

FROM ORGANIZATION-BASED TOWARD INDIVIDUALS-BASED ENGINEERS - CURRENT REFORMS IN JAPAN -

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ABSTRACT

Torrent of globalization forced us to reform our once renowned Japanese style management system that featured lifetime employment and seniority-based payment. The direction of the reform is definitely from organization-based toward individuals-based society.

The establishment of engineering profession is the key issue of this reform. Multilateral efforts, for example, foundation of accreditation body for engineering education, revision of Professional Engineers Law, introduction of integrated CPD system, are ongoing. Engineering societies are essential contributors for the design and implementation of such systems.

INTRODUCTION

International reputation swings up and down like riding on a jet coaster. When Japanese industries boasted their competitiveness on the global market in 1980's, Japanese style management, featuring lifetime employment, in-house job training and seniority-based payment, collected world-wide attention. In those days commentary books on the secret of Japanese management were found in bookstores everywhere in the world. Now the situation turned around 180 degrees. The same management style is criticized today as the culprit of declining industrial power.

Engineering education of Japan has followed the similar fate. Our engineering education was once thought as the driving force of the epoch making industrial development. Numerous groups from abroad visited us and asked "what is the secret?" There was no secret indeed. We could only mention several features of our engineering education, for instance, emphasis on fundamentals and principles, cultivation of cooperative mind by experiment and practice in a team, and enhancement of integration ability through graduation thesis. These features happened to match with the demand of Japanese industries, which did not expect job-readiness from fresh graduates and did lay value only on the possibility of future development. They considered new graduates as raw material, which should be

forged to powerful components of each organization through long-sighted in-house training programs.

Lifetime employment was, however, the presumption of the above practice. The features of Japanese engineering education could be effective only in association with Japanese management. It could not be a universal model for the rest of the world.

Since the end of the Cold-War Regime in the beginning of nineties, expanding economic activities and proliferation of information technology have lowered the borders of nations. In this borderless age, each nation cannot survive alone, but only possible in the economical and cultural interdependence on the global scale.

The torrent of globalization forced each nation to make their system transparent to outside and compatible with global standards. Now, Japanese style management undergoes rigorous reforms to adjust itself to the new circumstances.

The tacit role sharing of engineering education between academia and industries must also change. Japanese universities are no longer allowed to stand as "raw material suppliers with domestic sales territory" but should move to globally competitive institutions that can assure the quality of education in more definite and visible way.

FROM ORGANIZATION-BASED TO INDIVIDUALS-BASED SOCIETY

Japanese society has been reasonably safe, reliable and stable. Who have been supporting these features of our society?

The answer could be "Organization-based society" as illustrated in the left half of Fig. 1. In this society, individuals have a strong sense of membership to organizations, especially companies, to which they belong. As the reward to the royalty, individuals are protected lifetime by the organization. In a red organization, there are only red employees, who are almost useless in a blue organization.

In this kind of society, the responsibility for keeping reliable society is borne by organizations, private as well as public, but not by individuals. Japanese style management and "Organization-oriented society" are mutually dependent and inseparable.

The globalization forces Japanese companies to shift to more globally competitive management system. Re-engineering, restructuring and reduction of manpower are now common not only in deficit-ailing companies but also in profit-thirsty booming companies. Our society has started to adjust to this new situation, with great pains and troubles of people who are dismissed from shelters. What is the new goal of our society to which we try to make a soft landing?

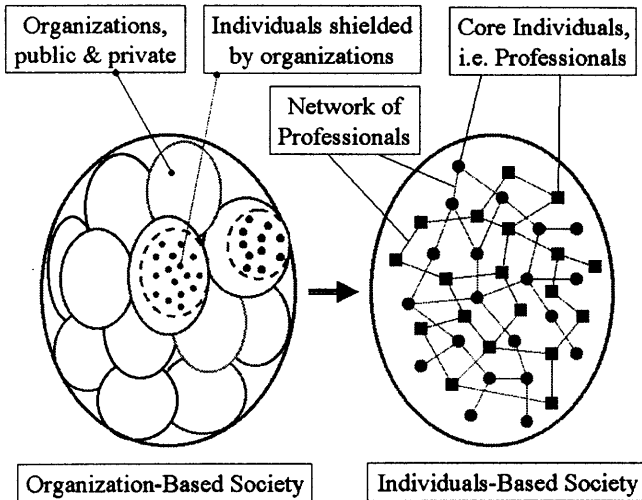


Fig. 1 Reform of Social Structure

The answer could be "Individuals-based society", as it is common in the western countries. The image of this society is illustrated in the right half of Fig. 1. The whole society is covered and supported by the networks of professionals who bear the responsibility in respective fields with their expertise and morality. There need networks of medical doctors, of lawyers, of accountants, etc., and not to the last, of engineers who are responsible for developing, designing, manufacturing and operating artificial hard-wares and soft-wares, the core of modern technological society.

To materialize the transformation from organization-based to individuals-based society, the hardest barrier consists in our culture and consciousness. We have long cultural tradition of respecting "learning" as the road to sublime truth, but of looking down "profession" as mere means of getting bread. As the result of this unconscious prejudice, being a professional, especially being an intellectual professional, has collected little interest and respect of our society. We need a revolution of our consciousness, that is, from ignoring to respecting professionals.

REFORMS IN ENGINEERING EDUCATION

After Meiji Restoration in 1868, Japanese government introduced a set of modernization programs, which were mostly the transplantation of advanced western political, judicial, educational and industrial systems. Establishment of higher

education was one of key issues. Engineering education on university level started in 1873 when Henry Dyer of Glasgow founded Engineering College (origin of the Engineering School of the University of Tokyo) by the request of the government. Thanks to his passion and endeavor, Japan succeeded to establish National (former Imperial) University system in which Engineering School was installed as an inevitable and key component of higher education. Prof. Dyer materialized his dream of combining technology and science in universities, not in his motherland but in Japan.

Though our engineering education started in British style, it had been modifying itself to adjust to the local situation. Especially in the last 50 years when Japanese industry experienced an unprecedented expansion and requested us continuously the massive supply of "raw material" which could be converted to competent engineers after the employment.

"Engineering" used to be translated into Japanese as "工学". These two Chinese characters mean literally "Technology" + "Science", that is, science of technology. According to the western definition (ABET, Eng. Council of UK, etc.), "Engineering" is a profession, but "Engineering in Japanese" was defined as science of technology or engineering science. We have been long unaware of this definition gap, which may have resulted from our unconscious prejudice as mentioned previously.⁽¹⁾

The most important reform in our engineering education consists in the conversion from teaching engineering science to building fundamental capacity of students, who later develop themselves to independent professional engineers, the core of individuals-based society.

We are talking frequently on global engineering and global engineers who are competent in borderless world. Building of global engineers is also an important target of our reform.

FOR ESTABLISHING ENGINEERING PROFESSION

Science Council of Japan (SCJ), Japan Federation of Eng. Societies (JFES) and Japan Society of Eng. Education (JSEE) have been cooperating closely to reform public consciousness on profession, especially to enhance public awareness on the importance of engineering profession.⁽²⁾ In December 1998, the president of SCJ, Dr. H. Yoshikawa, addressed a public declaration in which the following issues were pointed out:

- 1) The safety and reliability of modern society depend heavily on artifacts (artificial products; buildings, vehicles, communication and information devices and systems, etc.).
- 2) Engineers are totally responsible for artifacts, throughout planning, developing, designing, manufacturing and operating phases. Engineers must be qualified to accept such responsibility.
- 3) Society should recognize the role of engineers properly. To obtain the public understanding, there must be a publicly acceptable system that assures the professional qualification of engineers.

- 4) Introduction of Japanese version Professional Engineers is urgent, that should match, of course, with global standard.
- 5) Introduction of accreditation system of engineering education on university level is also urgent. Accreditation not only offers basic education for qualified engineers, but also generates strong driving force for the improvement of university education.
- 6) To maintain the lifelong expertise of engineers, introduction of CPD (Continuing Professional Development) must be also incorporated.

We have been trying to establish a consistent national system that can maintain the activities of engineers at the top gear throughout their lifelong career, for the benefit of the society and the individuals as well. Such system must include quality assurance of engineering education at the graduate level and also certification of engineering qualification (professional certificate) compatible to the global standards. They are described separately in the following chapters.

ACCREDITATION OF ENGINEERING EDUCATION

In order to establish quality assurance system of engineering education at graduate level, a committee named "Global Engineers Education Committee" headed by Dr. Yoshikawa was founded in 1987. After elaborate consultation and dissemination among relevant organizations, that is, educational institutions, major engineering societies, Ministry of Education, Ministry of Intern. Trade and Industry, Science and Technology Agency and also employers represented by Keidanren (Japan Fed. of Economic Organizations), the first Meeting of Promoters was held on September 1, 1999 to establish Japan Accreditation Board for Engineering Education (JABEE, <http://www.jabee.org>). JABEE was finally founded on November 19, 1999 by the enthusiastic support of all relevant organizations.

Membership of JABEE is categorized into two groups, i.e., ordinary and supporting members. An engineering program applied for accreditation is first evaluated by the relevant engineering societies and JABEE decides the accreditation on the basis of their evaluation report. In this context, only participating engineering societies are eligible for ordinary members. Industrial companies that have strong interest in the quality of engineering education are eligible for supporting members. Among 16 Board Members, 14 are presidents of major engineering societies. They are considered as the ex-officio representatives of more than 50 (as of April 2000) ordinary members.

Our accreditation practice follows basically that of Criteria 2000 set up by ABET. Introduction of engineering ethics and enhancement of communication capability are examples of what is rather new for us. Intensive preparatory works are now going on. Dissemination of the significance of accreditation to educational institutions and the training of evaluators are urgent tasks. JABEE started trial accreditation of 20 engineering programs this year and plans to enter full operation within 2

years. Immediately after the first announcement of accredited programs, JABEE plans to apply for the membership in Washington Accord, thus establishing the link of global equivalence of our engineering education.

The organizational structure of JABEE is illustrated in the following figure.

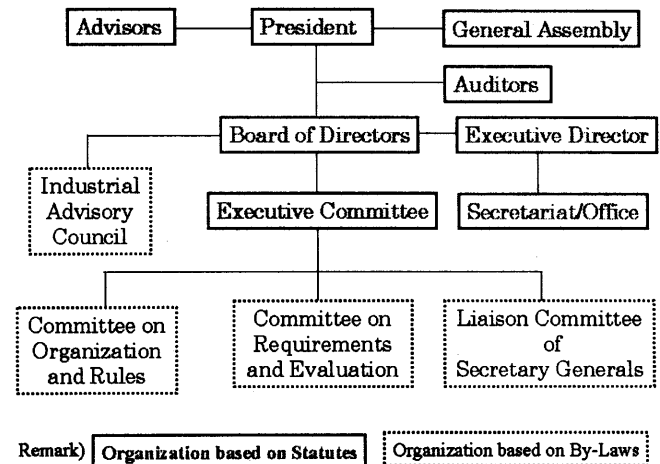


Fig. 2 Organizational Structure of JABEE

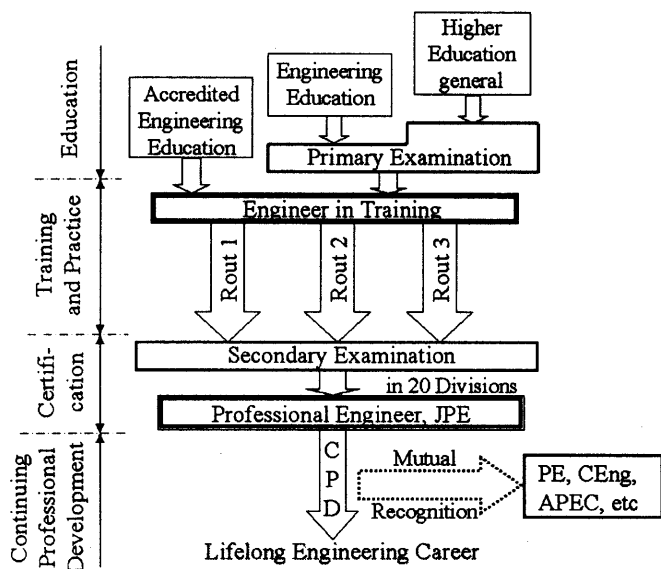
INTRODUCTION OF PROFESSIONAL ENGINEERS LAW

Introduction of engineering certificate compatible to PE of USA, CEng of UK, CPEng of Australia, for example, are urgently needed when engineering activities are expanding on global scale. The present Japanese engineering certification "Consulting Engineer" lacks global equivalence and is isolated. Last year, Consulting Engineers Council of STA submitted to the government a set of recommendations on necessary revisions of the present Law. The revised "Professional Engineers Law" was enacted in this April and will go into effect from April 2001.

The revised Law defines new procedures to obtain and maintain the engineering qualification called Japanese Professional Engineer, JPE, as illustrated in Fig. 3. The procedures consist of Primary Examination, training and practice (Initial Professional Development), Secondary Examination, certification of JPE, and Continuing Professional Development. Graduates of accredited engineering programs are exempt from Primary Examination, since the fundamental competence is assured by the program itself.

The enforcement of the new Law will have great influence on the public perception of engineering profession. We expect that the number of certificated engineers will increase tenfold from the present number (less than 40 thousand) in ten years and that the average age of rookie JPEs will reduce to around 30. The responsibility to the public (engineering ethics) is stressed in the new Law and it will hopefully help regain public confidence on engineers and engineering achievements.

Once we complete our national system for engineering profession, it will become far easier to adapt to any regional or international engineering certifications such as APEC Engineer and International Engineer now discussed by Engineer Mobility Forum. Engineering societies are expected to play principal roles in the implementation of accreditation and CPD.



Rout 1: 4 years training program under experienced supervisors
 Rout 2: 4 years training with assistance of a JPE
 Rout 3: 7 years practice in engineering
 Master in engineering is counted as 2 years training.

Fig. 3 Procedures of Japanese Professional Engineers

ROLES OF ENGINEERING SOCIETIES

There are 2.4 million engineers in Japan. Among them, approximately 600 thousands belong to one or plural number of engineering societies/institutions that have definite range of disciplines to serve.

Each engineering society has two major functions, that is, academic (scientific) and professional. Academic function of JSME (Japan Society of Mechanical Engineers), for example, is to promote the advance of mechanical engineering science on the basis of quality (originality) judgment by peer review. Another function is to help mechanical engineers maintain and develop their expertise as professionals. In the case of JSME, more than 70 % of her members are engineers working in industries and, therefore, the role as a professional society should be at least as important as the role as an academic one. So-called trunk societies such as of Civil Engineers, Electrical Engineers, Architecture, Chemical Engineers, etc., have the character similar to that of JSME.

The members of engineering societies come from all engineering-related sectors, academia, industry, government, local autonomy, etc. Engineering societies are the sole organizations that may represent engineering interests in integrated form. Engineering societies are expected to perform key contribution in every phase of engineering profession, as illustrated in the following figure.

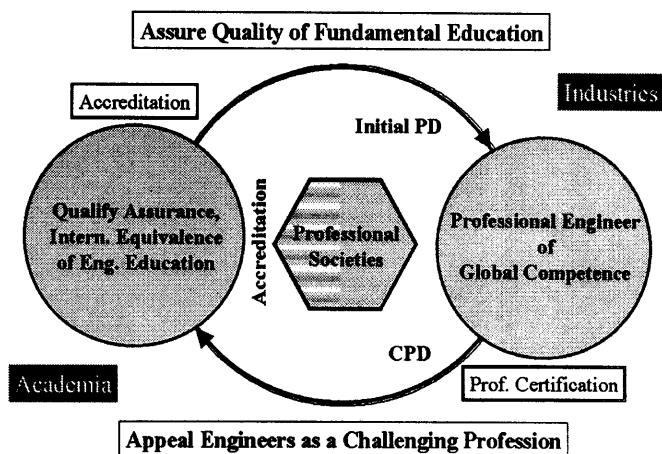


Fig. 4 Engineering Societies as the Key Contributor to Engineering Profession

CONCLUDING REMARKS

Recent criticality accident at JCO's Tokai Facility in Japan left severe damages to the public confidence on technology and subsequently on engineers. Short-term remedies are not sufficient to improve this situation. We are confident that the endeavor described in the above will be a sure step forward to recover the public confidence.

Every nation has own history, culture and feeling of amenity. The reforms we are trying to achieve seem all within the frame of so-called westernization or introduction of Anglo-Saxon systems. The same situation happened 130 years ago when we went through Meiji Restoration. After mixing and fusing native and introduced species, the leaders of Meiji succeeded to produce new systems optimized to Japanese climate and situation.

New Japanese system for the 21 Century is now under construction. The key word of the new system will be not competition but cooperation.

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