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		

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).

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(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

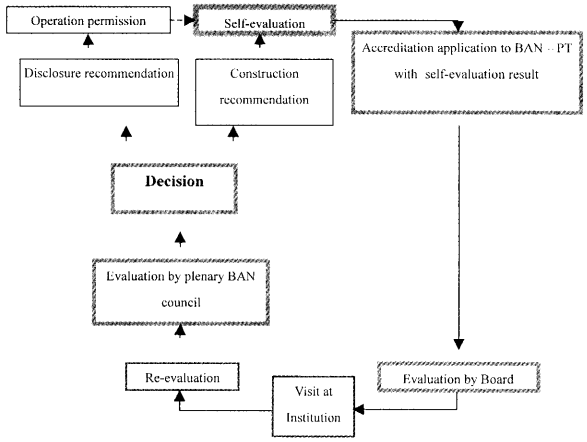

Table 2. Level and accreditation score

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.

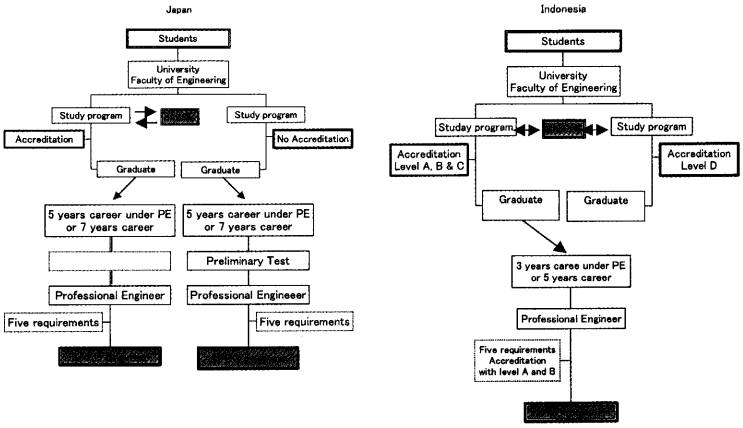

Fig. 1 Flow chart to APEC Engineer in Japan and Indonesia

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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

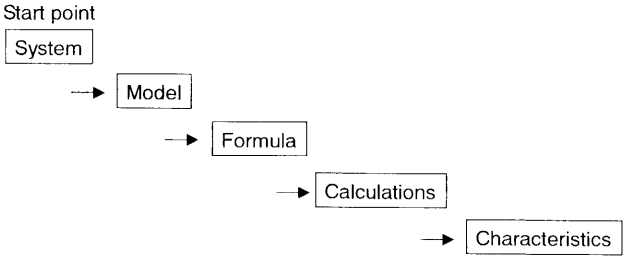

Fig.1 Steps of science or analysis

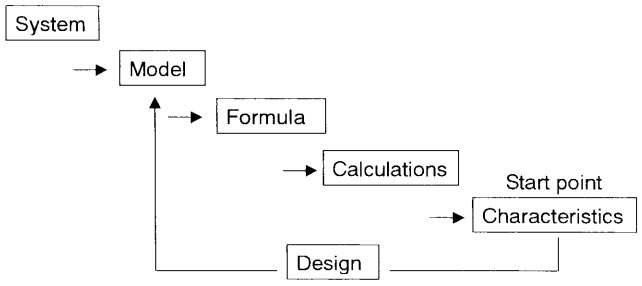

Fig.2 Steps of engineering or design