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LEMBAGA ILMU PENGETAHUAN INDONESIA

NATIONAL ACADEMY OF SCIENCES, USA

WORKSHOP ON INDUSTRIAL AND TECHNOLOGICAL RESEARCH

DJAKARTA, INDONESIA

JANUARY, 1971

VOLUME I

OVERALL FINDINGS AND RECOMMENDATIONS

This report is published with the expectation that the observations, findings, and recommendations presented will be of interest and value to a wide audience in Indonesia, particularly to industrial-research-policy makers; the industrial community; and research workers who are concerned with industrial development, organization of industrial and technological research, the building of R, D & E infrastructure, and the application of science and technology to economic and industrial development.

TABLE OF CONTENTS

		Page
	PREFACE	iii
I.	PLANNING R, D & E PROGRAMS IN RELATION TO OVERALL DEVELOPMENT STRATEGY IN INDONESIA	1
II.	THE INDUSTRIAL AND TECHNOLOGICAL RESEARCH SYSTEM IN INDONESIA	3
III.	PROBLEMS AND PLANS IN SELECTED INDUSTRIES AND THE R, D & E IMPLICATIONS	5
	Small-Scale Industries	5
	Food-Processing Industries	6
	Textile Industries	9
	Pulp and Paper Industries	11
	Chemical Industries	12
	Metal and Machinery Industries	14
IV.	FACTORS CONDITIONING R, D & E AND THE TECHNOLOGY-TRANSFER PROCESS	17
	Industrial Extension Services	17
	Standardization and Quality Control	18
	Patents	20
V.	KEY FACTORS CONDITIONING THE OPERATION OF INDUSTRIAL AND TECHNOLOGICAL R, D & E ACTIVITIES IN INDONESIA	23
	Problems Facing R, D & E Management in Indonesia	23
	Education, Training, and Career Requirements for Industrial and Technological R, D & E	24
	An Information System for Industrial and Technological R, D & E	26
	Funding	28
	Using International Sources of Technical Assistance	29

PREFACE

The Workshop on Industrial and Technological Research was held in Djakarta January 25 - 30, 1971, to formulate matters to be considered and to make recommendations to the Indonesian Government. The recommendations should be a useful means for motivating, orienting, and developing research activities--and for building the research, development, and engineering (R, D & E) infrastructure that is needed for an effective contribution to the national goals for both general and industrial development, as set forth in current and future five-year plans and other policy documents.

Overall findings and recommendations of the Workshop are contained in this Volume I of the three-volume Workshop Report. Volume II contains the results of the Plenary Sessions and Working Groups, and Volume III has supporting materials on the Workshop. Immediately after the Workshop, the Summary Report of the Workshop was distributed during the Closing Ceremony and presented to President Suharto and the Cabinet Ministers who are responsible for economic and industrial development programs, as well as to the chairman of the National Planning Agency.

Background materials include, among others, the following documents:

1. "Industry", excerpt from Appendix to the State Address by H.E. the President of the Republic of Indonesia, at the Parliamentary Session of August 16, 1970;

2. "Research and Economic Development", by Emil Salim;

3. "Sector B Industry" of the First Five-Year Development Plan.

In addition, 15 papers were prepared by NAS panel members, 2 by other foreign panels, and 24 by Indonesian panel members. In addition to the Academy's panel of 10 specialists, there were 15 experts and observers from Australia, England, Japan, Malaysia, the Netherlands, the Philippines, and Singapore, as well as regional and international agencies. The 90 Indonesian panelists, resource

specialists, and observers were drawn from various ministries, universities, research institutes, and industries.

I

PLANNING R, D & E PROGRAMS IN RELATION TO OVERALL DEVELOPMENT STRATEGY IN INDONESIA

Indonesia aspires to a 6 percent annual growth rate in GNP. Since the population is increasing at a rate of 2.5 percent per year, this leaves 3.5 percent for raising the living standards of the people. The current growth rate has been achieved by emphasizing major sectors such as agriculture, infrastructure, exports, and mining. The growth rate in agriculture is expected to level off at 4 percent, but it is not yet at a level to eliminate food importation. The remaining part of the 6 percent growth rate must be found through development of other economic growth potentials.

The main constraint on increasing the rate of growth is the lack of foreign exchange, technical skill, and capital. Economic growth potentials that deserve high priority are therefore those whose products are exportable--such as mining, forestry, and export-oriented manufacturing. For without the foreign exchange to import technology and capital, the "inward-looking" enterprises that serve important domestic needs and promote import-substituting industries cannot grow in their service to the people. In implementing this strategy, one cannot overlook the serious difficulties of developing these growth potentials--the absence of capital markets, the inadequacy of a growth-inducing body of corporate law, and an environment that does not fully encourage research and development in support of industry.

The strategy for using research, development, and engineering (R, D & E) to assist in achieving the desired industrial growth is the concern of this Workshop. The planning of R, D & E needs is to be done now, in anticipation of industrial growth. Proper decisions can assure the provision of the necessary technical support needed by industry to close the gap in the 6 percent GNP growth rate. To do this we must know our present status, the difficulties to

be encountered, and the decisions that are to be made to overcome them.

The Workshop agreed that present R, D & E capability is inadequate to support the implementation of planned industrial development in Indonesia. Numerous problem areas were discussed. The following appeared to be the most important:

- Lack of adequately trained manpower at all levels;
- Inadequate laboratory facilities, equipment, and supporting services;
- No clearly stated national science policy;
- Low funding level;
- Ineffective science planning and coordination at the national level; and
- Lack of a clear-cut overall organizational structure.

What should be done, and how the proper invironment can be developed for R, D & E to flourish and achieve its desired purpose, are the concerns for deliberation of the Workshop.

II

THE INDUSTRIAL AND TECHNOLOGICAL RESEARCH SYSTEM IN INDONESIA

There is no standard pattern for national R, D & E organizations, even in the developed countries, that could be directly used. In those countries where most of the industry is state controlled, the R, D & E organization is wholly government operated, but in countries with mixed economies, state, quasi-private, and private organizations occur.

There is a variety of R, D & E institutions, some of which specialize in either basic or applied R, D & E. An example of basic research is the Max Planck Institute in West Germany; and of applied, the Welding Institute in Britain, which includes information facilities. On the other hand there are some that are multidisciplinary, such as the Central Organization for Applied Physical Research (Toegepast Natuurwetenschappelijk Onderzoek, or TNO) in the Netherlands.

It is clear therefore that the types of R, D & E organizations and institutions established in this country must be designed to meet its own conditions and needs.

At present, R, D & E infrastructure is not well developed in Indonesia. To establish a good scientific climate it is necessary to have vigorous post-graduate research institutions that have established themselves as centers of excellence. The reserves of expert manpower, equipment, library, and information services thus provided enable R, D & E programs to be quickly implemented. The rate at which such programs can be implemented in Indonesia will therefore depend to a large extent on the speed with which a R, D & E infrastructure is built up in the country.

To serve the industrialization program effectively, R, D & E effort must be organized and disciplined at reasonable cost. Research projects need carefull planning, accurate budgeting and scheduling, and monitoring of progress.

Competent technical staff has to be developed so that the latest scientific and engineering techniques can be applied to the solution of R, D & E problems.

To develop a satisfactory R, D & E capability, it is essential to have adequate numbers of trained and experienced research personnel and enough laboratory equipment. As a result of these and related considerations, the Workshop recommended that

1. A reorganization of LIPI be considered. LIPI would continue advisory and coordinating functions, but its laboratories would be transferred to a separate organization.

2. An inventory of scientific manpower and facilities be undertaken to provide adequate information for planning at the national level.

3. An advisory group from government departments, universities, and industry be formed to meet at regular intervals with LIPI to recommend appropriate area mechanisms for cooperation.

4. A Committee of competent scientists and engineers be appointed as a National Council on Science and Technology, to assist in the development of priorities in manpower and budgets.

III

PROBLEMS AND PLANS IN SELECTED INDUSTRIES AND THE R, D & E IMPLICATIONS

Small-Scale Industries

Obsolescence of equipment and technical skills are problems in the small-scale industries, largely resulting from lack of capital. Research and new-product development are handicapped, and in general, the quality of the products is lower than desired. Regional research centers for small-scale industries should be established that focus attention on research to correct these deficiencies. Research should also be directed to the utilization of indigenous raw materials and the improvement of quality of products for export.

It was pointed out in Workshop discussions that the development of small-scale industries in Indonesia requires attention to the following points:

- Rehabilitation of light industries to reach their normal capacity;
- Upgrading and developing quality and increasing production in the agricultural-processing industries, both for domestic consumption and for export;
- Stimulating the growth of labor-intensive industries;
- Encouraging development and utilization of domestic raw materials to reduce imports and to increase exports of these materials;
- Encouraging the development of rural industries;
- Developing domestic and foreign markets for handicraft products;
- Encouraging domestic investment in the field of small-scale industry and handicraft, while controlling foreign investment; and
- Upgrading assembly work until it becomes manufacturing work in the light-industry sectors.

These objectives will not be achieved automatically, for the following reasons:

- Obsolete equipment and technological know-how;
- Lack of training in managerial skills;
- Inadequate financial services for small-scale industry;
- Current problems encountered in marketing products;
- Inadequate development of the basic technical services required by small-scale industry; and
- Lack of effective manufacturers associations.

The various R, D & E activities for small-scale industries, largely consisting of extension services, are assumed to be

- Product quality improvement, including testing and analysis of materials and products;
- Replacement of imported raw materials by domestic;
- Introducing new processes and more up-to-date process equipment;
- Making the most effective use of existing capacity, existing materials, and wastes;
- Upgrading from assembling to manufacturing; and
- Assisting in fulfilling domestic need for agricultural produce.

Food-Processing Industries

Food wastage caused by lack of preservation, processing, and adequate distribution systems is the primary opportunity for improvement. The lack of coordination in using research facilities, manpower, and programs are serious problems. Research programs are needed to provide the technology necessary to solve these problems under the conditions prevailing in Indonesia. Coordination and supply of more adequate facilities to train manpower can be provided by a Center of Food Technology.

The Workshop observed that objectives of the current food-production programs are

1. To provide sufficient food of adequate quality for every person in Indonesia;

2. To export indigenous foods not required to meet the above objective; and

3. To improve methods of handling food in order to reduce losses.

Under present conditions and methods of food-handling, there is a loss from production to consumer which has been estimated conservatively as at least 25 percent. Reduction of that loss would be more effective in increasing total food supply than an equivalent increase in production.

The Workshop felt that most losses occur during (1) preservation, (2) processing, and (3) food-handling.

Quality standards must be set for all foods permitted to be marketed in order to protect the health, as well as the nutritional well-being, of the individual. For the export market, standards and uniformity of product must be maintained if foreign markets are to be penetrated or protected.

Research projects in the food area must at first be heavily oriented toward applied and adaptive type of work, with the need for basic work becoming apparent as the research progresses. It is estimated that for the time being, an approximate division of effort might be 10 percent basic research, 45 percent applied and adaptive research, and 45 percent engineering.

In view of these considerations, the Workshop made the following recommendations:

1. A Center for Food Technology be established to serve the following purposes:

   a. To coordinate research on food technology

   b. To provide training facilities

   c. To solve problems of food technology

   d. To develop new standards

   e. To collect background information on food standards

f. To publish research results, particularly in food processing

g. To develop specialized expertise

h. To supply necessary equipment to undertake pilot-plant operations

i. To identify products suitable for export

j. To look for new items or innovative processing for export, i.e., essential oil.

2. A research program for the food industry be initiated in accordance with national development priorities. This program should include research in the following areas:

a. Drying

(1) Rice--development of a small drier

(2) Fish--level of salt, preparation and sizing for processing

(3) Copra--preparation, including fat-extraction

(4) Drying conditions for each commodity, including temperature and time

b. Refrigeration

(1) Comparative costs of refrigerant

(2) Effect of freezing methods on preparation of product and product quality and characteristics

c. Canning

(1) New products, such as indigenous tropical fruit, primarily for export

d. Variety studies--stage of maturity, respiration studies (post-harvest), chemical composition

e. Packaging--cost and effectiveness of various types

f. Pilot-plant studies--evaluation of methods of processing and production of small quantities of products for evaluation

g. Other unit operations--fermentation, new processing techniques, processing newer types of foods

h. Irradiation--low in priority only because of current doubts in the United States and other countries regarding the safety of products after irradiation; need for current information, to take advantage of exterior knowledge

Textile Industries

The inherent problems in the textile industry are the dependence on imported raw materials, and the intersectoral imbalance of capacity and structure in the industry. The transitional problems are undercapitalization, inefficient operating conditions, and the attitude of industrialists resulting from their past experience in obtaining underpriced raw material allocations from the Government.

The short-term program for textile industrialization is concerned with the rehabilitation of existing facilities, correcting imbalances, and the improvement of policy on priority credits, protection, and pre-investment expenditure for survey, research, and upgrading. The long-term program is concerned with increasing production, improving quality, and promoting employment.

Research projects will be needed to explore the possibility of manufacturing man-made fiber and to select the most appropriate cotton variety for Indonesia.

The Workshop felt that the medium- and long-term program, as set forth in the second and third five-year plans, should include among its objectives the following points:

- Improving the quality of domestic products to reach a level comparable with imported items;

- Utilization of Indonesia's natural resources (oil and natural gases) for the development and manufacture of man-made fibers;

- Balancing the intersectoral capacity of the industry;

- Providing modern machinery to match the growing change of consumption patterns from natural to blends of natural and man-made fibers; and

- Improving the existing R, D & E institutions to enable them to meet more efficiently the growing demands of the textile industry for technical, scientific, and educational services.

Therefore, the Workshop made the following recommendations:

1. The Institute of Textile Technology (ITT) in Bandung be strengthened by providing more equipment and qualified personnel to enable it to meet more efficiently the growing demands of the industry for technical services, and to enable it to conduct R, D & E activities;

2. The ITT form a control-testing institute, eventually setting up branches for quality evaluation (testing) in other parts of Indonesia;

3. Postgraduate training facilities be expanded to obtain more qualified research workers;

4. Consolidation of small production units into larger units to increase economic viability be considered;

5. A textile scientific information center for R, D & E activities be established;

6. Spare parts be identified that can be made in local machine shops or supplied by service centers or wholesale distributors in Indonesia;

7. Feasibility studies be undertaken on synthetic fibers applications to determine those most appropriate for development in Indonesia;

8. More domestic and foreign producers be invited to consider fiber supply, spinning, and finishing operations in Indonesia;

9. The Indonesian Textile Standards Association be assigned a more important role in determining quality standards for all textile products and authority to enforce the maintenance of the standards;

10. Studies of possible new products and applications for textiles in Indonesia be undertaken, such as tufted fabrics and nonwoven fabrics;

11. Potential international affiliations for the Institute of Textile Technology, Bandung, be explored; and

12. Market research studies within the country be conducted to increase domestic sales of textile products; eventually external market research to develop and increase markets be undertaken.

Pulp and Paper Industries

In addition to the general problems faced in other sectors, the pulp and paper industries are faced with problems of fuel-price policy and high interinsular transportation costs.

Valuable research activity in these industries would be to explore the use of indigenous cellulosic material.

R, D & E resources to support the pulp and paper industries and related industrialization programs are limited at present to the Cellulose Research Institute in Bandung and to the Forest Products Research Institute in Bogor.

The Workshop identified a number of problems in the industry:

1. Internal problems

a. Technical problems caused by inefficiency due to old equipment and processes, and low quality of products;

b. Economic problems resulting from the high price of domestic products, due to small production capacity and competition from imported products;

c. Manpower problems due to lack of skilled managers and technicians.

2. External problems originating mainly from government policies and regulations on bank-credit arrangements (high rate of interest, etc.); fuel prices, high interinsular transportation costs, and multiple taxation.

Therefore, the Workshop makes the following recommendations:

1. Feasibility studies be undertaken for the development of an

integrated forest-products industry within the framework of the National Development Plan;

2. The programs of the Cellulose Research Institute in Bandung and the Forest Products Research Institute in Bogor be integrated to eliminate unnecessary duplication of effort.

3. A research program to determine the most economic use of timber and other fibrous materials be established, working within the framework of the currently planned national study and including identification of the species suitable for lumber, plywood, chips, pulp, and other fibrous products.

4. An industrial-process-engineering study in each existing mill be undertaken to determine where the process can be improved to reduce operation costs, and to ascertain the most economic product mix.

Chemical Industries

The plan of action proposed is to rehabilitate, modernize, and expand the existing industries, and to provide surveys and studies for the preparation of a master plan. Studies are to be made on the mineral resources of the nation to provide local raw materials. The encouragement of foreign investment would serve as a complement to the national economic development and research within the sectoral group.

The Workshop identified several problems faced by chemical and pharmaceutical industries:

- A lag in technology and a low quality of product because of lack of R & D support;

- Obsolete equipment and inefficiency;

- Small-capacity plants;

- Lack of technical know-how regarding operation, maintenance, and quality control (except for a few industries);

- Excessive unqualified manpower;

- Multiple taxation (raw material, semifinished, and finished products);
- High freight cost and lack of regular interinsular lines;
- Competition with imports (except a few);
- Diminishing working capital, caused by inflation and devaluation (1966); and
- High interest rates and high fuel costs.

The Workshop noted that the engineering schools in Indonesia have been actively involved in research related to industrial problems. The areas of research and development activities, in which the services of the universities or engineering schools have been of value and are worth continuing are

- Long-range investigation of industrial problems that do not need immediate solution;
- Research utilizing facilities (equipment, expertise, and manpower) that are not available elsewhere except at the universities;
- Research to solve existing problems that need more fundamental analysis; and
- Assisting research institutes in developing and implementing their programs.

In the course of these discussions, the following recommendations were considered most urgent:

1. A group should be established to assemble and organize data on the Indonesian chemical industry and chemical processes that are available from international sources. The information accumulated should serve as a basis for nationwide studies which will lead to decision-making about future developments in the Indonesian chemical industry.

2. An engineering service group to provide technical assistance to the chemical industries should be considered.

3. An inventory of the potential mineral resources in the nation that are available to support specific industries should be undertaken, for

example,

a. Limestone, clay, and silica for cement;

b. Quartz sand for glass;

c. Kaolin for ceramic and paper; and

d. Sulphur for basic chemicals.

4. Further surveys should be conducted to locate raw materials needed for industry, such as phosphate rock, potash, and gypsum.

5. The program of the committee on quality specifications and implementation of control should be expanded and intensified. Regional control laboratories should be established in each province, and existing regulations should be amended to make them effective.

6. A mechanism should be provided to encourage and facilitate, when desirable, the merging of small pharmaceutical manufacturers into larger units that would permit the acquisition of more equipment and technical expertise. Most of the 158 firms in the nation are small. They cannot mobilize the technical talent and equipment required for profitable manufacturing, and control of drug quality.

7. An inventory of drug demand by region should be initiated as a basis for setting priorities for the allocation of permits to foreign companies and as a means of identifying the basic raw materials that should be manufactured in Indonesia.

8. A national study should be conducted on the potential for medical uses of herbs and other natural products found in Indonesia.

Metal and Machinery Industries

In addition to the general problems of other sectors, a main problem of this industry is education, i.e., to orient the people to the use and maintenance of metal-working machines and equipment.

The Workshop felt that development priority be given to the production

of components now being assembled; to the manufacture of electronic sub-components, components, and sets, machinery and parts; to production of aluminum in connection with the development of the Asahan Hydro Power Plan; and to promoting rolling and steel-making facilities.

Because licensing agreements will be necessary for some time as a major source of technology transfer, machinery industries should make improvements needed to produce according to license specifications.
Indonesia's comparative advantage is manpower and the possibility of "leap-frogging" to newly developing processes should be considered.

The Metal Industries Development Center is being constructed in Bandung and will have liaison offices in other cities.

Research programs are needed in the areas of foundry, welding, and heat treatment techniques, as well as machining practices and metallurgy.

Major problems facing R, D & E management in the metal sectors include limited capability to make feasibility studies, limited participation of industry in R, D & E activities, limited funding, poor incentives for the research personnel, low R & D productivity, lack of training programs, lack of confidence of R & D personnel, and ineffective communications.

To overcome these problems and to strengthen R, D & E activities in the machinery and metal-working industries, the Workshop recommended that

1. R, D & E programs be undertaken currently in the following areas--techniques for improvement of foundry, welding, machining, and precision measurement; electro-plating and polishing; forging; and other basic metal processing;

2. The following areas be studied and considered for developing R, D & E programs--powder metallurgy, spin forming and roll forming, and other new methods of metal fabrication;

3. In the first stages of industrial development, the R, D & E facilities be capable of upgrading (to the level of imported quality) the products

of the machinery industries, especially agricultural machinery, tools, and equipment; and textile machinery;

4. In the second stage, these R, D & E facilities be capable of product design and development;

5. In the long run, R, D & E include research on the extraction of metal from ore--especially iron, aluminum, copper, and tin--and research on the production of metal powder and its product applications;

6. The R, D & E centers in the metal-working industry be organized as an autonomous body that can be managed as a nongovernmental agency, with the general policy and the program set by both government and the industries that will use the results; and

7. Cooperation and coordination among R, D & E centers and universities be fostered so as to increase program specialization.

IV

FACTORS CONDITIONING R, D & E AND THE TECHNOLOGY-TRANSFER PROCESS

Industrial Extension Services

Extension services bring the results of research and information from the library to the user for adaptation and application. Such an organization must gain the confidence of a "client" and find a way to demonstrate that it can be of assistance. Problems are identified, and the service then provides practical information, and if necessary assists in its application. There are several obstacles to the development of useful extension services in Indonesia:

- An inadequate supply of qualified personnel;
- Concentration of technical manpower in major urban centers, which makes it difficult to tackle problems in dispersed areas;
- No organizational structure capable of drawing upon existing scientific and technical resources that are the necessary supports of effective extension services.

To ensure continuing industrial development, it is deemed essential that industrial organizations have adequate access to a range of technical extension services. Such access implies and requires an aggressive extension service, which must bridge the gap between those who have the necessary expertise and those who can effectively use it to better the performance of their organizations.

At present there are about 200 organizations in Indonesia that offer a number of extension services. Predominately, these organizations are the research-and-training institutes of various governmental departments, LIPI, public and private universities, private consultants, and other private institutions.

Services provided by these organizations, particularly as they relate to R, D & E, include testing and analysis (which is predominant), process devel-

opment, manpower development, management development, general technical assistance, etc. These services are characterized by a passive response to requests for help.

To initiate an effective program to overcome these problems, the Workshop recommended that

1. As many as possible of the provincial offices of the various governmental departments related to industry be placed in a centralized complex;

2. The workshop-and-training facilities required for effective extension work be attached to these industry complexes;

3. At least one research institute with extension and extension-support facilities with adequate financial support to discharge its assigned mission be established in each industrial sector, or technological discipline;

4. The regional laboratories of research institutes, wherever possible, be closely linked to provincial complexes or to a district center;

5. The development of industrial estates (as recommended by the Seminar on Industrial Estates held by the Department of Industry, October 1970) be encouraged;

6. Strong encouragement and support for university involvement in research-and-extension services be provided both directly and through interaction with the above institutions;

7. Planning be initiated for the educational development required to support the extension services, as well as promote industrial and economic development.

Standardization and Quality Control

The ultimate objective of standardization is to promote the exchange of goods and services, which includes the protection of consumers' health, safety, and property. Practically, it consists of formulating standards, then issuing and implementing them.

For developing countries, standardization plays an important role in directing the growth of industry. Therefore it should be done before or during industrialization. In Indonesia, standardization is at an early stage: There are laws but no implementing regulations of facilities. Therefore, there are no national standards.

Testing methods to assure quality are largely based on foreign standards, either wholly or partly adapted to Indonesian conditions. The difficulties in selecting the most suitable standard testing methods for Indonesia are manifold, for example, the poor condition of most testing facilities, lack of skilled personnel, and lack of information on foreign standards.

Standardization in Indonesia is now confined to departmental activities, i.e., government agencies which develop their own standards as the need arises, and the Indonesian Standards Foundation (ISF). For several reasons, the most significant one being the indifference of both industry and government--and thus lack of financial support--the ISF has not been able to meet current and projected needs. Because of its importance to national development planning, it should receive generous support for a program of expansion.

Efforts in this direction have been made with the establishment of a National Standardization Committee to review the needs for standards and the ways of implementing them.

Also worth mentioning is the Commodity Act of 1961, which stipulates government control on industrial and consumer goods. However, without a statutory decree it is ineffective.

Therefore, the following recommendations were considered to be of paramount importance:

1. Financial support for a National Standards Body (NSB) should be authorized and provided. Such an organization, like its counterparts in other developing countries, would perform the following tasks:

   a. Identify areas in which national standards are needed;

b. Encourage the development of national standards;

c. Promote within industry concepts of standardization and quality control;

d. Systematically review and classify existing standards; and

e. Represent Indonesia in such organizations as the International Standards Organization and the International Electrotechnical Commission.

2. The research-and-engineering facilities of organizations within Government should play a strong role in developing these standards, by

a. Testing to assure standards have been met;

b. Issuing certificates indicating satisfactory compliance with the standards; and

c. Training in standards and quality-control procedures.

Patents

The exclusive right to an invention conveyed by a patent stimulates progress in four ways:

1. It encourage research and invention;

2. It induces the inventor to disclose his discoveries;

3. It offers a reward for the expenses involved in developing the idea;

4. It induces firms to invest capital in new lines of production, which they might not risk unless some protection is afforded.

The first three of these incentives are applicable in Indonesia today. The fourth is coming into existence with the drive toward industrialization, which a legally authorized and operating patent system would help.

For a newly established Indonesian patent system to operate efficiently, it should be preceded by a detailed study, which might be undertaken by a three-man team comprising participants from (1) the International Patent Office in The Hague, (2) an industrial country, and (3) an Asian country operating an active patent system. The Bureau for the Protection of Indus-

trial Property (BIRPI) in Geneva might be requested to provide such a team. This procedure would speed up the establishment of an Indonesian patent system and ensure that it fits into the trend towards uniformity of the various systems now being developed throughout the world.

The Indonesian Patent Office does not process patent applications at present; its resources have to be strengthened to make the proposed patent system work. However, the resources required need not be excessive. The Workshop estimated that approximately a thousand applications may be received annually, largely of foreign origin. If the findings of overseas examinations are used, a full-time staff of five examiners and four clerical assistants should be able to handle this workload.

To initiate a patent system, it was recommended that

1. LIPI review pending legislation to assure that language contained therein encourages innovation;

2. LIPI thereafter use its influence to encourage enactment of an Indonesian patent law;

3. A technical assistance team be enlisted to provide a detailed plan for

   a. employing international search facilities, and

   b. creating a supplemental system of petty patents for minor inventions; and

4. Steps be taken to strengthen the Indonesian Patent Office so that patent applications can be processed promptly and effectively.

V

KEY FACTORS CONDITIONING THE OPERATION OF INDUSTRIAL AND TECHNOLOGICAL R, D & E ACTIVITIES IN INDONESIA

Problems Facing R, D & E Management in Indonesia

There already exists a substantial nucleus of dedicated and trained personnel in the several government research institutes and universities. The problem of increasing their effectiveness and productivity is at the heart of more efficient management of research. Delegation of greater authority to the research directors, lump-sum funding, authority over promotions, and encouragement to seek funds from outside sources are some of the methods of building confidence and competence in research managers. Attendance at management schools and frequent meetings among research managers and managers from industry are other familiar ways for spreading new research-management techniques.

To assure the proper climate for effective management, the Workshop made the following recommendations:

1. A national science policy be promulgated that will include

   a. Effective principles of personnel management--with special reference to scientific and technical personnel,

   b. Funding support through channels adapted to scientific and technological research, and

   c. Principles of planning, programming, and coordination;

2. Greater authority and responsibility be delegated to research-institute directors, especially with respect to project selection and assignment of personnel;

3. Consideration be given to the feasibility of permitting an individual research director to seek and accept research tasks related to his overall mission from outside sources; and

4. Research directors be given the opportunity to familiarize themselves with the most modern research-management techniques.

Education, Training, and Career Requirements for Industrial and Technological R, D & E

Creative scientists are some of the most valuable assets of a developing nation. Because of the limited number of scientists and engineers and the need to plan carefully for the development of more talent, manpower surveys should be undertaken first. LIPI and the Manpower Department have already started such an inventory. Once completed, it will help to identify the deficits in the various categories of specialized manpower.

In a country in which the industrial research tradition is yet to develop, universities and government laboratories are often the only sources of scientific and technological manpower. Appropriately, these are also the places to produce more such researchers. Graduate education (post-Sardjana) and research based in selected university laboratories, with cooperative programs in government research establishments, provide a strong institutional combination to produce researchers. Graduate education programs are expensive. They must be adequately supported over a long period of time. The concentration principle already applied in the support of a manageable cluster of centers of excellence in Indonesia is also applicable to research.

The lack of satisfactory schemes to provide monetary and professional incentives is an urgent concern of the research community in Indonesia. Although it is doubtful that salary scales could be changed overnight to correct this condition, reexamining salary scales, job reclassification, and equity in conditions of compensation and promotion between research workers and administrators would ameliorate the difficulties or researchers. If such incentives are not provided, people in whom a great deal of investment has been made may emigrate--needed skill and talent are lost in a "brain-drain".

Five major dimensions of the problem of educating and utilizing scientists in Indonesia were considered by the Workshop:

1. Centers for the development of scientists and engineers;

2. Graduate education;

3. Interaction among industry, university, and government research institutions;

4. Additional training programs and compensation to increase the output of research workers and technicians; and

5. International technical assistance in the form of visiting professors, consortia and university professors, and foreign enterprise--all as sources of training for scientific and technological manpower.

During the course of these discussions, the following recommendations were made:

1. Efforts to train research workers and selected technicians should be concentrated in leading universities in cooperation with selected government laboratories.

2. Graduate programs should be organized in science and engineering to adapt imported technology to national needs and circumstances and ultimately to develop indigenous technology. These programs should be started in a small cluster of universities considered as centers of excellence.

3. Industry-sponsored research at the universities should be expanded and reinforced.

4. Seminars on special topics by experts from Government and industrial laboratories should be held in universities to identify areas of mutual interest, promote communication, and make research and teaching more responsive to the needs of development.

5. Each university should establish norms for participation of its staff in outside-sponsored activities.

6. Committees to study job classifications in research laboratories of

Government and the universities should be established. Job classification and salary scales should be adjusted to reflect functions and responsibilities, not just rank and seniority.

7. Increased attention should be given on the incentives required to attract the best minds to the scientific and engineering professions, such as research fellowships, resources to attend international meetings, publication of research work done, and prizes and honors.

8. A more equitable adjustment of fringe benefits such as housing and transportation is urged, to make them more equitable between professionals and executives.

9. The dissemination of career information and guidance on scientific and engineering professions at the high-school level should be encouraged.

10. The merit system of promotion, instead of the traditional seniority system, snould be much more widely implemented throughout research institutions and universities.

11. The use of visiting professors and other industrial specialists should be encouraged; their efforts should be concentrated on training counterparts and initiating research.

12. Disparities in compensation levels between the visiting specialist and the counterpart should be reduced. Both the suppliers of the technical assistance and the recipient institution should contribute towards minimizing this disparity.

13. Consortia and university affiliations should be utilized on a selective basis for education and training of research workers and engineers, The main objective of these arrangements should be to build up an indigenous research capability.

An Information System for Industrial and Technological R, D & E

The process of technology-transfer depends to a great extent on an

efficient information system linked to sources of information abroad. Scientific journals, texts, and reference materials, periodic conferences on science subjects are some of the means to transfer information. There is indeed an explosion of information around the world, and acquisition and dissemination of pertinent information when needed are aspects of a new science of information storage and retrieval. Indonesia has already a National Documentation Center and a system of libraries, both of which are unfortunately inadequate to serve as a viable information infrastructure. Problems of disseminating information in a geographically dispersed country are indeed challenging. The need is urgent to fashion a system suited to Indonesian conditions.

The Workshop recognized that various agencies exist in Indonesia to receive and disseminate scientific and technological information. However, at present they do not have adequate facilities to perform the tasks of an information service for industry.

The major problems that inhibit the development of an effective information system in Indonesia include

- Unawareness of sources of information;
- The passive approach of many institutions and research workers towards dissemination of information;
- Underutilization of available data and literature; and
- Lack of communication facilities.

The most significant requirement is the development of an information service to meet short-term needs. Therefore, it was recommended that

1. As soon as possible, a plan for a scientific and technical communication system most suited to the future needs of Indonesia should be initiated. A joint committee consisting of information specialists, computer or data processing experts, appropriate numbers of representatives of probable users of the system, and representation from LIPI, as well as other organizations

that could make a significant contribution, should be formed and assigned the responsibility for preparing this plan.

2. As an interim measure, one or more existing facilities should be designated as national centers, to maximize effective use of existing resources. Consideration should also be given to the desirability of establishing a unified file of data sources and book holdings similar to that now in existence for periodicals. No major capital commitments should be made during this period.

3. Interpersonal communication should be facilitated by such means as meetings of local, regional, and national technical societies.

4. Research results that are applicable to industrial problems should be made available to industry on a systematic basis.

Funding

Most developing countries have the problem of providing adequate support for research. Several are now trying to tap new sources of funds, including the creation of research foundations, matching grants for research, a small percentage levy on industrial loans, and incentive and contributory plans for domestic and foreign enterprises. Streamlining budgets and disbursing funds opportunely increase the effectiveness of whatever funds may be available.

The Workshop identified several problems in funding and providing fiscal incentives for R, D & E activities:

1. The current government budget allocation is not sufficient for operation of existing institutions at the levels that are necessary and desirable. (The Workshop takes note, however, that in the last 3 years the government budget for R, D & E has been increasing. The Workshop welcomes the presidential instructions on fostering and maintaining close cooperation between ministries and universities on R, D & E activities and funding.)

2. Current administrative regulations concerning the management of

funds are not suited to research activities.

3. Contracts tend to be offered only by large industries; thus, R, D & E activities for the service of small- and medium-size establishments tend to be neglected.

4. Foreign grants are available to only a few R, D & E institutions.

5. The lack of funds tends to divert institutions toward activities that are incompatible with their primary R, D & E objectives. (It should be remembered, however, that the Workshop is considering funding problems confined to government institutions.)

Several alternate means of funding research were reviewed by the Workshop, and the following recommendations were formulated:

1. Government regulations on research funding should be modified to permit continuity of effort beyond 1 year.

2. The feasibility should be explored of establishing a foundation to promote and fund R, D & E activities, which would supplement the government budget allocation.

3. A counterpart fund system between companies and Government to stimulate research in small- and medium-size industries should be considered.

4. The participation of private industry in projects within research institutes should be actively promoted by means of client-oriented services and activities.

5. An assessment of industrial loans of 0.25 percent of the loan value, or another appropriate amount to be determined, to fund R, D & E programs should be considered.

Using International Sources of Technical Assistance

In solving many of the problems listed earlier, technical assistance from other countries and from international agencies and foundations has been a major source of help. However, on account of the high cost of such assistance

and the difficulty of synchronizing it--in time and substance--with the needs of the country, the assistance must be used with care, and must put major emphasis on the development of indigenous research capacity.

The Workshop directed its attention to technical assistance in the following forms:

- Education of qualified students in universities and colleges abroad;
- Provision of essential equipment to Indonesian institutions;
- Scientific and engineering specialists to provide training in R, D & E and supporting services;
- Stimulation of communication between Indonesian and overseas scientists and engineers;
- Interrelationships between Indonesian and overseas institutes;
- Participation of foreign companies with established operations in Indonesia; and
- Direct assistance to individuals and private companies and to the internal procedure of managing foreign assistance in Indonesia.

The following problem areas were identified:

- The need to improve the selection of specialists and equipment sent to Indonesia;
- The lack of communication and coordination in handling technical assistance;
- The need to create incentives and facilities to avoid a "brain-drain" of Indonesian scientists and engineers; and
- The current inadequate follow-up of studies and surveys undertaken through technical assistance.

As a result of these discussions, the Workshop made the following recommendations:

1. Information on international sources of technical assistance be periodically disseminated;

2. Involvement of the private sector in obtaining and utilizing international technical assistance be encouraged;

3. Indonesian counterparts to foreign experts be appointed as full-time co-workers and trained to work independently after the experts leave;

4. Foreign private corporations working in Indonesia be encouraged to support local research activities;

5. Affiliation between Indonesian and foreign research institutions be established; and

6. Procedures be established to assure that research equipment procured through technical assistance programs is compatible with existing equipment.