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Korea
Education Subsector Memorandum on Higher Technical Training

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KOREA

CURRENCY EQUIVALENTS

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ABBREVIATIONS

FFYP	- Fourth Five-Year Plan for 1976-81
KAIS	- Korea Advanced Institute of Science
KIST	- Korea Institute for Science and Technology
KOSEF	- Korea Science and Engineering Foundation
MOE	- Ministry of Education
MOST	- Ministry of Science and Technology
SNU	- Seoul National University

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EDUCATION SUBSECTOR MEMORANDUM ON HIGHER TECHNICAL TRAINING

SUMMARY

i. This subsector memorandum is based on the findings of a mission that visited Korea in July 1977. It focuses on engineering education (technician level and professional), management education and related university research.

ii. Central to the Government's Fourth Five-Year Plan (FFYP) for 1977-81 are three objectives: (a) to maintain rapid economic growth; (b) to equalize the distribution of incomes; and (c) to improve the efficiency of industry and social services. The achievement of these objectives is linked to a strategy of promoting a structural shift within industry (emphasizing chemicals, electronics, heavy machinery and shipbuilding over light manufactures), fostering technological research and development capabilities, and adjusting technical manpower training to meet the needs of more sophisticated industries.

iii. The trend towards more complex industrial output will require a strengthened capability for choosing and adapting more advanced technologies and, eventually, for developing new technologies. The Government has therefore elaborated a set of technology policies to build up research and development capabilities during the FFYP period. A long-range objective is to shift the burden of applied research from the public sector to industry: the policy therefore includes tax and other incentives for importing advanced technologies, and for promoting local research and development and engineering consultancies. However, since few companies are able to establish their own research laboratories, the Government is pursuing an aggressive institution building program and will establish five new research institutes (mechanical, electronic, electrical, chemical and shipbuilding) under related ministries where links with industry can be fostered. It also plans to support basic as well as industry-related research at universities. It will therefore become increasingly important to build a cadre of technology planners within the Government and to carry out a more systematic study of future high level manpower needs of Korean industry.

iv. A feature of Korea's industrialization has been dependence on its highly industrious and disciplined work force and intensive training programs. The FFYP foresees the need for further extension of these training programs to supply skilled workers and technicians. However, the structural changes and diversification of industry will add at least two dimensions to labor market demands, namely: (a) continuous adjustment in the composition of required skills at all levels of technical manpower; and (b) an increased demand for high level manpower (technicians, engineers, scientists and researchers). Government projections to 1981 indicate approximate balance between demand and supply of engineers but a shortage of some 20,000 (14%) technicians. Estimates for the following decade suggest that substantial expansion of technician training is required, while expansion of engineering at universities and colleges needs to be more selective. However, reliable demand projections for

technicians will require a clearer definition of the role of the technician in the Korean economy. The effectiveness of expanded training will thus depend on the Government's ability to classify technician level occupations and to provide training programs based on up-to-date job classifications. Disaggregated demand and supply of higher technical manpower could not be estimated as no breakdown is available of employment by field of training. However, earlier short-term projections confirm the need for a selective approach in the case of engineers by showing shortages in chemical and mechanical specializations and surpluses in certain other areas. Employment data for management suggest approximate balance between demand and supply with the exception of accountants who are in short supply.

v. Tertiary level enrollments, at about 10% of the relevant age group, are higher than in most developing countries and about half the average for developed countries. A unique feature at this level is the predominance of private institutions: of 72 universities and colleges, 57 are private and 70% of students attend private institutions. However, all institutions are supervised by the Ministry of Education (MOE) which controls or sets standards for student intakes, fees, curricula, and several other parameters. Recurrent expenditure at about US$500 per student per year is low due to high student/faculty ratios (average 22 for tertiary education). Private contributions to tertiary education costs, through fees primarily, explain the even lower public contributions to higher education: US$140 per student per year or US$44 million (only 6% of total MOE expenditures).

vi. Despite the minimum standards set by the MOE, there are still pronounced quality variations between educational institutions. These differences are largely (though not exclusively) due to variations in institutional incomes. Student/teacher ratios vary greatly as does the quality of physical facilities, libraries, etc. Private institutions, in particular, have found it increasingly difficult to upgrade their facilities.

vii. The internal efficiency of the system as measured by transition rates is good. Employment rates also appear satisfactory. However, there are three exceptions to the generally high efficiency. The first is associated with admissions procedures, since the number of students graduating from high schools is increasing more rapidly than quotas to higher education. Reportedly 100,000 student-years are wasted annually by students spending a year or more preparing for admissions exams, which has repercussions at both high school and college levels. The second exception relates to the timing of military service for college students, which disrupts the learning process and prolongs the period between college entry and employment to about seven years. As a result higher educational institutions respond only slowly to changing labor market demands. This situation is aggravated by early specialization in most professional programs. Completion of all or part of the military obligation before admission to tertiary education would alleviate this problem. The third exception is due to a tendency among colleges to establish too many departments and to weak planning of physical facilities.

viii. Technical training shares the general strengths and weaknesses of higher education in Korea, but the demands of industrial expansion magnify some of the weaknesses. Training concepts for technicians have been vague due to the insufficient understanding of the technician's potential role in industry. The junior colleges provide a relatively rigid and terminal two-year course with few opportunities for further training. A constraint to the development of more flexible and relevant technician training is the absence of systematic training of instructors: with few exceptions, the staff has no pedagogical training or industrial experience. Another constraint is the overall low level of equipment inventories, and attempts to equip some schools to a level commensurate with their objectives should be continued and broadened to encompass private institutions.

ix. Engineering colleges share the problem of low overall equipment standards. Additionally they suffer from shortages of staff, fragmentation into small departments which worsens the problem of equipment and facilities shortages, early specialization and curricula rigidities. The centrally approved curricula and small departments force early specialization and discourage mid-course adjustments in student programs and curricula innovations. To respond to changing industrial need, more flexibility and incentives for innovation and for cooperation with industry need to be injected into the system; this process has already been started by limited pilot reform projects. An "Engineering Specialization" program in which three universities are involved has further begun to consolidate departments into larger and more economic units.

x. Management education comprises a relatively large proportion of students (10%), 87% of whom attend private institutions. It has problems of a high student/teacher ratio (44), inadequately stocked libraries, insufficient access to training computers and great quality variations between the institutions. Accounting is one area of management education that needs more emphasis: only about 10% of total credit hours are devoted to the fundamentals of accounting, and as recently as 1976 there were no graduates in this field. Another issue is that curricula and learning materials frequently lack relevance to Korea. An important constraint to the development of management education in Korea is that no institution has adequate resources to be strong in research and postgraduate work and to serve as a model for other institutions.

xi. Postgraduate education and research in science and engineering are hampered by the generally small departments, insufficient research funding and lack of an independent body to make judgments concerning quality and priority of research proposals. To solve the latter two problems, the Government has established the Korea Science and Engineering Foundation (KOSEF). Financial resources for KOSEF have not yet been established.

xii. The Government's planned investment in higher education for the FFYP amounts to US$494 million. Investment plans center on selective expansion in accordance with manpower demands and on upgrading the facilities over the short run. About half of the resources (US$231 million) have been allocated to technician training where shortages of manpower were foreseen. However, with the exception of the Engineering Specialization program, the FFYP does

not include any specific proposals to restructure and consolidate higher technical education, to equalize the quality of education or to improve its efficiency and responsiveness to industrial needs.

xiii. The Bank has so far supported four education projects in Korea, the first of which was completed in 1976. These projects have consistently pursued the broad objective of technical manpower development, and other Bank-assisted projects, in various stages of implementation or development, reflect Korean technology objectives.

xiv. Future Bank lending in education should continue to support the development of manpower to meet the needs of the manufacturing sector but with a concentration on higher technical skills consistent with the increasing complexity of Korean industry. Bank lending to higher technical education should pursue the following objectives: (a) to increase the flexibility and responsiveness of the system; (b) to expand training capacity selectively in accordance with projected supply deficits; (c) to improve the quality of training; and (d) to promote postgraduate education and research. Related sectoral policy objectives would include changes in procedures for admission, curriculum development and curriculum control, consolidation of departments and increased cooperation with industry.

xv. The report proposes an investment program including four components related to technician training, engineering and management education, and postgraduate education and university-based research. The overall program would cost about US$200 million with a foreign exchange component of about 50%. Since the investment program would pursue broad institutional objectives not only related to project institutions, it could best be supported by a subsector loan. Finally, the report specifies areas of further study for the development of technician and engineering education.

KOREA

EDUCATION SUBSECTOR MEMORANDUM ON HIGHER TECHNICAL TRAINING

1. INTRODUCTION

1.01 An education subsector mission /1 visited Korea from June 28 through July 28, 1977. In accordance with its terms of reference, the mission focused its attention on higher technical education and technological research related to the development of Korean industry. The main objectives of the mission were to:

(a) analyze priority issues affecting long-term development of higher level technical manpower and technology;

(b) propose an educational investment program on the basis of this analysis; and

(c) ascertain the interest of Government in obtaining Bank Group financing for such investment under a fifth education project envisaged for FY79.

1.02 This subsector report is based mainly on data collected by the mission in Korea with the assistance of relevant government, education, research and private industry authorities. It further draws on information provided in an earlier education sector memorandum (Report No. 1471-KO of February 14, 1977) and an economic report on Korea (Report No. 1489-KO of February 23, 1977).

1.03 The subsector memorandum focuses on the present effectiveness and future development prospects of engineering education (technician level and professional), management education and related university research. It proposes a strategy for Bank assistance to this subsector and possible components for a fifth project. The Government has expressed its interest in obtaining Bank assistance for a fifth project in higher technical education and technology largely as proposed in this report.

/1 The mission was composed of Mr. O. Bergman (educator and mission leader), Mrs. E. Schreiber (economist), Mr. C. Weiss (science and technology advisor), Mr. J. Gailer (consultant in technical education), Mr. P. Holzer (consultant in management education), and Mr. H. Wagner (consultant in engineering education).

2. DEVELOPMENT STRATEGY

2.01 The Republic of Korea, with limited natural resources, has successfully developed an increasingly sophisticated industrial structure over the past 15 years. The changing economic structure is reflected in a decline in the share of agriculture in GNP (from 45% in 1961 to 21% in 1976) and an increase in the share of manufacturing (from 8% in 1961 to 27% in 1976)./1 The manufacturing and service sectors together employed 55% of the 1976 labor force. Korea's industrialization has been accompanied by high GNP growth rates of about 10% p.a. between 1961 and 1976. Since 1961, real per capita income has nearly tripled to reach US$700 in 1976. Income distribution has been more even in Korea than in most other developing countries. A survey in 1970 showed that the bottom 40% of the people in Korea received 18% of the total income and the top 20% of the people received 45% of the income.

2.02 Central to the Government's Fourth Five-Year Plan (FFYP) for 1977-81 are the three following objectives: (a) to maintain a rapid rate of export-led economic growth; (b) to achieve more equitable distribution of incomes; and (c) to improve the efficiency of industry and social services. Achievement of these objectives is linked to an FFYP strategy to promote an ongoing structural shift within industry, a move away from light manufactures (largely textile-related) towards chemicals, electronics, heavy machinery and shipbuilding. This strategy is based on the assumption that the country will face increasing competition in light manufactures from less developed countries with lower wage levels. Korea's comparative advantage would therefore lie with the more skill-intensive, export-oriented manufactures.

2.03 In accordance with the planned industrial shift, GNP is expected to grow at about 9.2% p.a. through 1981 and beyond./2 Exports would grow at a rate of about 15% per year and manufacturing generally would increase its share of GNP to 40% by 1990.

2.04 On the basis of past experience, income equalization would be pursued mainly through creation of employment opportunities. With the exception of actions to influence the rural/urban income distribution, direct fiscal intervention in favor of income equalization is small in Korea. The FFYP target of a 3.3% annual growth rate in employment slightly exceeds the anticipated 3.2% annual growth of the labor force through the mid-1980s. Total employment would increase from about 12 million in 1976 to 14 million in 1981 and to 19 million by 1990. Manufacturing would probably provide 40% of the seven million new jobs created before 1990 and services most of the remaining 60%. The manufacturing sector's share of the labor force would increase from 19% to about 28%. Agriculture would not be able to absorb large additions to its labor force. (Bank projections of employment growth rates by manufacturing subsectors are shown in Annex 1.)

/1 Expressed in 1975 prices.

/2 Growth and Prospects of the Korean Economy, Report No. 1489-KO, Annex D, Macro Model, February 23, 1977 and Alternative Development Strategies of Korea (1976-1990) in an Input-Output Dynamic Simulation Model, World Bank Staff Working Paper No. 250, March 1977.

2.05 The Government plans to improve industrial efficiency by including incentive packages directed towards industries of comparative advantage and supplementary infrastructure investments (including power, transport and communications). In addition, land use would be rationalized, marketing channels strengthened and industrial management improved. An essential plan element is the concentration of similar industries to form industrial estates, which also simplifies the provision of other essential services (such as testing, research and training). The FFYP proposes to develop several such estates with a total area of about 30 sq km.

2.06 The achievement of the Government's growth, equity and efficiency objectives will depend on Korea's ability to expand and diversify the manufacturing sector. Therefore the FFYP attaches priority to fostering technological research and development capabilities, and to adjusting technical manpower training to meet the needs of more sophisticated industries.

3. TECHNOLOGY AND MANPOWER REQUIREMENTS FOR INDUSTRIAL DEVELOPMENT

Overview

3.01 A notable feature of Korea's past success in expanding the volume of light manufactured exports (mainly textile yarns, fabrics and clothing) has been its ability to exploit fully existing market opportunities. Following this pattern, Korea began to move towards more complex manufactures during the mid-1960s (para. 2.02) and by 1975 had developed a wide variety of export products. Traditional exports have continued to grow (and still account for 35% of all commodity exports), but more sophisticated light manufactures (mainly electronics equipment) and industrial and heavy machinery (including ships) have been added. A second feature of Korea's industrialization has been its reliance on well-established, imported technologies, often developed 25 or more years ago. The continued trend towards more complex industrial output will, however, require a strengthened capacity for choosing and adapting more advanced technologies and, eventually, for developing new technologies. The Government has thus formulated a set of modern policy instruments designed to improve and expand the technological research and development capacity of the public and private sectors. A third feature of Korea's industrialization has been dependence on its highly industrious and disciplined force of unskilled and semiskilled workers and intensive training programs. The FFYP foresees that continued industrial expansion will necessitate extension of these training programs to supply skilled workers and technicians. However, the structural changes and diversification of the manufacturing industry will add at least two dimensions to labor market demands, namely: (a) continuous adjustment in the composition of required skills at all levels of technical manpower; and (b) an increased demand for high level manpower (technicians, engineers, scientists and researchers) with modern and practical training.

Research and Industrial Development

3.02 The Ministry of Science and Technology (MOST) has, since its creation in 1967, fostered technological cooperation and exchange between Korea and other countries, and has advised the Government on technical manpower needs. MOST also initiated technology development efforts in Korea when it created

the government-owned Korea Institute for Science and Technology (KIST). In ten years of operation, KIST has built a staff of 1,000 scientists (about 10% of all researchers and research assistants in Korea [Appendix]), contributed directly to the development of Korean industries (mainly through high quality contract work in technology adaptation) and earned an excellent international reputation. However, compared to the overall needs of Korean industry, the impact of KIST has been small. MOST and planning authorities have thus elaborated a technology policy package to build up research and development capabilities during the FFYP period.

3.03 The immediate objectives of this technology policy are to encourage and expand industry-related research. A long-range objective is to shift the burden for applied research from the public sector to private industries./1 The Government would continue to support basic research and research too extensive or uncertain for industry. Policy instruments include various tax and other incentives for importing advanced technologies and for promoting local research, development and engineering consultancies (Appendix). However, few companies will be able to establish their own research laboratories in the immediate future because of their relatively limited experience. Problems will also be encountered in expanding university-based research, since resources are divided between numerous small departments (para. 4.20). The Government's strategy for achieving its objectives therefore includes an aggressive institution building program. As part of this program KIST has begun to establish five new research institutes, each catering to a specific industrial field (mechanical, electronics, electrical, chemical and shipbuilding), and a standards institute. These institutes are being placed under user-ministries to foster close links between these institutes and industry, and ultimately to secure industry finance for research. KIST itself has begun to rethink its own role as the developer of technologies which cut across sectors or of projects more advanced than those that can be undertaken in sector specific institutes. Also as part of this institution building program, the Government recently created the Korea Science and Engineering Foundation (KOSEF). Once resources have been secured, this foundation will support and promote basic as well as industry-related research at universities.

3.04 Achievement of the technology objectives will require a rapid increase in research expenditures. The FFYP envisages a rise in research allocations from 0.5% of GNP in 1975 to 1.0% by 1981, with a total of about US$420 million over the plan period. The technology policy and incentive schemes, prepared by a small group of individuals familiar with the problems of Korean industry, are modern and pragmatic. However, their application is going to place great demands on government leadership in this area and severely strain Korea's high level manpower resources. Even in the initial stages of establishment, the new institutions are showing signs of hasty planning and politically motivated decisions on location and management, and they are experiencing difficulties in recruiting qualified research staff. As technology comes to play an increasing role in the development of Korean industry, it becomes important to build a cadre of technology planners within the Government and to carry out more systematic study of the future needs of Korean industry for technology and technological policies and institutions.

/1 Experience in industrially advanced countries suggests that separation of innovation and ultimate user is the main obstacle to technology transfer.

Requirements for Higher Technical Manpower

3.05 The accelerated pace of Korea's industrial and technological development will require a labor force with an increasingly high degree of technical and managerial competence. The proportion of technical and skilled manpower (scientists/engineers, technicians, skilled workers) in total employment will likely increase from 11% in 1975 to 16% in 1981. If the present trend continues as expected, this proportion will reach about 28% by 1990 (roughly the figure for Canada and the US in 1960). This anticipated change in the composition of the labor force has important implications for both the dimensions and the quality of manpower demand.

3.06 Available Government projections for demand and supply of higher level technical manpower (limited to industrial engineers and technicians) extend only through 1981 as shown below:

	Actual employment 1975	Projected demand 1981	Projected supply 1981	Difference 1981
Engineers	57,000	114,700	115,100	+400
Technicians	78,500	147,100	126,700	-20,400

Note: Teachers, medical personnel and agricultural engineers and technicians are excluded. Supply projections assume a 3% annual attrition rate intended to account for normal attrition, occupational transfers, immigration and overseas employment.

The usefulness of these short-term projections for education policy and investment planning is limited because the labor market impact of any investment in higher technical training during the FFYP period is likely to be visible only after 1981. In addition, the Government's projections probably underestimate technician supply for 1981 by limiting incremental stock to expected graduates of formal training programs. No provision has been made for what appears to be substantial (but unquantified) vertical substitution in employment, i.e., poorly qualified engineers and experienced skilled workers serving in technician level occupations. However, a more general problem has been the lack of formal recognition and definition of the technician's role in the Korean economy, since industry has only recently begun to recognize the technician as a valuable link between engineer and worker.

3.07 In view of the rapid expansion and increasing complexity of Korean industry, actual demand for suitably trained technicians is likely to increase. Accordingly, the Government plans to expand technician training during the FFYP period. However, the question of the appropriate level of expansion of technician training over the longer term is difficult to assess. There is, at present, no classification system for technician level occupations; information on expected directions of development within particular industries is inadequate to deduce appropriate manpower ratios for the future; and, it is unclear whether the present distribution, as between engineers and technicians, is desirable. The slight increase in the ratio of engineers to

technicians reflected in the Government's short-term projections (from 1:1.4 in 1975 to 1:1.3 in 1981) causes some concern since a decline in that ratio would result in more efficient use of engineers.

3.08 Cross-country data suggest that the growth of demand for tertiary level manpower approximates the rate of growth of the economy as a whole. On this basis, demand for higher technical manpower in Korea could be expected to grow at about 9% p.a. The growth in demand for technicians, whose numbers might be expected to increase by comparison with engineers, might be somewhat higher (10%) and that for engineers, somewhat lower (8%). The following projections (mission estimates) are based on these aggregate growth assumptions and on expected supply at current enrollment levels:

	Stock	Demand		Supply		Difference
			Ave. annual growth 1975-90		Ave. annual growth 1975-90	
	1975	1990	%	1990	%	
Engineers	57,000	170,000	8	160,000	7	-10,000
Technicians	78,500	340,000	10	200,000	6	-140,000

These demand forecasts for 1990 suggest a probable upper limit. They would, if met, result in an increase in the number of engineers in employment from 0.6% to 1% of total /1 and a decrease in the engineer/technician ratio from 1:1.4 to 1:2. The supply forecasts are restricted to output of graduate engineers and technicians on the basis that vertical substitution in technical employment would diminish significantly by 1990.

3.09 The orders of magnitude indicated by these long-term projections (in accordance with the 1976-81 government projections) suggest that substantial expansion of technician training is warranted, while expansion of engineering at universities and colleges would need to be more selective. In view of the uncertainty of the precise development of demand for technicians, however, the Government's planned expansion should be phased to lessen the possibility of excess supply./2 The effectiveness of the technician training will depend on the Government's ability to classify technician level occupations for each industry; to provide relevant training schemes based on up-to-date

/1 While engineers represent 1% of employment in the highly industrialized Western economies, Korea's development (in particular the nominal productivity increases expected in agriculture) may not be highly comparable. It should be noted, however, that without expanding engineering enrollments beyond present levels, supply would anyway represent nearly 1% of expected employment - 160,000 engineers for industry plus 20,000 (excluded from the above projections) for agriculture and other, or 0.95% of total employment.

/2 Present plans call for provision of 17 new junior colleges for training industrial technicians. The mission estimates that total stock would reach about 325,000 by 1990 if all schools were provided as planned, or nearly the number indicated in the high demand forecast (340,000).

job classification data; and to broaden the understanding of both industry and educational institutions of the technician's role.

3.10 The above projections do not reveal the continuous need to correct specific supply deficits and surpluses, to develop new skills or to improve the quality in both engineer and technician training. The disaggregated demand and supply projections from 1973 to 1981 shown below reflect one estimate of the imbalance among major subcategories of engineers and technicians required for Korea's growth industries.

	Civil/ architectural	Electrical/ electronic	Mechanical	Chemical/ metallurgical	Other/a
Engineers					
New demand	19,400	17,700	23,100	21,700	3,400
New supply	17,000	21,100	15,300	17,200	11,800
Difference	-2,400	+3,400	-7,800	-4,500	+8,400
Technicians					
New demand	62,500	37,200	48,900	27,900	13,100
New supply	10,700	10,500	8,500	6,900	10,600
Difference	-51,800	-27,700	-40,400	-21,000	-2,500

/a Includes largely textile, mining and ceramics engineers.

Source: Journal of Engineering Education in Southeast Asia, "Development of Engineering Education in Korea," December 1976 (based on MOST data).

Despite the general limitations of these projections (which include possible demand distortions as discussed in para. 3.07 and optimistic supply projections which do not take full account of the time lags between increased intake levels and actual employment), they demonstrate imbalances that might be expected as the newer industries expand (Annex 1) and related employment demand increases./1 For engineers, the data further illustrate the need for frequent updating of demand trends to allow early correction of supply imbalances (large deficits in the mechanical and chemical engineering fields could in part be offset by a correction in the surplus of "others"). Courses accordingly need to be flexible with possibilities for lateral transfers, late choice of specialization and a versatile rather than specialized output. While the data show deficits for all major subcategories of technicians, the planned training places must be allocated to meet the most urgent industrial demand.

3.11 The expansion and diversification of Korean industry will further require new types of technical manpower such as industrial processing and

/1 It has not been possible to estimate disaggregated demand and supply of higher technical manpower for 1990. The present format for presenting employment data (which categorizes manpower by level of training among 53 industrial sectors) does not readily lend itself to international comparison. No breakdown of employment by specialized field of training is available.

production engineers. Similarly, industry will require managerial personnel with new skills /1 to cope with the increasing size of firms, probably lower profit margins due to increased competition, and consequently the need for greater cost and quality control. The increased levels of research funding planned by the Government will necessitate high quality scientific personnel and specialized laboratory technicians. In addition, the increasing complexity of Korean industry will require a high standard of engineers: in particular, current wide variations in the quality of engineering training must be eliminated.

4. HIGHER TECHNICAL TRAINING

Overview of Higher Education

4.01 Structure and Dimensions of Higher Education. Tertiary level education in Korea is conducted in two parallel types of institutions: two-year junior colleges (Grades 13-14), and four-year colleges and universities (Grades 13-16) that also offer postgraduate programs of an additional two to four years. In 1976, enrollments reached 320,000 of which 74,800 (23%) were in junior colleges, 230,000 (72%) in colleges and universities and 15,300 (5%) in graduate schools (Annex 2). The enrollment ratio, at about 10% of the relevant age group, is higher than that in most developing countries and about half the average for developed countries./1 A national quota system, derived from manpower projections, is used to determine the number of students admitted each year by field of study and institution. Overall, postsecondary enrollment has expanded at about 8% p.a. since 1971.

4.02 Students in the technical fields of engineering, science and business management comprise approximately 40% of total enrollments (Annex 2). While the share of technical enrollments has remained constant since 1971, industrial technician enrollments at junior colleges have expanded rapidly from a small base, as shown below:

	Enrollment			Output		
	1971	1976	Per annum growth (%)	1971	1976	Per annum growth (%)
Scientists /a	14,100	17,300	4.3	2,200	3,100	6.7
Engineers /a	36,600	56,000	8.9	5,400	7,200	5.9
Industrial technicians	6,800	33,000	37	2,300	8,100	29
Business management/a	22,600	24,700	1.8	5,400	5,852	1.6

/a Undergraduate (four-year) students only.

Source: Ministry of Education (MOE).

/1 Employment data for management graduates suggest a current balance between demand and supply, with the exception of accountants who are in short supply.

/2 About 10% as a proportion of the population aged 20-24 years which may be compared to 15% in the UK, 18% in Japan and 20% in Italy.

The high growth rates in technician training have been accomplished through a conversion of five-year higher technical schools (Grades 10-14) to two-year junior (vocational/technical) colleges (Grades 13-14). The last Grade 10 enrollment occurred in 1975 and the conversion is now virtually complete./1 Enrollments by field of study are shown in Annex 3.

4.03 In addition, the Government operates an Air-Correspondence Junior College allowing students two to six years to complete the equivalent of the two-year full-time course. Enrollment totalled 20,000 in 1976 fairly equally divided between home economics, business management, agriculture, elementary education and public administration training. About 80% of the students are in employment. Completion rates after three years of study were about 30%.

4.04 Administration. A unique feature of the higher education system is the predominance of private institutions: of 72 universities and colleges in Korea in 1977, 57 were private, 11 were national universities, and the remainder were public colleges. On average, 70% of students attend the private institutions (Annex 4), but for technical students the figures are even higher: engineers 73%; industrial technicians, 83%; and business managers, 87%. Both public and private institutions are supervised by the MOE and the Provincial Boards of Education which together control or set standards for student quotas, fees, curricula and several other parameters of tertiary education. Recently, industrial corporations began to support and thus also influence higher education, particularly in technical fields. So far, only a few institutions have established such links with industry.

4.05 Finance. The cost of education per student is relatively low in Korea essentially as a result of large class sizes at all levels. The average student to faculty ratio in higher education is 22 and varies between 30 and 50 for lower levels. However, education is widely available and an estimated 5% to 6% of GNP is devoted to this sector. Public education expenditure has over the last ten years stood fairly steady at 16% of the total government budget. The MOE allocates only 6% of its expenditure for higher education (Annex 5), but this is supplemented by the high level of private contributions to postsecondary education in the form of fees (Annexes 6 and 7). Tuition and other fees, regulated by the Government, are charged at all schools except public primary schools and cover about half of total education costs. Although public subsidy of private institutions is permitted under the Education Law, private education costs are almost completely covered by fees and private donations. The only regular financial assistance to private universities is a research grant extended to all university professors. In 1976 the public contribution to recurrent expenditure for higher education amounted to US$44 million or US$140 per student. The average recurrent expenditure per student was about US$500 equivalent in 1976./2 The MOE

/1 This change was an objective of the first Bank-assisted education project in Korea (Credit 151-KO of 1969).

/2 Because of the format for educational finance reporting in Korea, per student recurrent costs cannot be calculated accurately and actual capital layouts are not readily available for private institutions. In 1976 public capital expenditure amounted to about US$11.5 million (or US$36 per student).

estimates that the average annual recurrent cost per engineering student is US$1,000, a relatively low cost by international standards.

4.06 Efficiency. The internal efficiency of higher education as measured by transition rates is generally good. Repetition and dropout rates are low and about 85% of students entering tertiary level institutions ultimately complete their programs of study. However, these figures conceal two serious problems associated with, respectively, admissions procedures and the timing of military training for tertiary level students.

4.07 High school graduates must pass a national examination to qualify as candidates for the entrance examinations at higher education institutions. The number of students graduating from high schools is increasing more rapidly than entrance quotas, so more students spend a year or more after high school preparing for the qualifying examinations./1 Sometimes students even spend a year in a low status college or repeat the final year of secondary school in order to retake the qualifying or entrance examinations and gain admission to a well-known university or college. Reportedly, 100,000 student-years are wasted annually in this way. Besides the direct cost to society, this has at least two negative side effects. It reduces the relevance of high school teaching since strong pressure is exerted to ensure that students pass the preliminary qualifying exam. Second, it reinforces qualitative disparities among tertiary institutions, since better students are selected by the more prestigious universities. An altered admissions policy, relying for instance on students' high school performance, and improved career guidance at the secondary level could ease the problem.

4.08 Male students in Korea are required to fulfill three years of military training beginning at age 20. Tertiary level students often interrupt their studies to fulfill part of their military obligations, leaving the remaining portion for the period between graduation and employment. Besides disrupting the learning process, usually seven years elapse between entry to tertiary education and employment, which is undesirable for at least three reasons: (a) students have to decide about area of specialization long before their occupational preferences have been crystalized, which leads to less optimal choices; (b) institutions can respond only slowly to changing market demands since it takes up to seven years before altered curricula or intake quota begin to have an impact on the labor market (para. 3.08); and (c) the return from educational investment is reduced by the long delay between expenditure for training and benefits from employment. Completion of all or part of their military obligation before admission to tertiary education would alleviate this problem.

4.09 The efficiency of higher education is further reduced as a result of colleges establishing too many departments and of an overall weak planning of physical facilities. The average department has 150 students and 7 staff (Annex 4). Many departments are thus too small to provide an environment conducive to academic growth, and in many subject areas, larger departments would make better use of expensive training equipment. In some departments, essential training facilities are either not provided or are inefficiently used.

/1 Between 1970 and 1977 the number of high school students grew by 150%, the number of applicants by 140% and the college quota by 42%. College quotas as a fraction of applicants fell from 38% in 1970 to 22% in 1977.

4.10 Equity. The extensive training network, the small size of the country and the high value attached to education by the population reduce the magnitude of educational inequity and access problems in Korea in comparison to other countries in the region. Some concentration of higher education in Seoul (76% of postgraduate and 58% of undergraduate students and about 20% of the population) does not represent real inequity since admission to tertiary level institutions is based on national competition. In terms of social groupings, however, there are two relatively underprivileged categories: the poor (urban and rural) and women. For a first year entrant to higher education, student fees range from US$175 to nearly US$1,000, or 25% to 140% of per capita income. Scholarships and tuition exemptions are available but cover only 6% and 16% of students enrolled, respectively. Discrimination against women occurs mainly outside the education system; no paths to educational advancement are officially closed to women, although slightly fewer girls than boys advance from each level of education to the next. Women comprise 27% of higher level enrollments but only 1% of engineering and 5% of business management enrollments. At the junior college level, women's enrollments in industry-related fields have increased from 2% in 1971 to 30% in 1976.

4.11 Quality and Relevance. Few quality indicators for tertiary education were available. Judging from the high performance of the Korean economy, the quality of current graduates appears to be satisfactory. Employment rates seem to confirm this: MOE statistics collected some months after graduation 1975 suggest that only 11% of junior vocational college and 14% of college and university graduates had not yet secured jobs (Annex 8). Other indicators show a less satisfactory picture: one is the employment of engineers for technician tasks in some companies, and another is the pre-employment examinations organized by many companies. (In some cases graduates from the three leading universities may be exempted.) Employer complaints on the quality and suitability of training have also grown recently, but this is probably due more to wide variations in institutional standards than to low absolute standards. It probably also reflects insufficient collaboration between tertiary level institutions and major employers.

4.12 The MOE sets minimum standards for many determinants of quality, such as graduation, faculty, curricula, physical plant and educational facilities (para. 4.04), but the quality of higher education still varies substantially among institutions, with a few high quality schools (public and private) concentrated in Seoul or near larger provincial capitals. The formal qualifications of faculty are usually high, with about 30% of college and university teachers holding doctorates, 35% masters degrees and 35% bachelors degrees. Some subject areas, including all the technical fields, suffer from a shortage of teaching staff: student/ faculty ratios at engineering colleges (four-year courses) range from 30 to about 80. In addition, the supply of equipment and educational materials varies substantially from one institution to another, e.g. institutions in Seoul own about two-thirds of all equipment items and books, but libraries are generally understocked. (For colleges and universities, the average reported library holding is 10,000 books.) These differences are largely attributable to variations in institutional incomes: private schools generally spend less than public schools and have found it increasingly difficult to upgrade educational inputs (Annex 9). This trend is discernible in annual recurrent expenditure levels per student compared below (in current prices):

	1971	1976
National universities	US$325	US$650
Private institutions	US$300	US$420
- Private institution expenditure as fraction of public	91%	65%

4.13 Curricula tend to follow MOE guidelines more rigidly than other educational inputs. This is explained in part by the quota system which directs entering students into early specialization in a single discipline. (Required general or elective subjects account for less than a third of student time at most colleges and universities.) The teaching methods most frequently used (lectures and rote learning) are inappropriate for the problem-solving orientation employers need, and centrally controlled curricula cannot be adjusted easily to meet changing labor market demands. In part, these teaching methods are the result of inadequate facilities and staff shortages at many institutions; in part, the result of tradition. In order to inject some flexibility and innovation into the system, the Government initiated a Higher Education Reform Project in 1971. This reform project (commonly known as the Pilot Project) has broad objectives, inter alia (a) greater breadth in student preparation for employment (double-major and major-minor options to be introduced, Annex 10); (b) increased student participation in the learning process (reduced credit hours, less lecturing and more laboratory and independent work); and (c) more efficient resource utilization (colleges open longer during the year). The project encourages innovation and grants are made available to participating institutions to study special problem areas. It includes the nucleus of an accreditation system: participation is decided by an Evaluation Committee. About 30 institutions are now involved. Experience with these innovations should be reviewed and evaluated for possible replication and expanded support.

Particular Issues in Higher Technical Training

4.14 Higher technical training shares the general strengths of tertiary level education in Korea: internal efficiency is high, unit costs relatively low, and most graduates appear to find appropriate employment. In view of the priority attached to continued industrial expansion and development, however, the problems of the subsector are magnified in the higher technical training categories where main weaknesses include:

(a) the inability of educational institutions to respond directly and rapidly to changing industrial needs (paras. 4.08 and 4.13);

(b) the shortage of faculty, equipment and materials necessary to provide an acceptable and even quality of training throughout the subsector (paras. 4.09 and 4.11-12); and

(c) an inadequate degree of cooperation and interchange among educational institutions and major employers (para. 4.04 and 4.11).

These weaknesses are discussed below.

4.15 Technicians. The recent expansion of industrial technician training (para. 4.02) in 29 junior vocational colleges reflects the growing awareness of the importance of the technician in the Korean economy. A major problem for training, however, is that the role of the technician is in a state of transition and not yet clearly defined. Technicians have been unrecognized as a group (para. 3.06) with regard to job situation (salary and career) and training. Students, parents and staff view the junior college as subordinate to the universities, and this impression is reinforced by the word "junior," by few opportunities for further education and by poorly equipped facilities.

4.16 The earlier lack of understanding between industry and educational institutions of the potential role of the technician has resulted in undefined training concepts and curricula that have emulated programs provided by four-year engineering colleges. Technicians are needed for a broad spectrum of occupations, many requiring a specific set of skills. A system is therefore needed that combines training in the fundamentals of a broad skill area with a range of industry-specific options and opportunities for future retraining in related skill areas. By contrast, the junior colleges provide a relatively rigid and terminal two-year course with no opportunity for further training or retraining. Cooperation with industry, with a few notable exceptions,/1 has been minimal. A more flexible system of technician training should be established based on closer contact with industry. The creation of industrial estates offers excellent opportunities for such collaboration (para. 2.05).

4.17 A constraint to the development of more relevant technician training is the absence of systematic training of instructors. Though the student/faculty ratio of 18:1 is satisfactory, the junior vocational colleges as a whole are inappropriately staffed. With few exceptions, staff have no pedagogical training or industrial experience. Training for technical secondary teachers is carried out in 11 universities,/2 but their programs give inadequate attention to industrial experience and provide little practical skills training. Plans are underway to consolidate this training at Chung Nam University; however, no special arrangements are included for junior college instructors. Furthermore, no major improvements in curricula are envisaged at Chung Nam and output from the one institution could not even meet the needs of technical high schools. In-service programs in both pedagogy and skills training should be initiated immediately for junior vocational college staff, with an appropriate pre-service scheme being developed thereafter. An economical approach would admit graduates of insitutions providing the necessary skills training to a separate diploma course that offers the required pedagogical and/or industrial experience.

/1 e.g. the Ulsan Institute of Technology, a private institution with industrial support whose junior college program has had partial success with short-term industrial placement of students during training.

/2 Graduate engineers, with or without pedagogic training, can also become technical teachers.

4.18 In addition, MOE statistics show that junior college equipment inventories are low at 43% of minimum requirements (Annex 9). Attempts to equip some schools to a level commensurate with their objectives should be continued and broadened to encompass private institutions also.

4.19 Engineering Education. Among common problems in higher education, shortages of faculty, equipment and materials (para. 4.12), fragmentation of facilities (para. 4.09) and training lags (para. 4.08) are particularly severe in undergraduate engineering education. A major problem in engineering education concerns the overall relevance of curricula to industrial needs.

4.20 The shortage of faculty at Korean engineering schools is acute. The student/faculty ratio in engineering is 31 (40% higher than the average of 22:1 in higher education), and in less prestigious colleges, ratios above 50 sometimes occur. This shortage of faculty reflects the demand for well-trained engineers in Korea. Faculty carry heavy teaching loads (often double the nine-hour minimum weekly requirement) which results in more lecturing and less practical work than desired. Also the shortage of materials and equipment, at only 37% of MOE standards (Annex 9),/1 is a constraint to quality education. To alleviate equipment shortages alone would require substantial investment (an estimated US$140 million) and should be gradually undertaken at both public and private colleges; however, the problem could be partially solved at a lower cost by fragmented engineering departments consolidating their resources (para. 4.09). Engineering colleges are split on average into eight relatively independent departments comprising 150 students and 5 faculty; equipment is similarly divided and averages US$90,000 per department. The Government recognizes the need to use facilities in engineering education more efficiently and has included an "Engineering Specialization" program in its FFYP to address the problem. The objective of the program is to create larger, more economical engineering departments through functional specializations at selected national engineering colleges./2 The specializations have been determined on the basis of regional resources, both educational and industrial (para. 2.05).

4.21 Another issue in engineering education is curriculum design. The average engineering program allocates 56% of course time for specialization, 12% for general engineering and 32% for general science and nonscience subjects (Annex 10). This forces a high degree of early specialization and

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/1 The standard equipment list appears reasonable and modest. Based on current average enrollments per department (which are low) the standard corresponds to about US$1,400 in equipment per engineering student. This standard list was introduced by MOE in 1974 and is, despite the limitation of any such list, a valuable planning tool. The list has the following major weaknesses: (a) needs are specified by department only and there is no indication of how quantity should vary with enrollment in the course; (b) no prices are given and technical specifications are provided for only half of the items; and (c) the link between type and level of experimentation and listed equipment is not specified. The list should also be revised to incorporate recent trends in both method and content.

/2 Initially, the program is to be limited to Busan (mechanical engineering), Kyung Buk (electrical engineering), Jeon Nam (chemical resource utilization).

leaves little opportunity for mid-course adjustments in student programs or final specializations. (This early specialization is particularly undesirable in conjunction with the long training lags caused by military service requirements [para. 4.08]). The quota system and the many small departments discourage curriculum innovations, such as the introduction of interdepartmental or other cooperative courses relevant for sophisticated industrial needs. Such options could include new programs in process, production and management engineering, or be related to sanitation and environment. To overcome these weaknesses, the structure of engineering education should be flexible enough to respond directly, and thereby more quickly, to market forces. Government support and more liberal application of engineering quotas, by broad subject areas, could encourage the development of new programs. This process has already begun through a pilot project (para. 4.13). At present possible liaisons with industry (industrial consultancies by faculty, industry's participation in curricula development and teaching) are minimal, but more extensive cooperation is necessary to develop new curricula and to increase the relevance of engineering training. Only a small number (5%) of faculty have had any direct industrial experience.

4.22 Management. Undergraduate business management and related enrollments comprise a relatively large proportion of students (10%), 87% of whom attend private institutions. Faculty are in short supply (the overall student/faculty ratio is 44:1, but is as high as 83:1 in computer sciences). Libraries are short of relevant books and periodicals and often lack even standard handbooks for production, marketing, finance and accounting, which is a severe limitation for students and faculty. Few students have access to computer facilities; however, given the increasing need for computerized accounting and information systems in Korea, computers are essential teaching aids.

4.23 In terms of curricula, the weakness of overspecialization in engineering education applies to most business curricula. Colleges are normally divided into several departments, including business management, economics, trade, commerce, industrial management and statistics. Curricula founded on a basic program in business administration could better prepare graduates for meeting employers needs: these curricula would cover the basics of management-related activities and be supplemented by work in one or more functional specializations such as finance, accounting, marketing, international business and human resource management. Accounting has received little emphasis in the past: only about 10% of total credit hours are devoted to the fundamentals of accounting and as recently as 1976, there were no graduates in this field. However, several colleges have introduced accounting majors in the last couple of years. On a national basis, only an estimated 20 faculty can be considered full-time accountancy professors. In addition, some students have been discouraged from entering the accounting profession because of barriers to certification by the Accountants' Association: a high proportion of applicants are rejected on the basis of this Association's examination. As a result of these problems, there is a critical shortage of trained accountants in industry.

4.24 A particular issue related to management education is that curricula and learning materials, adapted from foreign models, frequently lack relevance to Korea. No attempt has so far been made to develop curricula that stress the uniquely Korean aspects of human resource management and planning. Courses

in marketing use North American texts and case studies and thus do not acquaint the student with the marketing problems faced by Korean industries. New curricula supported by Korean textbooks and case studies would improve the relevance and quality of management education. Faculty upgrading and systematic research in such fields as management, marketing and organization are also necessary. An important constraint to achieving these objectives in the past was that no institution had adequate resources to be strong in research and postgraduate course work and to serve as a model for other institutions.

4.25 Postgraduate Science and Engineering. At present very few postgraduate science and engineering institutions can undertake research of the scope and quality required by industry (para. 3.03). These include the science faculty at Seoul National University (SNU), which has recently benefited from a USAID-assisted program in faculty upgrading and some limited equipment procurement, and the Korea Advanced Institute for Science (KAIS). There now appears to be a scope for a local faculty development program as a follow up of the SNU program. KAIS, which was created as a center of excellence for postgraduate science and engineering, enjoys advantages not shared by other institutions: students (numbering 420 in 1977) and faculty (50 professors and 20 adjunct professors mainly from industry) are both of high quality, and equipment and learning materials conform to high standards./1 Curricula, controlled by KAIS, are practical and flexible. The aim of training in KAIS' nine departments is to prepare scientists and engineers for advanced industrial positions and applied research, or university teaching.

4.26 By contrast, the majority of graduate programs at universities lack faculty and, as in undergraduate engineering, departments are scattered and small: about 3,500 graduate students in science and engineering were divided among 121 departments in 1976. In addition, expenditure on research was insufficient to provide adequate equipment for postgraduate education and research. Even KAIS lacks equipment for two of its newer programs (chemical process and mechanical production engineering). While teaching equipment at SNU has been upgraded, research equipment for science is still inadequate. Therefore a systematic program of support for university research and postgraduate education is needed.

4.27 Research equipment for Korean universities has to date been provided through block grants of equipment from the MOE./2 Experience with this method and other efforts to finance university research in Korea have shown the need for an independent body to make judgments concerning quality and priority of research proposals. KOSEF (para. 3.03) was adapted from American and German models to solve this problem and will rely on a peer review system to judge the quality of research proposals. The foundation has not yet begun to issue research grants as its financial resources have not been established.

/1 Recurrent expenditures for 1977 amounted to about US$8,700 per student (nine times the average in undergraduate engineering). In addition, students are exempt from military service, since they are considered critical to Korea's economic development.

/2 Some of this equipment was financed under the second Bank-assisted project, Cr. 394/Ln. 906-KO of 1973.

5. GOVERNMENT PLANS AND BANK STRATEGY FOR HIGHER TECHNICAL TRAINING

Government Policy

5.01 Investment. The Government's planned investment in education and manpower development for the FFYP period amounts to US$1.54 billion equivalent, corresponding to 4% of gross national investment. Of the total, US$268 million would be in private contributions and US$92 million in foreign capital. The share allocated for higher education is US$494 million (32% of the total) is shown below:

	Planned Investment (1976-81) (US$ million)
Technician Training	
Expansion of junior vocational colleges	200
Upgrading existing junior vocational college facilities	31
Total	231
College and University	
General expansion	150
Upgrading existing facilities and equipment	80
Engineering specialization program	33
Total	263

5.02 The planned investment in technician training reflects the Government's growing awareness of the importance of trained technicians in the Korean economy. In all, 37,000 student places would be established in 17 new junior colleges, 65% of enrollments allocated for industry-related training. The projected long-term shortage of technicians (para. 3.07) justifies an initial expansion of this magnitude. The estimated cost per student place would be in the order of US$5,000-6,000. The upgrading of existing facilities and equipment is also emphasized as a result of the generally poor quality of technician training (para. 4.15). About 20% of the planned investment for this purpose is likely to come from private sources and will be designated for specific private institutions.

5.03 At the college and university level, planned investment would support selective expansion on the basis of manpower demand. The total of 40,000 new places represents about a 15% increase (based on actual enrollments in 1975). Allocations by fields of study are not given in the FFYP but priority has been attached to the expansion of provincial institutions to promote balanced regional development (para. 4.10). The cost per student place is estimated at US$3,000-4,000 and private sources are expected to contribute US$60 million (30%). The upgrading of existing facilities would also favor provincial institutions as would the specialization program (para. 4.19).

5.04 Investment to promote basic research at universities is included in the overall allocation of US$420 million for research expenditures (paras. 3.03-3.04). Two specific investment projects include promotion of university level research through KOSEF and expansion of KAIS.

5.05 Policy Direction. Investment plans for higher education center on selective expansion of student places in accordance with manpower demand and on upgrading facilities and equipment over the short run. These objectives are in line with subsector needs. With the exception of the engineering specialization program, however, the FFYP does not include programs for restructuring higher technical education, which are needed to improve its efficiency, even out the quality of training, and improve responsiveness to industrial needs (para. 4.14). Such restructuring appears necessary for Korean industry to maintain the rapid growth and development envisaged for the next decade and beyond. Further, it does not appear probable that the investments can be completed before the end of the plan period.

The Bank's Role

5.06 Previous Projects. The Bank has so far supported four education projects in Korea, the first of which was completed in 1976. These projects have consistently pursued the broad objective of technical manpower development either through expansion of relevant subsectors or through specific quality improvements. Together they have catered for a broad range of manpower training needs within agriculture, fisheries, industry and services (teacher training) and will reach a student population in the order of 100,000. The first two projects addressed priority needs in various types of secondary and postsecondary level institutions, while the third and fourth projects focused on meeting needs for skilled workers in the manufacturing sector. These investments, together with the development of on-the-job training, are expected to meet the major shortages projected for skilled workers. University level research was also supported on a small scale under the second education project.

5.07 A number of other Bank-assisted projects, in various stages of implementation or development, reflect Korean technology objectives. At present, the Bank is discussing a Ministry of Commerce and Industry proposal to establish a Research Institute of Electronics Technology, in close collaboration with industry, as part of an ambitious plan to bring Korea to the state of the art in semi-conductor electronics. In addition, KIST has collaborated with the Bank on a number of techno-economic studies.

5.08 Proposed Strategy for Future Assistance. Future Bank lending in education should continue to support the development of manpower to meet the needs of the manufacturing sector. In recognition of the increasing sophistication of the Korean economy, Bank lending in education should also promote the development of human capabilities for research and development work. In addition, the Bank should consider providing more direct assistance to promote indigenous applied research in areas critical to Korean industry and to strengthen Korea's ability to plan and manage industrial research and to carry out studies of the needs of Korean industry for technology and for additional instruments of technology policy (para. 3.03-3.04). Any such assistance should probably be provided outside the Bank's education lending program.

5.09 In view of past investments in training skilled workers and the increasing complexity of Korean manufacturing, future Bank investments in manpower development should concentrate on higher technical/managerial education. A strategy for investment in this area should have three overall objectives. The first objective would be to make the system of higher technical education more flexible and capable of responding more quickly and effectively to the changing requirements of Korean industry. This flexibility would require structural and policy changes in higher education, inter alia, modifications to curricula that delay the student's final choice of specialization as far as possible (para. 3.08), changes in curriculum control and application of the quota system that encourage colleges to try alternate programs and teaching methods (para. 4.13), and possibly alternate forms of institutional management (or consultative arrangements) to ensure closer cooperation between industry and educational institutions (para. 4.11). The second objective would be to expand training capacity selectively in accordance with projected supply deficits. This would entail, inter alia, the expansion of junior technical colleges to meet projected demand for industrial technicians and the expansion of accountancy training. It would also involve support for the establishment of specific training programs, e.g. process engineering, as dictated by changes in the structure of industry. The third objective for Bank investment in higher technical education would be to improve the quality of training in engineering and management. This would require, inter alia, concentration of currently fragmented resources for engineering education, staff development and provision of equipment to make teaching programs more practical. These improvements would have to reach a large proportion of the private institutions to be effective.

5.10 As regards research and technology development, the Bank's education sector lending strategy should primarily emphasize development of human capabilities and, to a more limited extent, the institutional infrastructure for research and development work. Specific sectoral objectives would be to promote postgraduate education and research at educational institutions in order to strengthen the local capability for planning and implementing research and development work. A collateral institutional objective would be to support KOSEF to enhance its capacity for setting industrial research priorities.

Proposed Investment Program Within the Education Sector

5.11 Objectives and Scope. Within the context of the strategy outlined above, the Bank should develop an investment program with the following four components and objectives:

(a) Industrial Technicians. To help the Government meet an increasing quantitative as well as qualitative demand for technician level manpower the program would support the Government's junior technical college expansion program, provide equipment to new and existing colleges and establish pilot colleges to experiment with more flexible teaching programs;

(b) Engineering. To improve the internal and external efficiency of engineering education the investment program would help consolidate departments, introduce specialization among engineering colleges, upgrade equipment, provide for staff training and introduce more relevant (industry-related) teaching programs;

(c) Management. To assist in the upgrading of management education, investments would be made to develop and distribute new textbooks and case studies in the Korean language, provide library books and computer facilities, introduce improved teaching programs (specifically in accountancy and at graduate level in business management), expand accountancy training and upgrade faculty. An advanced management institute would also be established; and

(d) Postgraduate Education and University-based Research. To promote faculty development, postgraduate education and research the investment program, through KOSEF, would provide assistance to selected research proposals put forward by scientists at universities and colleges, and to establish a limited number of postgraduate programs of high national priority.

Overall policy objectives would be to achieve a greater flexibility and responsiveness among tertiary level institutions to changing labor market demands and a concentration of currently fragmented resources in engineering education to more economic and efficient units.

5.12 The first two components listed above have been discussed with the Government: they conform in broad terms with government plans. The third component, not mentioned in the FFYP, is gaining increasing government support. The fourth item differs substantially from a formal government request for Bank assistance in September 1977 by placing heavier emphasis on human resource development for research than research per se. Applied research elements originally submitted by the Government might better be assisted outside the Bank's work in the education sector (para. 5.08).

5.13 The four components above could constitute the main elements of a project designed to effect broad reforms within higher technical education. The objectives of the project are far-reaching, may concern all institutions within the sector and require structural and functional changes within institutions. While objectives and goals may be specified in some detail at this stage, the necessary policies, legislation, curricula, institutional requirements and investment can be formulated in successive stages only. For this reason, the project would best be designed as an ongoing reform where institutional requirements and investments are specified during implementation. It would appear promising to implement a project of that nature wholly or partially through an accreditation system. This accreditation system should have recourse to a pool of institutional incentives (including loan or grant funds for physical facilities and technical assistance and student quota adjustments) and certain fiscal powers. An essential benefit would be that the responsibility of finding solutions to some of the institutional problems that are bound to appear (e.g. reallocation of staff upon closing of departments) would be transferred to the institutions that are most directly concerned.

5.14 Since the proposed education investment program is large and pursues broad institutional objectives, a sector loan would seem to be a more relevant form of Bank support than a project loan. A large proportion of existing institutions within the areas of engineering, technician and business management education would be involved under the proposed program. Improvements or policy decisions (e.g., structural changes) derived from the investment

program would be applicable to other institutions within, or even beyond, the areas mentioned above. Details of investment at individual institutions would accordingly best be specified in successive stages during implementation. The investment program would, therefore, be prepared for support under a sector loan. This would focus investment on institutional changes and would require agreement between the Borrower and the Bank on criteria for expenditure of loan funds. These criteria must take into account the important role that private institutions play in Korea. Within this context details of project implementation (e.g., location of institutions, review of final equipment lists) would be delegated to the Borrower.

5.15 Program costs are tentative and can be determined only after additional study, but the following table indicates orders of magnitude.

	Program components	Tentative costs Total	Foreign
		-- (US$ million) --	
(a)	Junior colleges	70	30
(b)	Engineering colleges	65	50
(c)	Business management education	7	4
(d)	Postgraduate education and research (minimum)	60	15
	Approximate total	200	100

5.16 Further Studies and Project Preparation. Further studies are required to support the development of technician and engineering education. These studies should be directed toward defining:

(a) the needs for engineers and technicians by type of skill on a national and regional basis;

(b) the prospective wage and salary structures for engineers and technicians;

(c) an improved manpower classification system, in particular for middle level personnel and technicians, by types and levels of training and occupation;

(d) methods for strenthening cooperation between industry and educational institutions producing engineers and technicians and for improving the labor market information system;

(e) improved procedures for curriculum development that ensure a timely and flexible adaptation to changing industrial needs; and

(f) training policies which guarantee shorter lead times between college entry and in the case of engineers choice of specialization on the one hand and appearance of graduates on the labor market on the other;

Additional study should focus directly on the training system and institutions, both public and private. For technician training these studies would aim at developing:

(a) the most efficient institutional arrangements, governance, types of facilities and staff;

(b) a faculty development program;

(c) a curriculum development program; and

(d) the scope, procedures and broad criteria for provision of equipment to junior colleges.

In the case of engineering education similar studies should focus on the undergraduate level for which national standardization and guidelines (within limits) are feasible, and should be directed toward defining:

(a) programs with a stronger element of practice-oriented teaching;

(b) a long range staff development program;

(c) the amount of consolidation that could be achieved by closing unnecessarily small or other wise uneconomical departments (and, as suitable, increasing the enrollments of other departments within the same college);

(d) the scope for establishing regional specialization at engineering colleges in accordance with the dominant industries in the area, and principles for implementing such a program at the national and individual college level;

(e) a system for physical facility planning to be used at the national and local levels as a means to achieve an improved teaching effectiveness and utilization rate for laboratories, equipment and staff at national and college levels; and

(f) the scope, procedures and broad criteria for upgrading the equipment status of engineering colleges.

5.17 A crucial area of preparatory work for a sector loan would be to design an administrative framework which has the capability to manage a sector loan of the proposed nature.

KOREA EDUCATION SUBSECTOR MEMORANDUM ON HIGHER TECHNICAL TRAINING

Technology Policy and Research Experience

1. Technology Policy. Starting from the successful establishment of KIST, the MOST in collaboration with other parts of the Korean Government, has elaborated a policy which uses (or will use) a full array of modern technology policy instruments. These include:

(i) tax write-offs and other incentives to encourage the commissioning of research and development projects by private industry;

(ii) encouragements of the use of the local consulting and engineering capacity by the Korean public and private sectors;

(iii) a high-quality graduate school in engineering and science (KAIS);

(iv) technological institutes focused on the needs of specific industries, many of them under user Ministries but with the technical support of MOST;

(v) a "Science Town" at Daeduk, to provide a favorable climate for growth of the new technological institutions;

(vi) a technology transfer center at KIST to assist businessmen in the selection and acquisition of imported technologies;

(vii) a profit-making technology advancement company (KTAC), wholly-owned by KIST, to commercialize technologies invented by KIST;

(viii) an effort to make the public aware of the importance of science and technology and to bring their benefits to the rural population through visits of volunteer scientists;

(ix) a manpower qualification certification program to enhance the social status of the skilled technician and to ensure the quality of his training; and

(x) the Korean Science and Engineering Research Foundation (KOSEF) to support research at Korean universities.

2. The Government has also taken the first steps toward adapting its capital markets to the needs of technologically innovative industry. The Korean Development Bank has, for instance, set aside a percentage of its loan funds as a special fund to be disbursed only with the approval of the MOST for risky business ventures involving new technology.

3. Research Experience. Research and development work has been carried out primarily in public research institutes as can be seen from indicators of the combined research effort (1974).

	No. of institutions	Researchers or research asst. (W billion)		R&D expenditures	
Public research institutes	90	3,590	37%	15.80	69%
Private research institutes	23	1,220	13%	5.97	26%
Companies	121	2,160	23%	0.45	2.0%
Public univ. or colleges	40	1,230	13%	0.19	0.8%
Private univ. or colleges	61	1,390	14%	0.42	1.8%
Total	355	9,590	100%	22.80	100%

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL TRAINING

Projected Employment and Employment Growth Rates
By Manufacturing Subsector

	1975	1990	Annual growth (%)
Electronics	97,000	397,000	9.8
Machinery & Transport Equipment	202,000	666,000	8.2
Light Manufactures	790,000	2,237,000	7.2
Chemicals	441,000	888,000	4.7
Mining	122,000	160,000	1.8
Others	650,000	878,000	2.0
Total	2,302,000	5,226,000	5.6

Note: Includes technical and non-technical manpower.

Source: Alternative Development Strategies of Korea (1987-90) in an Input-Ouput Dynamic Simulation Model, World Bank Staff Working Paper No. 250, March 1977.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Enrollment at Third Level Institutions
by Field of Study (1976)

	Junior college	Junior voc. college	College & univ.	Post-grad.	Total	Grand total (%)
Humanities			7,228	720	7,948	2
Education	5,813		35,917	2,978	44,708	14
Fine Arts	1,070		10,850	558	12,478	4
Law			4,322	461	4,783	1
Soc. Sciences	800		38,027	4,637	43,464	14
Nat. Sciences	671		17,297	994	18,962	6
Engineering	194	32,699	55,934	1,703	90,530	28
Medicine	881	11,073	17,536	2,005	31,495	10
Agriculture	254	6,664	14,889	602	22,409	7
Other	106	14,805	27,811	632	43,354	14
(Of which business management)/a	(1,980)		(24,746)	(3,470)	(30,196)	(9)
Total	9,789	65,241	229,811	15,290	320,131	100

/a Business management in Korea includes the fields of economics, trade, applied statistics, public administration and accounting.

Source: MOE, Statistical Yearbook of Education, 1976.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Engineering Enrollments by Area of Specialization
in Tertiary Level Institutions, 1976

Area of specialization	Colleges & universities Enrollment	%	Junior colleges /a Enrollment	%
Civil Engineering	10,900	20	7,600	22
Mechanical Engineering	19,300	34	8,600	25
Electrical Engineering (incl. electronics)	10,500	19	8,800	25
Chemical Engineering	8,800	16	5,500	16
Other	6,400	11	4,100	12
Total	55,900	100	34,600	100

/a Includes a small number of students in grades 11-12 of Higher Technical Schools (grades 10-14).

Source: MOE, Statistical Yearbook of Education, 1976.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Enrollment, Staffing and Administration of Tertiary Level Institutions (for the Nation and Seoul Province) 1976

	Colleges & universities			Junior colleges		
	Public	Rural	Total	Public	Rural	Total
National Totals for:						
Institutions	15	57	72	50	72	122
Departments	409	966	1,375	-	-	-
Faculty	3,238	6,842	10,080	(1,792)	(2,082)	(3,874)/a
Students	62,852	166,959	229,811	25,363	52,521	77,884 /b
Of which in Seoul Province:						
Institutions	2	34	36			
Faculty	1,022	5,138	6,160			
Students	14,951	118,772	133,723			
Average Ratios						
Faculty/institution	215	120	140	35	28	32
Students/institution	4,190	2,930	3,190	510	730	640
Students/faculty	19.4	24.4	22.8	(10.8)	(22.1)	(16.9)/a
- Seoul	14.6	23.1	21.7			
- remaining Korea	21.6	28.3	24.5			

/a Number of teachers not reported for a group of 12,500 students which are about equally divided between private and public institutions. Student/teacher ratios are accordingly estimated.

/b Includes 2,854 students in the second and third year of five year technical colleges.

Source: Ministry of Education, Statistical Yearbook of Education, 1976.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

MOE Expenditure 1976 (Budget)
(in billions of Won)

Purpose	Amount	%
Ministry itself	11.6	3.3
Colleges and Universities	16.8	4.8
Junior Colleges	5.8	1.6
Special Schools and Academy of Arts & Science	1.8	0.5
Local Finance /a	270.2	77
Others /b	46.9	13
Total	353.1	

/a This includes expenditure for all public (non-National) institutions of all levels.

/b Includes special accounts inter alia for National University Hospital, SNU expansion and Economic Development Activities.

Source: MOE, Statistical Yearbook of Education, 1976.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Private School Expenditures 1976 (Budget)
(in billions of Won)

Purpose		Amount	%
Kindergarten		1.7	1.2
Primary		3.8	2.6
Middle		38.9	27
High Schools:	General	33.1	23
	Vocational	20.2	14
Junior Colleges		8.9	6.2
Colleges and Universities		36.6	2.5
Miscellaneous		0.4	0.3
Total		143.6	

Source: MOE, Statistical Yearbook of Education, 1976.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Officially Regulated Limits of Tuition Fees (1976)
(in thousands of Won; 1,000 Won = US$2.06)

	Public Institution Fee			Private Institution Fee		
	Minimum		Maximum	Minimum		Maximum
A. By Level for Selected Types of Schools /a						
Primary schools	2.4	-	5.4	2.4	-	5.4
Middle schools	37.7	-	72.3	36.7	-	72.3
High schools (general)	67.4	-	108.2	67.4	-	108.2
Junior colleges (vocational)	85.3	-	131.4	187.2	-	243.0
Colleges & universities (general)	102.4	-	199.9	282.8	-	344.4
(vocational)	102.4	-	180.8	321.2	-	380.0
B. By Type of Expenditure for Vocational University or College /b						
Registration fee (1st year)		1.8		25.0	-	60.0
Tuition fee		44.0		145.0	-	256.0
Faculty support funds	56.0	-	100.0	50.0	-	140.0
Practical train (lab) fee	6.6	-	36.0	18.0	-	68.0
Students self-governing fee	9.0	-	36.5	5.4	-	51.4

/a Does not include registration fees which usually are less than 10% of total first year fees.

/b No totals are given under Part B as ranges of total fees are governed by Part A.

Source: MOE, Statistical Yearbook of Education, 1976.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Employment Status of Graduates by Level and Type of Education, 1975

Level and type of education	Employment status		Further education	Others and unknown
	Employed	Unemployed /a		
Primary	8.3	10.7	77.2	3.8
Middle	5.2	11.3	74.7	8.8
General High School	9.7	25.7	41.5	23.0
Vocational High School	50.3	20.1	8.8	20.8
Junior Vocational College	45.1	11.4	6.7	36.9
Colleges and Universities /b	53.8	14.0	6.1	26.1

/a As reported by heads of institutions a couple of months after graduation.

/b Including junior colleges, junior teachers' colleges, colleges, universities and graduate schools.

Source: Ministry of Education.

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

An Estimate of the Equipment Status for Tertiary Level Engineering Courses in Korea

	Value of current equipment inventories (US$ million)	Equipment standard proposed by MOE (US$ million)	Current equipment status (%)	Enrollment	Value of current inventories per student (US$)
A. Colleges and Universities					
Engineering:					
Public	9.8	27.3	36	15,628	630
Private	17.0	45.5	37	42,000	400
Total	26.8	72.8	37	57,600	470
All Fields:					
Public	30.4	68.6	44	67,600	
Private	38.3	104.8	37	177,500	
Total	68.7	173.4	40	245,100	

B. Junior Colleges are estimated to have about 40% of the "Standard" equipment requirement for engineering.

Sources: A: Ministry of Education, July 1977.
B: Chai-Sung Lee et. al.,, Development of Engineering Education in Korea; Journal of Engineering Education in Southeast Asia, Vol. 6, December 1976.

Note: The standard list used by MOE to estimate equipment needs is based on 1975 prices, and needs per department rather than per student. Available equipment per engineering department averages US$93,000 (US$120,000 for public institutions and US$82,000 for private institutions).

KOREA EDUCATION SUBSECTOR MEMORANDUM
HIGHER TECHNICAL EDUCATION

Curriculum Composition in Engineering Colleges

	Standard curriculum (11 selected colleges)		Pilot college curriculum (3 selected colleges)	
	Credits	%	Credits	%
Basic Engineering Course	18	11	23	16
Related Science	15	10	11	8
Departmental Specialties	63	39	51	37
Required	26	16	21	15
Elective				
Nonscience Required Courses	38	24	34	24
Total	160	100	140	100

Source: Chai-Sung Lee et. al., Development of Engineering Education in Korea; Journal of Chmical Engineering Education in Southeast Asia, Vol. 6, December 1976.