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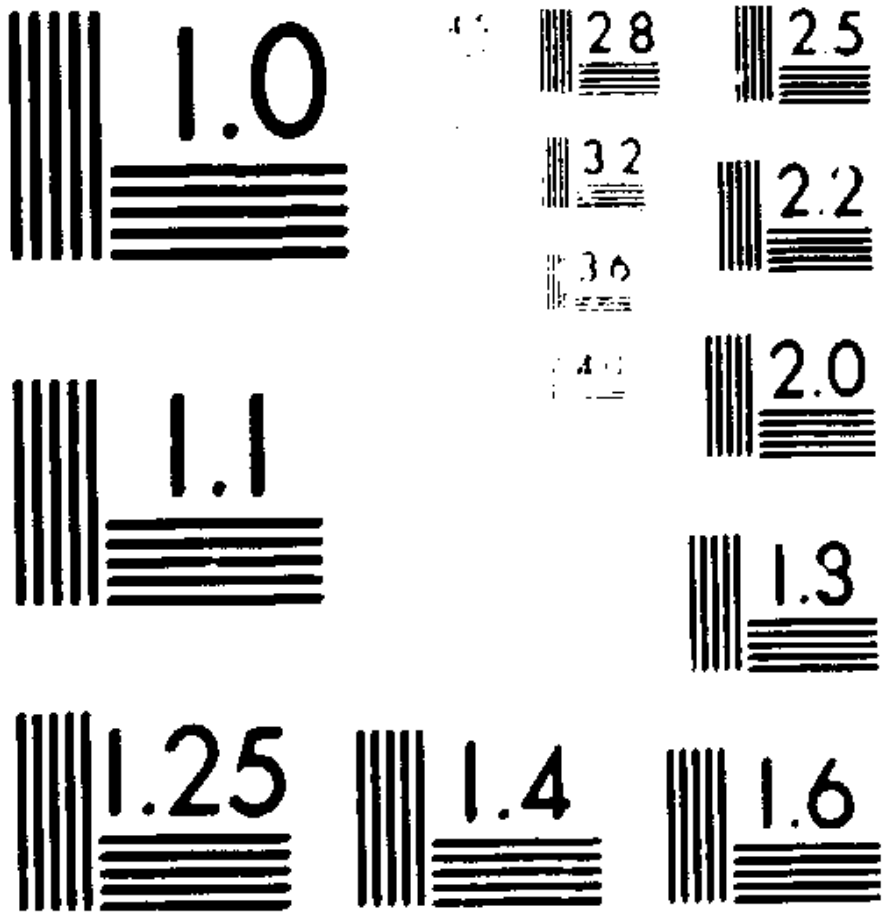
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



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THE COMPARATIVE STUDIES OF NATIONAL EXPERIENCE IN TECHNOLOGY POLICIES

THE CASE OF THE REPUBLIC OF KOREA*.

prepared by

Young-Hun Kim **

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** UNIDO Consultant

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CONCLUSIONS

1. National Technology Development Plans, Policies and Institutional Mechanisms have to be suited to the specific needs and resources in each developing country.
   Every developing country needs a combined development of both the consumer goods required to meet the basic needs of the nation and some, at least, of the major intermediate and capital goods without which economy cannot expand.

2. A technology development plan is the basis of an economic development strategy. Each country wishes to chart its own way but there are a number of politico-socio-economic goals which are common to all countries. Such goals are required to place on technologies which are appropriate to conditions of individual countries taking into account labor availability and particularly with regard to maximizing the value added through the least possible consumption of scarce resources, such as capital and energy. Industries deserving priority attention would be light industries for import-substitution and heavy and chemical industries for export-orientation.

3. A technology development plan has to specify the four main components with respect to the acquisition of technology:
   (a) What local technologies required are available now within the country,
   (b) What can be developed, including by adoption of existing domestic technology or of imported technology within the plan period,
   (c) What technologies should be developed locally,
   (d) What technologies should be imported.

4. Even though international technology transfer might be one of the best immediate ways to meet the necessary technological needs, it is made difficult by two major obstacles.
That is, a communication gap and a suitability gap.
The communication gap arises as a result of high costs of transfer, international restrictions, or the exercise of monopoly power.
Once these problems have been overcome and transfer has been effected, the suitability gap reflects the fact that most technologies which are available were designed to suit advanced country factor endowments. Therefore, the issue of indigenous R&D becomes critical even in the situation where most developing countries heavily depend on technology import by international transfer.

5. The interests of the technology recipient do not always represent the national interests of his country in the process of technology. Therefore, the policy-makers in developing nations have to devise effective and efficient laws and regulations in order to accomplish successful transfer of technology corresponding to their national interests.

6. Technology is ultimately selected by enterprises, where the selection and evaluation criteria are mainly governed by profitability. However, the government has a critical role in the selection process, either by direct intervention or indirectly through its industrial, trade, technology, fiscal, monetary policies.
The government's criteria must include socio-economic objectives that are not necessarily consistent with the criteria enterprise apply.

7. In the early stage of industrialization, all technology imports in developing country are inevitably screened on a case-by-case basis.

In the screening process, the appropriateness of technology to be imported is to be reviewed in accordance with the related law and regulation. However, once private industries' technical capabilities have been improved to the extent they could make autonomous decisions on the development and transfer of technology, the government's economic policy has to be shifted toward the economic system led by private industries.

8. Imported technology has been viewed as the major source of technological advance in developing countries. Japan is the most remarkable example showing that technology import might be the shortest way to achieve technological development if imported technology is fully digested and integrated into the infrastructure of indigenous R&D capacities. Thus, two crucial points underlying the importation of foreign technology would be how to choose appropriate technology and how to digest and adapt the imported technology in order to incorporate it into the indigenous technological ability.

9. In order to strengthen international competitiveness and diversify the export market through technology import, developing countries must import original technology directly from the source, not indirectly by way of sub-licensor.
Accordingly, the government has to play a leading role to establish the diversification policy of technology suppliers and to continuously implement the policy with industry's cooperation.

10. A recent tendency shows that the licensor intentionally shuns the granting of key patents related to the licensed product under the contract in order to control indirectly the licensee's exports. Thus, licensee has to include the stipulations for use of patent rights as far as possible, with the expression of the number of the patents registered by countries and the valid period of patent to be granted.

11. There has been general recognition of the need to assist developing countries in setting up technology transfer agents or centres so as to secure technology suited to their specific requirements. Technology transfer agents or centres can serve a crucial role in evaluation, selection and adaptation of technology which individual firms in the country could not duplicate in dealing directly with foreign industry or foreign transfer agents, and can advise on the key technology that should be brought into the country and the status of the raw materials needed in the processing and production.

12. Whatever form of institutional arrangement a particular country found suitable, the technology transfer agent or center should be established on such following conditions as:
    (a) It should not be created on the basis of a monolithic bureaucratic vertical structure, but within the framework of non-profit independent service organization regardless of whether its operation funds come from private or public sectors,
    (b) The scope and functions of the agent or center should be in accordance with the national development plan, needs, and new strategies for industrialization in each country and in particular its efforts should be directed towards promoting technology to meet the basic needs throughout the country.

13. It is very important to the promotion of technology import that technology acquisition source's information should be quickly provided to industries. In many cases, developing countries encounter an obstacle to obtain such information when they try to approach the advanced technology of developed countries. For the solution of this problem, the technology transfer agent or center has to assume the responsibility of providing the information services for industry.

14. In implementing industrial technology development plans, governments of developing countries should not only be concerned with the success of industrial projects in the short term, but also endeavour to develop a sound local basis for long-term industrial development by creating national indigenous technological capacities to develop and apply indigenous technologies, where appropriate, and to absorb and adopt foreign technology.
As a means for an effective implementation of the national plans, national technological institutions should be strengthened or new ones established to provide the necessary technology, to train technical personnel , and to improve foreign technology for industrial development.

15. Specifically, an important approach to the development of national industrial capacity is to involve indigenous technical personnel in the entire industrialization process. A national system and machinery must be developed to ensure the proper co-ordination and effective use of local technical expertise in industrial development. An important aspect of such a national system and machinery is the establishment of technological institutions to cater to the technological inputs at each point of the industrialization process.

16. Experiences indicate that, at the early stages of development, preference should be accorded to the single and multi-purpose institution in order to maximize the use of the limited national technological manpower and financial resources. In particular, close relationships need to be maintained among institutes, universities and industries to promote the tapping of the appropriate manpower resources of each organization for industrial development.

17. In developing countries, there is often a lack of participation of concerned spheres of the society in the development of science and technology, particularly in industry where most applied research and development efforts are being directed and ought to be directed. Without the active involvement of industry, it is almost impossible to expect a successful application of laboratory results of R&D to the practical problems of industry.

18. A country's capacity to develop and absorb modern industrial technology depend on whether it possesses a trained group of technical manpower. Only fully trained and competent personnel are capable of assessing the merits of the latest technologies developed abroad, and making wise choices on which technologies to import. The technological adaptations are a form of indigenous R&D, and usually require technical personnel with R&D training. Therefore, one of the important tasks in each developing country will be to determine the extent and areas of indigenous R&D to maximize long-range national benefits. The next step would be to promote the new techniques to insure that they are widely diffused in appropriate sectors.

19. Each developing country should, where appropriate, establish a national policy and create machinery for the commercialization of R&D results.

    Such political considerations should include appropriate incentives to promote the development and commercialization of local technologies as well as the creation of the required capabilities for the maintenance of not only locally developed technologies but also imported ones.

20. The policy measures that governments of developing countries have to implement in support of industries dual effort of technology import and in-house R + D are those incentive systems favourable to industries such as tax exemption and financial support under specific laws.

SUMMARY

1. A technology development plan should incorporate an explicit strategy for industrialization. It provides the basis for planning sectoral programmes and specific projects.
The plan should be formulated to achieve a reasonable balance between available resources and economic technological targets. Planners should set targets and work out schedules for achieving them not only for the short-term but for the long-term.

2. In Korea, the Fourth Five-year Economic Development Plan was set up by the government so as to achieve the economic development and industrial progress in the shortest period, and began implementation of the First Plan in 1962.
The Economic Development Plan reflects the increased maturity of the country's economic needs and attainments, and particularly aims at fostering self-supporting growth through industrialization. Since the efforts of economic development can only be successful with the effective support of science and technology, the government placed an emphasis on the need for executing an equally intensive policy for the development of science and technology to achieve the projected goals of its economic development policy.

3. For an effective implementation of the technology development plan, Korea designated strategic industries which were most needed in the country during the First Five-year Plan and which had big spill-over effects on the economy in the initial stage of industrialzation.
In the course of developing these industries, the country could learn related technology and develop the technology suitable to the Korean situation, thereby laying the foundation for developing other key industries in the next stage of industrialization

4. The industrialization process of Korea can be divided into three stages. That is, the initial stage in the 1960's, the maturity stage in the 1970's and the stage of self-reliant development in the 1980's.

   The initial stage of this process is marked by the First and Second Five-year plans (1962-71). Under these plans, import-substitution industries, light industries for domestic market and partially for foreign markets, and infrastructure were developed.

   In the maturity stage marked by the Third and Fourth Five-year Plans (1972-81), light industries for the domestic market are developing into export industries, and heavy and chemical industries have been selected as strategic industries for intensive development because of their technology-intensive nature, with a view to shifting the industrial structure to that of a semi-advanced economy.

   The 1980's is envisioned as the stage of self-reliant development in Korea's industrialization process, with the development of knowledge-intensive industries, as in advanced countries, in order for the country to find itself in the family of advanced countries.

5. The industrialization process of Korea has been relatively speedy, with a rapid shift of the industrial structure from the import-replacement orientation to the export orientation in a short period of a decade. As a result, there has arisen the need to develop higher-level industrial technology and establish economically feasible units of industrial facilities contributing to productivity increases in order to strengthen international competitiveness.

   This, in turn, requires the import of the technology appropriate to the Korean situation in order to utilize available resources in the country, create new employment opportunities and promote international competitiveness of export products.

6. The Foreign Capital Inducement Law (FCIL) and regulations governing the inflow of foreign technology and the Engineering Service Promotion Law (ESPL) governing the inflow of engineering services into Korea have been quite promotional in character and they have been increasingly liberalized.
   In Korea the licensing agreement is regulated and administered under the FCIL. The law defines a licensing agreement as an agreement concluded between a Korean national and a foreigner with a view to introducing technology or using it appropriately including industrial property or other technology which the Minister of the Economic Planning Board (EPB) approves. On the other hand, engineering service contract based on the ESPL is subject to the approval of the Minister of Science and Technology.

7. Before the revision of the FCIL in April 1978 for a partial liberalization of technology import, the Economic Planning Board had to refer to concerned ministries for their review of every license agreement submitted for approval.
   The approval procedures were so complicated and time consuming that the effective administration of the introduction of quality technology was jeopardized.

8. In the screening procedure and approval method for the importation of technology by the FCIL, the Economic Planning Minister is authorized to give the final permit for technology import.
   Receiving applications for technology imports from private, government and public organizations, the EPB conducts a preliminary review of the applications, chiefly examining if the application form is correctly filled and the applied method of import is proper, and then refers the applications to related government agencies for economic and technical review of the appropriateness of the technology to be imported.

9. The major part of the economic review in fact is done by the Ministry of Commerce and Industry. In addition, a technical review is done by Ministry of Science and Technology (MOST), and MOST uses KIST* in forming its opinion regarding the appropriateness of all technology import applications. The KIST study is actually done by the Technology Transfer Center (TTC) in cooperation with scientists and engineers of KIST laboratories.

10. Both of the reviewed results should be forwarded to the EPB in not later than 30 days. EPB refers the reviewed results from related ministries and MOST to the Foreign Capital Inducement Deliberation Committee (FCIDC) for the final decision.

11. With increasing inflow of foreign capital to the country in the 1970's, FCIDC's workload was increasing, and there arose the need to diminish FCIDC's workload and to simplify the administrative procedures for foreign capital inducement.
As a result, the Foreign Capital Project Review Committee (FCPRC) was established in 1975. The Committee was authorized to screen applications for technology imports whose royalties are 3 percent or less of the net sale price of the licensed product to be manufactured with the imported technology and whose import contract period or royalty payment period is less than 3 years, with the down payment of less than US$30,000.

12. In the screening procedure and approval method for engineering service contracts which is administered by the ESPL, the Bureau of Program Development and Promotion of MOST first receives the applications and reviews them, chiefly examining if the form is correctly filled and the applied method of import is proper.
The Bureau then refers the application to KIST(TTC) for the study of the appropriateness of the applied contract.
Upon receiving the study result from TTC, the MOST Bureau of Program Development and Promotion refers it to the Engineering Service Deliberation Committee for the final decision.

* Korean Institute for Science and Technology.

13. Between 1962 and 1978, Korea imported foreign industrial technology for a total of 1,210 projects.
By types, the imported technologies are divided into the grant of license for use of industrial property rights, provision of technical know-how and information, and visits of foreign engineers for technical assistance on the spot.

In terms of royalty payment, royalties paid for imported First Category Technology came to total of US$256 million in 1,210 projects for the period of 1962 through 1978, and those for imported Second Category Technology a total of US$54 million in 497 projects for the same period. By industry, the sector of heavy and chemical industries accounted for most of royalty payments, as this is the strategic area of the government's economic development program. The fact that technology imports were concentrated in that industry in the 1970's means that the structure of Korean industry was undergoing a fundamental shift in that period.

In terms of technology imports by country, Japan accounted for 717, 59.2 percent; the United States 282, 23.2 percent; F.R.G. 52, 4.3 percent; the United Kingdom 33, 2.7 percent; France 20, 1.6 percent; and other countries 106, 8.9 percent.
As seen in the above, Korea has heavily relied on Japan in technology import. In order to strengthen international competitiveness and diversify export market, Korean industries recognize the need to import western technology directly from the source, not indirectly by way of Japan.

In terms of level of imported technology, most of the technologies imported before 1975 were widely used in advanced countries, and were considered up-to-date due to the Korean industries attention to the level of technology they import.
Regarding contribution of imported technology, three effects of imported technology on cost down have been largely obtained.

First, imported technology has brought about the conservation of raw materials in most companies.

Second, imported technology has reduced the use of raw materials, labor and power, thereby bringing about a direct cost down effect.

Third, imported technology has increased the yield of product, thus increasing the production level.

In addition, the digestion, absorption and improvement of imported technology required relatively high local research and development capabilities and creative research efforts.
In the 1960's, the technical level of Korean industry was so low that many industries had to be content with the acquirement and understanding of imported technology for digestion, as they had no capability of developing new technology. As a result, technology -intensive electronics and machinery industries imported chiefly simple assembling techniques and concentrated efforts on getting familiarized with such techniques and developing them as indigenous techniques.
But in the 1970's when industries began to invest in research and development and attract overseas Korean scientists and engineers, the technical level of Korean industry rose to the level enabling gradual improvement of the industrial structure.

14. Before 1976, there was general recognition of the need to assist Korean industries in setting up technology transfer agents or centers so as to secure technology suited to their requirements at fair and reasonable terms. Technology Transfer Center (TTC) was established with government subsidies at KIST in February 1976.
It now has a dual function which is technical consulting agent to industries about technology transfer business and advisor to the government on technology import policy-making.

15. Korea's technology imports have undergone changes for development both in government policy and in industrial management during the past 18 years.
At the beginning of this 18-year period, technology imports were rather strictly controlled under FCIL, but the government liberalized the imports toward the end of this period.
In government policy, FCIL has been amended on several occasions to simplify approval procedures, with a view to promoting technology imports so as to meet the rapidly increasing demand for advanced industrial technology in the rapid industrialization process due to the government's intensive support in the development of heavy and chemical industries.
Moreover, in the latter half of the 1970's, the accumulated experience of industries in the application of imported technology, the government's policy to liberalize commodity imports, the need to increase technology imports, and other economic conditions both at home and abroad forced the government to liberalize technology imports.

16. Under the existing liberalization policy, the eligible contract period for liberalization was extended from three years to ten years, and the eligible amount of royalties for liberalization was raised to US$500,000 in initial payment, to US$1,000,000 in fixed payment and to 10 percent of the net sale price in running royalty.

17. After the technology import liberalization policy was put into effect, the authority to approve the contracts was delegated to pertinent ministries, and each ministry has established its own approval criteria. These criteria are so flexible as to provide an exception for some particular technology imports.

However, the criteria of the ministries are not very far from the technology import contract approval guidelines provided for under FCIL, and are based on the practice which had been applied before the liberalization policy.

18. In the past two years of technology import liberalization, the simplified approval procedures and the reduced approval time enabled industries to import advanced technology in time, and this institutional support is of great significance to the promotion of technology imports.
Accordingly, the technology imports in 1979 registered an increase of some 70 percent over the preceding year.

19. The basic goal of Korea's technology development policy is dual; digestion and absorption of imported technology for best applications to industries and promotion of research on modification and improvement of imported technology for development of better and more appropriate technology. To this dual end, the policy calls for increased investment in research and development for the promotion of research and development activities to achieve technological innovations by elevating the local capability of technological development and achieving technological self-reliance.

20. The government-industry ratio in R&D investment in Korea was 68 versus 32 in 1971, and 48 versus 52 in 1977. This tells that the leading role in R&D has been gradually moved from government to industry. According to the government's long-range development program of science and technology, the government-industry in R&D spending will be 40 versus 60 in the 1980's with the promotion of industrial R&D activities.

21. A balanced distribution of scientific and technological personnel with general level of skills is a crucial element for the development of both technology and economy.
For this reason, the Korean government has set up specialized R+D institutions by industries which are wholly or partly government -financed, and on the other hand, most of big enterprises also have established or are establishing their own R+D institutions with some financial incentives provided by government.
The main purposes for establishing such R&D institutions in public and private sectors, are to have scientific and technological personnel undergo competent technical training, to produce a large number of scientists, engineers, and technicians so as to sufficiently meet the requirements of industrial development, and to prevent brain-drain of qualified technical manpower and rather to recruit as many Korean scientists and engineers in foreign countries as possible for reverse brain-drain to make a direct contribution to R&D.

22. In connection with industrial development policy, it might well be said that strengthening the competitiveness of small and medium industries by optimizing and modernizing the industrial structures is one of the most important and immediate tasks of developing countries in order to achieve balanced development of national economy as a whole. In response to these requirements, the Korean Federation of Small Business was set up in 1962 with government funds.

23. The Technology Development Promotion Law enacted by the Korean government is intended to promote the development of industrial technology and the digestion and improvement of imported technology for the dissemination of its results, with a view to promoting technology exports and strengthening industries international competitiveness so as to contribute to development of the national economy.

24. In the FCIL, full holiday of corporate tax and income tax is granted for royalties on imported technologies in the first five years after the import and half holiday (50 percent reduction) for three years thereafter. In addition, fees paid to foreign experts invited to the country under the FCIL are exempted from earned income taxes.

25. For financial support in building a science and technology base, Korea Science and Engineering Foundation (KOSEF) was established in 1977 to help build a solid base of science and technology in the country. KOSEF intensively supports joint research programs of universities, research institutes and industries so as to help develop profound scientific knowledge needed in the development of technology meeting far-reaching national needs.

1. NATIONAL DEVELOPMENT PLAN FOR INDUSTRIALIZATION AND TECHNOLOGY DEVELOPMENT POLICY OF KOREA

Industrialization progress plays a leading role in economic development and social progress in most developing countries. Technological development not only contributes to economic growth and improved standards of living but also expedites modernization of the traditional economy and social structure based on cottage and manual industries in these countries.

The need for an adequate policy support to accelerate development and the desire for balanced development by reducing development gaps between the rural and urban areas, between agriculture and industry, and between the poor and the rich are the ubiquitous problem facing developing countries in the process of industrialization.

In order for a developing country to develop technology needed for its development, it must establish an effective technology development plan which can best contribute to national development in consideration of the resources and capabilities available to its development efforts.

In Korea, the Fourth Five-Year Economic Development Plan was set up by the government so as to achieve the economic development and industrial progress in the shortest period, and began implementation of the First Five-Year Development Plan in 1962.

The Economic Development Plan reflects the increased maturity of the nation's economic needs and attainments, and particularly aims at fostering self-supporting growth through the improvement of industrial structure, expansion of exports, and balanced expansion of social overhead capital.

Since the efforts of economic development can only be successful with the effective support of science and technology, the government placed an emphasis on the need for executing an equally intensive policy for the development of science and technology to achieve the projected goals of its economic development policy.

Figure I shows the basic direction for technology development policy stated clearly in the Fourth Five-Year Economic Development Plan.

Fig. 1. The basic direction for technology development policy in the period of the Fourth Five-Year Economic development plan

Development Period	Industrial Pattern	Industrial Areas To Be Developed
The First Period (1962-1966)	The first stage for industrial development of producer's goods (Development of intermediate goods)	1. Chemical fiber filaments (Nylon, Viscose Rayon, Polyacryl Fiber) 2. Fertilizer, Cement 3. Oil Refining 4. P.V.C. 5. Automobiles
The Second Period (1967-1971)	The second stage for industrial development of producer's goods (Development of intermediate and capital goods)	1. Chemical fiber filaments (Polyester Filament, Acetate Rayon) 2. Iron & Steel 3. Electronics 4. Automobiles 5. Petrochemicals 6. Machineries
The Third Period (1972-1976)	The third stage for industrial development of producer's goods (Arrangement for mutual organic linkage among consumer's producer's and intermediate goods)	1. Petrochemicals 2. Iron & Steel 3. Machinery 4. Electronics 5. Shipbuilding
The Fourth Period (1977-1981)	Initial development stage for knowledge-intensive and for export of technology services	1. Heavy and Chemical Industries 2. Computer (Hardware & Software) 3. Engineering Designs for Industrial Plants 4. Energy Resources 5. Environment Preservation

Industrialization efforts of developing countries generally start with the effort to develop inport-substitution industries, and this effort inevitably leads to the development of export-oriented industries.

Until the end of the 1950's, Korea had to rely on imports for its basic needs for daily necessities of the people, such as clothing, food and housing. This foreign reliance necessitated the development of import-substitution industries, and these industries gradually developed into export industries because of the domestic demand which was too small to make them economically feasible units and because of the need to earn foreign exchange.

Industrialization proceeds through several stages, and an industrial policy required, and suitable to a given stage cannot be continuously applied, more often than not, in the subsequent stages. In order to avoid the error of making an ambitious development program useless because of wrong policy or wrong execution of policy, Korea designated strategic industries, the industries which were most needed in the country during the first five-year plan and which had big spill-over effects on the economy, on the basis of a study of economic requirements of the country in the initial stage of industrialization. The government provided active support for the development of these strategic industries. In the course of developing these industries, the country could learn related technology and develop the technology suitable to the Korean situation, thereby laying the foundation for developing other key industries in the next stage of industrialization.

The selection of strategic industries was made by government economic planners in consultation with related government agencies and research organizations. Socio-economic conditions, such as market conditions both at home and abroad, domestic and foreign savings and industry's technical level, were carefully considered in this selection.

The fertilizer industry was, for instance, included in the strategic industries thus selected under the first five-year economic development plan in Korea. The fertilizer industry development program aimed not only at the import replacement effect but also at reduced food imports and increased farm income through increased farm productivity.

Under this program, fertilizer plants were constructed with equipment and machinery imported on a turn-key basis, and foreign experts trained Koreans in pl..' design and operation in these plants. The engineers thus trained and experienced in these plants were later able to make a technical contribution to expansion of their plants or construction of new plants.

What is noteworthy here is that engineers trained in these fertilizer plants played the leading role in the development of the chemical industry in Korea in the late 1960's and in the early 1970's. Korea's economy and technology grew in this process and the government made a maximum effort to speed up the growth with various supporting policies.

In Korea, industrial technology developed through the development of strategic industries, repeating the following processes.

1) Designation of strategic industries under an economic development, and survey of the needed technology to be developed.
2) Selection of the needed R&D subjects to be locally developed, and selective import of foreign technology in case of technology import.
3) Adaptation and application of imported technology for developing the technological base suitable to Korean industry.
4) Propagation and diffusion of technology.

The industrialization process of Korea can be divided into three stages -- the initial stage in the 1960's, the maturity stage in the 1970's and the stage of self-reliant development in the 1980's.

The initial stage of this process is marked by the first and second five-year plans (1962-71). Under these plans, import-substitution industries, such as petrochemical, fertilizer, and cement, light industries for domestic market and partially for foreign market, such as textile and plywood, and infrastructures (social overhead capital facilities) such as power, railroads, roads and harbors were developed.
During this period, the country's GNP grew at an annual average rate of approximately 9 per cent.

The country almost entirely relied on advanced countries for its needs for industrial equipment and technology, and industry acquired the technical capability of solving the problems arising in the application of imported technology to production, thus laying a foundation for importing higher-level technology.

In connection with research and development efforts, numerous actions and measures have been taken in the 1960's. The decade is recognized as an era of the establishment of a foundation for science and technology. The Ministry of Science and Technology was created as a central government organization of policy administration for science and technology in 1967.

The Ministry accomplished a huge step for the development of science and technology. It is the construction and establishment of the Seoul Science Park (or Complex) The Science Park has drawn a number of scientist repatriates, mostly from America, which might be cited as an example of "reverse brain-drain". The Ministry is now taking another step toward building a science town.

The main purpose of setting up such science complexes is to have those specialized R&D institutions conduct research works in particular technologies by industrial fields, to promote the commercialization of R&D results from research institution to industry, and to help industries in training their technical personnel in the matter of solution of technical problems, development of technology, transfer of technology from R&D institutions to industries and effective absorbtion and improvement of technology imported by industry.

For another measure of promoting the commercialization of R&D results, KIST established Korea Technology Advancement Corporation (K-TAC) as its sole investor and an independent corporation to play the role of facilitating the commercialization of R&D results in 1974.

K-TAC has successfully converted a lot of KIST's R&D results including metal power manufacturing plant to profit-making enterprise.

The ministry also takes the responsibility to connect R&D proposals by industry with proper research institutes or researchers in universities. Confidentiality of business related to the research proposals and projects is guaranted. Moreover, any patents and licenses originated by the research are to be given to the industry. The Ministry awarded 80 percent of its total funds to this scheme in 1972.

The implication of this drastic change in the way of grant awarding is

to aim for high participation by industry in industrial innovation not only by investment in R&D but also by the matching of recognition of needs or problems in industry to solid innovations.

Among lots of experiences in connection with industry's involvement in R&D, a typical industrial project commercialized by a joint research of a local firm and KIST could be briefly cited here.
The technology development project relates to a process for manufacturing biaxially oriented polyethylene terephthalate (PET) film.
Although many local firms were very much interested in development of the project because of the increasing domestic demand for the film and a bright prospect of export for the product, they could not readily set about the project development because it required a huge amount of R&D investment and involved commercial risk of R&D results.
Thus, there arose the need to develop the project as joint R&D between industry and research institute.
For the project development, a Korean firm and KIST agreed to develop the project on the basis of co-sponsorship and joint R&D efforts.
Both of the two organizations started research in 1975. As the result of research, the technology was successfully demonstrated in pilot-scale production in 1977, and since, expanded to commercial production in Korea.
According to the research contract, all of the process know-how, information, and licenses originated by KIST research was given to the industry, joint-research-partner with KIST, provided that the local firm refunds the R&D expenditure borne by KIST for the project development and pays a small running royalty to KIST for a certain period.
Another implication is to encourage researchers to consider industrial problems instead of those of only academic interest.

In the maturity stage marked by the third and fourth five -year plans (1972-81), light industries for domestic market are developing into export industries and heavy and chemical industries, such as machinery, metal, petrochemicals, shipbuilding and electronics, have been selected as strategic industries for intensive development because of their technology-intensive nature, with a view to shifting the industrial structure to that of a semi-advanced economy.

The selection of heavy and chemical industries as strategic industries under the third and fourth five-year plans in due to the fact that light industries, which played the leading role in export increase under the first and second five-year plans, have reached the limit of this role in exports because imports of raw materials have been on the increase proportionate to export increase, thus applying pressure to the country's foreign exchange reserves. As a result, there has arisen the need to reduce the economy's reliance on imports by basically improving the structure of foreign trade.

In parallel with the efforts to develop heavy and chemical industries, scientific and technological activities of the country have been shifting from the problem-solving in factories to the efforts to improve imported technology and develop import-replacement technology or the imitation of advanced technology chiefly at big industries and research institutes.

During the 15-year period between 1962 and 1976, Korea's per capita GNP grew eight times to US$700 and exports rose by more than 200 times to the $8 billion level.

The 1980's are envisioned as the stage of self-reliant development in Korea's industrialization process, with the development of knowledge-intensive industries, as in advanced countries, in order for the country to find itself in the family of advanced countries.

In the area of technology, the degree of foreign reliance will be further reduced, and light industries will almost completely stand on their own legs, while heavy and chemical industries will import only key technology. As a result, technical exchange with foreign countries in the form of technology and service exports will be promoted, as in advanced countries. The base of technological development, that is, science education and basic research, will be greatly promoted, and on this base, high-level applied research will be conducted for the achievement of self-sufficiency in technology.

So far I have discussed the difference of the quantity and quality of technological needs between stages of development.
This can be summarized as follows.

Fig. 2. Change in Development Pattern of Science and Technology by Stage of Industrial Development in Korea

Development Stage	Industrial Development	Scientific and Technological Development
Initial Stage (1960's)	1. Development of import-replacement industries. 2. Development of export industries producing consumer goods in the main. 3. Expansion of social overhead capital (infrastructure).	1. Import of industrial plants on a turn-key basis accompanied by foreign loans. 2. Adaptation and modification of imported technology. 3. Solution of problems arising in application of imported technology to production.
Maturity Stage (1970's)	1. Development of heavy and chemical industries. 2. Development of industries producing raw materials and intermediate materials. 3. Expansion of export industries. 4. Development of industries contributing to increased income of rural people.	1. Import of technology on an unpackaged basis, technology separated from loans. 2. Improvement of imported technology 3. Development of imitation of advanced technology to replace imported technology.
Stage of Self-reliant Development (1980's)	1. Development of knowledge-intensive industries. 2. Development of industries for export of technology and service. 3. Development of industries for improved social welfare.	1. Advanced country-type technical exchange with foreign countries. 2. Expansion of the base of basic science 3. High-level applied research.

As discussed above, the industrialization process of Korea has been relatively speedy, with a rapid shift of the industrial structure from the import-replacement orientation to the export orientation in the short period of a decade. As a result, there has arisen the need to develop higher-level industrial technology and establish economically feasible units of industrial facilities contributing to productivity increase in order to strengthen international competitiveness. This, in turn, requires the import of the technology appropriate to the Korean situation in order to utilize available resources in the country, create new employment opportunities and promote international competitiveness of export products.

In Korea, the shift from labor-intensive industries for the creation of new employment opportunities, the criterion generally used by developing countries in the selection of appropriate technology for import, to technology-intensive industries has been made in a relatively short period.

In view of this Korean experience, developing countries will be faced with the need to import not up-to-date equipment and technology, if they are to increase employment and contribute to fuller use of available resources in the country, or to import capital-intensive technology if it is needed to strengthen international competitiveness or bring about increased values added to industry, even though it does not contribute much to employment increase, depending on the domestic economic situation, especially on the stage of industrial development.

2. Gradual Change in Technology Import Process and Administrative Procedures for Technology Imports

Technology imports in the Republic of Korea are based on the Foreign Capital Inducement Law (FCIL) promulgated on January 1, 1960 to attract as much foreign private capital as possible to industrial development programs of the country. The law then provided for foreign loans, foreign investment and foreign technical assistance, with emphasis put on the attraction of foreign private capital. But the provisions for technology imports were not sufficient. For instance, it provided for foreign technical assistance contracts, not for technology import contracts, with the result that only grant-type technology imports were approved, in principle. In other words, the law failed to provide for means of payments for technology imports.

On August 3, 1966, the law was amended to provide in more specific terms for foreign loans, foreign investment and technology imports, with the enforcement decree of the law announced. The amended law included provisions for technology import contracts, replacing those of the old law for technical assistance contracts, and thus legally paved the way for technology imports. Under the amended law, technology import contracts were subject to the government's approval through the screening of the technology to be imported, and for only the approved technology imports, payment of royalties in foreign currency were authorized.

Before the promulgation of FCIL, most imported technology had been incidental to the importation of capital goods funded with foreign loans, and accordingly no accurate statistics on such imported technology had been prepared. Moreover, the imported technology itself was not the know-how of any specific production process as patent but simple technical knowledge needed in the operation of industrial plants imported and built on a turn-key basis.

It was in 1962, two years after the promulgation of FCIL, that Korea first imported foreign technology under a separate contract from the capital goods import contract.

Between 1962 and 1966, the government approved a total of 30 such technology import contracts, and all these contracts had been fulfilled. Beginning in 1967, the starting year of the Second Five-Year Economic Development Plan, technology imports rose sharply.

In addition to technology imports under FCIL, Korea also imports foreign engineering services under the Engineering Service Promotion Law. (ESPL). Under this law, foreign engineering service firms may provide engineering services for the work which local firms cannot do because of their low technical level, and a contract of such service is subject to the approval of the Minister of Science and Technology (MOST) and should have a period of no longer than one year under the Presidential decree implementing the law. The foreign engineering service under ESPL is called Second Category Technology, and the technology imported under FCIL First Category Technology.

In the Republic of Korea, the import of Second Category Technology carries as much weight as that of First Category Technology. In fact, many foreign engineers and specialists have visited the country for engineering consultation about plant design, construction and management.

However, the tempo at which technology imports have been increasing is not sufficient enough to meet the technical needs of the country striving to join the family of industrial countries. In 1977 when the Fourth Five-Year Economic Development Plan started with emphasis placed on the development of heavy and chemical industries, the government had to take steps to provide policy support for private technology imports so as to meet the rising needs to develop technology-intensive industries under its industrialization policy. In April 1978, the government took action to liberalize technology imports, and the scope of this liberalization policy was expanded in April 1979 as the measurement of liberalization effects proved that the liberalization had brought about positive results.

With the gradual change in technology import policy as discussed above, came change in the screening procedure and approval method of technology imports.

In the pre-liberalization period, all technology imports were screened on a case-by-case basis. In this screening, the appropriateness of the technology to be imported was reviewed in accordance with the related law and regulations. An import permit was then given when the appropriateness was recognized.

A summary of the screening procedure and approval method for the importation of First Category Technology follows.

The Economic Planning Minister is authorized to give the final permit for technology imports. Receiving applications for technology imports from private, government and public organizations, the Economic Planning Board conducts preliminary review of the applications, chiefly examining if the application form is correctly filled and the applied way of import is proper, and then refers the applications to related government agencies for economic and technical review of the appropriateness of the technology to be imported. The economic review includes the examination of such items as:

1) Appropriateness of total investment scale
2) Possibility for the stable supply of required raw materials to be imported
3) Justification of required machinery and equipment to be manufactured locally, or to be imported
4) Marketability and international competitiveness of licensed product (including export market)
5) Relation in local market with similar product(s) already existing in the country
6) Economic spill-over effects of the technology to be imported, or adverse effects on the economic order of the country.

In addition, the technical review includes the examination of the following items.

1) Needs for import
2) Scope of the technology to be imported and the method of delivery
3) Royalty and its payment terms
4) Period of import contract
5) Technical spill-over effects of the technology to be imported
6) Relationship with similar technology already existing in the country
7) Whether the applied technology would contribute to sound development of the national economy in the direction toward a self-supporting system and to improvement of the nation's balance of payments position.

Both of the reviewed results should be forwarded to the Economic Planning Board in not later than 30 days. The economic review is done by industry-related ministries. For example, in case of machinery, it is done by Ministry of Commerce and Industry, food by Ministry of Agriculture and Fisheries, and cosmetics and pharmaceuticals by Ministry of Health and Social Affairs. However, most economic reviews are in factdone by the Ministry of Commerce and Industry. In addition, a technical review is done by The Ministry of Science and Technology (MOST), and MOST gives its opinion regarding the appropriateness of all technology import applications.

MOST uses the Korea Institute of Science and Technology (KIST) in formulating such opinions, as KIST has the function of studying the appropriateness of technology to be imported. This KIST study is actually done by the Technology Transfer Center (TTC) in cooperation with scientists and engineers of KIST laboratories.

The Economic Planning Board refers the results of technical review from ministries and MOST to the Foreign Capital Inducement Deliberation Committee (FCIDC) for the final decision. This committee, chaired by the Economic Planning Board Minister, consists of the vice ministers of related ministries, including MOST, and heads of the government-designated public organizations.

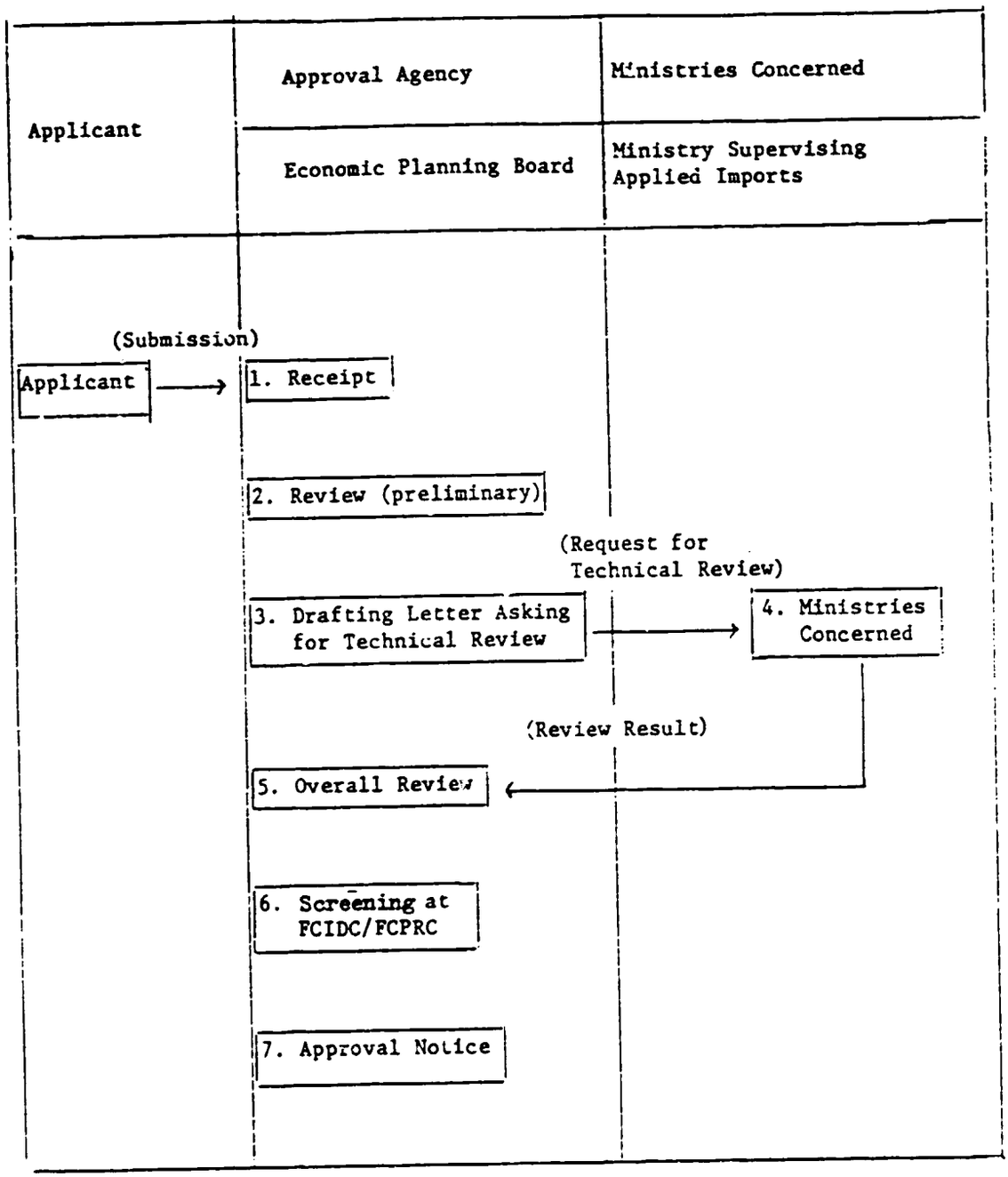
It serves as the top government decision-maker on foreign loans, foreign investment and technology imports.

With increasing inflow of foreign capital to the country in the 1970s, FCIDC's workload was increasing, and there arose the need to diminish FCIDC's workload and to simplify the administrative procedures for foreign capital inducement. As a result, the Foreign Capital Project Review Committee (FCPRC) was established in 1975. This new committee was authorized to screen applications for such technology imports whose royalties are 3 per cent or less of the net sale price of the licensed product to be manufactured with the imported technology and whose import contract period or royalty payment period is less than three years, with a down payment of less than US$30,000. In other words, small technology imports are screened by FCPRC, instead of by FCIDC.

The new committee is chaired by the Assistant Economic Planning Board Minister for Economic Cooperation and composed of bureau chief -level officials of the related ministries.

Shown in Fig. 1. is a simple block diagram of the screening and approval procedures for technology imports in the Republic of Korea.

Fig. 1 Approval Procedures for Technology Imports



A summary of the screening procedure and approval method for the importation of Second Category Technology follows.

As mentioned earlier, the Minister of Science and Technology is authorized to give the final approval for the importation of engineering services. Engineering service contracts are administered by the Engineering Service Promotion Law which aims at the promotion of local engineering companies and the active participation of local engineering companies with foreign engineering companies (or engineers)in the projected engineering service related to technology imports in particular. The law has a salient feature that the local engineering company should in principle be a prime contractor in any engineering service contract. Receiving import applications from private, government and public organizations, the Bureau of Program Development and Promotion of MOST preliminarily reviews them, chiefly examining if the form is correctly filled and the applied method of import is proper. The Bureau then refers the application to KIST (TTC) for the study of the appropriateness of the applied import.

TTC, in cooperation with KIST laboratories, conducts the study and submits the study result to MOST as soon as possible. TTC's study includes the following items.

1) Local engineering service capability of doing the applied project
   a) Technical level of local engineering service firms
   b) Problems to arise if local firms conduct the applied project
2) Needs for using foreign engineering service firms
   a) Needs
   b) Possible cooperation with local firms
3) Appropriateness of selecting foreign firms
   a) Technical capability and level of foreign firms
   b) Foreign firms' service export achievements in other countries

4) Appropriateness of the scope and method of service to be imported

   a) Scope of service

   b) Method of service

5) Appropriateness of service contract period and service fee payment

   a) Service period

   b) Justifications of service fee and its payment terms

6) Problems in contract terms

7) Economic and technical spill-over effects of the applied service import project

8) Overall opinion (recommendation)

Upon receiving the study result from TTC, the MOST Bureau of Program Development and Promotion refers it to the Engineering Service Deliberation Committee (ESDC) for the final decision. This committee is chaired by the Vice Minister of Science and Technology and composed of bureau chief-level of related ministries and Minister of Science and Technology-designated non-government people.

As with most other developing countries, the Republic of Korea in the 1960s had to import both foreign capital and advanced technology for rapid economic development through improved industrial structures, because the Korean economy then had many structural weak points. As a result foreign investment, both direct and equity, began to increase sharply. Direct investment was mostly made by multi-national corporations such as National Electric of Japan, Motorola of the United States and Philips of the Netherlands, and equity investment with local businessmen was made in the form of bringing in both capital and technology.

Foreign investment between 1962 and 1976 amounted to a total of US$9,540,000 in 865 projects. A summary of the screening and approval procedures for foreign investment follows.

The government reviews foreign investment applications on the basis of the following two questions; whether the applied investment project is appropriate to the local economic development program, and whether the investment ratio of local businessmen in the applied project is appropriate and proper.

In equity investment projects, local investor's share must be 50 per cent or above of the total investment. But this policy is flexible enough so that in specific projects foreign investors are allowed to have a 100-per cent share (direct investment) or a larger share than local investors in equity investment.

The screening of foreign investment applications is done with emphasis on the following questions.

A. Can the applied investment project export all of its products or substitute imports ?

B. Can the applied project be so technology-intensive as to contribute to the development of heavy and chemical industries in particular and to the development of the Korean economy in general ?

C. Can the applied project improve the structure of local industry ? Is it too large a project for local businessmen to invest alone ?

D. Does the applied project include a foreign license ? Cannot it be carried out without foreign investment ?

E. Will the applied project have big economic and technical spill-over effects on related industries of the country ?

On the basis of the above questions, the appropriateness of foreign investment is decided on, and the final green light is given by the Economic Planning Board Minister, as in the case of technology imports.

The approval procedure is shown in Fig. 2.

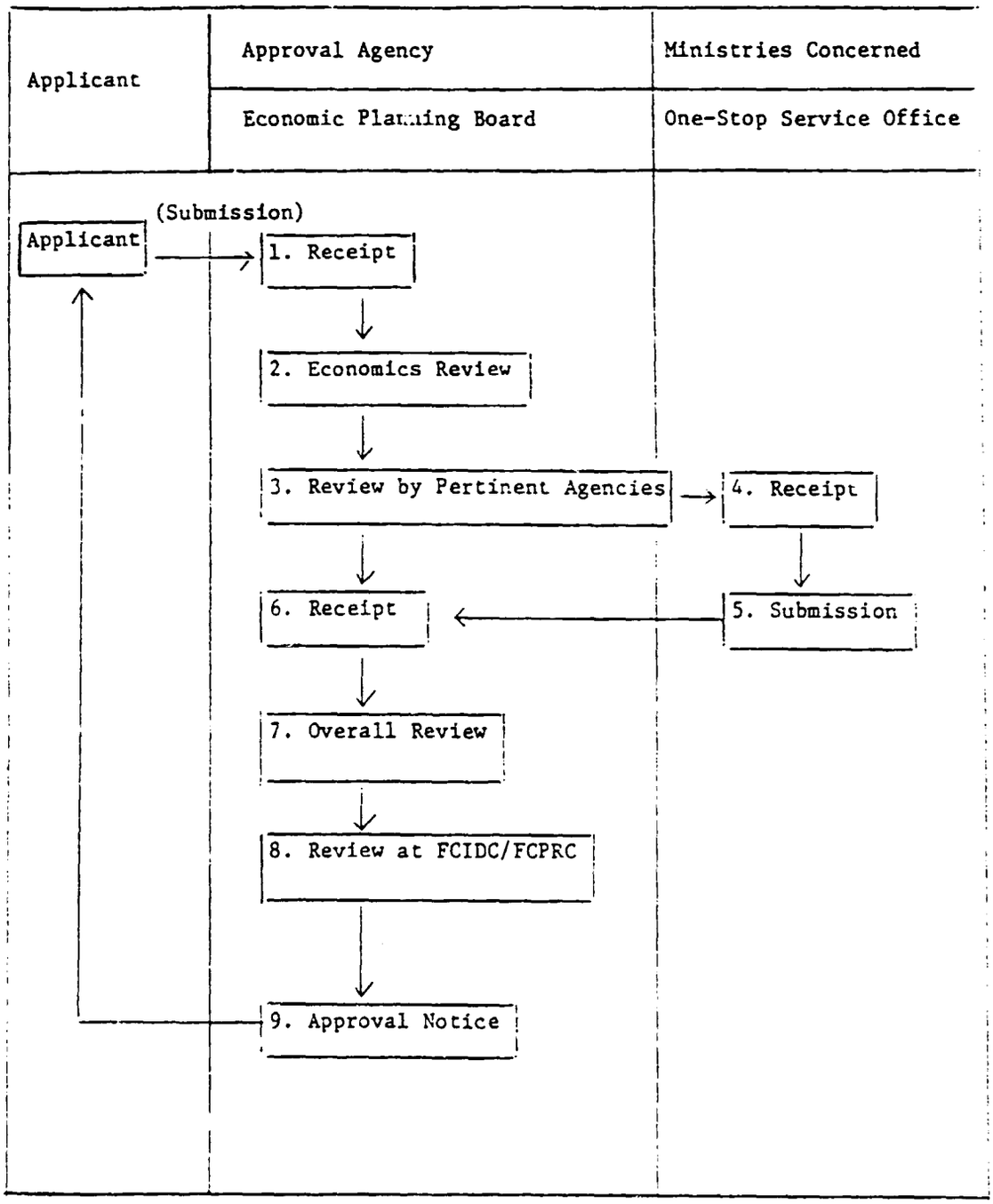
The Bureau of Foreign Investment Promotion at the Economic Planning Board receives applications for foreign investment for preliminary economic review. It then refers the application to pertinent ministries for technical, legal, taxation and financial review. The pertinent ministries here are the Ministries of Finance, Justice, Commerce and Industry, and Science and Technology and the Office of National Tax Administration.

Because of the many government agencies involved in the screening of foreign investment applications, the Economic Planning Board faces many inconveniences in its approval administration, including a relatively long period of screening. To redress this problem, the Board established the Office of Foreign Investment Officer in which officials of the pertinent government agencies also work for the so-called one-stop service to foreign investors.

Receiving review results from the pertinent agencies, the Economic Planning Board refers them to FCIDC for the final approval.

In case the applied investment is less than US$1 million, the application is examined by FCPRC for approval.

Fig. 2 Approval Procedures for Foreign Investment



3. An Analysis of Technology Import Status

Between 1962 and 1978, the Republic of Korea imported advanced technology for a total of 1,210 projects. By type, the imported technologies are divided into the grant of license for use of industrial property rights, provision of technical know-how and information, and visits of foreign engineers for technical consultation.

In the 1980s, technical know-how and information accounted for most of technology imports. In addition, many foreign experts visited the country for technical consultation about plant construction, equipment set-up and plant operations. This was because the Korean industry of the time did not need highly advanced technology as its industrial structure was based on labor-intensive light industries for domestic market. Moreover, even though advanced technology had been imported then, domestic industries would not have been able to absorb and apply it because of their low technical level. As a result, they had to be content with the importation of simple technical know-how and industrial information for improving the yields and qualities of products by replacing obsolete equipment or modifying out-dated production processes. In cases involving the building of big modern plants requiring big equipment + highly advanced technology, the plant was built on a turn-key basis and accordingly there was no significant technical problem in the operation of such a plant.

However, with emphasis of the government's economic development policy on such technology-intensive strategic industries as machinery, metalworking, petrochemicals, ship-building and electronics, as well as a shift of industrial structure from industries for domestic market to export industries, in the 1970s, Korean industries came to require key advanced technology to improve their international competitiveness, as the industries' technical level were not much improved. In addition, the license for using foreign patents related to export products was urgently required to increase exports through diversification of export market under the government's export-first policy. Under the circumstances, industries began in 1975 to include in their technology import contracts stipulations for a license of using foreign industrial property rights, as well as other necessary technical know-how.

A Royalty Payments

Royalties paid for imported First Category Technology came to a total of US$256 million in 1,210 projects for the period 1962 through 1978, and those for imported Second Category Technology a total of US$54 million in 497 projects for the same period. Between 1974 and 1978, royalty payments for First Category Technology imports rose nearly five times, averaging an annual increase rate of some 50 per cent, except for 1976 in which the registered increase rate was 14.6 per cent. (See Attached Statistics)

Second Category Technology imports in 1978 registered nearly US$10 million, up 14 times from the US$0.6 million recorded in 1968. Imports of First and Second Category Technologies in 1978 totaled US$95 million, 0.74 per cent of the total export achievement of US$12.8 billion in the year.

By industry, the sector of heavy and chemical industries accounted for most of royalty payments, as this is the strategic area of the government's economic development program. Of the royalties paid for First Category Technology imports, 32.7 per cent came from the petrochemical industry, 15.9 per cent from the metalworking industry, 12.2 per cent from the machinery industry and 10.2 per cent from the electric -electronic equipment industry. In other words, these heavy and chemical industries represented about 70 per cent of the total amount of royalties for the importation of First Category Technology.
In Second Category Technology imports, heavy and chemical industries also carried weight, as in the case of First Category Technology imports, with the petrochemical industry accounting for 37.1 per cent of the total amount of royalties paid for the importation of this technology, the machinery-metalworking industry 18.C per cent and the electric -electronic equipment industry 8.1 per cent. The combined total share of these industries came to 63.2 per cent.

The above industries are mostly technology-intensive, and they have large shares of research and development (R&D) spending in advanced countries. The fact that technology imports concentrated on these industries in the 1970s means that the structure of Korean industry was undergoing a fundamental shift in that period.

By country, Japan represented 32.9 per cent of the royalties paid for technology imports in 1978, the United States 28.5 per cent and other countries 34.0 per cent. Thus Japan topped other countries in 1978. Compared with 1977, however, Japan's share plummeted from 43.8 per cent to 32.9 per cent, while the share of other countries, mostly European countries, rose from 20.2 per cent to 34.0 per cent.

A brief discussion of how royalties are paid follows. This discussion is based on the fact-finding survey of technology imports done by KIST's TTC in 1975, covering 361 business corporations which imported technology for a total of 404 projects.

Korean business firms have paid royalties for imported technology in three ways -- initial payment, running royalty and initial payment plus running royalty. Running royalty accounted for 85 per cent, initial payment, including minimum payment, 37.3 per cent and initial payment plus running royalty 24.4 per cent. This indicates that running royalty is the most widely used method of payment to Korean business firms. Especially in the sector of electric and electronic equipment, running royalty accounted for over 98 per cent of the total royalties paid. As foreign equity investment began to increase in 1970, many electronics firms of advanced countries took part in such investment in Korea, and they opted for running royalty, expecting that production and sales would increase because of cheap labor, relatively high productivity and export-first policy in Korea. In the case of technology imported from European countries, initial payment was usually required in the form of guarantee fees, because the European countries had no agreement with most developing countries for the protection of industrial secrets such as technical know-how and classified information. As a result, initial payment plus running royalty accounted for 47.4 per cent of the total royalties paid for technology imported from European countries.

In terms of amount, an initial payment of US$30,000 or less accounted for 50 per cent of the total amount of payments, and that of more than US$40,000, 30 per cent. In the case of the running royalty, rates of 1.5 per cent to 4.5 per cent of the net sales accounted for 74.1 per cent of the total payments.

This is seemingly because of the government's policy of approving, in principle, the three-per cent level of royalty in technology imports.

In the case of the petrochemical industry in Korea, it has utilized an unusual method of royalty payment, resulting in great advantages to the industry. As an example, a Korean company concluded a technical assistance agreement with a U.S. company for an oil refining and processing technology (of the refined oil) which required large scale investment, and was not so much in demand in the country at that time.

In the contract, the royalty payment method consisted of running royalty as the fee for know-how and a lump sum payment for the engineering services. Both of the payment methods for the two fees had respective favourable incentives to the licensee. That is, the engineering service fee was fixed at about US$ 4,000,000 which could be paid in annual instalments of US$ 400,000 for ten years as a loan raised. On the other hand, the know-how fee also could be paid at a gradual low rate based on the amount of the licensed product manufactured and sold by the licensee.

Having paid a large royalty sum in a couple of years from the effective data of the contract, the licensee has made a good profit by paying a much small royalty sum at the moment, as the demand of the product has been drastically increased by the expansion of industrial production.

This means that the more of a product the licensee manufactures and sells, the lower the royalty rate that would be paid.

Since most developing countries are expected to have a large potential demand in the industrial products market in the course of economic growth and industrial development, this kind of royalty payment method is considered to be very beneficial to the licensee when it is applied to the particular industry having strategic importance in the development of heavy and chemical industries.

B. Technology Imports by Country

Between 1962 and 1978, projects which used imported technology numbered a total of 1,210. Of these, Japan accounted for 717, 59.2 per cent; the United States 282, 23.3 per cent; F.R.G. 4.3 per cent; the United Kingdom 33, 2.7 per cent; France 20, 1.6 per cent; and other countries 106, 8.9 per cent.

Korea's heavy reliance on Japan in technology import, as seen in the above, has several reasons. First, Korea and Japan have very close economic cooperation, especially in capital investment, and accordingly Korea imports raw materials, parts and components and industrial equipment (plants) chiefly from Japan. Second, Japan is geographically adjacent to Korea and there are many Koreans who can speak Japanese.

Third, Japan actively imported technology from American and European countries in the 1950s for modification and improvement so as to be applicable to Japan's industrial situation, and because the technology Korea imported from Japan in the 1970s was mostly such technology modified and improved from Western technology, it was easily applicable in Korea which then followed the Japanese pattern of industrial development.

However, to strengthen international competitiveness and diversify the export market, Korean industries must import Western technology directly from the source, not indirectly by way of Japan. Under the circumstances, the Korean government has adopted a policy of diversifying the sources of technology imports. As a result of this policy, the reliance on Japan dropped from 68.3 per cent (397 projects) in 1975 to 59.2 per cent in 1978. In view of this favorable result, the diversification policy of technology suppliers must be continuously pursued in the future.

C. Scope and Characteristics of Imported Technology

Imported technology in Korea is divided into three types, as mentioned earlier -- technical know-how and information, visits of foreign engineers for technical consultation, and industrial property rights.

The technical know-how and information imported in the 1960s chiefly included

1) plant layout plans,
2) procurement and installation of machines, equipment and tools,
3) assembling and manufacturing procedures and methods,
4) procurement of parts, and
5) methods of quality control and techniques of after-sales service.

The import of these assembling and peripheral techniques was inevitable in those days, in view of the low technical level and the poor capital formation of Korean industries at the time. In the 1970s when the industrial structure of the country was much improved and the development of strategic industries in the sector of heavy and chemical industries was promoted, the needs for key technology and know-how of the technology-intensive industries rose sharply, and accordingly the scope of imported technology began to expand. So the technology imported in the 1970s was marked by the characteristics of raising maximumly the localization ration of products manufactured in the country, improving the quality of local products and expediting the improvement or development of technology. The technology imported in the 1970s included:

1) Engineering drawings (basic and detail designs)
2) Material specifications, mechanical properties, dimensions, and shapes of all parts of the licensed products
3) Machining and assembling with the standards of material and workmanship, and process charts for the manufacture of the licensed products

4) Tooling, jig and equipment drawings which may be available in the files of licensor
5) Other manufacturing processes (process know-how)

Meanwhile, technology import contracts began to include stipulations for use of industrial property rights, such as patents and trademarks, in the 1970s. There were several reasons for increased licenses for use of industrial property rights in the 1970s over the 1960s when such licenses were rare. First, the government, in its approval policy, encouraged industries to get a license if the supplier (licensor) held patents related to the product to be produced under a contract. Second, with exports increasing and the export market being diversified, industries (licensees), worrying about the possibility of infringing upon industrial property rights of a third party in producing export goods, began to voluntarily include stipulations for guarantee against such infringement in technology import contracts. However, these stipulations have caused problems in relation to the stipulations for the license to use industrial property rights. Of the licensor's industrial property rights, what is directly related to the product under the contract?

In what country is such a right registered, and how long is the remaining valid period of such a right? Because Korean industries, without getting the answers to the above questions, sign a contract simply stipulating that the licensee is granted the license for use of all the licensor's industrial property rights related to the product under the contract, it is not clear what specific patent rights the licensee is granted from the licensor. This problem is partly due to the licensee's lack of knowledge about industrial property rights. But it is considered that the chief reason is that the licensor intentionally shuns granting the key patents related to the product under contract in order to indirectly control the licensee's exports.

D. Level of Imported Technology

Shown in Tables 2 and 3 are the responses obtained in the TTC's fact-finding survey of technology imports done by KIST's TTC in 1978, covering 148 business corporations which imported technologies for a total of 148 projects.

Table 2 Level of Imported Technology

Response	Response rate (%)
1. Widely used technology in advanced countries today	66.9 (178)
2. Up-to-date technology	21.4 (57)
3. Declining technology but appropriate to Korean situation	10.2 (27)
4. Declining or out-dated technology	1.5 (4)

Note: The figure in the parenthesis means No. of responses.

As seen in Table 2, 66.9 per cent of technologies imported before 1975 were those widely used in advanced countries, and 21.4 per cent were considered up-to-date. This indicates that Korean industries pay much attention to the level of technology they import. Declining technologies which were considered appropriate to the industrial situation of Korea at the time of importation accounted for 10.2 per cent, and this indicates that Korean industries usually evaluate the appropriateness of technology to be imported.

Table 3 shows the development years of technology imported by Korean industries. Technologies developed before 1955 represented a third of the total, and those developed before 1961 were slightly less than those developed after that year.

Table 3 Development Years of Imported Technology

Development year	Response rate (%)
1. 1955 and before	33.9 (86)
2. 1956 - 60	13.8 (35)
3. 1961 - 65	20.0 (51)
4. 1966 - 70	20.0 (50)
5. 1971 and after	12.6 (32)

Note: The figure in the parenthesis means No. of responses.

Regarding the domestic capability of developing imported technology, technologies which were considered not developable in any domestic research institutes represented a third of the total. The remaining were developable in the country, though they were imported because domestic development would take either a long period (38.4 per cent) or mean a higher cost than the import price (28.8 per cent). This reason for technology imports may be justified by the government's policy for active import and application of advanced technology, but it poses a problem in view of the basic policy goal of technology development requiring the accumulation of local technology development capabilities and the achievement of creative development of innovative technology.

E. Contribution of Imported Technology

The evaluation of how much imported technology has contributed to the development of Korean industry may be made from various aspects, but most important is the measurement of whether imported technology has directly helped improve domestic industrial structure and increase industrial production.

Shown in Tables 4 and 5 are the contributions of imported technology evaluated in terms of cost down and productivity increase in the TTC's fact-finding survey of technology imports.

Table 4 Contribution of Imported Technology to Cost Down

Items	Response rate (%)
1. 50% down of raw materials	36.5 (70)
2. More than 50% down of raw materials	5.7 (11)
3. 50% down of labor	28.6 (55)
4. More than 50% down of labor	9.0 (17)
5. 50% down of power	16.6 (32)
6. More than 50% down of power	3.6 (7)

Note: The figure in the parenthesis means No. of responses.

Table 5 Productivity of Imported Technology per Unit Hour

Items	Response rate (%)
1. Higher than local level but lower than level of Japan, U.S.	57.7 (150)
2. Almost same level as that in Japan, U.S.	28.5 (74)
3. Same as the local level before technology import	10.0 (26)
4. Higher than the level of Japan, U.S.	3.5 (9)
5. Lower than the local level before technology import	0.3 (1)

Note: The figure in the parenthesis means No. of responses.

Table 4 shows three effects of imported technology on cost down. First, imported technology has brought about the conservation of raw materials in most companies. Second, imported technology has reduced the use of raw materials, labor and power, thereby bringing about a direct cost down effect. Third, imported technology has increased the yield of product, thus increasing the production level.

Meanwhile, Table 5 indicates that imported technology has increased the productivity per unit hour. Especially in the chemical industry, the cost down effect of imported technology is conspicuous, according to the TTC's survey.

Another noteworthy contribution of imported technology to the development of Korean industry and economy is the expansion of exports.

In order for the Korean government to achieve export promotion through technology import, a few political support measures have been taken for local technology importers.

First, entirely export-oriented projects which do not conflict with related domestic enterprises in terms of markets, and which make substantial contributions to the improvement of technology in the industry concerned are encouraged.

Second, the duration of contract was as a rule to be as short as possible. Accordingly, contract extension were in principle not allowed except in some particular cases.

However, continuous extensions of contract periods could be possible if the technology importer wants to extend the contract period when it expires, provided that entire or a great deal of the licensed product is exported to foreign markets.

Third, the use of foreign-owned trade marks has not in principle been allowed in the country. If possible, the use of combined trade marks has been recommended. However, in cases where the entire or a great deal of the licensed product could be exported to foreign markets, the use of foreign-owned trade marks has been allowed.
As a result, imported technology has greatly contributed to the expansion of exports, and Korea's remarkable economic growth in the past decade.

F. Application and Improvement of Imported Technology

The digestion, absorption and improvement of imported technology required relatively high local research and development capabilities and creative research efforts.

In the 1960s, the technical level of Korean industry was so low that many industries had to be content with the acquirement and understanding of imported technology for digestion, as they had no capability of developing new technology. As a result, technology-intensive electronics and machinery industries imported chiefly simple assembly techniques and concentrated efforts on getting familiarized with such techniques and developing them as indigenous techniques.
But in the 1970s when industries began to invest in research and development and attract overseas Korean scientists and engineers, the technical level of Korean industry rose to the level enabling gradual improvement of industrial structure. However, the short history of technology development and the lack of technical experience make it almost impossible for most Korean industries to modify and improve imported technology.
This is shown in Tables 6 and 7 indicating the digestive and absoptive capabilities of imported technology and the capabilities of improving imported technology.

Table 6 Degree of Digestion and Absorption of Imported Technology

Items	Response rate (%)
1. Almost completely digested and absorbed imported technology	21.2 (74)
2. Almost completely digested and absorbed technology granted but imported technology found to have room or improvement	18.1 (63)
3. Use of local R&D institutes planned to improve and modify imported technology	15.0 (52)
4. Imports of more technologies planned	11.0 (38)
5. Took time to digest and absorb completely imported technology because it was highly advanced	18.0 (63)
6. Failed to completely digest and absorb imported technology because it was only partially disclosed by the supplier	9.8 (34)
7. Help of local R&D institutes' technical capabilities needed because of low in-company technical level	5.5 (19)
8. Completely failed to digest and absorb imported technology	1.4 (5)

Note: The figure in the parenthesis means No. of responses.

Table 7 Degree of Improvement of Imported Technology

Items	Response rate (%)
1. Operating in accordance with contract	50.5 (138)
2. Partially modified imported technology to meet licensee's particular needs	35.2 (96)
3. Whole process modified to meet licensee's particular needs	10.3 (28)
4. New process developed and applied for patent	4 (11)

Note: The figure in the parenthesis means No. of responses.

As seen in Table 6, simple assembly and manufacturing techniques were easily digested and absorbed by Korean industries, but higher-level techniques requiring advanced engineering knowledge, such as designing, were not practically digested and absorbed.
Basic designs and detail designs are the key industrial technology obtained from long technical experience and repeated R&D efforts. Design techniques represent a highly technology-intensive know-how needed in planning, constructing and operating industrial plants. So without sufficient design techniques, no capability of modifying and improving imported technology would have been developed. Korean industries must import basic designs and then make an effort to develop detail designs on the basis of the imported basic designs, and this is considered the best way for the industries to develop their own design techniques.

4. Establishment of Technology Transfer Center

The Technology Transfer Center (TTC) was established with government subsidies at KIST in February 1976. It now has a dual function -- technical counselor to industries about technology transfer business and advisor to the government on technology import policy-making.

For the basic work for establishing TTC, KIST conducted a study of technology transfer to Korea in 1965. In this study, problems involved in the importation and application of advanced technology by industries were identified. The study then recommended that to solve these problems a Technology Transfer Center be established in the country. Accepting the recommendation, the government provided funds for establishing what was to be the Technology Transfer Center of today.

The study gave the justifications of establishing TTC as follows: First, the lead time for technology imports averaged 24.5 months, in which negotiations with foreign suppliers were held and the government's approval was obtained. In addition, 79 per cent of the total approved technology import contracts surveyed in the study were conditional approvals, and renegotiations with foreign suppliers on the conditionally approved conditions and terms took three to four months. As result, the timely import of appropriate technology was almost impossible. This long lead time was due to industries' lack of information on sources of technology acquisition and their poor bargaining power even though they had found appropriate technology for import. Moreover, because industries had poor knowledge of the government's approval policy and procedures, they could obtain only conditional government approval of the contract already signed with the supplier, with the government's instructions to revise some contract conditions and terms. To solve this problem of long lead time, there arose the need for a technical service agency capable of surveying, collecting and storing information on technology acquisition sources and retrieving and distributing such information quickly upon request from industries.

In addition, such a service agency must be a technical counselor to industries importing advanced technology, enlightening and guiding them about the government's technology import policy and procedures and examining their draft contract for possible amendment. Second; medium and small industrie's represent some 41 per cent of the industries importing advanced technologies, according to the study. These small and medium industries had no technical capability of evaluating the appropriateness of imported technology, nor did they have research and development capability for modifying and applying imported technology. As a result, they were importing technology inappropriate to their own situation. Moreover, when they imported appropriate technology, because they could not easily digest and absorb the technology, it was often necessary to extend the license contract. Accordingly, they came to repeat the vicious circle of reliance on foreign technology without achieving technical self-reliance. Under the circumstances, there arose the need to lay a bridge between medium and small industries and R + D organizations so that the latter might help the former solve technical problems through technical consulting or by direct solution of such problems in projects sponsored by industry. In other words, there must be a technical service agency capable of laying such a bridge or assuming the role of a goObetween for small and medium industries and R + D organizations.

Third, the proposed technical service agency will help foreign technology sellers visiting Korea find a buyer, without the necessity for them to visit every Korean company related to the technology offered as the agency can serve as the single point of contact for such foreign companies, as well as for local firms wishing to import technology. To do so, it must be specialized in technology transfer.

Fourth, in promoting international co-operation in technology transfer through and with such international organizations as UNIDO, UNCTAD, ESCAP, etc. there must be a focal point in the country, and the proposed agency can and should assume that role.

Fifth, a need was also identified to support the government in the technology import business and advise the government about technology import policy from the industrial point of view and this need could be met by the proposed technical service agency.

In recognition of the above justifications or needs for technology transfer service, the government gave a green light to the establishment of TTC.

Until the establishment of TTC's functions and activities, there were questions, including:

First, should TTC be a government agency or a private institute ?

Second, how can TTC's operating funds be raised and how should TTC be operated ?

Third, what function should TTC have and what should be its business goal ?

Fourth, what should be the relationship between TTC and the government, industries and local R&D organizations ? What relationship should TTC establish with foreign technology suppliers, and what type of support should it give to industries ?

Fifth, what should be TTC's organization and personnel strength ?

To give the answers to the above questions, identify the need for a centralized national technology transfer service and provide for basic guidelines for its operations, there were a lot of discussions among government authorities concerned, R&D institutions, industries, and academic circles.

They were generally in agreement on the organizational frame of TTC, asserting that TTC must have the framework of a non-profit independent service organization, rather than a monolithic bureaucratic vertical structure of the government, regardless of whether the operating funds are provided by the government or industry.

They also were of the opinion that TTC's business should be limited to consulting and information services for technology imports by industries. In the face of this dominant opinion, the government set up TTC in KIST so that TTC might fully utilize scientists and engineers of KIST laboratories.
The government also decided to provide its operating funds from government budget.

A summary of TTC's major functions and its business achievements since February 1976, is as follows.

1) Counseling on Technology Imports

To promote technology imports by industries and support them in timely importation of technology on favorable terms, it is necessary to provide industries desiring to import technology with knowledge about the government's import policy and procedures and information on available technology for import. Of TTC's technical counseling service, some 30 per cent is the review of industries' draft import contracts for revision of contract conditions and terms so as to minimize the government's conditional approvals and prevent the conclusion of a contract to the disadvantage of industry.
Professional advice about appropriate technology suppliers accounts for another 30 per cent, consultation about conditions and terms of concluded contracts such as those concerning royalty payment and contract period 30 per cent and explanations about how to write a contract and the government's approval procedures 10 per cent.

Between 1976 and 1979, TTC's counseling service had some 493 requests, the yearly and industrial breakdown of this service is shown in Table 8.

Table 8 TTC Counseling Service

Industry / Year	Machinery	Metal-Working	Electric	Electronics	Chemical	Textile	Ceramic	Foods	others	Total
1976	40	6	4	11	16	9	2	5	3	96
1977	49	12	8	11	25	10	5	3	10	133
1978	36	10	7	9	46	6	2	10	10	136
1979	29	6	11	21	21	6	2	3	29	128
Total	154	34	30	52	108	31	11	21	52	493

According to a survey of the supply-demand situation of industrial technology in Korea, conducted by TTC in 1978, after TTC's counseling service the lead time for technology imports was reduced to six months and the government's conditional approvals of import contracts have also dropped to 15 per cent of the total.

2) Study of Appropriateness of Technology for Import

One of the important TTC functions is to recommend to industries whether the technology they desire to import is appropriate to their situation. This service keeps industries from importing low-level and outdated technology and helps them import appropriate key technology directly from the source.

In 1978, the government took measures to liberalize technology imports, and under this liberalization policy, all technology imports, except those requiring a royalty payment of more than US$ 1 million over a contract period of longer than 10 years, are automatically approved, without going through screening procedures. Between 1976 and 1979, TTC conducted a total of 1,111 examinations of the appropriateness of technology for import, upon request from the government and industries, as shown in Table 9.

In the future, TTC will place stress on such studies requested by industries, rather than by the government, before import contracts are signed.

Table 9 TTC Studies of Appropriateness of Importing Technology

Industry / Year	Machinery	Metal-Working	Electric	Electronics	Chemical	Textile	Ceramic	Foods	Others	Total
1976	83	32	28	24	48	14	12	2	9	252
1977	116	38	39	36	68	12	15	5	20	349
1978	136	56	25	22	70	13	28	7	27	384
1979	40	13	12	18	23	2	5	3	10	126
Total	375	139	104	100	209	41	60	17	66	1,111

3) Information Service for Technology Imports

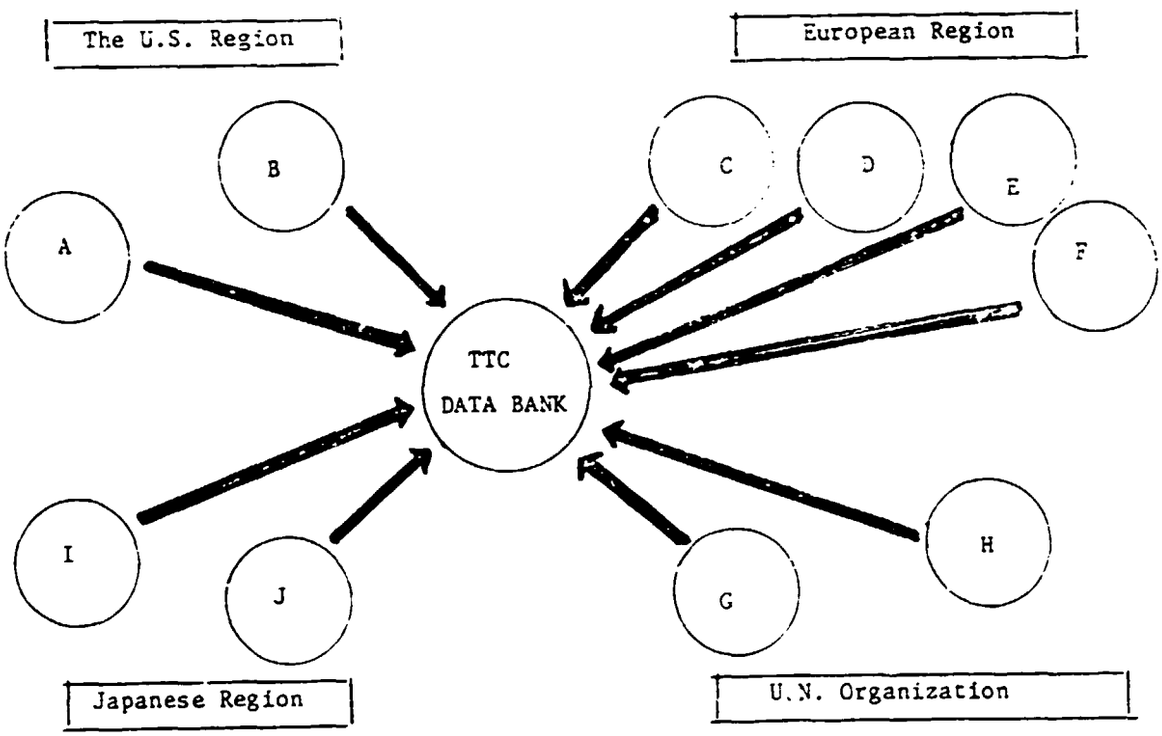
It is very important to the promotion of technology imports that information on sources of technology acquisition should be quickly provided to industries. Unlike general scientific and technological information, technology import information is not valuable in separate pieces. It is usable only when it is analyzed and processed together with related information. For example, even if we have located the source of technology for import, we must also know who the licensor is, when the technology is industrially applicable and if the technology is transferable from the licensor. In addition, we must know the scope and characteristics of the technology, an optimal scale of investment in the technology and whether the technology is patented. So to be usable, technology import information must cover all the matters related to the technology for import.

In order to quickly meet industries' demand for technology import information, TTC annually conducts a survey of the supply-demand status of industrial technology, and classifies the technologies expected to be imported in the future into short-term demand and long-term demand, and collects, analyzes, and processes information on appropriate suppliers of such technologies to put into the data bank. The data thus processed are revised with an input of the latest information. As of the end of 1979, the TTC data bank had data on some 20,000 technologies, and this is expected to increase to 50,000 in 1981 for service to industries.

For quick and effective acquisition of technology import information, TTC has focal points in Japan, the United States and Europe, as shown in Fig. 3, and uses them as information acquisition sources. TTC is also utilizing the Science Attach in Korean embassies stationed in foreign countries as one of its information acquisition sources.

In other words, TTC has placed an emphasis on providing information on industrial technologies, which are available for commercial production as well as those immediately transferrable into the country. In addition, the Korean Scientific and Technological Information Center (KORSTIC) is collecting, processing and storing scientific and technical information for use by industries, academic circles, R + D institutes, government organizations, and individuals.
That is, KORSTIC is mainly engaged in literature information services on science and technology, which are published all over the world as well as are particularly necessary for research and development efforts. Accordingly, both of the organization's information service activities are entirely different in functional nature.

Fig. 3. Information Acquisition Network



4) Technology Transfer Cooperation with International Organizations

TTC actively participates in international cooperation projects in technology transfer conducted by such U.N. agencies as UNIDO, ESCAP and UNCTAD, while assuming the role of the focal point (national center) of Korea for the Regional Center for Technology Transfer/ ESCAP.

In addition, it has been involved in the international transfer of technology projects which had been developed to the commercial production level by KIST. For the moment, foreign R&D institutes and industrial establishments from the developing countries in the regions of Middle East and South East Asia have been very much interested in importing KIST R&D results, which had already been commercialized with success by Korean industries. In order to facilitate those technology transfer projects, TTC has been deeply involved in a wide range of activities such as negotiation, conclusion of contracts, and actual transfer of technology on behalf of KIST.

As a means of promoting international cooperation on technology transfer and exchanging technical information and knowledge TTC is representing Korea in international seminars and workshops on Technology Transfer which are held in the country or foreign countries.

5) Study of Technology Transfer Policy

As an advisor to the government on technology import policy -making, TTC regularly studies the problems facing industries in technology imports to identify the solutions to such problems and recommends them to the government, with a view to helping the government take appropriate policy measures in support of industries' technology imports. In addition, it provides the government with basic data on technology import policy-making, upon request. The technology import liberalization policy the government adopted in 1978 was based on the data provided by TTC through a study of the problems involved in industry's technology imports.

5. Technology Import Liberalization Policy and Its Problems

As discussed in the preceding chapters, Korea's technology imports have undergone changes for development both in government policy and in industrial management during the past 18 years. At the beginning of this 18-year period, technology imports were rather strictly controlled under FCIL, but the government liberalized the imports toward end of this period. In government policy, FCIL has been amended on serveral occasions to simplify approval procedures, with a view to promoting technology imports so as to meet the rapidly increasing demand for advanced industrial technology in the rapid industrialization process due to the government's intensive support in the development of heavy and chemical industries. Moreover, in the latter half of the 1970s, the accumulated experience of industries in the application of imported technology, the government's policy to liberalize commodity imports, the need to increase technology imports, and other economic conditions both at home and abroad forced the government to liberalize technology imports.

(1) Background for liberalization

The conditions both at home and abroad conductive to this liberalization policy, or the policy background of technology import liberation, are discussed in some detail as follows.

First, the intensive development of heavy and chemical industries as export industries and the development of strategic industries gave rise to the need to strengthen international competitiveness of these industries by meeting their rapidly increasing demand for advanced technology.

Second, the rapid export increases, especially the rapid increase in construction service exports to Middle East countries, improved the nation's balance of payment position to the extent that the need to control technology imports from the foreign exchange control policy was greatly reduced.

Third, the establishment of many strategic applied research and development institutes in various industrial areas, along with the improved quality of technical manpower, contributed to laying the foundation of technological self-reliance to the extent that industries were ready to receive and apply foreign technology with help from industrial R&D organizations.

Fourth, with the government's economic policy shifting toward the construction of an economic system led by private industries from the past system led by the government, private industries' technical capabilities also have been greatly improved to the extent that they could make autonomous decisions on technology imports.

Fifth, amidst the world trends of capital and trade liberalization, Korea, striving to construct an industrial society, came to feel the need to take active part in the international exchange of industrial technology.

Sixth, in spite of changes in requirements of the time and society, technology import approval policy and procedures remained severe and complex, thus making impossible not only timely technology imports but also active participation in the international market of technology.

With the above-mentioned backgrounds of policy and situation, Korea could no longer put a side the need for technology import liberalization, and the government at last took measures for gradual liberalization of technology imports in April 1978.

In general, nations of the world are divided into three types by the technology import policy they adopt. The first type is the complete liberalization policy adopted by OECD countries today. The second type is the limited liberalization policy adopted by France and Japan in the 1960s, and under this policy technology imports are approved insofar as they do not have negative effects on the national economy. The third type is the protectionist policy adopted by five South American countries, including Columbia, Bolivia, Ecuador, Peru and Venezuela under the Andean treaty.

This policy allows technology imports on a strictly selective basis.

Of the above three types, Korea's liberalization policy in 1978 was similar to the policy adopted by France and Japan in the 1960s, though the Korean policy was marked by the aim of the gradual expansion of the scope of liberalization.

Following is a discussion of Korea's liberalization policy as being applied to the importation of First Category Technology.

(2) Range of liberalization

A. First-Stage Liberalization

The first-stage liberation was put into force under the following guidelines.

First, technology imports within a certain scope should be automatically approved, in principle, and the scope of liberalization would be expanded as the conditions of import matured both at home and abroad.

Second, there should be an institutional control system against technology imports considered to have negative effects on smooth industrial development, and all import contracts should avoid "poisonous clauses" to importers.

Third, industries' decisions and responsibilities concerning technology imports should be respected at maximum, and technology import information service should be systematically strengthened so as to effectively support industries in locating appropriate technology suppliers.
There should also be an effective support system for industries to modify and improve imported technology so that it may take root on the Korean soil as indigenous technology of Korea.

Under these basic guidelines, the first-stage liberalization policy defined the scope of technology imports for automatic approval by industrial area, royalty and contract period.

As shown in Fig. 4, the industrial areas of technology imports for automatic approval were limited to the heavy and chemical industries, such as machinery, shipbuilding, metalworking, electricity and electronics, petrochemicals, and the textile industry. Even if the imports fall in one of the above areas, they should have a contract period of three years or less, an initial royalty payment of US$30,000 or less plus a running royalty of three per cent or less of the net sale price and lump sum royalty payment of US$100,000 or less in order to be eligible for automatic approval. In the meanwhile, technology imports in other light industries having a contract period of three to ten years, an initial payment of US$30,000 to US$1,000,000 plus a running royalty of three to ten per cent of the net sale price and a fixed payment of US$1,000,000 or less were set for semi-automatic approval. On the contrary, technology imports in atomic power, computer and defense industries and those having a contract period of more than 10 years, an initial payment of more than US$1,000,000 plus a running royalty at more than 10 per cent of the net sale price and a fixed payment of more US$1,000,000 were set for individual screening before approval.

Fig. 4 Guidelines for 1st-Stage Liberalization

<table>
<tr><th>Contract period / Royalty / Industrial area</th><th>Less than 3 years</th><th>Less than 10 years</th><th>Over 10 years</th></tr>
<tr><td></td><td>Initial payment of less than US$30,000 plus running royalty at less than 3%
Fixed payment of less than US$100,000</td><td>Initial payment of US$30,000 to US$1,000,000 plus running royalty at 3 to 10%
Fixed payment of less than US$1,000,000</td><td>Initial payment of US$1,000,000 and above plus running royalty at above 10%
Fixed payment of above US$1,000,000</td></tr>
<tr><td>Machinery, ship-building, metal-working, electricity, electronics, petrochemicals & textile</td><td colspan="2">Automatic approval</td><td></td></tr>
<tr><td>Other light industries</td><td colspan="3">Semi-automatic approval</td></tr>
<tr><td>Atomic power, computer & defense</td><td colspan="3">Individual screening</td></tr>
</table>

The procedures for automatic approval were so simple that applicants could get an approval from the pertinent government ministry upon request. For instance, applicants of technology imports in machinery industry would get the approval from the Ministry of Commerce and Industry, in food processing industry from the Ministry of Agriculture and Fishery, in cosmetic and pharmaceutical industries from the Ministry of Health and Social Affairs. However, automatic approval was not granted, in cases where:

1) The import was intended for use of a simple design or a trademark.
2) The import was designed to sell raw materials, parts or components on the domestic market.
3) The technology to be imported was a technology already developed domestically and designated by the Minister of Science and Technology for protection from the import of similar technology.
4) The technology to be imported was relatively simple or outdated.
5) The import contract included expressly unfair or restrictive conditions and terms, such as:
   a) Tie-in clause
   b) Restrictions on sale territory, sale prices and sale quantities of the licensed products, except that:
      i) The licensor established and registered patents related to the licensed product in the area where the licensee's export of the licensed product was restricted by the licensor.
      ii) The licensor was already selling the licensed product in the area where the licensee's export of the same product was restricted by the licensor.
      iii) The licensor recognized the area where the licensee's export of the licensed product was restricted as the monopoly market of a third party.

c) Clauses restricting the importer's (licensee's) handling the competitive technology or product which the importer was already using or producing, or was capable of using or producing.

d) Clauses demanding royalties on a technology which has nothing to do with manufacture of the licensed product.

e) Clauses demanding return of technical data, or preventing or restricting continued use of such data, after the expiration of the contract

f) Grant back clause

In cases of semi-automatic approval, the final approver was the Economic Planning Minister, as in the case of individual screening for approval. He usually gave approval within 20 days of receipt of applications in which he referred the application to the pertinent minister and the Minister of Science and Technology for their opinion. If the ministers didn't present an opinion opposing the application, the Economic Planning Minister gave the application to the Technology Inducement Deliberation Committee for its recommendation, and in this case the final decision also rested with the Economic Planning Minister.

B. Second-Stage Liberalization

During the one year of the technology import liberalization, several expected problems arose, but technology imports began to increase sharply and industries' reaction to the liberalization policy was very favorable. Accordingly, the government took measures for second-stage liberalization in April 1979 to expand the scope of liberalization so that the importation of most technology could be liberalized.

As seen in Fig. 5, the scope of automatic approval was greatly expanded, and most industrial areas, except atomic power and defense industries, were included in the liberalization scope. As a result, the semi-automatic approval system was virtually discarded.

Fig. 5 Guidelines for 2nd-Stage Liberalization

Contract period / Royalty / Industrial area	Less than 10 years	Over 10 years
All industrial areas	Automatic Approval	
Atomic power & defense industries	Individual Screening	

Under the second-stage liberalization policy, the eligible contract period for liberalization was extended from three years to 10 years, and the eligible amount of royalties for liberalization was raised to US$500,000 in initial payment, to US$1,000,000 in fixed payment and to 10 per cent of the net sale price in running royalty.

Automatic approval procedures were the same as those under the first-stage liberalization policy.

(3) Criteria for Review of Technology Import Contract

After the import liberalization policy was put into effect, the authority to approve import contracts was delegated to pertinent ministries, and each ministry has established its own approval criteria. These criteria are so flexible as to provide an exception for some particular technology imports. However, the criteria of the ministries are not very far from the technology import contract approval guidelines provided for under FCIL, and are based on the practice which had been applied before the liberalization policy. The following is the introduction to these criteria on the basis of the check list of the Ministry of Commerce and Industry which is actually approving more than 90 per cent of technology import contracts.

1) Evaluation of the Need for Technology Import

Should the technology requested for import approval not be a technology that can contribute to the development of industrial technology and the economy but a technology that would have adverse influence on the economic order of the country, the importation of such a technology must be prevented. In this view, applications for technology imports are checked under the following guidelines.

-- Can the importing technology be of help in tapping of a new export market ?

-- Can the imported technology contribute to the manufacture of components in the machinery industry and to the development of a process in the equipment industry ?

-- Should the technology be imported because its local development is not economical ?

-- Can the imported technology contribute to cost-down, process improvement or quality improvement ?

2) Evaluation of the scope and Transfer Method of Technology

-- Does the licensor clearly define the form of technology, such as industrial property rights, know-how or technical service, and the form of license to make, use or sell the licensed product?

-- In case the licensor holds patents directly related to manufacture of the licensed product, does he grant the license to use such patents ?

-- In case technology is imported in the form of know-how, does the contract clearly specify the scope and transfer method of such know-how ?

-- In case foreign experts are invited to the country for technical service, does the contract specify the scope of work, the qualifications of experts, the number of experts and the work period ?

3) Evaluation of Royalties and Period of Technology Import

-- Are the royalties too high in view of the scope and level of the technology and in comparison with the international practice of royalties on the same or similar technology or with the royalties on the technology already imported to the country ? (In this case, the royalties Japan paid on the technology imported from European and American countries were taken into consideration.)

-- The fees of technical service consist of foreign exchange (dollar) expenses and local currency (won) expenses, and expenses accruing in the country, such as travel expenses and the cost of living other than salary and per diem, are paid in local currency in principle. In case the fees for technical services are not specified in the contract, the government instructs the contractor to specify the amount or requires a separate government approval of the amount before payment of the fees.

4) Evaluation of Whether Importing Technology Would Stand in the Way of Smooth Local Technology Development

-- Is there the possibility that the imported technology will adversely affect the technology already developed in the country or stand in the way of research work on the technology projected for development in the near future ? (In this case, the technology announced by the Minister of Science and Technology under the Technology Development Promotion Law is taken into consideration.)

5) Evaluation of Economic and Technological Spill-over Effects of Importing Technology

6) Approval Criteria for Use of Foreign Trademarks

The use of independent foreign trademarks is not approved, in principle, except when:

-- They are used for export items.

-- They are used for the licensed product such as capital goods or intermediate material not competitive with any domestic products.

-- The pertinent government minister approves the contract on condition that more than a fixed quantity (rate) of the production of the licensed product should be exported.

-- The Economic Planning Minister recognizes the use of foreign trademarks as necessary for the attraction of foreign investment.

-- They are used as joint-trademarks.

The use period of independent foreign trademarks is not longer than the technology import contract period, and no extension of the technology import contract intended only for use of foreign trademarks is approved.

7) Evaluation of Restrictive Clauses to Importers
(The restrictive clauses as provided for by FCIL for exclusion from the scope of automatic approval)

(4) Gains and Losses of Technology Import Liberalization Policy

In the past two years of technology import liberalization, the simplified approval procedures and the reduced approval time enabled industries to import advanced technology in time, and this institutional support is of great significance to the promotion of technology imports. Accordingly, the technology imports in 1979 registered an increase of some 70 per cent over the preceding year.

However, the liberalization policy has given rise to several important problems, as expected before this policy was implemented.

First, imports of low-level technology have conspicuously increased. It is not easy to determine whether the level of imported technology is low or high. But experts in the areas of imported technology have confirmed that many imported technologies are those which are on the decline in many countries and thus no longer in use or those which have been so outdated that they no longer have international competitiveness. This is due to the fact that importers have few technical capabilities of evaluating the appropriateness of imported technology. But the bigger reason is that the exporter does not disclose the scope and characteristics of the technology when he signs a contract. Before the liberalization policy, the import of low-level technology had been a matter of concern to the government as well as to industries, and to prevent this problem industries were to ask for expert opinion on the appropriateness of imported technology.

As seen in Table 10, which was derived from the TTC report on a fact-finding survey of technology imports, many technologies imported from Japan were found to be low-level, as evidenced by the wide gap between the import year and the commercialization year of technology.

Table 10 Low Level of Imported Technology

Technology	Developer	Year of Commercialization	Import year		Gap	
			Japan	Korea	Developer and Japan	Developer and Korea
Manufacture of Formalin	F.R.G.	1910s	1940	1963	30 years	53 years
Manufacturing Process of Printing Ink and its raw Material	U.S.A.	1930s	1951	1972	21 years	42 years
Manufacturing Process of coaxial cable	U.S.A.	1940s	1952	1966	12 years	26 years
Manufacturing Process of chassis for bogie	F.R.G.	1940s	1960	1974	20 years	34 years

In the case of formalin manufacturing process (the LUMUS process), we can see that it was developed and applied on a commercial basis for the first time in the F.R.G. in the 1910s and then imported by Japan in the 1940s. And Korea imported this technology from Japan in 1963, 53 years after it was first commercialized in the F.R.G.Although it was known that the formalin manufacturing process had been much improved for innovation, Korea imported the German process of the 1910s indirectly from Japan, and as a result, Korea's formalin industry is still weak in international competitiveness.

As mentioned above, most technology imports from Japan have been low-level or outdated, and this situation has been particularly conspicuous after the liberalization policy of 1978.

Second, some technology has been imported twice or thrice only to waste money. There is a strong tendency that industries compete in importing the technology which a particular industry has already imported. The reason for this duplicated import of the same technology by many industries is that although such technology import is not needed in view of the domestic technical level, industries need the technology to compete with other industries in the same area or to promote sales by use of the foreign trademark licensed along with the imported technology. In other words, non-technological and commercial reasons have prompted the duplicated technology imports. Needless to say, this not only is a waste of money to industries and the government but also has caused an overheated competition among industries for technology imports thereby impeding the promotion of the local technical level. Before the liberalization policy, the duplicated import of 'unnecessary' technology was maximumly checked by the government in the course of screening, but after the liberalization policy such a control system has been virtually discarded under the automatic approval system.

In September 1979, TTC reviewed a total of 63 technology import contracts automatically approved between February and July of the year and found that 25 contracts, 40 per cent of the total, were duplicated imports of the same technology in one form or another. In the case of a patent licensing contract on TV set manufacturing technology (black and white or color), however, duplicated imports are unavoidable in view of the need for the export of the licensed product. But the duplicated technology imports due to non-technological reason must be prevented by all means.

Third, import contracts containing clauses to the importer's disadvantage has been on the increase. It is desirable that a technology import contract be concluded on the principle of mutual reciprocity for both parties, and a contract to the licensee's disadvantage is due largely to the licensor's abuse or one-sided enforcement of its rights. But if the importer has sufficient experience in import business or bargaining power based on sufficient information on the technology to be imported, he could minimize such "restrictive clauses in contracts. Before the liberalization policy, the government's control could help eliminate the restrictive clause as much as possible, but after the liberalization policy such government control has been discarded and industries are only advised to eliminate such unfavorable clauses from contracts without avail.

According to the TTC's survey of 63 technology import contracts automatically approved between February and July 1979, 41 contracts, 65 per cent, were found to contain the so-called "HOLD HARMLESS" clause avoiding guarantee against infringement on the licensed patent rights by a third party, and 24 contracts, 38 per cent, a clause not guaranteering quality assurance of the licensed product, as seen in Table 11. These clauses are considered unfavourable to the licensees.

Table 11 Restrictive Clauses Found in 63 Contracts Automatically Approved Between February and July 1979

Restrictive Clause	No. of Contracts	Percentage (%)
a) Tie-in clause	10	16
b) Export restriction or ban clause	9	14
c) Clause banning licensee's modification, improvement of licensed technology	4	6
d) Clause avoiding quality assurance	24	38
e) Hold harmless clause	41	65
f) Clause banning import of similar technology during contract period	3	5

(5) Measures Against Problems

To prevent the import of low-level technology and promote the import of key technology from the source, indirect import of technology from Japan should be avoided. The indirect import here means that Korean industries import from Japan the technology which Japan had previously imported from European and American countries.
In addition, import sources of technology should be diversified so that direct technology imports from the original licensors in European and American countries may be promoted.

To meet this urgent need, information on technology acquisition sources in European and American countries should be surveyed, collected and distributed in the quickest possible manner to industries. Moreover, the function of the technical service capable of evaluating the appropriateness of the technology to be imported should be strengthened.

Efforts should be made to prevent duplicated imports of 'unnecessary' technology and promote the vertical transfer of imported technology to industries in the same area, even if the need for duplicated import of some particular technology is recognized. In addition, there should be a support system for the horizontal transfer of technology among technology importing industries, as well as the vertical transfer of technology. Under this system, a specialized industry will be established centering on a large business in each industrial area, and with this business on the top small and medium industries in the same area will be aligned for vertical transfer of technology, while horizontal transfer of technology will be promoted with the specialized industries of other areas. This would maximize the effect of technology transfer and achieve a balanced development of large industries and small industries.

There should also be a group technology import system. Under this system, local R&D institutions and other technical service organizations like TTC will regularly survey the supply-demand status of technology in industries and select several major subjects of technology deemed to have the need for import and consult with related industries about the possibility of group imports of such technology for sub-license to industries. This would prevent overheated competition of industries in the same area for the import of particular technology and prevent the waste of time, work and cost in individual imports. Moreover, the group import would make it possible for industries to import the desired technology at a much lower cost than in the case of individual imports.

In the past, Japan's chemical and foundry industries benefited from this group technology import system.
A few good examples could be cited here in the case of Korea and Japan.

In Korea, KIST has had a successful experience in group technology import on the "Viking System" of an automatic ship design from Sweden. Though a few Korean shipbuilding industries were very much interested in the technology which was imported at KIST's initiative, they didn't have any technical capabilities to absorb, digest, and apply it to their specific industrial situations. After the technology had been imported by KIST with the right to grant sub-license in Korea, KIST began to digest and improve the imported technology so as to be adapted to the particular requirements of Korean shipyards who wanted to utilize it, and then sub-licensed the improved technology to each of the firms with a much lower royalty than in the case of individual imports.

In Japan, a number of foundry firms competitively tried to import from the F.R.G. the Shell Mold Process patented in 1944, and the German exporter demanded royalties amounting to 100 million Yen. No fewer than 450 Japanese firms offered to import this process. The royalties were too high to be paid by any single firm, and an exclusive license to any single firm was problematic in view of the need to develop the foundry industry of Japan. As a means for solving this problem, the 450 firms formed the Shell Mold Process Association for joint purchase of the process on favourable conditions and terms. The Japanese government also supported the association, saying that the importation of the shell mold process would be allowed through the association only. The association then started negotiations with the German exporter and succeeded in obtaining the license with the initial royalty amounting to only 45 million Yen. It then sub-licensed its members to use the process with the initial royalty of only 100,000 Yen, one one thousandth of the 100 million Yen the German firm offered when Japanese firms separately negotiated the import.

6. Policy Support for Promotion of Technology Imports and Research and Development Activities

As discussed in Chapter 1, the basic goal of Korea's technology development policy is dual; digestion and absorption of imported technology for best applications to industries and promotion of research on modification and improvement of imported technology for development of better and more appropriate technology. To this dual end, the policy calls for increased investment in research and development for the promotion of research and development activities to achieve technological innovations by elevating the local capability of technological development and achieving technological self-reliance.

Between 1968 and 1977, Korea's research and development spending rose 16 fold to some US$230 million, 0.7 per cent of the GNP, and this rate rose to only 0.75 per cent in 1978, compared with the 2.0 to 3.0 per cent level of advanced countries. This means that Korea's research and development investment is still very low. If the Korean economy wants to reach the level of advanced economies through improvement of industrial structure and technological innovations, it must greatly increase research and development outlays.

The government-industry ratio in research and development investment was 68 versus 32 in 1971, and 48 versus 52 in 1977. This indicates that the leading role in research and development has moved from the government to industry. According to the government's long-range development program of science and technology, the government-industry ratio in research and development spending will be 40 versus 60 in the 1980s with the promotion of industrial research and development activities. If this program is successfully carried out, industries will play the major role in research and development activities, as in advanced countries, with the result of rapid development of industrial technology.

A balanced distribution of scientific and technological personnel with general level of skills is a crucial element for the development of both technology and economy. For this reason, the Korean government has set up specialized R&D institutions by industry which are wholly or partly government-financed; most big enterprises also have established or are establishing their own R&D institutions with some financial incentives provided by government. The main purposes for establishing such R&D institutions in public and private sectors, are as follows: One is to have scientific and technological personnel undergo competent technical training, and to produce a large number of scientists, engineers, and technicians so as to sufficiently meet the requirements of industrial development. The other is to prevent brain-drain of qualified technical manpower and indeed to recruit as many Korean scientists and engineers in foreign countries as possible for reverse brain-drain to make a direct contribution to R&D.

Particularly, as an effective plan for developing highly-qualified -technical manpower, the government established the Korean Advanced Institute of Science (KAIS) in the Seoul science complex. KAIS is a graduate school of basic & applied science and engineering, and produces capable graduate scientists and engineers, it seeks to modernize and upgrade Korean higher education, to undertake mission-oriented basic research of prime interest to the Korean industry and to foster the continuing progress and development of science and technology.

As far as basic research is concerned, most of universities and colleges in the country are implementing mission-oriented basic research projects with the research funds which come from government, industry, association, and schools themselves. In order to activate the mutual cooperative system between industry and academia, Korean Traders Association (KTA) set up Korean Traders' Scholarship Foundation (KTSF), which has been mainly engaged in providing finances to universities and colleges for their R+D activities for industry. The annual research funds supplied to universities and colleges by KTSF amount to about US$ 1 million.

In connection with industrial development policy, it might well be said that strengthening the competitiveness of small and medium industries by optimizing and modernizing the industrial structures is one of the most important and immediate tasks of developing countries in order to achieve a balanced development of the national economy as a whole. In response to this requirement, Korea Federation of Small Business was set up in 1962 with government funds, and it has been engaged in the busines of assisting small industries though consulting services and on-the-spot guidance on management improvement, technical training for technicians in the industries, and trouble-shooting of minor technical problems with the help of research institutions like KIST. Subsequently, the Small and Medium Industry Promotion Corporation (SMC) was established in January, 1979, in accordance with the Small and Medium Industry Promotion Act, as a comprehensive agency to implement the various national policies for the development of small and medium industries. SMC's funds mobilized as of the end of June, 1979 reach US$44 million, which are to be used for financial assistance of technology development, lease of facilities and equipment managerial and technical extention services for the promotion of cooperative, joint, and group projects among small and medium enterprises, and orientation and training activities for training extension service officers, enterpreneurs, intermediate management, and craftsmen. SMC will particularly emphasizes studies of the technical bottlenecks and weaknesses which the small and medium enterprises encounter and will entrust research and development projects to solve the technical problems to professional R&D institutions in the country. Since small and medium industries in developing countries in particular are lacking in capital manpower and technologies, it is very difficult, for the moment to expect that they will be able to implement R&D for solving their technological problems for themselves, and to achieve technological self-reliance on their own abilities immediately.

Large industries, however, have to be actively involved in the technology development activities because it is almost impossible to achieve the goal of technology development plans on a national basis without the active involvement of large industries in R&D activities.

Up to the 1960s, Korea's research and development activities had been chiefly the business of government and public research institutes. But with development of the economy and improvement of the industrial structure, along with the establishment of KIST in 1966, many specialized independent industrial laboratories were set up as mentioned earlier, and in 1977 there were 17 such non-profit independent applied research institutes in the country. These industrial laboratories are greatly contributing to the development of research and development activities both in quality and quantity so as to lay a solid foundation of scientific and technological development in the country.

As a result, the government's research and development investment concentrates largely on long-term projects requiring large sums, such as the development of new energy sources, including solar energy, tidal energy and wind energy, and the improvement of national welfare, including preservation of environment and improvement of health. These large scale projects are to be carried out in joint programs of government and public research institutes.

Policy measures the government undertaken in support of industries' dual effort of technology import and in-house research and development are briefly discussed in the following.

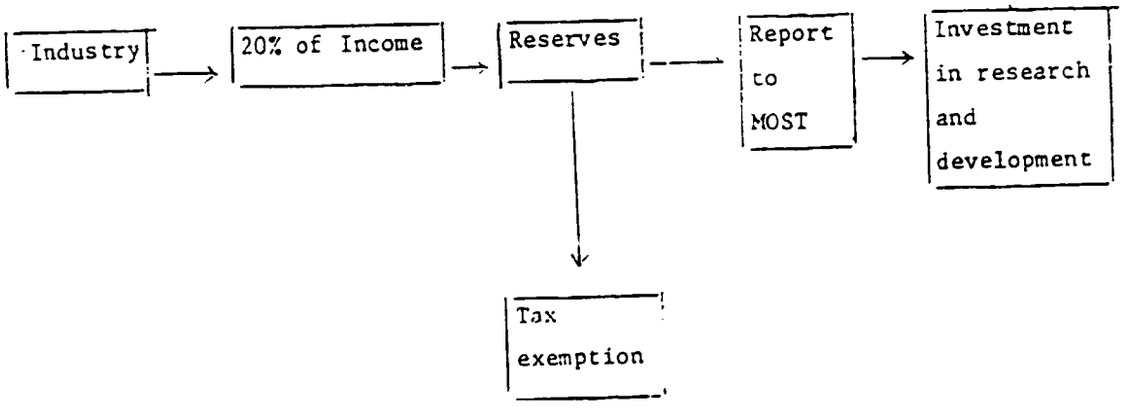
a) Tax Exemption and Financial Support Under Technology Development Promotion Law

The Technology Development Promotion Law (TDPL) is intended to promote the development of industrial technology and the digestion and improvement of imported technology for the dissemination of its results, with a view to promoting technology exports and strengthening industries international competitiveness so as to contribute to development of the national economy. The law provides the following incentives for industires to promote their technical levels.

First, under the law, expenses, for the development of technology, such as R&D spending for the development of new products and processes, research spending for the digestion and improvement of imported technology, technical information acquisition costs, technical training expenses, research equipment acquisition costs, sponsored research costs, expenses for petitioning and commercializing industrial property rights, etc. are recognized as tax deductible losses in income accounting. Where industry plans R&D activities in the future, they can reserve funds for investment in research and development, and under this system of technology development, need not pay taxes on these funds reserved for the development of new products and processes. In other words, industries can treat as non-taxable necessary expenses or losses from the funds reserved under this system and also receive with priority long-term low-interest loans from the government's fund for industrial development.

As shown in Fig. 6, the ceiling on reserve funds under this system is not larger than 20 per cent of the total income for the period in which the income is made or the taxation period of such income, and in case industries want to reserve funds for research and development investment under this system, they are required to fill the given application form and submit it to the Minister of Science and Technology (MOST). The funds reserved under this system must be invested in research and development within two years after the end of the above-mentioned taxation period.

Fig. 6. Technology Development Reserve Funds



Second, where industries establish their own laboratories, eight per cent of the acquisition cost of facilities (10 per cent if the facilities are procured in the country) is exempted from corporate taxes and income taxes. In addition, non-taxable special depreciation reserves are recognized on a one time basis for up to 50 per cent of the acquisition cost of test and analysis facilities for use in technology development. Moreover, industries building research facilities and acquiring test equipment can get priority long-term low-interest loans for such use.

Under this taxation and financial support system, 19 industries have already established their own laboratories and 38 more are now planning to build laboratories. Industrial laboratories currently in operation by area are two in machinery, four in electronics and communications, three in chemicals, two in food, two in textile and three in pharmacy.

Third, expenses for the application of research results on a commercial basis are also untaxable. For instance, up to eight per cent of the acquisition cost of facilities directly used in commercialization of new ideas (10 per cent in case the facilities are procured in the country) is exempted from corporate taxes and income taxes; such non-untaxable costs are applicable when patented new ideas or KIST research results are commercialized for the first time. Such commercialization should be recognized by the Minister of Science and Technology in consultation with the Minister of Finance.

Fourth, the application of research results on a commercial basis involves many risks. For instance, whether the application will be successful is especially risky, along with the marketability. To reduce such risks, the import of similar technology should be restricted for the time being, and marketing support should be provided. This would promote industries' will to develop technology.

In other words, there should be measures of protecting industries manufacturing new products developed locally so as to promote the commercialization of research results and new ideas. The new products here mean the products derived from locally developed new technology or from research on modifications and improvements of imported technology. The protective measures the government has already taken for the commercialization of new ideas and research results include restrictions on the import of similar products and the local manufacture of such products by other industries for a fixed period so as to guarantee the return of investment in research and commercialization as well as an appropriate profitability of the new products. In addition, the measures provide special financial support for applications of new ideas on a commercial level.

In connection with the above-mentioned measures in favor of industries investing in research and development, an actual case that happened a few years ago is discussed below.

A certain industry developed a polyester film (base film) in a joint program with KIST. The project proceeded so smoothly that a pilot plant was built for techno-economics test of the developed product. In view of the increasing local demand for the film and a bright prospect of export for the product, the industry came to worry that other industries might import the similar film technology for production, and then in September 1978 it asked the Minister of Science and Technology to protect under TDPL the film manufacturing process it developed with KIST from possible imports of the similar process. Then as expected, another industry submitted to the Minister of Commerce and Industry an application for the import of polyester film technology, but the Minister turned down the application for the reason that the technology had already been announced by the Minister of Science and Technology as a locally developed process.

As a result, the former industry was to monopolize the production of polyester film for four years under the said law, and it is now producing 5,000 tons a year for exports to Japan and Hongkong, as well as for the domestic market.

Fifth, favors are also given for the application of government-sponsored research results on a commercial basis. Some government-sponsored research projects have resulted in industrial property rights, and among such rights are those which can be applicable on a commercial basis. For such rights, the license is granted free of charge wholly or partially to the institute which developed them or those who jointly invested with the government in the research. Such favors regarding industrial property rights are designed to encourage industries to promote research and development activities through increased investment in the development of new products and processes.

b) Tax Holidays Under FCIL

First, under the Foreign Capital Inducement Law, full holiday of corporate tax and income tax is granted for royalties on imported technology in the first five years after the import and half holiday (50-per cent reduction) in three years thereafter. In addition, fees paid to foreign experts invited to the country under a technology import contract approved under the Foreign Capital Inducement Law are exempted from earned income taxes.

Second, as a means to promote foreign investment in the country, foreign investors are granted exemption or reduction of income taxes, corporate taxes and property taxes from the date of the first tax assessment as provided for under the respective tax laws. They are also granted a 50-per cent reduction of acquisition tax on the shares they hold from the date of registration of such shares.

c) Financial Support in Building Science and Technology Base

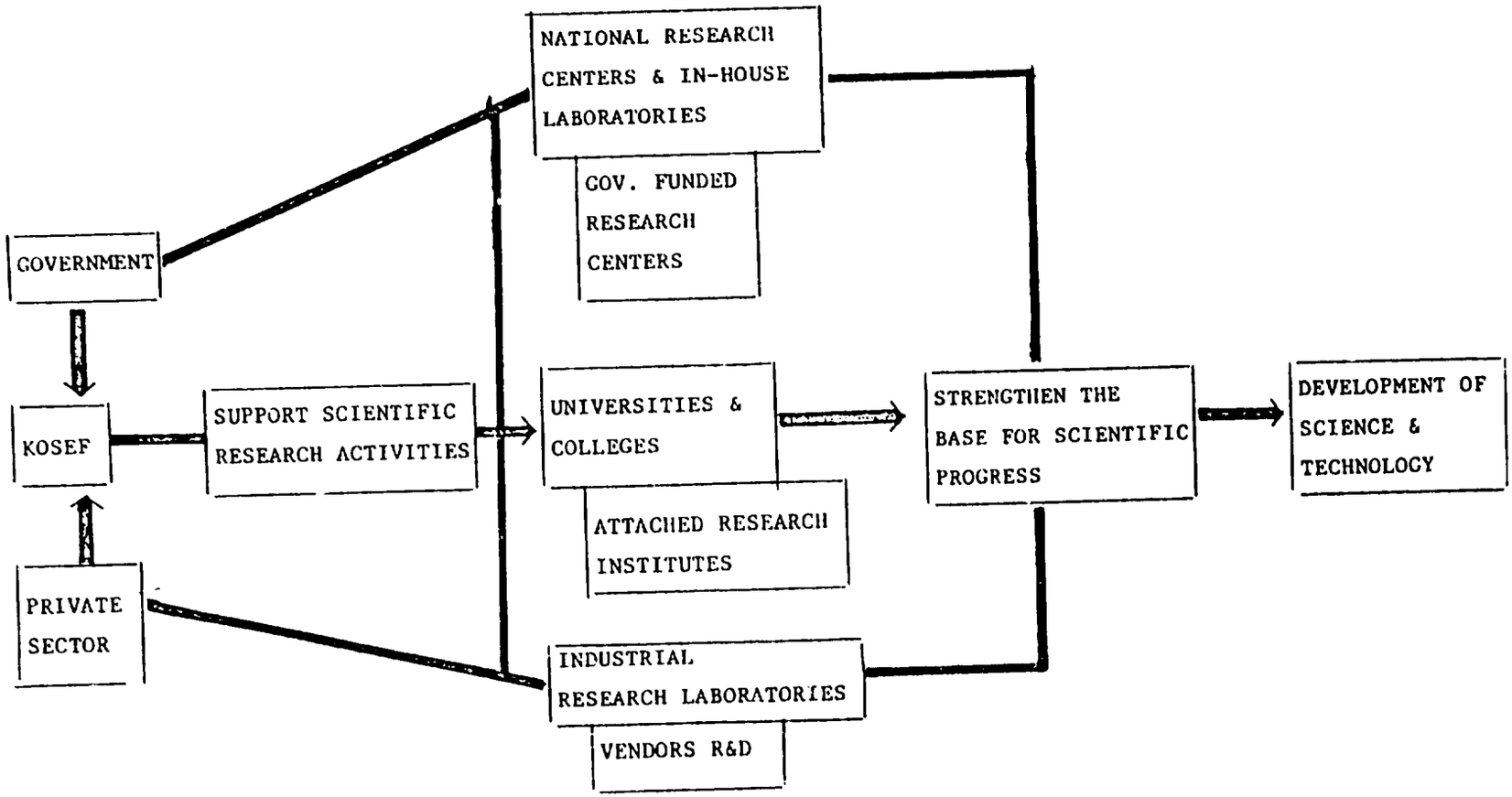
First, the Korea Science and Engineering Foundation (KOSEF) was established in May 1977 to help build a solid base of science and technology in the country. This foundation intensively supports such joint research programs of universities, research institutes and industries as help develop profound scientific knowledge needed in the development of technology to meet far-reaching national needs. It also gives scholarship funds to selected graduate students of science and engineering colleges (preferably those studying for a Ph. D. degree) to help develop higher technical manpower and research and development potentials of the country.

In addition, the foundation gives relocation and settlement funds to overseas Korean scientists and engineers returning home for contribution to the development of technology in the country.

As seen in Fig. 7, the foundation gives research funds to government and public research institutes, universities and industrial laboratories to support their basic and applied research programs conducive to the development of science and technology.

Especially, it intensively supports the research programs necessary in building a base for scientific progress.

Fig. 7 Function of KOSEF for Korean Scientific Development

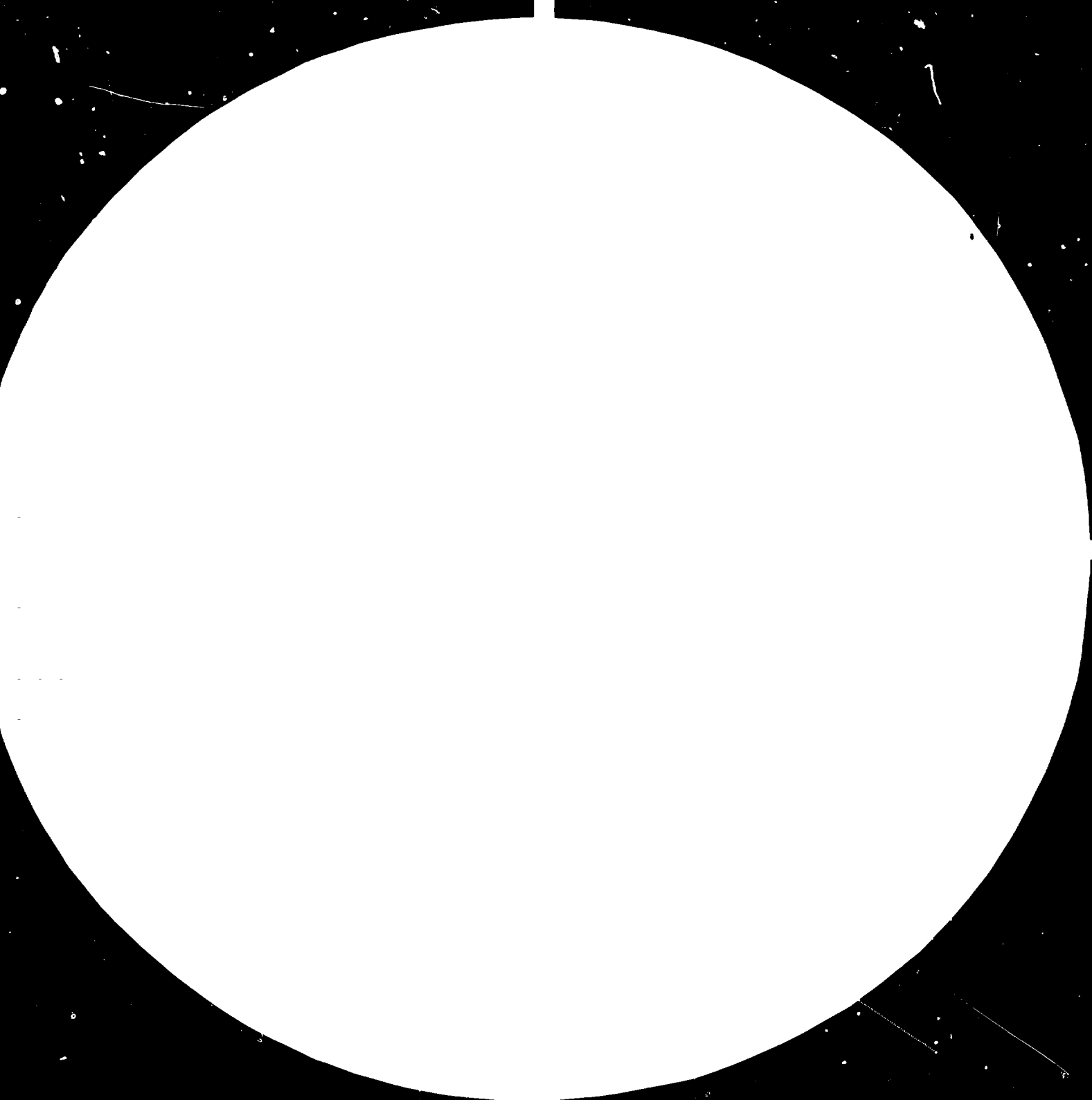


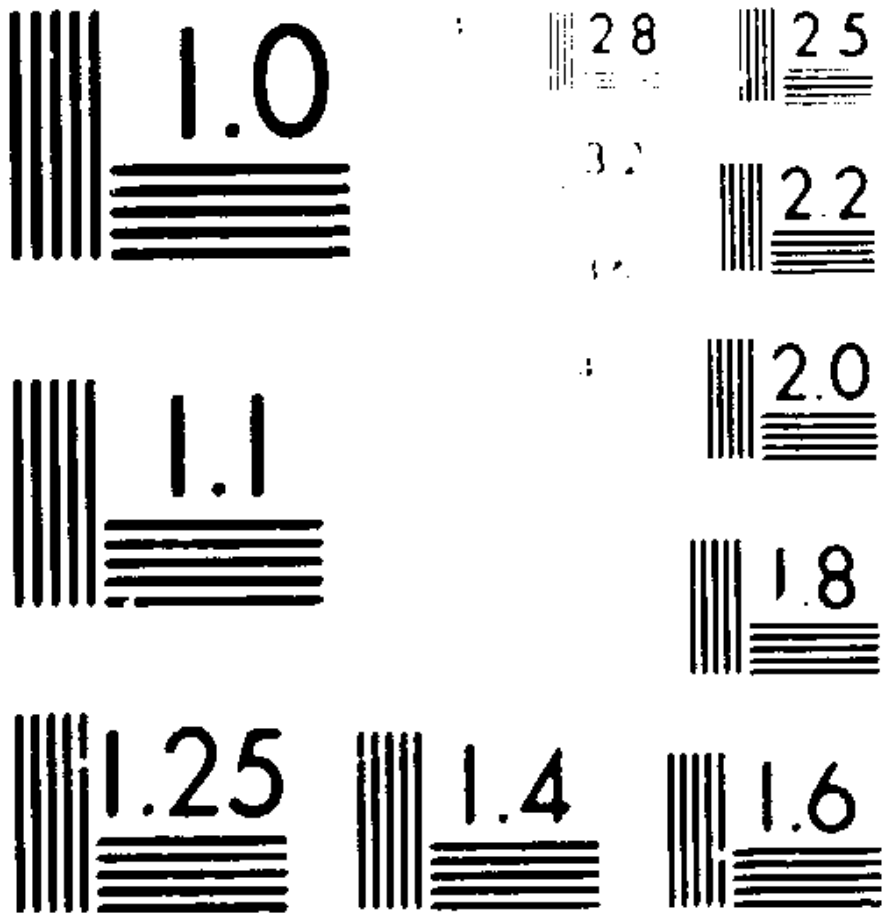
In 1979, the foundation gave a total of 965 million won(about US$2 million) in support of research and development activities--493 million won in support for basic and applied research, 98 million won for attracting overseas Korean scientists and engineers to the country, 173,667,000 won in support of international research programs and 200 million won for other programs.

Second, the government is planning to establish a revolving fund for technology development to actively support industries' technological development programs. At present, support to industries is concentrated on capital funds for construction of facilities and procurement of equipment. When the projected revolving fund is established, industries can get long-term low-interest loans from this fund for technology imports, research and development programs and development of software such as engineering. This fund is designed to encourage industries to play a major role in research and development. By so doing, research results will be directly applied for commercial purposes so as to maximize the effect of research and development investment. To provide for the fund, the government is now negotiating with the World Bank on possible loans, and studying the feasibility of the fund plan under UNDP's financial support.

APPENDIX

81.06.11

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1. Status of Approval, Cancellation, Expiration in Imports of Foreign Technology by Field

(As of Dec. 31, 1978)

Unit : Cases, $1,000

Field	Approved	Canceled	Expired	Royalty payment
Total	1,210	38	416	256,663.9
Agriculture & Livestock	7	—	4	3,239.5
Food	15	—	13	3,125.3
Pulp and Paper	13	1	3	7,207.6
Textile	21	—	6	2,674.7
Chemical Textile	28	2	12	16,554.8
Ceramic & Cement	31	3	9	3,417.3
Oil Refine & Chemical Ind.	209	4	73	83,822.3
Drug	31	2	22	1,597.8
Metal	114	6	42	40,988.2
Electronic & Electrical Equip.	231	9	93	26,034.6
Machinery	356	13	83	31,225.2
Shipbuilding	30	3	8	7,612.8
Communication	37	—	17	6,011.2
Electricity	27	—	9	14,853.0
Construction	14	2	3	3,141.5
Others	46	3	19	5,161.1

Source: EPB

2. Status of Approval in Imports of Foreign Technology by Nation

(As of Dec. 31, 1978)

(Unit : Cases)

Year \ Nation	Total	U.S.A.	Japan	F.R.G.	England	France	Others
Total	1,210	282	717	52	33	20	106
(Ratio)	(100.0)	(23.3)	(59.2)	(4.3)	(2.7)	(1.6)	(8.9)
62 - 66	31	13	10	4	-	1	3
67 - 72	326	68	232	9	3	1	13
73	67	17	46	2	—	1	1
74	86	12	62	2	3	2	5
75	99	23	58	1	5	2	10
76	131	30	76	5	7	—	13
77	173	50	79	16	3	5	20
78	297	69	154	13	12	8	41

Source : EPB

3. Foreign Technology Approval by Field and Year

(As of Dec. 31, 1978)

Unit : Cases

Field \ Year	Total	62-66	67-72	73	74	75	76	77	78
Total	1,210	31	326	67	86	99	131	173	297
Agriculture & Livestock	7	—	6	—	—	—	—	—	1
Food	15	2	6	3	1	—	2	—	1
Pulp and Paper	13	—	5	—	2	—	1	3	2
Textile	21	5	3	2	—	3	4	2	2
Chemical & Textile	28	2	9	5	1	1	3	1	6
Ceramic & Cement	31	—	10	2	3	2	2	3	9
Oil Refining and Chemical Ind.	209	5	69	9	16	20	23	25	42
Drug	31	1	22	2	1	—	—	1	4
Metal	114	1	27	9	9	14	12	17	25
Electronic & Electrical Equip.	231	5	72	16	19	17	24	31	47
Machinery	356	6	67	12	22	30	42	60	117
Shipbuilding	30	—	3	3	1	3	1	7	12
Communication	37	3	15	1	1	3	5	1	8
Electricity	27	—	2	—	2	1	4	8	10
Construction	14	1	2	—	1	—	3	3	4
Others	46	—	8	3	7	5	5	11	7

Source : EPB

4. Foreign Technology Approval by Nation and Field

(As of Dec. 31, 1978)

Unit : Cases

Year \ Nation	Total	U.S.A.	Japan	F.R.G.	England	France	Others	Ratio (%)
Total	1,210	282	717	52	33	20	106	
(Ratio)	(100.0)	(23.3)	(59.2)	(4.3)	(2.7)	(1.6)	(8.9)	(100.0)
Agriculture & Livestock	7	5	2	—	—	—	—	0.6
Food	15	7	6	—	—	—	2	1.2
Pulp and Paper	13	6	5	1	—	—	1	1.1
Textile	21	14	4	1	—	—	2	1.7
Chemical & Textile	28	5	21	—	—	—	2	2.3
Ceramic & Cement	31	5	20	3	2	—	1	2.6
Oil Refine & Chemical Ind.	209	49	129	4	6	2	19	17.3
Drug	31	8	12	4	2	1	4	2.6
Metal	114	21	69	1	5	2	16	9.4
Electronic & Electrical Equip.	231	48	163	4	1	2	13	19.1
Machinery	356	64	222	21	13	8	28	29.4
Shipbuilding	30	5	7	2	3	4	9	2.5
Communication	37	12	20	3	—	—	2	3.1
Electricity	27	13	9	4	—	—	1	2.2
Construction	14	9	2	—	1	—	2	1.1
Others	46	11	26	4	—	1	4	3.8

Source : EPB

5. Foreign Technology Payment by Field and Year

(As of Dec. 31, 1978)

Unit : $1,000

Year / Field	Total	Approval	62-66	67-72	73	74	75	76	77	78	Ratio (%)
Total	256,663.9	1,210	777.3	26,520.4	11,489.9	17,791.0	26,540.5	30,423.4	58,056.0	85.065.4	100.0
Agriculture & Livestock	3,239.5	7	—	717.3	199.2	154.7	465.6	503.8	408.2	790.7	1.3
Food	3,125.3	15	21.0	291.9	231.7	483.5	642.2	369.2	651.1	434.7	1.2
Pulp and Paper	7,207.6	13				7.8	69.2	34.7	699.2	6,396.7	2.8
Textile	2,674.7	21	148.0	120.0	70.0	103.2	77.5	145.4	301.4	1,709.2	1.0
Chemical & Textile	16,551.8	28	—	1,840.5	870.3	732.0	3,018.1	2,239.7	4,123.9	3,727.3	6.5
Ceramic & Cement	3,417.3	31	—	343.5	212.4	159.1	127.1	198.5	618.6	1,758.1	1.3
Oil Refining and Chemical Ind.	88,822.1	209	340.4	12,200.9	3,210.0	4,430.8	5,912.5	6,536.8	21,806.5	29,384.4	32.7
Drug	1,597.8	31	—	278.0	103.7	298.8	284.0	219.9	261.0	152.4	0.6
Metal	40,988.2	114	—	1,939.4	1,992.8	5,343.7	5,303.6	9,326.6	6,438.6	10,643.5	15.9
Electronic & Electrical Equip.	26,034.6	231	80.0	2,874.4	1,298.6	1,635.7	2,981.7	3,731.4	7,028.0	6,204.8	10.2
Machinery	31,225.2	356	—	1,687.6	1,925.5	2,296.0	4,674.6	3,982.8	8,142.8	8,515.9	12.2
Shipbuilding	7,612.8	30	—	870.0	879.0	1,226.0	1,301.7	814.3	1,002.1	1,519.7	3.0
Communication	6,011.2	37	185.9	1,971.2	413.4	627.0	628.4	1,205.5	518.4	461.4	2.3
Electricity	14,853.0	27	—	1,274.2	—	—	720.0	764.8	3,414.4	8,679.6	5.8
Construction	3,141.5	14	2.0	99.0	—	—	147.2		1,741.9	1,151.4	1.2
Others	5,161.1	46	—	12.5	83.3	92.7	187.1	350.0	899.9	3,535.6	2.0

Source : EPB

6. Foreign Technology Payment by Nation and Year

(As of Dec. 31, 1978)

Unit : $1,000

Nation / Year	Total	U.S.A.	Japan	F.R.G.	France	Others
Total	256,663.9	71,057.7	117,110.6	13,602.7	3,122.8	51,770.1
(Ratio)	(100.0)	(27.7)	(45.6)	(5.3)	(1.2)	(20.2)
1962 - 1966	777.3	553.1	—	194.2	—	30.0
1967 - 1972	26,520.4	11,009.4	10,452.7	3,068.4	—	1,989.9
1973	11,489.9	3,642.5	5,754.7	1,148.2	—	944.5
1974	17,791.0	4,178.8	9,985.7	1,641.4	373.3	1,611.8
1975	26,540.5	3,991.5	16,651.7	1,750.2	867.3	3,279.8
1976	30,423.4	6,259.5	20,850.3	401.0	333.7	2,578.9
1977	58,056.0	17,221.6	25,436.9	2,556.6	483.8	12,357.1
1978	85,065.4	24,201.3	27,978.6	2,842.7	1,064.7	28,978.1

Source : EPB

7. Trend of Investment for Science and Technology

Unit : 1,000 Won

Classification \ Year	1973	1974	1975	1976	1977	1978
A. Total Jnvestment for Sci. and Tec.	18,396,602	43,329,824	49,255,074	70,084,345	123,044,830	171,340,896
B. R&D Exp.	15,628,482	38,182,078	42,663,725	60,900,037	108,285,664	152,418,341
Funds from Gov't	8,271,728	25,051,196	28,458,760	39,461,581	51,705,277	74,447,145
Private Funds	7,356,754	13,130,882	14,204,965	21,438,456	56,580,387	77,971,196
Gov't : Private	53 : 47	66 : 34	67 : 33	65 : 35	48 : 52	49 : 51
C. Other Investment for Sci. and Tec. by Gov't	2,768,120	5,147,746	6,591,349	9,184,308	14,759,166	18,922,555
D. (GNP Billion Won)	5,238.30	7,332.50	9,792.85	13,272.59	17,021.37	22,917.60
A/D (%)	0.35	0.59	0.50	0.53	0.72	0.75
B/D (%)	0.30	0.52	0.44	0.46	0.64	0.67

Source : MOST

Note: 1) A=B+C

2) refers to government expenditure for science and technology which are not included in R & D funds from governments, such as expenditure for administration of MOST, Government Computer Center, Office of Rural Development, Office of Industry Advancement Administration and investment for education outside facilities of government and public colleges' by Ministry of Education.

3) A/D ratio and B/D ratio are changed by the revision of GNP (D)

8. Trend of R + D Expenditures and Researchers by Organization

	Research Institutes			Universities and Colleges			Companies		
	No. of Institutes	Researchers	R&D Exp. (1,000Won)	No. of Institutes	Researchers	R&D Exp. (1,000Won)	No. of Institutes	Researchers	R&D Exp. (1,000Won)
1969	96	2,413	8,445,790	80	2,142	331,506	104	782	996,689
1970	105	2,458	8,851,762	85	2,011	371,132	107	1,159	1,324,859
1971	106	2,477	8,795,983	81	1,918	572,173	118	925	1,298,555
1972	120	2,703	9,543,057	66	1,747	348,566	133	1,149	2,136,524
1973	127	2,949	11,840,999	74	1,711	366,908	167	1,405	3,420,575
1974	113	2,894	21,862,222	101	2,144	6,520,716	242	2,552	9,799,140
1975	104	3,086	28,139,243	146	4,534	2,181,819	303	2,655	12,342,663
1976	118	3,592	43,780,139	171	4,811	1,978,657	278	3,258	15,141,241
1977	132	4,039	61,088,513	183	4,836	5,482,211	311	3,896	41,714,940
1978	136	4,724	78,072,931	220	5,721	20,543,370	291	4,304	53,802,040

Source : MOST

9. Trend of R + D Expenditures and GNP

Classification / Year	GNP (Billion Won)	R&D Exp. (1,000 Won)	Researchers No. Persons	R&D Expenditures Per Researchers (1,000 Won)	Ratio to GNP (%)
1969	2,081.52	9,773,985	5,337	1,831	0.46
1970	2,684.02	10,547,753	5,628	1,874	0.39
1971	3,294.83	110,666,711	5,320	2,005	0.32
1972	4,028.88	12,028,147	5,599	2,148	0.30
1973	5,238.30	15,628,482	6,065	2,574	0.30
1974	7,332.50	38,182,078	7,595	5,031	0.52
1975	9,792.85	42,663,725	10,275	4,152	0.44
1976	13,272.59	60,900,037	11,661	5,223	0.46
1977	17,021.37	108,285,664	12,771	8,479	0.64
1978	22,917.60	152,418,341	14,749	10,334	0.67

Source : MOST

10. R + D Expenditures by Source

(Unit : 1,000 Won)

Source / Organization	No. of Institutes	Total	Gov't	Private	Foreign
Total	647	152,418,341	73,722,475	77,971,196	724,670
Research Institutes	136	78,072,931	61,640,742	15,985,266	446,923
- Gov't & Public	106	35,446,306	35,387,806	3,936	54,564
- Non-Profit Organizations	30	42,626,625	26,252,936	15,981,330	392,359
University & College	220	20,543,370	11,922,227	8,429,140	192,003
- Gov't & Public	87	13,349,214	11,426,670	1,884,991	37,553
- Private	133	7,194,156	495,557	6,544,149	154,450
Companies	291	53,802,040	159,506	53.556,790	85,744

Source : MOST

11. Research and Development Institutions

Institutions	Address	Activities
KORSTIC (Korea Scientific & Technological Information Center)	206-9, Cheong Ryang Ri-Dong, Dong Dae Mun-Ku, Seoul	1. Promotion of Korean science and technology, and the development of national industry. 2. Collect, process and store scientific and technical information comprehensively and systematically, and disseminate necessary information to industries, academic circles, R & D institutes, government organizations, and individuals on a non-profit basis.
KDI (Korea Development Institute)	207-41, Cheong Ryang Ri-Dong, Dong Dae Mun-Ku, Seoul	1. Assist the government in making strategic economic policy decisions. 2. Conduct from basic empirical and historical analysis as well as purely theoritical studies. 3. Serve as a bridge between scholarship and public policy, bringing new knowledge to the decision makers and affording scholars a better insight into policy issues.
KAERI (The Korea Atomic Energy Research Institute)	P.O. Box 7, Cheong Ryang Ri, Seoul	1. Atomic energy research and development. 2. Research on environmental protection and control. 3. R & D on nuclear power technology and nuclear fuel energy. 4. R & D on the use of radiation and radioisotopes. 5. Research in life sciences. 6. Basic research in physics, chemistry and biology.

Institutions	Address	Activities
KAIS (The Korea Advanced Institute of Science)	P.O. Box 150, Cheong Ryang Ri, Seoul	1. Graduate school of applied science and engineering. 2. Produce capable graduate scientists and engineers, modernize and upgrade Korean higher education, to undertake mission-oriented basic research of prime interest to the Korean industry and to foster the continuing progress and development of science and technology.
KIET (Korea Institute of Electronics Technology)	76-561, Yek Sam Dong, Kang Nam-Ku, Seoul	1. Support the specialization and the enhancement of the technological level of the electronics industry. 2. Develop marketable products of precision electronic items. 3. Help the industry meet the rapidly increasing domestic demand for electronic products. 4. Assist the industry in understnading severe international competition in the electronic export market.
KTRI (Korea Telecommunications Research Institute)	P.O. Box 125, Gwang Hwa Mun, Seoul	1. Conduct professional research and development activities on technologies of communication equipment, and electronic communication system operations to improve overall communication technologies.

Institutions	Address	Activities
KERTI (Korea Electric Research & Testing Institute)	P.O. Box 7537, 11-4 Soo Pyo-Dong, Choong-Ku, Seoul	1. Test and research domestic electrical equipment and heavy electrical machinery to improve the technology of electric industry.
KSRI (Korea Standards Research Institute)	1, Do Lyong-Ri, Tandong-Meon, Daeduk-Gun, Chungnam	1. Central authority on all the nation's standards. 2. Provide the essential basis to foster the scientific, technological and industrial development of the nation.
KRICT (Korea Research Institute of Chemical Technology)	100, Jang Dong-Ri, Tandong-Meon, Daeduk-Gun, Chungnam	1. Conduct professional tests and research on scientific technology of Chemistry and disseminate the technology to industries to improve overall technologies.
KRIS (Korea Research Institute of Ships)	171, Jang Dong-Ri, Tandong-Meon, Daeduk-Gun, Chungnam	1. Central research institute for the shipbuilding industry. 2. Conduct investigations and research import, modify and distribute advanced technology for and with the shipbuilding industry.

Institutions	Address	Activities
KORDI (Korea Ocean Research & Development Institute)	76-561, Yek Sam-Dong, Kang Nam-Ku, Seoul	1. Conduct basic practical research and development on the use of oceanic resources.
ADD (Agency for Defense Development)	Cheong Ryang Ri, Dong Dae Mun-Ku, Seoul	1. Conduct research and development on military arms and equipment for national defense.
KIMM (Korea Institute of Machinery and Metals)	222-13, Gu Ro-Dong, Young Deung Po-Ku, Seoul	1. Test and inspect the quality of produced machinery and metal product to determine if they meet the Korean Standard or not. 2. Conduct research and development on machinery and metals to establish effective basis to foster industrial development.

12. Consulting and Engineering Organizations

Organization	Address	Activities
Korea Engineering Co., Ltd.	1-6, Yeoui-Dong, Yong Deung Po-Ku, Seoul, Korea	Consultation and technical service in all engineering fields.
Chon Engineering Co., Ltd.	108-4, Susong-Dong, Chong Ro-Ku, Seoul, Korea	Consultation and technical service in all engineering fields.
Dae Lim Engineering Co., Ltd.	146-12, Susong-Dong, Chong Ro-Ku, Seoul, Korea	Consultation and technical service in civil & construction engineering.
Dae Woo Engineering Co., Ltd.	286 Yang-Dong, Chung-Ku, Seoul, Korea	Consultation and technical service in civil, construction, and electric.
Sam Hwan Engineering Co., Ltd.	98-78, Wooni-Dong, Chong Ro-Ku, Seoul, Korea	Consultation and technical service in mechanical & construction engineering.
Korea Chamber Of Commerce and Industry	111, So Gong-Dong, Chung-Ku, Seoul, Korea	Consulting services on law, tax, accounting, industrial property rights, technology transfer, etc.
Korea Management Association	48-20, 2 Ka, Jeo-Dong, Chung-Ku, Seoul, Korea	Consulting services on management improvement.

Organization	Address	Activities
Korea Federation Of Small Business	138-1, Gong Pyung-Dong, Chong Ro-Ku, Seoul, Korea	Consulting service in management, technical training and technology development.
Small and Medium Industry Promotion Corporation	151-11, Sang Lim-Dong, Chung-Ku, Seoul, Korea	Consulting service in management, technical problem, financing, training of technical manpowers, etc.
Technology Transfer Center	148 Anguk-Dong, Chong Ro-Ku, Seoul, Korea	Consulting information services on technology transfer.