Current Status of Engineering Education in Japan and the Role of JSEE

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I. Introduction

During the last decade of the 20th century, Japan had gone through various drastic changes in the social structure. Economic depression started around 1990 forced severe change in employment custom. Lifetime employment is no longer promised. Major Japanese industries used to provide in house CPD programs for the employees but this system may not be so effective in near future. On the other hand, educational institutions such as universities are not ready to take it over.

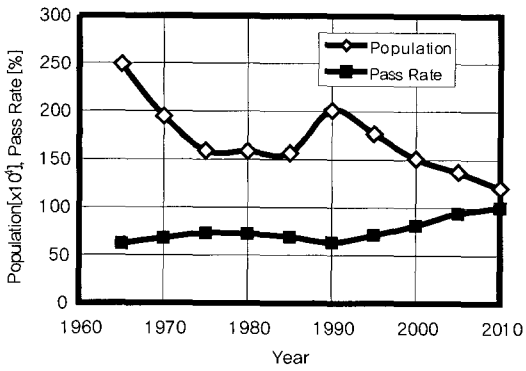
Japanese universities have their own problems. They devoted much effort to research activity and the development of teaching methodology for engineering education was not a major effort for professors. Promotion has been counted only on the research activities. Engineering education in Japanese university was more from the view point of "study" rather than from the view point of "technology". In other words, engineering education in Japan is said to be behind the international level, although the level of Japanese industries and their products are considered to be one of the highest in the world. Decrease of 18 years old population is, however, forcing universities to change these attitudes. University education is no more for elite only but is becoming very popular among young people. JABEE, Japan Accreditation Board for Engineering Education, has started with these backgrounds. Programs for engineering education must be tailored to meet the requirement of the demand to educate "engineers", not "engineering scholars". Another university reform came from the government. National universities will no longer be supported financially by the government in full but as of April 2004, private enterprise style administration will be introduced.

This paper describes the problems now Japanese engineering education is facing and the role of JSEE, Japanese Society for Engineering Education, in order to reorganize the engineering education in Japan.

II. Changes in Japanese Education

Primary and high school education in Japan used to be very dense and high level in knowledge base but was considered to be ineffective to develop creativity. At the end of the 20th century, Ministry of Education introduced so called "More Enjoyable Education" to these level of education in order to promote the development of creativity in the early stage of life. Learning hours were cut down but instead of developing creativity, reverse effect seems to dominate. New education programs seem to have resulted in "premature scientific education" for high school graduates.

The most urgent problem for universities to cope with is



〈Fig 1〉 Population of 18 Years Old and the Pass Rate of University Entrance Examination.

the decrease of the population of 18 years old as shown in Fig. 1. After peaking as 2 million in 1990, it is continuously decreasing and it will be 1.2 million in 2010, which is the same as the capacity of the freshman of the entire universities in Japan. This means that the pass rate of the entrance examination to universities will be 100% in 2010. It was foreseen in the last decade and universities have been making every effort to keep enough students. This attitude of universities also created problems by themselves by introducing various kinds of entrance examinations, some of which don' t require enough mathematical or scientific knowledge to enter to engineering schools..

As the engineering education in universities became so popular and the level of the freshman became lower, developing the teaching methodology for various levels of students is now very important. JABEE, with the cooperation of JSEE, is expected to have an intrinsic role to reorganize the system of engineering education in Japan.

Another pressure to reorganize university education came from the government. National University Corporation law will be implemented in April 2004. The present national universities will no longer be supported financially in full by the government but private enterprise style administration started in April 2004. Some of them have been combined to be one university and the number was decreased to 89 from 99.

The appointment of external specialists to university trustees or administrative positions is planned so that universities can be run in a well-planned yet flexible manner, by introducing new merit-based and ability oriented human resources system, as well as industry standard profit/loss accounting system. Introduction of the principle of competition to universities according to the 3rd party evaluations is also suggested. The evaluation should be made by specialists and private consultants, with the main allocation of funding based on the results of these evaluations, and aiming at the raising of levels of COE (Center of Excellence) universities to the world' s highest standards.

Table 1 shows the number of university, faculty of engineering and student for national, public and private universities. While private universities have majority of the undergraduate students, national universities have more graduate students, particularly in doctor course. This is partly due to the fact that the tuition of national universities is less than a half of private universities and the scholarships for graduate study are not enough to support the students in private universities. Table 2 shows the increase of the student from 1990 t0 2000. While the increase of the undergraduate is 20%, the number is doubled for master' s student and nearly tripled for doctoral student. National universities are recruiting more graduate students in the past decade and the increase of the graduate student is therefore mostly absorbed by the national universities.

The effect and the impact of the national university revolutions to the private universities are not clear yet and

〈Table 1〉 Number of University, Faculty of Engineering and Engineering Student as of 2000

	National	Public	Provate
University	99	74	497
Faculty of Engineering	57	14	90
Undergraduate Student	146,994	13,816	306,307
Master Student	38,374	2,272	18,436
Doctor Student	9,858	465	1,495

〈Table 2〉 Increase of Number of Student from 1990 to 2000 in Engineering School

	1990	2000	Ratio
Undergraduate Student	390,464	464,117	1.196
Master Student	28,399	59,076	2.080
Doctor Student	4,315	11,818	2.739

private universities are also looking for ways to survive the restructuring of the university education system.

III. Impact of ICT on Engineering Education

As ICT, Information and Communication Technology, has made a great progress in recent years, it has been increasingly making large influence to engineering education. The paper presented at the JSEE Annual Meeting recently showed notable increase over the previous year. The increase is mainly attributed to the papers concerning JABEE and ICT. The papers related to ICT were as follows:

System architecture exercises
Web use education
Computer hardware assembly
Computer graphics
3D CAD.
Teaching assistance system development
Programming contest.

The ICT also has a great impact on CPD programs in industries. At one particular company, there are over one thousand employees participating in e-Learning. This is not only considered as plain learning to upgrade skills, but as a corporate strategy. Some results of the survey we conducted at this particular company are as follows: (a) 70% answered that the program "was helpful", (b) 85% answered that they could put what they learned into practical use in the workplace, and (c) 91% believed that the program should be expanded to business partners. This is just one example, but there are many companies making use of ICT in ongoing education for employees

The effective use of ICT must be the key to the success of the revolution of engineering education both for national and private universities. Although most of the engineering institutions agree that the ICT would be necessary to improve the quality and possibly quantity of the engineering education considerably, the practical use of the ICT is not so popular yet. Methodology for ICT in engineering education is far from being established and the university that makes proper use of the ICT may be the winner in the revolution in engineering education.

IV. Development of JABEE

University education in Japan used to be a "sanctuary" and professors had great independence what to teach. Even colleagues in the same department did not interfere each other for their teaching contents. During the drastic social structure change in the last decade of the 20th century, however, university education suffered a lot by this outdated teaching system. The establishment of JABEE in 1999 was very timely to make necessary changes in the teaching system in universities. We used to use a Japanese word meaning "Engineering Scholar Education" for engineering education but JABEE explicitly uses the word meaning "Education of Engineers". As the university education became so popular in Japan, the graduates from engineering schools are expected to be "practical engineers" rather than "researchers". High level standard of the old day's undergraduate education has now shifted to the graduate schools. And even in the graduate school level for Master's degree, researcher type graduates are not so much in demand from the industries.

JABEE requires that each education program must teach the basic knowledge required for engineers including ethics as an engineer. Faculty members with industrial experience are particularly important in the program. The graduates from JABEE program will be exempt from the preliminary examination for Professional Engineer. Number of accreditation is shown in Table 3.

〈Table 3〉 Number of JABEE Accreditations

	1999	2000	2001	2002	2003
	Foundation				
Trial Accreditation	-	20	51	37	-
Accreditation	-	-	3	32	60 - 70
Washington Accord Membership			Provisional Membership		Full Signatory membership (2005)

During the trial period of 2000 - 2002, various improvements were made for the accreditation procedure and the requirements. Importance of supple-mentary standards for each particular field of engineering, in addition to the common standards, was clearly demonstrated. 'Plan-Do-Check-Action' order sequence of action for evaluation was noted. 'Amount of Study/Education' condition was added to give minimum of 1,800 hours of total guaranteed study time for each course.

The main activities of JABEE beside accreditation are as follows.

- Training of evaluation personnel.
- Participation in practical trials by ABET.
- Sponsoring symposiums nationwide to publicize the Engineering Education Accreditation System.
- The creation and the development of accreditation standards and evaluation methods, self-assessment documen-tation /methods, etc.

National College of Technology (NCT), a 5 year program of the combination of senior high school and junior college, is showing particular interest in JABEE. NCT cannot offer Bachelor' s degree because its engineering education program is equivalent to 2 yeas junior college program. However, additional 2 years advanced program in NCT may be able to offer Bachelor' s degree if the program is accredited by JABEE. It has passed 40 years since the establishment of NCT and now it is the turning point. NCT is searching for new role in engineering education among universities, particularly tied with JABEE.

JABEE has indicated its intention to join the Washington Accord. Through the assistance of related member countries, including official letters of support, JABEE was able to gain provisional membership status in the General Assembly of the Washington Accord held in South Africa, June 2001. JABEE is now aiming at achieving full signatory member status to the Washington Accord in 2005, and in order to realize this, JABEE is moving forward with careful preparations to gain the cooperation of all related member countries.

V. JSEE, Present and Future

JSEE was founded in 1952 with 7 Regional Societies of Engineering Education. This co-existence of JSEE and the Regional Societies left some administrative problems even today but we are aiming at consolidating all the regional societies to the single JSEE. The brief history of JSEE is shown in Table 4.

The present status of the memberships is shown in Table 5. While the individual members are nearly constant and university members are increasing, industrial and contributing members are constantly decreasing in the past decade. This is mainly due to the economy depression, however, it is true that JSEE could not well convince industries about the merit of the membership. The number of the individual members is not satisfactory either. We need more effort to make JSEE more attractive to both individuals in educational institutions and administrative personnel in industries. Table 6 shows the trend of the expenditure in the past decade. The increase of the operational expense is

〈Table 4〉 Brief History of JSEE

1952	Established with 7 Regional Societies
1973	AEESEA[1] established, JSEE joined as a Voting Member
1982	One regional society split into 2. Resulted in total 8 Regional Societies
1985	Organized 7th AEESEA Conference held in Tokyo
1993	Signed Agreement between JSEE and ASEE[2]
1996	Organized AEESEAP Midterm Conference in Tokyo
1997	Registered as a member of Science Council of Japan
1999	JSEE supported the establishment of JABEE
2001	IACEE[3] granted the 9th WCCEE[4] to JSEE to be held in Tokyo in May 2004
2003	Signed Agreement between JSEE and SEFI[5]
2003	Signed Agreement between JSEE and KSEE
2004	JSEE organized 9th WCCEE in May in Tokyo

[1] Association for Engineering Education in South East Asia. Later it became AEESEAP, Association for Engineering Education in South East Asia, East Asia and the Pacific.
[2] American Society for Engineering Education
[3] International Association for Continuing Engineering Education
[4] World Conference for Continuing Engineering Education
[5] European Society for Engineering Education (Societé Européenne la Formation des Ingénieurs)

〈Table 5〉 Trend of JSEE Memberships

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
University Members	157	178	181	191	192	193	194	200	205	211	212
Industry Members	239	203	203	194	192	178	161	144	129	103	101
Contributing Members	73	69	69	68	64	61	52	46	41	36	32
Individual Members	3,159	3,155	3,159	3,189	3,035	3,123	3,004	3,072	3,067	3,080	3,181

〈Table 6〉 Trend of JSEE Expenditure

Unit: 1000JPY, Exchange rate 110 JPY to USD, CA

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Operation Expenses	21,210	12,501	14,723	15,906	23,094	16,180	19,436	39,109	61,061	83,630	83,000
Administration Expenses	41,551	41,561	43,599	39,197	34,441	40,159	43,235	29,968	27,281	25,660	20,550
Other Expenses	2,997	1,500	3,328	5,755	0	500	2,075	14,425	10,000	1,789	1,172

mainly due to the increase of the income for the research contracts from the government and other organizations.

As JSEE has cerebrated its 50th Anniversary in 2002, we must step forward to recreate JSEE in order to fulfill the expectations of our industrial society. Issues now JSEE is facing to be accomplished in this decade are as follows.