Engineering Education in Korea and the Role of KSEETT

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As we approach the 21st century, the century for knowledge-based industry, we face strong challenges in engineering education as much as in other sectors of higher education. In response to the challenges, we are forced to be more fundamental on one side, and to be more practical on the other. As a consequence, it is very much demanding that engineering education programs be restructured such that the engineering science aspect as well as the engineering technology aspect be fully developed throughout collegiate engineering education.

Keeping this megatrend in mind, in this presentation we would like to first review the status of engineering education in Korea, and then introduce the efforts of the Korean Society for Engineering Education and Technology Transfer(KSEETT) for the enhancement of engineering edu-

cation in Korea.

Recent Status of Engineering Education in Korea

The 6-3-3-4 education ladder system, which consists of elementary school - middle school - high school - higher education, was introduced in 1948, with the establishment of the Republic of Korea, and has been effective through out the past half century. The higher education part of the education ladder has been diversified adding junior colleges, teachers colleges, air & correspondence colleges and industrial colleges to the existing regular college/university system.

The number of higher educational institutes has steadily increased during the past decade, from 1986 to 1996, as illustrated in Table 1. We

Table 1. Number of Institutions for Higher Education

Year	Regular Colleges/ Universities	Junior Colleges	Teacher's Colleges	Air & Correspondence Colleges	Industrial Universities	Others	Overall
1986	100	120	11	1	8	25	265
1987	103	119	11	1	8	26	268
1988	104	119	11	1	8	26	269
1989	104	117	11	1	8	26	267
1990	107	117	11	1	8	23	267
1991	115	118	11	1	8	22	264
1992	121	126	11	1	8	19	267
1993	127	128	11	1	12	21	300
1994	131	135	11	1	14	18	310
1995	131	145	11	1	17	18	323
1996	134	152	11	1	17	18	333
Increase in Decade	34.0%	26.7%	–	–	112.5%	-28%	25.7%

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Table 2. Number of Departments for Higher Education

Year	Regular Colleges/ Universities	Junior Colleges	Teacher's Colleges	Air & Correspon-dence Colleges	Others	Overall
1986	3,181	986	381	13	78	4,639
1987	3,266	994	267	13	84	4,724
1988	3,626	1,059	336	13	108	5,142
1989	3,854	1,161	346	13	108	5,482
1990	4,009	1,264	345	14	109	5,741
1991	4,140	1,365	350	14	113	5,982
1992	4,315	1,662	350	17	115	6,459
1993	4,408	1,843	350	16	131	6,748
1994	4,593	1,987	350	16	124	7,070
1995	4,931	2,062	472	16	125	7,606
1996	5,441	2,179	468	17	116	8,221
Increase in Decade	71.0%	121.0%	22.8%	30.8%	48.7%	75.9%

Table 3. Number of Students in Higher Education

Year	Regular Colleges/ Universities	Junior Colleges	Teacher's Colleges	Air & Correspon-dence Colleges	Others	Overall
1986	971,127	250,352	21,106	148,856	19,608	1,262,493
1987	989,503	259,898	20,616	146,990	21,568	1,291,585
1988	1,003,648	266,844	18,765	142,074	22,796	1,312,053
1989	1,020,771	291,041	17,182	148,817	24,094	1,353,088
1990	1,040,166	323,825	15,960	148,650	23,947	1,403,898
1991	1,052,140	359,019	16,019	163,433	22,449	1,449,657
1992	1,070,169	404,996	15,504	180,358	19,759	1,885,393
1993	1,092,464	456,227	17,158	327,895	17,399	1,995,047
1994	1,132,437	506,806	18,291	310,955	17,011	2,086,912
1995	1,187,735	569,820	19,650	314,977	17,206	2,230,058
1996	1,266,876	642,697	20,439	327,185	14,828	2,412,025
Increase in Decade	30.5%	156.7%	-3.2%	119.8%	-24.4%	91.1%

see an increase of 25.7% overall, and increases of 34.0% and 26.7% respectively for regular colleges/universities and junior colleges. The rate of increase in these two categories is noteworthy, as they form the main stream of higher education.

The trend of diversification is better demonstrated by comparing the growth in the number of departments in each year. According to Table 2, the number of departments has increased from 4,639 to 8,221 in total during the decade, which amounts to an increase of 75.9%. This rate culminates in the category of junior colleges, which records 121%!

Even more striking changes appear in the number of students in higher education. According to Table 3, the number of student has increased from 1,262,493 to 2,412,025 during the decade, which corresponds to an increase of 91.1%. This increase is mainly driven by the categories of junior colleges and air & correspondence colleges, which have increases of 157% and 120% respectively. In contrast, the increase of students in the regular universities/colleges is comparatively low : roughly 30.5%.

There is significant growth in terms of the number of faculty members also. According to Table 4, during the decade the number of faculty members has increased by 81.5%, excluding the faculty members in the

Table 4. Number of Faculty Members in Higher Education

Year	Regular Colleges/ Universities	Junior Colleges	Teacher's Colleges	Air & Correspondence Colleges	Others	Overall
1986	27,580	6,465	644		453	35,162
1987	28,642	6,458	653		459	36,521
1988	29,885	6,762	680		507	38,252
1989	31,675	6,999	679	132	597	39,950
1990	33,340	7,382	694	136	504	41,920
1991	25,175	7,953	693	142	410	44,231
1992	37,287	8,518	719	149	340	46,864
1993	39,511	9,024	736	159	350	49,621
1994	41,576	9,375	745	164	402	52,098
1995	45,087	10,384	766	166	468	56,705
1996	46,582	11,515	786	168	403	63,809
Increase in Decade	68.9%	78.1%	22.0%		-11.0%	81.5%

air & correspondence colleges. This is mainly due to the 68.9% increase in the faculty members of regular colleges/universities. While the increase of faculty members in professional colleges is 78.1%, this is comparatively low when compared with the 91.1% increase of the number of students.

From these observations, we may conclude that the higher education in Korea has been driven by the regular colleges/universities and junior colleges during the past decade. In fact, there is a contrast in the two categories in that the former has made steeper increases in faculty members while the latter has made sharper increases in the number of students.

Next we consider the status of engineering education as a subset of higher education in general. Noting that the engineering education is included mainly in the categories of regular colleges/universities and junior colleges, we concentrate on these two categories in comparing various statistics below.

The number of colleges that provide engineering education has increased as listed in Table 5 during the past decade. This table may be viewed as an extension of Table 1, and thus the column for "overall" encompasses the same categories in both tables. If we extend Tables 2 through 4 in a similar manner to exhibit the statistics on engineering ed-

Table 5. Number of Colleges Providing Engineering Education

Year	Regular Colleges/ Universities		Junior Colleges		Overall	
	Overall	Engineering	Overall	Engineering	Overall*	Engineering
1986	100		120		265	
1987	103		119		268	
1988	104		119		269	
1989	104	76	117	38	267	114
1990	107	71	117	40	267	111
1991	115	72	118	40	264	112
1992	121	81	126	46	267	127
1993	127		128		300	
1994	131	91	135	64	310	155
1995	131		145		323	
1996	134	90	152	76	333	166
Increase in Decade	34%		26.7%		25.7%	

* "Overall" encompasses all the categories of higher education

Table 6. Number of Departments for Engineering Education

Year	Regular Colleges/ Universities		Junior Colleges		Overall	
	Overall	Engineering	Overall	Engineering	Overall*	Engineering
1986	3,181	496	986	306	4,639	802
1987	3,266	539	994	309	4,724	848
1988	3,626	621	1,059	328	5,142	949
1989	3,854	688	1,161	349	5,482	1,037
1990	4,009	720	1,264	379	5,741	1,099
1991	4,140	777	1,365	411	5,982	1,188
1992	4,315	766	1,662	492	6,459	1,258
1993	4,408	806	1,843	546	6,748	1,352
1994	4,593	870	1,987	610	7,070	1,480
1995	4,931	977	2,062	678	7,606	1,655
1996	5,441	1,119	2,179	729	8,221	1,848
Increase in Decade	71.0%	125.6%	121.0%	138.2%	77.2%	130.4%

* "Overall" encompasses all the categories of higher education

Table 7. Number of Students in Engineering Education

Year	Regular Colleges/ Universities		Junior Colleges		Overall	
	Overall	Engineering	Overall	Engineering	Overall*	Engineering
1986	971,127	202,588	250,352	98,961	1,262,493	301,549
1987	989,503	210,684	259,898	103,448	1,291,585	313,132
1988	1,003,648	216,449	266,844	105,754	1,312,053	322,203
1989	1,020,771	227,554	291,041	119,196	1,353,088	346,750
1990	1,040,166	239,436	323,825	134,195	1,403,898	373,631
1991	1,052,140	249,925	359,019	151,225	1,449,657	401,150
1992	1,070,169	240,835	404,996	177,092	1,885,393	417,927
1993	1,092,464	255,620	456,227	201,594	1,995,047	457,214
1994	1,132,437	274,430	506,806	223,803	2,086,912	498,233
1995	1,187,735	299,665	569,820	254,015	2,230,058	552,680
1996	1,266,876	334,120	642,697	285,122	2,412,025	619,242
Increase in Decade	30.5%	64.9%	156.7%	188.1%	91.1%	105.4%

* "Overall" encompasses all the categories of higher education

ucation, we obtain Tables 6 through 8, respectively for the number of departments, the number of students, and the number of faculty members.

Comparing the statistics in Tables 5 to 8, we observe that in every feature the growth rate is much higher in engineering education than the rate in overall higher education. If we single out the number of students for comparison, we see an increase of 105% for the engineering education, which was 91.0% for the overall higher education. This increase is contributed mainly by engineering colleges in the regular colleges/universities category; their increase rate is double that of the overall colleges.

Table 9 lists a summary of the statistics for engineering education in contrast to those for higher education in general.

As an extension of engineering education, we consider the advanced education in engineering graduate schools and the R/D(research and development) activities in the science and technology fields.

The numbers of engineering students in master's and doctoral studies are 21,486 and 5,480, respectively, as of year 1996. These numbers correspond to 17.9% and 23.4%, respectively, of the total numbers of students at the same level of advanced education in general. According to Table 10, during the past decade, the numbers of engineering students in

Table 8. Number of Faculty Members in Engineering Education

Year	Regular Colleges/ Universities		Junior Colleges		Overall	
	Overall	Engineering	Overall	Engineering	Overall*	Engineering
1986	27,580		6,465		35,162	
1987	28,642		6,458		36,521	
1988	29,885	4,366	6,762	2,140	38,252	6,506
1989	31,675	4,475	6,999	2,236	39,950	6,711
1990	33,340		7,382		41,920	
1991	25,175	5,181	7,953	2,547	44,231	7,728
1992	37,287		8,518		46,864	
1993	39,511	6,537	9,024	3,123	49,621	9,660
1994	41,576		9,375		52,098	
1995	45,087	7,957	10,384	3,728	56,705	11,685
1996	46,582		11,515		63,809	
Increase in Decade	69.9%		78.1%		81.5%	

* "Overall" encompasses all the categories of higher education

Table 9. A Summary of Statistics for Engineering Education

Year	Number of Colleges		Number of Departments		Number of Students		Number of Faculty Members	
	Overall	Engineering	Overall	Engineering	Overall	Engineering	Overall	Engineering
1986	265	–	4,639	802	1,262,493	301,549	35,162	
1987	268	–	4,724	848	1,291,585	314,132	36,521	
1988	269	–	5,142	949	1,312,053	322,203	38,252	6,506
1989	267	114	5,482	1,037	1,353,088	346,750	39,950	6,711
1990	267	111	5,741	1,099	1,403,898	373,631	41,920	
1991	264	112	5,982	1,188	1,449,657	401,150	44,231	7,728
1992	267	127	6,459	1,258	1,885,393	417,927	46,864	
1993	300	–	6,748	1,352	1,995,047	457,214	49,621	9,660
1994	310	155	7,070	1,480	2,086,912	498,233	52,098	
1995	323	–	7,606	1,655	2,230,058	552,680	56,705	11,685
1996	333	166	8,221	1,848	2,412,025	619,242	63,809	
Increase in Decade	25.7%		77.2%	130.4%	91.1%	105.4%	81.5%	

Table 10. Number of Students in Advanced Engineering Education

Year	Master		Doctor (Ph.D.)	
	Overall	Engineering	Overall	Engineering
1986	59,184	8,124	10,778	1,899
1987	59,490	9,305	10,874	1,894
1988	63,254	10,334	11,863	2,129
1989	67,840	11,063	13,331	2,545
1990	72,417	11,861	14,494	2,898
1991	76,338	13,085	14,966	3,156
1992	80,417	13,334	16,160	3,532
1993	80,329	15,419	17,645	4,198
1994	90,890	17,090	19,093	4,576
1995	93,993	18,322	18,735	4,599
1996	119,910	21,486	23,464	5,480
Increase in Decade	102.6%	164.3%	117.7%	188.6%

master's and doctorial studies have increased by 165% and 118%, respectively, which are higher than the increase rates of overall master's and doctorial students. We find a similar trend in the number of departments that provide master's and doctorial study programs from Table 11. Especially, we observe a dramatic 197% growth in the number of departments that provide master's studies in engineering.

Table 12 lists a summary of statistics for advanced engineering education including the master's and doctorial studies in comparison with that for undergraduate engineering education. From the table we observe that the growth in engineering education has been predominated by the graduate school level education.

The R/D investment in science and technology in Korea has escalated as shown in Table 13 during the past decade. In this period the R/D investment has increased by 6.6 times in total amount. In terms of the percentage over GNP, the R/D investment has increased from 1.73% to 2.71%. However, the portion invested by the government has gradually decreased.

If we consider the number of SCI(Science Citation Index) journal papers as a measure of the outcome for R/D investment in science and technology, we get the statistics listed in Table 14. The growth rate is impressive in number of papers, as well as in country rank.

Table 11. Number of Departments for Advanced Engineering Education

Year	Master		Doctor (Ph.D.)	
	Overall	Engineering	Overall	Engineering
1986	1,931	339	1,020	225
1987	1,938	353	1,004	219
1988	2,533	453	1,137	241
1989	1,774	466	1,239	265
1990	1,998	541	1,289	284
1991	3,217	609	1,358	318
1992	3,418	620	1,426	324
1993	3,607	704	1,503	349
1994	3,784	770	1,546	365
1995	4,225	855	1,602	378
1996	4,787	1,008	1,737	419
Increase in Decade	147.9%	197.4%	70.3%	86.2%

Table 12. A Summary of Statistics in Engineering Education

Year	Number of Students		Number of Departments	
	Undergraduate	Graduate	Undergraduate	Graduate
1986	301,549	10,023	802	564
1987	314,132	11,199	848	572
1988	322,203	12,463	949	694
1989	346,750	13,608	1,037	731
1990	373,631	14,759	1,099	825
1991	401,150	16,241	1,188	927
1992	417,927	16,866	1,258	944
1993	457,214	19,617	1,352	1,053
1994	498,233	21,666	1,480	1,135
1995	552,680	22,921	1,655	1,233
1996	619,242	26,966	1,848	1,427
Increase in Decade	105.4%	169.0%	130.4%	153.0%

Table 13. R/D Investment in Science and Technology

Year	R/D Investment (million $)	Percentage over GNP	Government : Industry Ratio
1986	1,856	1.73	23 : 77
1987	2,506	1.81	25 : 75
1988	3,587	1.87	21 : 79
1989	4,416	1.90	20 : 80
1990	4,676	1.88	19 : 81
1991	5,670	1.94	20 : 80
1992	6,391	2.09	18 : 82
1993	7,666	2.32	17 : 83
1994	9,826	2.60	16 : 84
1995	12,240	2.71	19 : 81
1996	*	*	*
Increase in Decade	(559.5%)	(56.6%)	–

* Data for 1996 not available

Table 14. Number of SCI Paper Publication (in Science and Technology)

year	Number of Published Papers	Rank among Countries
1986	846	
1987	1,082	
1988	1,227	37
1989	1,567	33
1990	1,780	33
1991	2,461	32
1992	2,997	30
1993	3,910	27
1994	5,814	24
1995	7,295	22
1996	(726.3%)	19
Increase in Decade		–

Comparing Tables 13 and 14, we find that the growth rate in the outcome of R/D in terms of SCI papers is comparable to that of the R/D investment. We may interpret this as showing that R/D in science and technology in Korea has been productive and rewarding.

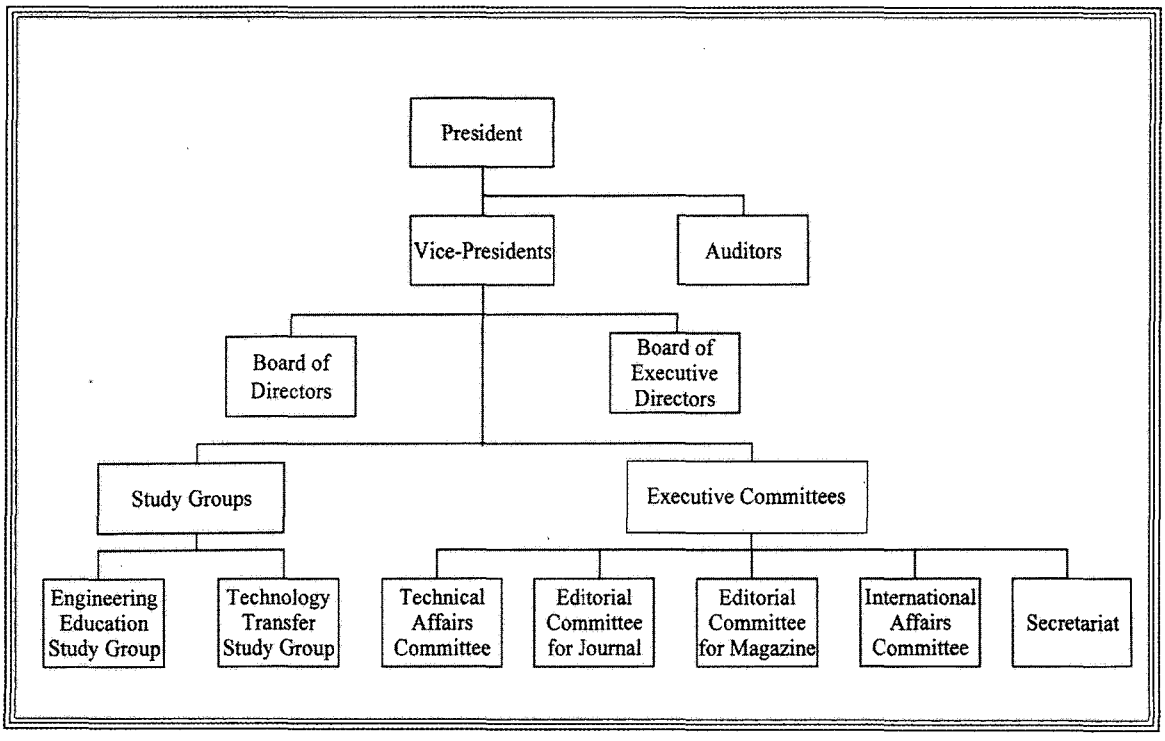
So far we have reviewed, using various types of statistics, the recent status of engineering education in Korea along with the related advanced studies and R/D activities. We have observed that higher education in the past decade in Korea has been driven by engineering education, and, further, engineering education itself has been predominated by the graduate school level advanced education. Also, we observed that the escalation of R/D investment in science and technology matches the growth of engineering education. On this basis, we may state that the progress in engineering education and the related R/D activities has supported the progress of high-tech industry in Korea during the past decade, and will further contribute to its future development. In addition, the diversification in the types of departments that has dominated the growth of engineering education during the past decade has to continue to drive the progress of engineering education of tomorrow so that it can pave the way for realizing the knowledge-based society in the upcoming new country.

Role of KSEETT

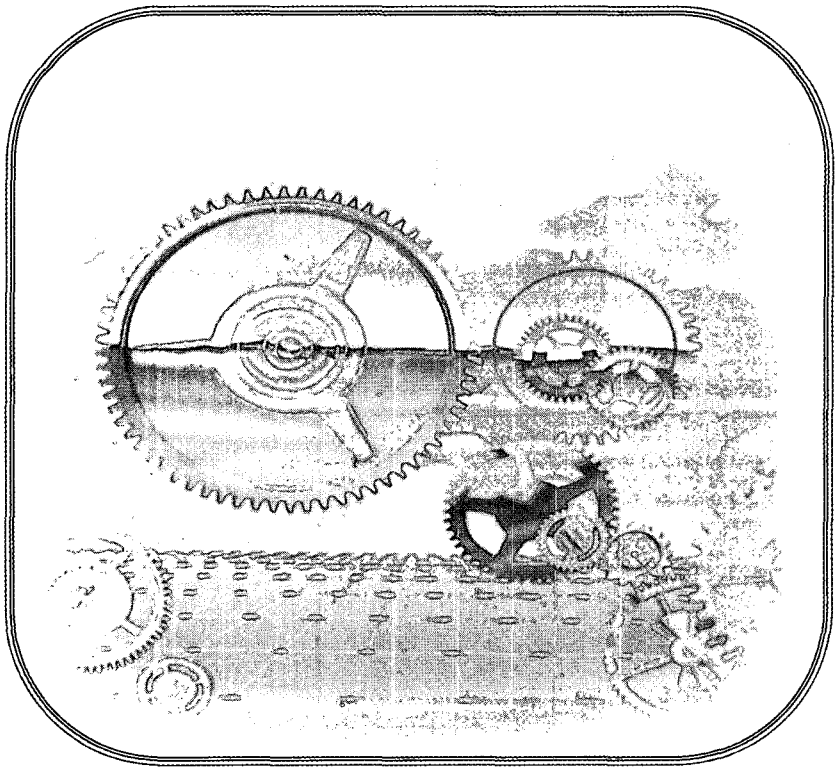
The KSEETT was established in 1993 for the goal of enhancing the engineering education and technology transfer activities in Korea. The Association of Deans of Engineering Colleges played a key role in establishing the society and has closely collaborated in sponsoring workshops, symposia, and conferences so far. The National Academy of Engineering, which has been collocated with the KSEETT since its foundation in 1995, is a sister organization of the society that shares a close partnership in various activities.

In order to accomplish the founding goal of the society, the KSEETT has concentrated on studying the methodologies, laws and regulations, and policies that involve engineering education and technology transfer. The related activities are carried out by two study groups — Engineering Education Study Group and Technical Transfer Study Group, respectively chaired by the Vice President for Technical Affairs and the Vice President for Industry Cooperations(see the organization of the KSEETT in Figure 1).

Figure 1. Organization of the KSEETT



In support of the above activities, three major committees are functional — the Technical Affairs Committee, the Editorial Committee for Journal and the Editorial Committee for Magazine. The Technical Affairs Committee supports the society activities by holding conferences and workshops for presentations and discussions on engineering education and technology transfer. The two Editorial Committees respectively do editorial jobs for the journal that publishes reviewed academic papers and the magazine that publishes various types of articles related to the society activities.



The KSEETT has conducted several government-supported projects related to engineering education and technology transfer. Some selected subjects include "Reformation of engineering education to nurture high-quality engineers and technologists", "Enhancement of engineering education to secure international competitiveness", and "Renovation of engineering education curricula."

The KSEETT plans to organize a joint-meeting of industry leaders and engineering professors to open a forum for mutual exchange of information on engineering education and technology transfer. It also plans to organize an inter-society meeting among all major engineering societies in Korea, including the societies/institutes for chemical engineering, civil engineering, electrical and electronics engineering, and mechanical engineering, so that it can discuss common interests and problems among all fields of engineering.

More recently, the KSEETT has been considering ways to improve the quality of engineering education in preparation for the knowledge-based soci-

ety. Several possibilities have been considered, such as developing a series of lectures for fresh engineering professors, developing sample courses for engineering design education, and developing engineering education accreditation program fitted to Korean culture.

The KSEETT is a young organization but has formed a solid foundation for future growth and functionality in a short period of time. Its internal structure has been well organized and the financial status has become stable. Its identity as a society for promoting engineering education and technology transfer has been well received within the country and, as a consequence, its membership has grown continuously. The KSEETT is now entering its second stage of development, during which it will play a more important role in the advancement of engineering education in Korea. Further, the KSEETT will also actively pursue international collaboration in engineering education, contributing to the exchange and enhancement of engineering education in the Asia Pacific region and all over the world.

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