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International Engineering Education

Perspective in Engineering Education and the Role of JSME

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From domestic to global, Changing Society

In this issue of JSME International News, engineering education is featured. This is because large scale revision of higher education system in Japan is currently going on and JSME has been deeply involved in it.

The role of the Society of Mechanical Engineers changes with the change in the definition of mechanical engineering itself, and further, with the fluctuating demand from the society to mechanical engineers. One important point at the present stage is the demand for educating an engineer as a global player.

Although now the world encounters a great confusion of economy and industrial transition, importance of production technology is increasingly clear.

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The Need to Establish a Technologist Certification Program in Japan

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Polytechnic University of Japan

What is an Engineering Technologist? The website of the Institution of Engineers, Australia, defines a technologist as follows [1]:

A Technologist is a person with high level theoretical skills in engineering combined with practical skills in the management and implementation of engineering projects. Technologists have completed three years (or equivalent) recognised engineering tertiary study.

Table 1 International Agreements (professional categories and signatories)

Washington Accord	Sydney Accord	Dublin Accord
Professional Engineer	Engineering Technologist	Engineering Technician
Australia	Australia	Canada
Canada	Canada	Ireland
Hong Kong	Hong Kong	South Africa
Ireland	Ireland	United Kingdom
New Zealand	New Zealand	
South Africa	South Africa	
United Kingdom	United Kingdom	
United States		

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Accreditation System in Indonesia

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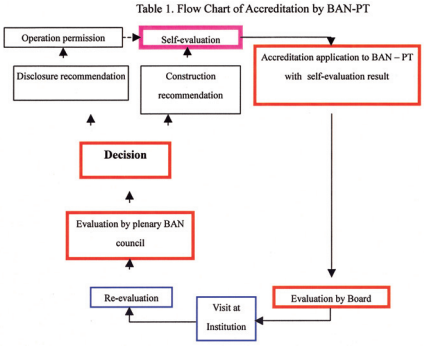
1. Introduction and situations

Asian countries have been making tremendous efforts to enhance quality of higher education over a couple of decades taking assistance from developed countries, such as Japan, USA, Australia, Germany, UK, and other European countries. Many organizations have been established to enhance the education quality.

Table 1. Flow Chart of Accreditation by BAN-PT



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Engineering Education in Universities and Industry Requirement

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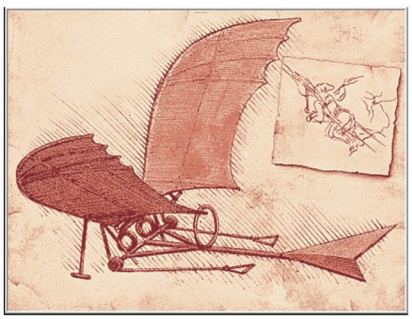
Introduction

It is obvious that Japanese education system, from primary school to universities, promoted innovations of Japanese industry and strengthened its international competitiveness through the second half of the 20th century.

But the engineering education in the universities of all through this period was not strictly fit to the request of industry.



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Perspective in Engineering Education and the Role of JSME

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Continued from page 1 World economy is expected to return to more stable state of healthy and sustainable progress. The key factor is production industry and mechanical engineering is in its center. The time is swinging back to mechanical engineering and mechanical technology after decades in the past for electronics, computer engineering and information engineering. Industry has always needed integration of various new and conventional technology. It is mechanical engineering that accumulates and integrates accomplishments in many other fields of science and engineering. Not only researches of pin-point advanced technology but also their integration into production technology is needed.

Another demand from industry is engineering education of global standard, not only in technology level but also in wide and flexible ability to work worldwide. The demand extends to cover such ability as designing, engineering ethics, international knowledge and communication skill.

Reform of higher education system in Japan

At present, Japanese higher education system is in a great turmoil. All of government-funded universities, which included many of influential universities, have been privatized starting in April, 2004. Although they are still financially supported by the government, each of former national universities and institutions now has autonomous governing body and all of teaching staffs and administrative officers have lost their status of civil servants.

Other Japanese colleges including many private universities are under the heavy pressure of competition. There are decrease of number of college applicants and change of professional motivation among young people. Governmental regulations on private universities and colleges are less tight and free competition is recommended. The competition is domestic and global.

In addition to these reforms, waves of large scale evaluation of all institutions of higher education is expected although standards and procedures of the evaluation are not fully established. Engineering education is not the exception.

Engineering education

In these circumstances, engineering schools in Japan are changing also with introduction of general evaluation by JABEE, the Japan Accreditation Board of Engineering Education. In the present days, work place of engineers is naturally worldwide and internationally accepted status of the engineer is a key to it. Up to now, status of Japanese professional engineer was more domestic and the new accreditation system has recently been started. Of course, accreditation of engineering education has long history in Britain, USA and some other countries. It was considered that the most important infrastructure of a prosperous industrial society was securing enough number of well-qualified engineers.

JABEE was founded in 1999. Since then, accreditation of engineering education programs has been actively promoted. Such subjects as engineering designing, engineering ethics, communication skill and international understanding are explicitly included in engineering curriculum. Since the accreditation is carried out by engineering societies of various different field, the responsibility of the societies on the expected level of education is very large. In the case of Japanese system, graduates from schools of these accredited programs are exempt of the first grade examination of Japanese PE. This is an attractive stimulation and a large number of programs from a number of institutions are applying for the accreditation.

Due to a large scale metamorphosis in Japanese industry, engineering education has to change its engineering contents to meet with advanced technology and also to add new subjects to build interfaces with such fields as management of technology, professional ethics, international law, intellectual property policy and international relations.

The role of JSME as the professional society

What contribution can the professional society make in this situation ? Not only education of young engineer candidates but also level-up training of careered engineers is one of its responsibilities. JSME continues effort in various ways. We expect that this effort on engineering education will contribute for forming a strong wing of prosperous industry and will lead to establish higher status of professional engineers in the society.

Firstly, JSME is one of the most important partners to JABEE and send key members to its committees. And actual accreditation teams of mechanical engineering and related fields are composed of members selected by JSME and cooperating societies. JSME are also organizing seminars for schools preparing for accreditation, training evaluators, editing texts, and so on.

Secondly, it is important to provide CPD (Continuing Professional Development) courses, to re-educate engineers pacing with the progress of technology. Not only headquarter of JSME but also its regional branches and divisions organize or coordinate CPD courses.

Thirdly, publication of text books is another contribution of JSME to engineering education. New series of text books started last year and three books were published and receiving very positive responses.

The responsibility and the activity of the professional society on engineering education are increasingly valued for building and sustaining healthy industry and society. JSME always wishes to contribute for it domestically and internationally.

The Need to Establish a Technologist Certification Program in Japan

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Continued from page 1 Engineering Technologists make an important contribution to the engineering profession by:

- using a strong knowledge background that is specific in depth and complexity that enables the practice of specific, complex engineering;
- focusing on interactions within engineering systems; and
- identifying and solving complex, specialised engineering problems by application of innovative practices and procedures.

Recent years have seen dramatic changes in the situation surrounding engineers and technologists, as witnessed in the expanded opportunities for international activities, greater mobility due to employment across national boundaries, rising social status, higher professional standards, and heightened awareness on social responsibilities. Along with these greater expectations in the role of the engineering/technology professions, Japan has begun moving toward establishing an internationally recognized certification system for engineers. This led to the founding of the Japan Accreditation Board for Engineering Education (JABEE) in November 1999, and a revision of the Professional Engineers Law (Gijutsushi Hou) in April 2000. In 2001, Japan (JABEE) was granted provisional membership status to the Washington Accord, which is an international agreement for mutual international recognition of engineering education programs, and is expected to be officially admitted as a signatory in 2005. This accord concerns the certification process for Professional Engineers, who number some 50,000 in Japan, which comprises less than 2 percent of the approximately 2.67 million (2000 national census) working in the engineering and technology professions in Japan. There are plans afoot to increase the number of Professional Engineers to levels comparable to Chartered Engineers (about 200,000) in the United Kingdom or Professional Engineers (approx. 400,000) in the United States, but this would still only amount to about 10 percent of Japanese engineering and technology professionals. While it is certainly a worthy cause to seek international recognition of engineer certification standards and international accreditation of engineering education programs, the problem is that only the relatively small population of Professional Engineers is addressed while the vast majority consisting of mid-level technologists who comprise the backbone of Japan's industry are overlooked. The author has for some time felt the need to stimulate a broad-level discussion on the certification process and educational programs for the large population of mid-level engineers, and in 2001 began a study on the relevant issues with research funding provided by the Labor Issues Research Center of Japan.

Signatories of the Washington Accord agreed to expand the initiative of the Accord to address other categories of engineering and technology professionals (technologists and technicians), and began investigating this issue in November 1997. The working group met in July 1998 in London. At this meeting, it was agreed to extend the accord to operate for technologists, whose numbers were expected to grow although the numbers listed on national registers were still relatively small. (Technicians were placed outside the scope of this extension at the time.) The participating countries met in June 1999 in Ottawa, then in November 1999 in Sydney, and in June 2001 signed the Sydney Accord [2] in South Africa. The term used to address the technologist category differs among the signatory countries, but the Sydney Accord employs the term "Engineering Technologist." The Dublin Accord, which is an agreement addressing technicians, was then signed in May 2002. The three Accords and the professional categories that they respectively address are presented in Table 1, along with the signatory countries.

The United Kingdom, for example, has the three professional categories of Chartered Engineers, Incorporated Engineers, and Engineering Technicians, while Japan only has two: Gijutsushi (spanning 20 engineering fields as set forth in an Ordinance by the Ministry of Education, Culture, Sports, Science & Technology) and Ginoushi (137 occupational types specified by an Ordinance by the Ministry of Health, Labor & Welfare) (see Table 2).Thus in Japan, there is no category of Technologists as covered by the Sydney Accord. This may be because the term "engineer" is used broadly in Japan to include technologists, and so there has been no need for a separate designation for technologists. However, international accords on the certification of engineering professions make the distinction between Professional Engineers and Engineering Technologists. The Institution of Engineers of Australia defines, in its Career Categories, the two professions in the following manner: [3]

Professional Engineers apply advanced skills in the analysis and knowledge of science, engineering, technology, management and social responsibility to problem solving and synthesis in new and existing fields. This encompasses advanced design and research, development of systems and products, manufacturing and field engineering and, with further professional formation, in specialist practice or supervision and management. Professional Engineers lead teams or work in them and need to be innovative and creative to develop the best possible solutions. The engineer must frequently make balanced judgements between design refinement, cost, risk and environmental impact.

Engineering technologists apply skills in analysis and knowledge of scientific and technological principles, management and social responsibility to new and existing technologies in standard design, testing, inspection plant operation, manufacturing or field work and, with advanced

Table 1 International Agreements (professional categories and signatories)

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New Zealand	New Zealand	
South Africa	South Africa	
United Kingdom	United Kingdom	
United States		

expertise, adapt standard practices to particular applications and supervise and manage such work.

The changes occurring today in the environment of engineering professions not only concern Professional Engineers. Many Japanese firms are engaged in overseas production, and in such matters as recruiting local workers, categories other than Professional Engineers, in particular, qualified Engineering Technologists who are recognized as such by international standards, are likely to play important roles. It is therefore a matter of import to establish in Japan a certification process for Engineering Technologists or their equivalent and reexamine current engineering technology education programs in this light. The following are some of the issues that must be considered in this undertaking.

- What should be the definition of Engineering Technologists or their professional equivalent?
  What should this profession be called (in Japanese)?
  What roles should this profession play? (how would they differ from, and what relationship should they have to Professional Engineers)
- Would the establishment of a certification system for Engineering Technologists be positively received by Japanese industry?
- Under which ministerial ordinance should this certification system be set forth, that of the Ministry of Education, Culture, Sports, Science & Technology (MEXT) or of the Ministry of Health, Labor & Welfare (MHLW)? (Such an undertaking would necessarily require the close cooperation among these ministries as well as the Ministry of Economy, Trade & Industry (METI).)
- In what manner should the engineering technology education programs be implemented?
  Should a three-year higher education program be established? (for instance, along the lines set forth in The Bologna Declaration [4])
  How feasible would it be to set up the necessary environment (facilities, instructors, etc.)?
- Should Japan apply as a signatory to the Sydney Accord, or should it establish a system based on Japanese or Asian initiative?

Table 2 Categories of engineering/technology professions

	United Kingdom	Japan
Professional Engineer	Chartered Engineer (approx. 200,000)	Gijutsushi (slightly less than 50,000)
Engineering Technologist	Incorporated Engineer (approx. 50,000)	
Engineering Technician	Engineering Technician (approx. 20,000)	Ginoushi (2.5 million inclusive of above)

It is essential that a lively discussion on these issues be initiated at the earliest date, so that Japan can participate meaningfully in the international meeting planned for 2005 to discuss the Sydney Accord (held at the same time as the meeting to discuss the Washington Accord and at the same location).

References

(1) http://www.ieaust.org.au/about%5fus/sig/technologists/
(2) http://www.ipenz.org.nz/ipenz/careersed/IntAgreements/SydneyAccord.cfm
(3) http://www.ieaust.org.au/careers/categories.html
(4) For instance, http://www.iei.ie/uploads/comon/files/bologna.pdf

Accreditation System in Indonesia

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Continued from page 1 For instance, those are ASAIHL (Association of South-East Asian Institutions of Higher Learning), UMAP (University Mobility in Asia and the Pacific), SEAMEO RIHED (Southeast Asian Ministers of Education Organization Regional Centre for Higher Education and Development), AUN (ASEAN University Network), and so on. On the other hand, independently of the above movements, Singapore started a new scheme in 1998. It is called Singapore-MIT alliance. Using an Internet communication, National University of Singapore (NUS) and Nanyang Technological University (NTU) are mutually connected with MIT in USA. Singapore university students can take lectures given in MIT on real time and vice versa. The same criterion is applied to the students when they take credits. Of course, when they started this program, NUS, NTU and MIT were supposed to have agreed that their education qualities were almost equal, namely three universities accredited the education program of each other university. So far, this alliance program is only for the graduate program. Singapore universities recruit excellent students for this program from all Asian countries providing scholarship.

Many developing countries made strategic plans to industrialize their countries and then to achieve the economic development. To realize their strategic plans, they needed enough number of highly qualified engineers. They had supports from European or North American countries as well as Japan to achieve their plans.

For instance, Republic Indonesia asked Japan to support improvement of higher engineering education in Sumatra and Kalimantan universities. Higher Education Development Support Project was initiated in April 1990 under the tripartite cooperation between Indonesia, Japan and USA. This project was called "HEDS project", and many Japanese professors in the engineering faculty were involved. The HEDS project was terminated in July 2002. Directorate General of Higher Education (DGHE), Ministry of National Education launched a double expansion plan of the engineering students and directed universities to expand the student intake capacity to double during the HEDS project period. In parallel to this plan, DGHE established the accreditation board called "BAN: Badan Akreditasi Nasional=National Accreditation Board" in 1994. In the early stage, BAN evaluated human resources and teaching materials of a study program for accreditation. Then, BAN modified the accreditation system to evaluate students' learning process and outcomes provided by the study program in 1999. In 2000, the first trial by the new accreditation system was brought up for Indonesian higher education.

At the same time, Indonesia government initiated a pilot program of national university autonomy. Four established universities were selected for this program. They are Institut Teknologi Bandung (ITB), Universitas Indonesia (UI), Universitas Gajah Mada (UGM) and Institut Pertanian Bogor (IPB). Those universities devised comprehensive plans including education, finance, research and social service and submitted the plans to DGHE to obtain the approval. Four universities then, have become legal entities since 2002. After this movement of four universities, the other universities such as Universitas Sumatra Utara (USU) followed them. In Malaysia, the same movement was taken ahead of Indonesia.

Now, Japanese universities receive many international students from Asian countries and educate them. Especially, faculty of engineering educates them as engineers who can work internationally. In this article, the comparison between the accreditation systems of Japan Accreditation Board for Engineering Education (JABEE) and BAN will be done to consider how the education systems in Asian countries are globalizing and to find something about the way in which Japanese university educates Asian students for qualified engineering.

2. Accreditation system of BAN-PT

The flow chart of the study program evaluation by BAN-PT is shown in Table.1. The basic flow is almost the same as the JABEE one.

The BAN accreditation flow is outlined as follows:

1. Each higher education institute writes an application form for accreditation and sends BAN-PT the application form with the self-evaluation result.
2. After receiving and reviewing the application form from each institution, BAN-PT accepts the accreditation documents including self-evaluation report.
3. An evaluation team dispatched by BAN-PT visits the study program site to verify the self-evaluation results concerning fourteen accreditation components shown as:
   a. Visions, missions, and objectives of the study program
   b. Students
   c. Teaching staffs and supporting staffs
   d. Curriculum
   e. Facilities
   f. Funding
   g. Governance
   h. Program management
   i. Study process
   j. Academic atmosphere
   k. Information system
   l. Quality assurance system
   m. Research, publication, thesis, and society service
   n. Graduates and the other outcomes

   Note: Bold frames mean the BAN-PT activities and furthermore thick frame is the study program activity.

   The evaluation team consists of three assessors and the visit at the study program site is for three working days.
4. Evaluation team scores points to the study program based on their investigation results
5. BAN-PT council scores the final points comprehensively judging the portfolio based on the self-evaluation results and the visit evaluation results.
6. BAN-PT discloses the accreditation results.

A study program to be accredited by BAN-PT must complete a self-evaluation concerning fourteen accreditation components as mentioned above. In addition, the program must analyze the self-evaluation results with a SWOT method. The SWOT is abbreviation of Strengths, Weaknesses, Opportunities and Threats. Internal factors are strengths and weaknesses, and external factors are opportunities and threats. Then, the SWOT analysis is used to work out the solution and the recovering way of

Table 1. Flow Chart of Accreditation by BAN-PT

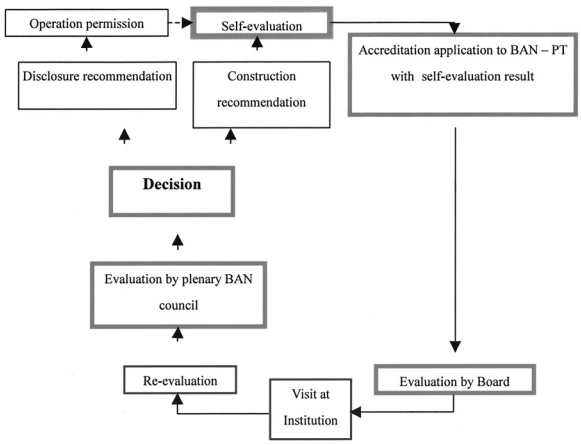

Table 2. Level and accreditation score

Rank	Accreditation score
A	361 ~ 400
B	301 ~ 360
C	200 ~ 300
D	~ 200

the weaknesses and threats, or strategic plans to solve them.

According to the accreditation score, the evaluation is categorized into four levels A, B, C and D as shown in Table 2.

A study program of the rank A or B is accredited for next five years and one of the rank C is accredited for next three years. A study program evaluated as the rank D is not accredited.

3. Different points between JABEE and BAN-PT evaluation systems

Main difference is that in Indonesia, all the higher education institutions including universities must compulsorily take BAN-PT evaluation of their study programs as a Ministry decree, but in Japan, the accreditation of the study program is not mandatory to universities and depends on the university's decision. It should be also noticed that BAN-PT is a government organization to accredit all the higher education programs including engineering education, but JABEE is a third-party's organization to accredit only engineering education programs.

To compare the criteria between both the accreditation systems, we can recognize that the criterion of students outcomes specified in JABEE Criterion 1 is not clearly stated in BAN-PT components. Maybe, it results from the facts that BAN-PT evaluates not only engineering study programs, but also other field study programs, such as economy, education, law, mathematics, management, pharmacy, religion, account and so on, and that it is impossible to set common student outcomes among those study programs.

Next, we will consider a relation between certification of professional engineers and accreditation of higher education in both Japan and Indonesia. In Indonesia, Institution of Engineer, Indonesia (Persatuan Insinyur Indonesia: PII) confers professional engineer certificates on engineers. An applicant to a professional engineer must be a graduate from an engineering study program accredited with the rank A, B or C and has acquired at least 5 years career as an engineer, or at least 3 years career as an engineer under a program supervised by a professional engineer. On the other hand, in Japan, all the applicants to professional engineers must pass the preliminary tests and have acquired 4 years career under the supervision of a professional engineer or an excellent leader, or 7 years career. If an applicant is a graduate from a study program accredited by JABEE, he or she is exempted from a preliminary test.

Mutual qualification system of professional engineers started within Asia-Pacific Economic Cooperation in 2000. At the beginning, the member countries were Australia, Canada, Hong Kong, Japan, Korea, Malaysia and New Zealand. Indonesia joined this system in 2001. For registration to APEC engineer, a professional engineer must satisfy five common requirements. However, an Indonesian professional engineer can register himself or herself as an APEC engineer if he or she is a graduate from a study program accredited with the rank A or B with majority of A.

Flow charts from accreditation of higher education to APEC engineer in Japan and Indonesia are summarized in Fig. 1.

4. Summary

Comparison between accreditation systems of university study programs in Japan and Indonesia is very briefly described in this article. BAN-PT and JABEE have been establishing their accreditation systems, which contain ABET criteria, namely criteria of learning process and student outcomes as their basic components as well as the other criteria for their own missions. Therefore, both the accreditation systems are not substantially different from each other. However, apparent disparity of both the systems can be seen on the practical application. We can infer the disparity from comparison between the study program accredited by JABEE and the rank-A study program accredited by BAN-PT, but the author would like to emphasize that this does not mean the comparison of Japanese and Indonesian students' capabilities.

Most of all Asian countries conduct evaluation and accreditation of higher education programs. However, if we take a look at human resources and facilities of higher education institutions in developing countries comparing with those in Japanese universities, a large gap can be seen. When Japanese universities receive the students from developing countries, understanding of the accreditation systems in their countries, the practical application manners of the systems and the accreditation results must bring useful and effective hints and advice to educate the students for international engineers, because the universities can know the students' learning process and outcomes.

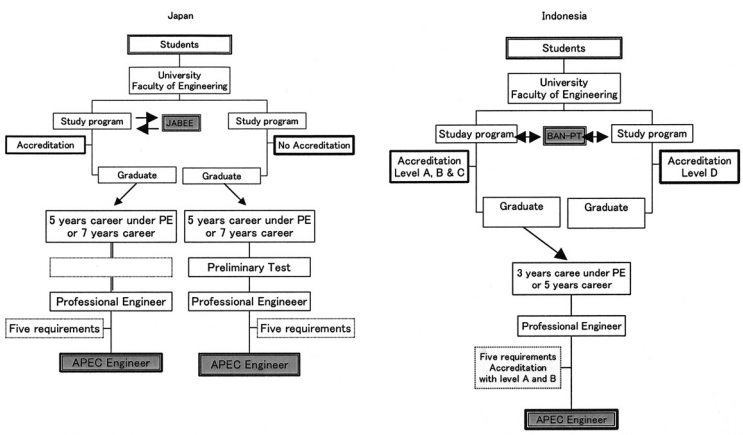

Fig. 1 Flow chart to APEC Engineer in Japan and Indonesia

Bibliography
1. 2004-2005 Criteria for accrediting engineering programs, ABET Inc. available at www.abet.org
2. Final Report of the Sixth Session of the Regional Committee for the Regional Convention on Recognition of Studies, Diplomas and Degrees in Higher Education in Asia and the Pacific, UNESCO Bangkok Office, available at www.unescobkk.org/education/aceid/higher-edu/Sixth-Session.
3. Documents concerning BAN-PT, PEDOMAN EVALUASI DIRI, ALUR KEGIATAN AKREDITASI, Hasil Pencarian Data Penilaian, all documents are available at www.ban-pt.or.id/
4. Documents concerning Professional Engineers, SERTIFIKASI INSINYUR PROFESIONAL, available at www.pii.or.id/sertifikasi/, and JAMINAN DAN KENDALI MUTU, available at www.ban-pt.or.id/jaminan_dan_kendali_mutu.htm, The APEC Engineers Manual, APEC Engineers Coordinating Committee, available at www.ccpe.ca/apec/

Engineering Education in Universities and Industry Requirement

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Continued from page 1 Japanese industry remarkably changed in 50 years, from fibers and textiles to complex chemical products, from vacuum tubes to semiconductors, from abacuses and slide rules to computers and from steam locomotives to mammoth oil tankers, and automobile became a big business while mining almost disappeared.

Did Japanese universities lead these industry changes successfully? Unfortunately the university change seemed to be behind the social change. Industry got less depending on university directly not only in education but also in research. Many companies had their own basic research laboratories in 1980s and prepared their own introduction education for new employees from universities to change their specialties from traditional engineering to new fields like semiconductor or information technology.

After this most unfortunate period of the engineering education, the economic bubble collapsed in 90s and restructuring wave attacked the companies. Simultaneously innovating movement occurred in universities and they start to change their education system to fit them to social request. JABEE (Japan Accreditation Board for Engineering Education) was planned and born in the end of 90s in such context. Better relation between universities and industry is expected in next ten years.

What is engineering?

Most significant difference between natural science and engineering is: Engineering makes new products that have not been in the world before while science researches the universal rules (truth) hidden in the space, on the earth or in the human body.

Fig. 1 shows the typical scientific research or analytical method. In any scientific field, there is a system to be researched such as the solar system, the energy flow system on the earth or information system in the brain. Then the scientist can start his research from the system.

First of all, he makes a model that can show the characteristics of the system correctly. And the next step, he tries to make a mathematical formula that expresses the model. Now he calculates the formula with high performance computers and he gets the characteristics of the model that should be equal to those of the system.

Amount of information of each step decreases from left to right that is shown in Fig.1 like potential energy change. The method of science seems to be the information reducing process discarding the needless parts of the system.

On the other hand in engineering, an engineer should start from characteristics at the most right hand side shown in Fig.2 that has least information. He must imagine a model that could realize the needed characteristics like Fig.3 that was imagined by Leonardo da Vinci when he wanted to fly like a bird. Making the model from the characteristics is the process adding a lot of information to the simple need. This is the essence of designing that is the start of engineering.

But once the engineer succeeds to make a model, he

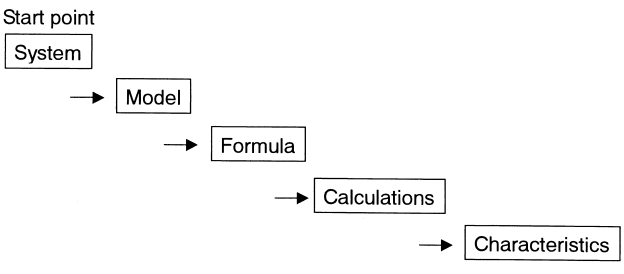

Fig.1 Steps of science or analysis

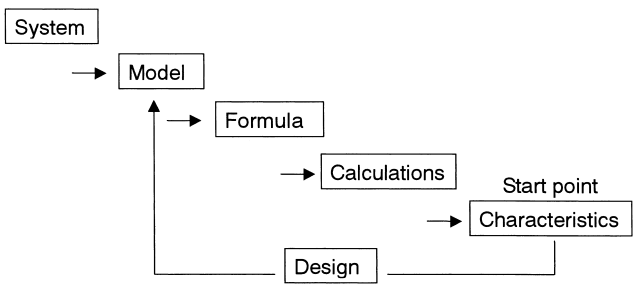

Fig.2 Steps of engineering or design

can use the scientific method to refine his model. When he gets different nature from his need through analytical steps, he can make a small change in the model and try the analysis again, that is the optimizing process of design. Obviously we cannot get a thoroughly new product through the optimizing process.

Anyway real engineers must invent world newest products (hardware, software or service) from social needs. That is the reason why the engineering ethics is needed.

Developing country engineering

Japan was a developing country for more than 20 years after World War II and there were a lot of advanced industrial products imported from Europe or United States. Since they were very good models for us, we could start from the model step in Fig.2 even in engineering. We used only scientific method for engineering at that time. We investigated imported products or foreign engineering papers precisely and could better them by the optimizing process. As the labor cost in Japan was still low, we got strong international competitiveness. "Catch up and overtake!" was our motto.

We scarcely needed the real designing ability through this period. And in 70s, the campus dispute came over the universities. Universities said that they do not educate students for industry and industry stopped saying their requirement to universities. In 1980s, we experienced overheated economy growth and industry hired any graduate from universities. Some famous company executive said he wanted graduates of universities as raw material to make it easy to educate them for proper engineers suitable to his company. Really they educated the graduates in the companies to get sufficient number of engineers to fit the newly growing fields. Sometimes it lasted for 3 years with 8 hours education a week in the fields such as semiconductors or information systems. Then the education in universities lost the chance to change and science-like-engineering without design in the university education was frozen until 90s when the economic bubble collapsed.

Engineering education for forerunner countries

Japanese industry had the motto, "Catch up and overtake!" but they did not understand well what to do after overtaking. 90s were the time for Japanese industry to start developing world newest products to get large share in world wide market but it was hard way to change the developing country industry to forerunner country industry. We suffered long lasting recession and 90s are said to be lost ten years. Most companies lost margins to educate their engineers by themselves. Now Japanese companies and university education should change to collaborating in making the strong competitiveness to develop the world newest engineering and products.

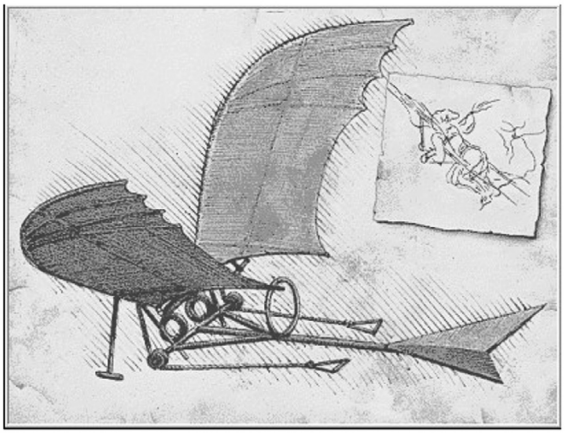

Fig.3 Plane by Leonardo da Vinci
(Compton's Interactive Encyclopedia)

JABEE (Japan Accreditation Board for Engineering Education) was born in 1999 under these situations. It aims real engineering education other than traditional engineering science education that has been popular in engineering departments in Japanese universities for a long time. JABEE can change the cold relation between universities and industry into collaboration. It accredited 3 educational programs in the fiscal year of 2001, 32 programs in 2002 and more than 60 programs in 2003.

The change in universities seems going ahead of industry now and most companies still believe universities do not work for them in education. It is the reason why they recruit new employees from students without seeing the result of education, more than a year before their graduation. Their education systems for newcomer employees are strongly based on the lifelong employment system and the seniority system. But the situation around the engineers has changed through the long recession.

Conclusion

JABEE, the accreditation system for engineering education is established in Japan that could not be dreamed 20 years ago. This is the symbol of change in the engineering education in universities. Next, companies must change their mind about the engineering education. They must find that well educated students are really powerful for competitiveness of companies. If universities show the masters are much better engineers than the bachelors moreover, companies begin to believe in universities and their education.

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