

*The Proceedings of the
1997 ASME Mechanical Engineering Department Heads Conference
March 19-20, 1997, San Diego, CA*

MECHANICAL ENGINEERING EDUCATION FOR GLOBAL PRACTICE



ASME International

RECENT ACTIVITIES OF INTERNATIONAL ENGINEERING PROGRAMS IN JAPAN

Hideo Ohashi

Kogakuin University
Tokyo, Japan

Okitsugu Furuya

SynTech Ltd.
Pasadena, CA

SUMMARY

Japan has long history of providing global engineering capabilities due to the country's worldwide industrial development. The training and education of the engineers are totally left with the hand of the industry, ranging from foreign language conversation to cultural education. In recent years, however, the Japanese academic societies and educational institutions are becoming aware of the importance of providing college students and young engineers with such education and training. They have now initiated various programs to meet the industry's need, including such programs as:

1. Establishing Accreditation System in Japan,
2. Offering FE/PE examinations in Japan, and
3. Establishing new international courses/departments or programs in a four-year college.

These new trend and effort of the engineering education in Japan will be presented and discussed hereinafter.

ENGINEERING STUDENTS IN JAPAN

It is a social recognition and also a fact that the majority of engineering students in Japan are a group of people who have a poor capability in literature and particularly in foreign languages. This may be attributable to the entrance examination system for high school students to enter colleges through; those students having a poor grade in literature and English do not want to compete with those having a good grade in those courses to apply for the school of arts. Possibly, half the engineering students come to the engineering schools for the reason of poor English or language capabilities and are thus naturally labeled as being "not good" at English. Precisely speaking, however, this theory does not hold true to all the engineering students in Japan. In the entrance examination most of the national universities of Japan weigh all the subjects equally, whereas some private universities and colleges give weighed points to the applicants' courses they are applying for; for example, the science courses are given higher priority to the engineering students. It does not mean however that the national university graduates of the engineering schools meet the expectation from the industry. The industry still needs to train and educate them before they are put into the global business environment.

INDUSTRY'S IN-HOUSE PROGRAM OF TRAINING GLOBAL ENGINEERS

There is a recent article in one of the weekly magazines in Japan (February 23, 1996 Issue of "SHUUKAN ASAHI") that Fujitsu Ltd. announced to its 30,000 employees that they are given an opportunity of taking TOEIC (Test of English for International Communication). Although the announcement does not indicate the employee's taking TOEIC to be mandatory, it is said that all management, general administration and engineering personnel are forced to take TOEIC. The company expects that the outcome of the test can certainly be reflected on the manpower allocation process including the selection of the employees being sent to foreign countries and eventually the employee's promotions and compensations. Many Japanese companies depend on the scores of TOEIC for sending their employees to foreign countries; the TOEIC score of 600 points or higher is required for the employee to be considered to go abroad for a short period of time and that of 720 points or higher for a long period of time such as a two-years or longer stay. The article indicates that the idea came from the top executive with the company's background information and request that a total of 3,500 additional people who can speak English are required to pursue their business properly. This kind of program certainly seems to have been accelerated by a wide use of Internet System in Japan. Fujitsu is no exception in that sense; they need to have a quick access to the newest information of computer and communication technologies and businesses which should be obtained through Internet in English. We hear from some of the Fujitsu employees that they are a kind of panic, buying English drill books here and there.

Another form of the company's in-house English enhancement program is to give an English conversation class paid by the company, which is offered either in or out of the office hour, depending on the company's policy. In most cases native English teachers are invited to the company's premises from English conversation schools. Again at the end of a certain period of class hours, the employees who attended the classes are tested either through TOEIC or its own testing method. There are of course people who volunteer to go to an English conversation school by paying the tuition by themselves, but the number is very limited. Most of the company's employees have a heavy burden of work so that they either cannot find any time to spare for any extra curriculum or are too tired to go to school at night.

In any case the training of English conversation for those employees who are planned to be sent abroad is entirely left with the company's hand because they were not trained through their college education.

ACCREDITATION SYSTEM OF JAPANESE STYLE

Accreditation of engineering education is a finding of English speaking nations such as the United Kingdom and the USA. The UK and American accreditation systems are, however, considerably different in their nature to each other. In the UK, accreditation was introduced as an element of procedures for the registration of engineering profession like Chartered Engineer. In order to assure the educational basis of the profession, the engineering institutions such as the Institution of Mechanical Engineers are entrusted by the Engineering Council, the registration authority, to accredit the programs of education in the relevant field. All graduates who successfully complete such accredited courses of the program will then be automatically deemed to have satisfied the requirement of the basic education for the profession. In the US, however, the accreditation of engineering education was introduced to assure the minimum level of education so that employers may presume the initial competence of new graduates and may assign an appropriate task and responsibility for them. The ABET, the accreditation authority, is therefore operated in a close cooperation between the industries and academia, and the requests of industries are strongly reflected on the contents of accredited courses. In this case, however, graduation of accredited courses does not necessarily mean the completion of basic education for an engineering profession. An additional examination, Fundamentals of Engineering (FE) Examination, is the first gateway to become a Professional Engineer(PE).

There is no accreditation system like those of the UK and the US in Japan to date, because we have had no need of accreditation as these two countries had in their histories. Japanese engineering profession, "Gijutsu-shi", has no requirement of university education. Japanese employers have had little interest in the minimum level of engineering education. What they expect from newly employed graduates, is a good understanding of fundamentals and principles along with a positive attitude of cooperation. New graduates are considered as raw materials that can be wrought and shaped by OJT (on-the-job-training) and in-house training "after their employment.

The above description may lead to the misunderstanding that the Japanese university education has no means of quality assurance. Our quality assurance is guaranteed by the following procedures:

(1) *Initial permission of establishment by the Ministry of Education, Science, Sports and Culture ("Monbusho")*

In order to establish new universities, faculties or even departments at both undergraduate and graduate levels, a permission of "Monbusho" is mandatory. "Monbusho" sets the regulation on the minimum requirement for the area of available land, buildings and class rooms, number of library books, quantity of teaching facilities, and finally number and quality of teaching staff.

A special commission, the Council of University Establishment, is entrusted by "Monbusho" to carry out the inspection whether every requirement is fulfilled in the application. The commissioners and inspectors are nominated by "Monbusho" from academia (majority) and industries and have responsibility to maintain the minimum quality of higher education. Private universities and colleges of Japan educate 75 % of all students and bear a big responsibility in the higher education. Private institutions receive a government's subsidy equivalent to about 10 % of their total expenditure on average. The above mentioned permission procedure is also necessary for the governmental subsidy to be authorized. The quality assurance of higher education is very strict in Japan at least at the initial stage.

(2) *Inspection by auditors nominated by "Monbusho"*

"Monbusho" nominates a group of auditors, comprising mainly experienced university professors to ask the inspection of established universities at an appropriate timing. The auditors submit inspection reports which sometimes include a strong recommendation for the improvement.

(3) *Mutual inspection and estimation by Japanese University Accreditation Association (JUAA)*

JUAA was established in 1947 by the recommendation of the US to carry a US style accreditation. The founders of the Association were the representatives of educational institutions. Since we have had no urgent need for accreditation as explained above, this Association has had a long, difficult time to prove her raison d'être. The situation has started to change in recent years. In order to become an institutional member of this Association, it is necessary to pass the admission inspection/evaluation on the quality of education. After admitted, each member institution may apply for mutual inspection/evaluation at an appropriate timing, for example, after the completion of organizational reform or the establishment of new faculties. The inspection/evaluation of JUAA has no legal enforcement but offers a very valuable opportunity to judge the own institution by the impartial eyes of experienced third parties. JUAA restricts however her mission to the inspection/evaluation of institutional organization and management, and excludes the accreditation of individual courses of program in specified disciplines.

(4) *Self inspection and evaluation of individual universities*

In 1991 "Monbusho" abolished the regulation on the contents of university education (i.e., 36 units of general and foreign language education, 4 of physical training/science and 76 of the major specialty). Each university may now compose the distribution of required credits according to the objective of its education. With this change, each institution is now recommended to carry through a self inspection and evaluation procedure and to publish the result as the regular status report. Majority of the Japanese universities are following this procedure and have built own internal mechanism (often including external auditing) to assure the quality of education.

The above mentioned four procedures of quality assurance are functioning as an integrated accreditation

system of Japanese style. They are however quite invisible especially from abroad and we feel the necessity to develop our current system to a unique comprehensive system of accreditation. The Japan Association of Engineering Education established last year a Special Committee on the Design of Japanese Style Accreditation System (chairman: H. Ohashi) and is looking for a proper recommendation with a close cooperation with "Monbusho", Science and Technology Agency, and Japan Federation of Engineering Societies.

FE/PE EXAMINATIONS IN JAPAN

The roles of the licenses of FE (Fundamentals of Engineering) and PE (Professional Engineer) Examinations are well recognized in the United States. The PE system was established in 1907 and since then PEs are serving as experts to the public engineering decision processes. In Japan there is a similar license called Engineering License ("Gijutsu-shi" in Japanese) but its roles are not quite clear. This fact is well explained from the total number of each licenses, about 400,000 PEs in the United States while only about 30,000 "Gijutsu-shi" in Japan. With the increased need of global engineering capabilities in recent years, The Japan Technology Transfer Association (JITAS, "Nihon Kogyogijyutsu Shinkoukai") recently arranged with the National Council of Examiners for Engineering and Surveying (NCEES) and the State of Oregon to offer FE/PE examinations now in Japan. The test uses the same test problems in English and is taken on the same time as in the United States.

In 1996 there are about 510,000 four-year college graduates in Japan and the only 65.9% of them were employed. This number is the lowest since 1951, and the lowering employment trend of the college graduates continues since 1991. Among the 510,000 graduates, about one fifth is the engineering school graduates, the employment rate being nearly 100%. However, the Japan's economical boom is well over and the competition for the engineering graduates for employment is becoming very keen, if they want to get a good offer from a good company. Under such domestic situation, the license of FE/PE will put those students well ahead of other engineering students. The industry will not expect to utilize the power of such license but rather expect those engineering students having licenses to be bilingual and international.

In coordination with the new opportunity of getting FE/PE licenses now in Japan, there are a few companies that announced a special one-time bonus of e.g., \$500 for any employee receiving an FE license.

There is also a move of the about 120 major universities that the engineering students be recommended to take the FE examination at their senior year (an article from one of the Japanese newspapers, "Nihon Keizai Shinbun", Oct. 4, 1995)

PAST ACTIVITIES OF ACADEMIC WORLD

The role of the universities and colleges in engineering globalization is recognized for many years. Many schools have programs of inviting foreign engineering scholars for a short period of time, the maximum of two years. These invited scholars usually give a series of lectures of their own specialties or a course in English. Although these programs

greatly help the engineering students in a bilingual education, they are by far short of educating them to the global engineers.

NEW DEPARTMENT/COURSE FOR DEVELOPMENT OF GLOBAL ENGINEERS

The Kogakuin University is planning to open a new course named "Global Engineers Development Course" within the Department of Mechanical Engineering, starting April 1997. A total number of the students to be registered under the new course will be about 50, the total number of the ME Department becoming 190. The objectives of the new course are to educate the engineering students to meet the urgent need of the industry that the engineering graduates can be immediately utilized in the global engineering business environment. The programs are yet to be developed and then finalized but will place an emphasis on the foreign languages and communication skills in addition to the normal mechanical engineering education. Some special courses offered to the students of the Global Engineers Development Course will include "Technical Communication in English", "International Relationship and its Basic Knowledge", "Seminar Series on Foreign Industries", etc.

Furthermore, some basic science, engineering and mathematics courses will be offered in English to have the students familiarize with the English terminology used in these subjects. In order for the Kogakuin University to facilitate such courses both permanent and part-time engineering professors who can speak English need to be newly hired. At the senior year all the students are required to take an FE examination either in the United States or now in Japan. This will be part of their thesis work, possibly working in international companies abroad as an internship. By the time of the students reaching the senior year they are all expected to be well educated and trained to obtain the FE licenses.

In the near future, The Kogakuin University is planning to upgrade the Global Engineers Development Course to a new department, i.e., the Department for Development of Global Engineers. In this new department the discipline is not only limited to the mechanical engineering but includes all other engineering courses.

CONCLUDING REMARKS

It is a well known fact that Japan cannot economically survive without import and export businesses. Millions of people were associated with the global businesses implicitly and explicitly. Although the engineering schools made every effort on teaching their students with engineering materials, the two-years English education offered there was quite non-satisfactory. The industry needed to re-train and educate the employees to be sent abroad in both languages and other necessary matters.

It seems however that for the first time in the history the university has started taking actions in educating the engineering students which can be truly utilized in the global business environment without being retrained. It will still take the Kogakuin University four years to send those students to the real world and whether or not the new course will be a success is yet to be seen. However, this new move is historical and worth reporting herein and watching its outcome.