ideas

FOR BETTER EDUCATION & TRAINING FOR ENGINEERS

ACCREDITATION, ENGINEERING EDUCATION AND PRACTICE

NUMBER 4
JULY, 1997

WFEO

COMMITTEE ON EDUCATION AND TRAINING

WORLD FEDERATION OF ENGINEERING ORGANIZATIONS

A NEW PRESIDENT FOR THE COMMITTEE

At the WFEO General Assembly to be held in Hong Kong in November 1997, the Hungarian engineer, Prof. János Ginsztler will take office as chairman of the WFEO Committee on Education and Training.

The Internal Regulations for the WFEO Technical Committees approved during the General Assembly (GA) in Vancouver, in 1987, established that "the President of the Committee should be appointed for a four-year term, renewable once. The process of appointment or re-appointment, should be performed at least one year in advance, in order to ensure a smooth transition and continuity of operation". Later, a modification included the following: "Rotation of the chair is to be encouraged and the maximum period for a chair and for national member support is to be eight years".

The present Headquarters located in Argentina under the auspices of WFEO National Member, UADI, and the President were elected by the GA in Prague in September 1989 and their term was renewed for another four years in October 1993 during the GA of Havanna. According to these dispositions, a new President and new Headquarters are to commence their first four-year term as from the GA in Hong Kong in November 1997.

Towards the end of 1995 the WFEO Secretariat started up the mechanisms to search, among all the National Members, the one that could take over the Headquarters and sponsor the activities of the Presidency and the local support group for the Committee.

Hungary, through its National Member MTESZ, submitted a proposal in time which was analysed by the Committee at its 1996 Annual Meeting in Washington and approved by the WFEO Executive Council in Río, in October 1996.

The new President will be Prof. János Ginsztler (1943). Prof. Ginsztler graduated as a Mechanical Engineer at the Technical University of Budapest (TUB) in 1966 where he obtained the degree of MSc. and PhD. in Welding Engineering (1973). In 1980 he became Doctor of Technical Science of the Hungarian Academy of Sciences. At present and since 1966 he is a Professor at the Institute for Technology and Materials Science of the TUB, where he is also Vice President. He is a member of several Academies and professional Societies in his country and in Europe and has received important awards. He is and continues to be member of several Editorial Boards of renowned Journals in the USA and Europe, which ensures a promisory future of quality and growth for the Journal IDEAS.

Prof. Ginsztler has demonstrated his capability in leading international organizations: he has been Vice President of FEANI, the European Federation of Engineering Societies.

Those of us who witnessed the birth and growth of the WFEO Education Committee are happy to know that its presidency will be, as from November 1997, in very good hands.

M. A. Y.

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

COMMITTEE ON EDUCATION AND TRAINING
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CONTENTS

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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EDITORIAL

KNOWLEDGE FOR DEVELOPMENT IN THE INFORMATION AGE
Sharing knowledge means sharing development

Prof. Miguel A. Yadarola

Which is the origin of the motivation that impulsed the World Bank together with the Canadian Government to summon a Global Conference in Toronto in the last days of June 1997, to discuss "how can developing countries, and particularly the world's poor, gain access to and effectively use knowledge and information to foster sustainable development, promote economic growth, empower individuals and communities, and enable lifelong learning?". The Conference has been sponsored by UNESCO, the Government of the United States and several imporant multinational companies, institutions and organizations.

I am amazed at the spontaneous generosity enclosed in the argument of the Conference and more so, because multinational companies are involved in the summons, they who up to today have jealously defended their right to the property of knowledge, achived through expensive research processes.

Are we perhaps on the threshold of a new world, more solidary and human where authentic cooperation with poor or underdeveloped countries from other more developed countries and especially from their leading multinational companies is a reality ?

If so, this would be an interesting answer for the sceptic people who believed that some of the statements in my opening speech at the 3rd World Congress of Engineering Education and Training in Cairo, 1994, were uthopic:

"I believe that in a new solidary world, knowledge should no longer have nationality or absolute owners and should become the social property of mankind. It is to be hoped that this statement will be true very soon, but for this to happen, developed countries and their leading enterprises must be willing to share their knowledge with developing countries. This must happen especially in those selected areas that display creative advantages in generating a comparatively larger aggregate value to their raw materials and energy inputs. Undoubtedly, a stream of knowledge will also be generated in the reverse direction, since intelligence is not the exclusive property of the more developed countries or their efficient enterprises. As Bernard Shaw would say, *If you have an apple and I have an apple and we exchange them, in the end each of us will still have one apple. But if each of us has an idea and we exchange them, at the end each of us will have two ideas.*

A lot is said in the leading countries of the world about aiding in the development of the countries less favoured by progress. If they are really convinced of this need they should start by sharing knowledge by means of a generous flow of information towards the universities, having in mind that *sharing knowledge means sharing development.*

Universities need updated knowledge to develop researchers, professors and future engineers, who will then be in the right place to make this transfer true. They must be in a condition to offer information of the highest quality, both in contents and in methods, to start up creativity and competitiveness in all the actors of this educational process".

Cooperation between the Canadian International Development Agency (CIDA) and the American Federation of Engineering Societies (UPADI) has continued producing working documents that will serve as a basis to establish engineering evaluation and accreditation systems in Latin America. The document reproduced in this Section is one of the last drafts resulting from the joint work of experts from several countries in Latin America

UPADI

FRAMEWORK FOR THE ACCREDITATION OF ENGINEERING PROGRAMS IN LATIN AMERICA

Technology, globalization and competition are dominant forces in the modern world and it is therefore essential that the education of engineers meets the rigors of contemporary engineering practice. Furthermore, the North American Free Trade Agreement (NAFTA) together with its side agreement on engineering provides for licensed engineers, who are well-qualified by virtue of their education and experience, to work and pursue work in all NAFTA countries. Only engineers and companies with engineers who meet these requirements can therefore benefit from the Agreement.

In the NAFTA countries, the quality of engineering education is now indicated by graduation from accredited engineering programs. Accreditation may be defined as the objective assessment of the quality of engineering programs in accordance with well defined principles, criteria, policies and procedures. The United States of America and Canada have had accreditation systems for engineering programs since 1936 and 1965, respectively. In response to the North American Free Trade Agreement, Mexico created an accreditation system for engineering in 1995.

Since other countries in Latin America have indicated their intention to join the North American Free Trade Agreement or align themselves with the Agreement, it was decided to initiate in 1993 a collaborative project on engineering accreditation involving representatives from Canada, Chile, Colombia, Costa Rica, Mexico, Peru and the United States of America. The project was funded, in part, by the Canadian International Development Agency (CIDA).

The present document provides a "Framework" for the accreditation of engineering programs in Latin America. Consideration is restricted to educational programs which lead to entry into professional engineering practice. In general, such programs are offered at the baccalaureate level. Advanced and research oriented engineering programs are not the subject of this framework. The framework, which identifies the principal features of accreditation without giving specific details, is presented in pointwise form. The details should be determined by individual countries and reflect the characteristics of their practices. Compliance with the framework is expected to result in a high degree of equivalency and thereby lead to mutual recognition at the international level of the academic qualifications of graduates from accredited engineering programs.

Section I defines professional engineering practice and states the general objectives of accreditation whereas Sections II gives the general requirements for accredited engineering programs. Section III provides information on the nature, policies and procedures of accrediting organisations.

I. BAS1S FOR ACCREDITATION

A. Definition of Professional Engineering Practice

Engineering practice is any act of planning, designing, composing, evaluating, advising, reporting, directing or supervising, or managing any of the foregoing, that requires the application of engineering principles and that concerns the safeguarding of tife, health, property, economic interests, the public welfare or the environment. (CCPE definition of Professional Engineering Practice).

B. General Objective of Accreditation

The general objective of accreditation is to identify to the public engineering programs which provide graduates with appropriate competencies for contemporary engineering practice. The competencies for engineering practice include the ability to:

- Apply mathematics, science and engineering science for the design, operation and improvement of systems, processes and machines;
- Formulate and solve complex engineering problems;
- Understand and resolve the environmental, economic, societal implications of engineering work;
- Communicate effectively;
- Engage in continuing education and professional development;
- Act in accordance with the ethical principles of the engineering profession;
- Function in contemporary society.

II. ACCREDITATION CRITERIA AND PROGRAM CHARACTERISTICS

Information on the following characteristics must be addressed in the policy documents of the accrediting organisation end information must be elicited on programs considered for accreditation:

A. Program Level, Name and Length

1. The program must be offered by a university-level institution.
2. The program name must reflect the nature of the program and indicate that it is an engineering program.
3. The normal time required to complete the Program must be stated.

B. General Program Objectives

1. Competencies, skills, and values to be developed in the program;
2. Career and/or employment expectations of graduates from the program.

C. Program Characteristics

1. *Curriculum*

a. Curriculum structure;
b. Mathematics content;
c. Basic science content
d. Engineering sciences content;
e. Engineering design content;
f. Computing content;
g. Complementary Studies content.

2. Regulations

a. Admission regulations;
b. Promotion regulations;
c. Graduation regulations;
d. General regulations;
e. Compliance with regulations.

3. *Teaching-Learning* Process

a. Institutional philosophy, strategies and systems supporting teaching and learning;
b. Development of competencies to apply mathematics, basic sciences and engineering sciences to solving engineering problems;
c. Development of engineering design competencies;
d. Development of competencies in effective communication, teamwork, autonomous learning and the assessment of environmental and societal impact of engineering work;
e. Development and appreciation of ethical and societal values.

D. Students

1. Entrants

a. Number of applicants and admitted students;
b. Competencies of admitted students;
c. Information provided to prospective students.

2. Enrolled Students

a. Number (full-time and part-time);
b. Success rates in promotion and attrition rates.
c. Morale.

3. *Graduates*

a. Competency of graduates;
b. Employability of graduates;
c. Nature of initial employment;
d. Long-term careers of graduates;
e. Success in advanced engineering and other programs;
f. Involvement in continuing education.

E. Program Resources

1. Human Resources

a. The number of Faculty members (full-time and part-time) must be sufficient, by virtue of their knowledge and experience, to cover all areas of the program and to provide effective guidance to students.
b. Faculty members must have achieved a level of education which is at least equivalent to the program in which they teach.
c. Faculty members must be capable of communicating effectively using the available teaching and learning materials.
d. Full-time professors must be involved in technological research and/or innovative professional engineering activities.
e. The support staff must be appropriate in number and competency to meet the program requirements, including the laboratory and workshop needs.
f. The senior administrative staff (i.e. Dean, Head and/or Director) must be appropriate for the number of students, faculty members and support staff.
g. The senior administrative staff must have achieved a high level of distinction in the engineering profession through advanced studies, professional practice, research and/or development.
h. The program staff (i.e. senior administrators, faculty and support staff) must manifest a high level of dedication to the program and the engineering profession.

2. Physical Resources

a. The financial resources must be sufficient to meet the program objectives and needs.
b. The buildings must be appropriate in relation to the number and nature of students, staff and services offered.
c. The laboratories must be appropriate for the number of students, for the student work load and for enabling the students to engage in hands-on operations.
d. The equipment (including computational equipment) must be appropriate in quantity and quality to meet the program requirements.
e. The quantity and quality of library holdings must be sufficient to meet the requirements of the program and related professional practice.

F. Program Management

1. Management

a. The management of the program must ensure that its objectives are met.
b. Self-evaluation, continuous improvement and planning must be integral parts of program management.
c. The program management must be responsive to the needs of the engineering profession, students and program staff.
d. There must be effective communication between university administrators, program administrators, program staff, students, the engineering profession and the public.

2. Coherence

There must be global coherence between the objectives of the program and its activities, resources and management.

III. ACCREDITING ORGANIZATION: NATURE, POLICIES, PROCEDURES

A. Nature of the Accrediting Organization

1. The accrediting organization must be reflective of engineering practice and foster innovation in engineering education.
2. The accrediting organization must operate at all times in accordance with the highest standards of professionalism, ethics and objectivity.
3. The members of the accrediting organization must be knowledgeable and competent in **matters related** to engineering accreditation, engineering education and engineering practice.
4. The accrediting organization must not be controlled by the universities (since their programs are being accredited) or governments (if they fund the programs).
5. The accrediting organization must conduct its activities in relation to individual engineering programs in confidence, except for the publication of the accreditation status of the program.
6. The accrediting organization must have appropriate financial, human and physical resources.
7. The accrediting organization comprises an accreditation board, evaluation teams and organization staff.

B. Accreditation Board

1. Composition

a. The Board must be representative of the engineering profession, the institutions offering engineering prograrns, engineering employers; representatives from government and the public may also be included.

b. The Board must be representative of the principal engineering disciplines and regions in the country.
c. The Board must consist of members who have achieved a high level of distinction in their area of expertise.
d. The number of Board members must be commensurate with the workload of the Board.

2. Mandate

a. To accredit engineering programs;
b. To define and revise accreditation criteria, policies and procedures;
c. To oversee the operation of the evaluation teams and the accrediting organization staff;
d. To keep abreast of developments in engineering practice, education and accreditation nationally and internationally;
e. To enter into mutual recognition agreements with accrediting organizations in other countries.

C. Evaluation Teams

1. Composition

a. The membership must be commensurate with the number and nature of programs to be accredited.
b. Evaluation Team members must be engineers in good standing, knowledgeable in engineering practice and familiar with engineering education.
c. The Evaluation Team members must be knowledgeable in accreditation.
d. The Evaluation Team members must not have a conflict of interest with the program being evaluated (e.g., they must not be instructors in the program, have close relatives in the program, be members of program advisory committees).

e. The Evaluation Team membership must ensure an effective linkage with the Accreditation Board.

2. Mandate

a. To evaluate the program through examination of documentation and onsite visits in accordance with specified accreditation objectives and criteria;
b. To report the findings to the Accreditation Board.

D. Accreditation Staff

1. The number and competence of the Accreditation Staff must be appropriate to the accreditation workload.
2. The Accreditation Staff publishes lists of accredited programs, accreditation

policies and accreditation procedures.

3. The Accreditation Staff liaises with members of the engineering profession, institutions offering engineering programs, employers of engineers, industry, government and the public on matters related to accreditation.

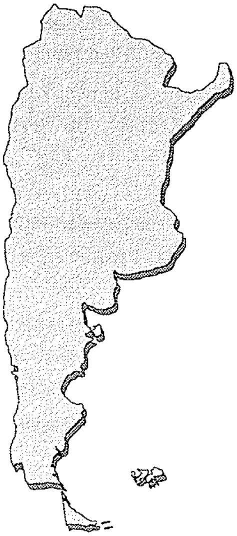
E. Accreditation Policies

1. Accreditation is voluntary and only undertaken upon the request of an institution offering an engineering program.
2. Accreditation is only granted to individual engineering programs (and not to departments, faculties or universities).
3. All program routes (including options) must meet the accreditation criteria.
4. All graduates must meet the program and accreditation criteria.
5. Accreditation is granted for a limited number of years (typically no more than six years).
6. When accreditation is granted for less than the maximum permissible period, responsible deficiencies must be specified together with the requirement for a follow-up report by the institution and/or a visit to the institution.
7. There must be stated conditions under which decision of the Accreditation Board can be appealed.
8. There must be stated policies for withdrawing accreditation.

F. Accreditation Procedures

1. Accreditation is undertaken at the request of the institution offering the program.
2. The visit by the Evaluation Team is preceded by a self-evaluation of the institution and the submission of documentation in accordance with guidelines approved by the Accreditation Board.
3. The on-site visit by the Evaluation Team includes an assessment of program facilities, examinations and student work as well as interviews with institution and program staff, students, alumni, employers and any others relevant to the program.
4. The institution must have an opportunity to respond to the findings of the Evaluation Team.
5. Evaluation procedures must allow flexibility in the approach to satisfying the accreditation criteria.
6. All aspects governing accreditation must be regularly reviewed, updated and improved.

ARGENTINA



ACCREDITATION OF PROGRAMS AND CURRICULAR UNIFICATION IN ENGINEERING EDUCATION

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I. ACCREDITATION

The global tendency towards quality in education, especially in higher education, is rapidly impulsing countries that do not wish to remain aside progress, to adopt appropriate mechanisms to ensure the level of graduate formation.

During the last few years Argentina has impulsed economic and administrative reforms within the framework of a model of growth that privileges the participation of the private sector in the management and ownership of public services, in an effort to reduce the permanent deficit these services showed while handled by the State.

The motto "to reduce the State is to enlarge the country" is being fulfilled inexorably, with evident growth in macroeconomy but bringing about a cost of unemployment and social unrest.

Modernization of the educational field started in the mid 80's, establishing a point of reference for all studies, primary, secondary and university by means of a Federal Law of Education, the bases of which were analysed and discussed by all sectors in the country before being approved. The same procedure was followed with a project submitted by the Ministry of Culture and Education (MCE) to the Congress to regulate higher education. The third version of this project, that incorporates some of the objections made by Universities and several political sectors, was approved in July

1995. The new Law of Higher Education maintains the autonomy of the National Universities, students admittance without restrictions, gratuitious tutoring and the qualifying nature of professional degrees, characteristics present in the previous law.

Novelties introduced by this new Law refer fundamentally to demands related to the degrees and evaluation/accreditation

Degrees	Minimum curricular contents for a specific degree Award and validity of university degrees
Evaluation and accreditation	External institutional evaluation of all universities Postgraduate program accreditation (Master and Doctor) Evaluation and accreditation of graduate programs (careers) for professions that are ruled by a Law.

University Degrees

Only universities recognized by the Ministry (MCE) can grant professional degrees and also Master and PhD titles. All these titles have national validity. Professional degrees recognized by the MCE qualify for the practice of a profession throughout the country with no other demand except a formal registration in each Province where the graduate wishes to work. The activities for which the owners have compeence are established by the Ministry (Art. 42). Article 43 of the Law contains interesting remarks:

> When dealing with degrees corresponding to professions ruled by the State, where practice could endanger health, security, rights and property of people, it will be necessary that:
>
> a) Plans of study bear in mind the basic curricular contents regarding intensity of practical formation and the minimum load time established by the MCE, in accordance with the Council of Universities (CU).
>
> b) The respective careers should be periodically accredited by the National Commission for University Evaluation and Accreditation (CONEAU) or by private institutions established for this purpose and duly recognized.
>
> The MCE will determine with a restrictive criteria and in accordance with the CU, the list of these titles, as well as the professional activities reserved exclusively for them.

Evaluation and Accreditation

The Law distinguishes the two ways of controlling educational quality: One is the evaluation and accreditation of careers (programs) when the State controls the practice of the respective professions. (Engineering, Medicine, Law, etc.) in accordance with the contents of paragraph b) of Article 43 transcribed above and the other is the external evaluation of universities as a whole that answers certain objectives for the creation and transmission of knowledge. Article 44 reads:

> Universities should ensure internal institutional evaluation methods with the purpose of analysing achievements and the difficulties encountered in fulfilling their functions, and suggest measures for improvement. Self evaluations shall be complemented with external evaluations, performed each six years as a minimum. This will embrace teaching, research and extension, and in the case of National Universities, institutional administration as well. External evaluations will be the responsibility of CONEAU with the participation of academic peers of renowned competence. Recommendations for institutional improvement arising from the evaluations will be made public.

Accreditation of programs (careers)

As can be seen, the Law allows the creation and formation of private entities to take part in the process of evaluation/accreditation without specifying their origin, integration or establishing a certain representation. Nevertheless, Artice 45° demands that these entities be authorized by the Ministry following a report from CONEAU. Also in accordance with the Law, we find that these entities can only intervene in the process, since the corresponding standards and guidelines will be established by the Ministry following consultation with the Council of Universities (CU).

An initiative of UADI, the National Member of WFEO and other Societies that represent national engineering as well as Councils that rule professional practice, will allow the establishment of private entities for university evaluation and accreditation (EPEAU) to act in the field of engineering.

It will be necessary to analyse different ways of association, as the model of ABET from the U.S.A. or the CACEI model of Mexico, or with our own model that meets both the requirements of the Law as well as the present conformation of the representative organizations of engineering in Argentina. It is probable that during the rest of 1997 and during 1998 the EPEAU will start operating and especially, the entity or entities that will be responsible for the accreditation of engineering programs thus completing the Argentine University Accreditation System. A system that could have been better, less dependent on the Government, or legislative bodies or the universities to be at the same level as the world trend. A system that leaves in the hands of engineers, through their representative organizations, the definition of the patterns, standards, criteria and procedures for evaluating and accrediting, in answer to the needs arising from professional practice. However, the System exists and has meant great progress in the road to implemening quality control in university studies and their compatibility with those of the rest of the world.

Accreditation of postgraduate programs or careers

In the case of postgraduate studies, the universities themselves went ahead of the demands of the Law, voluntarily requesting accreditation of over 300 postgraduate degrees. The Ministry then created in 1994 the Commission on Accreditation of Graduate Programs (CAP) formed by outstanding academic personalities. So far two thirds of the total programs evaluated has been accredited. At present, after the Law was approved this responsibility has been transferred to CONEAU.

Universities have a special interest in having postgraduate program accreditation, since only these receive subsidies from the Government through FOMEC.

Institutional evaluation was also in force before the Law was approved and the Ministry signed, as from 1993, sixteen agreements with national universities, two with faculty societies and one with a private university in order to program and implement the requested process of institutional evaluation. These agreements foresee technical assistance in carrying out the self-evaluations by universities and in making and guiding external evaluation committees. In 1995, the evaluation of three national universities was completed: Universidad Nacional del Sur, Universidad Nacional de la Patagonia Austral and the Universidad Nacional de Cuyo. CONEAU will take over the responsibility of carrying out the remaining agreements.

The public nature of the recommendations that are to arise from external evaluations, will no doubt constitute an element motivating change in those institutions that do not comply with the minimum standards established by the Ministry.

II. CURRICULAR UNIFICATION

As a result of three Latinamerican seminars on methods, media and experimental teaching of engineering, summoned between 1982 and 1985 by UPADI and UNESCO, towards the end of 1986 the "Iberoamerican Structure for the Support of Engineering Education" was created with the participation of UPADI, UNESCO and universities in Spain, Portugal, Argentina, Brazil, Chile, Colombia, Venezuela and Mexico. One of the programs of the Structure was "Curricular Homogenization in Engineering" the purpose of which was to agree on the minimum contents for the different engineering careers in Latin America, Spain and Portugal and make possible the formation of engineers with a solid scientific basis, with analogous level and orientation in order to eliminate future barriers in the reciprocal acknowledgement of degrees. The "Structure" coordinated by an expert from Spain Eng. Ramiro Cercós worked efficiently between 1987 and 1991, performing eleven workshops of curriculr homogenization in different countries of Latin America, solely on Basic Sciences: Mathematics, Physics and Chemistry, as a result of which three synthetic documents were produced that coincide in minimum basic contents for all engineering careers. Some of these documents include proposals on teaching methodology, improvement of professors and institutional development. The lack of funds from UNESCO discontinued this activity in 1991. Nevertheless, the results of the program have started to bear fruits, in Argentina among other countries.

The proposal of the Engineering Deans

In 1988 Engineering Deans in Argentina reached an agreement to create an entity that would allow them to discuss solutions to improve engineering education. The Federal Council of Engineerng Deans (CONFEDI) that arose then as a private entity took upon itself to carry out a Program of Modernization of Engineering Education, starting in 1993 with the "Project for Curricular Unification" that has received the academic and financial support of Spain through ICI, Institute of Iberoamerican Cooperation. Two Coordinators and eight experts, all from Spain, for the different areas of engineering, offered between 1993 and 1996 the experience of a similar process performed in Spain, the difficulties and achievements of which were stimulating for the success of the Argentine project. Towards the end of 1996, the ICI-CONFEDI Project for Curricular Unification of Engineering Education was submitted to the Ministry that has to approve them after agreement with the Council of Universities.

The present situation in Argentina could not be more heterogeneous: a great deal of engineering degrees, of different denomination but with the same professional attributes; curricula with marked differences that intends to form comparable professionals; excessively long studies for the obtention of all engineering degrees, 6 years in principle that very few comply with: the average time of permanency of an engineering student in the University is 8 years; different time load to obtain the same degree of engineer (3495 hours - U. N. de Cuyo - Plan 5 years to 6.412 hours U. N. del Nordeste - Plan 7 years); obvious dispersion in the naming of the subjects and their contents.

The diagnoses showed the need for urgent agreements between Engineering Deans, who left aside preconcepts, and agreed on a Project that has the following characteristics: 1) Total time load (minimum) = 3.750 hours = 5 years, 2) Degree of curricula homogenization = 55% (Electronic Eng.) 68% (Civil Eng.), Homogenization by area: a) Basic Sciences 20% (20%), b) Basic technologies 15% (21%), b) Applied technlogies 15% (19%) d). Complementary subjects 5% (8%).

The remaining Time Load must be defined by each University in accordance with the regional modalities, demands of the working market and professional competence that they wish to emphasize.

The Project defines for each career, the professional profile adequate for the requirements of a modern country, but barely sketches the teaching methodology and does not judge a key matter: updating and improvement of the teaching staff. These aspects will form part of future agreements.

To summarize: the ICI-CONFEDI project for Curricular Unification in Engineering Education will allow all universities in the country that adhere to it, to possess an optimum and homegeneous level for the formation of engineers. It will also contribute to mutual acknowledgement of degrees between Argentina and Spain and will facilitate integration of engineers in the Mercosur.

ARGENTINA

APPLICATION OF THE STANDARD ISO-9000 TO EDUCATION

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1. Situation

The country in its entirety is confronting an obvious and growing dilemma in its industrial structure. The way in which the world makes its business is changing and, almost as a question of national survival, we should also change.

At all levels in organizations fundamental changes are necessary, if institutions seek to follow the rhythm of international competitiveness, the growing sophistication of consumption goods and the constant changes in technology.

Universities are not excluded in this model. When required to weigh up the need for change, many factors show their influence, for example:

- Reduction of the educational base
- Increase of national and international competition
- Budget reduction
- Increase of no quality costs
- Decrease of public confidence in the manner in which university activity is carried out.

Considered as a whole, these factors aim clearly at the need to revalue the manner in which this task is carried out.

It is not probable that in the coming years the university population and the investments in higher education will increase significantly as regards present levels. It is possible that their growth continues to be behind the inflation index.

The only manner in which the University and Industry may be successful is to seek continuously for the way to improve their operations and also their results

In order not to lose the hegemony that may have been achieved, it is indispensable to perform concrete actions aiming at a reduction of the operational costs of the organization in an efficient manner.

The three main factors to keep in mind for a correct measurement of the evolution of a system are efficiency, quality and operational costs.

The increase of efficiency achieves a direct effect on the reduction of operational costs.

Although quality has always been associated with excellence, and therefore to higher costs, the use of current administration techniques, improvements in quality acheive substantial increases in efficiency and important reductions in operational costs.

Administration and organization systems aim basically at the "Satisfaction of the Client", that should be achieved by means of actions that allow obtaining increasing quality and dropping costs.

Direct satisfaction of the Client is obtained by fulfilling the conventional requirements of quality in service, adequate fees and compliance with the educational proposal.

An educational organization must therefore confront its reconversion aiming at reducing costs, improving quality and the Opportunity to Learn. But how?: applying different techniques and norms such as:

- Quality Assurance according to ISO 9000 (BQM)
- Total Quality Management (TQM)
- Just in Time (JIT)
- Continuous improvement (KAIZEN)
- Benchmarking
- etc.

Among the activities for Quality, three levels can be differentiated:

a) Quality Control Evaluation of the compliance with the requiremets established between the Client and the Educational Organization

b) Quality Assurance: A system of basic administration that ensures that the clients will receive the established formation.

c) Total Quality. A total system of administration that includes Quality Assurance and includes all the areas and personnel of the Organization.

2. ISO 9000 Standards

ISO 9000 is a guide of voluntary reference to establish documented systems of quality administration, that allow organizations to establish a basic system of continuous improvement, where global non conformities that affect the global efficiency of the organization are easily detected, and corrective actions can be applied in order to erradicate the causes of the malfunctioning, thus avoiding their repetition.

For an educational system that develops its own plans of study, ISO 9001 is applicable.

The Standard has basic functions (20 elements) that directly affect the Opportunity to Learn. These operational functions rule the interaction between areas, their obligations of each of them, the responsibilities of the different functional areas of the organization, and the actions to take in the face of the discovery of a nonconformity.

The administration system has four levels of documentation, the first level consists in a Quality Manual where the quality policy the organization wishes to apply should be reflected, expounding the objectives to be reached, the resources and the organization proposed to achieve them.

The second level contains the Operational Functions that consist in the implementation of the quality policy of the organization.

In the following level the applications of the functional operations are developed as working instructions.

The fourth level basically contains the registers generated by the system, that constitute the evidence of the implementation and the correct operation of the aforementioned documentation.

The requirements of the system of quality proposed by ISO 9001 are summarized in 20 points that contain all those actions that directly affect the Opportunity to Learn, which should be regulated (if applicable to the organization) in order to ensure a basic system that complies with the objectives set by the ISO 9000 norms.

Perhaps one of the most important elements that can be obtained from a basic system of quality administration is the detection of no quality costs, that are normally hidden and difficult to detect. Within this characteristic the lack of efficiency of an organization that must often re-do tasks performed initially with errors can be included. Time dedicated to "re-work", materials misappropriated due to errors, the client's dissatisfaction that obliges rectifying, etc. can in some cases amount to 25% of the organization's income.

Implementation of these systems demands periods of over a year and half, mainly because they have to be "custom-designed" for each organization, and this requires training personnel to assimilate this intense cultural change in the working methodology.

Certification, for an independent entity, accredits the existence of third parties within the organization of an effective quality administration system, that ensures the client achievement of the agreed objectives.

Implementation of ISO 9000 norms allows any organization to have a system to generate indispensable information for decision-taking to improve and make future projections, and constitutes the basis for application of optimization techniques in organizations, such as JIT, Kaizen, Total Quality, etc.

3. Application of ISO 9001 in an Educational Project

The product is in the center of all processes where the main objective is quality. The concept of product, therefore, is a basic requirement. One way of defining it, for an educational project, is to say that the product is "the opportunity to learn".

Once the program is established, the product is nothing but the means to develop it. These means shall fulfill specific requirements. Among them, playing the main role, are human resources, whether they are related or not to the quality of the product.

Since man is the fundamental vehicle to achieve the quality that the norm proposes (element 18 of ISO 9001/2), it is evident that formation and training have a basic significance. It is in few disciplines where the norm is applied, that we find the figure of man so permanently, be it in the supplying or receiving process.

The project of applying ISO 9001 to an educational system, specifically a University, finds its correlation in a work developed by the National Accreditation of Certification Bodies (NACCB) in England, attached, where each element of ISO 9001 is interpreted in the form of individual guides for application in the educational field.

One way of summarising the principles of this interpretation is to take certain definitions that arise from it, where the concepts of ISO 9001 are transferred to the educational terminology. For instance, "Learner", "Program", "Client", "Organization", "Accreditor", "Opportunity to Learn", "Teacher".

If we take the 20 elements of the norm and analyse their applicability in an educational field we may select some of them, for example: Organization, Contract, Design, Documentation, Processes, Inspection, Formation, as those that can be applied immediately, together with the System of Quality, in a process of progressive adaptation. These, and each of the 20 clauses have their based application.

4. A few reflections

The definition of product proposed by the guides appears as an alternative to the definition of ISO 9001. This is not so. The definition of the norm as regards the product is clear "Result of activities and processes". The norm itself broadens and clarifies the concept of product when referring to service as a form of provision.

When entering the field of education there is no doubt that one is closer to services than to goods. Therefore, and from our standpoint, what the NACCB guide does is to be loyal to the concept of the norm and adapt it to an educational organization. This is the rule of ISO 9000: to adapt general concepts to specific applications. Thereby its universality.

The guides cover the twenty elements or clauses of ISO 9001. It can be said that in all of them there is an easy way to find correlation between the norm and a center of study.

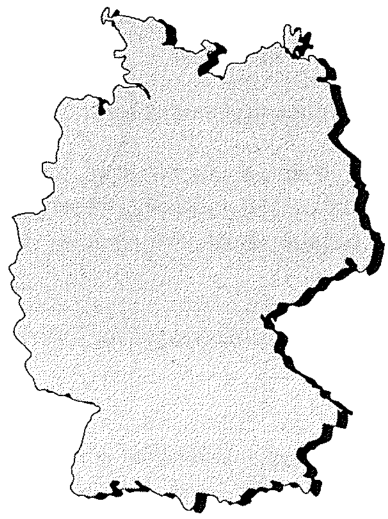
At first, to experts in applying ISO 9000 norms in production and industrial services, the terminology that appears in the analysis of the norm applied to the educational field may seem strange. However, and as a counterpart, the versatility of a norm of these characteristics stands out immediately when, except for minor details, its applicability is demonstrated in all its extension.

There are no conflicts in the manner of facing the application. All the elements are there, and combined transform the organization in an entity that provides products to a recipient, all of this in accordance with preestablished requirements and periodical controls, also scheduled, that ensure the quality of the product and the right moment in which the recipient or learner must receive it. It is all fluid and coherent with the precepts of the norm. Like in any other application of ISO 9000, the most important thing is to study in detail the particular case in which it shall be applied, diagnose and plan the process. In an educational environment, specialized professional participation will be indispensable and we will surely find that part of the road that ISO requires has already been trod or at least outlined.

Reviewing the NACCB guides and highlighting what is really different in the universal concepts of ISO 9000, we must mention the "contractual" relationship educational organization-learner or supplier of the product-recipient. In most cases and entering the grounds of conventional application, the recipient, normally called the client, is an entity to which - according to the normative principles - no requirements are established. They are all on the side of the supplier. At the most and before closing the contract, both supplier and recipient should be sure that there is an agreement within the terms of the contract.

In the educational application and following the English interpretation, we find the concept "the qualifications" as a main requirement the learner should comply with to enter or participate in the "opportunity to learn". We are totally in agreement with the interpretation, except that in the conventional world for application of ISO 9000 we have not yet found an organization that selects its clients, except for economic-financial conditions. But this has not yet been contemplated by the quality philosophy that ISO 9000 promotes.

GERMANY



Engineering courses at the crossroads
VDI Recommendation
for future-oriented training courses for engineers

VDI
Düsseldorf, February 1997
Association of German Engineers

Summary

1. The VDI recommends maintaining and building on Germany's system of autonomous universities and polytechnics and stepping up cooperation.

2. The VDI recommends reviewing the structure of engineering degrees, which currently comprise a general grounding in mathematics, natural-science, technology and interdisciplinary skills, followed by specialisation in a single field. Specialisation should be reduced in favour of a broader general training. Alongside engineering skills, degree courses should foster an analytical, interdisciplinary approach.

3. The VDI recommends a four-module course comprising 30 per cent mathematics/ science, 30 per cent basic technology, 20 per cent specialisation in a specific field and 20 per cent non-technical/interdisciplinary skills to ensure closer links between the various branches of engineering and to make sure that courses are updated regularly to reflect technical progress and social change.

4. The VDI recommends that all new engineering students should be given an opportunity early on to review their basic choice and switch courses if necessary.

   To facilitate this, the first two semesters of all engineering degree courses should be structured in a similar manner to ensure compatibility and enable students to switch courses at the end of the first year.

5. The VDI recommends that

- efficiency of further training courses

- guidelines should be drawn up to assist further education institutes

- universities and polytechnics should have the facilities and incentives to organise training courses for graduates, thereby enabling them to cooperate with independent training institutes such as the VDI-Bildungswerk and industry

- a financial framework should be created for further training of graduates.

Preamble

The demands made on engineers have altered as a result of far-reaching changes in technology, industry and society, triggered on the one hand by new scientific discoveries, increasing globalisation of the marketplace and mounting competitive pressure and on the other by growing environmental awareness, society's ambivalent attitude to technology and the ambivalence of technology itself.

Companies have responded to the challenge of structural change by stepping up the pace of innovation, introducing production methods designed to enhance quality and cut costs, and improving their service. One way in which they are achieving this is by reorganising management structures and working processes. This involves a shift away from rigid, hierarchical structures to more open, flexible and customer-oriented systems with flatter hierarchies, broader delegation of operational responsibility and a more complex and interdisciplinary organisational structure.

This refocusing of working practices and decision-making procedures is having an impact on the training of engineers and on their professional role.

As a result of this structural change, specialist knowledge and skills need to be complemented by the ability to work in a team, a broad knowledge of engineering methods and a systematic, interdisciplinary approach. Engineers are also expected to take account of social, intercultural, political, economic and ecological conditions and understand the implications of technological developments and the use of technology.

This calls for a fundamental change in the structure of degree courses, including course content and teaching methods.

Recommendations on the structure of the higher education system

Different job specifications make different demands on engineers. Those engaged in research and development primarily need to be able to take an abstract, theoretical approach to problems while for those employed in manufacturing, assembly, maintenance, technical marketing and service the bias is more practical. Every engineering assignment requires a combination of theory and practice but the weighting varies.

Similarly, students have a wide range of skills, abilities and preferences. The higher education system therefore needs to accommodate both professional requirements and the individual skills and the abilities of students.

Since this would be difficult to achieve with a single type of higher education institute, theVDI supports a diversified higher education sector with autonomous institutions running different types of courses. Entry requirements should depend on the qualifications to be obtained. Economic success depends to a large extent on a country's ability to provide enough qualified and motivated engineers for all functions in the innovation cycle. Consequently, degrees awarded by different types of higher education institute should be accepted as being different but equal.

In our view, the German system comprising universities and polytechnics offering a range of different engineering courses meets these basic requirements. Graduates are able to take up posts that match the training they have received.

The VDI recommends maintaining and building on Germany's system of autonomous universities and polytechnics and stepping up cooperation.

Recommendations on the structure of degree courses

If we analyse the work performed by engineers, we see that it is made up of many different components which vary according to their job. The exact job specification depends on a number of factors such as field of activity, function, employer and size of company. Each job makes specific demands on the employee's skills and qualifications. Despite the enormous range of skills required for different jobs, the basic requirements can be met by a general training designed to equip students with basic knowledge and skills. Specialisation at undergraduate level is becoming less important as the pace of change increases.

Engineering degrees should give students a broad grounding in mathematics, natural-science and technology. This is essential for an understanding of natural phenomena and their relation to basic technical applications. A broad general grounding also provides a sound basis for subsequent specialisation and is essential to ensure good communication with colleagues from other areas of natural-science and engineering. Consequently, degree courses should not be too specialised and should include practical exercises and periods of work experience.

Training in interdisciplinary skills and non-technical subjects is also becoming more and more important. The aim is to ensure that the rising generation of engineers is able to take a creative approach to solving problems, has the interpersonal skills required for management and communication and is able to gain a comprehensive overview of technical projects. Last but non least, tomorrow's engineers need to be equipped for European and international assignments.

Qualifications alone do not make engineers employable. Alongside their basic training, they need a more detailed insight into a specialist field and the methods used to tackle engineering assignments. Any additional specialist knowledge required for specific jobs should be learnt on the job and through supplementary training after graduation.

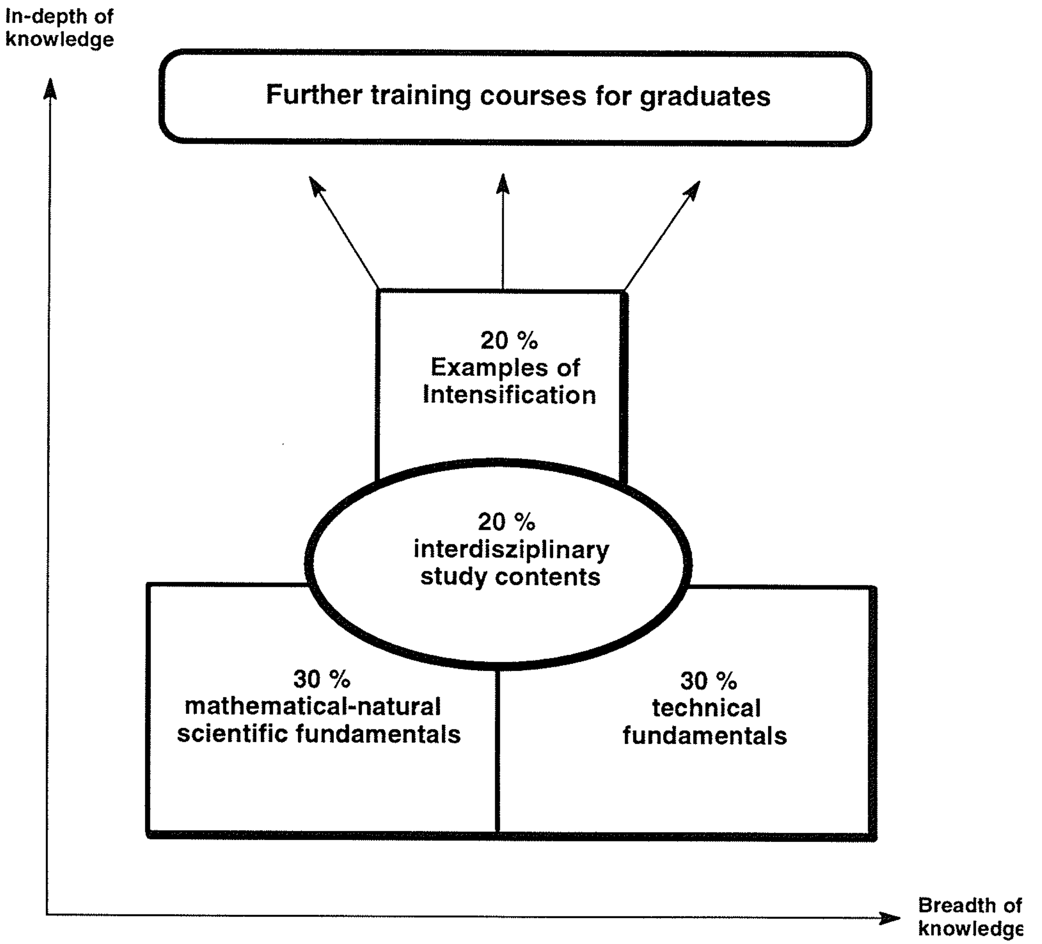


Figure 1: Education concept for engineers

In-depth knowledge of a specific field enables an engineer to gain an overview of the scope of an assignment and to integrate his specific solution into the overall project and deal with problems arising at the interface to other fields. This requires basic knowledge of the functioning of other systems used in that field and the technical and scientific tools available to support the engineering project. Given the growing complexity of modern equipment, facilities and systems, the ability to gain a general overview, take a system-oriented approach and communicate with people at all levels of a project is becoming increasingly important. Engineers are expected to have a strong theoretical background and understand the increasingly complex tasks involved in designing, operating and marketing technical products and systems.

The VDI recommends reviewing the structure of engineering degrees, which currently comprise a general grounding in mathematics, natural-science, technology and interdisciplinary skills, followed by specialisation in a single field. Specialisation should be reduced in favour of a broader general training. Alongside engineering skills, degree courses should foster an analytical, interdisciplinary approach.

Recommendations on course content

Engineering degrees should aim to provide a broad grounding in mathematics, natural-science, technology and interdisciplinary skills. Moreover, they should cover all potential fields of application, thus providing the basis for professional mobility during an engineer's career. It is crucial to give undergraduates a sound general background at this stage because it is extremely difficult to make up later on.

The VDI feels that these days basic knowledge should include an awareness of the ecological implications of technology and the theory and practice of evaluating technology.

This foundation should be used as a basis for subsequent specialisation in a small number of fields, providing students with an introduction to the technical and practical aspects of their chosen discipline. Here, too, courses should include relevant interdisciplinary and non-technical aspects.

Grouping together the various subject areas suggests that an optimum compromise can be achieved if about 30 % of course time is allocated to mathematics/science, 30 % to basic technology and 20 % to specialisation. About 20 % should be allotted to non-technical subjects with the objective of fostering interdisciplinary skills. This is something the VDI has already called for in a Recommendation published in 1990.

In particular, degree courses should place greater emphasis on interdisciplinary skills and problem-solving. They should also establish closer links between theory and practice. That means increasing practical exercises and project work at the expense of conventional lectures and theoretical exercises. It also involves developing integrated methods of teaching specialist/technical subject matter and interdisciplinary skills. In particular, cooperation with industry and other areas of society should be stepped up. New forms of cooperation should be developed through joint training projects and teamwork.

In Germany, engineering degrees already include a strong practical element as well as lectures, theoretical exercises and laboratory work. However, the full benefits can only be reaped if both teaching staff and students make active use of the options open to them and ensure that they are fully incorporated into courses. Evidently, the prerequisite for this is sufficient technical equipment.

The VDI recommends a four-module course comprising 30 per cent mathematics/natural-science, 30 per cent basic technology, 20 per cent specialisation in a specific field and 20 per cent non-technical/interdisciplinary skills. There should be closer links between the various branches of engineering and courses should be updated regularly to reflect technical progress and social change.

Recommendations on the status of different types of degree course

In Germany, engineering may be studied at either university or polytechnic (Fachhochschule). Although there is no set deadline for completing courses, polytechnic students are expected to study for eight semesters while their counterparts on university courses are expected to graduate after ten semesters. The VDI feels that course content and the number of obligatory subjects should be the same in all federal states to ensure equality of opportunity.

Courses are organised on a three-tier model (foundation course, main course, project/dissertation). Each university or polytechnic is responsible for structuring ins courses so that students can graduate after eight or ten semesters.

However, infernal politics and social and personal pressures result in a high proportion of students failing to complete degree courses and increase the time taken to graduate. Experience has shown that the foundation course is particularly important for motivating students and ensuring that they successfully complete their studies.

The VDI recommends that all new engineering students should be given an opportunity early on to judge their suitability for the course and be able to switch courses if necessary.

To facilitate this, the first two semesters of all engineering degree courses should be structured in a similar manner to ensure compatibility and enable students to switch courses at the end of the first year.

Further training courses for engineering graduates

An engineering degree alone cannot provide engineers with all the tools required for the rest of their career. Consequently, it needs to be supplemented by further training to enable them to acquire the skills they need. While a first degree has to be confined to providing broad general skills for economic reasons, there should be a wide range of professional training courses on offer to enable engineers to gain the additional skills they need and update their knowledge throughout their working life.

Although degree courses play a key role in determining the future career path of engineers, there is no way of telling what additional training they will require in the future.

Overall, higher education institutes do not offer suitable further training courses for technology graduates. There is a lack of courses tailored to the requirements of typical engineering jobs and geared to specialist fields and the requirements of teaching adults.

The only way to harness the strengths and experience of a broad range of institutions and provide courses that cover a broad range of international knowledge and experience is through cooperation between universities and polytechnics, independent organisations such as the VDI-Bildungswerk and industry.

The VDI recommends that

– strategies, tools and methods should be developed to enhance the effectiveness and cost-efficiency of further training courses

– guidelines should be drawn up to assist further education institutes

– universities and polytechnics should have the facilities and incentives to organise training courses for graduates, thereby enabling them to cooperate with independent training institutes such as the VDI-Bildungswerk and industry

– a financial framework should be created for further training of graduates.

Outlook

The ability of companies to cope with the present structural change is largely dependent on the training engineers receive as a basis for innovation and technological progress.

The VDI would like to help increase the proportion of students successfully completing engineering degrees and provide a better match between the expected and actual length of study in Germany. Ongoing structural change, poor job prospects and the situation at universities and polytechnics have already reduced the number of students enrolling for engineering degrees.

It is anticipated that in the future, as at present, about two-thirds of school leavers will enter the labour market via vocational training courses. Greater interaction between general and professional training is required to tap the skills found among the workforce.

In many of Germany's federal states it is possible for adults to enrol for polytechnic courses without formal qualifications. Some states are extending this to universities. Prospective students with relevant professional experience are accepted on the basis of an aptitude test or for a probationary period.

The VDI would like to take this opportunity to remind readers of the problem of German students entering the career market at a relatively late stage. This could be solved to some extent by streamlining degree courses. The VDI also suggests reviewing the structure and content of secondary education and especially the length of time spent at grammar school (currently 8-9 years).

The teaching of mathematics and natural-science at grammar school level should focus on general understanding rather than on testing students' ability to solve complex problems or grasp intricate subject matter. Even more importantly, consideration should be given to introducing general technical education at this level, as we have suggested in the post.

Through these recommendations, the VDI is calling on students and academic staff, together with politicians and industry to take concerted action to introduce the necessary changes.

VDI (Association of German Engineers)

President	Chairman of the Policy Board	Chairman of the Training Unit	Director
Prof. Dr.-Ing. Dr. h. c. mult. H.J. Warnecke	Dr.-Ing. K.A. Detzer M S	Prof. Dr.-Ing. V. Hopp	Dr.-Ing. P. Gerber

SPAIN

ENGINEERING EDUCATION AND PROFESSIONAL PRACTICE IN SPAIN

José M. Montes - Polytechnic University of Madrid

Engineering degrees in Spain are only granted by universities. These institutions may be created or accredited solely by a specific law, passed by the National Parliament or the legislative body of the region where the university is to operate. Most universities are public, reporting to a regional government or to the national government. There are some few private universities, fulfilling the institutional accreditation requirements set up by Law. As the whole of university or college education in Spain, engineering education is estructured in three phases or cycles:

a) At the end of a first cycle (three years of study) in a Technical Engineering University School, the student earns the degree of Technical Engineer (Ingeniero Técnico) in a specific field of practice.

b) First and second cycle studies, with no intermediate degree, are provided by the Higher Engineering Schools (five or six years of study), thus granting the degree of Engineer (Ingeniero). Technical engineers can enter a Higher Engineering School to pursue second cycle studies and earn an Engineer's degree.

c) The degree of Doctor in Engineering may be reached after a third cycle of graduate study in a Higher Engineering School and the successful defense of a Doctoral Dissertation.

The engineering profession is state-regulated. Recognition for professional purposes is exclusively based on university-level education, as assured by an academic degreee earned upon completion of state-accredited programs. The recognised diploma in itself qualifies the holder to practice the regulated profession. Engineering professional practice requires the individual to be registered in a professional board (colegio oficial). Professional boards oversee the fulfillment of ethical rules and the quality of engineering design work and projects.

Any program conducive to an Engineering Degree must satisfy a common set of basic directives set up by the State. Moreover, each particular program must meet the specific set of requirements enacted for the concrete degree pursued. These specific requirements are set by the State too. The accomplishment of these conditions is checked by the National University Council, which is the only accreditation body agreed by law. Universities are free to grant engineering diplomas not subject to any of these requirements. The Engineering degrees thus obtained are only academic in character and do not entitle the holder for professional practice. People holding such degrees can enter the labor market and be hired by companies, but are not entitled to hold responsibilities on state-regulated functions, such as design or project management.

JAPAN

RECENT CHANGES of ENGINEERING EDUCATION in JAPAN

Kaneichiro IMAI
Japanese Society for Engineering Education

Introduction: Globalization

Education comes from the peripheral to the center of national policy to meet the future demands of the nation and society. Conceptually speaking, it proceeds by three steps and the features of society corresponding to the rnarket from an educational standpoint, as shown in Fig. 1.[1]. Engineering Education plays a leading role in the curriculum.

Fig. 1 Three steps of Development of Industrialization

Industrialization	Modern Industrialized Society	Advanced Industrialized Society	Future Industrialized Society
Features of Industrialized Society	Equalization Efficiency Humanity	Standardization Control by Govern-ment	Deregulation Indivualization Diversification

Fig. 2 Development of Market

Market	Domestic	International	Global

Remarkable feature in Future Industrialized Society is, as the demand of society becomes diversified, education also becomes diversified, deregulated and individualized. And education will also change from elite type to universal type in steps, as the number of students who receive higher education grows from less than 15 percent to over 50 percent as the American Educator explained in Fig.2 [2]. Market also grows from domestic market to global market.

Not necessarily. all engineers, but leading engineers have to work for the global market. In the case of manufacturing output, it must be fit for the global market. Currency must be convertible to be useful globally, and travel and work developments must be recognized across boarders. People can travel world wide with the passport issued by native government, but need to have visa when he/she stay in some outside country for long term or for a job. Fig.2.

Fig. 3 Development of Education

Steps of Higher Educaton	Elite Type	Mass Type	Universal Type
Feature Scale(% to Age Group) Opportunity	<15% Privilege of limited people	15% to 50% Privilege of majority	>50% Privilege of everybody

Paradigm Changes of Higher Education in Japan

The era between 1985 to 1990 was the time, Japan changed from playing catchup to being an advanced economy, even one of the most advanced economies. The market became a Global Market and living standard also has became higher, and manufacturing GDP growth rate slower than total GDP growth rate. So Japan had to restructure as a future industrialized . country, though many of the Japanese did not realize. [4]. When the rate of higher education (rate of the age group who will receive higher education) became over 40%., {as shown in Fig.4, in Japan it is 43.9% (1994), USA 48% (1992), UK 56.2%(1992)}, a drastic change occurred in Engineering Education. (Fig.4).

Fig 4. Paradigm Changes in Engineering Education. .

	1945 to 1984	1985 to
Market	Domestic to International	International to Global
Industries	Enhancement of Efficiency Productivity, Quality of Product	Living and Working Together for Common Prosperity (5)
GDP Growth Rate (5)	Enhancement of Efficiency	Deregulation, Globalization * Revised Ordinance for Accreditation for Universities (1991) * Policy for Science and Technology (1993 Gov.) * The Science and Technology Basic Law (1995) * The Science and Technology Basic Planning
Continuing Education	Enhancement of Social Education/Sports	Refreshment Education Enhanced (Government, University, Academic, Society, Institute), Distant Education
Technology Development	Import	Export
Climate of Labor	Life Long Employment Respect Seniority Management Labor Good Relation	Competence. Challenge Spirit respected
Life Style (Major Concern of Engineers)	Company Oriented	More Family/Home Oriented
% of Age Group receive Higher Education (Univ. + J. College)	10.1% (1954) (3) 35.4% (1984)	45.2% (1995)

A new ordinance was issued in 1991, by Minister of Education, Science, Sports and Culture (MESSC)., and three major changes were, 1) it gave a complete freedom to the universities to select and organize programs and curricula by themselves, 2) University must begin self study and assessment by themselves and 3) these study and assessment reports must be published for public use. . The Science Technology Basic Law (1995) stated as "The objective is the achievement of science and technology , to contribute to the development of the economy and society in Japan and' to the improvement of the welfare of the nation, as well as to contribute to the progress of S&T in the world and the sustainable development of human society, through prescribing the basic policy requirements for the promotion of S&T and comprehensively and systematically promoting policies or the progress of S&T.". Basically the role of universities is to provide welleducated students with basic knowledge of basic engineering to industry, and by inhouse education, industry educates and trains them to meet the entrepreneurial goals. The climate of Japanese Labor in Industry is changing : lifelong employment, promotion by seniority, familial relations between management and labor union might be all gradually disappearing. Industries prefer to hire students who are more competent and committed to the work for industry, who may have creative minds rather than only academic knowledge Globalization is a key factor in industries which are working for the world market. Several universities started new international courses and the number of foreign students is increasing year by year. Some universities started giving lectures in English for Japanese and students from abroad. Several universities are carrying on exchange program with foreign universities.

Fig.5 Engineering Education change in Japan.

	1945 to 1984	1985 to
Expectation on Students from Industry	Good Raw Material	More prepared for work
Management Accreditation	Under the control of MESSC	Deregulated. Self study, Assesment Required ** Introduction of Assessment by third party suggested
Funding Allocation	Under the control of MESSC	Varies Case by Case + Industries, STA
Tenure	Secured until Retirement Age	Become Flexible
Courses	Bachellor Increased Information, Bio, Material Courses Enhanced	Master and Doctor Courses Enhanced. Double by year 2000
Entrance Examination	Academic Knowledge	Academic knowledge + Human Factors **I
Curricula	Under the control of MESSC	Diversified to meet Society and Industry needs
Foreign Students	Encouraged to accept	More welcome
Precollege education	Standardized	Diversified Computer Introduced Foreign Language Individuality Creativity Highly respected
InCompany Education	Teaching Advanced Technology and Teamworking	Postive Learning Expected

Accreditation for University

MESSC had tried its best to keep and improve the quality of Engineering Education by itself, to meet these changes. When MESSC realized the paradigm is changing so rapidly and number of high education institutes is so large and the needs from society are so diversified, it changed its policy for Education at the University level to deregulate, and encourage universities to become more fit to serve the needs of a competitive society.

Official Accreditation and Assessment

The Council of Standards for the Establishment of Universities and Educational Foundation was formed by MESSC for the standardization of the accreditation system to keep up the level of engineering education. Under this council composed of members of leading Academia, Government officers and specialized experts, two subcommittees, School Foundation Committee and Establishment Committee were organized.

Financial, administrative affairs and physical issues like library, class room, and gymnastic equipment are major concern of School Foundation Committee. Curriculum structure, teaching method, credits, and human resources including Faculty capability developments are under the concern of Establishment Committee . And by the 1991 reformation , control of Establishment Committee became very flexible and many regulations were relaxed However items which are under the control of the School Foundation Committee are almost unchanged.

At the time of founding a new university, the founder must submit a very detailed plan of the project to MESSC for a approval.. Every detail of plan is examined by a special committee under the direction of MESSC. During first four years ,the school will be examined unto the detail of performance in accord with the plan. During this period and after, the school must work for self study and assessment to improve the quality of the performance ,to maintain quality in education and research.

Otherwise the school might face difficulty with outside financial aid, which is a very strong motivation to keep the level. From time to time, a school inspector assigned by MESSC visits the school to investigate the conformity of the performance.

During this stage ,the self study and assessment will be recommended and examined.

Japanese University Accreditation Association (JUAN)

In 1949 when a study team from America visited Japan, upon their recommendation the Japanese University Accreditation Association was formed. However, as the policy was established to make MESSC totally responsible for the higher education including Universities, that Association was kept dormant until the recent reformation took shape. and become effective.

As stated before MESSC will not directly intervene in the accreditation of education and research. When it examines the application from universities the specialized committee appointed by MESSC will handle the allocation of Government tiding. MESSC is not influential in every respects is the official understanding. Last year, after strenuous efforts by JUAN, "University Assessment Manual "(JUAN, 1995) was published. And many member schools will start self study and assessment using this manual as their guide from 1996. Within ten years they expect to accomplish this as standard procedure. For the first step they will start mainly submission of self study and assessment reports, so site visit might not be taken up as the major events at the beginning . This is one of the proposed ideas and plans. Many of schools have started their own study and evaluation in their own way.

Self Study, Assessment by University

Quality improvement starts with "selfstudy and selfassessment". It is generally accepted that quality is built in outcome while it is processed in process. In other words quality of outcome is not made by some third parties but it must be made by provider itself and is started with selfstudy. and self assessment. Quality improvement must be made through the Demimg cycle of PDCA (Plan, Do, Check, Action) working together with the people concerned. under the targeted leadership [6]. In the newordinance, three major changes were requested.

As mentioned above self study and assessment was recently introduced for the improvement of quality of education including engineering education. Many of university believe, that engineeing education might be relatively susceptible to self study and assessment, as is already shown in various countries.. And in order to assure the improvement of Quality of Education MESSC had requested the establishment of system to ensure the performance Responding to these new ordinances many universities in Japan started actual implementation.
Following was the recent report of the reactions by universities, although these were universities in total, we may judge the engineering and science oriented courses are leading this tendency. [7]

Table 1 Number of Selfstudy Assessment Report

	Universities	Implementing	Published
National University	98	98 (100%)	94 (95%)
Public University	48	42 (88%)	17 (35%)
Private University	407	294 (72%)	102 (25%)
Total	553	443 (78%)	190 (34%)

Science and engineering oriented courses in some leading universities started to introduce evaluation by third party to have more fair evaluation of the performance, and published the result of evaluation [8]

Requirement of Examination Qualification for State Registered Engineering Profession

In Japan there are several Government Registered Profession for the purpose of carrying out business in Engineering fields like construction work in civil engineering or building houses as listed in the following table as for the example. Typical professional requirements for State Registered Engineers are shown in Fig. 6.

Fig. 6 Typical professional requirements for State Registered Engineers

Name of Job Title	Minimum Requir. for Qualitifaction for Examintion	Registering Ministry	Reference
Registered Architect and Building Engineer (1st. class)	4U+2E	Ministry of Construction	By Law No nationality limit 258, 121 (1995/9/30 Pass Ratio <10%
*Registered Civil Construction and Management Engineer (1st. class)	4U+2E	Ministry of Construction	By Law No nationality limit 350,000

U: year course of University{ Accredited from MESSC), In case of foreign university Minister will make judgment case by case.
E: Directly related engineering experience *Gijyutsushi in related area is recognized as equivalent depend on assessment by Minister

Recent Results of FE examination of Professional Engineers in Japan

Very recently, though it was only three examples of Engineering Examination which were carried under the full administration of one of the US states (State Board of Oregon), in case of FE examinations the results seem to show that have engineering education in Japan might be world level..

Date of Exam.	1994/10/30	1995/04/09	1995/10/29	1996/4/21
N° of Examinees(a)	153	120	252	121 (68)
N° of Pass (b)	117	107	217	85 (50)
% pass (a/b)	76	82	83.7	70.2 (73.5)
% of Pass Oregon	67	N.A.	N.A.	N.A.
All U.S.	66	N.A.	N.A.	N.A.

Comparison of Professional Engineer (USA) and Gijyutsushi (Japan)

Comparison of Professional Engineer (USA) and Gijyutsushi (Japan) is shown in following Figure.

	Professional Engineer (USA)	Gijyutsushi (Japan)
Minimum Requirement for Qualification	4U+4E	4U+4E
Major Concern for Qualification	Good Common Sense + Engineering	Engineering
Language	English (Globally accepted)	Japanese (Local, Limited Use)
Examination	Basic Engineering+Practical Experience	Application, Practice. Achieve Engineering Results

Available References at Examination	Text, Reference Book No limit.	Not Allowed
Effective	Each State	All Japan
Internationally	More international	Only in Japan
Merits	Salary up Properly accepted Highy regarded by Society Can act as witnes for engineering issues in the court.	Gain more recognition in the related field.

CLOSING REMARKS. I reported mainly the present status of assessment in universities in Japan focusing upon the engineering education.. From my observation self assessment of quality of Engineering education by university will give strong impact on recent engineering education reformation, It needs to be more transparent and to accept assessment by third parties.. Introducing third party involvement, evaluation of teaching by students evaluation by peer review and curriculum discussion, exchange of lectureship by experts from industries or from abroad, and more close link with industries as a profession,. may give more openess. If we extend our scope in globalization of engineering education and engineer. though university education the accreditation of professional education in universities have to be carefully considered to remove the wall, between discipline and nations if they exist. In order to survive in the future. and realize the purpose of engineering, secure the safety and welfare and enrich the lives of mankind I hope people are wise enough to solve these difficulties.

And when state registered engineer would have an appropriate third party evidence of competence and commitment to show equivalence, it would help to secure the status of engineer in the day of Globalization I must conclude my observation with an assessment of engineering education in Japan, it had made a first step for proceeding following the world trend —"Globalization." by self assessment.

For the formation of engineers for the era of a boarderless word the establishment of an internationally acceptable system of Accreditation of Engineering Education must he a first step.

And when state registered engineers would have an appropriate 'third party evidence of competence and commitment to show an international equivalence, it would help to secure the status of engineer in the day of Globalization.

REFERENCES may be consulted in original paper.

ENGINEERING COMPETENCE EVALUATING EXAMINATION TO COLLEGE STUDENTS IN JAPAN

from "The Nihon Keizai Shinbun"
Ocober 4, 1996

In order to evaluate the engineering competence of college students in Japan, the Fundamentals of Engineering (FE) Evaluating Examination will be started as from late 1997 in about 120 Engineering Colleges. This examination will be taken in English using the Fundamentals of Engineering (FE) Examination in the U.S.A., for which the Fundamentals of Engineering Center (FEEC) has been organized by noted engineering colleges and institutes.

Although taking this examination is optional, it will be advantageous for new engineering employments if examinees exhibit a high competence in the examination result. Also, it will raise the attention of industries who wish to acquire high level new engineers.

This common examination will use the popular engineer qualification test among U.S. engineering students known as FE Examination. It is composed of 180 multiple choice questions including fundamental subjects such as mathematics and professional disciplines: civil, chemical, electric and mechanic. Senior college students will be encouraged to take this FE examination. The result will be reported to each examinee with the deviation score.

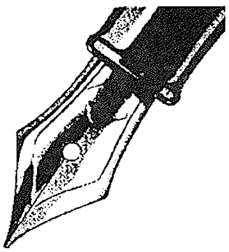
The Fundamentals of Engineering Examination Center (FEEC), chaired by Dr. Sogo Okamura, President, Tokyo Denki University, has been organised with the agreement of some 126 nationwide Universities and Institutes including first rate engineering schools, such as University of Tokyo, University of Osaka, Tokyo Institute of Technology, Ritsumeikan University, etc.

Although the examination is compulsory for college matriculation, there are no assesment measures to the academic competence of graduating college students in Japan. Participating schools will encourage their senior students to take this common examination as a substantial engineering academic degree qualification test.

Conventionally in industries, new graduates are employed from either brand named engineering schools or through professors' references, and later re-trained within an enterprise OJT program. As this is inefficient, industries are asking colleges to supply more practically educated engineers. This request from the industry has led to the introduction of the new FE examination.

Industry spokesmen welcome this new engineering competence examination stating that "This internationally scaled engineering examination establishment will be very helpful in comparing the competence level of engineering students in Japan with those in other industrialized nations in the world scale" (by NEC). Dr. Okamura from Tokyo Denki University states that "It will strongly stimulate young engineers who wish to progress in the global market".

READERS CORNER



Each edition of this Journal IDEAS, has a Readers Corner with the purpose of receiving comments from people or persons responsible in WFEO National Member Associations and other Institutions that have received the previous issue free or charge. The ideas and proposals contained in the letters received plus the information they may provide to enrichen our knowledge, will be valued. That is why we wish to publish them so that all readers can update their information with background from other countries in the world, and exchange ideas between themselves.

Paris, june 5, 1996

Dear Prof. Yadarola,

I acknowledge receipt of your letter dated 22 May 1996 and the Journal "IDEAS N° 3" that contains articles referred to the subject "Accreditation and Professional Practice".

I would like to thank you for the good work you have accomplished and in particular your editorial articles "UNESCO on its 50th Anniversary" (page 3) in which you pay homage personally and in the name of WFEO to the institution which works towards peace through cooperation building and positive action in the fields of education, science and culture.

Yours sincerely,

Dr. Adnan Badran
Deputy Director General
UNESCO

Rome, July 10, 1996

Dear Professor Yadarola,

I thank you very much for the interesting publication you sent us.

We are deeply interested in the problem of the quality of the formation of future Engineers and therefore we share the opinion that to find efficacious accreditation systems to assess the study programs in the various countries is a remarkable step towards the internationalization of the Engineering profession we deem very important too.

Thanking you once more, I remain

Yours sincerely,

Giovanni Angotti
President
Consiglio Nazionale Degli Ingegneri

Vienna, September 20, 1996

Dear Prof. Yadarola,

Thank you for sending us a copy of your periodical publication, IDEAS N° 3. I wish to congratulate you for this initiative. As you are aware, effective accreditation systems and quality are of utmost concern to developing countries and to countries with economies in transition.

I would like to take this opportunity to draw your attention to UNIDO's home page section "Investing in People". On the Human Resources Development web site you will find our interactive electronic magazine IHR-Interface, which is a forum for the presentation, discussion and exchange of ideas in the field of human resources development for industry. We welcome all contributions in the form of suggestions for discussion topics, as well as HRD-related articles and project descriptions. We would appreciate hearing from you.

Yours sincerely,

Camilo Antonio
Acting Director
Human Resources Development Branch
United Nations Industrial Development Organization

La Paz, August 30, 1996

Dear Mr. President:

Thank you for your letter E.T. 863 of August 20, 1996, with which you kindly sent us information and guidelines regarding an effective method and norms to be applied for accreditation of universities.

In the name of Mr. Edgar Venegas Ledo and the Board, we thank you for your kindness in orienting us in the process of accrediting universities. We shall be writing to the addresses you provided to request cooperation on the matter.

Once more, thank you and our very best regards.

Carlos Escóbar Santillán
Executive National Secretary
Association of Engineers of Bolivia

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