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INTELLIGENCE MEMORANDUM

South Korea: Industrial Technology Development Programs

Key Points

-- The Western nations recently have begun to view South Korea as an "advanced developing country," and Seoul too believes that its economy is approaching a decisive turning point.

  -- Since 1962 the country's development strategy has been export-led growth based on labor-intensive light industry.

  -- Korea now intends to shift the economy to technology-intensive industries with growing emphasis on the export of machinery, electronics, and heavy industrial goods such as autos.

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-- To achieve this goal, Korea must first improve its industrial technology.

  -- The country is a long way from innovative technology development, but planners are confident Korea will achieve substantially greater self-sufficiency in technology over the next decade.

  -- Korea's immediate goal is to make its goods more export competitive in Western markets; in the longer term Seoul hopes to reduce expenditures for foreign licensing rights.

-- Few business enterprises as yet have their own research and development programs, although industry is collectively assuming greater funding responsibility for government-initiated programs.

-- Planners in Seoul see technology development as a problem that requires the improvement of both labor and research institute resources.

  -- By 1981, Korea anticipates training 430,000 more skilled workers and establishing a network of specialized research organs that will begin to develop technology indigenously.

  -- For near-term advances, however, Seoul is banking on the accelerated import of foreign technology.

-- Korea's technology development efforts have not been without some rough patches, but the program on the whole has been successful.

Basic Policy Directions

Although they are still a long way from the independent development of innovative technology, the South Koreans are embarked on an ambitious program of upgrading the quality of their industrial technology. Seoul anticipates that this program will lead to greater technological self-reliance over the next decade, which in turn will pave the way for the country's planned transition from an economy built on labor-intensive light industry to one concentrating on skill- and technology-intensive heavy industry. The restructuring of the economy is now in its early stages of execution under a 15-year development plan. It is designed to cope with a changing international trade climate, in particular the movement toward greater protectionism, as well as with changes in Korea's comparative trading advantages stemming from steeply rising wages.

In upgrading their industrial technology, the Koreans also seek to:

-- Avoid problems caused by increasingly stringent commercial controls applied abroad to the export of advanced technology. Seoul wants to increase its freedom of action, especially in the application of defense industry technology.

-- Meet the quality standards of the international community so as to strengthen the export appeal of Korean goods.

-- Reduce expenditures for technology imports. Between 1962 and 1975, Seoul paid a total of $83.1 million in royalties for foreign technology. The annual outlay rose to $30.4 million in 1976 and to $42.1 million last year.

South Korea defines technology development goals within the framework of its overall economic plans, projecting expenditures first on a five-year schedule and thereafter on a yearly basis. The goals outlined and the measures

proposed to implement them have become progressively more ambitious. So too has the financial commitment. The Fourth Five-Year Plan (1977-1981) calls for raising the ratio of research and development (R&D) expenditures to gross national product (GNP) from 0.5 to 1.0 percent.

Investment Projections for Manpower Development and Science Programs, Combining Government and Industry Expenditures*

	Technical Training	Research Programs
Second Plan (1967-1971)	$98.37	$72.58
Third Plan (1972-1976)	$345.64	$244.88
Fourth Plan (1977-1981)	$692.98	$420.12

Korean planners view technology development as a dual challenge that requires separate but interrelated programs for improving labor skills and increasing the resources of research institutions. Long-term goals are kept in mind, but implementing measures are geared to more immediate targets. In the area of manpower development, these short-term targets include:

-- Training technicians and craftsmen to meet present industrial needs and, by engaging larger segments of the work force in high-productivity labor, advance social welfare.

* *Investment in defense-related research is not included. It should be noted that actual expenditures may fail to match five-year plan projections. Figures are in million dollars at 1975 prices.*

-- Developing standards of advanced education to the point where Korea is generally self-sufficient in training its own scientists and is able to reverse the "brain drain."

The major share of investment in technology development will be in the establishment of specialized science institutes, to both facilitate the introduction of advanced foreign technology and undertake independent developmental research. For these R&D efforts to be successful, however, Korea must first rationalize the structure of industry to achieve greater economies of scale and more efficient production methods, internationalize its patents system, strengthen its standardization systems, and expedite the exchange of technical information with other countries. Liberalized guidelines for the import of technology are meant to give impetus to all these endeavors.

In the current plan period (1977-1981), training labor for, and improving technology standards of, the nuclear energy, resource utilization, metallurgical, semi-conductor, and chemical industries have top priority.

Government Versus Private Initiative

The most prominent feature of the Korean technology development program is the dominant role played by the government in initiating programs. Seoul is seeking to transfer more responsibility to the private sector, but the shift is so far mostly limited to the assumption of greater costs by industry.

Investment Projections for Manpower Development and Science Programs, Showing the Balance of Government and Industry Expenditures

	Technical Training		Research Programs	
	Government	Industry	Government	Industry
Second Plan (1967-1971)	100%	0%	100%	0%
Third Plan (1972-1976)	55.9%	44.1%	60.7%	39.3%
Fourth Plan (1977-1981)	77.4%	22.6%	55.7%	44.3%

Investment Projections, Showing the Division of Government and Industry Expenditures*

	Technical Training		Research Programs	
	Government	Industry	Government	Industry
Second Plan (1967-1971)	$98.37	0	$72.58	0
Third Plan (1972-1976)	$193.09	$152.52	$148.59	$96.27
Fourth Plan (1977-1981)	$536.33	$156.65	$233.90	$186.21

* *In million dollars, at 1975 prices.*

Prodded by Seoul, major enterprises are expanding in-plant vocational training programs, extending technical aid to suppliers, and sponsoring the establishment of technical high schools and engineering colleges modeled after those in Europe. The government usually takes the first step in "inviting" corporate groups to establish sister relations with technical schools; it also solicits funds for these facilities from foreign governments. Again at Seoul's behest, business is assuming collective financial responsibility for the operation of several new research institutes.

Unilateral corporate initiative in the research and development field is as yet quite limited. According to the Ministry of Commerce and Industry, Korean enterprises spent only $48 million on research related to technological and managerial innovation in 1977. These sums will probably climb as high economic growth continues, industries most in need of technological improvement--such as the fragmented machine tool sector--are streamlined, and competition in the domestic market sharpens. Artificially depressed consumer demand and Seoul's policy of limiting competition among Korean corporations that operate or sell abroad have thus far reduced the incentive for R&D competition among local firms.

The case of the Lucky Group, a newcomer to the "Fortune 500" list of non-US industrial firms this year, appears to illustrate the importance of domestic demand to corporate investment in R&D. Lucky is probably the most domestically oriented of the Korean conglomerates, monopolizing several key areas of consumer production. The group, with combined sales of $1.7 billion in 1977, spends about $4 million on research in the electronics and chemical fields, a sum that is small by Western but immense by Korean standards. Apparently some 600 of the group's 36,000 employees are engaged in R&D work. The group still relies on imported technology for most of its product-line development, however, demonstrating the current limits to Korea's technological advances.

To encourage private investment in research, Seoul will extend financial and tax benefits to enterprises that

follow the Lucky example. The government will also protect developers of selected new technologies by controlling for a period the import, as well as domestic reproduction, of items based on that technology.

Technical Training Programs

Although private enterprise is expected to train two-thirds of the 430,000 additional skilled workers Seoul estimates will be needed by 1981, massive investment in new technical schools--including the establishment of 12 technical colleges--will swing the percentage of spending for training programs sharply back in the direction of the central government. A recently negotiated loan from the US Export-Import Bank is slated to cover some of these costs, as is financial aid from West Germany, France, Belgium, and Japan. The funds are part of the $49.3 and $91.6 million in foreign capital that the Economic Planning Board is counting on to help meet technical training and research program costs, respectively, in the fourth plan period.

Export-Import Bank funds, together with a loan from the International Bank for Reconstruction and Development, will be used to expand the facilities of the Korea Advanced Institute of Science (KAIS). This institute, founded in 1971 with support from AID, is Seoul's major hope for producing the applied science and engineering specialists required in a rapidly industrializing society. In exchange for generous scholarship support, students at KAIS are obligated to serve the Korean industrial or scientific research community for three years after graduation. This requirement, combined with the institute's repatriation of staff members, nearly all of whom hold doctoral degrees from the US, will help significantly in keeping top scientific talent at home.

KAIS expects to grant its first ten doctoral degrees this autumn, increasing the number to 60 in 1981 and to 500 by the late 1980s or early 1990s. The masters program, which graduated 135 students this year, is expected to double or even triple in size within a few years. The institute's curriculum is tailored to meet industrial development needs,

and students at KAIS receive on-the-job training. KAIS recently set up a program in industrial electronics engineering in response to private sector demand, and it expects to open a nuclear engineering division soon.

Science and Technology Programs

The establishment of research institutes which are to begin the independent development of industrial technology keynotes current science and technology programs. These new research institutes--along with Korea's existing engineering consultative services and information control banks--will serve business on an industry-wide basis.

In the mid-70s, the Ministry of Science and Technology (MOST) sought to bring these dozen or so new institutes under its control by having them located in the science city being constructed near Taejon. In fact, not all of these specialized institutes will operate there. Some are being located close to the specific industries they will serve, and a number have been transferred to the jurisdiction of ministries other than MOST. The new Metallurgical and Machine Industry Institute, for example, will be established in the Changwon Mechanical Industrial Estate outside Masan, while the Electronics Technology Institute is going into the Kumi Semi-Conductor Industrial Estate near Taegu.

Despite this setback, MOST retains control of the centerpiece of the country's industrial R&D program, the Korea Institute of Science and Technology (KIST). The institute was founded in early 1966 as a result of a commitment by President Johnson to help the Koreans develop their technology base. It undertakes research in applied science and industrial technology, conducts techno-economic surveys, and disseminates technical information. The principal activities of KIST are based on contract research, which is also the major source of revenues. Clients include private enterprises and government organizations at home and abroad.

Over the next decade, KIST plans to continue performing short-term contract work in support of industry, but it will switch its emphasis to long-term developmental projects.

Early this year the institute unveiled a research blueprint calling for expenditures of $125.98 million between 1979 and 1983 in five major areas: energy, industrial materials, environmental protection, technology-intensive industries, and community development projects. Within these broadly defined areas, KIST will concentrate on solar energy, uranium extraction, coal use, oil substitutes, aluminum combinant technology, and the exploitation of natural resources. The software aspect of the computer industry is the prime area of interest regarding technology-intensive industries.

Officials at the institute and its parent organization MOST hope that these efforts will partially offset costs for the introduction of foreign technology that they estimate would otherwise amount to $258 million annually by the early 1980s.

As a means to promote basic rather than applied research, Seoul established the Korea Science Foundation (KSF) with the help of the US National Academy of Sciences in December 1976. The foundation is to encourage scientific study at the university level and to arrange technology cooperation agreements abroad. By January 1978, it had concluded agreements with the US and Germany, and was planning to add Japan, France, Great Britain, and Australia to the list this year.

Technology Import Liberalization

While Seoul is banking on its research institutes to help the country attain greater self-sufficiency in industrial technology over the long haul, the South Koreans look to accelerated technology imports for more immediate advances. In the 18-month period from January 1977 to June 1978, the government approved 28 percent of all licensing agreements made over the past 16 years.

Earlier this year, the economic ministers liberalized licensing guidelines to further step up the tempo of introducing Western know-how. Approval is now automatic in seven major industrial areas so long as licensing terms meet certain criteria. For cases that do not qualify, the ministerial review process has been speeded up. Seoul considers the

defense, nuclear energy, and computer industries to have special sensitivity, and in these areas all licensing proposals go to the newly formed Technology Inducement Review Committee.

Typical of the manner in which the Korean Government makes even seemingly minor economic decisions, Seoul will take the lead in identifying technology for import. The Commerce Industry is to list the kinds of industrial processes that will be needed by 1981, and KIST is to designate equipment and patents best suited for Korean needs.

This process may be used to implement what early indications suggest will be an officially sanctioned effort to purchase more technology from the US and less from Japan. Between 1962 and 1977, over 65 percent of Korea's technology imports came from Japan--about three times the number of licensing cases for US technology--contributing to what Seoul perceives as an increasingly intolerable trade deficit with Tokyo. A "Buy America" policy may be given further impetus by a Federation of Korean Industries' survey published in March 1978. The study concluded that US-Korean business links (direct investment, joint ventures, and technical licensing ties) usually provide Korean industry with proportionally more advanced technology capability than similar arrangements with other countries.

A Case Study: The Automotive Parts Industry

Efforts to upgrade the automotive industry illustrate the magnitude of the technology improvement problem, the need for government planning coordination at this stage, and the manner in which industry is assuming greater program costs.

One goal of the current economic plan is to expand the automotive industry so that Korea will be among the ten top exporters of cars by 1981. That goal entails raising exports from a current level of 10,000 cars sold abroad in 1977 to 100,000. This will require penetration of the European and American markets which cannot be achieved unless quality standards are markedly improved. South Korea's main problem

is its parts industry. Last year a government survey revealed that only 5 percent of the country's 300 parts suppliers produced items at quality levels that meet international demands. Worse, Seoul judged that 36 percent of the firms were beyond redemption.

Korea has drafted a comprehensive strategy that treats quality improvement and export development as mutually supporting objectives. Central to its plan of attack is a reorganization of the parts industry in an effort to achieve production economies that will place advanced technology in closer reach. The government will also mate parts suppliers with the major automotive manufacturers. The latter are obliged to assist the parts industry by supplying technical training. Meanwhile, the parts producers are committed to introduce better technology and to improve standardization and quality controls.

This year Korea will set up a Metallurgical and Machine Industry Research Institute at the Changwon Machine Industrial Estate and expand the work of the Standards Research Institute. Each institute will undertake work for the machine industry as a whole. The government has applied for a loan from the Asian Development Bank to purchase testing equipment for these and other institutes, but private industry will shoulder a good share of the R&D costs. Help for individual machine tool makers, including auto parts suppliers, will come from the Commerce Ministry. In 1976, the ministry began designating small and medium-sized enterprises in these sectors to receive special governmental development assistance in the form of soft-term loans and technical aid.

Some Rough Patches, But General Success

Ironically, economic success is responsible for the failure of at least one aspect of the technology advancement program--vocational training--to keep pace with current needs. For each of the five-year economic plans, Korea's real GNP growth has exceeded plan expectations. In the plan period that ended 1976, for example, GNP growth averaged 11 percent against an anticipated 8.6 percent when the plan was drafted

in 1970. This has resulted in consistent shortages in skilled manpower. The lucrative export of Korean labor to the Middle East has exacerbated the situation in a manner that no planner could have anticipated five years ago. Over 40,000 workers are employed on construction projects in that region, constituting a significant drain on Korea's pool of engineers, in particular and on its skilled labor force in general.

The development of the research institutes has occasionally been clouded by a Korean tendency to force their R&D pace. Scientists, encouraged by the ambitions of MOST, have preferred to work on individual research projects, many of them theoretical in nature, rather than form applied science teams in support of industry. Top policymakers in Seoul now believe that their country does not have sufficient expertise or financial and personnel resources to make "pure" research pay in the near future. The government has therefore taken a stronger line on this issue over the past year or two. It is reinforcing business-research institute links, more carefully molding research programs to Korea's industrial development strategy, and setting the adaptation of advanced foreign technology needs as the first task of the researchers.

The matter of choosing specific sources or types of technology has become more controversial. Planners in Seoul are agreed on the need for rapid technology advances but--as the stakes grow higher--have become divided on how to best achieve that goal. Simply put,

-- The Ministry of Commerce tends to take a narrowly defined and short-term look at technology acquisition questions. This often results in decisions to go with the cheapest system available.

-- The Economic Planning Board is more likely than the Commerce Ministry to consider points such as gaining experience with varied technologies and investing for the long-term in the best, even if sometimes more initially costly, process. With the board's director serving concurrently as deputy prime minister, politico-economic factors such as adjusting the balance of trade and cementing broader

cooperative ties with a foreign country, may also be weighed in technology import choices.

The influence of the Economic Planning Board is increased because it chairs both the Technology and Foreign Capital Inducement Review Committees. It does not impose its views on Korea's consensus-style decisionmaking process, but it is taking a more aggressive interest in technology questions, and that a trend is likely to persist.

Even with these problems and growing controversies, the Korean technology development program, as presented in each of three economic plans, is proceeding well. Technical training programs, particularly at an early stage, paved the way for a transition from an agricultural to a highly productive industrializing economy. Research programs, while less well developed, have also grown more sophisticated in each plan period. Now, for the first time, the Koreans look forward to developing their own technology rather than merely importing it. The contrast between the R&D goals of the second and fourth economic plans reveals the measure of progress. In the late 1960s, Seoul planned for no more than an engineering consulting service--i.e., KIST in its beginning years--that would acquaint Korean business with foreign technology. Developmental research was at that juncture a distant dream.

It is also notable that the fourth plan's program, both for vocational training and scientific research, has been devised by Korean, not foreign, planners. KIST and KAIS, the triumph of the second and third plans, were the carefully nurtured children of the US Agency for International Development. Similarly, early vocational training programs were established with funds and guidance from specialized United Nations agencies. Foreign loans continue to be applied to technology programs, but today Korea has assumed virtually full responsibility for the shape and success of its developmental endeavors.

Annex I: Major Research Institutes Being Established During the Fourth Economic Development Plan Period (1977-1981)

Korea Standards Research Institute

Korea Research Institute of Shipbuilding and Oceanography

Korea Nuclear Fuel Development Institute

Korea Energy Conservation and Monitoring Institute

Metallurgical and Machine Industry Research Institute

Korea Institute of Electronics Technology

Chemistry Research Institute

Electrical Machinery Research and Testing Institute

Korea Solar Energy Development Research Institute

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