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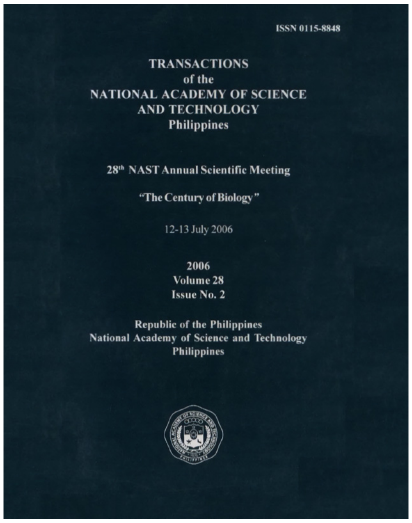

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Introduction

The purpose of this paper is to contribute to the current discussions on how to enhance the prospects for Philippine engineers to provide professional engineering services in the global marketplace. The enterprise of producing goods from research and development, product design, manufacturing, sales, maintenance, to disposal, has been a global operation for decades. This has been the case in recent years for information technology systems and software systems. The United States and other countries are starting to outsource engineering services that are tightly specified. These are usually close to manufacturing and minimally involve professional engineering. Although this type of service could provide a new market for Philippine engineering services, the sector of professional engineering that requires a high level of creativity could provide greater economic return for the Philippines. This latter category of professional engineering will require quality assurance commensurate with the capabilities expected of creative professional engineers. This paper focuses on the quality assurance process for engineering education designed to achieve levels of competencies of engineering professionals for the international marketplace.

Quality assurance of competencies of engineers to practice globally demands quality assurance in engineering education that could be regarded as equivalent to those established in countries such as the United States, United Kingdom, Australia, and Japan. Although each country has its own system of accrediting engineering programs at degree granting institutions of higher learning, there is a need to relate the various systems for comparison purposes. There are countries that have mutual recognition agreements (MRA) for substantial equivalency of their engineering education accreditation systems and engineering programs that each accredits. These MRAs are *de facto* standards. The Philippines is not a signatory to any MRA, placing it at a substantial disadvantage.

Desired Goals

A key to the competitiveness of Philippine engineers in the global marketplace is the positioning of Philippine engineering education to be comparable in substance and in quality assurance to those in countries that have reached mutual recognition agreements among themselves with respect to the substantial equivalence of their accreditation processes. Global acceptance of the comparability of Philippine engineering education and its system of quality assurance could be deemed as accomplished when a Philippine organization representing engineering accreditation becomes a signatory to a mutual recognition agreement. Thus a second goal is to seek such a mutual recognition agreement with respect to engineering education accreditation processes.

Courses of Action: Near-term Strategy

There are three groups of MRAs for engineering which we will be described later. In all cases, each signatory represents the single accreditation body for the whole country. Furthermore, the accreditation body is usually an umbrella organization of professional engineering societies. This is not the case for the Philippines at this time. We need to realign our processes if we seek to join one of them.

Restructuring Accreditation of Engineering Programs in the Philippines

Currently, there are several engineering accreditation systems in the Philippines; each system is administered through an association of universities. The evaluators are all from academe in the same association. Aside from a lack of uniform standards for the entire country, there are no representations, direct or indirect, from groups such as employers and professional societies. There is a need to broaden the set of stakeholders to include employers of engineers and professional engineering societies. The following courses of action are suggested:

(a) Unify the several separate accreditation systems in the Philippines under a single organization with a single set of accreditation criteria. Develop a unified accreditation process. The single organization could be the Philippine Technological Council (PTC). PTC could convene a meeting of representatives of various engineering education accreditation bodies and propose to have a single body for accreditation for all engineering schools in the Philippines. This has been suggested by the Foundation for Engineering Education Development (FEED). Define the new stakeholders. This needs to be widely discussed by all stake holders.

(b) Review the accreditation processes of other countries. It will be noted that a common feature is the use of principles of continuous quality improvement, including the primary importance of engineering educational objectives, the need to relate all processes to the objectives, the need to have performance metrics, and the focus on outcomes. This might be a major shift in philosophy compared to the existing accreditation systems. The formulation of new criteria is a critical step and it needs to be widely discussed and accepted.

(c) Decide what body will conduct the accreditation. For example, FEED could be the accreditation organization for PTC, as FEED suggested. All stakeholders should have an influence on how the processes would be structured. This needs wide discussion.

(d) All existing accredited programs should continue to be accredited under the new system for the same period as indicated in the previous accreditation.

(e) Provide a transition process.

Application to the Washington Accord for Provisional Status

Concurrent with the near-term strategy, some attention should be devoted to preparing to apply for provisional status to the Washington Accord [1]. Of the three MRA groups, the Washington Accord is the only one appropriate for the Philippines. The Bologna Declaration is for European countries only. The Western Hemisphere partnership is for North America and South America only. The Sydney Accord is for engineering technology programs only, and the Dublin Accord is for engineering technician programs only. The following are suggested action items:

(a) Develop a time table for implementing the new accreditation process.
(b) Complete at least one cycle of program evaluation under the new system before submitting an application to the Washington Accord.
(c) Establish an arrangement with the Washington Accord group to assist in the preparation for application.
(d) Apply for provisional status. FEED suggests that PTC be the proposed signatory.

Massive Training Program for Accreditation Evaluators

Even without a restructuring of engineering accreditation, it is important to introduce new evaluators to the system. New evaluators provide a fresh perspective, but it is extremely important for the evaluators to understand the goals of accreditation, details of various criteria, avoiding inconsistencies in the evaluation, and rules of behavior for evaluators. Secondly, in the new systems there will be evaluators from industry who will need to understand the application of the criteria as they relate to the missions of the universities. Evaluation teams will include representatives from academia and representatives from industry. Listed below are suggested action items:

(a) Start with a small core of experienced evaluators who will plan and develop workshops in the Philippines.
(b) Develop a time table for training a cadre of evaluators to include practicing engineers from industry.
(c) Consider hiring consultants to assist in the program planning and execution.

Courses of Action: Long-term Strategy

The time scale involved in the near term strategies discussed previously could be of the order of two to five years, particularly in terms of gaining full signatory status in the Washington Accord. Since provisional status will take a minimum of two years after application, this means an estimated time of three years between now and approval of provisionary status. There is much to be done and perhaps the burden is on FEED and PTC to convene a meeting as described previously.

Even as plans are being developed for near term strategies, it is not too early to think of long term strategies. It would take sustained effort to obtain some consensus on what to plan for the long term. Furthermore, as ideas for long term strategies are discussed, some implications for the near term could develop and these might be the basis for some changes in near term strategies.

We need to develop a vision for the Philippines to be a leader in some areas of engineering and not be content with catching up. This is possible with a judicious choice of unexplored territory, potential economic impact, and matching with our own unique talents. This might be coupled with developing some intellectual property.

Preparing for Engineers of 2020

About four years ago, the U.S. National Academy of Engineering established a steering committee to conduct a study of what engineering might or should be like in 2020 and how might the engineers be educated in an effective manner. The concern then was whether the education of engineering students then was appropriate for the practice of engineering twenty years hence. Phase I of the study focused on developing a vision of engineering in the new century. This led to a report, "The Engineer of 2020" [7]. Phase II of the project focused on what engineering education might be, based on the vision in Phase I. This led to a report, "Educating the Engineer of 2020" [8]. Although the recommendations are intended for the U.S., the study involved the global nature of engineering. Many of the recommendations are appropriate world-wide. For example from [7]:

Engineering is about design under constraint (technical, economic, business, political, social, and ethical issues).

- Technological innovations occur at an astonishing pace and this is not expected to slow down in the near future.
- The innovations and breakthroughs redefine the workplace. Some of the recent breakthrough technologies are:
- Biotechnology: tissue engineering, drug delivery engineering, bio-inspired computing, virus protection computer architectures, pumps, filters, detection and early-warning instruments for biological agents.
- Nanoengineering and nanoscience: nanobots, creating and manufacturing structures at the molecular level.
- Material science and photonics: smart materials.
- Information and communication technology.
- Information explosion.
- Logistics.

Some recommendations from NAS [8] are:

- Certain basics of engineering will not change, but the explosion of knowledge and the global economy will reflect an ongoing evolution.
- The economy will be strongly influenced by the global marketplace for engineering services, a growing need for inter-disciplinary and systems-based approaches, and an increasingly international talent pool.
- Reinventing engineering education should be by engineers in industry and academe.
- The B.S. degree should be regarded as "engineer-in-training degree".
- Engineering programs should be accredited at both B.S. and M.S. levels, and the M.S. degree recognized as the "professional" degree.
- Institutions must teach students how to be lifelong learners.
- Institutions should take advantage of the flexibility of ABET's EC2000 accreditation criteria.

Development of a niche for global market for Philippine Engineers

This should be a continuous process that might involve trial and adjustment periods. It should involve a continuous evaluation of our strengths and creative talents that might be unique. This is not to avoid direct competition with others. This is to take advantage of our strengths.

As a start, it would be worthwhile to conduct brainstorming sessions. PTC or FEED could sponsor such events, workshops, or strategic planning. Potential topics should include possible services that might combine professional engineering with other areas such as management of technology, total system solutions, etc. Another possible activity is to conduct a global needs analysis or market analysis of projected needs, particularly ones that would involve our special talents. The concept of "first to market" could apply to professional engineering services, and the development of workshops to prepare to offer the services ahead of others could be a good long term strategy.

Educational Programs in the Philippines for Global Engineering Practice

Intensive English training for global business. In the development of engineering programs, one of the thrusts is to educate students to gain good communication skills, in both verbal and written form. Engineers need to express ideas clearly. In both the national and global arenas, engineers need to present proposals and reports with clarity and brevity. In terms of language, English is the preferred medium for communication for global business. It is important to reiterate the importance of communication skills in the curricula. In addition it may be beneficial to provide post graduate short courses in communications for global business.

Courses in world cultures and customs. The global practice of engineering might take Philippine engineers to various countries in the world. It would be an advantage for Philippine engineers to understand local customs and mores in their temporary places of work. Broad education of engineers should include more humanities and social sciences, and particularly world cultures. Both western civilization and eastern civilization should be included.

Courses in global business practices. It would be good for Philippine engineers to learn global business practices as they relate to engineering. It would not hurt for them to learn Philippine business practices as well. This could be part of some course.

Graduate Degree Programs in Global Engineering Practice

Within the Master of Engineering Program (MEP), it is possible to design a program emphasizing global practice. This could involve adding some courses from a selection in world cultures, global business practices, foreign languages, and a global engineering project. This might be attractive to graduate students from neighboring countries as well.

Restructuring Engineering Degree Programs

In the Philippines there is a strong coupling between licensing through the Professional Regulations Commission (PRC), and the engineering curricula as approved by the Commission on Higher Education (CHED). This situation has both advantages and disadvantages. One of the disadvantages of such a tight coupling is the difficulty of proposing changes in the curricula. One issue is the changing nature of emerging sub-disciplines in engineering. Many of the sub-disciplines are cross-disciplinary. In the Philippine context, they could be covered by two or more licensing boards. For example the field of mechatronix is based on electrical engineering, electronics and communications engineering, computer engineering, and mechanical engineering. In the Philippines, practicing in this field would require three licenses. Teaching a course in this field in the Philippines would require the instructor to be licensed in three professional engineering areas at the present time. Adding such a course with an instructor licensed in only one discipline might entail the concurrence of three licensing boards. Other examples: solar energy engineering which involves electrical engineering, and electronics and communications engineering; intelligent transportation systems engineering, requiring knowledge of electrical engineering, electronics and communications engineering, mechanical engineering, and civil engineering. Philippine engineers are probably not sufficiently educated and experienced in these fields through no fault of their own, and most likely they would not be able to compete successfully in the global marketplace. This points a need for universities and PTC to work with PRC and CHED to allow greater flexibility in the curricula, and enable the teaching of cross-disciplinary subjects. In contrast, engineering programs accredited by ABET and other signatories to the Washington Accord encourage depth in a discipline and breadth in several engineering disciplines. A related feature of ABET accredited engineering programs is a provision for students to work in teams, and opportunity to work in cross-disciplinary projects.

Another characteristic of Washington Accord signatories is the broader science base that is permitted. For example, the life sciences are now permitted to be acceptable science courses. The Massachusetts Institute of Technology has required biology for all engineering curricula for more than 20 years. This is the century of biology and there are numerous connections to engineering. It would be wise to anticipate emerging engineering technologies, based on a wider scope of sciences including biology.

Directly relevant to the global practice of engineering, it would be beneficial to allow some engineering students to study abroad for a year. This could accomplish the objective of learning world cultures and gaining knowledge of foreign languages at the same time. Numerous engineering programs allow and even encourage students to study abroad for a year. Coordination with CHED and PRC would be needed here. One action item for universities might be to develop relationships with universities abroad to establish exchange programs.

Mutual Recognition Agreements for Engineering Programs

The Washington Accord (1988)

The Washington Accord Agreement [1] is a mutual recognition agreement among engineering accreditation bodies of different nations. Originally signed in 1989 by six organizations (from North America, Europe, Africa, Australia, New Zealand, and Asia), there are now nine signatories, and three provisional signatories. The agreement recognizes the substantial equivalence of the accreditation systems and the engineering programs accredited by them.

Bologna Declaration (1999)
This is an agreement among 29 European countries regarding the comparability of their engineering degrees.

Western Hemisphere Partnership
This is an agreement among the United States of America, Canada, Mexico, and Latin American countries regarding the equivalency of their professional engineering programs.
International Accreditation

ABET Substantial Equivalency
The Accreditation Board for Engineering and Technology (ABET) [2], which is the US signatory to the Washington Accord, directly conducts evaluations of engineering programs outside the United States. An ABET Evaluation Team visits an institution and evaluates one or more engineering programs. Although it does not accredit any engineering program outside the United States, it certifies that certain programs are substantially equivalent to those in the United States that are accredited. The ABET criteria are outcomes based [3, 4].
The ABET criteria follow the principles of continuous quality improvement (CQI). CQI transcends its role in accreditation, and we believe that it is a key to the globalization of engineering education [5].

ABET International Accreditation Plan
ABET is at an initial stage of developing plans for international accreditation that will meet standards for full accreditation [6]. The Task Group on International Accreditation appointed by the President of ABET in late 2005 will present a progress report to the ABET Board at its meeting in October 2006. It is expected that ABET will conduct a pilot study involving three institutions outside the United States in the autumn of 2007. ABET will continue to honor its commitment of mutual recognition (Washington Accord and others) with other nations. Very recently, ABET placed a moratorium on further evaluations for Substantial Equivalence. Evaluations in progress and already planned will be completed. It is anticipated that ABET would replace the current "Substantial Equivalence" certifications with International Accreditation when this is fully established.

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