

# Re-Engineering of Engineering Profession in Japan

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## 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 wages, collected worldwide attention. In those days commentary books on the success and secret of Japanese style 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 style 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. Every nation must design its future in consideration of the economical and cultural interdependence on global scale. This new situation forced each nation to make its system transparent to the outside and compatible with global standards. Now, Japanese style management undergoes rigorous reforms to adjust itself to the new circumstances.

## FROM ORGANIZATION-BASED TOWARD INDIVIDUALS-BASED SOCIETY

Japanese society has been reasonably safe, reliable and even dynamic. 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 trained to make the most of facilities and human relations of the organization. Red employees may be almost useless in a blue organization, until they re-dye themselves to the new color. In this kind of society, the responsibility for maintaining reliable society is borne by organizations, private as well as public, but not by individuals. Japanese style management and "Organization-based 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 were unexpectedly dismissed from their shelters. What is the new goal of our society to which we try to make a soft landing?

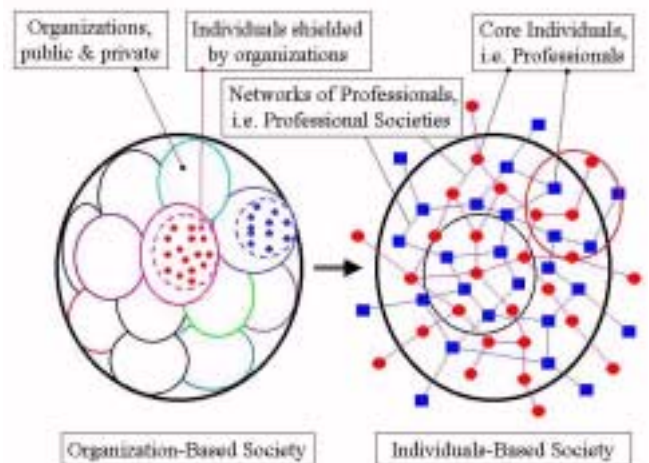


Fig. 1 Reform of Social Structure

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 human-made hard-wares and soft-wares, the core of modern technological society.

Even in the individuals-based society, the role and importance of organizations will never change or become greater. Activities of organizations cross easily the borders of nations. Multinational enterprises are becoming common. The networks of professionals, i.e., professional societies are also becoming borderless. In such borderless age, each professional must prove own competence by some kind of globally acknowledged credentials, preferably by professional certificates.

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 a mere means of getting bread. As the result of this subconscious 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.

### FOR ESTABLISHING ENGINEERING PROFESSION

Science Council of Japan (SCJ), Japan Federation of Eng. Societies and Japan Society for Eng. Education have been cooperating closely to reform public awareness on the importance of engineering profession.

In a public address of December 1998, the president of SCJ, Dr. H. Yoshikawa made a declaration in which the following issues were pointed out:

- 1) The safety and reliability of modern society depend heavily on human-made products such as materials, buildings, vehicles, communication and information devices and systems, etc.
- 2) Engineers are totally responsible for such products, 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 Engineer is urgent, that should match, of course, with global standards.
- 5) Introduction of an accreditation system of engineering education on university level is also urgent. Accreditation not only assures the quality of basic education for engineers, but also generates strong driving force for the improvement of university education.
- 6) To maintain lifelong expertise of engineers, the importance of Continuing Professional Development (CPD) must be recognized.

### RE-ENGINEERING OF ENGINEERING PROFESSION

Responding to the above-mentioned address, we have started to re-engineer our traditional systems. The Target is to build an integrated national system that can maintain the output of engineers in the top gear throughout their lifelong career, for the benefit of the society and the individuals as well. Such system must cover every stage of the Professional Development of Engineers (PDE), that is, engineering education in universities, training and practice, professional certification and finally CPD, as illustrated in Fig. 2.

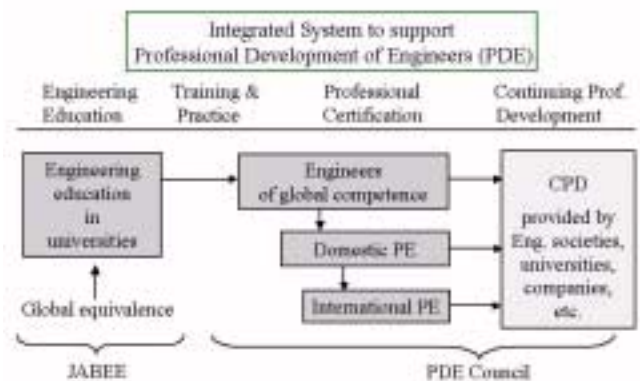


Fig. 2 Integrated System for PDE

Engineering education in universities provides basic education needed for entry level engineers. To improve the quality of education and to assure the global equivalence, Japan Accreditation Board for Engineering Education (JABEE) was established in November 1999. Accreditation of engineering programs are conducted by JABEE with close cooperation of relevant engineering societies. Those who finish basic education start to accumulate training and practice and gradually build up professional competences as globally deployable engineers. At an appropriate stage of the development, one may apply for a professional certificate such as domestic Professional Engineer as the token of an independent professional. Since the requirements for domestic PE and international PE, e.g. APEC Engineer or EMF International Engineer, are fundamentally compatible, domestic PEs may apply for an

international professional certificate, once their length of engineering practice exceeds the respective requirement.

CPD is essential for engineers of every stage. Engineers without professional certificates need CPD to maintain and enhance their employability. For PEs, domestic as well as international, CPD is requested as their professional responsibility. CPD is driven, of course, by the initiatives of individuals as the means of endless updating of their expertise. Professional societies, educational institutions like universities, in-house training centers of private companies, they are all providers of CPD service and must share their roles so that the clients, all engineers, have a variety of programs to choose from. The documents (contents) needed for CPD must be also prepared and provided by them.

There are so many participating organizations in the downstream of PDE. There must be a conductor that harmonizes the interests of stakeholders and integrates whole components into an effective system, similar to the role of JABEE in the upstream of PDE. The foundation of PDE Council is now under preparation for this purpose.

The details of our re-engineering are described further in the following sections.

## **ACCREDITATION OF ENGINEERING EDUCATION**

In order to establish a quality assurance system of engineering education in universities, 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 (STA) and also employers represented by Keidanren (Japan Fed. of Economic Organizations), JABEE (<http://www.jabee.org>) was finally founded on November 19, 1999 by the enthusiastic support of all relevant parties.

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 18 Board Members, 16 are presidents of major engineering societies. They are considered as the ex-officio representatives of more than 80 (as of May 2001) ordinary members.

Our accreditation practice follows basically that of Engineering Criteria 2000 set up by the Accreditation Board for Engineering and Technology, USA. 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 has finished trial accreditation of 20 engineering programs last year and plans to start authentic accreditation this year. JABEE was accepted as the provisional member of Washington Accord at its general assembly in June this year and wish to join its signatory members in two years, so that Japanese engineering education can establish a firm link of mutual equivalence on global scale..

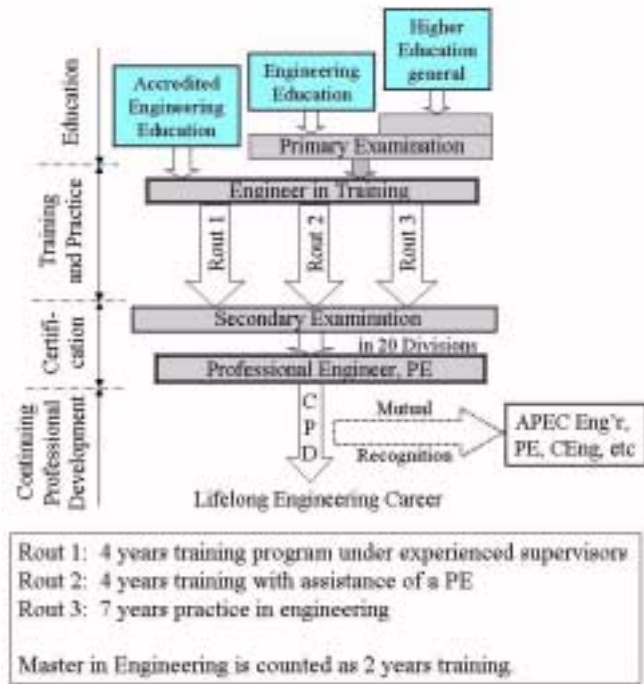
## **INTRODUCTION OF PROFESSIONAL ENGINEERS LAW**

Introduction of professional 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 past Japanese engineering certificate based on "Consulting Engineers Law" lacked global compatibility and was isolated. Last year, Consulting Engineers Council of STA submitted to the government a set of recommendations on necessary revisions of the previous Law. The revised "Professional Engineers Law" was enacted April last year and went into effect from April 2001.

The revised Law defines new procedures to obtain and maintain Japanese professional certificate called Professional Engineer, PE.JP, as illustrated in Fig. 3. The procedures consist of Primary Examination, training and practice (Initial Professional Development), Secondary Examination, certification of PE, and CPD. Graduates of accredited engineering programs are exempt from Primary Examination, since the basic capacity as an entry-level engineer 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 certified engineers will increase tenfold from the present number (about 40 thousand) in ten years and that the average age of rookie PEs 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.

Since the requirements and procedures for our professional certificate PE.JP are globally compatible, it will be easier for Japanese PEs to apply for any regional or international engineering certificates such as APEC Engineer and International Engineer now discussed by Engineers Mobility Forum. There will be also no obstacles to the mutual recognition of professional certificates among the interested nations.



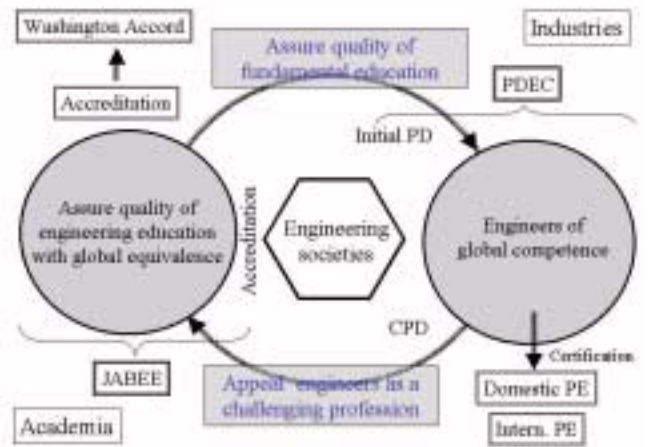
**Fig. 3 Procedures of Japanese Professional Engineers**

**ROLES OF ENGINEERING SOCIETIES**

There are 2.4 million engineers in Japan. Among them, approximately 650 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 Japan Society of Mechanical Engineers (JSME), 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 its 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 Society 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 an integrated form. Engineering societies are expected to perform key contribution in every phase of professional development of engineers as illustrated in the following figure.



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

**CONCLUDING REMARKS**

The criticality accident at JCO's Tokai Facility in 1999 left traumatic 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 for the re-engineering of engineering profession 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. We hope our new system will be acknowledged as a universal model to enhance our service and contribution to the society.

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