Accreditation as the Entrance to Professional Development of Engineers (Record of Presentation)

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Introduction

It is my great pleasure to participate in this Conference organized jointly by CMES and ASME. My first visit to China was in 1984 when CMES and JSME organized the first China-Japan Joint Conference on Fluid Machinery in Hangzhou. Every time I visit China, I am pleasantly surprised by the change and progress taking place with unbelievable speed.

This time I would like to report small progress we have made in Japan for enhancing professional development of engineers.

First, I would like to start with the facts we experienced.

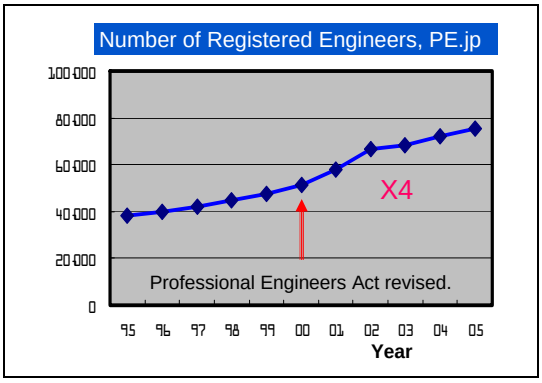

Figure 1: Number of Japanese PEs

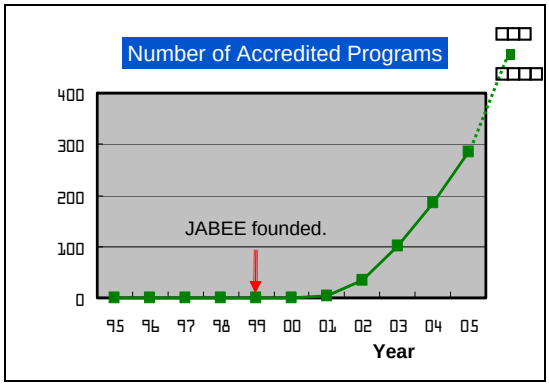

Figure 2: Number of Accredited Programs

Fig. 1 shows how number of registered professional engineers increased in the past ten years. The title of our professional engineer is indicated by PE.jp and can be distinguished from PE of the UAS. Japanese PE is a national qualification based on the Professional Engineers Act. This Act was revised in April 2000 to improve the compatibility and equivalence to globally acknowledged registered engineer such as PE of USA and Chartered Engineer of UK. Since the Act was revised, the number of annual registration increased four times, a remarkable increase.

Fig. 2 indicates the number of engineering programs that were accredited by JABEE, Japan Ac-

creditation Board for Engineering Education, since it was founded in 1999. JABEE accredited the first three programs in 2001, and has been adding about 100 programs each year. JABEE expects to accredit about 700 programs, a half of total programs presently offered in Japan, by the year 2010.

As you see from these figures, two big changes occurred almost simultaneously in Japan. They were of course coupled, and were driven by the common historical background.

The Background

Now, I would like to follow the background using the chronology shown in Fig. 3.

Impact of Globalization

1991: **Termination of Cold War Regime**
Globalization started to accelerate!
1995: /1 WTO founded > Free trade of services
/11 APEC Summit Meeting > Mobility of engineers
1996: /3 Coordination of APEC Engr by HRD-WG started
/5 Preparation for revision of PE Act
/7 Study of accreditation of eng. education
1997: /11 Final agreement on requirements for APEC Engr
1999: /11 Foundation of JABEE
2000: /4 Revision of Professional Engineers Act
2001: /3 First registration of APEC Engineer
2005: /6 Signatory to the Washington Accord

Figure 3: Chronology

The termination of Cold War Regime in 1991 was the beginning of big changes. Since then, globalization was accelerated by world-wide economic activities and rapid progress and diffusion of information and communication technologies.

1995 was a special year for engineering profession in Asia. World Trade Organization, WTO, was borne in January this year and took initiative to remove the barriers that restricted free trade of not only commodities but also services. Services are provided by humans, especially by specialists like accountants and engineers.

In accordance with this movement, the leaders of the Asian Pacific Economic Cooperation, APEC, held Summit Meeting in Osaka, Japan in November 1995 and adopted a resolution to accelerate the mobility of registered engineers within the region.

Next year in 1996, Human Resources Development WG of APEC started energetic coordination among member countries to establish a common regional engineering qualification called APEC Engineer. In the initial stage of the coordination, the educational requirement for APEC Engineer was to complete an *accredited* engineering program of Bachelor level at universities.

As the framework of APEC Engineer became gradually concrete, Japanese government started in 1996 to revise national systems to make them compatible with APEC or global systems. There were two major issues to cope with, that is, 1) the revision of old-fashioned domestic Professional Engineers Act and 2) the introduction of accreditation system for engineering education. The former started in May and the latter in July.

The final agreement on the requirements for APEC Engineer was settled in Sydney in November 1997, and the monitoring committees were founded in member countries for the registration of APEC engineers. Since the accreditation of engineering education was not common in the majority of Asian countries, the requirement for engineering education was later modified to include also engineering programs provided by *government-recognized* universities.

Japan Accreditation Board for Engineering Education was finally founded in November 1999 after intensive feasibility study and preparation for three years.

The revision of Professional Engineers Act passed the Diet in April 2000 and was enacted next year.

In March 2001, Japanese Monitoring Committee announced the names of 1500 APEC Engineers who were registered as the first entry.

In June 2005, JABEE was admitted as the ninth signatory member to the Washington Accord.

As you recognize from this chronology, big reforms in Japanese engineering profession took place in a relatively short period under a strong pressure to improve the mobility of engineers across the border of nations.

Life-long Professional Development of Engineers

In order to enhance engineering profession, it is needed to build an integrated national system to support life-long Professional Development of Engineers (PDE).

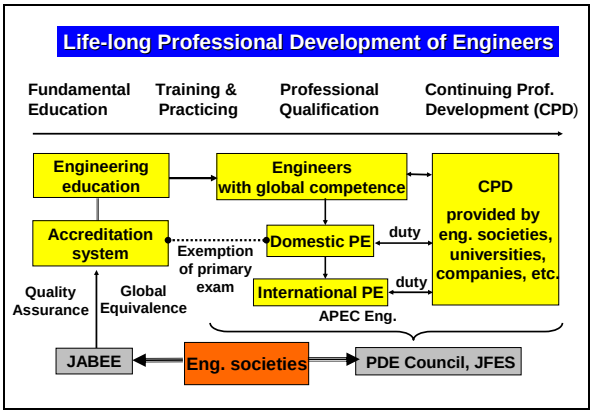

Figure 4: Integrated System for PDE

As shown in Fig. 4, such system must cover every stage of PDE, that is, a) fundamental education in universities, b) training and practicing or Initial Professional Development (IPD), c) professional qualification and finally d) Continuing Professional Development (CPD).

Engineering education of Bachelor level in universities provides fundamental training needed for entry-level engineers. To improve the quality of education and to assure the global equivalence, JABEE was newly established as an accrediting organization. Accreditation processes of engineering programs are conducted by JABEE with the close cooperation of relevant engineering societies.

Those who have finished fundamental education start to accumulate training and practicing and gradually build up their professional competency as globally deployable engineers. At an appropriate stage of the development, one may apply for a professional qualification such as domestic PE as the token of an independent professional. Since the requirements for domestic PE and international PE, for instance APEC Engineer, are fundamentally compatible, domestic PEs may apply for an international professional qualification, once their length of engineering practice exceeds the respective requirement. As the result of the quality assurance by JABEE, the graduates from accredited programs are exempt from the primary examination of PE. By this measure, a direct link between engineering education and professional qualification has been established.

CPD is essential for every engineer. Engineers without professional qualifications need CPD to maintain and enhance their professional value or employability. For PEs, domestic as well as international, CPD is requested as their professional duty. CPD shall be driven by the autonomous initiatives of individuals as the means of endless updating of their expertise. Engineering societies, educational institutions like universities, in-house training centers of private companies, and industrial associations of individual sectors; they are all providers of CPD services and must share their roles so that the clients, that is, all engineers have a variety of programs to choose from. In order to harmonize and integrate the activities of CPD providers into an effective and client-friendly system, a coordinating body, named PDE Council, is established in 2005 by the Japan Federation of Engineering Societies (JFES) with the close cooperation of affiliated societies.

The members of engineering societies are gathering from all engineering-related sectors; academia, industry, government, local autonomy, etc. Engineering societies are the sole organizations that may represent engineering interests in an integrated form. Engineering societies are expected to perform key contribution in every stage of professional development of engineers.

Progress of JABEE

After elaborate consultation and dissemination among relevant organizations, that is, educational

institutions, major engineering societies, Ministry of Education, Ministry of International Trade and Industry, Science and Technology Agency and also employers represented by Keidanren (Japan Fed. of Economic Organizations), JABEE was finally founded in November 1999 as a Non Governmental Organization (NGO) by the enthusiastic support of all relevant parties (cf. http://www.jabee.org).

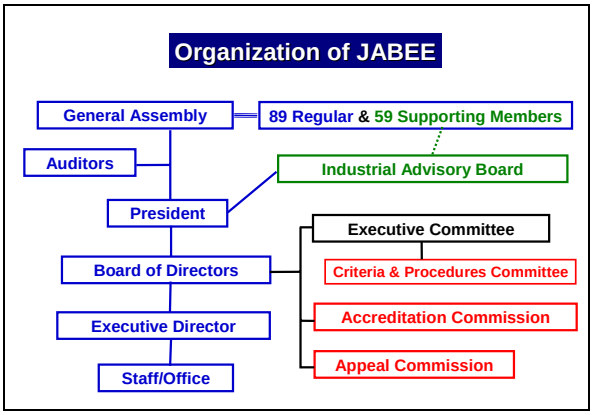

Figure 5: Organization of JABEE

The organizational structure of JABEE is shown in Fig. 5. Membership of JABEE is categorized into two groups, namely regular and supporting members. Major engineering societies (89 at present) join as regular members with the vote in the General Assembly and the majority of Board Members are elected by their recommendation. Industrial companies that have strong interest in the quality of engineering education are eligible as the supporting members (59 at present) without the vote. The cooperation and communication with industries are materialized by the function of Industrial Advisory Board that has a direct advisory channel to the President. Accreditation and Appeal Commissions are independent from Executive Committee that manages all pre-review/decision processes such as setting of rules, criteria and procedures.

Fig. 6 shows the role sharing among JABEE and engineering societies. An engineering program applied for accreditation is first examined by the relevant engineering societies and then the final decision is made by JABEE's Accreditation Commission on the basis of the submitted examination reports. Conferment of accreditation certificates and the public release are made only in the name of JABEE.

The table shown in Fig. 7 summarizes the progress of JABEE activities since its foundation. In order to evaluate, inspect and then improve the accreditation processes, pilot accreditation was conducted prior to the formal one in every discipline. Dissemination of the significance of accreditation to educational institutions and the training of examiners were also urgent tasks. At present, total engineering field is divided into 16 disciplines and the criteria are composed of the common and discipline-specific descriptions.

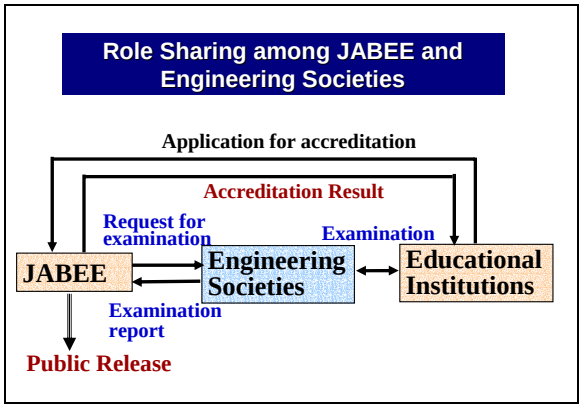

Figure 6: Role Sharing

There are over 1400 engineering programs currently running in Japan. By the year 2010, JABEE expects to accredit about half of them and to approach to a stable operation.

Year	2000	2001	2002	2003	2004	2005
Pilot Acc.	20	51	35	7	4	0
Formal Accreditation	total	3 3	32 35	67 102	84 186	ca100 286
Examiners	102	335	529	796	1043	1450
Observers sent abroad	13	12	15	13	9	6
Invited Advisors and Speakers	4	3	11	3	13	6
International Affairs		5th WA Provi.		6th WA		7th WA Signat.
International Symposia on					Eng. Design	Acc. of Master Programs

Figure 7: Progress of JABEE Activities

Financial independence is an important factor to operate an independent accrediting organization. Fortunately JABEE could get promise from the government and industries that they would support us for the first five years by governmental aides and membership fees of supporting members. Thanks to these financial supports during take-off period and also to the rapidly increasing income from accreditation fees, JABEE has almost achieved the financial independence as initially planned.

It was also encouraging for JABEE that the government decided in March 2004 to connect the accreditation of engineering education with Japanese PE system formally. Every graduate from a JABEE accredited program is exempt from the Primary Examination of PE and can start training and practicing as an Associate Professional Engineer after having officially registered the training program along with the name of a supervisor, PE in the same discipline.

Our accreditation practice follows basically that of Engineering Criteria 2000 adopted by ABET of USA. Introduction of outcome-based evaluation, engineering ethics and communication skill are examples of what were rather new for us.

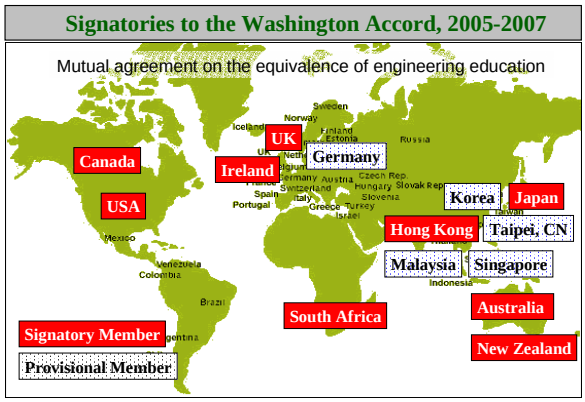

Figure 8: Members of the Washington Accord

Besides the quality assurance, JABEE's another objective is to prove that the quality of our engineering education is equivalent to global standards. This can be achieved by joining the Washington Accord as a signatory member. JABEE was first admitted as a provisional member at 2001 WA Meeting in South Africa. Two years later, JABEE submitted a progress report at 2003 WA Meeting in New Zealand and solicited a formal review for full membership. The WA nominated three reviewers

(Canada/chair, USA and NZ) and sent the team to inspect our examination and decision-making processes. The team submitted a review report to the WA in January 2005 recommending that JABEE be granted signatory status.

JABEE's application for signatory status was discussed among signatory members at the 2005 WA Meeting in Hong Kong. They unanimously approved the admission of JABEE as a signatory based on the review report and the short presentation made by JABEE. The present membership of the WA is shown on the world map in Fig 8.

JABEE is deeply grateful to the signatories shown on this figure for their advice and support throughout the process of designing, implementing and improving our accreditation system. Now JABEE is a member of the signatories and is committed to reciprocating the support we received. As the first signatory representing non-English-speaking countries, JABEE would like to share our experience with the accrediting organizations that wish to join the WA.

Barriers to overcome

In order to introduce a completely new accreditation system to Japanese engineering education, JABEE had to overcome many barriers throughout its planning, founding, take-off and expansion period. Most of the barriers resulted from the prejudice and traditional perception of university faculties on the education itself.

The following are examples of the prejudice JABEE has been fighting against:

- Universities are the holy place where sublime truth is taught
- Universities are not a popular place where preparation for a career is made. In the past fifty years, the nature of university education has changed drastically from elite- to mass- and further to universal access-type in Japan. Many of traditional faculties were reluctant to accept this reality and have not changed their perception of university education. However, the mind reform of university faculties has progressed remarkably in the past decade.
- Engineering is a part of science. Engineering is translated in Japanese into two Chinese character as 工学. These two Chinese characters mean the science for engineering. Engineering education in Japan was in reality the education of engineering science. Needless to say, education of engineering science is only a part of engineering education.
- Engineering is a profession. What does it mean? In Chinese-character cultural zone of East Asia, there is no indigenous terminology corresponding to "profession". Of course, we can find the word in every English dictionary but its superficial translation cannot convey the substance and weight that the word bears in western societies. It took enormous effort to disseminate the concept of profession and subsequently professional education.
- Institutional accreditation is sufficient enough. Why is program accreditation necessary? In Japan institutional accreditation became mandatory since 2004 for every higher education institution. The purpose and effect of these two accreditations are different and independent. Many faculties do not understand, or do not want to understand the meaning of program or professional accreditation.
- Accreditation hinders progress because of stiff regulation and control. The shift from input-based to outcomes-based evaluation system is quite helpful to persuade those opponents who advocate accreditation hinders progress.
- Our quality is high enough. We hear often this kind of insistence, but it is merely an illusion in most cases.
- We don't care about quality assurance of the minimum level. This is also an excuse to avoid the application for accreditation. After accreditation is given to a program, we ask the faculty team of the program "What you feel is the biggest merit of the accreditation? " Their answer is not the assurance of the minimum level. They say almost unanimously "For the first time in the history, the faculties and administrative staff of our Department recognized themselves as the member of a team that has its own mission to materialize." The real value of a program accreditation is to implant PDCA cycle in an organization. Repeating Plan, Do, Check, Action processes is the best mechanism to materialize a continuous improvement.

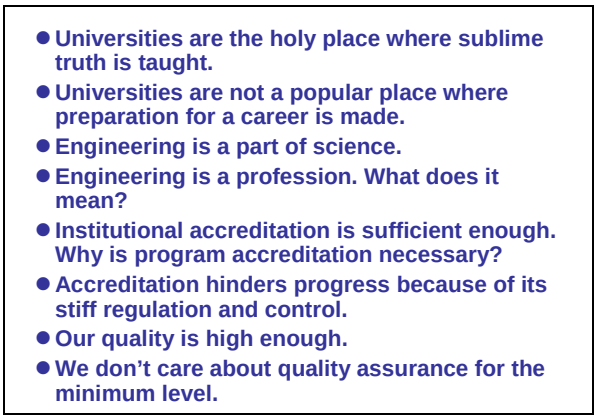

Figure 9: Prejudice to Overcome

JABEE has been successful to overcome most of the prejudice cited above. We are now trying to persuade those who show little interest in accreditation because they claim the quality of their education is high enough.

Future Tasks

It took six years for JABEE to achieve its major objectives, that is, introduction of reliable accreditation system and establishment of global equivalence. After completing its take-off period, JABEE is now tackling with the following tasks to make JABEE's activities more effective and reliable.

Continuing Improvement of Accreditation System: In 2005 JABEE finished the examination of more than 150 programs including interim review, and the number is expected to peak soon. JABEE's past efforts to cope with increasing numbers of applications have been successful so far, but now our efforts should be shifted to improving the satisfaction of students, faculties, examiners and industries. Satisfying all the constituents is our next target.

Enhancing Collaboration with Industries: derstanding and recognition of JABEE among industries are still low, especially among small and medium-sized enterprises. To disseminate the merits of accreditation, the "Academia-Industry Collaboration Platform" has been introduced by JABEE as an initiative for frank communication between both parties.

Introduction of accreditation for Master's Programs: On average, 30% of engineering graduates go on to study Master's programs. This figure exceeds 70% in leading research universities. Industries urgently seek quality assurance for Master's programs. JABEE started a feasibility study three years ago and is about to complete criteria for several disciplines. We will finish the preparatory work, including pilot accreditation, in the nearest future, and wait the days when the domestic as well as the global environment demands the accreditation of Master's programs.

Promotion of International Collaboration: JABEE is willing to bear the responsibility as a signatory to the WA. We have been concentrating in the training of examiners for domestic needs. We now recognize further needs to train future mentors and examiners to participate in WA activities.

Conducting Self-Inspection and External Evaluation of JABEE for Further Improvement: Five years have passed since JABEE conducted its first accreditation in 2001. It is time to self-inspect JABEE's system and complete a PDCA cycle to ensure continuing improvement. Internal and external evaluation committees have been established. JABEE started the study on the outcomes by which JABEE's performance can be properly evaluated.

Concluding Remarks

It is painful to admit the fact that the public confidence on technology and subsequently on engineers is gradually deteriorating. Recent scandal in Japan, building construction based on a fabricated anti-seismic structural calculation, is a typical example of numerous reasons that cause mistrust of the public. Short-term remedies are not sufficient to improve this situation. We are confident that the endeavors for establishing engineering profession and making it visible to the public will be a sure step forward to recovering the public confidence.

Engineers as professionals are expected, of course, to be the front runners of innovations that activate business and economies. However, we shall not forget the public expectation that engineers

are responsible to the consequences resulting from products and systems created by engineers.

Accreditation of engineering education is definitely useful to improve and assure the quality of education. But its most important task is to implant the awareness in our students -future engineers- that they are responsible to the consequences of their activities. This task can not be accomplished by merely introducing a course on engineering ethics. Implanting this awareness must be the backbone that consolidates an engineering program. In this meaning, accreditation is the most promising way to improve the public confidence on engineering and engineering profession.

Japan has been trying to establish an integrated system to support life-long professional development of engineers in the past decade. In many cases we found that the difficulties consisted in the gap between western and traditional concept and perception. Among East Asian countries, we may share a lot of experiences and solutions to cope with the common difficulties.