

# Renovation of Engineering Education System for ABEEK Accreditation at the Yeungnam University

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## Abstract

The needs for change in the traditional engineering education system in Korea have been evoked since 1998 when the Accreditation Board for Engineering Education of Korea (ABEEK) was about to be established. The engineering college at Yeungnam University has been one of the most active members in the Korean higher education institutions which participated in the ABEEK movement at the earliest stage. This paper reports the efforts made by Yeungnam University in preparing for the trial accreditation of engineering programs for the first time in Korea. The reformation and restructuring were made in many areas in order to establish the self-improving circulative engineering education system. The accreditation criteria were thoroughly investigated, and reforms were made in individual programs based on the critical assessment of existing system. The contents of educational reform and the experience during the trial accreditation process are summarized and discussed.

## 1. Introduction

To lead the knowledge and technology based society in the 21st century, many countries are putting a great deal of efforts in renovating and strengthening the engineering education system and educational environment at the government level. The renovation is being made for better engineering education based on new paradigms set by the international community. The EC(Engineering Criteria)

2000 by the Accreditation Board for Engineering and Technology(ABET) tends to be adopted as an international standard in engineering education. More than 30 countries including U.S.A., Canada, Australia and Great Britain participated in constructing the international network of mutual accreditation of engineering education (Washington Accord), in which the graduates from the accredited engineering programs are equally recognized as first class engineers among the

member nations. The ABET is a federation of 28 engineering specialty groups in the U.S.A., and about 95 percent of engineering colleges in the U.S.A. are currently participating in the accreditation. Japan also organized the JABEE(Japan Accreditation Board for Engineering Education) in 1999 and plans to operate the accreditation system in the near future.

In Korea, the ABEEK(Accreditation Board for Engineering Education of Korea) was established in 1999 to keep pace with the transitions occurring in the international community, and the era of engineering education accreditation has just started with the trial accreditation performed in the year 2000. The ABEEK plans to join the membership of Washington Accord in the near future and serve as a nucleus for improving the quality of Korean engineering education to the international standards.

Yeungnam University had been systematically preparing for the accreditation of engineering education well before the establishment of ABEEK to cope with domestic and international transitions in engineering education and thus to improve the quality of engineering education as well as the reputation of the university. Especially since the engineering college was selected as one of the eight government-supported engineering colleges in education (mechanical engineering, materials and metallurgical engineering), continuous efforts have been made to improve the contents of engineering education and develop new programs for better education. A research project, "the development of engineering education model for the 21<sup>st</sup>

century", was carried out in 1998 which was sponsored by engineering college, and as a result new engineering curricula ( $\pi$ -type curricula) were developed to educate the students as practicing engineers tailored to the industry(1, 2). The board of engineering education was also formed in the engineering college in 1999 and has been working as a strategic planning team to reform the education system in order to accommodate the various aspects of ABEEK criteria into the existing university education system. With these preparations Yeungnam University participated in the trial accreditation by ABEEK for the first time in Korea with Dongguk University in the year 2000.

Three programs (architectural engineering, mechanical engineering, and chemical engineering) in the engineering college participated in the ABEEK accreditation. The program self-study reports were first prepared and submitted to the ABEEK on November 15<sup>th</sup>, 2000(3, 4, 5). The on site evaluation was then carried out by the evaluators from ABEEK for three days from March 25<sup>th</sup> to 27<sup>th</sup> in 2001. The ABEEK accreditation board was formed in each program to prepare for the self-study report, and the board was composed of four committees (program committee, curriculum committee, evaluation committee, and external advisory committee) in which all the faculty members in the program and the advisory members from industry and alumni association were included. The ABEEK accreditation boards carefully investigated the existing education system on the whole and developed the new system for further improvement of each

program. This task was accomplished with full support and cooperation from the university head quarters and the engineering college. In this report, some of the contents of educational reforms made at the Yeungnam University were summarized and discussed.

## 2. The activities of the board of engineering education for the trial accreditation

The board of engineering education at the college of engineering was formed in May 1<sup>st</sup>, 1999 just before the establishment of ABEEK. It has been working as a steering team to renovate the engineering education system on the whole. The board is composed of the representatives from 11 different disciplines at the engineering college and 2 associate deans. The major

activities made by the board were as follows:

- 1) Benchmark the education system of ABET accredited foreign institutions(6, 7)
- 2) Study the ABEEK accreditation criteria and transmit the acquired information to the departments
- 3) Hold the conferences and workshops related to the engineering education
- 4) Attend the meeting and conferences related to the ABEEK
- 5) Conduct the surveys and statistical analyses to analyze the existing system
- 6) Investigate the current engineering curricula and develop the new curricula
- 7) Establish the educational objectives of engineering college

〈Table 1〉 The credit structures of the college of engineering

Old Credit Structure				New Credit Structure	
Division		Minimum credit for graduation		Division	Minimum credit for graduation
General Education	General Education Basic	7	35	General Education	20
	General Education Elective	28			
Engineering Major	Basic Major	12	65	Engineering Basics (BSM)	36
	Major	53			
General Elective		40*		General Elective	14*
Total		140		Total	130

\* The general elective credits are assumed to be the minimum credits for graduation.

<Table 2> The construction principles of engineering curricula

	First Semester	Second Semester
Freshman	Instill basic abilities	Present visions, Search aptitude, Introduce major fields
Sophomore	Engineering commons, Core basics in major	Enter major courses, Related engineering commons
Junior	Core major courses	Major deepening courses, Design-oriented courses
Senior	Major deepening courses, Interdisciplinary courses, Design-oriented courses	Introductory courses for various industrial fields, Multidisciplinary courses, Capstone design courses, Major deepening courses related to the graduate school

- 8) Investigate the general education and BSM(basic science and math) for engineering education
- 9) Brainstorm and conform the ideas to develop the new education system
- 10) Work with university headquarters and other colleges to accomplish the structural changes at the university level

One of the achievements made by the board of engineering education was to change the structure of credits required for graduation. Table 1 shows the comparison between the old and new credit structures at the engineering college. The new structure was proposed and implemented to satisfy the ABEEK criteria, in which the total credit hour is reduced from 140 to 130, and the BSM courses are grouped in separate division and further strengthened. These changes were made after carefully analyzing the transcripts of the recent graduates from all the disciplines in the engineering college.

The principles of constructing the engineering curriculum were also developed by the board and shown in Table 2. The

concept of  $\pi$ -type curriculum was embedded in the principles and the various aspects of ABEEK criteria were fully considered[2].

The BSM subject pool of total 60 credits was newly established for the engineering college and shown in Table 3. Students in the individual programs are supposed to take the minimum 36 credits offered by the program in the new system, and the requirement for the BSM credits is much more strengthened compared to the old system.

Many new courses were developed by the board and added to the general education courses, and these are communication skills, engineering economics, engineering ethics, etc. The BSM syllabi were reorganized to meet the demands in outcomes of individual programs with the help from the college of natural sciences. The system for advisory conference between the faculty and the student is also developed and introduced. The activities of the board of engineering education are still continuing to further improve the engineering education system at the Yeungnam University.

<Table 3> The BSM subject pool for the college of engineering

Division		Course	Credit
Mathematics	General Education Elective	CALCULUS <sup>3)</sup>	4
		VECTOR CALCULUS <sup>3)</sup>	4
		MATRIX AND MATRIX EQUATIONS	2
		BASIC STATISTICS	3
		APPLIED STATISTICS	3
	Engineering Major	ENGINEERING MATHEMATICS(1) <sup>1)</sup>	3
		ENGINEERING MATHEMATICS(2) <sup>2)</sup>	3
		ENGINEERING MATHEMATICS(3) <sup>2)</sup>	3
	Credit Total		25
Basic Science	General Education Elective	GENERAL PHYSICS (I)	3
		GENERAL PHYSICS LABORATORY (I)	1(2)
		GENERAL PHYSICS (II)	3
		GENERAL PHYSICS LABORATORY (II)	1(2)
		GENERAL CHEMISTRY (I)	3
		GENERAL CHEMISTRY LABORATORY (I)	1(2)
		GENERAL CHEMISTRY (II)	3
		GENERAL CHEMISTRY LABORATORY (II)	1(2)
		GENERAL CHEMISTRY	3
		GENERAL CHEMISTRY LABORATORY	1(2)
	GENERAL BIOLOGY (I) <sup>4)</sup>	3	
	General Elective	EARTH SCIENCE <sup>5)</sup>	2
Credit Total		25(30)	
Computer Science	General Education Elective	COMPUTER PROGRAMMING WITH EXERCISES <sup>3)</sup>	3(4)
	Engineering Major	NUMERICAL ANALYSIS WITH PRACTICE <sup>1)</sup>	3(4)
		CAD AND PRACTICE <sup>2)</sup>	2(3)
		COMPUTER-AIDED INSTRUMENTATION AND LABORATORY <sup>2)</sup>	2(3)
Credit Total		10(14)	

1) Engineering Mathematics (1) is offered as a major core course in each program.

2) Being included in the engineering major courses of each program.

3) Being included in the general education elective courses.

4) The contents of General Biology (1) are specially designed for the engineering college.

5) Being included in the general elective courses.

### 3. The preparation for the trial accreditation in architectural engineering program

The School of Architecture at the Yeungnam University has two separate programs: architecture program and

architectural engineering program. The architecture program is mainly aimed at fostering architects, and the architectural engineering program is aimed at fostering professionals for architecture related industries. The architectural engineering program was recently renovated to meet the education customers' demand and to cope with social changes and technical developments and participated in the trial ABEEK accreditation. In the preparation of trial accreditation, various aspects of accreditation were carefully analyzed, and the curriculum was reconstructed according to the self-improving circulative engineering education model.

Engineering major education in the architectural engineering program at the Yeungnam University emphasizes practical aspects rather than theoretical aspects.

Especially, the program is aimed at fostering architectural engineers and construction managers through the educational system to improve analytic thinking, to emphasize fundamentals and to experience various experiments and practical training. Construction structure, environment and facility, execution of construction and construction management are much emphasized during the education to foster the professionals suited for various types of jobs including structure engineers, facility engineers, operation engineers, construction managers, and researchers in the construction fields. The newly developed curriculum will be applied to the freshmen from 2002, and the graduates from the architectural engineering program will have the necessary abilities as practicing engineer right after

the graduation[3].

#### **4. The preparation for the trial accreditation in mechanical engineering program**

The School of Mechanical Engineering was selected as one of the eight government supported programs by the Ministry of Education (MOE) of Korea through nation-wide competition in 1994, the Government-Sponsored Innovation Program for Engineering Education (GSIPEE). It received over 25 million dollars from the Korean government for 5 years from 1994 to 1999 to pursue the educational excellence in the undergraduate programs.

Dramatic improvements have been made in the following key areas: upgrade of the educational environment (educational lab equipment and facilities, multimedia facilities, scholarships and other student welfares, new buildings, scientific and engineering instrument center, university-industry cooperative research center, learning factories, student dormitory, etc.), strengthening of research and educational personnels (new faculty members, adjunct-industrial research professors, invited distinguished professors, teaching assistants, etc.), renovation of curriculum (innovative and practical engineering education, design-oriented program, CAD/CAM and other computer application courses, interdisciplinary courses, technology management courses, etc.), and development of university-industry cooperative programs which had been continued to receive financial support for promotion of quality engineering

education and growth of the school.

Also, in 1999 the School was selected by MOE as a headquarter school of BK21 regional university upbringing project in the area of mechanical engineering to receive financial support for the next 7 years in order to cultivate high quality creative human resources to lead the knowledge-based society of the 21<sup>st</sup> century. Hence, the school has acquired a profound base to provide quality education and research in this era of international competition in technology and ever-changing industries.

The curriculum of the school consists of three fields: Thermal and Fluid Mechanics, Materials and Mechanics of Solids, and Manufacturing and Control. These fields all provide basic and advanced mechanics courses and applications and experiments to enable students to lead in practical application of theories and research[4].

### **5. The preparation for the trial accreditation in chemical engineering program**

The School of Chemical Engineering and Technology was established in 1996 by the integration of the department of chemical engineering and the department of industrial chemistry. The school originated from the department of applied chemistry founded in 1947, which was the second in Korea, thus the school is 55 years old. This long history and tradition makes the school as one of the best chemical engineering related schools in Korea. Especially, more than 5500 graduates from the school are

working as professionals in many areas in the society who are definitely helping the school to develop in various aspects.

The school has been continuously taking necessary actions to enhance the quality of education and research, and among these the primary objective was chosen to upgrade the undergraduate education to foster the practicing engineers suited for a variety of chemistry related fields. The step by step actions were taken to achieve the goal as early as possible and as a part of these efforts the two majors (chemical engineering and industrial chemistry) were integrated into a single major, which was designed to foster the practicing engineers in the chemistry related industries. The participation in the trial accreditation by ABEEK was made with this newly developed "chemical engineering program" [5].

The renovations made in the school are shown in Figure 1. Several investigations and surveys were conducted before the reformation of curriculum structure to meet the demands from the education customers and also to meet the ABEEK accreditation criteria. The educational system was completely reorganized and documented to meet the international standards in chemical engineering education. This newly developed system is well predictable and well documented and thus can be mostly run by the officials in the school (not by the faculty) office. The yearly calendar of ABEEK accredited education is made and posted for all the students and faculty members. The advisory conference between the faculty and the student (including office hours)

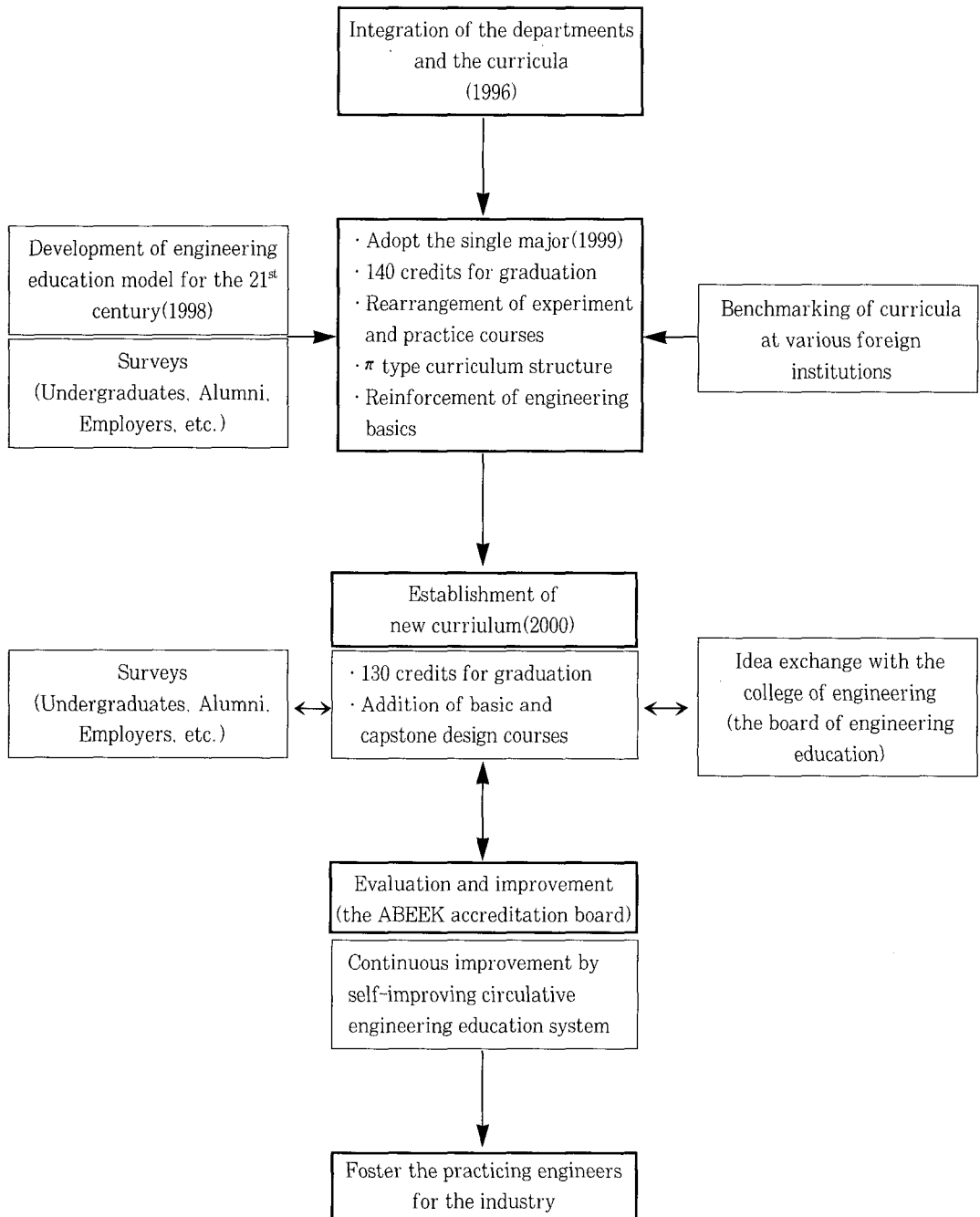


Fig 1. Renovation process flow of chemical engineering education system



becomes mandatory before the course enrollment, and regular surveys and course evaluations are made to assess the outcomes of the program. The objectives and syllabi of all the courses were documented and open to the students through home page and many course materials are electronically processed and open to the students. The curriculum tree was constructed to help the students in choosing the courses in the program.

Several assessment tools were also developed to measure and guarantee the quality of the graduates, and one of them is the web-based SPA(Student Portfolio Analysis) program which takes into account all the possible ingredients of outcomes achieved by the student upon graduation (not just the grade point average of all the courses taken). The measures from the SPA evaluation will be compared with the results from other assessment tools including the feed-backs from the employers and modified to

upgrade the system{8}.

## 6. Concluding remarks

Three engineering programs, architectural engineering, mechanical engineering, and chemical engineering, at the Yeungnam University participated in the trial accreditation of engineering education by ABEEK for the first time in Korea.

Careful investigations and preparations are made by each program and university before entering the accreditation process to meet all the accreditation criteria and demands from the education customers. The trial ABEEK accreditation was successfully implemented, and the accreditation of engineering education is believed to upgrade the quality of engineering education in Korea. Further renovations should be continuously made to effectively operate the self-improving circulative engineering education system.

### [ References ]

- [1] Yeungnam University, "The Development of Engineering Education Model for the 21st Century", 1998.
- [2] Byeong Gi Lee, Doh-Yeon Kim, Tai-Yoo Kim, Jang Moo Lee, Young Je Yoo and Yoo Shin Kim, "π Structured Education System", Journal of Engineering Education Research, 1, 5, 1998.
- [3] Yeungnam University, "Program Self-Study Report for Architectural Engineering", 2000.
- [4] Yeungnam University, "Program Self-Study Report for Mechanical Engineering", 2000.
- [5] Yeungnam University, "Program Self-Study Report for Chemical Engineering", 2000.
- [6] Miami University, "Program Self-Study Report for Manufacturing Engineering", 1998.
- [7] University of Florida, Chemical Engineering, "Engineering Criteria 2000 Program Self-Study Report", 2000.
- [8] Proceedings of the AEESEAP Midterm Conference 2001, "A New Approach to the Quantification of Program Outcomes", 149, 2001.