THE FEASIBILITY STUDY
ON
THE ESTABLISHMENT
OF
THE CENTER FOR INDUSTRIAL TECHNOLOGICAL INFORMATION
IN
THE REPUBLIC OF INDONESIA
(SUMMARY)

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MARCH, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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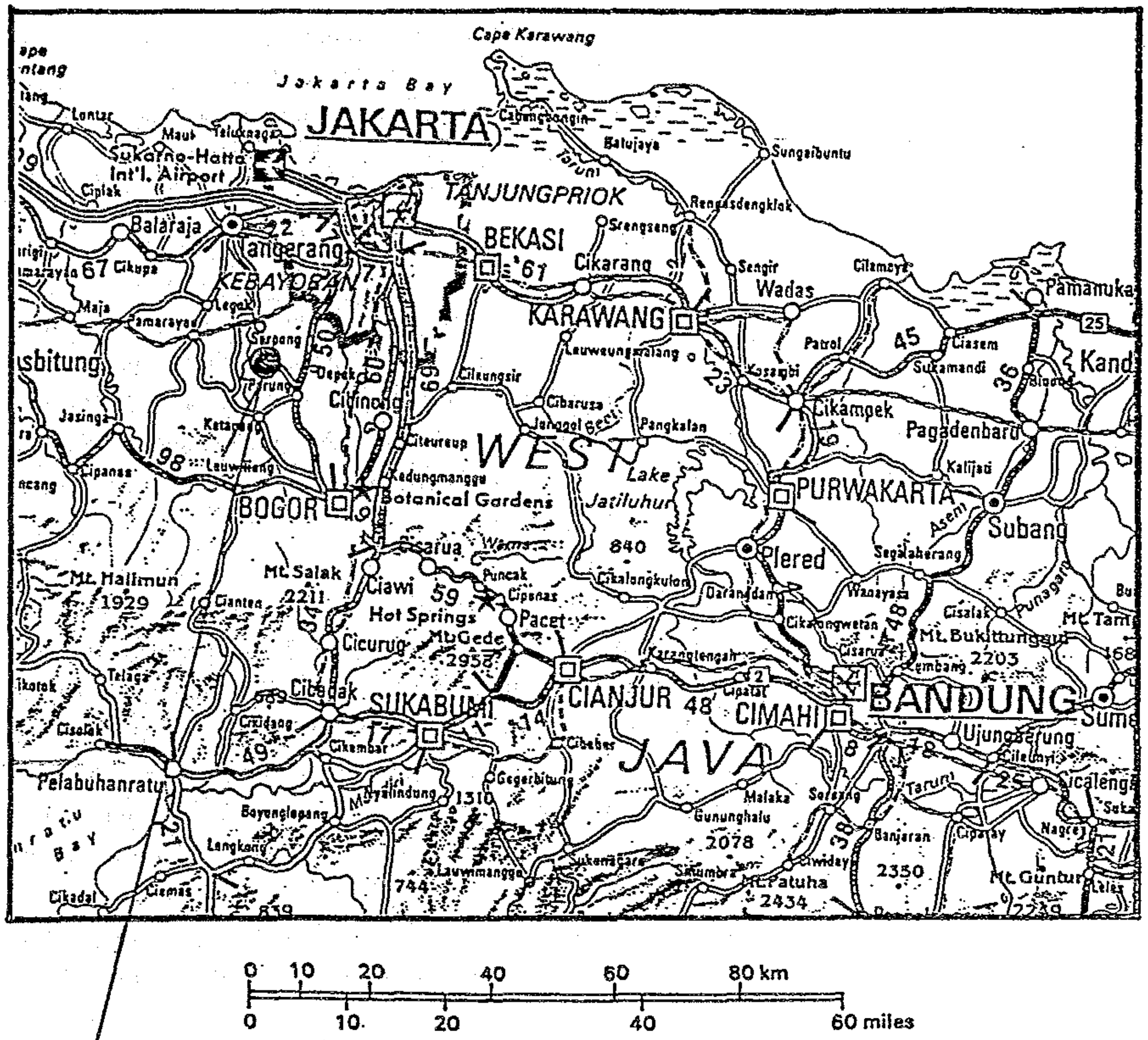


PUSPIPTEK-Serpong

CONCLUSIONS AND SUGGESTIONS

This study was carried out in order to present the functions of the Center for Industrial Technological Information, taking into account the roles of PUSPIPTEK-Serpong in industrial field and to conduct the feasibility study on the planned center. The followings are the conclusions of this study and the suggestions related to future realization of the Center.

(1) Achievements of This Study

1) It has been recognized that PUSPIPTEK-Serpong has started to develop as a new complex for interdisciplinary research in conjunction with the progress of industrial technology of the Republic of Indonesia and that it is indispensable to have the functions of the Center for Industrial Technological Information in order to achieve effective promotion of the current research and development and step-by-step progress for the future.

The PUSPIPTEK projects have as their target, the formation of a laboratory complex in which laboratories encompassing a variety of fields backed by different governmental organizations such as BPPT, LIPT and BATAN, serving as parent organizations, will be gathered together in a progressive environment that will be conducive to the carrying on of research and development activities. PUSPIPTEK-Serpong, which was begun as the first of these projects, is currently still under construction. For promotion of activities aimed at basic and application type research and development in major industrial fields, the utilization of engineering databases and software/hardware for technical analysis, and the functions like those of the Center for Industrial Technological Information, which has necessary personnel for such utilization, have not developed enough.

These functions have already been in operation in industrialized nations for 20 to 30 years, where they have proven to be indispensable. Even in an industrializing country such as the Republic of Korea, such means are being established and further developed.

It was apparent from the oral interviews and questionnaire results obtained from the staff of each of the organizations visited by the study team that such functions as these are indispensable for the stimulation of research and the improvement of the level of activity in each laboratory of PUSPIPTEK-Serpong.

2) This study has focused on ① the collection and the utilization of technological information through databases and communication technology, ② the analytical means such as simulation with technical analysis software, and ③ the possibilities for application of a general-purpose computer to be a central function of the above ① and ② , all of the three items which the Center for Industrial Technological Information should have as a common facility. This survey has shown that such an application is possible, if certain requirements are met, and that the net effect of this application would be quite substantial.

At present, the collection and utilization of technical information and analysis of data in the laboratories of PUSPIPTEK-Serpong are dependent on individual research conducted within each laboratory. It is, however, technically feasible to collect, arrange and utilize this technical information according to a defined procedure and thereby to conduct more effective data analysis, which in turn can be made available for common use.

This report has demonstrated that such procedures and means can have a considerable impact on the development of industrial technology in the Republic of Indonesia, in addition to the significance of benefits that will be derived by each of the laboratories in PUSPIPTEK-Serpong.

3) We have presented the function of the so-called Center for Industrial Technological Information and we have also demonstrated an example of a realistic development. As a result of estimation of personnel and cost for the Center, taking various conditions into account, it will be necessary to have 40 persons and the maintenance and operation costs of about 280 million rupiahs in early stages and thereafter, 67 persons and those costs of about 1,550 million rupiahs for smooth operation of the Center.

(2) Problem to be Solved

As the conclusion of the feasibility study, securing the routine budget (1.2 billion rupiahs per year) incurred after the third year from the service start and reserving the necessary staff (40 personnel) at the initial stage of the Center service are the mandatory conditions to realize to establish the Center. In addition to this mandatory conditions, the following matters should be taken into account.

1) This study has prepared a conceptual design for the Center for Industrial Technological Information which has as its core function the providing of hardware and

software material and the analysis of technological information. This facility would be the first of its kind in the Republic of Indonesia.

To make this Center possible it will be necessary to foster the use of the application software system and the construction of the database system and to conduct a basic design.

2) The collection and use of information and the means of data analysis can all be achieved with currently available technologies. It will be necessary, however, to select the method for collecting and arranging various data, the hardware and the software for analysis and the operating methods.

(3) Suggestions

The following five items are suggested to realize and promote operation of the Center for Industrial Technological Information, based on the current situation of industrial technology and research and development in the Republic of Indonesia as well as the concept and problems in developing the functions of the Center.

1) Following the conceptual design, BPPT, which is the primarily promotive body, should arrange staffing and funding. Fellowship overseas program will give a great help to early staffing.

2) The research and development personnel associated with the related industrial technologies should gather opinions on how the Common Information Center should be set up. These personnel should also establish a common objective for the growth and development of the Center through continuing collaboration with the related staff.

3) The personnel of the government agencies and budgetary administration who are involved in the realization and operation of the Center must be made aware that considerable efforts, the necessary budgetary allocation (1,200 million rupiahs per year), and staffing at initial stage (40 staff) are required. They should also emphasize the efficiency in the collection of technological information and the elimination of redundant research effort.

4) The personnel responsible for research and development of industrial technology must come to recognize the current lack of a systematic accumulation and exchange of technological information and the means of appropriate analysis of advanced infor-

mation. These leaders need to understand and exhibit enthusiasm for the concept of the Center and cooperate in improving the quality of information as well as the accumulation and proper utilization of such information, so that the ultimate aim of the Center, the development of the nation, will be achieved.

In order to effectively realize a love in early stage, it is necessary to invite specialists from overseas.

5) The government and the head administrator of the Center must continue to stress the importance of the wide use of the functions of the Center at each and every level in PUSPIPTEK-Serpong in order to maximize its potential for future technological development. In so doing, the Center will become recognized as a primary source of Industrial Technological Information and will become a model for similar information centers that will be needed for the governmental and private sectors in the future.

SECTION 1 PURPOSE AND BACKGROUND OF THE STUDY

1.1 Background of the Study

In light of low petroleum and gas prices worldwide, the Republic of Indonesia is currently planning to shift its income resources from primary products such as petroleum, gas, etc. to secondary/tertiary products such as industrial products with higher values added. To carry out industrialization, the government of the Republic of Indonesia has first established state-run strategic enterprises to introduce oversea technologies through contracts for licenses with oversea enterprises and those for joint technology developments. By placing these state-run strategic enterprises in charge of industrialization, the Republic of Indonesia aims to substitute imports of industrial products with domestic industrial ones by bringing up related medium- and small-sized enterprises, and finally, to promote exports to obtain foreign currencies.

The chairman of the Agency for the Assessment and Application of Technology (BPPT), Minister Habibie, proposes the following 4-stage technical developments as processes to change the Republic of Indonesia into a industrialized country.

The first stage makes use of existing know-how in processes to increase values added in assembling and manufacturing products already prevailing on the market; that is, to import technologies from overseas for production under licensed contract. This stage cultivates the ability to understand product processes developed overseas and provides manufacturing know-how and managing ability.

The second stage introduces existing know-how into the designing and manufacturing of completely new products. This stage selects optimum elementary technologies from among existing ones at the time of designing a new system and builds up a final system by combining the selected elementary technologies. In this stage, it is necessary to become familiar with existing technical information worldwide, including advanced technologies. It is also necessary to increase laboratory facilities and improve facilities require for design, inspection and simulation.

The third stage develops technologies. This stage requires innovation and the creation of technologies to produce parts which are to be incorporated in products requiring advanced technologies. This stage will secure international product competitiveness.

The fourth stage creates new lifestyles and ways of working through the application of advanced technologies.

Industry in the Republic of Indonesia is currently undergoing the first of the four stages mentioned above. Although some of the state-run enterprises have already moved into the second stage, most enterprises are still in the first. As described above, in order to substitute imports of industrial products with domestic industrial ones and to promote exports, it is important to verify what are the elementary technologies and to develop and diagnose new technologies required for second and third stages.

In order to do this, the government of the Republic of Indonesia established the National Center for Research, Science and Technology in Serpong located near Jakarta under the leadership of the BPPT (Agency for the Assessment and Application of Technology) and started a construction project in 1980. The construction of the center is currently under way. This national project is called PUSPIPTEK (Proyek Pusat Penelition Ilmu Pengetahuan). In the future, the government of the Republic of Indonesia has conceived of the idea to carry out in similar national projects in other regions, although they will be in different fields. The objective project of this study is to be called PUSPIPTEK-Serpong (with the place name added to distinguish it from the other projects).

Upon establishing PUSPIPTEK-Serpong, the government of the Republic of Indonesia expects the following results:

① Carrying out an efficient research by bringing together researchers and engineers, who will participate in common scientific and technological fields at a single location.

② Saving facility investment by concentrating required research facilities in one location.

③ Producing more advanced research themes by combining interdisciplinary research subjects.

④ Achieving international exchanges in scientific and technological fields by providing an academic environment through exchanges between researchers in many fields and inviting rescarchers from oversea countries.

⑤ When doing research work requested by enterprises other than PUSPIPTEK-Serpong, each laboratory can get a high income by incorporating a value added in research results, and at the same time, can contribute to technical improvements in the Republic of Indonesia.

Looking back at activities at some of the existing laboratories, however, the following problems have arisen. These problems are expected to apply to the laboratories to be completed in the future and must be solved by 1992, the completion date for PUSPIPTEK-Serpong.

① Liaison and cooperation systems among governmental organizations such as BPPT (Badan Pengkajian dan Penerapan Teknologi), LIPI (Lembaga Ilmu Pengetahuan Indonesia), BATAN (Badan Tenaga Atom Nasional), which are the parent bodies for each laboratory, are not completed yet, and each laboratory proceeds with its research individually. This, in turn, interferes with mutual exchanges of necessary scientific and technological information and increases the amount of labor necessary to collect information.

② Information exchange is difficult because proper data communication networks are not functioning not only between individual laboratories but also between Serpong and Jakarta.

③ A computer environment, which sufficiently serves as a tool for the verification of elementary technologies, and development and evaluation of technologies has not yet been established.

In order to solve these problems, the Indonesian government has requested the Japanese government to conduct a feasibility study for establishing the Center for Industrial Technological Information in PUSPIPTEK-Serpong, taking into account the industrial technological information systems in the Republic of Indonesia. This report has been compiled based on the field survey results and analyses performed by the study team.

1.2 Purpose of the Study

The following four items delineate the purposes of this study.

① To grasp the problems related to industrial technological information systems of each laboratory in PUSPIPTEK-Serpong, and to present the functions to be established for the Center for Industrial Technological Information, taking into account the roles of PUSPIPTEK-Serpong in the field of industrial technology in the Republic of Indonesia.

② To consider a construction schedule, centering around three functions of database, scientific and technological calculation and education/training and to make a concrete development plan for the functions. When making the function development plan, considering priority of the functions realized as much as possible, in accordance with significance of the functions and actual situation of PUSPIPTEK-Serpong.

③ To conduct the feasibility study on the Center according to the above function development. A proportion of the operating costs can be recovered by charging for some of the services.

④ To simultaneously review the economical and social effects to be had on the Republic of Indonesia by establishing the Center.

1.3 Progress of the Study

In July 1987, the government of the Republic of Indonesia requested the Japanese government to conduct a feasibility study for establishing the Center for Industrial Technological Information. Based on this request, the Japanese government dispatched a pre-study team to the Republic of Indonesia in March 1988 and S/W related to this study was discussed with the Indonesian government and subsequently determined.

Afterward, a main study team was dispatched to the Republic of Indonesia in July 1988. The team remained there for about a month and surveyed the collection and use conditions of industrial technological information in each laboratory of PUSPIPTEK-Serpong, use condition of computers for scientific and technological calculation and needs for the Center for Industrial Technological Information. Furthermore, this main study team visited not only PUSPIPTEK-Serpong but about 30 private companies and governmental organizations as well in major cities like Jakarta, Bogor, Bandung and Surabaya. A survey was conducted by personal interview to discover the need for technological information and scientific and technological calculation. They also conducted a questionnaire survey as well and obtained about 20 valid responses.

Based on the results of such field surveys and data collection, the main study team started preparing a report in September 1988 and finally, reported the results of the feasibility study. Meanwhile, a meeting to explain a draft final report was held at the office of BPPT in the Republic of Indonesia in January 1989 and this report was officially finalized.

SECTION 2 CURRENT SITUATION AND FUTURE OF PUSPIPTEK-SERPONG

2.1 Situation of Construction of Each Laboratory in PUSPIPTEK-Serpong

Since the start of construction of PUSPIPTEK-Serpong in 1980, about 60% of the planned 12 laboratory facilities have been completed as of August, 1988 with about 20% still under construction. The remaining 20% are still being planned (**Table 1**). In the housing zone across the main road, 80% of the construction of housing for staff have been completed on the schedule.

Both in the laboratory and the housing zones, paving of roads, planting of trees and other plans for the environment have made considerable progress. Also, most of buildings have been completed by governmental organizations of the Republic of Indonesia.

Table 1 Constructional Situations of Laboratories in PUSPIPTEK-Serpong

	Laboratory	Parent Organ	Situation (Note)	Year Started – Year Completed	Cooperative Countries
1	LAGG	BPPT	B	1984 ~ 1988	The Netherlands, West Germany
2	LUK	BPPT	A	1980 ~ 1984	West Germany
3	LTMP	BPPT	E	———	France
4	LET	LIPI	F	1982 ~ 1991	U.S.A.
5	LKT	LIPI	B	1983 ~ 1991	
6	LFT	LIPI	B	1983 ~ 1992	
7	KIM	LIPI	A	1980 ~ 1988	West Germany
8	LMT	LIPI	D	1988 ~ 1993	Japan
9	LTP	BPPT	E	1990 ~ 1994	U.S.A.
10	RSG-LP (including 8 labs)	BATAN	C	1980 ~ 1991	West Germany, France, U.S.A. Italy, Canada, Japan
11	LMBA	BPPT	E	1990 ~ 1994	Japan (Pending)
12	LSDE	BPPT	C	1983 ~ 1992	U.S.A., West Germany, Japan

(Note) A : Completed with research activities in progress
B : Partially completed with research activities in progress
C : Under construction with planning, and research activities in progress
D : Under construction and still planning

E : Under planning

F : Buildings completed with research activities not yet started

Source : Prepared by the study team

2.2 Status of Activities at Each Laboratory

(1) Aerodynamics, Gasdynamics and Vibration Laboratory (LAGG)

1) Constituent personnel

50 persons in total (to be increased to 117 for researchers, 20 for assistant researchers, and 40 for clerical personnel)

2) Research objectives

This laboratory researches problems related to aerodynamics, aeroacoustics and vibration. It takes charge of technical developments with respect to various fields of industries such as aeronautical technology and transportation. It also performs research entrusted by P.T. IPTN and its licenser, Boeing Inc.

(2) Strength of Materials, Components and Structures Laboratory (LUK)

1) Constituent personnel

Researchers: 123 persons, Assistant researchers: 20 persons, Clerical personnel: 47 persons

2) Research objectives

This laboratory conducts research into mechanical testing (tensile strength, strain, fatigue, corrosion, etc.) of various materials, and the characteristics and structures of materials (metals, concrete, plastic, etc.) used for such structures employed in vehicles, trains, ship, airplanes, buildings and bridges, etc.

For requested research projects, the laboratory conducts a fatigue tests on airplanes manufactured by P.T. IPTN and research conducts on vibration for large vehicles manufactured by Mercedes Benz.

(3) Thermodynamics, Engine and Propulsion Systems Laboratory (LTMP)

Construction of this laboratory is still in the pending phase. It was designed with financial assistance from France. It is anticipated to carry out research and development of large-scale industrial machines such as power machines, hydraulic machines and heat exchangers.

The basic design of the laboratory building is under progress with aid from foreign countries. At present, plans for construction of buildings and installation of machinery have not yet been determined.

(4) Applied Electronics Laboratory (LET)

1) Constituent personnel

230 persons in total (to be increased to 700 persons within 10 years)

2) Research objectives

This laboratory is intended to carry out research in various fields such as electronic circuit instruments, electronic materials, electronics, telephone switching systems, broadcasting/communications and electric engineering.

(5) Applied Chemistry Laboratory (LKT)

1) Constituent personnel

280 persons in total

2) Research objectives

This laboratory makes various analyses such as general chemical analyses and fundamental chemical analyses, and conducts fundamental chemical research, food chemical research, applied chemical research, and so on. For the moment, however, this research has no link with private enterprises and centers around independent research within a governmental budget. Most of the research is carried out at its headquarters in Bandung and the number of researchers working here is limited.

(6) Applied Physics Laboratory (LFT)

1) Constituent personnel

220 persons in total (to be increased to 150 for researchers and 350 for other personnel by 1990)

2) Research objectives

This laboratory conducts research into structural and physical characteristics, solid technical and mechanical characteristics, material technology, polymerization technology, ceramic technology, etc.

(7) Calibration, Instrumentation and Metrology Laboratory (KIM)

1) Constituent personnel

435 persons in total

2) Research objectives

This laboratory provides guidance for research and development of measuring technologies used in physics and engineering, assurance and maintenance/management of domestic and overseas measuring standards as well as promotion and guidance for the establishment of Indonesian instrument manufacturers, education and training of experts in the field of measurement, and technical information and services in this field. The laboratory also undertakes work on a project basis from private enterprises and governmental organizations thus obtaining considerable operating funds from outside sources. The ratio of such income is greatly increasing due to a recent reduction of a governmental budget.

(8) Applied Metallurgy Laboratory (LMT)

1) Constituent personnel

250 persons in total, of which 75 persons are to be researchers

2) Research objectives

This laboratory is intended to conduct research into metal refinement, metal materials and nonferrous metal materials as well as to conduct various corrosion tests.

(9) Process Technology Laboratory (LTP)

This laboratory does research and development of process technology and provides guidance for research. It also researches manufacturing methods for polymer and composite materials, and studies and develops material handling methods and product storage/packing/transportation methods. It is still in the construction planning phase. The scale of the total floor area of the laboratory building is planned to be about 10,000 m^2.

(10) Multipurpose Reactor and Its Supporting Laboratories (RSG-LP)

1) Constituent personnel

Researchers: 148 persons, Assistant researchers: 195 persons, Clerical personnel: 87 persons

2) Research objectives

RSG-LP consists of eight laboratories. Its main roles include;

① Development of scientific technology for nuclear power.

② Education and training for experts in nuclear power.

③ Production of fundamental parts used for reactors.

The reactor has a 30 MW-class thermal output. Although it is currently being operated at a thermal output of 10 MW, its output is planned to be increased to 30 MW in near future.

(11) Natural Disasters Mitigation Laboratory (LMBA)

This laboratory is designed to study actual conditions of nature and natural disasters, and to find out and provide methods for securing human sefety. It is expected to measure various disasters and forecast weather, earthquakes, volcanic eruptions, etc. Its construction is still in the planning phase and foreign aid is expected to help complete the plan.

(12) Energy and Energy Resources Laboratory (LSDE)

1) Constituent personnel

66 researchers out of 107 persons in total (to be increased to 462 persons in future)

2) Research objectives

This laboratory aims to contribute to an integrated energy policy for the country in order to cope with future energy demands. It also directs strategic schedules for the development of the energy industry and supports accomplishment of its policies. Although the Republic of Indonesia is one of the world's prominent energy-exporting countries, it is now actively working to tackle energy problems on a global basis. This laboratory is also planning to study use of energy resources such as solar energy, wind force and biomass, and other future energy technologies, as well as development, manufacturing, storage and economy of energy resources.

(13) Project Management Office

This office undertakes the management of all facilities, their constructions and infrastructures such as water supplies, roads, electricities, telephones. This office is also engaged in a future development plan of PUSPIPTEK-Serpong.

SECTION 3 ECONOMY·INDUSTRY

3.1 Economy

Under the government of Suharto, the first four of the 5-year master plans have been carried out since 1969. The year 1988 will mark the last year of the fourth 5-year master plan. Currently, the contents of the fifth 5-year master plan are being discussed in detail. The following outlines economic trends in the Republic of Indonesia based on these 5-year master plans.

The first 5-year master plan accomplished a substantial growth rate in the GNP on an average of 7.7% due to relatively stable political and economic situations both domestically and internationally. This plan brought about various successful results, such as increased yields of rice, an end to inflation etc.

In the second 5-year master plan, started in 1974, the economy was greatly enhanced due to increased export prices of crude oil caused by the first "oil shock." However, the GNP growth rate grew no more than 6.9% compared with a target growth rate of 7.5% because of the subsequent worldwide depression and the financial failure of Purutamina in 1975. Furthermore, in November of 1978, the currency of Indonesia, the Rupiah was devaluated by 50%.

The third 5-year master plan began in April 1979, which encountered many fortunate obstacles such as increased export prices for crude oil. The plan revised many existing economic and political systems such as the tax system, tariffs, exports, building up of medium- and small-sized enterprises, etc. As a result, there was remarkable progress in both the economy and standard of living. The GDP growth rate reached 6.3% in 1979, 9.9% in 1980 and 7.9% in 1981; the GNP per capita exceeded US$500 in 1981 and the Republic of Indonesia became a middle-income country (according to classification by the World Bank). However, the oil market continued to be sluggish due to a deep worldwide depression that began in 1981, and the Indonesian economy, greatly dependent on oil exports, was greatly damaged. The GNP growth rate dropped sharply to 2.2 % in 1982. To make up for revenue shortages caused by low export prices for oil, the Republic of Indonesia devaluated its currency 38% from 703 rupiahs to 970 rupiahs for US$1 in March 1983, and also took special measures in May to reconsider major projects, etc. Although the GNP growth rate recovered slightly to 4.2% in 1983, the third 5-year master plan ended rather fruitless.

An average GNP growth rate during this period was 6.0%, which was lower than the expected rate of 6.5%.

The fourth 5-year master plan was initiated in April 1984. The target GNP growth rate was set at an annual average of 5%, which was lower than previous master plans because of vague prospects for international demands. Although, in 1985, the Indonesian government reformed its economic structure because excessive dependence on oil, and tried to increase exports of non-oil/non-gas products through the promotion of economic efficiency, etc. However, the Indonesian economy stayed sluggish again under more severer economic conditions such as the abrupt reduction of oil prices and the stagnation of the world economy. The GNP growth rate in 1985 was only 1.9%. In 1986, the Indonesian economy was forced to face difficulties caused by an unexpectedly sharp decline in oil prices resulting from a share expansion strategy of a crude oil export proposed by OPEC. In May of the same year, the Indonesian government decided upon comprehensive economic policies related to the promotion of non-oil and non-gas product exports and the introduction of foreign capital. It also introduced various measures to simplify administrative procedures, etc. However, balance of international payments deteriorated continuously, and in September of the same year, a rupiah-to-dollar conversion rate was further devaluated by 45% (31% devaluation according to the IMF system).

From that time up until now, a strict budget has been imposed due to the uncertainty of oil prices and to increased repayment of foreign loans. **Table 2** shows transition of economic indexes.

Table 2 Transition of Major Economic Indexes

Item \ Year		1984	1985	1986
1. GDP	[billion rupiahs]	78,144.4	79,910.8	82,474.5
2. GDP par capita	[rupiahs]	490,010	490,554	495,765
3. GNP	[billion rupiahs]	74,442.3	76,330.4	78,645.5
4. GNP per capita	[rupiahs]	446,796	468,575	472,748
5. National income	[billion rupiahs]	69,405.4	69,942.8	69,890.0
6. National income per capita	[rupiahs]	435,212	429,363	420,118
7. GNP except oil and gas	[billion rupiahs]	60,764.3	62,963.3	64,717.4
8. Population	[1,000 persons]	159,475	162,899	166,358

Source: Statistical data according to the Central Bureau of Statistics

3.2 Finance

The financial policy for the Republic of Indonesia is geared to prevent inflation by balancing expenditures and domestic revenues, plus foreign financial aid. Therefore, the difference between revenues and necessary expenditures is automatically used as a development budget, and insufficient funds required for development are compensated by foreign financial aid. The Government of the Republic of Indonesia pays close attention to maintain the delicate balance between prevention of inflation and investment for development. The following aspects can be found out through the recent transition of Indonesian national budget.

1) For domestic revenues, oil company tax and LNG tax accounted for 64.2% of the total domestic revenue in 1983 and 1984, 59.7% in 1985 and 54.6% in 1986, comprising more than half of the total each year. In the 1987 and 1988 fiscal budgets, however, dependency on oil and gas was reduced due to falls in international oil prices, and revenue ratios of oil and gas to domestic revenues were 40.3% and 40.6%, respectively; the ratio of these to the total revenue dropped greatly to 30.5% and 30.6%, respectively. These figures are considerably low compared with previous ones.

2) Income tax, value-added tax, consumption tax, etc. account for large ratios of non-oil and non-gas revenues. In 1987 and 1988 fiscal budgets, value-added tax and luxury tax have accounted for larger ratios than income tax. This shows that reduction of income from oil and gas is intended to be compensated by taxes from the people.

3) On the other hand, foreign financial aid for development has risen sharply. The sharp rise in revenues for development causes a simultaneous burden in repaying foreign loans. This problem has been further aggravated by devaluation of the currency resulting from the depression of the oil industry.

4) There have been large increases in expenditures, due to repayment of foreign loans.

As described above, financial circumstances in the Republic of Indonesia have seen a major turning point over these two years. Particularly, revenues from oil and gas have been gradually replaced by tax payments from the people and by foreign loans. While a large number of foreign loans continue to be taken, it is necessary to direct development investments to import substitute and export industries. These development investments are also desired to provide international competitiveness for

Indonesian industry. On the other hand, the operational budget, which was deficient in past years, is being prepared by means of foreign loans (1000 billion rupiahs set aside in 1987) and smooth execution and operation of projects to be supported by foreign aid is also expected.

3.3 Manufacturing Industry

(1) Current Situation in the Manufacturing Industry

The manufacturing industry in the Republic of Indonesia is largely divided into two categories; large-scale enterprises centering around a small number of state-run strategic enterprises, and small home manufacturers that form the majority. There is an extreme difference in the value-added output of these two groups, showing what is called a polarized structure.

In order to understand the manufacturing industry in the Republic of Indonesia, the subsequent analysis describes national strategic enterprises.

The strategic industries in the Republic of Indonesia have been determined by the Ministerial Council for Raising Strategic Industries presided over by Minister Habibie, and eight strategic enterprises are listed.

① Airplane manufacturing

The state enterprise IPTN in Bandung produces four kinds of helicopters and two kinds of small airplanes under license contracts. Its number of employees is 13,000.

② Shipbuilding

In cooperation with Mitsui Engineering & Shipbuilding, the state enterprise PAL builds 3,500-ton class tankers and freighters. Its number of employees is 5,727.

③ Land transportation machinery

The automobile industry mainly comprises private enterprises. Six domestic groups produce automobiles as joint ventures with major enterprises in Europe, Japan and the U.S.A. Commercial vehicles such as buses and trucks are produced rather than passenger cars.

The state enterprise INKA manufactures railway vehicles under a license contract with Nippon Sharyo Seizo. Its number of employees is 830.

④ Communication equipment

The state enterprise INTI produces digital telephone switching systems under a license contract with Siemens of West Germany, and cellular telephones as a joint venture with Japan Radio. Also, under license contracts with NEC and ITT of the U.S.A., it constructs ground facilities for wireless communications. Its number of employees is 1,500.

⑤ Steel

The state enterprise KRAKATAU STEEL produces 3,500,000 tons of steel annually and exports it as well. Its number of employees is 7,000.

⑥ Gunpowder manufacturing

The state enterprise DAHANA produces dynamite used for mining and construction. Its number of employees is 750.

⑦ Electronics

With four electronics-related laboratories as the core, PUSAT LEN produces parabolic antennas, wireless transmitters, and so on. Its number of employees is 450.

⑧ Weapons manufacturing

Under a license contract with a Beligan company, the state enterprise PINDADT produces rifies and buliets. Its number of employees is 5,200.

These strategic enterprises were not established only to obtain foreign currency. Rather than that, the Indonesian government invested to establish them after considering the potential domestic demand due to the specific conditions and geographic features of the Republic of Indonesia.

The Republic of Indonesia extends from east to west by a distance equivalent to that between New York and Los Angeles, and has almost countless small islands. Accordingly, securing means of transportation and communications is an essential condition. Therefore, the Indonesian government has fostered such industries as airplane, shipbuilding, land transportation machines and communication equipment. At the same time, the Indonesian economy will maintain a prosperous condition if foreign currency is obtained by exporting these products.

On the other hand, technologies in these fields have already been established in developed countries. Currently, the Indonesian government is introducing them by making lincense contracts and joint venture contracts with private companies in Europe, U.S.A. and Japan.

In the manufacturing industries of developed countries, such fields as automobiles, electronics and electrical/machinery make up the bulk of their industrial output. In the Republic of Indonesia, on the other hand, most of the major products have a home manufacturer's characteristic.

As already stated, large enterprises give high value-added production compared with the home manufacturers. This will be because of differences in production control and production efficiency between the two groups, but not of the difference of values added to their products. However, the products manufactured by some of the state-run strategic enterprises are similar to those manufactured in developed countries, and these enterprises make products with higher added values than other products. In world markets, on the other hand, the demand for products from such industrial fields as food and tobacco, textile and leather products, wooden products and furniture, which have the largest labor population in the Republic of Indonesia, does not seem to be great enough to become a sufficient income source of foreign currency for the Republic of Indonesia. It is instead expected that necessary foreign currency would be obtained through the industrial fields that the state-run strategic enterprises are involved in; that is, technological industries such as shipbuilding, airplanes, steel making and electrical machinery, by acquiring international competitiveness.

(2) Problems in the Manufacturing Industry

The manufacturing industry in the Republic of Indonesia is still in a developing phase and is suffering from various problems.

First, there is no mutual support system between the state-run strategic enterprises and the other enterprises in the design/production of products and procurement of parts. Taking developed countries as an example, the shipbuilding, airplane, electrical machinery and automobil industries have many subcontractors which support them. These subcontractors research and produce in cooperation with them and supply parts. In the Republic of Indonesia, however,the state-run strategic enterprises have extremely strong ties with overseas enterprises rather than local industries for the design and procurement of parts. As a result, local industries have not been brought up.

Since the parts manufacturing industry hardly exists in the Republic of Indonesia, it depends on parts procurement from overseas countries, and as a result, cannot obtain a high value-added income. Currently, the industrial technology required is only for parts procurement or assembly. However, this technology will not be satisfactory for manufacturing parts, which will require in the near future controlling the quality of finished products and verifying imported technologies.

Next, it was confirmed during the field survey that products are rarely designed by themselves, even by the state-run strategic enterprises. This will also be the case for almost all firms. Most of the designs are provided by overseas enterprises, based on license contracts. Although the airplane industry does some design by itself, most of the businesses have assembling work as their main activity. Therefore, they should completely master technologies from overseas as early as possible and establish their own design methods. This would reduce by a large amount the license fees paid to overseas enterprises, and increase the international competitiveness of their products.

To design products by themselves, it is necessary not only to directly use the technologies and designs of foreign enterprises, but also to verify those technologies by themselves for assimilation purposes. The need for verification has been proven from the fact that industrial countries also have passed through a similar process during their growing period. In such technology verification and self-designing processes, it is necessary to have methods for the verification of safety and optimization, and a computer is an indispensable tool. Since there are not sufficient computers with necessary functions and personnel for them, however, it is almost impossible to carry out sufficient verification of technologies and self-designing.

Thus, the Republic of Indonesia is currently facing a slowdown in technological development and growth due to the vicious cycle defined below.

Dependence on foreign technology → Not designing domestically → Not carrying out technological calculations/Not managing technological information systems → Low use of computers → Inability to develop and produce items for import substitution and for international competitiveness → National income remaining dependent on oil and gas → Dependence on foreign technology.

In order to overcome this vicious cycle, it is necessary to introduce computers as an effective means for realization of domestic design capability. When computers are introduced and the environment for domestic design is prepared, designers and researchers become accessible to computers; they are then able to assess, verify and simulate overseas technologies. In the long run, import substitution and export encouragement through international competition are expected to be realized.

3.4 Trade

The Republic of Indonesia exports primary products such as mineral resources and agricultural, forestry and marine products, and imports industrial products, intermediate goods and capital goods.

The export values of oil and gas account for over half of the total. With the export values of oil and gas excluded, the trade balance has been in deficit every year. Since this deficit is not decreasing each year, the industry obtains the funds (foreign currency) required to make up for the deficit and balance the national budget every year by exporting oil and gas. However, oil and gas reserves are not limitless, only about 500 million barrels having been allowed to be lifted in recent years, and it has been more practical to obtain financial aids from overseas countries.

In addition, petrochemical products that utilize oil and gas as raw materials, are imported in a relatively large amount. Domestic construction of oil refineries, petro-checmical plants, etc. can restrain the export of precious natural resources, accordingly substitute the import of these products, and finally, export them. In practice, however, there are not sufficient project fund to achieve this.

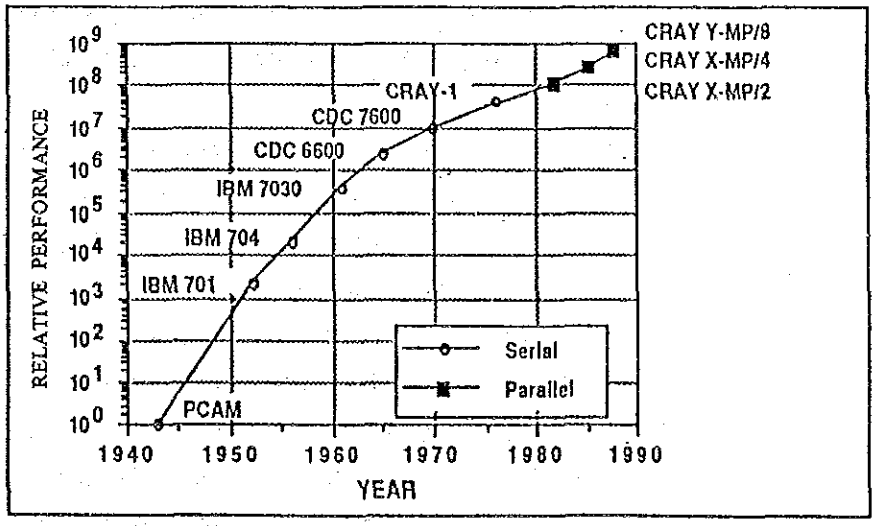
As described so far for the Republic of Indonesia, a shortage of internationally competitive products leads to exports of oil/gas and loans from overseas countries, and as a result of its austere budget, this has the effect of suppressing development expenditures. To overcome this vicious cycle, it is necessary to promote industrialization that will lead to import-substitute products and export products.

SECTION 4 TECHNOLOGICAL DEVELOPMENT TRENDS AND PRESENT UTILIZATION OF INDUSTRIAL TECHNOLOGICAL INFORMATION

4.1 Current Situation and Problems of Technological Development in the Republic of Indonesia

In the following passages, the current situation and problems of technological development in the Republic of Indonesia are discussed in contrast to examples in developed countries.

One of the technological fields where the performance of products has been most rapidly improving is the field of computers, and the technology which supports computers has been developing remarkably. **Fig. 1**, for example, shows the trend of the computing power in Los Aramos National Laboratory (LANL). Computers are made by the most advanced technology, and there has been keen competition among developed countries, especially between Japan and the U.S.A., where a huge amount of money has been invested for technological development. This severe competition is supported by technological development.



Note: The capability of punched-card accounting machine is counted one.

Fig. 1 Trend in Execution Rate at LANL.

Source: Jack Worlton, "Technology Forecasting for Super-computers", the JSME Seminar Tokyo September, 1988.

The technological development that has been carried out in the Republic of Indonesia may be understood more easily if we study the four-stage theory announced by Minister Habibie regarding the industrialization of developing countries. As mentioned previously, this four-stage theory is planned in such a way that the developing country should (1) manufacture mainly foreign country's products under license agreements, which may be called "copy manufacturing"; (2) design and manufacture new products by utilizing existing technologies; (3) develop the technology and create new products and new manufacturing process; and (4) create the highest level technology, thus reaching the level of truly developed countries. Presently, the Republic of Indonesia is fundamentally in stage 1 with the exception that some of the state-run enterprises have just advanced into stage 2. The Indonesian industry would be truly competitive in the international market only when it reaches stage 3. Judging from these present situations, we can understand the importance of technological development in the Republic of Indonesia.

Since the word "technology" has a very broad concept, we define this word as one of the engineering methods used for creating industrial products. This is supposed to be the method used for "a computerized qualitative and quantitative" prediction of the performance and safety design of products. It is also believed to be the method for rationalization and optimization of design. These methods are necessary for the development and design of new products. It also means predictive calculations with a computer that is used for changing the design, so as to rationalize the design and to reduce the production cost of products which have already been developed or are available in the market.

We believe that when the above-mentioned concept of technology is taken into consideration, technological development may have two meanings. One is to manufacture a new product or improve a product by using technology, and this type of technological development should be actively carried out by private enterprises which are directly involved in production. The second meaning of technological development is to develop the technology itself. This type of technological development is fundamentally the same as the research activities conducted in each engineering and science field of universitites. It should be carried out not only in universities but also in research institutes such as PUSPIPTEK–Serpong and research centers in private companies as well.

Although this definition of technological development has been divided into two meanings, they are closely related. Generally speaking, existing technology alone is not sufficient to design any product, the development of new technology being generally necessary in such a case. Therefore, what is vital is cooperation between the industry that is directly related to production and such research institutes as the ones located in PUSPIPTEK–Serpong. This cooperation is the most important function of the planned Center.

An example of an organization in a developing country which has similar functions to the planned computer center is the Systems Engineering Research Institute (SERI) of KAIST (Korean Advanced Institute of Science and Technology). KAIST is sponsored by the Korean government, and is responsible for evaluation and promotion over a broad range of scientific and technological fields. SERI serves as KAIST's computer center, and in addition to having acquired a full range of powerful computing hardware, is engaged in software development services. SERI was established in 1967, and in 1969 installed a CDC3300, which at that time was a large and powerful computer. SERI has since been expanding steadily, and expects to place a CRAY–2 supercomputer in service during this year (1988). In addition, SERI is actively engaged in assembling a library of the state of the art software packages. SERI functions primarily as an internal section of KAIST, but also markets its computer time and engineering services in the private sector. In this manner, SERI is able to recover a portion of its operating costs. The Center being planned for the Republic of Indonesia would be expected to play a central role similar to that played by SERI in Korea, and to provide the computer and engineering services necessary for industrialization of the Republic of Indonesia.

4.2 Role of the Computer in Technological Development

As explained previously, when technological development is defined as the development of new products and the improvement of existing products, the importance of computer technology and especially application software becomes evident. At the same time, the conditions most urgently required in this situation are environmental, where multi-functional high-performance application software can be fully utilized and the highly trained engineers can actually use the application software. The role of the computer is discussed with the concept that one entire system consisting of software and hardware is represented by the word "computer". The role of computer covers a wide range of applications, but in this particular report, we discuss only the following methods which require analysis by computer:

① Safety analysis
② Simulations for designing
③ Optimization of design

① Safety analysis

Safety analysis means the calculation and analysis necessary to confirm the safety of products. Every factor supporting modern civilization such as industrial products, large-scale structures (buildings, bridges and dams), chemical plants, transporting machines (road vehicles, ship and aircraft) and power plants must be checked for safety as the minimum requirement, if they are to be accepted in society. The safety of some products may be analyzed by various experiments, but the role of the computer used for such analysis is almost limitless. However, it is also true that none of these artificial systems can never be "absolutely safe". Therefore, safety is judged by what is called a "trade off" between the usefulness and cost. In this sense, safety analysis is closely related to the optimization of design in ③ above.

Safety design also needs appropriate safety standards. These safety standards should be officially issued by a public organization that can certify that commercial products, structures, etc. meet the standard. When cerfified, approval for manufacture or construction can be given. It is necessary to establish such a system.

② Simulations for designing

The most important role of the computer used in the field of technological development is in simulation for designing. Before computers were used for a wide range of applications, new products were designed by skillful engineers with many years of experience and intuition, and by the "handbook". Experiments were used very little for verification. However, as people started using computers, they could simulate their designs in ways never possible before, thus enabling to judgement on the validity of their designs. As a result, the performance of machines, equipment, etc. could be greatly improved, or economical merits obtained by making a comparatively small change in the design. When, for example, the Boeing 737–300 was designed, the engines under the wings were mounted in a further-forward position and the performance of the aircraft was greatly improved as a result. (With the convertional design, engines were hung directly under the wings.)

③ Optiomization of design

For designing one industrial product or a large-scale structure, a great number of parameters can be changed, and when designing, the most optimum combination of these parameters is chosen. The object of choosing this optimum combination is to ensure the optimum cost, optimum performance, etc. in relation to the safety, design, materials and production process. It is not easy to find parameters most suitable for these "objective functions". Many methods to optimize these problems have been proposed, but so far, none have been utilized for practical design. As a result, optimization of design is made by the trial-and-error method, which means making as many parameter combinations as possible and designing for each of such combinations. Each design is then evaluated and the best one is chosen. Therefore, without using computers, it is impossible to obtain the best design by making many trial designs.

As already described, computers are indispensable for technological development. Computers are also indispensable for the analysis of currently used commercial products, large-structures, etc., in order to ensure their safety, although this type of application of the computer cannot be regarded as direct technological development. This type of computer application has not yet been fully developed in the Republic of Indonesia, but as the four-stage theory raised by Minister Habibie is further materialized, the lack of application technology will become one of the most important problems to be solved.

4.3 Present Utilization of Industrial Technological Information

(1) Problems the Concerning Collection and Distribution of Industrial Technological Information

In order to view the current status of industrial technological information in the Republic of Indonesia, let us look at the present situation of the country's libraries. **Table 3** shows the distribution of books in libraries in the Republic of Indonesia and **Table 4**, the numbers of books in the major domestic libraries. In general, the number of books available is still insufficient. The same thing can be said for PDII, the Center for Sciencific Documentation and Information, the nation's leading document/information institute in the field of science and technology. Many other libraries now face problems which are even more serious. In the field of science and technology, especially, as the latest information tends to be dependent on foreign sources, a library of sufficient size becomes necessary to maintain the quality of information distribution.

Table 3 Distribution of Books in 295 Libraries (1981)

No. of Books	No. of Libraries
· 40,000 books or more	11
· 30,000 – 40,000	4
· 20,000 – 30,000	13
· 10,000 – 20,000	33
· 1,000 – 10,000	182
· Less than 1,000 books	51
· Not reported	1
TOTAL	295

Source: Workshop and Conference on SCIENCE AND TECHNOLOGY INFORMATION SERVICES, Summary Report, 1986.

Table 4 Number of Books in Major Libraries (1986)

Name of Library	No. of Books (incl. reports, microfilm/microfiche, etc.)
· PDII-LIPI	147,617
· PUSTAKA, BOGOR	95,000
· NATIONAL LIBRARY	350,000
· BPPT LIBRARY	3,500
· ITB, BANDUNG	55,840
· BATAN, JAKARTA	6,501
· PUSLITBANG GEOLOGI, BANDUNG	8,451
· LEMIGAS, JAKARTA	4,000
· LMK, JAKARTA	13,000
· PERPUS, SENTRAL-LIPI, BANDUNG	11,500

Source: Workshop and Conference on SCIENCE AND TECHNOLOGY INFORMATION SERVICES, Summary Report, 1986.

In collecting industrial technological information, the use of databases has become increasingly important all over the world. In the Republic of Indonesia, however, due to reasons to be mentioned later, a database service has not yet become the major means of information distribution. Therefore, the role of libraries and document centers is of considerable significance for researchers, engineers, educators, students, etc. who use them in collecting industrial technological information. An information distribution means by computers and communication systems will considerably contribute to the convenience and benefit of the users, when properly established in future.

As an approach to use limited information resources in the nation more effectively, the so-called STK (Science & Technology Information) service has been promoted. In 1986, a workshop was held jointly by the Republic of Indonesia and the U.S.A. concerning science and technology information services to discuss various matters.

These services aim at integrating information resources so that they are easily accessible to users in various fields. This, however, still remains in the planning stage.

(2) Development of Database Services and their Current Situation of Use

In the Republic of Indonesia, on-line database services are not yet widely used, with some exceptions like PDII, which has access to overseas databases to carry out document research. However, due to the high cost required for utilization of overseas databases, even specialized instituetes can not afford it. Besides these cost problems, in consideration of the quality of communication lines and the number of users secured, it is almost too difficult to carry out, on a large scale, on-line database services within the country. On the other hand, under off-line database services, there is currently an approach in which various databases can be used at a relatively low cost by CD-ROM. For example, information can be provided locally through the use of such a medium.

The use or preparation of a database is promoted individually by government offices and private enterprises. This is based on their own needs and is not intended to serve wide public use.

SECTION 5 INFORMATION COMMUNICATION NETWORK OF PUSPIPTEK–SERPONG

Information communication networks are of two types: one between the laboratories in PUSPIPTEK–Serpong and the computer introduced to the Center for Industrial Technological Information, and the other for retrieving the databases, overseas ones included, from the Center and making use of the computer at the Center from the outside.

5.1 Information Communication Network in PUSPIPTEK–Serpong

Direct lines are used for connection between the computer of the Center for Industrial Technological Information and each of the laboratories. The cables installed in the site of PUSPIPTEK–Serpong for telephone switching can be used as these direct lines (see **Fig. 2**).

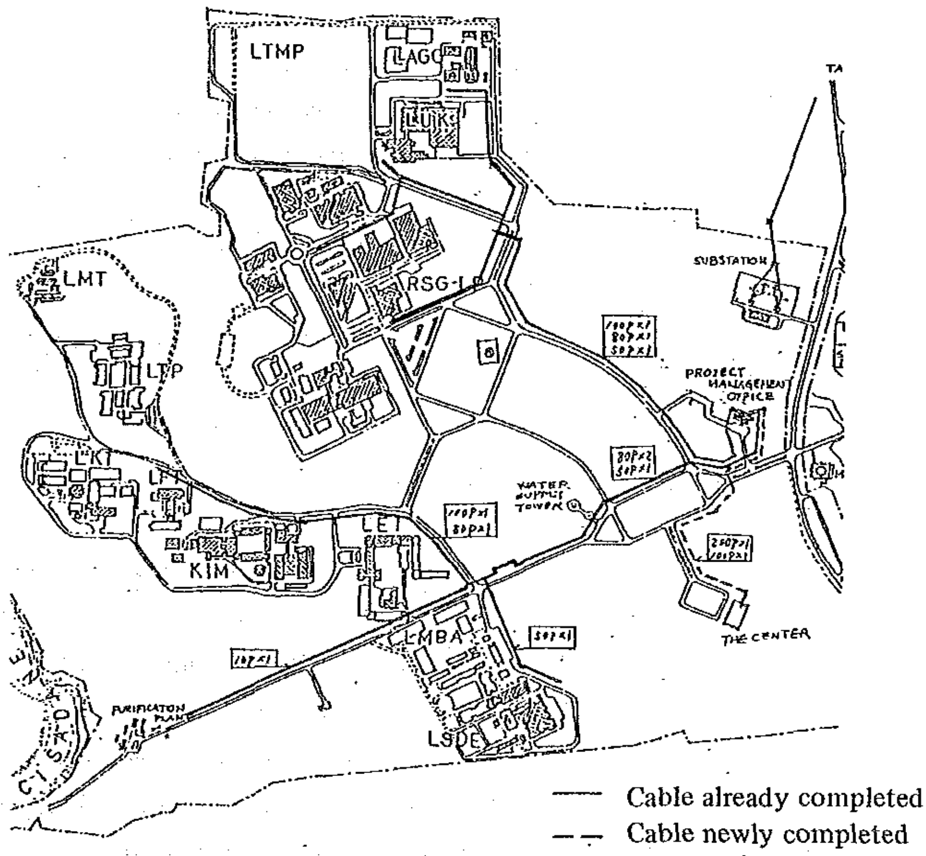


Fig. 2 Private Communication Cable Route in PUSPIPTEK–Serpong

Source: Prepared from results of the field survey

The cables installed for telephone switching are sufficient not only for telephones, but also for data communications in quality and method. Furthermore, as they are installed underground, there is no problem with their safety and stability. The number of pairs of cables has a sufficient line capacity to allow combined use of the cables for both telephones and data communications.

To make use of this line facility, it is necessary to install a cable between the Center for Industrial Technological Information and MDF in the Project Management Office, there being no problem in installing the cable underground between them. To unify management of the line facility, cable installation and maintenance should be taken care of by the Project Management Office.

The cable length is within 3 km, even between the Center construction site and the farthest laboratory (LMT), and private modems are available. Current commercially available private modems can be stably used up to 19.2 kilobits/s, which is sufficient for the communication rate of the computer introduced to the Center for Industrial Technological Information.

PUSPIPTEK–Serpong has a digital PBX CBX–II made by ROLM INC. in U.S.A. for telephone switching. With modems, data communications between the laboratories can be achieved through this PBX. Electronic mail is also provided by adding a function.

5.2 Information Communication Network for Connecting Outside PUSPIPTEK–Serpong

(1) Public Packet Exchange Network

The SKDP domestic public packet exchange network operated by PERUMTEL is currently available in four cities, and will cover six cities by the end of 1988. It is planned to make its services available in all of the major cities in future.

An overseas database from the Center for Industrial Technological Information can be retrieved by connecting a foreign packet exchange network through this SKDP and the international public packet exchange network, INDOSAT, operated by the International Communication Corporation. The same route is taken when accessing the database at the Center from overseas.

To retrieve the database or to make technical calculations by connecting to the computer of the Center for Industrial Technological Information from a domestic government office, university or enterprise, it is most general to use SKDP.

To use SKDP at the Center, it requires a data communication line between the Center and the nearest SKDP node location, Jakarta. Currently, there is no data communication line between PUSPIPTEK–Serpong and Jakarta. According to a project of the Posts and Telecommunications Agency, however, fiber optic cables are to be installed between Jakarta and PUSPIPTEK–Serpong by 1992. In the near future, it will be possible to use SKDP at the Center.

(2) UNInet

The inter-university network UNInet currently has seven universities connected to it. In future, 44 universities will subscribe to it.

To make use of the computer at the Center from a UNInet-subscriber university, it is necessary to connect UNInet to the computer of the Center. This, however, depends on the construction of a data communication line between Jakarta and PUSPIPTEK–Serpong like the case of SKDP. Since the UNInet network is based on SKDP, communication protocols have no problems because they are internationally standardized like SKDP.

(3) Telephone Network

The Current telephone network is of poor quality and not suitable for data communications. As its preparation and expansion progress, however, it is expected that there will be no hindrance for data communications in the near future.

If the telephone network can be used for data communications, it is also possible to directly connect from Jakarta, etc. to the computer of the Center through the telephone network, because recent telephone line modems are advanced and of high speed, and those of 9,600 bits/s (V. 32) are internationally standardized.

In the long term, switching boards and communication lines will gradually become digital, and ultimately, when the integrated service digital network (ISDN) is completed as in developed countries, this will make it easily possible to use the computer of the Center from anywhere in the Republic of Indonesia.

SECTION 6 FUNCTIONS OF THE CENTER FOR INDUSTRIAL TECHNOLOGICAL INFORMATION

6.1 Preconditions for the Needs Analysis

The investigation of needs and demands for the Center for Industrial Technological Information was first conducted in the laboratories of PUSPIPTEK-Serpong. Major themes for an investigation fell into the following categories:

① Database system
② Education/training system for computer users
③ Technical calculation system

Further, in order to clearly grasp the current state of use of computers in general industrial fields, and also requests to the Center from industries, personal interviews were simultaneously conducted with state-run enterprises, private firms, governmental organizations, universities and research institutes. Thirty-five enterprises were canvassed.

6.2 Outline of Results of the Needs Analysis

In this section, an outline of the analysis results is presented.

(1) Needs for Database Systems

In relation to database systems, the needs are discussed mainly regarding procedures for information management and distribution to effectively carry out research and development in PUSPIPTEK-Serpong. **Table 5** summarizes these needs.

Although having a small-sized library for its own use, each laboratory still lacks a sufficient number of publications to provide high-quality advanced technological information to its researchers. Especially, technological information often depends on overseas resources, and requires much time and cost to acquire. In other words, it becomes essential to have available a distribution service of technological information and, at the same time, to maintain its quality.

The results of research and development, at present, simply kept separately by each laboratory. This is caused by that the management method for serving necessary information related to experiment and for systematizing standard data structures and formats is not utilized. No systematic management based on a comprehensive plan has yet been practiced. These research results, as well as the publications, are not yet available as publicly common information. Therefore, considering the future development of research studies and technology transfer to industries, PUSPIPTEK-Serpong as a whole should make all efforts to collect research papers, etc. and to input them into a database, aiming at systematic management and distribution. Such a collection should include technical reports, papers, developed software and experimental data as shown in **Table 5**.

Table 5 Needs Concerning Information Management and Distribution

① Improved efficiency in obtaining and using information necessary for research and development
  e.g. : Procurement of reference books and data books in specialized fields
  : Obtaining the latest technological information
  (use of overseas on-line databases)

② Facilitation of information exchange and research activities
  e.g. : Mutual exchange of information among laboratories
  : Practice of interdisciplinary forums and joint research

③ Systematic management and distribution of research results
  e.g. : Management and distribution of reports, papers and experimental data
  : Sharing of computer software resources

At present, information exchange among laboratories still rare, where research activities are rather individually carried out. Therefore, interdisciplinary research activities, which is the aim in founding of PUSPIPTEK-Serpong, have not yet been realized. Joint research needs to be encouraged by increased mutual exchange with the industries, etc. through the use of interdisciplinary forums and other means.

(2) Needs Concerning Education/Training in Computer Use

Education/training in computer use should be considered in relation to the needs of technical calculation systems. In other words, while education and training courses for computer use technologies are widely offered, the aspect of use of computer for research and development should be emphasized at the same time.

A computer should be a tool to support research and development for each researcher, whereas learning a computer language can not be a major object. However, computers are indispensable in carrying out modern research and development in order to save labor and improve efficiency. Therefore, upon introducing software for technical calculation in each field, it is also necessary to organize an environment suitable for the most effective use of computers. In the present situation, where the use of personal computers and minicomputers is dominant, there is not sufficient use of software for technical calculation. As one of conditions necessary to achieve this goal, it is necessary to set up education/training courses in computer use. Emphases on education/training in computer use should be placed not only on training in general programming languages, SA/SE education and effective use of the Center, but also on the matters listed in **Table 6**.

Table 6 Emphases on Education/Training in Computer Use

① Learning computer use techniques as a tool to support research and development
  e.g. : Numerical analysis
  : Methods to use technical calculation software

② Learning methods to process measured experimental data using computers
  e.g. : Error analysis, Regression analysis, etc.

(3) Needs Concerning Technical Calculation Systems

① Problems in carrying out research and development

At present, technical calculation is not widely practiced in the PUSPIPTEK-Serpong laboratories. This is partly due to insufficient introduction of large computers. On the other hand, personal computers and minicomputers that were introduced in a fairly large number are still limited in their use, and they are not used for technical calculation. The reasons for such a situation can be summarized into the three points shown in **Table 7**. In order to actively use computers for technical calculation, it is necessary to emphasize such aspects as the potential of research activity, improvement in incentive, capable personnel with leadership, and the improved morale of researchers, in addition to the establishment of computers and software.

Table 7 Problems

Characteristic of Laboratories	Outline of Problems
a. Characteristics	O Laboratories largely categorized into those conducting their own research and those conducting commissioned research. Although the former have insufficient experimental equipment due to financial reasons, they can be expected to become capable of achieving theoretical studies when appropriate computers and software are introduced. O The latter, on the other hand, mainly conduct measurements and gathering of data. However, with computers and software introduced, they can be expected to expand their territory, to experiments, measurement and analyses, and not be limited to data collection.
b. Background	O None of laboratories has a long history and the number of research staff is insufficient. They are especially lacking experienced leaders, thus having problems in selecting subjects and guiding young researchers.
c. Presentation of research activities	O Researchers' incentive is not strong because opportunities for presenting research activities are scarce.

② Needs for computer use

The use of large computers has become essential for laboratories and institutes which are carrying out up-to-date research and development, in order to save both labor and time and to help researchers for creating new ideas. Thus, the needs of technical calculation can be clarified by the purpose of computer use in research. It is especially important to develop the orthodox approaches of computer use shown in a. – c. of **Table 8** and, at the same time, new computational science fields, keeping both in good balance.

Table 8 Needs for Computer Use

Method of Use	Outline
a. Experimental analysis	Reliability of data obtained from experiments is confirmed.
b. Predictive analysis	Confirmation of safety of newly planned experiments, precomputation of performance/behavior (especially in fields of nuclear power, airplanes, shipbuilding, large-scale construction, etc.)
c. Design calculation	Calculation of design aspects in lenses, ICs, etc.
d. Computational science	Research is carried out by simulating phenomena on computers. This can be expected in the fields which involve high experimental cost and accompanying risk, and in which experiments on the ground can not be conducted. For example, simulation of tidal waves, flood, large-scale structures, design of new materials or molecules, etc.

6.3 Defining and Developing the Major Functions

The investigations concerning the needs of laboratories pinpointed five major functions for the Center. **Table 9** shows these five functions, of which three functions (① – ③) were defined concerning database systems. **Fig. 3** shows the details of these functions. It seems to be, however, too defficult to realize all these functions at the same time in practice. Therefore, appropriate steps to realize these functions are described in **Table 10** in three phases.

Table 9 Defined Functions

Main Theme for Needs Investigation	Defined function
· Detabase system	① Effective support to research and development through information distribution
	② Systematic technological information and technology transfer to industries
	③ Translation/publication and promotion concerning industrial technological information
· Computer use education	④ Computer use education/training
· Technical calculation system	⑤ Technical calculation service and consultation

MAJOR FUNCTION	SPECIFIC ACTIVITY
Center — 1. Effective support to research and development through information distribution	• Collect monographs, data books, reference books, etc. for specialized fields • Exchange information among laboratories • Facilitate research exchange by holding interdisciplinary forums • Facilitate joint research among different fields
2. Systematic technological information gathering and transfer to industries	• Management and distribution of disclosed technical reports, etc. • Management and distribution of developed software • Stock and management of research data
3. Translation/publication/advertisement of industrial technological information	• Translate specialized books • Publish specialized books • Advertise each laboratory's work (technology, personnel, facility, etc.)
4. Computer use education/training	• Train educational staff • Train SA and SE • Train software engineers • Train numerical analysis engineers • Train engineers for management of the Center • Train production control engineers
5. Technical calculation service and consultation	• Organize technical calculation software • Technical calculation service • Consultation service • Organize computer systems

Fig. 3 Functions of the Center for Industrial Technological Information

Table 10 Phases of the Center Functions

Function \ Phase	I	II	III
1. Effective support to research and development through information distribution	O To gather monographs, data books, etc.	O Management/distribution service	O ——— · ———→
	O To train database searchers	O To offer latest expert information (use of overseas on-line databases)	O ——— · ———→
	O To distribute expert information (exchange of information among laboratories)	O ——— · ———→	O ——— · ———→
	O To encourage exchange research (forums)	O ——— · ———→ (interdisciplinary forums)	O ——— · ———→ (joint research among different fields)
2. Systematic technological information gathering and transfer to industries	O To stock/manage technical reports, etc. (to make them into a database)	O Management/distribution service (to offer to PUSPIPTEK and others)	O ——— · ———→
	O To collect/manage developed software (to make them into a database)	O Management/distribution service (to researchers in PUSPIPTEK)	O ——— · ———→
	O To manage and distribute research results (distribution of a data file)	O Management/distribution service (to researchers in PUSPIPTEK)	O ——— · ———→
3. Translation/publication/advertisement of industrial technological information	O To translate specialized books	O ——— · ———→ (publication and sales)	O ——— · ———→
	O To publish specialized books (technology, capacity, facility, etc.)	O ——— · ———→	O ——— · ———→

(To be continued)

Function \ Phase	I	II	III
4. Computer use education/ training	O To carry out software technology education (Educating staff should be trained beforehand.)	O ——— · ———→	O ——— · ———→
	O To carry out numerical analysis education (Educating staff should be trained beforehand.)	O ——— · ———→	O ——— · ———→
	O To train educating staff for center management/operation	O Center management/operation education	O ——— · ———→
		O To train SA and SE educational staff	O To practice SA/SE training courses
	O To train educational staff for production control technology	O To practice production control education courses	
5. Technical calculation service and consultation	O To offer a technical calculation service (technical calculation software)	O To facilitate the use of technical calculation software	O To promote development of technical calculation software O Technical consultation

SECTION 7 CONCEPTUAL DESIGN FOR COMPUTER SYSTEM

As each laboratory researcher of PUSPIPTEK-Serpong will be using a computer system of the Center for Industrial Technological Information for the purpose of scientific and technological calculation, program development, data retrieval, and computer education/training, this computer system must be able to perform smoothly and quickly, and also be able to correspond to a diverse range of uses which will constantly be expanding.

The following shows the operation environment and uses of the Center's computer system, and describes its conceptual design which is based on these factors.

7.1 Conceptual Design Policy of Computer System

1) To establish an operation environment that satisfies the Center functions as early as possible.

2) To facilitate extensions of the system's functions and performance against future diversification and increased usage.

3) To consider the infrastructure of the existing electric power and communications of PUSPIPTEK-Serpong.

7.2 Software

The following shows examples of software fields to be set up in the Center by the application example in **Table 11**.

Table 11 Required Number of Software by Technological Field

Field	No.	Remarks
Structural design and analysis	2 ~ 3	including pre-/post-
Impact analysis	1	ditto
Fluid analysis	2	ditto, flow mode
Nuclear energy	1 set	
Chemistry	2 ~ 3	
Chemical engineering	2 ~ 3	Piping design, distillation column, etc.
Optics	1	Lens design
Electronics	1	IC chip design
Electromagnetism	1	Electric field, electromagnetic field analysis
Mathematical routine	1 set	
Graphics	1	

7.3 Operation Environment of Computer System

(1) Provision of Service

1) Form of service provision

Mainly consists of on-line service which uses communication line and terminals.

2) Service area

As a general rule, the range of on-line service is within the PUSPIPTEK-Serpong laboratories. In the future, when the communication conditions are improved, the on-line service will be performed also outside the PUSPIPTEK-Serpong.

3) People who take service

① Researchers in each laboratory in PUSPIPTEK-Serpong

② Education trainees

③ Visitors outside PUSPIPTEK-Serpong approved by the Center's chief director

4) Service hours

Same as the business hours of each laboratory in PUSPIPTEK-Serpong

5) Services provided

① Database service (Industrial technological information provision service) (database retrieval)

② Provision of computer resource relating to education/training

③ Scientific and technological data processing service (use of application programs, creation of new programs)

(2) Jobs Inside the Center

1) Detabase operation management

① Source data management

② Database design, construction and revision.

2) User education

Preparation of teaching materials

3) System operation management

User environment arrangement, resource control, operation control, data backup

4) Center management

The Center operation/administration

5) Customer service

7.4 Job Format and Use Format of Computer System

Jobs under the operation environment of the system are classified, as in **Table 12.**

Also, the number of users in a day (75) and 15 terminals for education/training, other 15 terminals for job inside the Center, so altogether 105 terminals would be necessary (including CAD terminals).

Table 12 Job Format of Computer System

(I) Scientific and engineering data processing service

Job	Usage	Terminal
① Routine job	· Batch processing . . . Input job or data from remote batch terminal and job is executed. Output to printer, plotter, and graphic terminal in the Center.	· Personal computer terminal · TSS dedicated terminal · CAD/CAM (graphics terminal)
	· TSS . . . Perform job processing in on-line real-time from TSS terminal, and output to CRT display or required equipment.	
② Development working	· TSS . . . Perform job processing and modification of program and data in on-line real-time by TSS terminal.	

(II) Database service

Job	Usage	Terminal
· Database provision	· TSS . . . Perform data retrieval and inquiry service to general user by TSS terminal.	· Personal computer terminal · TSS dedicated terminal

(III) Education/training regarding computer system

Job	Usage	Terminal
· Provision of computer resource regarding education/training	· Perform practice on programming language and system development education by TSS terminal.	· Personal computer terminal · TSS dedicated terminal

(To be continued)

(Continued)

(IV) Job inside the Center

Job	Usage	Terminal
① Database design construction	• TSS . . . Perform application developing and modifying job for database access by TSS terminal.	• Personal computer terminal • TSS dedicated terminal
② Data management	• TSS . . . Perform management regarding data input/revision by TSS terminal.	
③ Data input	• Input source data from magnetic tape, floppy disk, etc.	

7.5 Conceptual Design of Basic Software

The basic software should improve the execution of job programs and the productivity of software development by the computer system, perform system management for the Center operation efficiently, and possess functions for enhancing the system extension smoothly by simplifying the operation.

The following shows the basic software functions for establishing the operation environment.

Configuration of Basic Softwares

- Management/Control programs
  - Hardware management, system management functions
  - Task management function
  - Job control function
  - Data management, database management functions
  - Communication control function
  - Control function of safety protection
- Processing programs
  - Language processor
    - FORTRAN compiler
    - COBOL compiler
    - PL/1 compiler, PASCAL compiler
    - C compiler and others
  - Utility programs
    - System editor
    - Link editor
    - Sort, merge
    - File editor
    - Scientific and engineering data processing library and others
    - Software development and support tools

Also, as an arranged environment of basic software, suppori by the mainframe manufacturer is required for one year to install and operate the above basic software smoothly.

7.6 Conceptual Design of Network System

The network system for the conceptual design for the Center describes the system requirements of the following:

1) Connection between the center and each laboratory
2) Access from outside the PUSPIPTEK-Serpong

(1) Connection between the Center and Each Laboratory

The communication network inside PUSPIPTEK-Serpong is able to use the telephone cable which is provided on the site as a transmission line for data communication. This shall connect the computer and communication equipment to be installed in the Center, and terminal equipment to be placed in each laboratory.

Main system requirements are as follows.

① Because of its economy and the ease of maintenance, the data communication line is, at present, the private communication line which is star network via MDF inside the Project Management Office.
② As for data communication equipment, analogue modem and a base-hand line terminal device with a high cost performance have been adopted. Also, the configuration is such that it can flexibly correspond to the layout change of terminal equipment.
③ Data communication equipment to be located in the Center is placed in their own cabinet, which ensures both ease of maintenance and safety.
④ Terminals shall have connecting line concentrator which facilitate maintenance and provide for future increase and change, 5 ~ 10 display devices and a printer are connected per one line concentrator.
⑤ Communication control devices shall be placed by considering future extensibility and shall have more than 64 ports for placing 105 terminal devices at the start of operation, and shall also have enough room to increase data communication lines in the future.
⑥ Control systems such as division of work and range of responsibility shall be clear as well as the work process, for operation and execution control of the data communication.
   - System configuration creating and changing
   - Line construction arranging and supervising
   - Communication equipment procurement

(2) Access from Outside PUSPIPTEK-Serpong

The following may be considered as receptacles for outside users to use the Center functions through on-line connection in the future. Some parts which are difficult to cope with technically at present will be partially constructed and left open to be completed up further technological advances.

① Access by dedicated line
② Access by SKDP
③ Access by telephone exchange network

① Dedicated line . . . . .Possible to use if PERUMTEL service is offered.
② SKDP . . . . .Connection with the host computer shall be X. 25,

as advised by CCITT (Consultative Committee for International Telegraph and Telephone) as a connection interface with exchange network. This connection requires compatibility with the application software.

③ Telephone exchange network .... At present, as the communication system between Jakarta and Serpong is wireless, it is difficult to use because of poor data transmission quality, but connection between the host computer and the exchange network (including ISDN) may be counted open in accordance with the progress of a plan to lay an optic fiber cable in the future.

(3) Conceptual Diagram of Network System

Fig. 4 shows the concept of network system which satisfies functions in (1) and (2) above.

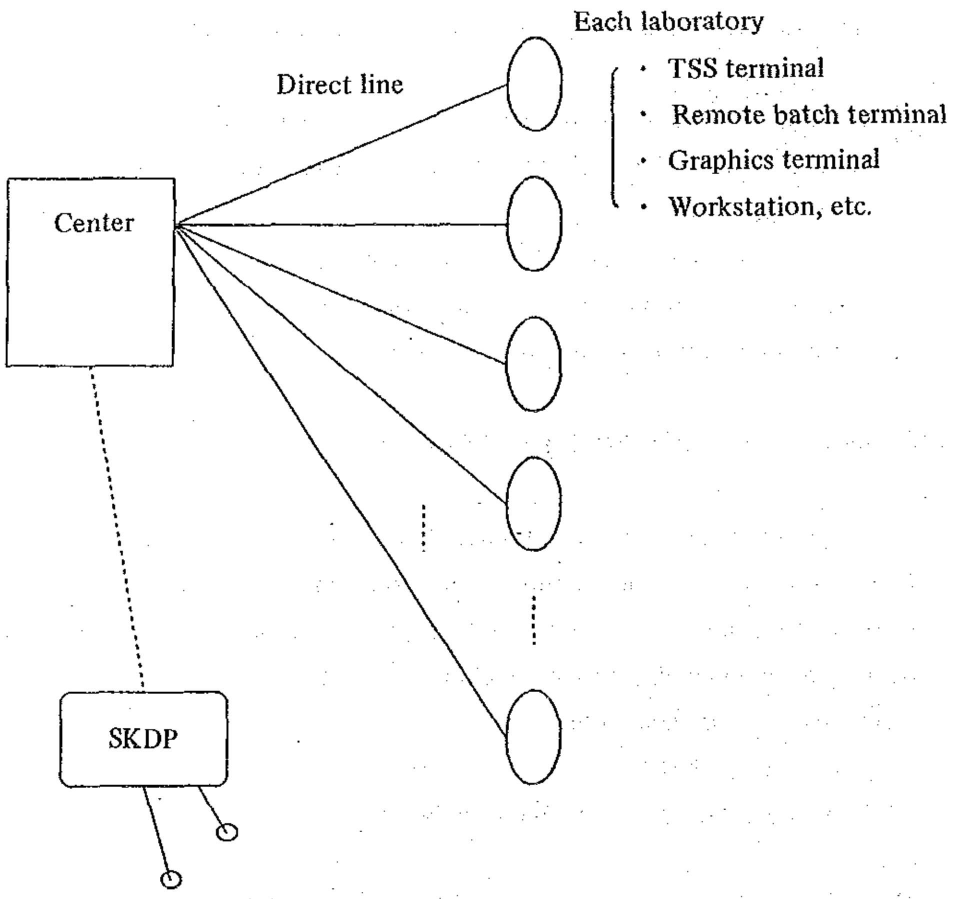


Fig. 4 Conceptual Diagram of Network System (PUSPIPTEK-Serpong)

7.7 Conceptual Design of Hardward System

It must satisfy the functions of the basic software, ensure the environment for application programs and other various programs to be processed quickly, provide for the smooth operation of the network system and enable it to cope with use format, future diversification and demand increase.

(1) Required Scale of Hardware System

According to the operation example of a computer center, there are actual results of service by assigning the resource as the following in the mainframe computer system using both typical TSS and batch job processing.

1) Batch job rate 10 Region size 1MB
   TSS service rate 12 Work area 1MB
2) About 50% of CPU operation ratio against operation time of batch job system.
3) Response time of 100 TSS terminals is 1 ~ 3 seconds.

Basic requirements of the hardware system to satisfy the above operation environment are as follows:

· Processing speed of CPU	15 MIPS or more
· Capacity of main storage	32 MB or more
· Capacity of magnetic disk device	10 GB or more
· Connection against disk device	4 channels or more
· Data transfer rate/channel	3 MB/s or more

(2) Hardware System

The following shows the requirements of the hardware system's configuration elements to satisfy conditions as stated above.

1) CPU (Central Processing Unit)

It has hardware functions which satisfy basic software functions, such as processing speed, which is necessary for processing database reference, scientific and technological calculation, and program development job smoothly. It must also have enough I/O channels.

In this system a processing speed of 15 MIPS or more shall be required, and the required number of I/O channels shall be twelve or more.

2) Main storage

As job processing performance is largely affected not only by the processing speed of the CPU but also by the capacity of main storage, the main storage must have a capacity that is large enough for effective job processing and future extensibility.

In this system, a storage capacity of 32 MB or more shall be required.

3) Magnetic disk device

The magnetic disk device must fulfill requirements of smooth job processing, ease of use, and extensibility. In order to insure smooth job processing the magnetic disk control device must have a cross-call function. The magnetic disk device shall also be arranged separately for the database and for other systems.

4) Magnetic tape device

The recording method and recording format of the magnetic tape shall be compatible with different machines, and shall be able to read and write data with 1600 bpi/6250 bpi record density which are being generally used. Also, it shall have cross-call function, and shall have extensibility as to the number of devices to be placed in preparation for the future increase in demand. In this system, a minimum of 2 for data I/O and 1 for work are required.

5) Line printer

One line printer shall be required for printing job processing result output with the performance of 136 characters/line and 800 lines/minute print speed at the minimum by alpha-numeric character set.

6) Laser printer

One laser printer shall be required not only for job processing result output, but also for high-quality output such as research thesis and reports.

7) Floppy disk device

One floppy disk device shall be required for keyed-in data input by key punchers and for data output.

8) XY plotter

The XY plotter shall have an output precision and performance which can be used for architecture drawing (A0 size) such as graphic output of calculation results and output of design drawing.

9) Communication control device

One communication control device shall be required, equipped with 64 ports or more and able to connect 105 terminals (including several CAD terminals). As for extensibility, it shall be equipped with the function in conjunction with any future increase in demand.

7.8 Configuration of Related Facilities and Auxiliary Facilities

(1) Computer Related Equipments

In order to operate the computer dependable for a long period, good power, and an air-conditioning which maintains a good, constant environment in the computer room and the data storage room under any outside circumstances, are required. In addition, safety measures which might save the computer from disasters must also be considered. Finally, a storage facility enabling the smooth operation of the computer and safe maintenance of recording media for the computer is also required.

The following describes the requirements regarding each equipment.

1) UPS (Uninterrupted Power Supply)

① Constant frequency/constant voltage device

The device which supplies good power for operating the computer system dependable for a long period, and although the capacity is determined by the range of hardware system, a minimum of 150kVA shall be required for the Center's system.

② Battery device

This device protects the hardware system from power failure and momentary interruption of the commercial power supply. It also provides stable power until the generator starts its operation (backup time). In this system, one battery device with backup time of minimum 5 minutes and capacity of 150 kVA or more shall be required.

③ Generator

It is the power supply device in case of commercial power failure for a long period, and the performance shall be to supply power of more than 300kVA at the minimum.

2) Air-conditioning facility for computer room and data storage room

It is the facility which keeps temperature and humidity of the computer room and the data storage room constant. It also keeps operation of the computer stable for a long period, and stores the recording media safely. Temperature and humidity standards of each room are shown as follows:

Computer room. . . . . .temperature 25°C ± 2°C humidity 45 ~ 70%

Data storage room. . . . . .temperature 20°C ± 2°C humidity 50%

3) Distribution board for computer

One distribution board shall be required for power distribution to each equipment of the computer hardware system and protection of the system.

4) Storage facility for computer recording media and expendable supplies.

It is the facility for operating the computer system smoothly and for storing the recording media safely.

① Magnetic tape storage rack (must have storage capacity of minimum 5000 tapes)

② Floppy disk storage rack (must have storage capacity of minimum 5000 disks)

③ Computer expendable supplies rack (to store paper and ribbons)

④ Modem rack

Facility for easy maintenance of the network and placing modems safely. 50 modems must be able to be stored at the minimum.

(2) Facilities and Equipment Related to Other Services

1) Industrial technological information provision service

Device to supply information recorded on CD-ROM and overseas database information.

① Personal computer with CD-ROM reading device and modem

2) Publicity and publication equipment

① Electronic publishing system with high-quality printer for publicity and publication

② Simple bookbinding machine for binding output forms

③ Photocopying machine

3) Education related equipment

Audio-visual equipment and software for efficient education

① Audio-visual equipment

- Overhead projector/screen (can be connected to personal computers)

- Video monitoring device

② Softwares

- DBMS, statistics and spreadsheet softwares for personal computers

SECTION 8 CONCEPTUAL DESIGN FOR CENTER FACILITIES

8.1 Basic Plan of Construction of the Center

The following points are to be considered for the basic plan;

① Facilities shall be suitable for the climate and the geography in Serpong.

② The basic plan shall meet the total development plan of PUSPIPTEK-Serpong.

③ Facilities shall be properly sized and designed according to the required functions.

④ Facilities shall express the advanced aspects.

8.2 Center Site and Layout Plan

(1) Site

The site is located at the southeast end of the laboratory zone of 350ha including the existing facilities of PUSPIPTEK-Serpong. It is close to the front gate and has an area of approximatly 18ha. Besides this Center, a Science Center and International Conference Hall are also being planned. Roads around the planned center are already finished; however, grass has grown all over the place. The site is at an average altitude of 100m and relatively flat. A valley is running at about 10m below the ground level at the east, west and south ends of the site.

Fig. 5 shows the site plan provided by the Project Management Office.

(2) Layout Plan

Although the Science Center and International Conference Hall are planned in the site plan shown in **Fig. 5**, it was confirmed by the Project Management Office at the time of this survey that this plan had not been finalized. From the viewpoint of installation of the data communication lines, it may be desirable to relocate the Science Center, and therefore, a decision should be made after careful and enough discussion on the exact location of the Center. In other areas, since many visitors are expected, consideration should be taken to their pedestrian linkage plans, materials, and supplies and other service traffic plans. As a part of amenity services to employees in a high-technology environment, some consideration should be taken to providing them with opportunities of observing the surrounding scenery.

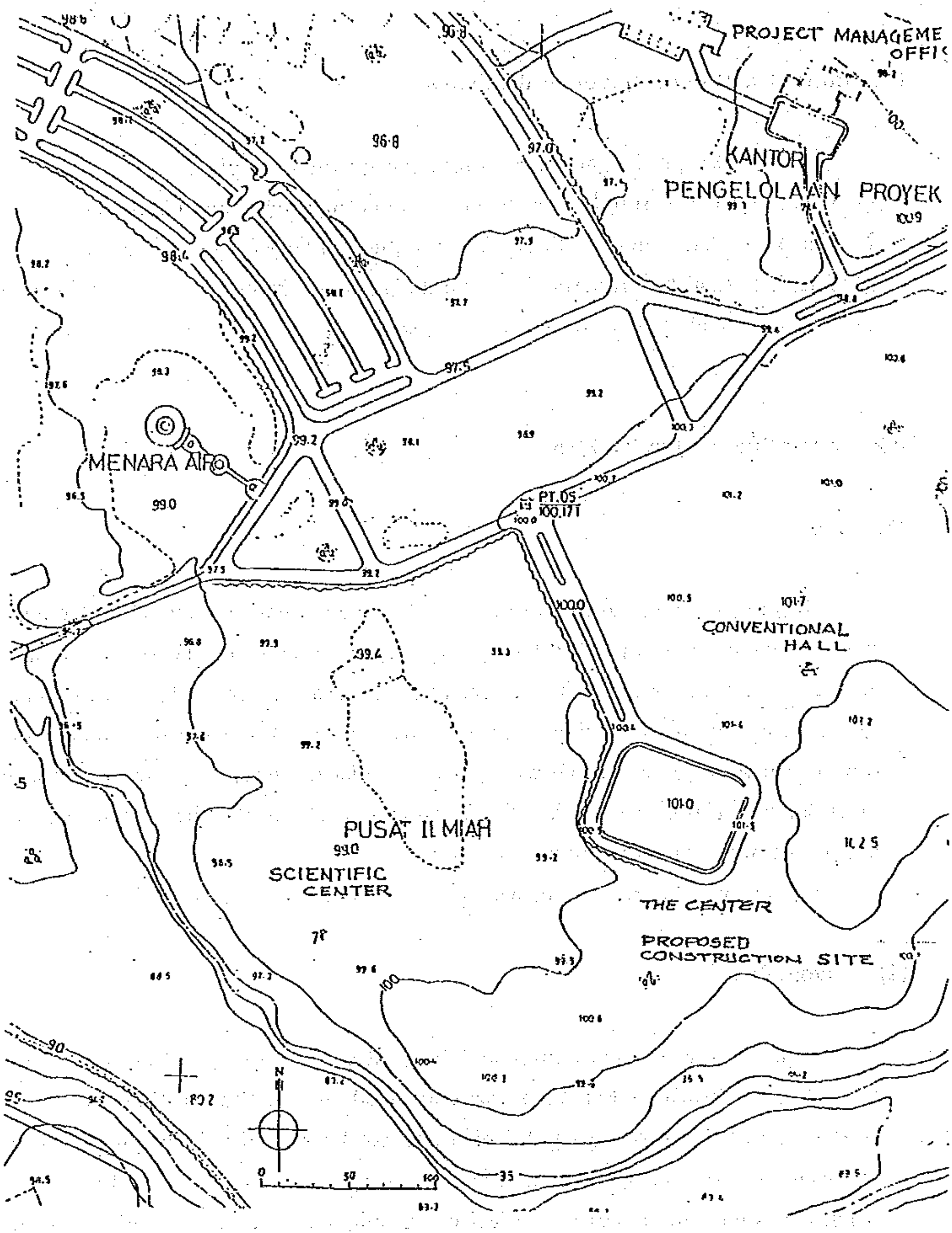


Fig. 5 Map of Center Construction Plan

Source: Prepared by Study Team based upon the materials provided by the Project Management Office.

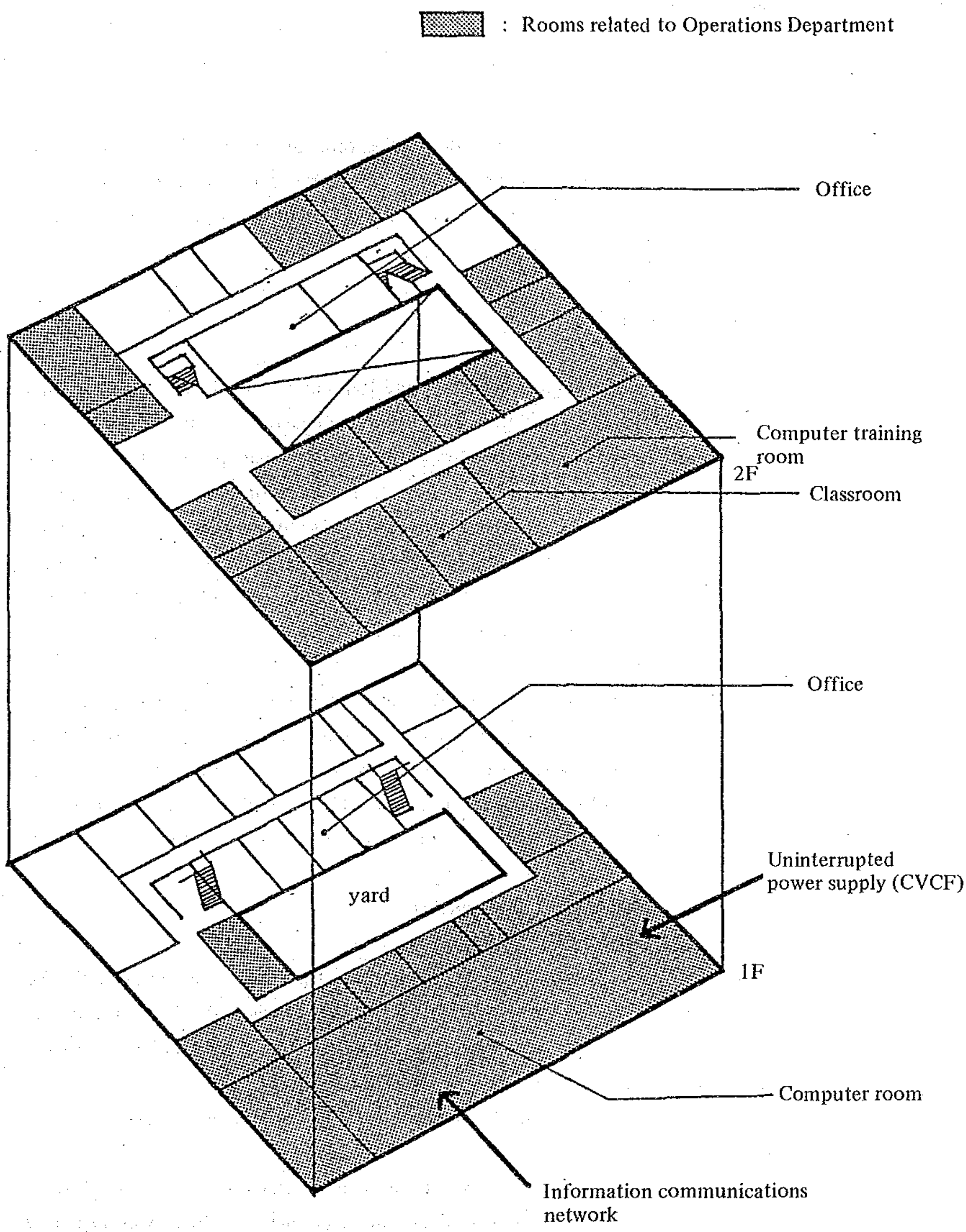


Fig. 6 Functional of the Center for Industrial Technological Information

8.3 Architectural Plan

(1) General concept

In the conceptual design plan of the Center, three blocks are planned in the form of the headquarters building for the Planning, Administration and Operations Departments, entrance hall building and forum building, depending upon their respective functions.

(2) Operations Department

Since the computer room will include the IDF communications room under one roof, it will occupy the largest floor space in this department. In consideration of the convenience of future machine relocation, a large-span plane will be recommendable. Also, the rooms which will have a close relationship with the computer room should be located as adjacent as possible. It is important to consider keeping the interconnecting cables between machines as short as possible. It is further necessary to provide a fore-room before entering the computer room for dust prevention or data security. With this consideration, the front door should be a slide type with a card lock.

It will be convenient to locate the computer terminal room and application consulting room closest to the entrance hall because they will be used most by visitors.

The computer training room and the classrooms should be located in consideration of their relationship with staircases and lobby to comfortably accommodate visitors and trainees. **Fig. 6** shows a sample layout with the functions considered.

(3) Planning and Administration Departments

Since both the Planning and Administration Departments are responsible for the overall operation and administration of the Center, they should be located at accessible place. Also, since these departments will have the largest number of visitors, they should be located close to the entrance hall.

Inside the entrance hall, there will be an exhibit area for public relation of the operation of the Center.

In the Forum building, there will be a seminar hall for national and foreign researchers to gather and to hold seminars and meetings, and there will also be a lounge.

(4) Power station

The power station of the Center will not only receive a high-voltage power supply and transform it to lower voltage for distribution, but will also supply stable, high-quality power without interruption. Due to vibration and noise, this station should be in a separate building from the headquarters building; however, it should be located close to the computer room to avoid unnecessary wiring.

8.4 Scale of Facilities

The facilities of the Center will be planned as follows according to the basic policies which are set forth in the preceding 8.1. The three major buildings, headquarters, entrance hall, forum can be separately constructed. Therefore, the cost schedule divided by phase will be possible.

(1) Headquarters Building — 3,090 m²

	Chief Director's office Secretary's room Reception room	120 m²
1)	Planning Department Department Manager's office Planning administration room Visitor conference rooms	160 m²
2)	Administration Department Department Manager's office Office (administration, supplies) Office (finance, accounting) Office (personnel, labor, welfare) Conference room Custodian's room Sundry room	350 m²
3)	Operations Department Department Manager's office	1,625 m²

Publication service room (editing, publication)
Database service section
User terminal room

Searcher room
Data edit/input room

Library
Reading room
Librarian's room
Storage of books
Education service section
Education division's office (education planning, education/training)
Computer training room
Classrooms
Trainers' room
Trainers' waiting room
Computer-related room (705 m^2)
User terminal room
Application user consulting corner
Operations control room (operators' waiting room)
S/A, S/E, C/E and application programmers' room
Data storage (Materials storage)
Computer room (IDF communications room)
Fore-room of computer room

4) Others 835 m^2
Air-conditioner room
Pantry, toilet
Corridors and staircases

(2) Entrance Hall Building 300 m^2

Entrance Hall (Exhibit area)

(3) Forum Building 1,660 m^2

Seminar hall (including projection room)

Lounge lobby (with coffee/tea service)
Preparation room
Air-conditioner room
Toilet
Terrace

(4) Power Station 150 m²

Transformer room
CVCF room
Battery room
Generator room

Total Floor Space 5,210 m²

SECTION 9 OPERATIONAL PLANS

9.1 Operating Body

The functions which should be provided by the Center for Industrial Technological Information were discussed SECTION 6, and are summarized as follows:

(1) Effective support of research and development through information distribution
(2) Systematization of technological information and technology transfer to industries
(3) Publication/provision/promotion activities concerning industrial technological information
(4) Computer use education/training
(5) Technical calculation service and consultation

These service functions can be divided into those which cover laboratories in PUSPIPTEK-Serpong and those which cover firms and outside institutes.

To operate these service functions, it is necessary to initially offer services free of charge to researchers (users), to make them recognize the usefulness of the Center and to establish reliability, until the Center starts to achieve effective operation. Judging from actual results of use thus obtained, it will be practical to start charging for service at an appropriate time. The purposes of cost generation are to let users find the value of a computer use and to obtain a part of the operation cost.

The body for operating the Center should be BPPT, which is closely related to the industries and has many lobratories of PUSPIPTEK-Serpong. Further, in order to effectively provide an information service, it will be necessary to obtain the co-operation of LIPI, the main body of PDII which already is providing scientific and technological information services. As for the demand for scientific and technological calculation, a large portion is expected to come from BATAN, which is running general-purpose research reactors. Therefore, cooperation should also be obtained from BATAN.

It is necessary that appropriate staff members are accepted from the major parent institutes and placed in appropriate job positions. The personnel placement schedule was discussed in SECTION 10.

9.2 Operation Plans

Table 13 shows the results of the short-term, medium-term and long-term operation plans.

Table 13 Service Functions at the Center

PHASE	0 (Preparation stage)	I	II	III
Outline of operation	–2.5 yrs.	1-2 yrs.	3-5 yrs.	6-8 yrs.
1. Effective support to research and development through information distribution (within PUSPIPTEK)	· Selecting special books/ data books, CD-ROM DB, etc. · Organizing special books/ data books/CD-ROM DB, etc. · Organizing information collecting form/procedure/system · Collecting reserach information within PUSPIPTEK (subject/ staff) · Preparing research exchange plan	· Management/provision service · Training database searchers · Providing research information exchange among laboratories · Encouraging research exchange (forums)	· - - - - - - - - - > · Providing latest technical information (use of overseas on-line database servises) · - - - - - - - - - > · - - - - - - - - - > (interdisciplinary forum)	· - - - - - - - - - > · - - - - - - - - - - - > · - - - - - - - - - > · - - - - - - - - - > (joint research with laboratories in different fields)
2. Systematization of technological information and technology transfer to industries	· Setting management/ basic policies · Preparing operation procedure (SOP) and starting collection technical reports issued and disclosed · Preparing operation procedure (SOP) and collecting developed software	· Collection/management (preparation of databases) · Collection/management (preparation of databases) · Collection/management (preparation of databases)	· Management/provision service (inside/outside PUSPIPTEK) · Management/provision service (inside/outside PUSPIPTEK) · Management/provision service (inside/outside PUSPIPTEK)	· - - - - - - - - - - - > · - - - - - - - - - > · - - - - - - - - - >

(To be continued)

(continued)

3. Publication/provision/promotion activities concerning industrial technological information	· Recruiting/training staff for translation promotion activities	· Translating special books · Promotion concerning activities of laboratories (technology/capacity/facilities, etc.)	----------> (publication/sales) ---------->	------------> ------------>
4. Computer use education/training	· Training educational staff · Training center management staff	· Learning application use · Practicing software technological education · Conducting numerical analysis education · Training educational staff in center management/operation technology · Training educational staff in production control	----------> ----------> ----------> · Training SA/SE educational staff · Practicing education of center management/operation technology education · Practicing education of production control technology	------------> ------------> · Practicing SA/SE educational course -----------> ----------->
5. Technical calculation service and consultation	· Selecting technical calculation software · Introducing technical calculation software	· Providing technical calculation service	· Encouraging use of technical calculation software	· Developing technical calculation software · Technical consultation service
*Preparation/organization of the computer system *Preparation/improvement of SOP	*System design *System introduction *Completing basic SOP	*Operation of computer system *Free service *Confirmation of SOP	*Expansion of system *Improvement	*-----------> *----------->

The developmental stages of the service functions are set in the first phase (1-2 years from foundation of the Center), the second phase (3-5 years) and the third phase (6-8 years).

Upon sequentially scheduling the service function, as many functions as possible are expected to be realized during the first phase, which can be expanded during the scond and third phase with the consideration of how much the Center will be utilized.

In order to realize as many service functions as possible during the first phase, it will be necessary to do sufficient preparation during or even before construction of the Center. The preparation stage would be two and half years and in this stage, a basic design, bidding, a detailed design, construction and material procurement will be conducted. The preparation activities needed to realize the five service functions will now be discussed.

(1) Effective Support of Research and Development Through Information Distribution

1) The selection of specialized books, data books and database in CD-ROM for information provision services should be completed prior to construction of the Center. The collection of these books should also be completed in time for the opening of the Center, in addition to the preparation of a book list. These books should be continuously collected and organized after the first phase, whose menu can then be input into database as needed.

2) In order to collect information concerning research subjects, the number of researchers, personal histories of researchers, and details of researchers sent abroad for study, it is necessary to establish the information collection form, procedures and system before the opening of the Center. Such information gathering and preparation of databases should be completed before the opening date. Even after completing the information gathering, efforts for maintenance such as review, exchange and supplementation of information will be necessary.

3) Schedules and selection of themes for forums should be completed before the opening of the Center and reviewed when necessary.

4) As for the provision of services for overseas technological information, these services should be started when the operation reaches a stable stage and its reputation has been established. By this stage, it can be expected that the Center would have budgetted to afford the cost of international data communication.

(2) Systematization of Technological Information and Technology Transfer to Industry

It is necessary that the basic control policies concerning material to be serviced such as technical reports, experimental data and developed software, issued by the laboratories are made known prior to the foundation of the Center. Based on these basic policies, the Standard Operation Procedures (SOP) should be prepared and technical materials and tools should be collected before the Center opens. It will be also necessary to prepare a menu of these materials and tools by the opening date. Collection and organization should be continued after the first phase, in which the menu of technical reports, especially, needs to be incorporated into databases in parallel with collection and organization.

(3) Publication/Provision/Promotion Activities Concerning Industrial Technological Information

Staff members should be obtained before the Center opens and, by this time, the selection of documents to be translated as well as all promotional activities should have been planned. These translation and promotional activities should be continued after the first phase.

(4) Computer Use Education/Training

1) Appointment and training of the management staff of the Center should be started before the opening date. To train the staff, either a governmental center in the Republic of Indonesia possessing a large computer, or a computer center for science and technology outside the country could be the good ways. It would also be effective to hire experienced persons from similar centers.

2) The appointment and training of software education staff and numerical analysis staff needs to be started before the Center begins to operate. It is, therefore, necessary to carry out the recruitment of staff based on a staff training schedule and the scheduled date of inauguration, thus to be able to provide enough technical guidance exernally. After the first phase, it will be necessary to increase the staff depending on the use of the Center.

(5) Technical Calculation Service and Consultation

1) The application and basic software for technical calculation should be selected

before the Center opens and additional softwares should be added after the first phase.

2) It will be necessary to recruit and train the application engineers who can consult users (researchers and general engineers) in the field of science and technology before the Center begins to operate.

The configuration, introduction and expansion of the computer system should be carried out in order according to the preparation plans to achieve these five functions.

9.3 Specialists from Overseas

It is essential to complete preparing SOP, training staff, preparing database construction during the said preparation stage in order to operate the Center smoothly right after its construction.

Besides the staff in the Center, the following specialists are absolutely indispensable.

① Management experience of a computer center ; 1 man x 18 months

② Experience of application software analysis in the field of scientific and engineering ; 1 man x 8 months

③ Experience of database management analysis ; 1 man x 8 months

Although these specialists should be secured inside the country, it was found to be difficult during the field survey. Therefore, these specialists need to be invited from overseas.

SECTION 10 PERSONNEL PLAN

In order to carry out proper planning concerning assignment and training of the personnel necessary at each phase of the Center's construction, as well as commencement of service and expansion of service, it is necessary to clearly determine the nature and volume of operations at each phase. It is also necessary to acquire personnel for the work (called "leading work") to be done during the service preparation phase (hereafter called "preparation phase").

10.1 Acquisition of Personnel

(1) Early Establishment of Core Functions in the Initial Stage

Upon approval for the construction of the Center, the organization should be structured as follows:

① The Advisory Board of Directors for Center Operation should be organized first.

② The core functions of the planning and administration departments will be organized and started with a small number of staff.

(2) Acquisition of Personnel for Leading Works, Start-up of Works and Long-term Personnel Planning

With the establishment of the initial core functions as referred to in (1) above, the following steps should be taken simultaneously:

① Plans for the leading works, acquisition of personnel for leading works, and initiation of the leading works.

② Long-term personnel hiring and training plan.

(3) Gradual Staffing Plan

① First half of preparation phase

Before starting service, there will be a great deal of leading work to be processed during this phase. **Table 14** shows the personnel required to carry out the leading work and their functions.

Table 14 Staffing during First Half of Preparation Phase

Organization	Job Description	Function	(Grade)	Number	
a. Chief Director			(1)	1	
b. Planning Dept.					
Manager			(2)	1	
Progress control/budget control			(4)	1	
Board secretariat: Promotion			(6)	1	
c. Administration Dept.					
Manager			(2)	1	
General/Finance/Personnel					
	General administration		(3)	2	2 managers
	Assistants & recruiting		(8)	3	
d. Operations Dept.					
Manager			(2)	1	
Information service					
	Selection of specialized books		(4)	1	
Information service					
	Coordination of information gathering system		(4)	1	
Information service					
	Planning basic policies for information control		(4)	1	
Publication					
	Staff (training)		(4)	1	
Education					
	Software training staff (training)		(3)	1	Manager
	Numerical analysis		(4)	1	
	Center administration		(4)	1	
Computer					
	Planning of operating control system		(3)	1	Manager
	Selection of technological software		(2)	2	Specialists
			Total	21	

② Second half of preparation phase

Leading works should continue, with 7 additional personnel as shown in **Table 15.**

Table 15 Staffing during Second Half of Preparation Phase

Organization	Job Description	Function	Previously Hired	Addition (Grade)	Total
a. Chief Director			1		1
b. Planning Dept.					
Manager			1		1
(Continued from the first half)			2		2
c. Administration Dept.					
Manager			1		1
General administration (Continued from the first half)			3	(8) 1	4
Personnel and labor relation (Continued from the first half)			2	(8) 1	3
d. Operations Dept.					
Manager			1		1
Publication (from the first half)			1		1
Information service		Selection of specialized books	2		2
Information service		Collection of research information	1	0	1
Information service		SOP and collection of research results	0	(7) 1	1
Information service		SOP and collection of research reports	0	(6) 1	1
Education (from the first half)			3		3
Computer		Manager	1		1
		Data entry	0	(7) 1	1
		Coordinating operating control systems	0	(4) 1	1
		Introduction of technological software	2	(2) 1	3
		TOTAL	21	7	28

③ Service initiation phase

At the time the center fulfills all functions, all the necessary personnel (67) should be secured. However, the 40 personnel is indispensable at this phase. Therefore, in addition to the second half of the preparation phase mentioned above, 10 staff members will be newly recruited for the Operations Department upon initiation of service; refer to **Table 16.**

Table 16 Personnel at Starting of Service

Department		Ideal Final Plan	Cumulative Staff at the Second Half	Minimum Recruiting Persons at Start	Total at Start
a. Chief Director		[1]	1		1
Secretary		[1]			
b. Planning Department					
Manager		[1]	1		1
Staff		[5]	2		2
c. Administration Department					
Manager		[1]	1		1
Staff		[14]	7	(8) 2	9
d. Operations Department					
Manager		[1]	1		1
Publication (Manager)		[5]	1	(3) 1	2
Information service (Manager)		[7]	5	(3) 1	6
Education (incl. Manager)		[5]	3	(5) 1	4
Computer	Manager	[1]	1		1
	Service	[5]		(4) 1	1
				(6) 2	2
	Operation	[10]	1	(6) 4	5
	System	[5]	1		1
	Application	[5]	3		3
TOTAL		[67]	28	12	40

④ Service expansion phase

Expansion of service is targeted for the third and sixth year after start-up. The staffing plan should be worked out according to this expansion plan.

a. Replenishment service personnel should be hired during the year previous to the start-up of service. If training is necessary during the previous year, a decision should be made during the first and fourth year as to whether or not replenishment personnel will be needed for the following years, thus to be incorporated in the staffing plan of the previous year.

b. If additional personnel are required, they should be hired at an appropriate time, approximately at the end of the second and fifth years.

c. However, expansion of service activities should be properly coordinated with changes and diversification of user needs after start-up of Center operations. The expansion should be planned flexibly, and no hasty decisions should be made regarding staffing and job positions.

In **Table 17**, certain examples are presented for expansion of services, related job positions and possible job assignment.

Table 17 Services for Expansion and Replenishment Personnel

Department	Services for Expansion	Replenishment Personnel
a. Third year		
Information service Div.	Use of overseas on-line database service.	Experience in use of overseas DB service.
Education Div.	Development of SA, SE training personnel.	Transferred from Computer div.
Education Div.	Center administration/ training on operating technology.	Same as above.
Education Div.	Training in production control technology.	Replenishment of production control engineers.
Computer Div.	Promotion of use of technological calculation softwares.	Replenishment of software engineers.
	Correspondence with demand for data entry operation.	Replenishment of support engineers. Replenishment of staff transferred to Education div.
b. Sixth year		
Education Div.	Training course on SA, SE	(none)
Computer Div.	Technological consulting service.	(none)

10.2 Training of Personnel

(1) For Personnel Education and Training

As in the hiring of new staff and replenishing personnel, personnel education and training should be conducted throughout various phases of construction and operation. This is important because of difficulties in locating and hiring qualified personnel for the various job positions. Personnel education and training should be conducted all the time for new employees and for personnel reassigned from other departments, with consideration given as well to possible decreases in staff size.

Accordingly, mid-range personnel education and training programs and annual programs (as a part of the former plan outlined above) should be worked out continuously, while following the training guidelines of the Center employees.

We will now show certain guidelines on personnel education and training as follows.

(2) Guidelines and Contents for Personnel Education and Training

It is recommended that personnel education and training be conducted on the basis of specific guidelines covering the length and contents of respective job types as shown in **Table 18**. And the example of courses is shown in **Table 19**.

Table 18 Education/Training Guidelines (Example)

① Short-term class
This is intended for gneral personnel, including inexperienced employees for whom a short-term (within 2 months) education and training and on-the-job training will be sufficient for performing the duties assigned.

② Standard class
This is for special personnel for whom a longer (6 months approximately) education and training program will be needed for performing assigned tasks.

③ Special class
This is for a selected group of personnel, with previous education in basic fields, who are sent out to outside institutions (firms, universities) selectively for additional education or practical training.

Table 19 Proposed Training Courses for Each Job Position

Training course \ Appointment	Planning manager	Staff	Staff	Operations manager	Publications manager	Staff	Staff	Information service manager	Staff	Staff	Staff	Librarian	Assistant	Education manager	Staff	Staff	Computer manager	Service sec.	Staff	Operations sec.	Staff	Staff	System sec.	Staff	Staff	Application engineering sec.	Staff	Total
(grade)	(2)	(4)	(6)	(2)	(3)	(4)	(6)	(3)	(4)	(4)	(7)	(4)	(6)	(3)	(4)	(5)	(3)	(4)	(6)	(4)	(6)	(7)	(4)	(4)	(5)	(2)	(4)	
no. of persons	1	3	2	1	1	2	2	1	1	1	2	1	1	1	2	2	1	1	4	2	4	4	1	1	3	3	2	67
Basic knowledge of computer	O	O		O	O	O		O	O	O		O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Basic computer usage (PC level)	O	O	O		O	O		O	O	O		O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Basic computer usage (terminal level)	O	O	O		O	O		O	O	O		O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Basic knowledge of data-communication	O	O		O	O			O	O	O		O		O	O	O	O	O		O	O		O	O	O	O	O	
General knowledge of DBMS	O	O		O	O	O		O	O	O		O		O	O	O	O	O		O			O	O	O	O	O	
Basic knowledge of information service	O	O		O	O			O	O	O		O					O											
Basic knowledge of scientific/engineering calculation	O	O						O						O			O											
Rule of organization	O	O																										
SOP implementation	O	O																										
Budget control	O	O		O				O						O			O											
Project control	O	O		O				O						O			O											
Database related operating language								O	O	O		O		O	O	O	O						O	O		O		
Database implementation								O	O	O													O	O		O		
Database searching						O	O	O	O	O	O	O	O										O	O		O		
Basic knowledge of electronic publication					O	O	O	O	O	O		O		O			O											
Basic computer usage (mainframe)														O	O	O	O	O		O			O	O	O	O	O	
Basic computer usage (packaged program)	O	O												O	O	O		O		O			O	O		O	O	
Programming languages (compilers)	O	O												O	O	O		O		O			O	O		O	O	
Programming language (assembler)															O	O							O	O		O		
Basic knowledge of numerical analysis	O	O												O	O	O		O		O			O	O		O	O	
Programming tool		O												O	O	O	O	O					O	O	O	O	O	
Basic knowledge of QC/production control	O													O	O													
Center administration		O												O			O			O			O					
OS general knowledge																							O	O				
Data file back-up/restore		O																		O	O		O	O	O			
Claim handling		O															O	O		O			O			O		
Knowledge of specified OS																		O		O			O	O	O	O	O	
OS generation procedure (I/O GEN)																							O	O				
Accounting system planning/implementing																		O		O			O	O				
Configuration control																	O			O			O					
Resources planning																	O			O			O					
Resources control																	O			O			O					
Purchasing/inventory cntrl of Materials.																		O		O								
Console operation (start-up/shut-down/etc.)																				O	O	O	O	O	O			
Computer operation (peripherals)																				O	O	O	O	O	O			
Communication system configuring																							O	O	O			
Communication system checkout																							O	O	O			
Local area network construction																							O	O	O			
Common mathematical program library														O	O	O							O			O	O	
Programming of numerical analysis														O	O	O								O		O	O	
Statistics														O	O											O	O	
Computer graphics and CAD (/CAM)															O								O			O		
Knowledge of several related fields																O								O		O	O	

(3) In-house Personnel Education and Training

It is recommended that personnel belonging to the above classes ① and ② receive appropriate education and training in the respective organizations to which they belong, according to annual in-house education and training programs. Shown below is a sample guideline for such an in-house education and training.

① At the beginning of each year, long-term education and training plans are reviewed and initiated for incorporation that year.
② The education division or experienced training instructors from outside organizations will handle the education and training.
③ Course and text materials will be selected by training instructors.
④ When necessary, the education division will cooperate with training instructors on the course and text materials.

(4) Education and Training Outside the Center

If the above-mentioned in-house education and training in (3), including courses, self-training and OJT's, are not considered to be sufficient in providing the required level of qualification, knowledge and experience needed for performing the duties assigned, education and training outside the Center will be considered to cover gaps and to provide education and training at the desired higher level.

Some of the job positions which may require such education and training outside are listed in **Table 20**.

Table 20 Job Positions Requiring Education and Training Outside

Department/ Division	Job Position	Recommended Training Course and Experience	Length
Planning	Planning staff	Private from: Practical training in operational planning	About 1 year
Information service	Searcher	Information service provider: Practical training	About 1 year
	Librarian	Practical training in library science university audit course	About 1 year
Education	Training instructors	Education in computer school	About 2 years
Computer	Operators	On-the-job training with computer users	About 1 year
Computer	Computer technology	On-the-job training with computer users	About 2 years
Computer	Application engineering	On-the-job training with computer users	About 2 years

SECTION 11 COST EVALUATION

11.1 Construction Cost

The calculated result of a rough estimate of construction cost is shown in **Table 20** based on the Conceptual Design for the Center for Industrial Technological Information in SECTION 8. This rough estimate was calculated with the following preconditions:

(1) Calculation date of the rough estimate: November, 1988

(2) Currency exchange rate: 13 rupiahs/yen

(3) Materials are procured from the local market as much as possible. An imported material cost is based on FOB Yokohama, Japan.

(4) The construction costs show a main case and an alternative case. The main case is based on the result of the conceptual design conducted in SECTION 8. The alternative case excludes the forum facility from the main case.

(5) The construction cost for communication facilities (for computer networks) is limited to the cost of the plan and equipment within PUSPIPTEK-Serpong, and does not include external connections. Any material and labor costs relating to these construction costs are based on the local price system.

(6) The computer system cost includes computer hardware, software and any related devices. This cost does not include any cost of expansion plans and equipment which is expected in future, and was calculated within the range of Conceptual Design described in SECTION 8.

3.2 Operation and Maintenance Cost

Similarly, the calculated result of a rough estimate of the operation cost is shown in **Table 20** based on the Operation Plan in SECTION 9 and the Personnel Plan in SECTION 10. This rough estimate of cost was calculated with the following preconditions:

(1) Calculation date of the rough estimate: November, 1988

(2) All cost items are based on local prices.

(3) Personnel cost was calculated by trial in steps from the preparation phase based on the Personnel Plan in **Table 21** and the Local Wage Standard in **Table 22**. The local wage system values were confirmed during the field survey.

(4) Maintenance and repair costs are 6.5% of the computer system cost. Maintenance and repair costs in the first and second years are included in the construction cost, and those in the third year onwards are appropriated as an operation cost.
(5) The facilities repair cost is 0.15% of the construction cost for the building.
(6) It was confirmed in the field survey that, among service charges, water and communication costs will be borne by the PUSPIPTEK CENTER OFFICE. The Center will only bear the electricity charge.
(7) The database construction cost includes three local typists for the input work. When the Center is in full operation, it is expected that manpower can be reduced to 60% of that of the initial phase.
(8) Book purchasing cost and overseas database use cost are appropriated to be purchased and to be accessed within the assumed budget. These costs are likely to change in future by going through the utilizing conditions.

3.3 Budget Arrangements

Operation costs that are generated from the preparation phase to the second year after the start of service, conform to the budget arrangements of the Republic of Indonesia. Services up to the second year will be free to various users inside and outside PUSPIPTEK-Serpong, and consolidation of the Center functions and system are planned against chargeable services from the third year onwards in this period.

From the third year onwards, it is planned that operation costs other than those for maintenance and repair can be paid by the cost generated from the chargeable service. On the other hand, maintenance and repair costs generated from the third year onwards will need to be preserved by the Indonesian government.

Budget arrangements borne by the Indonesian government are summarized below.

(1)	First half of preparation phase	; 50,500 (thousand rupiahs per year)
(2)	Second half of preparation phase	; 62,500 (thousand rupiahs per year)
(3)	Initial and the second year	; 280,500 (thousand rupiahs per year)
(4)	Third year onwards after the initial year	; 1,200,000 (thousand rupiahs per year)

Table 20 Construction Cost and Operation and Maintenance Cost

1. Construction Cost (in 1,000 yen)

	Local Currency	Foreign Currency	Total
1) Building construction cost	550,000 *) 385,000	450,000 *) 315,000	1,000,000 *) 700,000
2) Cost for related facilities (CVCF, receiving/transforming facilities, battery, a generator, etc. . .)	1,000	199,000	200,000
3) Computer system cost (hardware, basic software, application software)	—	1,400,000	1,400,000
4) Construction cost for communication facilities (for computer networks)	5,000	5,000	10,000
5) Education equipment cost	—	6,000	6,000
6) Purchasing cost for publications etc.	—	50,000	50,000
7) Cost for recording medium of computer	—	8,000	8,000
8) Accessories cost	10,000	23,000	33,000
9) Basic software preparation cost (Residential cost of manufacturer's SE for a year)	—	20,000	20,000
10) Consultant charges (36 persons · month)	—	90,000	90,000
11) Transport insurance cost	—	20,000	20,000
Grand Total	566,000 *) 401,000	2,271,000 *) 2,136,000	2,837,000 *) 2,537,000

*) The case excluding the forum building

2. Operation and Maintenance Cost

(1,000 rupiahs/year)

	First half of prepara-tion phase	Second half of prepara-tion phase	Initial year and the second year	In full operation (third year onwards after the initial year)
1) Personnel	48,000	60,000	78,000	120,000
2) Mainatenance and repair				1,200,000
3) Facilities repair			20,000	20,000
4) Electricity			60,000	60,000
5) Consumables for computer			40,000	40,000
(paper, etc.)			40,000	40,000
6) Other consumables				
7) Database construction	2,500	2,500	2,500	1,500
8) Book purchase			15,000	15,000
9) Overseas database uses			25,000	50,000
Total	50,500	62,500	280,500	1,546,500

Table 21 Phased Personnel Plan by Grade

Appointement	Third year onwards after the service starts (grade)	no. of persons	First half of preparation phase person	Second half of preparation phase	Starting operation increase/ total
Chief director	(1)	1	1	/ 1	/ 1
Secretary	(6)	1			
Planning manager	(2)	1	1	/ 1	/ 1
Staff	(4)	3	1	/ 1	/ 1
Staff	(6)	2	1	/ 1	/ 1
Administration manager	(2)	1	1	/ 1	/ 1
Manager class	(3)	2	2	/ 2	/ 2
Staff	(7)	3			2 / 2
Staff	(8)	5	3	2 / 5	/ 5
Staff	(9)	4			
Operations manager	(2)	1	1	/ 1	/ 1
Publications manager	(3)	1			1 / 1
Staff	(4)	2	1	/ 1	/ 1
Staff	(6)	2			
Information service manager	(3)	1			1 / 1
Staff	(4)	1	1	/ 1	/ 1
Staff	(4)	1	1	/ 1	/ 1
Staff	(7)	2		1 / 1	/ 1
Librarian	(4)	1	1	/ 1	/ 1
Assistant	(6)	1		1 / 1	/ 1
Education manager	(3)	1	1	/ 1	/ 1
Staff	(4)	2	2	/ 2	/ 2
Staff	(5)	2			1 / 1
Computer manager	(3)	1	1	/ 1	/ 1
Service div.	(4)	1			1 / 1
Staff	(6)	4			2 / 2
Operations div.	(4)	2			
Staff	(6)	4			4 / 4
Staff	(7)	4		1 / 1	/ 1
System div.	(4)	1		1 / 1	/ 1
Staff	(4)	1			
Staff	(5)	3			
Application engineering div.	(2)	3	2	1 / 3	/ 3
Staff	(4)	2			
Total		67	21	7 / 28	12 / 40

Table 22 Local Wages Standard

Grade	Type of job	Rough monthly estimate (1000 rupiahs)
1	General manager	500
2	Chief engineer	300
3	Manager	250
4	Officer, manager	150
5	Assistant engineer	125
6	Foreman	100
7	Mechanic	70
8	Operator, driver, typist	60
9	Helper, guard	50

SECTION 12 EFFECTS FROM THE CENTER OPERATION

12.1 Effects on Economy and Society

As was described in SECTION 3 due to a vicious cycle, the Republic of Indonesia is facing a slowdown in technological development and growth.

Dependence on foreign technology → Not designing domestically → Not carrying out technical calculation/Not managing technological information → Low use of computers → Unable to develop and produce items for import substitution and for international competitiveness → National income remaining dependent on oil and gas → Dependence on foreign technology

As has been discussed at the beginning of this report, in order to proceed from phase 1 to 2, Indonesian industry needs to overcome this vicious cycle. To do that, it is essential to introduce computers as an effective means for realization of domestic design capability. When computers are introduced and the environment for domestic design is prepared, designers and researchers become accessible to computers; they are then able to assess, verify and simulate overseas technologies.

As the result, import substitution, export encouragement through international competition and internationalization of the Republic of Indonesia are expected to be realized.

12.2 Effects on the Industrial Field

(1) Import Substitution

The share of machinery imports out of the total import value in 1987 was around 40%. When oil products, chemical products and processed products are included in the industrial products, this share reaches around 80%. When referring to the national budget expenditure for 1987/88, these figures correspond to around 30% and 70%, respectively. The import value for industrial products is unlikely to reach zero, even if industrialization advances. However, the import load for the Republic of Indonesia will be considerably lessened through encouraged import substitution by industrialization.

(2) Export Promotion by International Competition

The export value for oil/gas, currently amounting to more than half of the total export value, will be saved by exporting manufactured industrial products. The national revenue can be increased from fields of non-oil/non-gas and valuable energy resources can be saved. On the other hand, export tax, which produced approximately 0.3% of the total revenue in 1987/88, will increase its share by industrialization. Accordingly, it helps to reduce overseas loans and possibly to reduce income tax and value added tax. Domestic demand will be expanded as the burden of taxation for individuals is decreased, which will result in further activation of the Indonesian industry.

The export of industrial products, thus, will end the current financial vicious circle, contributing to the creation of a sound economic environment.

(3) Industries Effected by the Center Service

The industries requiring computation of structural designs in their engineering designs, such as shipbuildings, constructions, vehicles, aircrafts, steel manufacturing (tank design), industrial machineries, etc. will be well supported by engineering computations accessing the computer system in the Center. Manufacturers related to minings, optics, electronics (designing printed circuit boards) will also have a lot of opportunities to access the computer system in the Center.

In addition, the database system in the Center will be widely utilized not only by the said industries but also many private firms in their designs and R & D activities.

On the other hand, some private firms already have a close relationship with the existing laboratories in PUSPIPTEK-Serpong, such as KIM, LUK and LAGG through entrusted research activities. The Center will help laboratories create new research activities and relationship between laboratories and private firms will be closer and enlarged by expanding entrusted activities.

Consequently, the technology for engineering computations will be transferred from the Center to an industrial field.

(4) Effects on Communication

Indonesian companies have been making efforts to collect and control the technological information and documents, etc. necessary for designing and manufacturing. They have also obtained information from overseas as needed. The Center for

Industrial Technological Information, by providing necessary technological information to domestic companies can contribute to reduce the considerable cost of data collection. Further, the Center can grasp domestic needs for technological information and promote technological exchange and information exchange among local firms and finally, it would be possible to industrialize the whole country. This effect applies not only to industrial fields but also to laboratories and universities, thus greatly contributing to an improvement in communications.

(5) Effects on Basic Research Activities

Although the environment for research and development activities has not been fully developed among companies in the Republic of Indonesia, the needs will surely increase as industrialization is realized. PUSPIPTEK-Serpong is indeed useful to support research and development activities in the Republic of Indonesia. Therefore, the Center for Industrial Technological Information can contribute to the technological development of companies by linking each laboratory in PUSPIPTEK-Serpong and companies outside by the provision of technological information.

(6) Internationalization

Through increase in the competitive ability, opportunities to merge with overseas companies, technological exchange, joint development, etc. will be increased. Internationalization of companies and a competitive position will be created in the international market.

12.3 Effects on PUSPIPTEK-Serpong

(1) Effective Use of Technological Information

Centralizing the management function of technological information by the Center helps individual institutes not to spend unnecessary duplicated labor for gathering information and for managing of an information system.

As needed, they can obtain information from the Center for more efficient research work. Further, recycling of information would improve and enhance both the quality and quantity of research activities in the laboratories.

(2) Facilitation of Technological Development

Verification of elemenary technologies, technological development and assessment can be carried out relatively easily by the Center's computer, which is capable of processing various applications.

(3) Effects on Communication

When a data communication network is established among the laboratories around the Center, communication exchange among the laboratories and technological exchange among their researchers will be strongly driven.

Forums and other formal gatherings will also provide favorable communication among the laboratories.

(4) Internationalization

The creation of an advanced computing environment attained through research exchange among various fields and through an inflow of foreign researchers will encourage international exchange in the field of science and technology.

(5) Supporting Firms

By offering computer services to companies, the Center can give support to private firms so that they can carry out optimization, simulation and verification of the safety necessary for effective designs.

JICA