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Engineering Accreditation: A Developing Nation Perspective

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Abstract - In many developing countries engineering education is young and characterized by two contradictory trends. On the one hand, strained finances may force available resources to fall below the levels required by world standards. On the other hand, many engineers are graduates of foreign universities and more graduates of local engineering schools are having their careers in industrial nations, be it for postgraduate studies or for employment. This results in many institutions trying to meet the global accreditation standards where possible at the expense of local considerations in engineering programs, an effort that may not extend to areas where the costs are substantial such as laboratory equipment and faculty load and training. Pressure mounts to increase class size and to replace real lab work by simulations, traditional instruction by virtual classes. This resulted in a situation where a large number of engineering programs meet the accreditation criteria only partially, a fact that complicates the task of accreditation bodies. They find it necessary to practice retrospective accreditation of engineering degrees from widely varying educational systems, without clear local standards to measure against. Outcomes based assessment is the exception and the focus is almost entirely on incomes and numbers. No major studies or exams are being performed to evaluate and compare the quality of graduates and to offer ranking of programs. On the example of export oriented engineering education in Palestine we elaborate on the efforts to adapt ABET style accreditation requirements and procedures to a developing nation context and the effects of such an approach on the quality of outcomes in terms of the suitability for the market place. We argue that proper accreditation can do much to encourage engineering schools to improve performance, consolidate programs and attract/retain qualified faculty and subsequently contribute to economic development in the country.

Index Terms – Developing countries, Education Quality Assurance, Engineering Accreditation.

INTRODUCTION

In many developing countries engineering education is still in its early formation stage. A large proportion of engineers may hold foreign degrees and almost all engineering faculty are graduates of universities in foreign countries with diverse educational systems, language of instruction and levels of industrial development. Many schools tailor their programs to cater to the needs of multinational companies or foreign countries where many of their graduates find employment. This gives rise to what is in a sense an export oriented engineering education. The weak industrial infrastructure in developing countries and the limited financial resources available force engineering schools to resort to cost cutting measures that reflect negatively on the quality of graduates.

One can observe two contradictory trends that characterize engineering education in developing countries. On the one hand, strained finances may force available resources to fall well below the levels required by world standards. On the other hand, more and more graduates of engineering programs are having their careers in industrial nations, be it for postgraduate studies or for employment. Mobility is more from developing to developed countries than between institutions within the same country. This results in many institutions trying to meet global accreditation standards where possible, especially in terms of curriculum and testing requirements. This is frequently done at the expense of local considerations in engineering programs. The effort, though, does not extend to areas where the costs are substantial such as laboratory equipment and faculty load and training. Pressure mounts to increase class size and to replace real lab work by simulations and to replace traditional instruction by virtual classes. This results in a situation where a large number of engineering programs meet accreditation criteria only partially. The high selectivity of engineering schools may guarantee the success of their graduates, despite the shortcomings of their home programs, a fact that hides the major challenges facing engineering education in developing countries.

All this complicates the task of licensing/accreditation bodies and professional societies trying to evaluate the multiplicity of degrees and organize the engineering profession. They are finding it necessary to practice retrospective accreditation of engineering degrees from widely
varying educational systems, frequently without clear local accreditation standards. Outcome based assessment is still the exception and the focus is almost entirely on incomes and numbers. No major studies or exams are being performed to evaluate and/or compare the quality of graduates and offer ranking of available programs. Government accreditation bodies are susceptible to political pressures dictated by the growing demand for engineering education on the one hand and limitations on the resources dedicated to education, research and development on the other.

On the example of export oriented engineering education in Palestine we elaborate on the efforts to adapt international accreditation requirements and procedures to a developing nation context. We argue that proper accreditation, aware of the global efforts but able to deal with the local context, can do much to encourage local engineering schools to improve performance, consolidate programs and attract/retain qualified faculty. The resulting increased competition will work to improve the overall quality of engineering education and subsequently contribute to economic development of the country.

THE ENVIRONMENT

The Palestinian population of about 4 million in the West Bank and Gaza, with per capita income of less than US$2000 per annum, is being served by 11 universities and 5 colleges offering engineering programs leading to a bachelor degree. The number of engineering students at local universities is about 8,000 (10% of total enrollment) with about 1000 graduates a year. Less than one third of engineering students are female as opposed to more than 50% female students for the general university student population in Palestine[1]. Only top students are admitted to the better programs. However, drop out rate is high. The faculty members in Palestinian Universities are mostly graduates of North America, Western and Eastern Europe, the Middle East. The faculty to student ratio is about 1:30 and hasn't been showing signs of improvement over the last several years[1]. This is in line with that for the general university system. Most of the faculty are involved in teaching and the loads are usually heavy. The proportion of tenured professors at many schools may be less than 20%[1]. Hiring and retention of faculty members in certain fields is proving problematic[2]. Not only it is tough to attract qualified faculty members but it is proving difficult to retain the ones they have and to get back those sent for PhDs on faculty development grants. Low salary levels, stagnant research environment, heavy teaching loads and lack of support and the abundance of attractive job opportunities abroad are among the reasons for this state.

According to the Engineer's Association data there are about 14,000 registered engineers, 15% of whom are women[3]. Less than 30% of the total are graduates of local universities and about 20% are graduates of regional (Arab universities). A correction for non-registered engineers will bring the total to about 16,000. They are increasing at a rate of about 500 a year, with the decrease of foreign graduates being offset by graduates of local universities. A shift towards computing is noticed in the last years. Opportunities for continuing education are limited. Graduate programs are also limited or nonexistent in most engineering fields. Exposure to global developments and encounters with the regional and international engineering community are limited due to the prevailing political conditions placing major restrictions on travel.

The interaction between universities, local industry and professional engineering societies is very limited. The societies have no provisions for student branches and university chapters. Society rules and many university regulations limit the chances of combining professional practice with college instruction. Professional societies have no practical role in curriculum development at local universities. The connection of engineering education to local industry is mainly through training opportunities offered by industry to engineering students and limited participation of professional engineers in evaluating student graduation projects of college seniors.

Universities have two major sources of funding for recurring expenses. The first is the student fees which are generally discipline specific but do not vary from one institution to another. This part may cover as little as a half of running costs for established public and semi public universities and as large as the full costs for private for profit and distance education institutions. The other source is government funding which is distributed in proportion to the number of students per school and is not influenced by performance and generally none of it is intended for facility upgrade or scientific research. The latter have to be covered by the fundraising efforts of the individual institutions. Clearly, this funding policy tends to discourage quality assurance practices like hiring high quality faculty, restricting class sizes and improving faculty to student ratios. Equipment and research support follow unpredictable patterns and long term planning is problematic.

THE NEED FOR ACCREDITATION

In general, accreditation, as a quality measure, has the advantage of helping stakeholders in the education process, including students and their parents, funding agencies, employers and the general public to make informed choices regarding the schools/programs they chose to deal with[4]. The continuous nature of proper accreditation encourages competition and forces educational institutions to adhere to quality assurance practices, including allocation of proper resources and curriculum development to guarantee continued accreditation. Accreditation can help departments gain access to more resources as a measure against losing accreditation[5].
This was clearly observed during the recent evaluation effort conducted for all Engineering schools in Palestine: both in universities and community colleges[2]. However, the process may acquire more importance in the Palestinian context due to several factors.

Engineering education in Palestine has a major regional/international component. This is reflected in the large number of graduates gaining employment and pursuing higher education outside Palestine. Engineering and information technology are being advanced as national priorities and a path for economic growth mainly through product export and catering for outsourcing needs of multinational companies. Therefore, producing graduates employable by foreign companies and joint programs with foreign institutions of higher education are on the table.

Multiple instruction modes coexist in the small Palestinian educational system which are competing for the same pool of students and producing graduates that have to work together. The Open University has about 40% of overall student enrollment in the country[1]. E-education is being promoted as an alternative to traditional education and a remedy for the lack of educational resources at local schools, frequently without adequate consultation with the relevant academic bodies. This requires an accreditation system capable of assessing the quality of all modes of education offered to enable potential customers (students, parents, employers) to make informed choices about their educational paths.

Financial pressures, be it insufficient government funds for public universities, or business considerations in private, for-profit, universities, work to force these institutions to resort to cost cutting measures that are bound to reflect negatively on the quality of engineering education. This needs to be offset by quality assurance measures at the heart of which is a well developed accreditation system.

Additionally, in the absence of other indicators of program quality such as university/program ranking, comparative studies of graduates quality and a long history of employment at local companies, accreditation gains special importance as the sole tool for judging the quality of engineering program on part of all the stakeholders in the process.

**CURRENT ENGINEERING QUALITY ASSURANCE EFFORT**

To operate a new academic/professional program at a local university requires a mandatory advance permission issued by the Ministry of Higher Education through its Accreditation and Quality Assurance Committee (AQAC). The license is granted based on several factors such as perceived society needs, resource availability and curriculum as reflected in the application. The evaluation team, if one can call it that, must include local and international members. It is an ad hoc team that may change with each application and no clear continuity or consistency is maintained in the system, except through the AQAC administration. While the evaluators may be experienced in their fields, they generally have no formal training in accreditation issues and are not supplied with material to guide their work and to ensure consistency of the evaluation process as a whole. The program reviewers work in isolation; they have no contact with (or knowledge of) each other and have no access to each other reports. They rarely make on site visits to the institution concerned. This usually results in widely varying program reports which makes the licensing process more protracted and prone to faults and appeals. Follow up on the program performance is not part of the system so far, which makes conditional licensing as good as unconditional one. The limited numbers of potential evaluators, especially in areas where many programs are being created such as Information Technology, and the lack of incentives for such work, financial or otherwise, strain the decision making process. Usually it is difficult to raise the licensing standards and, as a result, the least resourceful accredited program in the country sets the standard for subsequent programs. The committee has been granting conditional/provisional licensing with the main conditions dealing with the need to meet certain requirements in terms of equipment, faculty members, and other resources as the program gets implemented. However, the record of thus accredited programs has been less than satisfactory. The conditions are rarely met in the specified time frame.

A separate ministry branch deals with equivalency of foreign degrees, including engineering certificates, sometimes using the consulting services of faculty members at local universities. This is usually a complicated process as it has to deal with a huge variety of universities, disciplines and educational systems. Decisions are taken based on applicant's university transcripts and maybe on the home accreditation of the institution from which the applicant graduated with no mechanism for outcome evaluation, say through standard tests or similar mechanisms. On the other hand professional certification of engineers is done by the engineers association, in full isolation from certificate equivalency department at the ministry, though both have to deal with similar issues. The interaction between the two entities is minimal despite the overlapping work scope.

For a long time, most Palestinian universities had little quality assurance effort. However, prompted by a recent major grant from donor countries, most universities established quality assurance units to try to tap the quality improvement fund. However, they still have little outcome assessment; none of it is formal. Contacts with engineering alumnae is almost nonexistent. Feedback from the industry on the quality of graduates is very limited and is not formal. Neither the industry nor professional societies have any say in engineering education governance or in accreditation/licensure efforts despite being major stakeholders. A concept that is gaining popularity is so called *tunneling* or *proxy* accreditation.
through joint ventures or association agreements with accredited foreign universities, mainly in developed countries[2,6].

No clear distinction is made between accreditation and licensing. Programs cannot operate without the mandatory license, in contrast to the situation in many countries where non-accredited programs can coexist with accredited ones. This makes the process of revoking even conditional licenses a difficult one as it usually implies that students can't transfer to other schools and that graduates can no longer be employed or join professional societies.

PROPOSED ACCREDITATION SYSTEM

We believe that a well developed and sustainable accreditation system for Palestine will serve to advance engineering education more than any other single quality assurance measure. The attraction of engineering careers is associated, to a large degree, with the ability of graduates to join engineering societies, a precondition for practicing the engineering profession, and a source of many social and professional benefits. Given the choice, engineering students will only join programs recognized by these societies, which in turn may be based on the accreditation system.

The standard, input based approach to accreditation, listing a set of demands that have to be met in order to get approval for a program[7], is proving to be inefficient and easy to circumvent in many cases. Double faculty count, the interdisciplinary nature of new programs, migration of faculty between institutions, novel teaching methods, modern modes of access to academic literature and fast technical developments work to complicate income based accreditation.

We believe that to be credible, an accreditation system for Palestine has to take into account the local environment in which it operates while at the same time being open to the best practices worldwide. In particular, we think that a good system will take notice of the following points:

1. The accreditation body must be independent from the entities funding and supervising higher education to avoid any negative influence. To make the effort manageable it may be wise to separate engineering/technology accreditation from similar efforts in other fields. The accreditation body must guarantee adequate representation of the main stakeholders in engineering education, including universities, ministry of higher education, professional societies, local industry and the general public. Academicians, practicing engineers, educators and industrialists must take part in drafting accreditation standards and evaluating programs.

2. Multiple classes of accreditation must be considered, including initial short term provisional accreditation under which programs are given permission to operate for 1-2 years after which they are reevaluated. Based on the level of (non)compliance with the conditions, the program may be disbanded and its students dispersed into other programs according to a proposal submitted with the initial accreditation application.

3. The accreditation process must be continuous. Re-accreditation must be required, initially over short intervals (2-3 years) then for longer intervals. Accreditation must be accompanied by continuous reporting by the institution concerned on the status of the program under consideration, including on curriculum, faculty development, library and laboratory acquisitions, employment and repeat employment of graduates[5]. Longer term accreditation must be based on the performance over the entire period between accreditations, and not only at accreditation point, to avoid misleading reporting. Feedback for the accreditation process must be collected in the shape of test results, employer reports/rehiring statistics and graduate school performance. This data must be used to fine tune the accreditation process and ensure it is outcome centered. Programs must be warned once their performance indicators fall below the required standards.

4. Technology aware accreditation. The system must account for the rapid changes in technology and its role in engineering education. Faculty development to ensure up to date knowledge through conference participation, continuing education[8] and research must be integrated into the accreditation requirements list. In an environment where cost considerations may force equipment use beyond the usual lifetime, product life cycle and computer technology advances must be integrated into the accreditation process to ensure that the available equipment is not outdated, the systems studied are up to date and the engineering methods are in line with market trends. Issues like the role of simulation and virtual laboratories as substitutes for real equipment must be addressed.

5. Preference should be given to a regional licensing/accreditation body. The number of programs to be accredited in a single country may not be sufficient to motivate the creation of a fully fledged accreditation body and the number of potential evaluators in any given discipline may be below the needed threshold. Resource pooling will improve the process efficiency and outcomes. Similarities in culture, development level and educational systems may encourage this approach[9].

6. International dimension. The accreditation process needs to have some links with similar institutions worldwide to give the process international legitimacy and to encourage global mobility. These contacts may be stronger at the earlier stages for the
purposes of developing local expertise including training in evaluation skills, raising the accreditation bar and encouraging bold initiatives in engineering education. However, this should be combined with encouraging the local content of engineering programs on a scale that allows the graduates to work efficiently on the local market. Examples of such local content is traditional architecture and local building materials for architects/civil engineers, and local natural language processing for computing professionals[12]. One may want to enter into agreements with accreditation bodies in developed countries on establishing standards and on equivalency for programs achieving certain levels of local accreditation.

7. In line with the current international practices, accreditation must strive to be outcome based. Competency standards for outcomes for all program types, be it E-learning, Distance or traditional education, must be set to ensure coherence of the work force and encourage mobility[10,7]. It is essential to have preset measurable goals changing only with high need and with some objective component such as corresponding to an international standard. The goals need to reflect a curriculum that responds to changes in the high school curriculum and technological developments[11].

8. The goal should be well rounded education, and life-long learning skills, that need not focus exclusively on the scientific content of engineering programs. Research and development methods, group work skills, experimental component of lab work, practical training/industrial experience, scientific writing and work ethics must be integral parts of the education of the engineer. Program designers need to demonstrate that their programs have such components as a condition for licensing/accreditation and these components should feature prominently in outcome assessment.

9. Governance and policy considerations. The accreditation guidelines may give weight to governance practices and policies that encourage quality education and relations with industry for programs seeking accreditation. One example is having an advisory board for engineering programs with members in leadership position in industrial companies with the ability to create jobs and projects[5] and senior faculty from major world universities. Another example is to encourage the participation of senior practicing engineers in the educational process. Additionally, the accreditation process must be concerned with processes as well as in numbers in areas like faculty recruiting and promotion, student recruiting and selection and program/institution governance[12]. The accreditation criteria need to evolve to accommodate advances in technology, industrial development in the country and the need to maintain a steadily improving engineering education.

10. Publicity and transparency considerations. The accreditation regulations and results must be communicated to all concerned through an organized effort to publicize the benefits of the process. Institutions are to be encouraged to use positive accreditation results in their recruiting and fundraising efforts and this information should be made accessible to (potential) students, teachers and parents especially at university application time. An accreditation based ranking system may be used to encourage competition, pending rankings based on other criteria.

11. The funding policies of higher education must be amended to take quality factors into account when deciding funding levels for individual institutions/programs. The fee structure at universities must be flexible enough to allow superior institutions to charge fees commensurate with program quality.

CONCLUSION AND REMARKS

In this paper we argued that engineering accreditation acquires special importance in developing countries. On the one hand it may be the only quality indicator that can be used by stakeholders to evaluate the multiplicity of available programs in the absence of other quality measures such as program rankings, standardized testing and employment statistics. On the other hand it may serve as an insurance policy to guarantee that programs acquire sufficient resources to guarantee their success in an environment with strict financial constraints. This sounds like burdening accreditation with more baggage than it can carry, but the experience shows that accreditation and licensure considerations carry more weight than any other factors when educational institutions debate issues related to programs, new and existing.

To fulfill this mission, the accreditation process has to meet several requirements that we outlined in the paper. Meeting these requirements is a challenge in the developing nation context. The prevailing culture is that of centralized control of higher education and insufficient inter-institutional, regional and international coordination. The basic premises of accreditation in terms of encouraging mobility may be associated with the negative phenomenon of brain drain from developing to industrial nations rather than the role in encouraging competition and growth in the global market. Limited financial resources and local accreditation expertise may complicate matters. The experience of other countries[13,12,6,14,7,4], especially that of the emerging economies of South East Asia may serve as a good model for Palestine. Accreditation bodies in industrial nations can contribute much by offering their experience and services to developing countries at nominal cost and involving...
engineering educators and practitioners from developing nations in their work to gain expertise and transfer knowledge and best accreditation practices to the local scene.

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