INTERNATIONAL ACCREDITATION BASED ON GLOBAL QUALITY ASSURANCE PROCESS

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Abstract *¾ The current interest in international accreditation of engineering programs is motivated by a number of factors, not the least of which is the increasing need for mobility of engineers across the globe. Although the accreditation bodies of several countries have made significant progress towards harmonizing their accreditation systems and processes, most of the world is still not an active participant in this activity. One reason may be the lack of an international organizational structure to promote and facilitate accreditation of programs across national borders. This paper introduces the organizational structure for global quality assurance based on the ISO-9000 quality systems standard and proposes a similar model to enable international accreditation of engineering education programs.*

Index Terms ¾ ABET, Accreditation, International, Organization Structure, Quality Assurance.

INTERNATIONAL ACCREDITATION OF ENGINEERING PROGRAMS

Engineering accreditation, as defined by the US Accreditation Board for Engineering and Technology (ABET), is a voluntary, non-governmental, peer review process that ensures educational quality [1]. It is understood that the graduates of an accredited program are adequately prepared for the practice of engineering. Accreditation is conducted by assessing the program against accreditation criteria using a combination of document reviews and site visits. This form of accreditation has been the primary recognition of an engineering program in the US for over seventy years. Organizations similar to ABET provide similar functions in other countries. For example, the Canadian Engineering Accreditation Board, Engineering Council of UK, Hong Kong Institute of Engineers, and the Institution of Engineers of Ireland.

Current trends in communication and information technologies, transportation, competition, quality, government deregulation, and interest in environmental concerns have led to globalization of the engineering profession. One effect of this phenomenon is the increased mobility of engineers across national boundaries. Employers are concerned about the need for understanding and recognizing the competencies of engineers from all over the world. Furthermore, engineering students are transferring credits across international borders. Finally, the growing availability and acceptability of distance learning courses around the globe make it necessary for academic programs to understand and recognize engineering curricula on an international level. These driving forces have resulted in an interest in approaches for the awarding of transfer credit for engineering courses, recognition of engineering degrees, and the acceptance of professional licensing and qualifications across international borders. The first two can be viewed as issues relating to accreditation of engineering programs and is the focus of this paper. The reader is referred to a recent paper by Jefferies and Evetts [2] for a discussion of international exchange of professional engineering licenses.

In recent years, there have been a number of conferences, proposals, working groups and publications aimed at facilitating an international system for acceptance of engineering programs or a formal system of mutual accreditation. Notable among these are the International Workshop on Computer Science and Engineering Accreditation held in Salt Lake City in 1996 [3] and the European Workshop on Accreditation of Engineering Programs held in Utrecht in 1998 [4].

Significant work has been accomplished in this direction on a multi-national scale by ABET (see for example, the Washington Accord [5], ABET's extension of substantial equivalency to programs offered in non-US universities [6], and a summary paper on ABET's international activities [7]). In a limited context, mutual recognition of accreditation has been practiced by regional consortia of universities or related professional bodies. For example, FEANI (European Association of Professional Engineers) maintains and publishes a list of "accredited institutions and degree programs" as a mechanism for trans-national recognition of professional qualifications [4]. However, engineering programs around the world still face a difficult challenge when trying to gain formal international recognition. This paper is based on the premise that an international organizational structure that facilitates accreditation on a global scale is necessary to address this challenge.

ISO 9000

The ISO-9000 quality standards were adopted in 1987 (and revised in 1994 and 2000) by Technical Committee 176 of the International Organization for Standardization [8]. This organization is responsible for standardization efforts

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internationally; at present its membership includes the national standards bodies of 91 countries. ISO-9000 certification occurs when a neutral and independent "registrar" uses one of the ISO-9000 standards to certify a supplier. This results in an official designation of the supplier as a "ISO-9001 (or 9002)" certified supplier. A supplier registered in this manner is viewed as a reliable worldwide supplier of quality products and services; its customers can reduce or eliminate inspection of purchased parts thereby resulting in an efficient system for global trade. For some regulated products in the European Community (for example, toys, gas appliances, pressure vessels), ISO-9000 registration is not just desirable; it is a legal requirement. As of December 2000, over 270,000 companies in 143 countries were certified to one of the ISO-9000 standards. It is worth noting that the ISO quality standard does not refer to the products or services delivered, instead to the production and administrative processes that produce them. It is generic enough to be applicable to any industry type. Although most of the ISO-9000 certifications have occurred in the manufacturing sector, it is interesting to note that almost 4,000 educational institutions have also been certified. Specifically, the standard focuses on the need for organizational structure, well-documented procedures, and management's commitment of resources to implement quality management.

ORGANIZATIONAL STRUCTURE FOR ISO 9000

At the top level, the International Organization for Standardization (referred to as ISO) consists of 91 member bodies. Each member body represents one country - for example, ANSI (USA), BSI (UK), NSF (Norway), NEN (Netherlands), and JISC (Japan). A member body of ISO is entitled to participate and exercise full voting rights on any technical committee and policy committee of ISO. In addition, there are 35 correspondent members and 10 subscriber members; these represent countries that do not have a fully-developed national standards activity, but are entitled to be kept fully informed about the work of interest to them. The principal officers of ISO are elected from its member body delegates for limited terms. The members and officers participate through the ISO General Assembly, secretariat and various standing committees, ad hoc committees and technical committees. Most of the work within ISO is done by its Technical Committees (approximately 800 at last count), which are responsible for the first draft of standards statements. The development of a standard begins when an industry sector communicates this need to a national member body. The member body petitions the ISO Secretariat, which in turn assigns the work to an existing or a new technical committee consisting of experts from countries interested in the subject matter. After agreement has been reached on which technical aspects are to be covered in the standard, countries negotiate the detailed specifications within the standard using a consensus-building approach. The formal approval of the resulting draft International Standard is accepted by an affirmative vote of two-thirds of the ISO members that have participated actively in the standards development process followed by approval by at least 75% of all member bodies. Most standards require periodic revision, often at intervals of not more than five years. To date, ISO's work has resulted in some 12,000 International Standards, which include the ISO 9000 series of quality management standards. The financing of the Central Secretariat derives from member subscriptions and revenues from the sale of the Organization's standards and other publications [9].

It should be noted that ISO only produces the standards, but does not verify compliance to it. That work is done by registrars – independent companies that are accredited by a national accreditation body. This is discussed in the next section.

National Accreditation Bodies and Registrars

Each ISO member country has appointed a National Accreditation Body to certify and oversee the operations of the registrars. Once accredited, a registrar company then actually performs the assessments that lead to the certification of a firm to the ISO 9000 standard. In the US, the Registrar Accreditation Board (RAB) is responsible for accreditation. Other accreditation bodies include United Kingdom Accreditation Service (UK), Norwegian Accreditation (Norway), Raad voor Accreditatie (Netherlands), and The Japan Accreditation Board for Conformity Assessment (Japan).

Although the ISO 9000 certificate issued by an accredited registrar should be recognized worldwide, the reality is that certificates issued by some registrars are preferred and carry more credibility. This may be due to either the reputation of the registrar or the accreditation agency that endorsed the registrar. Some registrars seek and obtain accreditation from several accreditation bodies to increase their market share and reputation. Some registrars have begun to form coalitions so as to reach a bigger market. An example of such a coalition is IQNet, which was created in 1990 as a federation of registrars from 28 countries, each with the endorsement of its national accreditation body [10]. With this structure, IQNet offers a one-stop shop to companies seeking ISO 9000 certification that is respected on a worldwide basis. IQNet claims to have over half of all ISO 9000 certificates issued worldwide.

CSAR and IAF

Responding to demands for a formal process that ensures worldwide acceptance of ISO 9000 certifications, ISO and the International Electrotechnical Commission (IEC) established the ISO/IEC Quality System Assessment Recognition (QSAR) program in 1996. The purpose of the QSAR program was to eliminate the need for companies to undergo multiple audits by several registrars to satisfy clients in different countries. An ustated purpose seems to

be to preempt the formation of private organizations like IQNet. Under the QSAR program, a single ISO 9000 certification would be recognized and accepted anywhere in the world, regardless of the location of the client or the registrar. A key feature of QSAR is that the qualifications of the accreditation bodies would be regulated and monitored through peer evaluation [11].

Recently, the CSAR program has been supplanted by the International Accreditation Forum (IAF). IAF membership includes accreditation bodies from nations in all parts of the world, industry representatives and accredited certification/registration bodies, in an international organization which seeks to encourage development of a single world-wide system of mutual recognition of conformity assessment certificates. IAF aims to facilitate trade and commerce, in accordance with World Trade Organization policies, by establishing Multilateral Mutual Recognition Agreements (MLAs). The MLAs are based on the equivalence of accreditation programs operated by accreditation body members, verified through peer review among those accreditation body members. Accreditation body members of IAF are admitted to the MLA only after a most stringent evaluation of their operations by a peer evaluation team which is charged to ensure that the applicant member complies fully with both the international standards and IAF requirements. Once an accreditation body is a member of the MLA it is required to recognize the certificates issued by certification/registration bodies accredited by all other members of the MLA. The first fourteen members to join the IAF Mutual Recognition Arrangement (MLA) signed the Arrangement in Guangzhou, China on 22 January 1998. The consequence of joining the IAF MLA is that ISO 9000 conformity assessment certificates issued by certification/registration bodies accredited by any one of the members of the MLA will be recognized in the world wide IAF program [12].

PROPOSED MODEL FOR INTERNATIONAL ACCREDITATION

The proposed model for international accreditation of engineering education is based on the quality management model discussed earlier. The model is discussed in the context of (i) developing an international standard for accreditation and, (ii) implementing and verifying conformance to the standard.

Developing an international standard

An accreditation standard is a set of criteria against which an engineering degree program can be assessed. An example would be EC 2000 of ABET. The standard should include (a) the competencies and abilities of the graduating engineer, and (ii) certain important elements of the way the engineering program is administered. Competencies and abilities of the graduating engineer can be further viewed as comprising of technical competencies (for example, knowledge of Physics, Chemistry, Linear Algebra, Calculus, Statistics, Strength of Materials, Circuit Analysis, Engineering Economy, etc.) and professional skills (for example, communication skills, teamwork, leadership, concern for societal needs, etc.). Guidance on the technical competence and professional skills attributes is available in several places (see for example, ABET EC 2000's Criteria 3, 4 and 8 [1], EuroRecord [13], Boeing's survey on industry needs [14], MIT's CDIO Syllabus [15], and benchmarks published by the Quality Assurance Agency for Higher Education [16]). Using these resources, a first draft of a "universal" set of attributes as well as a "minimal" set of attributes can be prepared by an international body consisting of academicians, industry representatives, and members drawn from professional and civic societies and political circles. Individual engineering programs can then select attributes that, at least, include the minimal set of technical competencies and professional skills in their curriculum planning and assessment processes. Figure 1 illustrates the notion of the universal and minimal set of technical competencies and professional skills. The outcome of this approach will be that graduating engineers from a program will receive credentials that attest to their satisfactory performance on an internationally accepted minimal outcome measures. These can then form the basis for bilateral (or multilateral) acceptance of courses and even entire programs of study across institutions. This idea is similar to "Qualification Attribute" proposed by the Chair of the H3E (Higher Engineering Education for Europe) Working Group on Internationalisation [17]. Recently, this approach has been used collaboratively between the University of Derby (UK) and the Higher Technical Institute (Cyprus) to formulate a common set of generic learning outcomes followed by institution-specific mapping of skills onto program content [18].

The second component of accreditation standards refers to the management practices at the institution awarding the engineering degree. This includes processes for admission of students, advising, recruitment and professional growth of faculty members, funding and support services, and program leadership. It should be possible to arrive at a consenus view of what these practices ought to be. An excellent resource for this is ABET EC 2000 (especially criteria 1, 2, 5, 6 and 7).

Implementing and verifying conformance

The national accreditation body (for example, ABET in USA) must have government patronage and endorsement. This is necessary for the accreditation body to have the standing in the international community and for it to have the authority to represent its country in international agreements. ABET enjoys government recognition through the US Department of Education. Similar agencies around the world must have the same status. We propose the formation of a Federation of National Accreditation Bodies (FNAB) that will provide a forum for joint agreements on

minimal technical competencies and professional skills. FNAB will also establish procedures for qualifying national accreditation bodies and maintaining a roster of membership.

The national accreditation bodies, in turn, establish (or revise) accreditation standards that apply within a country. These standards should be consistent with minimal requirements for technical competency, professional skills and program management guidelines stipulated by the FNAB. The national accreditation bodies also certify program evaluators and make final decisions to accredit (or not to accredit) programs of study leading to degrees in engineering. The proposed structure (see Figure 2) allows autonomy within national boundaries while facilitating international recognition of engineering programs.

ACKNOWLEDGMENT

This work was supported in part by a grant from the Southeastern University and College Coalition for Engineering Education (SUCCEED), which is funded by the National Science Foundation to bring about systemic reform in engineering education.

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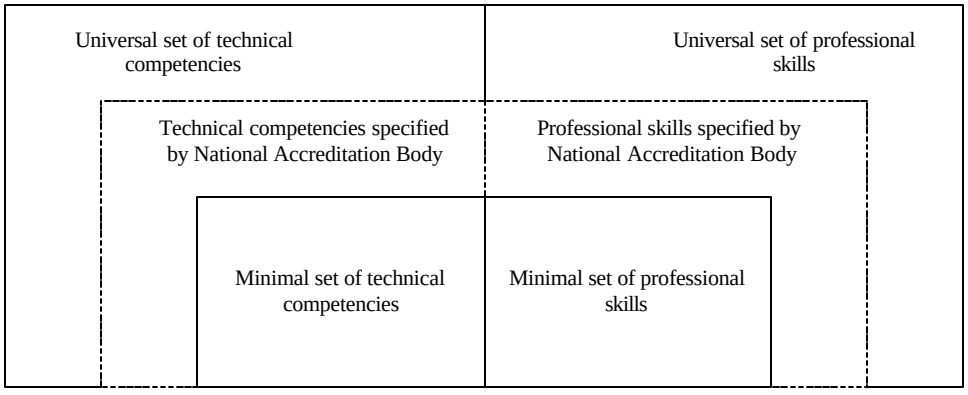

FIGURE. 1
RELATIONSHIP BETWEEN MINIMAL AND UNIVERSAL SET OF TECHNICAL COMPETENCIES AND PROFESSIONAL SKILLS.

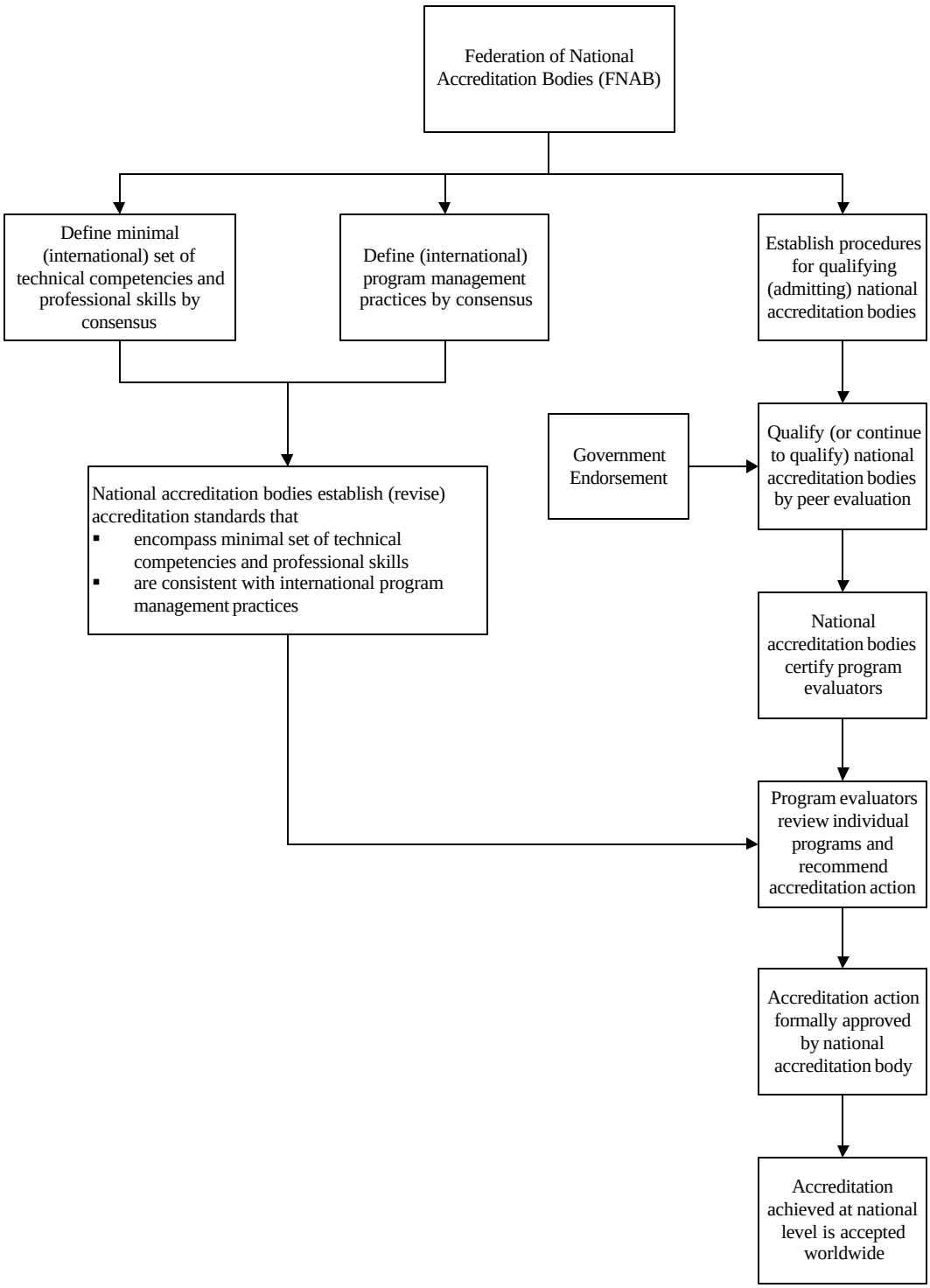

FIGURE. 2
STRUCTURE FOR WORLDWIDE ACCREDITATION OF ENGINEERING PROGRAMS.