

# ideas

FOR BETTER  
EDUCATION  
& TRAINING  
FOR ENGINEERS

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ACCREDITATION OF ENGINEERING STUDIES

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DECEMBER 1994



COMMITTEE ON EDUCATION AND TRAINING

WORLD FEDERATION OF ENGINEERING ORGANIZATIONS



**WORLD FEDERATION OF ENGINEERING ORGANIZATIONS  
FEDERATION MONDIALE DES ORGANISATIONS D'INGENIEURS**

**HISTORY, PURPOSE AND OBJECTIVES**

WFEO/FMOI is an international non-governmental organization.

It was founded in Paris on March 4, 1968 promoted by UNESCO and as a result of several meetings between representatives of regional engineering organizations, with the object of creating a structure

- of a general nature, not tied to any particular discipline
- aimed at joining Associations representative of engineering from all the countries of the world

WFEO/FMOI is the world leader of the engineering profession and cooperates with national and other international professional institutions in developing and applying engineering to the benefit of humanity.

The missions and objectives of WFEO are:

- To provide information and leadership to the engineering profession on issues of concern to the public or the profession.
- To serve society and to be recognized, by national and international organizations and the public, as a respected and valuable source of information and guidance on the policies, interests and concerns that relate engineering and technology to the human and natural environment.
- To foster peace and socio-economic security among all countries of the world, through the proper application of technology.
- To facilitate relationships between government organizations, business forces and the people, collaborating with discussions aimed to improve the benefits of policies and investments related to the engineering competence.

WFEO/FMOI Secretariat is presently in London, G.B. The Secretary, Mr. John C. McKenzie may be contacted at: 1/3 Birdcage Walk, London SW1H 9JH - Fax (44) (171) 222 0812.



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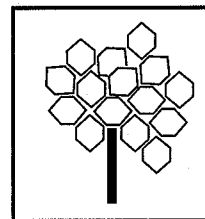
**COMMITTEE ON EDUCATION AND TRAINING**

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## **ACCREDITATION OF ENGINEERING STUDIES**

The Third Congress of Engineering Education and Training held in Cairo, Egypt in November 1994, summoned by WFEO and the Egyptian Engineers Syndicate, was attended with enthusiasm by engineering educators and deans from a great number of countries members of the Federation. The theme chosen was the main attraction: "Quality in Engineering Education - An International Perspective". The Congress served to show the interest of those who work in each country in improving the quality of engineering education and everyone coincided that one of the most effective means to achieve this was to establish standards to evaluate that quality in education by means of the development of national or regional accreditation systems of engineering programs.

A Resolution on Accreditation was unanimously approved by the Congress and later, at the request of the WFEO Committee on Education and Training, was sent out by the President of WFEO to all National Members, offering the Committee's assistance to the countries interested in establishing a national accreditation system in engineering education.

In the way of an answer the Committee on Education and Training has prepared a brief summary of the systems of accreditation ruling in Australia, France, Japan, the United Kingdom and the United States of America.

**Prof. Miguel Angel Yadarola**  
President, WFEO Committee on Education & Training

IDEAS is a publication of the WFEO Committee on Education and Training, addressed to engineering educators, educational officers at Universities and leaders responsible for establishing educational policies for engineering in each country. The articles it contains reflect the concern of people and institutions linked to WFEO, to provide ideas and proposals with the object of improving formation of engineers.

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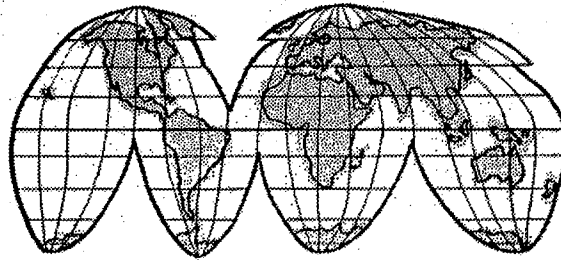
## **RESOLUTION ON ACCREDITATION**

**The third World Congress on Engineering Education and Training, held in November 1994 at Cairo, has highlighted the need for national or regional accreditation systems for engineering education. Only by the development of effective accreditation systems can the engineering programs of a given country be systematically enhanced and their quality assured; and only through such accreditation within countries is there developed a basis for mutual recognition of education credentials for engineers who will practice across national and regional boundaries-**

**When appropriate accreditation standards are developed and implemented in a country or region, graduates from accredited programs will be recognized as having acquired the educational and professional knowledge needed to enter national and international practice.**

**It is recommended by the participants in the third World Congress that nations which do not currently have accreditation systems for engineering education proceed to develop them, and that nations or regions which have such systems in use offer the benefit of their expertise and experience with such systems to others in the international engineering education community.**

## ACCREDITATION: A GLOBAL IMPERATIVE



**By Dr. David R. Reyes-Guerra, PE, Ing, CEng, Eur Ing**

The WFEO Committee on Education and Training met in Cairo, Egypt, on November 1994. The occasion was the 3rd World Congress on Engineering Education and Training. One of the priority items considered by the committee as well as the Congress was accreditation. A commitment was made to publish a relevant summary of accreditation. The members of the WFEO Committee were charged with submitting, if appropriate, details of their countries' involvement in accreditation. This paper distills the data available.

Accreditation, in education, is a system by which an academic program or a university is measured against specified criteria, which, if it is found to meet or exceed, becomes certified as accredited. Accreditation can be a quality control device, based on the applied criteria. These can reflect the desired "standards" that are to be met. The criteria can be set at any level that is desired. They can be at a minimum, average, or desired levels - they can, and usually do, reflect state of the art conditions.

The validity and acceptability of accreditation depend on many factors. Who controls it being one of the most important ones? . Is it run by the government? ; is it independent in its judgments? ; are the criteria developed by the academic institutions themselves or imposed by government? ; what role do the professions have in all the many aspects of accreditation, such as developing criteria and carrying out the accreditation function? .

There is a multiplicity of questions that arise. These make accreditation subject to much controversy; the fundamental concept that accreditation is a way of determining the quality of an academic program is not questioned. As stated above the chosen criteria is the determinant of quality.

The accreditation process has several components: 1) a self evaluation or self study by the program or university; 2) an evaluation site visit by an outside, qualified,

peer, group; 3) a judgment made by the accreditation agency of the findings of 1) and 2) as being compatible and indicating compliance with the criteria; 4) publishing the decision on accreditation (in some systems only positive decisions are released); 5) a finite time before the process must be repeated (usually the maximum is 10 years).

Accreditation lends itself to being adopted by governments, universities, and professional organizations as a method to certify the quality of educational programs. It is often adopted as a determinant of qualifications for financial and other assistance to programs and universities. Accreditation also serves as a basic requirement for licensing or right to practice of professionals who graduate from accredited programs. Corporations, industry, students and the public also look at accreditation as a measure of quality of academic offerings.

The advent of technological marvels, designed and produced by engineers, have made it possible to communicate and travel across large distances without major effort. Geographical, economical, financial, commerce, market, political, and other boundaries are disappearing or being ignored. This planet earth is now a global community.

Engineering is one profession that recognizes its practice as global. Of paramount importance in any profession is the protection of the public. Thus, each country has set up its own rules governing professional practice. All of them have a call for proof of competence of the individual professional by means of acceptable academic qualifications, experience, and, in some cases, examinations. Academic qualifications can be determined through recognition by the accreditation system or any such quality assurance system.

The world has become a global marketplace. Manufacturing industry finds itself located anywhere in the world that is convenient to it by other reasons than market proximity. Transportation is no longer a prime consideration. Shipping is very efficient and of reasonable cost, that location of manufacturing facilities is based on other considerations, such as availability of labor.

Trade agreements among countries are being negotiated all the time. New regional groups are being formed, some with strong political connotations. The North American Free Trade Agreement, better known as NAFTA (Canada, Mexico and the United States) is a prime example of a trade agreement. The European Community is another example. There are groupings of countries in Asia, Africa, Middle East, Central America, and South America that are entering into trade agreements. They each have market and manufacturing components. They each also make provisions for a system to allow "right to professional practice" exchange among "registered professionals" of the different countries. This can be complicated and difficult; as registration, right, or license, to practice regulations may be different in every country. Engineering, as a profession, would ultimately seek a "practice passport," however, that will not be here within the foreseeable future.

All professions require that their practitioners have a specialized body of knowledge acquired by study at a university (higher education). In engineering one finds the length of study programs will vary from 3 to 7 years. Thus it becomes rather diffi-

cult to allow a person with a 3 year degree, to practice in a country that has a 7 year program leading to the degree. This is not only professionally dangerous but would be considered discriminatory to the residents of the latter country who must take 7 years to qualify as professionals.

Accreditation thus becomes very important, because it is the vehicle by which assurances of the quality of the academic programs in the various countries can be measured or assured. The length of the program becomes secondary; the content and quality - based on the criteria - is the dominant feature.

Thus, engineering has lead higher education in adopting accreditation as a means of determining the quality of the academic programs. Other professions have or are developing accreditation or similar systems. In the United States over 50 professions from Medicine, through Speech Therapy, Veterinary Medicine, Law, Acupuncture, Journalism, Business Administration, Engineering, and others have accreditation agencies. This becomes almost mandatory for professions that require licensing, registration or some sort of government permit to practice.

The accreditation agency is usually recognized by the government agency that controls higher education and professional licensing. Accreditation is taken as proof that the academic program fulfills the academic requirements for practice. This affects funding of the universities by government as well as recognition by industry and the public. This recognition is essential. In some countries the accreditation agency itself is a government agency; in most this is not acceptable, the agency must be independent of government to function effectively. The agency, however, must be recognized and sponsored by government but has to be independent in its operation. It is closely related to the organization that represents the given profession and the faculties at the universities that teach the programs leading to the degrees in the profession. To avoid the influence of the political process it can not be within the Ministry of Education (Department of Education) or any such government agency. The accreditation agency has to be an independent body.

Accreditation, in a formal way, started in the early 1900's. Engineering, in the United States, began its accreditation system in the early 1930's. Canada - which was previously accredited by the U.S. - started its own system in the early 1970's. Mexico just initiated its own accreditation system in 1994. This now provides the academic/education basis for the "Mutual Recognition of Registered/Licensed Engineers by Jurisdictions of Canada, Mexico and the United States to Facilitate Mobility in Accordance with the North American Free Trade Agreement" scheduled to be signed on June 5, 1995.

An expansion of this agreement to include other countries becomes possible in the future. Presently there are accords for recognition of equivalency of engineering education among different countries through their accreditation bodies or the organizations that represent the engineering profession in accreditation. Among the agreements is one referred to as "The Washington Accord" (Australia, Canada, Ireland, New Zealand, United Kingdom, and the United States - South Africa has

applied to be included); the other is with FEANI, the Fédération Européenne d'Associations Nationales d'Ingenieurs (22 countries and 58 national engineering organizations).

The member countries in FEANI include: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom. The FEANI banner assembles over 1,500,000 engineers.

The designation of European Engineer (Eur Ing) maintained by FEANI is based on the minimum standard for engineering education: a) a high level of secondary education (B), and b) 3 years (full time or equivalent) of approved engineering education (3U) in which the following contribution of subjects in the curriculum is expected:

Basic Sciences	about 35%
Engineering Subjects	about 55%
Non technical Subjects	about 10%

and which prepares the candidates to develop toward professional competence.

The minimum standard for Eur Ing designation is a total of 7 years comprising,  $B + 3U + 2(U \text{ or } E) + 2E$ , where E denotes relevant engineering experience.

There are now over 20,000 registered European Engineers. The "accreditation" of engineering educational programs is not carried out by FEANI. Each member country has a National Monitoring Committee that attests to the quality of the curriculum (by an accreditation system or other such quality control system) and is in turn overseen by a FEANI European Monitoring Committee that makes the final acceptability decision. This is based on the recommendation of the National Monitoring Committee, an extensive study of pertinent documentation, reports, and a visit to the National Monitoring Committee making the recommendation.

Most of the countries in FEANI have adopted or are studying implementing an accreditation system. This is also true for other countries throughout our globe. There are obvious difficulties and problems: the variety of technical offerings and first professional degree designations (engineer, technologist, technician, associate, etc.); the length and content of curriculum; the difference in secondary school preparation; the pre-qualifying academic requirements for engineering study; and others.

The fact that most universities have not had to submit to accreditation of their programs (unless it is mandatory in their country) brings, in their minds, further erosion of their autonomy, coupled with professional and/or government interference, making it difficult to implement an accreditation system. Unless the institutions of higher education (universities) endorse accreditation it is very difficult to implement. Universities that are certain of the quality of their programs have no problems with accreditation; marginal institutions and those that know they have poor offerings are the ones that fight accreditation.

Accreditation becomes acceptable when a fair understanding that accreditation is not an enemy but a partner to help the universities in the improvement and the

assurance of quality education. Accreditation is based on criteria, that the universities help develop, that reflects the minimum standards necessary to successfully enter the practice of the profession, and is controlled independently from (but recognized) by the government authorities.

When setting accreditation criteria, care must be exercised to not be prescriptive. Engineers are prone to want to quantify. The guiding principle is to seek quality and not quantity. Outcome measures and flexibility in the curriculum to reach desired outcomes should be the goal.

In the United States, the engineering accreditation deals with a 4 year curriculum leading to a Baccalaureate Degree (the first professional degree). The curriculum must include: a) one year of an appropriate combination of mathematics and basic sciences; b) one half-year of humanities and social sciences; c) one and one-half years of engineering topics.

Though the criteria only identify three years, the following statement defines the criteria that must be considered in completing a four-year curriculum: "The overall curriculum must provide an integrated educational experience directed toward the development of the ability to apply pertinent knowledge to the identification and solution of practical problems in the designated area of engineering specialization."

The criteria relate to many aspects of an educational enterprise, but distinguish as essential certain issues, they are: a) Faculty; b) Curricular Objective; c) Curricular Content (expressed above); d) Student Body; e) Administration; f) Institutional Facilities (Physical Plant, Libraries, Computer Facilities, etc.); g) Institutional Commitment (Resources, Laboratories, Finance).

Each of the items is further clarified with explanatory language. Engineering design is emphasized as being at the core of the curriculum.

In Japan there is, at present, no accreditation agency. The government issues approximately every ten years, a policy document with their long-range plan for Science and Technology. This becomes the national guide that defines targets for education.

The Ministry of Education, Science and Culture publishes the ordinances that must be followed by the universities. The curriculum is to be decided by the university itself. A mandated self study and self assessment must be carried out by the university itself and the results must be made available to the public. The reports stress the free market concept of competitiveness, integration, and creativity as necessary elements in the curriculum.

Each university appoints its own self-assessment committee. Outsiders to the university are not on the committee.

A student entering an engineering degree course in the United Kingdom (UK) normally aims to become a Chartered Engineer (CEng). A professional title conferred

by The Engineering Council. The requirements for this title include: a) academic education represented by an accredited honors program in engineering; b) training at the appropriate level; and, c) experience..

The accreditation requirements are known as the "Standards And Routes To Registration" or SARTOR. Courses (programs) that meet the SARTOR requirements are known as Accredited Courses.

In the UK and in the U.S. graduating from an accredited program (course) automatically qualifies the graduate to seek professional registration. In the U.S. the title is Professional Engineer, P.E., in the UK, Chartered Engineer, CEng. For this reason universities seek to have their programs (courses) in engineering accredited.

SARTOR emphasizes that accredited courses must be geared to the real needs of practicing engineers, and to the integration of theory and practice. They must enable the students to expand their engineering knowledge in a logical, broad manner.

The aim of accredited courses should be to educate students in their own particular interests in appropriate depth while at the same time giving them the breadth of outlook to prepare them to work in interdisciplinary fields.

The distinctive features which determine if a course is accredited are:

- a) appropriate depth and breadth of technical content, with emphasis on fundamentals and inclusion of relevant mathematics and science.
- b) application of scientific and engineering principles to the solution of practical problems of engineering systems and processes.
- c) an introduction to good engineering practice and the properties, behavior, fabrication and use of relevant materials and components.
- d) mandatory inclusion of design studies (including manufacturing, reliability, maintainability, quality assurance as well as economic aspects) as an expression of the practical application of theory and accumulated experience.
- e) emphasis on methods of practical problem solving using the latest technology excluding obsolete methods, theories and topics. Using computers to facilitate modelling and a range of possibilities for problem solving.
- f) technical decision making, its commercial and economic implementation; the ability to use technical information services; knowledge of government regulations and labor management as well as other obligations of the engineer to his profession, community and the environment.

- g) communication skills and the ability to cultivate a motivation to seek further education and stay up on new developments.
- h) significant industrial involvement.

A course seeking accreditation submits full details of the course to the engineering institution (society) covering that field and approved by The Engineering Council. The application is considered by a committee of the institution and a site visit is conducted. On the basis of the dossier and the visit a recommendation is made on accreditation. There is a finite time for which the accreditation is valid, usually 5 years.

The accreditation systems all have similar requirements. They all demand a self-study, compliance with a criteria, a campus (on site) visit by a team of peer evaluators, a judgment by a board of representatives of the profession (academic and practicing engineers), and a finite period of accreditation. The system is constantly reviewed and kept up to date with state-of-the-art knowledge.

Accreditation is voluntary. There is no obligation to seek accreditation. The benefits obtained are such that universities seek the recognition given by accreditation.

Japan is studying accreditation in depth, but has not made any overtures toward implementing such a system. Countries like China, Korea, Singapore, Kuwait, Saudi Arabia, Russia, Turkey, Colombia, Chile, Argentina, to name a few, have studied accreditation. They have sent delegates to international meetings on the subject, have sent representatives to accompany accreditation teams in the United States on site visits. Many have also invited evaluation accreditation visits to their universities, mostly from the United States. An evaluation visit is conducted with the same requirements, documentation, and criteria that are demanded in an accreditation experience. Adjustments are made in the criteria to incorporate local needs. The major difference is that no judgment is made on accreditation. The evaluation is handled as a consultant visit.

The value of accreditation in higher education, specially in engineering, has become accepted. There will be a time when accreditation (or some facsimile) becomes the norm. This will lead the way to the next logical step, the World Engineer recognition. A scheme similar to the FEANI European Engineer credential will provide the necessary mobility for an engineer to practice globally.

Accreditation will open the door of opportunity to implementing the concept of the World Engineer.

#### References:

The Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, Maryland 21202-4102, USA

Fédération Européenne d'Associations Nationales d'Ingénieurs (FEANI), 7 Rue  
Édouard Jacques, 75014 Paris, France

Prof. Dr. J. C. Levy of The Engineering Council, United Kingdom, and Dr.  
Kaneichiro Imai of the Japan Society of Engineering Education, Japan, provided  
assistance with material included in this paper. The reflections on SARTOR came  
from Dr. Levy. Both of these engineers are very active in the WFEO Committee on  
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# AUSTRALIA



## THE INSTITUTION OF ENGINEERS, AUSTRALIA ACCREDITATION OF PROFESSIONAL ENGINEERING COURSES IN AUSTRALIA

**Ann Ryle**

Executive Officer to the Director, Education and Training

**Harry Wragge AM, HonFIEAust CPEng**  
Chairman, Accreditation Board

### 1. Introduction

The Royal Charter [1] of the Institution of Engineers, Australia (IEAust) states that one of the purposes of the Institution is:

"To increase the confidence of the community in the employment of engineers by admitting to the Institution only such persons as shall have satisfied the Council (of IEAust) that they have an adequate knowledge of both the theory and practice of engineering."

In carrying out this function, the Institution evaluates undergraduate professional engineering and engineering technology courses at higher education institutions in Australia and awards recognition to courses meeting the requirements of the Council of IEAust for membership at either the Grade of Graduate or Stage 1 Engineer, the entry point at the professional engineer level or at the Grade of Affiliate at the engineering technology level, as appropriate [2]

The Institution has recently developed procedures for the recognition of two year full-time Associate Diploma courses in Engineering conducted in technical and further education institutions as distinct from universities. Graduates from these courses are eligible to apply for the Grade of IEAust of Associate.

With the exception of the assessment criteria, the accreditation processes used in the assessment of Professional Engineering (four-year) courses and Engineering Technology (three-year) courses are similar. Therefore the Paper will only deal with the processes relating to the accreditation of the professional engineering courses.

Accreditation is undertaken at the invitation of a higher education institution, and ensures that graduates from that course are admitted, on application, to Graduate membership of the appropriate Grade of the Institution.

The IEAust currently accredits:

- Undergraduate Professional Engineering courses (Bachelor of Engineering) - an acceptable course must contain the equivalent of at least four years of full-time study or equivalent within a Recognised School of Engineering.
- Undergraduate Engineering Technology courses (Bachelor of Technology) - an acceptable course must contain the equivalent of at least three years of full-time study or equivalent within a Recognised School of Engineering Technology.

The Institution accredits some 200 Bachelor of Engineering courses in 35 tertiary institutions [3] and some 50 engineering technology courses in 22 tertiary institutions, with the number of courses increasing.

Accreditation assessments are carried out under the auspices of the IEAust Accreditation Board and its six Discipline Committees, using clearly defined policies and procedures approved by Council of the Institution.

## 2. Why accredit courses?

The Institution's course accreditation system has been established for many years and is well known within Australia to industry, government, universities and their Schools/Faculties of Engineering and to the Technical and Further Education system.

In addition to meeting the requirements of the Council of IEAust for membership purposes, accreditation of courses provides a significant advantage to Australian Engineering graduates wishing to practice not only in Australia but also overseas.

Accreditation also serves a useful function in raising tertiary education standards nationally, being based upon a peer review process. Both the Universities, the academic members and the Panels benefit from exposure to new ideas and suggestions. Potential students also benefit from accreditation because they can have confidence that the course of study which they are about to embark on has credibility in the profession.

Many employers require that applicants for professional engineering positions be able to prove that they are eligible for membership of the IEAust. This is also a requirement of Australian immigration authorities for potential immigrants planning to practice as engineers in Australia.

The Institution's accreditation system is also recognised internationally through the *Agreement on the Recognition of Equivalency of Engineering Education Courses/Programs leading to the Accredited Engineering degree*, 1989. This Agreement provides for mutual recognition of accredited courses between the IEAust, the Canadian Engineering Accreditation Board of the Canadian Council of Professional Engineers, the Accreditation Commission of the Accreditation Board for Engineering and Technology Inc (USA), The Institution of Engineers, Ireland, The Engineering Council (UK) and the Institution of Professional Engineers, New Zealand. In 1993 the Engineering Council of South Africa became a signatory to the Agreement and more recently the Institution of Engineers, Hong Kong has sought to become a signatory.

Most recently the IEAust has advised counterpart institutions in the South East Asia/Pacific region on accreditation systems, and has held discussions and conducted visits with counterparts of other nations on accreditation systems - examples are South Africa, Russia, Poland and Tanzania. Such international networking enables the IEAust to establish and maintain world's best practice in accreditation systems.

### **3. Features of the IEAust Accreditation System**

Three stages of accreditation exist for professional engineering and engineering technology courses - Preliminary Assessment/Provisional Recognition and Full Recognition [4].

#### *Preliminary Assessment*

A tertiary institution seeking IEAust recognition of a proposed course provides an outline of the course on which the Institution makes an assessment as to whether or not the fully developed course is likely to meet its requirements.

Accreditation at this stage should be requested prior to introduction of a course.

Preliminary Assessment does not constitute formal recognition, but it does meet the Council's recognition requirements for the grade of Student, pending formal recognition of the course. Graduation from a course that has only had a Preliminary Assessment does not meet the Council's requirements for the grade of Graduate.

#### *Provisional Recognition*

A developing course, in which some students have reached the halfway stage, may be assessed for Provisional Recognition.

Provisional Recognition is usually for a period of three years. Graduates of courses with Provisional Recognition may be admitted as Graduates of IEAust.

#### *Full Recognition*

A fully developed course, from which some students have graduated, may be assessed for Full Recognition.

Full Recognition completes the accreditation process and confirms that the qualification awarded on completion of the course satisfies the requirements of the Council of the IEAust for the grade of Graduate and the academic requirements for the grade of Member.

Full Recognition is normally granted for a period of five years from the date of endorsement of accreditation status by the constituent Board of IEAust Council.

Where a visit has been conducted to an established School of Engineering within two years of an application for assessment of a new course, the Institution has moved to conduct the Preliminary Assessment by "desk top" assessment with the visits being scheduled for only the latter two stages of accreditation. With the increasing number of courses being assessed, the Accreditation Board is also moving to Faculty accreditation rather than individual course assessments [5].

Faculty visits not only allow for a rationalisation of resources, both manpower and financial, but also provide an opportunity to identify and comment on Faculty-wide trends such as resources, funding, staff development.

On receipt of a request for accreditation, the IEAust will convene a team of two senior members of the Institution (preferably one academic member and one member from industry) to evaluate the course against prescribed criteria.

#### **4. Accreditation Criteria**

All courses are assessed against a set of basic criteria [6] covering the following issues:

- Curriculum content
  - . mathematics
  - . basic sciences
  - . engineering science material
  - . engineering synthesis or design
  - . engineering applications material, including project work
  - . humanities and social science issues, including interpersonal skills
  - . management studies
  - . professional ethics
  - . occupational health and safety
- Course objectives/ specialisation
- Course length
- Faculty information
  - . Resources (both manpower and physical resources)
  - . Staff: student ratios

- . Funding (if appropriate)
- . Faculty course review process
- . Admission requirements
- . Graduation requirements

The Institution receives no subsidies from the Government or other sources to meet the cost of accreditation. The whole of the cost is met by the Institution and its members - the Panel members give their time free of charge, with the Institution meeting all travel and accommodation costs associated with accreditation visits.

## 5. Pressures for Change

Although the Institution's accreditation system has been in place for many years, the Institution is mindful of the pressures for change that are occurring in engineering education not only in Australia but around the world. With the changes occurring in the requirements for engineering standards and the delivery systems for engineering courses

there is a corresponding need for course accreditation systems to adjust to change [7].

In Australia the nature of the changes that are occurring in engineering education is a change from specification of inputs requirements to an assessment of desired outcomes;

from an emphasis on assessment of specific course details towards an assessment of the processes by which the educational institutions can guarantee that appropriate outcomes are achieved; from the need for students to study on campus towards delivery systems using modern information technology which will ensure that the same, or better, personal attributes and attitudes are developed in the graduates.

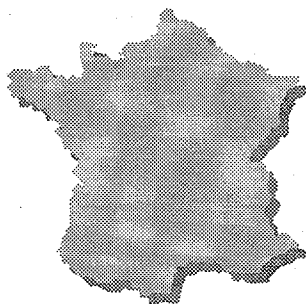
The immediate challenges facing the Institution relate to the move towards lifelong learning and the provision of opportunities for members of the various Grades of the Institution to undertake additional study to move from the Associate level to Professional Engineer level.

Issues such as credits for prior learning and experience, combined qualifications and accreditation of courses offered by distance education in the context of globalisation of engineering education are challenges that the IEAust is currently having to meet. With a well established national accreditation system in place, the task of reviewing and refining existing processes is made much easier.

## REFERENCES

1. The Institution of Engineers, Australia *Supplemental Royal Charter and Bye-Laws 1994* (R:EX\RCB.1003)
2. The Institution of Engineers, Australia *MEMBERSHIP REGULATIONS* (R:EX\REG\5000 December 1994)
3. The Institution of Engineers, Australia *Australian Engineering Courses Recognised by the Institution* November 1994 (R:ET/ACC.0004)
4. The Institution of Engineers, Australia *Accreditation Procedures Manual for Accreditation of Professional Engineering Courses*

# FRANCE



## THE ACCREDITATION OF ENGINEERING STUDIES IN FRANCE COMMITTEE FOR ENGINEERS' QUALIFICATIONS Commision des Titres de'Ingenieur (CTI)

Conseil National des  
Ingenieurs et Scientifiques de France  
CNISF

### I. An original structure

Under the Ministry of National Education, Youth and Sports, the "Commission des Titres d'Ingenieur" has the following objectives:

- to consider alll questions relating to the training of engineers in whatever field,
- to examine requests for accreditation and engineering trainings that are submitted by higher education establishments and to monitor such training
- to intervene, wherever necessary, in order to protect the standards of engineering trainings and to carry out any enquiries relating to higher establishments and the professions.

The "Commission des Titres d'Ingenieurs", created by a law of July 10, 1934 plays a fundamental role in controlling the granting of the degree of qualified engineer that is protected by law. On the basis of a modification decreed in 1985, the Commission has 32 members, appointed by the Ministry of National Education, Yough and Sports for a period of 4 years. The members are proposed by different sectors with interests in the quality of education:

- 4 members are nominated out of senior training personnel from Public Establishments of a scientific, cultural and professional nature (EPCSCP).
- 4 members among personnel from relevant schools and institutions belonging to the Ministry of Education, possessing the degree of engineer
- 8 members are nominated on the basis of their scientific and technical capability
- 8 members are chosen by the most representative organizations formed by enterprises, industry and services that employ engineers
- 8 members are nominated by the most representative professional engineering associations and organizations.

This representation has, therefore adapted itself to the emergence of new requirements and to the opening up of new training methods, development of the environment and that of the teaching.

This composition is particularly interesting, since it brings together representatives of those responsible for the training of engineers, as well as experts associations, representatives of the professions and companies and the main trade union organizations and engineers' associations.

## II. Operation

Normally, the "Commission des Titres d'Ingenieur" meets in full session five times a year, unless a special meeting is called, to consider an agenda by its Officers. This agenda generally includes:

- ▶ the nomination of the "Commission des Titres" Chairmen for any "in situ" missions or to consider requests for accreditation or any modifications,
- ▶ discussion of the reports of missions during the preceding weeks,
- ▶ presentation of a survey or enquiry into certain aspects of engineers' training.

Any public or private training establishment, whether French or foreign, with a high level of scientific and technical training, satisfying a specific professional objective, may request that such training be authorized for engineers' diplomas. Such requests are addressed to the Ministry of National Education, Youth and Sports which, after considering its suitability, transmits it to the "Commission des Titres".

The latter will then appoint, from amongst its members, the Chairmen who will, more often than not, be drawn from the various professional representatives. In addition to those Chairmen, experts or specialists in the disciplines being taught or

the professions concerned may be appointed. An "in situ" mission is then organized, so that the Chairmen can study the training project on the ground, meet the teaching staff and management team and visit the facilities and laboratories. A report will then be submitted to the "Commission des Titres" in full session, who will then:

- put forward an opinion, in the case of all national training schemes coming within the responsibility of a Ministry.
- take a decision, in the case of training provided by private establishments. The Managers of the Colleges in question will be sent the enquiry reports and may request to be heard by the Committee. They, as well as the Ministry of National Education, may appeal within two months from the decision to the standing Committee of the "Conseil National de l'Enseignement Supérieur et de la Recherche (CNESER) (I) which will make the final decision.

New technologies and new teaching methods developed, accreditations for the issuing of engineer degrees have progressively increased to 216, for 177 higher education establishments. Authorized in this way by the "Commission des Titres d'Ingenieur", the training of qualified engineers must progress constantly if today's trainee engineers are to be ready to face tomorrow's challenges and the new requirements of their profession, so far as scientific knowledge, technological know-how, professional and management competence are concerned. This essential progress must not, however, be allowed to alter the spirit and the quality of the initial objectives. The "Commission des Titres" will then, on its own initiative decide:

- either, to undertake, together with the professional organizations and companies, a detailed enquiry into the future of certain professions or employment prospects and the future development of such or such a discipline,
- or, to carry out an inspection of one or other of the qualified training establishments, to verify the content and organization of the training.

### III. A few examples of activities

The Committee carries out forecast studies, organizes high level meetings and participates in ambitious projects.

The following studies can be given as examples:

- the development of advanced training in chemistry (physical chemistry, industrial chemistry and chemical engineering),
- the training of engineers qualified in risk prevention and work safety

(1) National Council for higher education.

- ▶ the grouping together of certain engineering training programmes so as to reinforce the synergy between training establishments, so that a better common use is made of facilities and laboratories.
- ▶ continuous training for a diploma

On the basis of this work, the "Commission des Titres" organizes study and exchange conferences, where teachers and professionals can meet to discuss current themes. These conferences, thanks to the value of the meetings and discussions, make it possible to decide on useful recommendations applicable to all trainings of engineers.

The "Commission des Titres d'Ingenieur" is following the E.E.C.'s preparation for 1 January 1993 very closely. It has launched a number of initiatives in this area. It has organized working meetings with the main professional organizations and engineering associations on the convergences and specific considerations relating to the training of qualified engineers in the different European countries. Studies are carried out at its request, into the different regulated professions in Europe which might limit the possibility of engineers qualified in France practising such or such a profession abroad.

#### IV. Conclusions

The tasks of the "Commission des Titres" are many and varied. Every year, more than 60 "in situ" missions are organized, each lasting a minimum of 3 or 4 working days. Two or three more general surveys or enquiries take place each year, these require numerous preparatory meetings and many hearings.

For all these activities, the "Commission des Titres" has at its disposal a small highly competent and qualified team within the Ministry. When asked to, members of the Committee participate in surveys and work, whilst, at the same time, carrying on with their own professional activities. They are conscious of the need for this close relationship between training and the economy and the importance of continually seeking to harmonize essential economic requirements and the training of tomorrow's engineers.

#### V. After the manner of a synthesis

##### V.1 C.T.I Objectives

- ▶ To consider all questions relating to the **Training of Engineers**
- ▶ To examine requests for **Accreditation of Engineering Training**
- ▶ To protect the **Standards of Engineering Training**

## **V.2 C.T.I Composition**

**32 members nominated by Ministry of National Education, Youth and Sports.**

- 16 from amongst senior training personnel or appropriate scientific and technical qualifications
- 8 nominated after proposal by the most representative group of employers
- 8 nominated after proposal by the most representative engineers' professional associations and organizations

## **V.3 C.T.I The Accreditation Process: Ways to have "Habilitation".**

1. A request is addressed by the establishment who wishes to have a training authorized for engineers' diploma. Such request is addressed to the Ministry of National Education, Youth and Sports.
2. After considering suitability, the Ministry transmits it to the C.T.I.
3. C.T.I. appoints a Chairman and one or two experts, who "visit" the training, meet the teaching staff, the management team, see laboratories. Then a report is submitted to C.T.I. whose opinion is now established on solid bases.
4. C.T.I. will then:
  - Put forward an opinion (in the case of public establishments).
  - Take a decision (in the case of private establishments).

**(If not satisfied, applicants may appeal within two months from the decision to the Standing Committee of CNESER).**

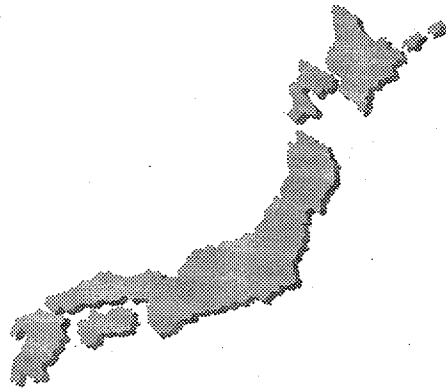
## **V.4 Activities of the C.T.I**

### **• Studies**

Such as: - development of advanced training in chemistry  
- training of engineers qualified in risk prevention and work safety  
- continuous training for a diploma

- **Organization of meetings of high level**
- **"Missions"** In engineering training establishments about 60/year
- **Regular Meetings:** 6 to 10/year

# JAPAN



## ACCREDITATION IN ENGINEERING IN JAPAN IS ON THE WAY

Kaneichiro IMAI  
Vice President  
Japanese Society for Engineering Education

### INTRODUCTION

As used in America or the United Kingdom, Accreditation of Engineering Education" in Japan is in the stage of transition to increasing transparency, in the observation of the author. Almost one hundred years ago when the Meiji government started Tokyo Imperial University accepting the advice of a special advisor from the UK, the Engineering Department was taken up as the one of the faculties of the university for the first time in the world. Since then, universities in Japan have steadily increased the number of students graduated from engineering and science- oriented courses.

During this period, the quality of engineering education also changed to meet the requirements of society, mainly under the strong direct control of the Ministry of Education. Generally, several national universities have always lead in scale and quality of higher education . It is only a slight exaggeration to say that, the other universities try to follow these models, in many respects to keep their reputation. Today's Ministry of Education, Science and Culture tries its best to maintain and improve the quality of engineering education by herself to meet the changes of paradigm. For this purpose more Freedom is rendered to universities .Self study and assessment is the key word for universities to improve their educational performance. Responding to this, universities have started to work along this line, however it may take some steps and time to establish the process of self study and assessment and the procedure of improvement of engineering education to meet the requirements of the society. as the trend to enhance creativity and globalization to survive in the borderless era.

## SELF STUDY /ASSESSMENT REQUIRED

In 1991 Ministry of Education, Science and Culture issued a new ordinance, called a revision, but actually it was radical change of the policy on the university education, under the new ordinance, the two major changes were 1) it gave complete freedom to the universities to select and organize programs and curricula by themselves, 2) universities must undertake self study and assessment by themselves and these studies and assessment reports must be published for public use.

Responding to these new ordinances many universities in Japan started actual implementation.

Following is a table of the action, by universities. Although this covers universities as a whole, we may understand that the engineering and science-oriented courses are leading this tendency.

	Number of Universities	Self-study Assessment Implementing	Report Published
National University	98	(100%)	94(95%)
Public University	48	42( 88%)	17(35%)
Private University	407	294( 72%)	102(25%)
Total	553	434( 78%)	190(34%)

Some universities have started to introduce evaluation by third party to have more fair evaluation of the performance. Tokyo, Kyoto, Tohoku, Tsukuba University and Tokyo Institute of Technology, are top class universities, some of which had published the results of evaluation by outside persons. Mainly science and engineering-oriented courses received this evaluation.

Moreover, Ibaraki, Keio, and Tokai University started assessment of teaching by students. The results of these evaluations by students are used for the improvement of teaching. The introduction of student evaluations for the improvement of teaching will become more general in the future.

## STRUCTURAL CHANGE REQUIRED

Here I would like to report on the total structure of university accreditation in Japan,

In the Ministry of Education Science and Culture, a Council of Standards for the Establishment of Universities and Educational Foundations was formed consisting of leading members of academia, government officers and specialized experts. Under this council two subcommittees, the School Foundation Committee and the Establishment Committee were organized.

Financial and administrative affairs and facility issues like library, class room, and gymnastic equipment are the major concern of the School Foundation Committee. Curriculum structure, teaching method, credits, and human resources including faculty development are under the purview of the Establishment Committee. In 1991 reformation, the Establishment Committee became very flexible and many of its regulations were liberalized. Items which are under the control of the School Foundation Committee, however, changed very little.

At the time of founding a new university, the founders must submit every detail of the project and plan to the Ministry of ESC for approval. During its first four years the school will be examined to see that details of its performances are in accordance with the proposed plan. The school must also develop self-study and assessment to improve the quality of its performance and maintain the level of education and research.

At the starting of new colleges and universities, a high level of quality in engineering education is required by government regulation. Schools have to maintain that level as minimum requirement or possibly face difficulty in obtaining outside financial aid, which acts as a very strong motivation. From time to time, school inspectors will visit the school to investigate the conformity to performance guidelines.

During this stage, the self study and assessment will be learned and practiced.

As mentioned above self study and assessment was recently required by regulation, however, detail is not shown. It is quite new to universities, and many universities believe that an introduction of self-study/assessment might be easier in engineering education than in courses for humanities or social sciences, so in many cases Engineering Department acts as a model.

To meet the new requirements universities have to change their concepts and structure

## JUAA

In 1949 when a study team from America visited Japan, and upon its recommendation, Japanese University Accreditation Association (JUAA) was formed. However when the Ministry of ESC took full responsibility for higher education including universities, the Association was kept dormant until the recent reformation had started.

At the time of Government funding allocation for education and research, MESCC will examine the applications from universities, and make the decisions so still MESCC is influential in many respects. However, today, MESCC will not directly intervene in the accreditation of education and research.

This year, under the auspices of the JUAA, a "University Assessment Manual" was published, and many member schools will start self study and assessment using this manual as their guide from 1996. They expect within ten years to accomplish

as the standard procedure. As a first step they will start with the submission of self-study and assessment reports, so site visit might not take place broadly.

## CONCLUSION

I reported mainly on the present status of university accreditation in Japan, focusing upon the engineering education. From my observation, self-study/assessment as a first step of accreditation will have a strong impact on recent education reformation in Japan. Actually engineering and science-oriented courses are leading in introduction of accreditation in university, by the removal of the walls between disciplines and introducing third party involvement, and by applying student evaluation.

However universities still need to take some measures to increase the openness of their performance, for instance, by a peer review and a curriculum discussion, exchange of lectureship by experts from outside, and more close link with industries.

Very recently, though it was only one example, the result of Engineering Examination has shown that perhaps engineering education in Japan might be world level.

I must conclude my observation on accreditation of engineering education in Japan, which is proceeding along the world trend — "Globalization".

## EDITORIAL NOTES

To the paper by Dr. Kaneichiro Imai of Japan

To a Western mind, reading the excellent paper by Dr. Kaneichiro Imai, may bring different questions to mind; based on our own experiences with our own universities and our unfamiliarity with the culture and environment of education in Japan. There is a vast difference in the work and employment scenes in their culture. To understand better the concepts and the basis for the approach towards accreditation by Japan we must have some understanding of their environment.

Japan has a national commitment to developing an educated and trained work force that will be committed to placing their country as the world leader in "engineered products". Thus education is foremost to prepare this needed force work. People need to work in teams giving each other support and benefiting from the characteristics of each team member to produce a superior result. The education in Japan stresses the team concept and produces researchers, engineers, technologists, technicians and skilled workers in numbers that support their needs. There is both a hierarchical structure as well as a number structure among all these specialties.

The role of the university is seen as teaching. Research is secondary. Thus research is undertaken in large measure in industry. This approach cements the ties between industry and the universities.

The team concept is prevalent in all enterprises. The responsibility of a manager is seen as that of developing his people. Continuous improvement is the banner under which all rally. For this reason, management is next to its employees during the continuous improvement time and as a matter of fact even senior managers conduct many of the sessions.

Total quality and consumer satisfaction are by-words of any enterprise in Japan. This is also true of university education. Loyalty to a company by the employee and by the company to the employee is a sacred obligation of both which is practiced without a second thought. Higher Education (indeed all education) is controlled by government. The Ministry of Education is responsible for the control of education and works most assiduously to fulfill that obligation without interfering with university autonomy and academic freedom. Standards of education are set by the Ministry and the universities (public and private) are obligated to comply with them.

In Japan there is a "reputational" ranking of universities and colleges. The so called premier universities are the seven Imperial Universities. There are a number of private universities which themselves are very prestigious. Universities tend to identify with certain industrial companies who recruit their graduates and have support arrangements with those industries. The quality ranking of the industry is also applied to the university and vice-versa.

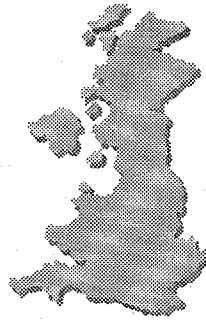
Based on Total Quality precepts accreditation as known in the West has been studied in Japan. The goal of excellence indicated that no rigid standards could be set for the educational enterprise, the quality of the product (the graduate) would be determined by the performance in the working environment for which the university education has prepared him. The measure of that accomplishment was on a long range basis. There is an openness and truthfulness in thinking and actions in Japan. This cultural characteristic is the foundation of honesty.

Analysing the accreditation system the self-assessment or self-study part was considered by the Ministry to be the key in the accreditation process. They then directed the universities to carry out the self-assessment as explained by Dr Imai. The results of the self-assessment are to be made public. This is something that would not be acceptable in the West by the universities. This public exposure would condemn the self-assessment document to a very biased report dedicated to extolling the virtues of the university and ignoring any shortcomings. This is not a problem in Japan.

The use of outside third party evaluators to go and "verify" the conditions as provided by the self study assessment document will become the next step that will lead to an accreditation process similar to what is being done in some Western countries. Dr. Imai indicates that outside evaluators are already being used by some universities in making their self study assessments.

There probably will be a few years before Japan defines the total structure for their accreditation system. Meanwhile it is felt that the university education of engineers in Japan is at a global level and equivalent in order of quality of educational service, to any other university education in world leading countries.

# UNITED KINGDOM



## THE ACCREDITATION OF ENGINEERING DEGREE COURSES IN THE UK

J. C. Levy

A student entering an engineering degree course in the UK normally aims to become a Chartered Engineer (CEng). This is a professional title conferred by The Engineering Council, a national body responsible for setting standards in engineering education and training. Academic education is only the first part of the path to CEng, and in fact the requirements for the Chartered Engineer title include:

1. Academic Education represented by an accredited honours degree in engineering (called stage 1).
2. Training at the appropriate level (called stage 2)
3. Experience, including responsible experience (called stage 3).

Stages 1, 2 and 3 together take at least 7 years. When they have been satisfactorily completed, the final stage is a professional review, including an interview by at least two senior engineers, of the whole of the candidates engineering formation.

The academic requirements for Stage 1 are detailed in The Engineering Council's publication "Standards and Routes to Registration", usually known as SARTOR. Courses in universities and polytechnics which are judged to meet SARTOR requirements are known as "Accredited Courses". This means that graduates from these courses automatically fulfil the Stage 1 requirements for CEng. For this reason almost all university and polytechnic engineering departments apply for their courses to be accredited because without accreditation they would be greatly hampered in their efforts to attract well-qualified students. This is why the SARTOR document provides a unifying factor in degree courses across all fields of engineering.

The advantages for the students are that, besides being assured of fulfilling the requirements for registration, they are spending their time at an important point

in their lives on courses and programmes which have been thoroughly vetted to high standards and therefore give the best prospect of later advancement in the profession and practice of engineering.

SARTOR emphasises that accredited academic courses for CEng must be geared to the real needs of practising engineers, and to the integration of theory and practice. The Engineering Council's view is that each course should embody and integrate theoretical and practical elements commensurate with the level of study being pursued, so enabling the student to expand his or her engineering knowledge in a logical, broad manner.

The aim of accredited academic courses should be to educate students in their own particular interests in appropriate depth while at the same time giving them the breadth of outlook to prepare them to work in interdisciplinary teams. The Engineering Councils' Board for Engineers Registration (BER) looks for a number of distinctive features in determining whether a course can become "Accredited". It is accepted that the relative weight and extent of these features may vary according to the purpose, level and field of the course.

The features are:

- a) Appropriate depth and breadth of technical content, with emphasis on fundamentals and inclusion of relevant mathematics and sciences.
- b) Application of scientific and engineering principles to the solution of practical problems of engineering systems and processes. Emphasis on the relevance of theory and analysis including the ability to develop and use theoretical models from which the behaviour of the physical world can be predicted. Each course should embody and integrate theoretical, practical and project work commensurate with the level of study being pursued.
- c) An introduction to good engineering practice and the properties, behaviour, fabrication and use of relevant materials and components. However, syllabuses will vary greatly from one field of engineering to another.
- d) Mandatory inclusion of design studies (including manufacturing, reliability, maintainability and quality assurance as well as economic aspects) as an expression of the practical application of theory and of accumulated experience.
- e) Emphasis on methods of practical problem-solving using the latest technology, and the exclusion of obsolete methods and topics. It should be noted particularly that the availability of computer facilities a more, not less, fundamental approach to problem-solving because real systems can be modelled more closely, fewer assumptions need to be made and a range of possibilities can be rapidly investigated.
- f) Technical decision making and its commercial and economic implementation; the ability to use technical information services; knowledge of government

legislation affecting work, eg. safety, health, environmental requirements; an understanding of the principles of management and industrial relations; some knowledge of trade unions and their organization; an understanding of an engineer's responsibility to the profession, to the community and to the environment.

- g) Special measures, (eg. teaching methods) to cultivate students' ability to find out and learn for themselves. This involves communication skills, powers of expression both oral and written, and a critical approach to problem-solving.
- h) Appropriate methods of examining and assessing students, having special regard to paragraph (e) above.
- i) Significant industrial involvement in the preparation of the degree course, eg by means of a consultative or steering committee; courses, or numbers of single lectures, given by engineers employed in industry; projects and design studies supervised by engineers employed in industry.

It is possible for courses which combine two or more branches of engineering - egelectro-mechanical engineering, to become accredited using the same standards as for single discipline courses.

### **Procedure for Accreditation**

A University engineering department seeking accreditation of a course must submit full details to an engineering institution (e.g. The Institution of Civil Engineers) approved for the purpose by The Engineering Council. The course details include curricula, facilities, resources, staffing, student assessment methods and industrial links. The application is considered by a committee which includes academics and industrialists and if there is a *prima facie* case for accreditation a visit to the university department will be organized by the engineering institution. On the basis of the visit (see next section) a decision will be taken whether to accredit the course and for how many years, with a maximum of five.

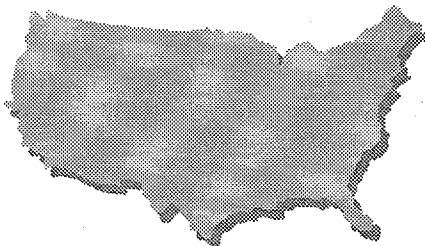
### **Guidelines for the Conduct of Accreditation Visits to Engineering Departments in Universities**

- 1. The purposes of the visit are to:
  - a) To clarify any points which may have arisen in connection with the committee's consideration of the written submission. Such points may be concerned with:
    - i) the purpose and objectives of the course
    - ii) its management
    - iii) admission requirements and method of student selection
    - iv) criteria for progress of students through the course
    - v) failure rates

- vi) sponsorship of students
  - vii) course structure and methodology
  - viii) the technical subjects taught and teaching methods
  - ix) tutorials
  - x) subject options
  - xi) the integration of design, management and professional studies
  - xii) (spare)
  - xiii) projects
  - xiv) methods of assessment
  - xv) standards and their control
  - xvi) teaching loads of academic staff
  - xvii) research
  - xviii) resources generally
  - xix) staff qualifications and experience
  - xx) industrial/employer involvement in the course, for example in teaching and project supervision
  - xxi) the involvement of staff with industry
  - xxii) support staff
  - xxiii) arrangements for external moderation
  - xxiv) extent of, and arrangements for, practical work including, for example, laboratory, drawing office, computing, field studies and industrial visits.
  - xxv) the need for all students qualifying for the award of the degree to meet the minimum academic requirements for registration
- b) To meet staff and students and discuss the course with them.
  - c) To inspect a selection of students' work, particularly in projects and design.
  - d) To ascertain by inspection whether adequate facilities are available for the course, for example in laboratories, equipment, computing.
2. The visiting party should consist of at least three qualified persons preferably accompanied by one other member of the staff of the visiting Institution. At least one of the three must have substantial experience of teaching engineering degree courses and at least one must have substantial industrial/employer experience.
  3. The visit should last at least one working day. It should include the following phases:
    - i) an initial meeting among the visitors alone
    - ii) a meeting with the head of department and course leader
    - iii) discussions with members of the academic staff
    - iv) meeting with a representative group of students, say three from each year of the course
    - v) a tour of laboratory areas and design offices associated with the work
    - vi) a final meeting among the visitors alone
    - vii) if desired, a final meeting with the course leader and senior academic staff

4. The recommendations of the visiting party must not be divulged to the applicant department at the time of the visit.
5. A visit report approved by the visiting party, will be considered by the committee of the Visiting Institution. The decision will then be communicated to the applicant department and the Engineering Council's Board for Engineers' Registration informed in the approved manner.

# UNITED STATES OF AMERICA



## ENGINEERING ACCREDITATION IN THE UNITED STATES

by

David R. Reyes-Guerra

Accreditation has a complicated history. It took hold and became a necessity when either government or the professional organizations decided to implant a system that would, in some way, guarantee to the public that an educational institution was delivering to the consumer an education that met certain standards. Towards the end of the last and the early years of this century accreditation became a "quality" assurance system of keeping standards in education. The medical profession, together with the engineers and the lawyers, realized that their obligation to serve the public, in a responsible manner, was threatened by unscrupulous organizations that were posing as institutions of higher learning, giving degrees, and thus foisting on the public practitioners that were unable to function as representatives of their claimed profession. The professions, conscious of the need to require certain minimum competencies among those entering the professions, launched accreditation. It was a system that defined minimum educational criteria that needed to be met by any institution purporting to graduate qualified persons to enter a given profession.

Government kept its distance. They realized that this was better handled by the professions themselves in cooperation with the universities. Thus government became independent from the accreditation process, except that it set certain standards for the accrediting organizations to meet.

Those that chose to meet those standards were then "recognized" by government. The individual states (in the federal republic which is the United States) had the control of practitioners through "licensing". They then opted for recognition of the accredited status of a graduate from an accredited program as a prerequisite for seeking a license to practice the given profession. Thus even though the seeking of accreditation is voluntary on the part of the universities it becomes necessary because of the many benefits it brings.

Accreditation means that a program has met "minimum criteria/standards". This in itself is a measure of a certain degree of quality. Industry, government, universities, foundations, licensing bodies, and others recognize the value of accreditation. Therefore accreditation is used for determining recognition of the given program. This facilitates receiving grants, other types of support, recognition, qualifying for education licensing requirements, and other types of benefits for both the university and the graduates of accredited programs.

There are over 50 accrediting agencies that deal with individual program specialties - medicine, engineering, business, dentistry, law, etc. - and 6 which deal with institutional - entire university - accreditation. The latter have divided the country into 6 regions and only accredit within the borders of their assigned region. They each have their own procedures and criteria. Thus there is no single standard that applies to all institutionally accredited institutions in the United States. This is different from specialized or program accreditation where the same criteria applies to all programs across the United States.

Institutional accreditation criteria basically addresses whether the university is organized so that it can deliver the education it claims to offer in an effective manner. It does not deal with the value of the programs ... this is left to the specialized/program accreditation agencies.

Engineering accreditation started in 1932, when the Engineers Council for Professional Development (ECPD) was created by a group of engineering societies and the coordinating body for state licensing bodies (the National Council of Engineering Examiners). The first accreditation actions were taken in 1934. Since that time engineering accreditation has grown to handle not only "first professional degrees" usually taken as the baccalaureate degree, but also "advanced level programs" taken as the masters of engineering degree, engineering technology programs at the associate and the baccalaureate degree levels, and related engineering programs. The engineering societies represented in the Accreditation Board for Engineering and Technology (ABET) - the new name of ECPD - has 27 engineering organizations in its membership. There are over 1400 accredited programs in engineering at over 300 institutions; over 750 accredited engineering technology programs at over 240 institutions; and over 11 engineering related programs (surveying and industrial hygiene).

Over the years the accreditation criteria and procedures have evolved to a fairly complicated and all encompassing process. However the main criteria developed in the early years is still prevalent. Programs to be considered must be designed to "prepare graduates for the practice of engineering at a professional level". The general criteria relates to:

- Faculty (the heart of any educational program. Competence, qualifications, pedagogical ability, attitude, and scholarly commitment)
- Curricular Objective (application of pertinent knowledge to the practice of engineering)
- Curricular Content (one year of mathematics and basic sciences; one half year of humanities and social sciences; one and one-half years of engineering topics)

Student Body (admissions, retention, scholarship, record of graduates)  
Administration (attitude and policy towards teaching, research, and scholarly production)  
Institutional Facilities (physical plant: classrooms, offices, laboratories, etc.)  
Institutional Commitment (financial and philosophical commitment of the institution)

Each of the above seven criteria have been the core of the accreditation criteria. Each is amplified in detail to explain to those seeking accreditation for their programs what is meant by each criterion. Additionally a special criterion is offered for Cooperative Education Programs (where the student alternates periods of supervised industrial experience with the educational program). There is a special criteria for non-traditional programs.

Because of the general nature of the criteria, the various engineering disciplines introduced what is called "program criteria". This is simply an interpretation of what is required by the discipline for fulfilling its criteria. For example, electrical engineers when referring to mathematics define that "additional work is required in one or more of the subjects of probability and statistics, linear algebra, numerical analysis, advanced calculus, partial differential equations, and complex variables, and must be used in electrical and electronics courses."

The criteria must be approved by the ABET Board of Directors and by the member societies that classify as Participating Bodies (those with curricular responsibility). They are 21 out of the 27 members - one an Associate Body and six Affiliate Bodies.

Possibly one of the sources of much controversy is the criterion on "curricular content". Note that the requirements only add to a total of three years. However even though a flexible approach is favored towards the design of the curricula, specific coverage is required for each curricular area. Thus mathematics are specified beyond trigonometry; in basic sciences, general chemistry and calculus based physics, as well as life sciences earth sciences, and or advanced chemistry or physics are suggested as being appropriate to satisfy the requirements.

One must keep in mind that the criteria is a "minimum criteria". Most programs are based on a baccalaureate degree, which in the United States is a 4 year - eight semesters of 15 weeks each - 120 semester credit hours - 5400 total hours. However in engineering the average baccalaureate program is of 134 or more semester credit hours, where the mathematics courses before calculus are not counted. Thus the engineering program - though it can be completed in four years by taking an overload or taking summer courses (during the summer recess - June to September - usually 8 week offerings) - is completed on the average in 4.7 years.

There has been much discussion in the United States concerning the need to recognize that the knowledge that is needed to enter the practice of the engineering profession has increased to the point that a four year program is not sufficient. Several research efforts are being implemented among a group of universities supported by the National Science Foundation to design, revise and change the under-

graduate curricula. The results of all these ongoing efforts may be a recognition of the need to increase the time necessary to obtain a first professional degree in engineering.

The accreditation criteria is constantly under study and, when found necessary, revised. A recognition of design as being the chief characteristic of engineering, has moved into the criteria as a subject that must be developed and integrated throughout the curricula, including a capstone design experience; so has "hands-on" laboratory experience, and ethics and administrative experiences, as well team functions that integrate various disciplines and professions.

There is a strong move to limit the specificity of the criteria. Return to the early "general" concept; relate to total quality precepts, rely more on outcome measures than on process; eliminate quantifying "bean counting" and look for quality indicators.

The accreditation process involves

- A request to be evaluated for accreditation submitted by the chief administrative officer from the institution, indicating the programs to be considered.

- A self study submitted with details as to how the accreditation criteria is met by each program. The form follows a Questionnaire Format.

- A total profile of the university and all its offerings as well as the governing structure.

- An on-site-visit by a team of "peers" selected by ABET from a list of trained evaluators from the Participating Bodies who are matched by experience and knowledge to the program(s) to be evaluated

- A report by the visiting team that is submitted to the institution for corrections of fact and then submitted as corrected to the Engineering Accreditation Commission (EAC), which makes the decision on accreditation.

- A presentation before the EAC of the visit report by the chairman of the visit team - in most cases a member of the EAC. The report is then discussed and a decision made on accreditation.

- A notification, giving the accreditation action(s), with a comprehensive report sent by the President of ABET to the Chief Executive Officer of the institution.

The process from start to finish usually takes 18 months. The institution request for evaluation is sent before January, the questionnaire and copies of the applicable criteria is then sent to the institution. The self evaluation completed Questionnaire is returned to ABET before June. The EAC meets during the summer and selects the visiting teams. The On-Site-Visit takes place between September and December. The processing of the visit reports is completed by March. The EAC takes action during its meeting in June. The final report is sent to the institution as soon as possible - usually by September.

There are provisions for appeal of not-to-accredit actions. In some cases there is reconsideration of actions. Accreditation, when granted, is for each individual program submitted is for a maximum of 6 years. There is a 3 year accreditation. Some programs, at the same institution may be granted different accreditation terms. A

program that fails accreditation may request a new evaluation immediately.

During the on-site-visit the visiting team will go over samples of student work, textbooks, notes, laboratory reports, transcripts, etc. The program administrators must collect all this material and have it available for inspection.

Engineering accreditation is controlled by the engineering profession, and recognized by government and other interested and concerned publics, including the institutions themselves. The academic faculty members and the practitioners are considered engineers who choose to practice their profession in a different setting. This allows for the concerns of each to be taken into account with equanimity. The accreditation process is not looked upon as an adversarial situation between the accreditor and the accredee. The process is more of an exercise in self evaluation where the accreditor is a helpful consultant and contributor to the program being evaluated.

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