in each province and are distributed throughout the nation. Of these colleges, there are 79 technical colleges and the beneficiary of this Project, the PTC, is among them.

Rajamangala Institute of Technology (RIT), Ministry of Education

The Rajamangala Institute of Technology has under its administration 29 institutions in the same fields as mentioned above, which are located in Bangkok and in the major cities throughout the country. Of these institutions, there are 10 technical institutions.

Office of Private Education Commission(OPEC), Ministry of Education

There are 341 institutions in the aforementioned fields under OPEC administration, of which 122 are technical colleges.

King Mongkut's Institute of Technology (KMIT), Ministry of University Affairs

KMIT has attached technical college and faculties of science and technology, and agricultural technology.

The organization in charge of formal vocational education and the number of schools are shown in Table 2.2.

Table 2.2 Organization in Charge of Formal Vocational Education and Number of Schools

Unit: school

Ministry & Dept.		Division		No. of Schools	Total
Ministry of Education	Dept. of Vocational Education (DOVE)	Division	Technical College	79	165
			Vocational College	40	
			Agricultural College	46	
	Rajamangala Institute of Technology (RIT)	Campus	Industry	10	29
			Commerce,	5	
			Home, Econ.,Art/craft	4	
			Agriculture	10	
	Office of Private Education Commission (OPEC)	Course	Industry	122	341
			Commerce, Home Econ. Art/craft, Agriculture Administration	219	
Ministry of University Affairs	King Mongkut's Institute of Technology (KMIT)	Institute of Faculty of Industrial Education		1	2
		Faculty of Agricultural Technology			
		College of Industrial Technology		1	

Source: DOVE, RIT & KMIT

Remarks: Underline shows Divisions in Industrial Technology

(2) System of Vocational Education

The structure of vocational education is shown on the following page in Fig. 2.2.

Vocational Colleges (under DOVE)

The vocational colleges under the administration of DOVE have four courses available to students, which are the Vocational Educational Certificate Level(PWC),the Vocational Educational Diploma Level (PWS), the Technician Educational Diploma Level(PWT), and the Technician Educational Higher Diploma Level (PTS). The PWC is a vocational course equivalent to three years of high school and the PWS is a two year vocational education course equivalent to a junior college. The PWT is a two year vocational education course for technicians equivalent to a junior college for regular high school graduates. In 1990 DOVE created a PTS course for PTS only at PTC.

Rajamangala Institute of Technology (under RIT)

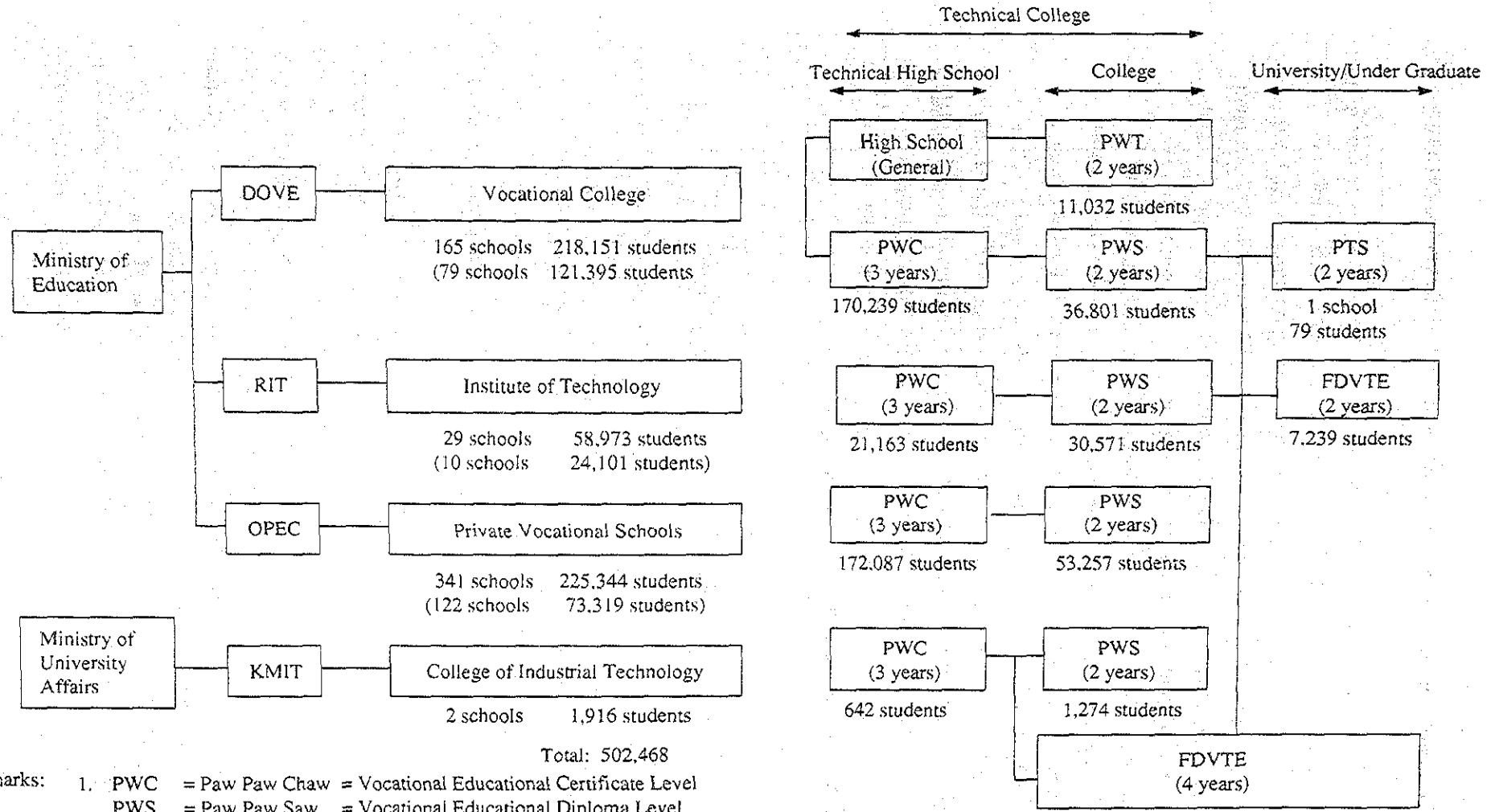
The institutes under the administration of RIT offer three vocational courses. They are the Vocational Educational Certificate Level, the Vocational Educational Diploma Level, and the First Degree in Vocational Technological Education. The duration of each course is the same as the courses offered by DOVE. The only difference between this system and DOVE's is the lack of a Technician Educational Diploma Level course.

Private Vocational Colleges (under OPEC)

Private vocational colleges under the jurisdiction of OPEC offer only two courses, the Vocational Educational Certificate and the Vocational Educational Diploma Level. The duration of each course is the same as the courses offered by DOVE.

Attached Vocational Colleges of King Mongkut's Institute of Technology (under KMIT)

The vocational colleges under the administration of KMIT offer three vocational courses which are the same as those offered by RIT.



Remarks:
1. PWC = Paw Paw Chaw = Vocational Educational Certificate Level
   PWS = Paw Paw Saw = Vocational Educational Diploma Level
   PWT = Paw Paw Taw = Technician Educational Diploma Level
   PTS = Paw Taw Saw = Technician Educational Higher Diploma Level
   FDVTE = First Degree in Vocational Technological Education
2. ( ) means Technical Schools

Fig. 2.2 Structure of Vocational Education

(3) The Number of Vocational School Students and the Differences between DOVE and RIT

The number of students enrolled in vocational colleges as shown in Table 2.3 was approximately 500,000 in 1990. In categorizing the number of students according to administering agency, there were approximately 220,000 students enrolled in DOVE affiliated institutions, 60,000 students in RIT affiliated institutions, and 220,000 students in OPEC affiliated institutions. Approximately 45 percent of all students entered private institutions. Subsequently, the contribution of private institutions to vocational education is extensive. In examining the participation rate according to course of study, DOVE and OPEC institutions have a high ratio of vocational students enrolled in the PWC course, whereas RIT institutions have a high ratio of students in the PWS and FDVTE courses. Although DOVE and RIT are both under the jurisdiction of the Ministry of Education, Dove focuses on vocational education in the lower level course and RIT emphasizes vocational education in the upper level course. In examining the participation rate according to subject matter, those specializing in the fields of industry and commerce are overwhelmingly high.

Table 2.3 Number of Students in Vocational College (1990)

Unit: person

Course		PWC	PWS	PWT	PTS FDVTE	Total
Field	Dept.					
Technology (Industry)	DOVE	97,526	20,096	3,694	79	121,395
	RIT	8,630	12,981	-	2,490	24,101
	OPEC	62,228	9,799	1,292	-	73,319
	(KMIT)	(642)	(1,274)	-	-	(1,916)
	Sub-total	168,384	42,876	4,986	2,569	218,875
Commerce	DOVE	47,719	11,955	6,449	-	66,123
	RIT	10,459	9,056	-	1,757	21,272
	OPEC	104,314	26,882	14,716	-	145,912
	Sub-total	162,992	47,893	21,165	1,757	233,307
Agriculture	DOVE	7,733	2,406	802	-	10,941
	RIT	580	4,393	-	1,753	6,734
	OPEC	104	35	8	-	147
	Sub-total	8,425	6,834	810	1,753	17,822
Art/Craft	DOVE	6,403	284	-	-	6,687
	RIT	263	2,081	-	631	2,975
	OPEC	5,441	525	-	-	5,966
	Sub-total	12,107	2,890	-	631	15,628
Home Econ.	DOVE	10,858	2,060	87	-	13,005
	RIT	1,223	2,060	-	616	3,899
	Sub-total	12,081	4,120	87	616	16,904
Music	RIT	-	-	-	192	192
Total	DOVE	170,239	36,801	11,032	79	218,151
	RIT	21,163	30,571	-	7,239	58,973
	OPEC	172,087	37,241	16,016	-	225,344
Grand Total		363,489	104,613	27,048	7,318	502,468

Remarks: PWC--- Vocational Certificate Level PWT--- Technician Diploma Level
PWS--- Vocational Diploma Level PTS--- Higher Diploma Level
FDVTE--- First Degree of Vocational Technological Education Level
Number of students in KMIT is that in 1989
Source: DOVE, RIT, OPEC

(4) Issues in Vocational Education

High unemployment rate of graduates is one of the problems in vocational education. In case of DOVE vocational college, unemployment rate of its graduates from 1985 showed more than 25% until 1988 when it dropped to 17.8% with the economic growth. Unemployment rate of agriculture sector is the highest while it is the lowest in the industrial sector. This high unemployment rate was attributed to the expansion of institutions in 1980s which did not reflect the actual demand of private sector.

Other problems are insufficient educational equipment and inadequate re-education program for teachers. In the Seventh National Plan, DOVE came out with plans for the establishment of information network of labor market and on-the-job training under the close cooperation with private sector.

2.2.4 Department of Vocational Education (DOVE), Ministry of Education

The executing agency of this Project, DOVE, has been responsible for implementing policies on vocational education since its establishment in 1941. It has increased educational facilities and planned their expansion by enlisting the assistance of foreign nations (namely the USA and Denmark), the World Bank, the Asian Development Bank, the UNDP, ILO, etc. Currently, the agency has under its administration 165 formal vocational colleges and non-formal vocational schools that offer short-term training courses, 13 polytechnic schools, 3 occupation colleges, and 13 area vocational centers.

In addition, DOVE has established Technical Manpower Centers (TMC) in six technical colleges in six regions, in order to collect data on employment conditions from the private sector and to serve as an employment agency for students graduating from DOVE institutions.

The main policies of DOVE, in accordance with the Seventh National Development Plan, are outlined below.

-To produce skilled manpower to cope with rapid economic growth, technological changes, and flourishing industrialization of the private sector.

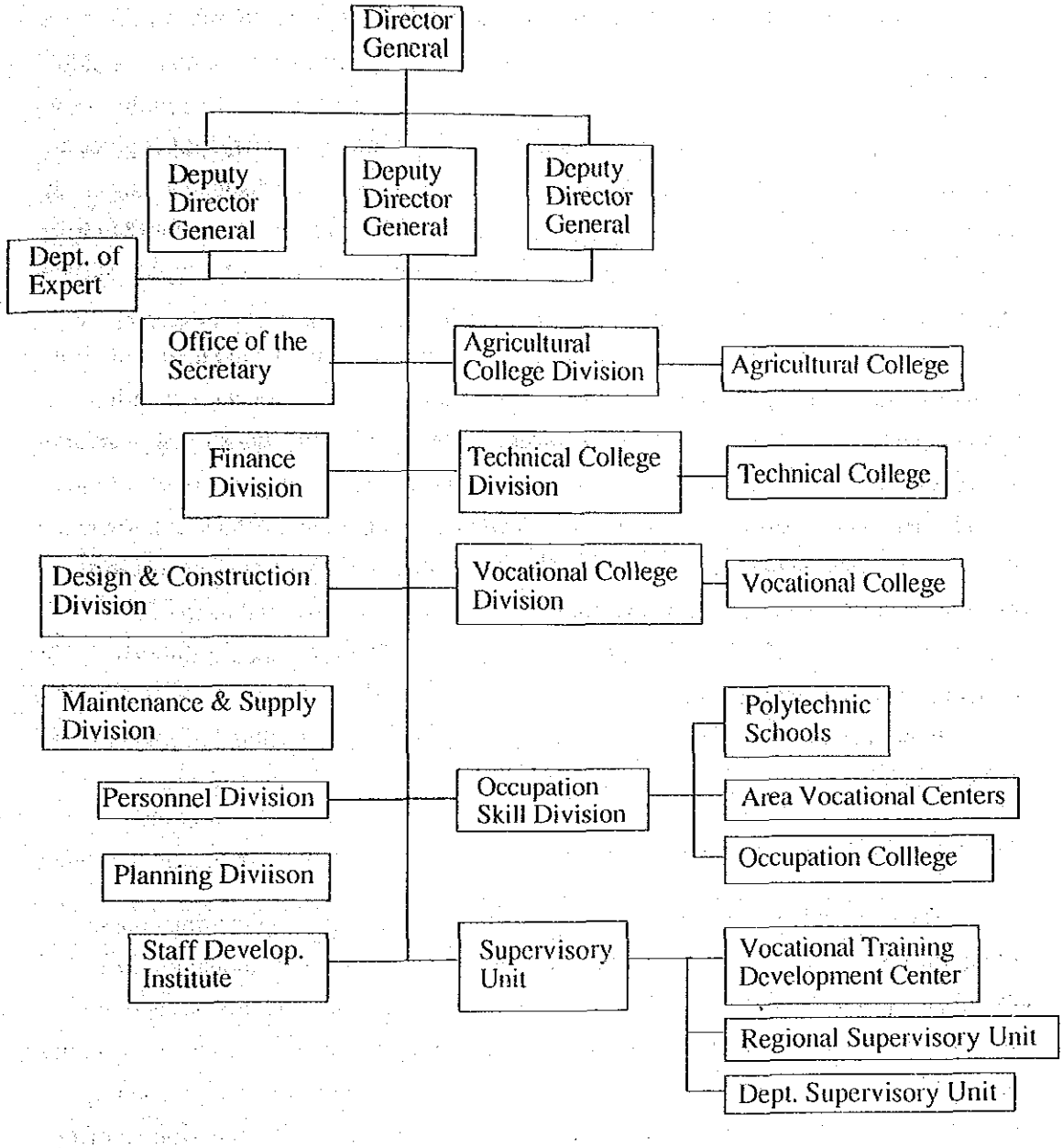
-To provide expanded vocational educational opportunities to the public.

-To develop and promote flexible curriculum, teaching, and training methods that are consistent with the demands of the labor market and the individual needs of the private enterprises.

-To upgrade the quality of vocational education through cooperation with private and state enterprises.

-To establish an information network to support vocational education policy planning, based on surveys which follow up on the jobs of its graduates and their evaluation in the private industries.

Organizational chart of DOVE and the Ministry of Education is shown in Fig.2.3. and Appendix 2.4, respectively.



Source: DOVE

Fig. 2.3 Organization Structure of DOVE

2.2.5 Conditions and Issues Surrounding Technical Education

(1) General

Industrialization in Thailand has been active particularly in the fields of engineering in such areas as electronics, electrical machinery and appliances, mechanical engineering, automobile manufacturing, etc. In addition, the Eastern Seaboard Development Plan to construct an oil and gas plant is in progress. Subsequently, the demand for highly skilled engineers in these areas is high.

There are few engineering faculties of Universities in Thailand and the number of graduates in engineering is limited. However, there are many vocational engineering colleges (technical colleges) and their graduates. As the training institutes for skilled labor and middle level engineers, those technical colleges have become a major source of labor for industrial sector. However, insufficient educational equipment and lack of knowledge of new technology on the part of teachers in those technical colleges are problems in offering satisfactory education. Consequently, it is unable to satisfy the need of the employers for the qualified technicians with the capability of putting their training to immediate practical application.

It has become an urgent issue for vocational education in Thailand to solve the above situation.

(2) Faculties of Engineering in the Universities

There are only seven universities which offer an academic engineering course among the 43 national and private universities in existence; and the annual number of engineering graduates is about 3,000. The Ministry of University Affairs has actively promoted the creation and increase of science engineering faculties within the universities, supported by an aggressive government policy. However, they have been plagued by a shortage of instructors, facilities, and equipment which has made it impossible to meet the demands for quality as well as quantity.

(3) Technical Colleges

There is a total of 211 national and private technical colleges (a combination of upper level secondary school and junior college) which produce skilled labor and technicians. The graduates of these institutions numbered approximately 56,000 at the upper secondary level in 1990, 24,000 at the junior college level, and 1,300 at the university level; and the number of graduates was higher than the academic universities. Despite the difficulty in securing university graduates in industrial engineering, the number of technical college graduates is high. As a result, technical colleges are becoming a major source of human resources for private firms, particularly in engineering related

fields. Especially, graduates of junior college level are active in private companies as middle level engineers and some companies gave them an administrative post after in-house training.

In Thailand they fall under the administration of DOVE, RIT, OPEC, and KMIT as delineated in 2.2.3. (1). As shown in Table 2.2, there are 79 DOVE, 10 RIT, 122 OPEC, and 1 KMIT affiliated institutions. The total number of students in 1990 was about 220,000, of which half were enrolled in DOVE institutions. Moreover, DOVE institutions play an important role among technical institutions as the largest producer of PWS, PWT, and PTS. PTC is the center of DOVE institutions.

(4) The Educational Level, Equipment, and Retraining of Teachers of Technical Colleges

Industrial standards in Thailand, particularly in engineering fields, are technologically high and the industrial sector has high tech facilities which are readily available for practical application. Engineering related private industries are seeking qualified technicians with the capability to put their training to immediate practical application; and they are striving to upgrade educational standards. Unfortunately, both the public and private institutions lack appropriate equipment for basic subject and practical application to cope with the present industrial level with the exception of a segment of these institutions. They have been trying to overcome this deficiency by offering practical training courses at private companies. With the limited budget, following two measures can be taken to overcome the insufficient equipment; 1) increase opportunities for on-the-job training under the close cooperation with private companies, 2) provide updated facilities/equipment to specific institutes so as to retrain teachers of other institutes at those institutes, and thus upgrading the overall educational standard.

As for improving teachers' level, it has become necessary to provide retraining program to upgrade their technical knowledge and to revise teaching methods in order to allow them to keep pace with the rapid advances in modern technology. DOVE has the Staff Development Institute within the department and RIT maintains Research and Training Centers at five different locations across the country. Both conduct intensive training courses during the summer season. However, to improve vocational eduction level which is an urgent task, shortage of instructors capable of providing retraining to teachers should be solved. Therefore, it is necessary to invite technicians from private companies as visiting instructors or to request the dispatch of expert from other countries or international organizations under the technical cooperation.

(5) Number of Instructors at DOVE Technical Colleges

There were 7,801 instructors at DOVE technical colleges in 1990 as shown below

in Table 2.4. Of this figure, 4,521 are engineering related instructors. Although the student population numbers 121,395, there are 27 students per one instructor; and this ratio is low in comparison to Japan where the average is 20 students for every one instructor.

A shortage of teachers is prevalent in all levels of the educational system in Thailand; and due to the differences in wages between public and private organizations, there is an exodus of engineering related instructors to the private sector. A major task for the future will be to stop this flow. Therefore, fundamental policies such as review of teachers' salary system, creation and/or strengthening of incentives such as scholarship and overseas study system will be necessary to solve the problem.

Table 2.4 Number of Teachers in Vocational College under DOVE (1990)

Unit: person

Qualification / Field	Doctor	Master	Bachelor	Bellow Bachelor	Total
Technology(Industry)	1	27	2,323	2,170	4,521
Core Subject	0	110	1,395	29	1,534
Commerce	0	0	467	203	670
Art/Craft	0	4	175	24	203
Home Econ.	0	4	243	80	327
Agriculture	0	1	5	0	6
No state	0	14	331	195	540
Total	1	160	4,939	2,701	7,801

Source: DOVE

2.3 Pathumwan Technical College (PTC)

2.3.1 Outline of PTC

(1) History

The Pathumwan Technical College is located in an upper class area, in the center of Bangkok, on Rama 1 Road facing the National Stadium near Siam Square. It was originally established in 1932 as a training center for experienced technicians by the Retired Royal Thai Navy Officers. Later, it was placed under the jurisdiction of the Ministry of Education where it has remained to this day, as one of the technical colleges under the administration of DOVE. Moreover, it is the only DOVE technical college which offers courses beyond the PWS. It is also the college with the largest student body; and the institution fulfills a major role in technical colleges. PTC offers the PWS,

PWT, and PTS courses but no PWC course differing from other technical colleges. The education level of PTC is higher than other technical colleges.

(2) Number of Students and Field of Study

The institute offers the PWS, PWT, and PTS to its students and in 1990 the student body numbered 1,593 men and women. The PTS is a teachers' training course for DOVE technical colleges. The student body was divided according to department and is shown below.

Table 2.5 Number of Students by Department (1990)

Unit: person

Course	Dept	1988			1989			1990		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
PWS	Production Technology	192	1	193	176	1	177	177	1	178
	Industrial Technology	358	3	361	252	2	254	143	1	144
	Automechanics Technology	531	-	531	384	-	384	378	-	378
	Electric Power Technology	519	6	525	513	4	517	358	1	359
	Electronic Technology	525	19	544	461	14	475	330	12	342
	Instrumentation & Process Control Technology	-	-	-	36	5	41	75	5	80
PWT	Petrochemical Industry Technology	-	-	-	-	-	-	21	16	37
PTS	Production Technology	-	-	-	-	-	-	29	-	29
	Automechanics Technology	-	-	-	-	-	-	14	-	14
	Electrical Technology	-	-	-	-	-	-	30	2	32
Total		2,125	29	2,154	1,822	26	1,848	1,555	38	1,593

Source: PTC

(3) PTC Faculty and Administrative Staff

In 1990 the PTC faculty and administrative staff numbered 124 members, of which 98 were faculty members (one doctorate, six master degree holders, 89 bachelor degree holders, two non university graduates) and 1,593 students. The teacher/student ratio with exception of teachers of administration, was one to 16 students. The average teacher/student ratio for technical colleges in Japan is only slightly less at one to 14 students. Moreover, 96 instructors out of a total of 98 had bachelor degrees or above. This may be due to the fact that PTC offers courses above the PWS. See Table 2.6.

Table 2.6 Number of Teachers in PTC (1990)

Unit: persons

Field \ Qualification	Doctor	Master	Bachelor	Below Bachelor	Total
Administration	0	5	20	1	26
Core Subject	0	2	19	0	21
Elect., Electro., Instrumentation	1	0	31	1	33
Production Technology	0	2	13	0	15
Automechanics	0	0	14	0	14
Industrial Technology	0	2	12	1	15
Total	1	11	109	3	124

Source: PTC

(4) Classes

The PTC offers a two year course for day classes and a three year course for night classes, which are mainly composed of adults who work in private firms during the day. One academic year is comprised for two semesters, each 18 weeks long. One week is five days (Monday through Friday). Day classes begin at 9:00 and end at 16:30 and night classes begin at 17:00 and end at 20:30.

(5) Class Content

1) Vocational Educational Diploma Level (PWS)

Although curriculum content differs according to department, each student is required to complete 91 credits on the average, in order to graduate. Courses are divided into related subjects, basic technology subjects and required and elective technology subjects.

a. Related subjects

Related subjects include mathematics, science, foreign language (English), human relations, organization & management, industrial economics, etc. As a rule, the students are required to complete these courses in the first year of their studies.

b. Basic technology subjects

Although course content differs according to department, students are required to complete their major basic courses within the first and second years of their program; and half of the course hours must be spent in experiments and practical training.

c. Required and elective technology subjects

The specialized subjects of each department must be completed within the first and second year of each student's curriculum; and half of the course hours must be spent

in experiments and practical training. These are divided into compulsory and elective subjects.

The required credits for each department are shown in Table 2.7 and the curriculum is shown in Appendix 2.5.

Table 2.7 Required Credits by Each Department (PWS)

Unit: credit

Department	Related Subject	Basic Technology Subject	Technology Subject	Elective Subject	Total
Production Technology	23	21	34	10	88
Industrial Technology	22	42	20	6	90
Automechanics	22	40	21	7	90
Electric Power Technology	28	51	9	3	91
Electronic Technology	29	43	16	8	96
Instrumentation & Process Control Technology	22	33	34	5	94
Mechatronics	29	32	25	10	96
Average	25	37	23	7	92

Source: PTC

2) Technician Educational Higher Diploma Level (PTS)

The object of the PTS course is to produce teachers for DOVE technical colleges. Subsequently, much of the course is dominated by subjects on education and most of the subjects are common to all department, and it is divided into related subjects, basic subjects, technology subjects, and elective technology subjects. Students are required to complete an average of 94 credits in order to graduate.

a. Related subjects

Related subjects include mathematics, science, social studies, human relations, foreign language, etc. and must be completed within the initial year of the course curriculum.

b. Basic subjects

Basic subjects include educational theory, educational philosophy, teaching ethics, teaching methodology, teachers' training, etc. These subjects must be completed within two years.

c. Technology subjects and elective subjects

Technology subjects and elective subjects of each department must be taken and completed within two years.

The credits according to each department are shown below in Table 2.8.

Table 2.8 Required Credits by Each Department (PTS)

Unit: credit

Department	Related Subject	Basic Technology Subject	Technology Subject	Elective Subject	Total
Production Technology	33	24	42	2	101
Automechanics Technology	33	24	29	6	92
Electrical Technology	35	24	28	2	89
Average	34	24	33	3	94

Source: PTC

(6) Summer Programs

Short-term retraining programs for teachers of DOVE technical colleges are held during the summer holidays.

(7) Cooperation with Private Vocational Schools

OPEC affiliated private vocational schools suffer from a shortage of training equipment. Due to these circumstances, OPEC provides scholarships for their outstanding students to enable them to pursue a PWS at PTC. There were 35 such outstanding students in 1990.

(8) Current Status of Job Opportunities for PTC Graduates

The total number of PTC graduates in 1990 was 907 as shown in Table 2.9;.and 147 or 16 percent of these graduates continued on to higher degree programs. The remaining 760 or 84 percent got positions through the college placement service. Approximately 95 percent found employment within the private sector and the remaining 5 percent became government officers or were self-employed. Eighty-six percent of the graduates obtained good jobs. These statistics reflect their competency. About 73 percent of them obtained employment in their professional field.

Table 2.9 Follow-up of Graduates in Pathumwan Technical College (Diploma Level) in 1990

Fields & Education	Production Technology	Industrial Technology	Electrical Power Technology	Electronic Technology	Automechanics Technology	TOTAL	SHARE (%)
Number of Graduates	93	139	174	245	256	907	100.0
Continuing on to higher degree programs	11	16	38	49	33	147	16.2
Number of Employed	82	123	136	196	223	760	83.8
NUMBER OF EMPLOYED							
Fields & Education	Production Technology	Industrial Technology	Electrical Power Technology	Electronic Technology	Automechanics Technology	TOTAL	SHARE (%)
Looking for the job	-	-	-	-	-	-	-
Unemployed	-	-	-	-	-	-	-
Official	-	1	4	4	2	11	1.5
Private Sector	72	114	128	189	216	719	94.5
Personal Business	10	8	4	3	5	30	4.0
TOTAL	82	123	136	196	223	760	100.0
TYPES OF WORK							
Fields & Education	Production Technology	Industrial Technology	Electrical Power Technology	Electronic Technology	Automechanics Technology	TOTAL	SHARE (%)
Qualified Work	73	105	114	170	192	654	86.0
Non-Qualified Work	9	17	19	24	31	100	13.2
Unknown	-	1	3	2	-	6	0.8
TOTAL	82	123	136	196	223	760	100.0
NUMBER OF PERSONS EMPLOYED IN THEIR FIELD OF STUDY							
Fields & Education	Production Technology	Industrial Technology	Electrical Power Technology	Electronic Technology	Automechanics Technology	TOTAL	SHARE (%)
25%	9	17	19	24	31	100	13.2
50%	12	26	20	26	18	102	13.4
75%	54	77	89	134	161	515	67.7
100%	7	3	8	12	13	43	5.7
Unknown	-	-	-	-	-	-	-
TOTAL	82	123	136	196	223	760	100.0
Number of persons using College Placement Service	82	123	136	196	223	760	-

Remarks: Salary is 3,500 - 6,500 baht/month

Source: PTC

(9) Current State of Equipment

Experiment and practical training are indispensable to technical education. Equipment for experiment/practice in PTC is particularly deficient in electric and electronic equipment. Existing equipment has depreciated and it is inadequate for training and education in high technology. Major equipment currently in use is as follows:

Machinery Equipment

CNC electric discharge machine (one unit), plastic mold extruder machine (one unit), manual machine tools (60 units), no CAD/CAM.

DOVE is concentrating on efforts to upgrade the equipment at PTC and have taken budgetary measures to purchase a CNC machining center and lathes within this year. They have already purchased one unit.

Electric and Electronic Equipment

Logic circuit trainer (6 units), power source (8 units), model television (4 units), electric torque machine (5 units), oscilloscope (15 units), spectrum analyzer (one unit), PC Tavon (10 units), personal computer trainers (5 units)

Process Control Equipment

Universal station (2 units), printer (2 units), FD drive (one unit), process manager (one unit), programmable controller (2 units)

Hydraulics and Pneumatic Equipment

Basic hydraulic training unit (2 units), electrohydraulic training accessory (one unit), basic pneumatics training units (3 units), electric pneumatics training unit (2 units), automatic control valves 1 lot.

Audio Visual Equipment

Video production camera, one unit (a 10 year old National VHS home video), two VTR (old), four OHP (placed in the classrooms), no audio visual room.

LL Educational Equipment

There is one language laboratory donated by a private firm is installed. The lab consists of one master control (with headset), 40 booths (with headsets), no tape recorder, and no video display system.

(10) PTC Organizational Chart

An organizational chart of the PTC is shown in Fig. 2.4.

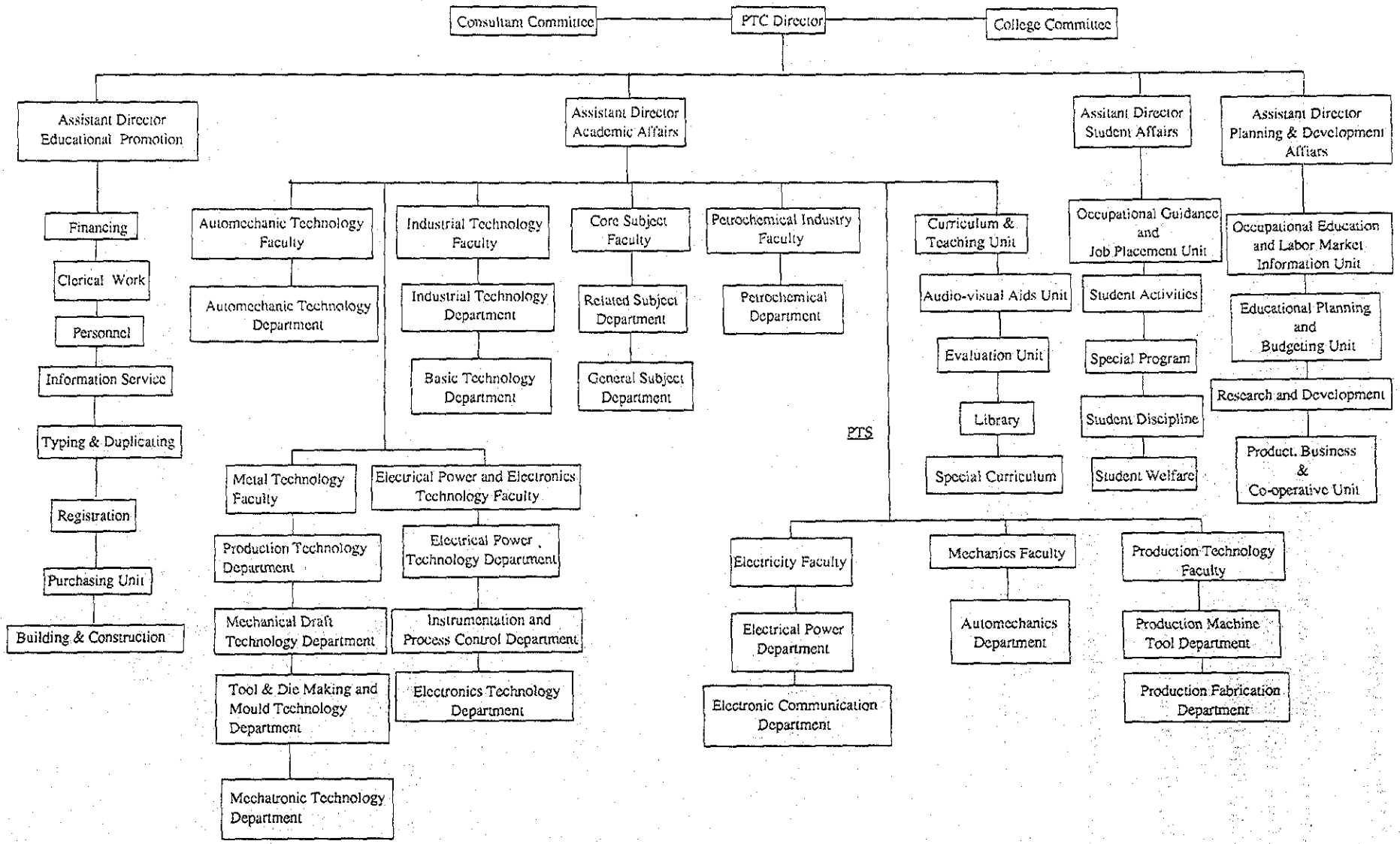


Fig. 2.4 Organization of PTC

2.3.2 PTC Budget

The PTC draws up an annual budget based on its achievements of the past year and its educational activities and submits it to DOVE. In turn, DOVE submits its budget request, based on the needs of each college, facility, and projects, to the Ministry of Education. The Ministry of Education will study the request and determine the scope of the budget. The PTC budget from 1989 to 1991 is shown in Table 2.10 below.

Table 2.10 Budget Record of PTC

Unit: baht

Budget Items	1989	1990	1991
Salary/Regular Wages	10,889,600	14,050,800	14,701,800
Operation & Maintenance Cost	15,186,200	51,238,540	42,674,526
Honorarium, Materials and Supplies	8,283,600	7,490,500	6,487,500
Utilities	1,497,600	1,658,040	1,689,126
Equipment Purchased	1,960,000	27,985,000	26,622,900
Land Lease	75,000	75,000	75,000
Construction Cost of Building	2,100,000	12,400,000	5,670,000
Miscellaneous	70,000	130,000	230,000
Maintenance Cost	1,200,000	1,500,000	1,900,000
Total	26,075,800	65,289,340	57,376,326

Source: PTC

2.3.3 Future Plans of PTC

The educational environment of PTC will improve greatly after the Project has been implemented. The following future plans have been devised:

(1) To add one new department offering a PWS (mechatronics department) and three new departments offering a PTS (industrial instrumentation technology, mechatronics, and civil technology).

(2) To increase the total student body of 1,593 students in 1990, by 38 percent or 2,200 students by 1993, and by 52 percent or 2,420 students by 1996. See Appendix 2.6 for the PTC plan through 1996.

(3) To implement training programs for technical college teachers throughout the nation.

(4) To establish itself as an international training center for ASEAN nations.

2.4 Outline of the Request

2.4.1 Background of the Request

Thailand has pursued a policy of industrial diversification since the 1960s. Although this policy came to a brief standstill during the two oil shocks in the 1970s, economic industrialization of the nation has proceeded at a rapid pace. In particular, agricultural products which have traditionally been the top export item of the country was replaced by industrial commodities after 1985. Among these commodities, the growth in the manufacture of IC parts for electrical household appliances such as television sets has been especially prominent. However, in conjunction with the rapid development of the industrial sector, the nation has not been able to produce a sufficient number of qualified and competent engineers to keep up with the advances in technology.

Pathumwan Technical College (PTC) which is the implementing agency of this Project, has been providing the Vocational Educational Diploma Level (PWS), the equivalent of junior college, in production technology and electronic engineering fields. Recently, the Ministry of Education has planned for PTC to offer more advanced and practical vocational education and the Technician Educational Higher Diploma Level (PTS) curriculum (equivalent to the third and fourth year of university); while making it the foremost central technical college in Thailand. The Ministry of Education has initiated a government approved project to construct a new PTC building as part of its plan and 32 million bahts were appropriated for the construction project. This construction project began in June 1990 and is expected to be completed on April 30, 1992.

However, despite these endeavors to improve PTC, basic educational and training equipment equivalent to the high technological levels of the industrial sector is deficient. Hampered by a limited budget, the Ministry of Education has found it difficult to correct this situation, and has officially requested the Government of Japan, an advanced nation in the industrial field, to provide educational equipment mainly in the electronic engineering fields under the auspices of the Japanese grant aid program.

2.4.2 Contents of the Request

(1) Field of the Request

The equipment requested in the Project was for experiment and practice for two existing and one new department and supplementary equipment for three fields .

Fields requested are as follows:

1) Mechatronics
2) Industrial Electronics
3) Instrumentation & Process Control
4) Video Program Production & Display
5) Text Printing
6) Language Laboratory

The equipment in the abovementioned fields has been requested according to each lab or classroom and not by each course.

(2) Requested Equipment

Major requested equipment in each lab, training room, or classroom is shown in Table 2.11.

Table 2.11 Equipment Under Request

Laboratory	Major Requested Equipment
1. Instrumentation Lab	Electric Measurement Trainer, Oscilloscope Trainer, DC/AC Bridge,LCR Meter, Other Electric Instrument
2. Electric Device and Circuit Lab	Electric Circuit Trainer, Storage Oscilloscope, Thyristor Trainer,LCR Meter, Semiconductor Characteristic Curve Tracer, Other Electric Instrument
3. Digital Electronics and Microprocessor Lab	Logic Circuit Trainer, Single Board Microcomputer Trainer,Digital Circuit Trainer, Oscilloscope, Other Electric Instrument
4. Microcomputer lab	Logic Analyzer, Single Board Microcomputer, Personal Computer,Emulator, Stepping Motor Control Board
5. Personal Computer Lab	Personal Computer, Printer, Software
6. Computer Aided Design Lab	CAD/CAM Training Computer, Software, Printer, X-Y Plotter,Uninterrupt Power Switch
7. Power Electronics and Electric Drive Lab	DC Servomotor Trainer, Stepping Motor Trainer, Positioning Control Trainer, Oscilloscope, Universal Counter
8. Automatic Control Lab	AD/DA Converter, Temperature Servo Control, Servo-Feedback Control Trainer, Sequence Control Experiment Equipment

Laboratory	Major Equipment
9. Computer Aided Measurement Lab	Personal Computer, Printer, X-Y Plotter, GP-IB Board, FM/AM Standard Signal Generator, Audio Analyzer, FFT Analyzer, Spectrum Analyzer, Micro-torquemeter
10. Industrial Electronics Lab	Transistor Inverter Training Unit, Robot Model, Flexible Manufacturing System
11. Hydraulics and Pneumatics Lab	Basic Hydraulic Training Unit, Electrohydraulic Training Unit, Proportional Hydraulic Training Accessory, Electric Pneumatic Training Unit, Programmable Controller
12. Transducer Lab	Instrumentation Transducer Unit, Orifice Plate with Ring, Diaphram Seal
13. Industrial Instrumentation Lab	Pneumatic Recorder, Pneumatic Controller, Electronic Controller,Thermocouple with EME/RTD-EMF, Vortex Flowmeter
14. Process Control Lab	Distributed Control Trainer 1) Highway Gateway 2) Application Module 3) Advanced Multifunction Controller 4) Logic Controller system
15. CNC Machining Workshop	CNC Wire-cut Discharge Machine, CNC Milling Machine, CNC Precision Surface Grinding Machine, CAD/CAM Computer
16. Metrology Lab	Coordinate Measuring Machine, Roundness Tester, Surface Roughness Tester, Microscope, Micrometer, Granite Surface Plate
17. Telecommunication Lab	Optical Fiber Communication Training Set, Microwave Link Demonstration and Training Set
18. Video Program Production Studio	3-CCD Color Video Camera, S-VHS Portable Video Cassette Recorder, Video Monitor, Microphone, Lighting Kit, S-VHS Editing video Cassette Recorder, Editing Controller, Dubbing VTR, Installation Materials
19. Auditorium	Video Projector, Motor-drive Screen, Speaker, Microphone, Installation Materials
20. Audio/Visual Room	Video Projector, Motor-drive Screen, Speaker, Installation Materials
21. Text Printing Room	Duplicator, Bookbinding Machine, Word Processor, Printer,Copying Machine
22. Language lab.	Master Console, Booth Section, Headset, Tape Recorder, Speaker, Video Projector, Motor-drive Screen, Installation Materials

3. OUTLINE OF THE PROJECT

3. OUTLINE OF THE PROJECT

3.1 Objective of the Project

The objective of the Project is to provide equipment for PTC, the foremost technical college in Thailand, in order to foster qualified and competent engineers to assist in producing technical college teachers and retraining programs for current technical college faculty members.

3.2 Study and Examination of the Request

3.2.1 Validity and Necessity of the Requested Project

Rapid economic development, industrialization, high technological standards of Thai industries have created a strong demand for competent personnel in science and engineering related fields; and with the existing acute labor shortage in these fields, it is not rare for companies to head hunt personnel of other companies.

In order to resolve this growing problem, the Thai government instituted a policy to increase the engineering departments of universities and to upgrade the educational standards of the technical colleges in the Revised Sixth and Seventh National Development Plans. Under this policy DOVE, which is in charge of vocational education, has made PTC, the foremost technical college under its administration, the leading central technical college in the nation; and it has instituted a plan to construct a new PTC building. In order to achieve this goal, PTC has striven to provide comprehensive educational curriculum, to foster highly skilled technicians, to resolve the shortage of teachers which is one of the educational problems today, and to implement re-education programs for its faculty members, as well as the faculty members of other technical colleges in order to upgrade their knowledge and skills.

This Project is to provide equipment required for the new building of the PTC under the auspices of the grant aid program of the Japanese government. Furnishing PTC's educational facilities will greatly contribute to upgrading the level of Thailand's technology education and the steady development of its industries.

Therefore, the objective of this Project is in line with the National Development Plan of Thailand and judged appropriate and necessary to be implemented under the grant aid program of the Japanese Government.

3.2.2 Evaluation of the Requested Fields

The equipment will be provided for six fields of study, two existing departments, one new department , and educational support equipment for three fields of study. An evaluation of each field of study is given below.

(1) Mechatronics Department

The standard of technology in Thailand is high and industries from abroad have established fully automated plants with welding, conveyer, and assembly processes carried out by robots. The creation of this new department devoted to teaching basic knowledge, operation, and maintenance of high tech machinery is based on realistic demands and conditions of the nation.

(2) Industrial Electronics Department

It is impossible to function in the high tech fields without the knowledge of electronics technology. The objective of this department is to teach basic electronics technology and its practical application. However, the existing equipment within the department is incomplete, hindering thorough training and educational programs in this subject. Therefore, this department is considered an appropriate recipient of the equipment to be provided by the Project.

(3) Industrial Instrumentation & Process Control Department

Instrumentation and process control is about intensive control system of production lines in modernized plants and factories. The department offers courses in basic theory, operation, management techniques, maintenance, and inspection methods applicable in intensive control system of high tech equipment.

Providing educational and training equipment in this field is crucial in producing skilled labor who will directly affect the development of industrial technology in Thailand.

(4) Video Program Production & Display

Equipment for this department is audio visual equipment and video production of educational materials. PTC has experience in producing video materials for lectures and seminars; and currently it has a library of 106 video tapes. However, the existing video camera and VTR have depreciated and produce blurry projections, thereby limiting the number of productions. After the Project has been implemented, PTC has plans to distribute its video productions to the technical colleges, polytechnic schools, and area

vocational centers under DOVE administration, in order to carry out effective technical vocational education. In addition, there are plans to broadcast vocational education programs once a month on the Thai educational station (Channel 11) for the general public.

Presently, PTC does not have an audio visual classroom and is utilizing only OHP in a few classes. Provision of audio visual equipment by the Project is expected to be effective in implementing technical vocational education.

Therefore, equipment provision for this department is considered valid, not only for PTC, but for upgrading vocational education in general.

(5) Text Printing

The annual printing volume produced by PTC in 1990 was 3.6 million pages; and it is anticipated to increase by 50 percent in future when the new department is established and the student body increases. Current equipment is antiquated and some are out of order.

Therefore, replacement of old equipment is judged necessary in order to carry out a comprehensive educational program.

(6) Language Laboratory Equipment

Although much of the technical literature available in Thailand is in English, the English ability of Thai engineers is poor; and there is a strong demand for English language programs.

Recently, the existence of Japanese industries in Thailand has become conspicuous and many graduates have become employed by Japanese industries. These Japanese firms conduct Japanese language classes within the company for their employees, however in many cases, it has been inadequate in promoting mutual understanding.

The LL equipment to be provided in the Project is judged effective to improve the English conversational ability of students and to promote Japanese language classes for students who will be employed by Japanese firms.

3.2.3 Evaluation of Project Implementation and Operation Plan

(1) Securing of teachers

According to the future plan of PTC, one PWS and three PTS departments are to be opened after the implementation of this Project. It will be necessary to increase number of teachers along with the opening of new departments. PTC has a PTS for the purpose of fostering teachers for technical college and it is expected to produce graduates

of about 71 to 235 yearly from 1991 as shown in Appendix 2.6. Therefore, there will be no problem in securing teachers.

(2) Securing of budget

The PTC budget for 1989 - 1991 is given in Table 3.1. An estimate of necessary expenses after the implementation of this Project based on the past performances is shown in Table 3.1.

According to the table, necessary budget for the year 1993 is 45,019,000 bahts and this figure will be sufficiently appropriated judging from the past performances.

Table 3.1 Budget Record of PTC

Unit: baht

Budget Items	1989	1990	1991	1993
Salary/Regular Wages	10,889,600	14,050,800	14,701,800	25,010,000
		(1.29)	(1.05)	(1.78)*
Operation & Maintenance Cost	15,186,200	51,238,540	42,674,526	20,009,000
		(3.37)	(0.83)	(0.47)**
Honorarium, Materials and Supplies	8,283,600	7,490,500	6,487,500	10,336,000
		(0.90)	(0.87)	(1.38)**
Utilities	1,497,600	1,658,040	1,689,126	3,378,000
		(1.11)	(1.02)	(2.0)**
Equipment Purchased	1,960,000	27,985,000	26,622,900	1,960,000
		(14.28)	(0.95)	(0.07)**
Land Lease	75,000	75,000	75,000	75,000
		(1.00)	(1.00)	(1.00)**
Construction Cost of Building	2,100,000	12,400,000	5,670,000	0
		(5.91)	(0.46)	(0.00)**
Miscellaneous	70,000	130,000	230,000	460,000
		(1.86)	(1.77)	(2.00)**
Maintenance Cost	1,200,000	1,500,000	1,900,000	3,800,000
		(1.25)	(1.27)	(2.00)**
Total	26,075,800	65,289,340	57,376,326	45,019,000
		(2.50)	(0.88)	(0.78)**

Source: PTC

Remarks: 1. ( ) indicates multiplication ratio of the previous year.

( )* indicates multiplication ratio of 1990 and ( )** shows that of 1991.

2. Increase in Salary/Regular wages is supposed to be proportional to the increase in the number of department and student.

The number of departments: 10 in 1990 and 40% increase or 14 in 1993.

The number of students: 1,593 in 1990 and 38% increase or 2,200 in 1993.

Total increment is 78%.

3. Honorarium, Materials and Supplies are considered to be proportional to the number of students. 1,593 in 1990 and 2,200 in 1993, amounting to 38% increase.

4. Utilities is expected to increase by 100% from the year 1991 considering the construction of new school building and provision of new equipment.

5. Purchasing cost of equipment is expected to be reduced to the level of year 1989 with the provision of equipment in this Project.
6. Land Lease is expected to be the same.
7. Construction Cost of Building is expected to be zero with the completion of construction of new school building.
8. Miscellaneous is expected to increase by 100% from the year 1991.
9. Maintenance Cost is expected to increase by 100% from the year 1991.

3.2.4 Similar Project and Technical Assistance from Various Governments and International Organizations

Educational assistance from various countries and international organizations are provided in the forms of assistance in policy planning and upgrading of scientific research , provision of equipment and technical cooperation.

With the increase of educational budget and cooperation from various countries and international organizations, DOVE has established or expanded its educational institutions to promote vocational education since its creation. Ongoing technical cooperation plans related to technical colleges are shown in table 3.2. These ongoing assistances are provided in the form of equipment provision combined with technical cooperation.

Table 3.2 Similar Projects and Technical Assistance from Various Governments and International Organizations

Project	Source of Assistance	Contents of Project
1. Establish Production Technology Training Division at Technical College, Samutprakan	UNDP/ILO	Total fund: 37 million bahts providing the equipment for new Dept. of Production Technology. Training by experts from ILO.
2. Enhance Nakhon Si Thammarat Technical College	Government of Germany	Total fund: 50 million bahts providing electricity/communication equipment
3. Improve Machines and equipment of Sattahip Technical College	Government of Austria	Total fund: 60 million bahts. Implementing under 3 phase. At present 3 phase is on going. (14 instructors are trained in Austria)

3.2.5 Necessity of Technical Cooperation

The Thai government is requesting project type technical cooperation for PTC along with the request for this grant aid project.

The equipment to be provided in this Project is mainly electronics and mechatronics technology equipment; and the educational programs which will be using

this equipment is anticipated to become the foundation for modern automatic control related technology. Current educational standards in this field in Thailand are behind actual production site conditions and upgrading standards is earnestly desired. Although PTC has an electronic technology and instrumentation & process control department, the necessary equipment and the knowledge of faculty members in the field are insufficient and it has been difficult to provide effective education. Therefore, although the Thai staff will manage to operate the equipment to be provided in this Project, it will greatly contribute to the improved educational, if Japan, an advanced country in the field, is able to transfer its technology by dispatching experts for retraining of teachers and for effective use of the equipment as part of Japan's technical cooperation.

Therefore Japan's technical cooperation for following fields such as dispatching her experts is greatly anticipated.

Microcomputer (basic and application)
Personal computer & CAD
Computer Aided measurement
Optical communication
Micro-wave/High frequency measurement
CNC machine manufacturing/measurement

3.2.6 Basic Policy on Implementation of Cooperation

It is concluded that implementation of the Project under the Japanese grant aid is appropriate in terms of Project effectiveness, feasibility and management ability of the implementing agency of Thailand. Therefore, based on the premise that the Project will be carried out under Japanese grant aid, the contents of the Project was studied and the basic design was done in the following section of this report.

3.3 Project Description

3.3.1 Executing/Implementing Agency and Operational Structure

The executing agency of this Project is DOVE and the Pathumwan Technical College is the implementing agency. System of implementation is shown in below.

DOVE is fully responsible for all aspects of the Project to be implemented by the Government of Thailand. The External Relations Section, Planning Division within DOVE will carry out the Project with the cooperation of the Technical College Division, Design and Construction Division, and the PTC.

DOVE will oversee the construction of the new PTC building, installation of necessary facilities and equipment, budget planning, etc. required for Project implementation.

The facilities and equipment which will be installed in the new building will be utilized by PTC for educational activities. PTC will be responsible for the operation and maintenance of the building and equipment, procurement of faculty staff, and management of the budget.

There are four Assistant Directors under the Director of PTC and they are in charge of Academic Affairs, Educational Promotion, Student Affairs and Planning & Development Affairs respectively. A total of 196 faculty members including 26 administrative staffs and 170 teachers is planned after the implementation of the Project. The number of teachers according to fields is shown below. Organization of PTC is given in Fig. 2.4.

Core subject/Curriculum unit	27
Electric/Electronic/Instrumentation	57
Production Technology	39
Automechanics	14
Industrial Technology	21
Petrochemical Industry	6
Civil Engineering	6
Total	170

3.3.2 Operational Plan of PTC

Operational Plan of PTC includes opening of new departments and increasing the number of its students.

(1) Opening of new departments

PTC is planning to open following four department making present 10 departments to 14 by the year 1993 (refer to the Appendix 2.6).

PWS: Mechatronics

PTS: Industrial Instrumentation
Civil Engineering
Mechatronics

(2) Increasing the number of students

PTC is planning to increase the student number from 1,593 in 1990 to 2,420 in 1996. Planned number of students according to the department is shown below (refer to Appendix 2.6).

PWS	
Production Technology	210
Mechatronics	80
Industrial Technology	200
Automechanics	360
Electrical Power	480
Electronics	360
Industrial Instrumentation and Process Control	80
Petrochemical Industry	80
PTS	
Production Technology	130
Mechanical Technology	40
Electrical Technology	180
Industrial Instrumentation	80
Civil Engineering	80
Mechatronics	60
Total	2,420

3.3.3 Location and Condition of Project Site

DOVE is constructing a new school building on PTC campus to install the equipment to be provided by this project. Details are given as follows.

(1) Contents of Construction Plan of New School Building

The PTC building is currently under construction on campus and approximately 35 percent of the building has been completed as of June 1991. According to the construction plan, the building is a six storied RC structure, with a floor space of 6,735 square meters, and is expected to be completed in April 1992. The construction is supervised by the Division of Design and Construction of DOVE.
An outline of the building is as follows:

-Structure

Foundation:	Concrete Pile
Building:	RC Rahmen structure, six stories

-Exterior Finishing

Floor:	Stone and tile
Outer Wall:	Paint coating, partially with tiled segments
Roof:	Waterproofing by asphalt, mortar finish

-Interior Finishing

Floor:	Tile, with double floor deck in certain areas
Walls:	Mortar, steel troweled, VP finish
Doors and Windows:	Wooden

-Furniture

Wooden and steel furniture

-Electrical Facilities

Incoming Distribution System:	3 phases, 3 wires, 12KV/50Hz, one incoming line
Transformer System:	Pole-type transformer, 750KVA-12KV/380N220V
Distribution System:	3 phases, 380V/50Hz, single-phase/220V/50Hz
Emergency Power Source:	Diesel generator, 35KW

-Elevator

Two elevators

-Air Conditioning and Ventilation Facility

Air conditioners and ventilation fans will be installed in rooms as needed.

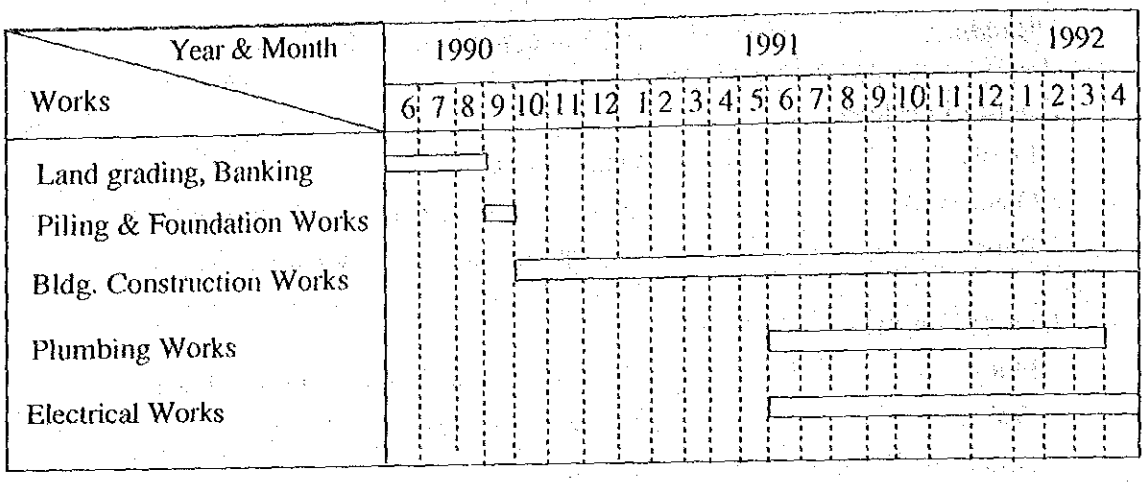
-Water Supply & Drainage Facilities

Elevated water tank system

(2) Construction Schedule

The construction schedule of the new PTC building is shown in Table 3.1.

Table 3.1 Construction Schedule



(3) Budgetary Measures

The PTC budget for this construction plan was submitted to the Ministry of Education by DOVE and was put into effect upon receiving Cabinet and Parliamentary approval. The Government of Thailand allocated 32 million bahts for the construction of the new PTC building in 1989. However, actual construction began in June 1990 and was delayed approximately one year. During this interim, due to the construction rush in Bangkok and its surrounding environs, the cost of construction materials skyrocketed. Funds allocated in the initial budget has become insufficient; and presently, contract for a segment of the electrical work for the building interior remains unfinished due to a shortage of funds. Due to this deficit, PTC is currently filing a request for supplementary funding from DOVE.

3.3.4 Outline of Facility and Equipment

The major equipment in this project and its purpose of use are shown as follows.

(1) Instrumentation Lab

Electric Fundamental Training Unit:	Training of measuring method by combination of fundamental instrument
Transistor Checker:	Check of transistor quality
OHM's Law Trainer:	Study and experiment of OHM's Law
Oscilloscope Trainer:	Study of fundamentals/operation of oscilloscope (observation of wave form)

(2) Electronic Devices and Circuit Lab

Semiconductor Characteristic Curve Tracer:	Display of characteristic of semiconductor
Rectification and Smoothing Circuit Training Unit:	Study of electric circuit (Rectification)
Semiconductors Circuit Trainer:	Characteristic Measurement of diode and transistor
Thyristor Trainer (Training):	Fundamental application experiment for thyristor circuit

(3) Digital Electronics and Microprocessor Lab

Logic Circuit Trainer:	Demonstration of logic circuit
Digital Circuit Trainer:	Study of digital circuit
Single Board Microcomputer Trainer:	Study of microcomputer software

(4)Microcomputer Lab

Single Board Microcomputer:	Application experiment for computer
Personal Computer:	Application experiment for microcomputer & software development for computer experiment
A/D, D/A Converter Board:	Experiment for analog to digital and digital to analog conversion.

(5) Personal Computer Lab

Personal Computer:	Study of computer programming
Software Set:	Software for computer operation

(6) Computer Aided Design Lab

CAD Computer:	Practice for computer aided design
Software Set for CAD:	Software for CAD operation
X-Y Plotter:	Plotting out for drawings by CAD
UPS Unit:	Protection for electric break down and instantaneous cut down of electric source

(7) Power Electronics and Electric Drives Lab

DC Servomotor Trainer:	Study for DC servomotor
Stepping Motor Trainer:	Study for stepping motor
Positioning Control/Screw-Drive & Wire Drive:	Practice for positioning control

(8) Automatic Control Lab

Sequence Control Experimental Equipment:	Experiment for sequence control
Temperature Servo Control:	Study for servo control by temperature
Servo-Feedback Control Trainer:	Study for servo-feedback control

(9) Computer Aided Measurement Lab

Personal Computer:	Control for measurement equipment
Board for Personal Computer:	Control for instrument and signal I/O
FFT Analyzer:	Frequency analysis of low frequency
Spectrum Analyzer:	Frequency analysis of high frequency
Function Generator:	Signal source of electric circuit
Valuable Frequency Filter:	Experiment of frequency characteristic of signal
Torquemeter:	Measurement of shaft-torque of smallish motor

(10) Industrial Electronics Lab.

Transistor Inverter training Unit:	Study of DC-AC conversion
Robot Model:	Study of robot
Personal Computer:	Computer for robot control
Flexible Manufacturing System (FMS):	Experiment of FMS (automation system in plant)

(11) Hydraulics and Pneumatics Lab

Basic Hydraulic Training Unit:	Study of basic hydraulic control
Electro-Hydraulic Training Accessory:	Study of electro-hydraulic control
Proportional Hydraulic Training Accessory:	Study of proportional hydraulic control
Electric Pneumatic training Unit:	Study of electric pneumatic control
Programmable Controller:	Study of program control
Air Compressor (Screw Type):	Supply of compressed air

(12) Transducer Lab

Instrumentation Transducer Unit:	Study of sensor and instrumentation transducer

(13) Industrial Instrumentation Lab

Pneumatic and Electronic Square Root Extractor:	Study of control system
Recorder:	Recording of data
Pneumatic Controller (PID):	Display of data
Electronic Controller (Programmable):	Study of electronic automatic controller

(14) Process Control Lab

Distributed Control Trainer:	Study of process control system of equipment

(15) CNC Machining Workshop

CNC Wire Cut Electric Discharge machine:	Study of computerized machine tool
CNC Milling Machine:	Study of computerized machine tool
CNC Precision Surface Grinding Machine:	Study of computerized machine tool
Handling Robot:	Study of robot fundamentals and operation
CAM Computer:	Transmittal for CNC machine control data
CAD/CAM Software:	Software for CAD/CAM operation

(16) Metrology Lab

Coordinate Measuring Machine:	Study of measurement of size of cubic manufactured material
Roundness Tester:	Measurement of roundness of manufactured material
Surface Roughness Tester:	Measurement of surface roughness of manufactured material
Tool Microscope:	Observation of tool cutting part

(17) Telecommunication Lab

Optical Fiber Communication Training Set:	Study of basic optical fiber communication
Microwave Link Demonstration and Training Set:	Study of basic microwave measurement

(18) Video Production Studio

3-CCD Color Video Camera:	Video camera for producing teaching material
S-VHS Portable Video Cassette Deck:	Recording of video tape
Portable Color Video Monitor:	Display for video camera
Portable Stereo Cassette Deck:	Recording of audio sound
Lighting Kit:	Lighting for making tape
Time Base Corrector:	Editing for video tape
S-VHS Editing Video Cassette Recorder:	Editing recorder for VTR
Editing Controller:	Editing VTR
Microphone:	Collection of surrounding sound

Audio Mixer:	Editing of effective audio sound
Master S-VHS VTR:	Master VTR for dubbing
Time Base Corrector:	Dubbing for video tape
Slave S-VHS VTR:	Slave VTR for dubbing
Dubbing Controller:	Dubbing for video tape

(19) Auditorium

Video Projector with Screen:	Projection of video tape for text
Speaker:	For lecture
Microphone:	For lecture
Video Rack:	Video equipment and rack
Audio Rack:	Audio equipment and rack

(20) Audio-Visual Room

Video Projector with Screen:	Projection of video tape
Main Speaker:	For video projection
AV Rack:	AV equipment and rack

(21) Text Printing Room

Super Digital Duplicator:	Printing of document, text, examination paper
Bookbinding Machine:	Bookbinding for text
Word Processor with Printer:	Making for document and text
Copying Machine:	Copying of document, text, examination paper

(22) LL Room

Master Section (teacher):	Operation desk for teacher
Booth Section (student):	Operation desk for student
Video Projector with Screen:	Projection of video tape
Main Speaker:	For video projection
AV Rack:	AV equipment & rack

3.3.5 Operation and Maintenance Plan

(1) Operational Structure

The three departments relevant to this Project are part of the Faculty of Metal Technology, and Electric Power and Electronics Technology under Academic Affairs; and each laboratory is under the control of each respective department. Each laboratory is responsible for carrying out production of curriculum and educational materials, guidance in research and training activities, and lectures of their respective faculty and department.

The Audio Visual Aids Units under Academic Affairs is responsible for the video production studio; Typing & Duplicating Section under the Educational Promotion Affairs is in charge of the printing room, and the Related Subject Department of the Faculty of Core Subject is responsible for the language lab. Each laboratory carries out its operations in conjunction with the curriculum of each faculty or department.

(2) Operation and Maintenance System

Presently, operation and maintenance within PTC is carried out by various sections as outlined below.

Building/Facilities:	Building & Construction Section, Educational Promotion Affairs
Experiment/Training Equipment:	The departments of each lab
Audio Visual Equipment:	Audio Visual Aids Unit, Academic Affairs
Text Printing Equipment:	Typing & Duplicating Section, Educational Promotion Affairs
LL Equipment:	Related Subject Department, the Faculty of Education

There is no specific specialist for operation and maintenance of equipment; and the daily maintenance or simple repairs are done by each lab, department instructors, or students. For operation and maintenance of high tech equipment, training in operation and maintenance of such equipment is carried out in other schools or private plants.

Purchasing Unit, Educational Promotion Affairs, is responsible for providing spare parts and consumables upon request from respective labs.

(3) Budget for Operations and Maintenance

Past performance of PTC budget is shown in Table 2.10 in article 2.3.2 PTC Budget.

1) PTC Personnel Expense Plan

The personnel expenses of PTC for 1989 was about 10.9 million bahts and about 14.1 million bahts in 1990. For the 1991 budget, about 14.7 million bahts has been requested.

After Project implementation, the student body in 1993 is anticipated to increase from 1,593 students in 1990 to 2,200 students. Accordingly, PTC will increase the number of teachers for each of the 12 departments by six members (four newly established and eight existing departments which expect an increase in students). Subsequently, the total number of faculty members is anticipated to increase from 124 members in 1990 to 196. PTC estimates personnel expenses to rise to 30 million bahts. Estimates of personnel expenses are shown in Table 3.3.

Table 3.3 Personnel Expenses of PTC

Unit: thousand baht

Items	Actual		Proposed	
	1989	1990	1991	1993
Salary and Regular Wages	10,899	14,050	14,701	30,000
No. of Instructors	101	124	124	196
No. of Students	1,848	1,593	1,846	2,200

Source: PTC

In 1991 the total number of PTC instructors was 124 and the annual average salary of a faculty member was 118.6 thousand bahts.
If salaries were to increase at an annual rate of 5 percent, per capita annual salaries would average 130.7 thousand bahts in 1993. This would allow the institute to hire up to 230 instructors. Therefore, 196 instructors required by Project implementation is not expected to become a financial burden for the administration of PTC.

2) Operation and Maintenance Expense Plan

With the exclusion of personnel expenses, operation and maintenance expenses were approximately 15.2 million bahts in 1989, about 51.2 million bahts in 1990, and is anticipated to be about 42.7 million bahts in 1991. These expenses include the staggering

building construction and equipment costs. After implementation of the Project, these construction and equipment costs are expected to drop to normal levels, and their will be a budget increase to cover operation and maintenance expenses for the new building and equipment.

The budget for operation and maintenance of overall PTC activities is shown in Table 3.4 and the estimated annual utility expenses of the equipment to be provided for the new building are given in Table 3.5

Table 3.4 Budget for Operation and Maintenance of PTC

Unit: baht

Items	Actual		Proposed	
	1989	1990	1991	1993
Honorarium, Materials and Supplies	8,283,600	7,490,500	6,487,500	8,039,200
Utilities	1,497,600	1,658,040	1,689,126	2,672,958
Equipment Purchased	1,960,000	27,985,000	26,622,900	1,960,000
Land Lease	75,000	75,000	75,000	75,000
Construction Cost of Bldg.	2,100,000	12,400,000	5,670,000	-
Miscellaneous	70,000	130,000	230,000	460,000
Maintenance Cost	1,200,000	1,500,000	1,900,000	3,800,000
Total	15,186,200	51,238,540	42,674,526	17,007,158

Remarks: Budget in 1993 is estimated on the following assumption.

(1) Honorarium, Consumables, Materials and Supplies

Budget in 1993 = Budget in 1990 plus increment expense for textbooks.

Increment expense = 3,600,000 sheets x (2200-1593) / 1593 students x 40 bahts/100 sheets = 548,700 bahts.

(2) Utilities expenses are assumed to be the total of the proposed budget in 1991 plus estimated expenses of the new building shown in Table 3.5

(3) Equipment purchase expenses are assumed to be the same as the actual amount in 1989.

(4) Miscellaneous is expected to increase by 100% in 1991.

(5) Maintenance cost is expected to increase by 100% in 1991.

Table 3.5 Estimated Annual Utility Expenses of New Building and Equipment

Electricity		Water		Total Expense (Baht)
Consumption (KW.hr)	Expense (Baht)	Consumption (m^3)	Expense (Baht)	
482,815	878,723	12,222	105,109	983,832

Remarks: Electricity Charge: 1.82 baht/KW.hr
Water Charge: 8.6 baht/m^3

The estimated total budget for operation and maintenance of PTC in 1993 is 47,007,158 bahts as shown in Table 3.6. This amount is sufficient to fully cover the operational and maintenance expenses of the Project considering its past performance.

Table 3.6 Total Budget of Operation and Maintenance of PTC

Unit: baht

Items	Actual		Proposed	
	1989	1990	1991	1993
Personnel Expenses	1,0899,600	14,050,800	14,701,800	30,000,000
Operation & Maintenance Expenses	15,186,200	51,238,540	42,674,526	17,007,158
Total	26,075,800	65,298,340	57,376,326	47,007,158