

2006-1269: UPDATING FOR ENGINEERING FACULTY MEMBERS IN DEVELOPING COUNTRIES

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UPDATING FOR ENGINEERING FACULTY MEMBERS IN DEVELOPING COUNTRIES

Abstract

Many faculty members at engineering schools in developing countries have difficulty in participating in professional development activities such as international conferences on engineering education, or conferences on their technical specialty areas. Often advanced graduates from engineering programs in developed countries, they are heavily constrained for resources upon return to teaching positions in their native countries – little funding for labs and research, limited access to current publications, and scarce if any funding for travel to professional and technical meetings. This paper describes efforts of the WFEO Committee on Capacity Building and other groups to address these problems, typically through electronic means.

Introduction

In the global economy of the 21st Century, engineers play a key role in overall economic development for countries and regions. In the well developed countries, the role of the engineer is well understood and utilized. In much of the developing world, however, the available pool of engineering talent is typically below critical mass – and economic development and even important basic societal needs that rely on engineering – such as clean water supply and sanitation – lack the technical talent to address them.

Indigenous engineering schools, and the faculty to effectively staff them, are key to the forward progress of developing countries. Technical capacity building efforts, such as those being pursued by the World Federation of Engineering Organization and UNESCO, rely heavily on local engineering educators to develop the necessary pool of well educated and certified engineers to allow developing countries to begin to be competitive in the global marketplace.

Faculty members in engineering schools in least developed countries often have had the advantage of high quality graduate educations, with master's and doctoral degrees from well respected universities in the highly developed countries. Those who are dedicated to improving the situation in their native countries often return home after graduate study abroad, and take teaching position at local universities. They are then often beset by a multitude of problems – inadequate salaries, forcing them to have an additional job which detracts from their university effectiveness; lack of financial resources for teaching and research laboratory equipment, and for publications that could keep them abreast of developments in their technical and professional fields; and lack of funds for travel to conferences that could keep them technically and professionally up to date.

With developments in electronic tools and communications over recent decades, it is increasingly possible to provide resources to engineering faculty members in developing countries through the Internet, satellite transmissions, and digital media. Several organizations are pursuing such delivery systems to facilitate continuing professional and technical development opportunities for engineering faculty members in developing countries.

This paper is intended to provide a resource to engineering faculty members in developing countries, by outlining various options for their continuing professional development and providing pointers on how to access them. In addition, it is intended to call to the attention of providers of continuing education in the engineering field that a potential audience may be being underserved. It is hoped that such providers will advertise their offerings to engineering educators in developing countries, and offer them at prices that are affordable to that audience.

Capacity building

Economic development for developing countries can be effectively stimulated by building the technical capacity of their workforce, through quality engineering education programs. A competent technical workforce base can then provide several paths to economic development: attraction of technically oriented multi-national companies, who can invest effectively in the developing country once there is a cadre of qualified local employees available; effective utilization of foreign aid funds, providing a legacy of appropriate infrastructure projects and technically competent people to operate and maintain them; and small business startups by technically competent entrepreneurs. Both UNESCO and the World Federation of Engineering Organizations are currently actively engaged in technical capacity building in developing countries.

High quality engineering education is a necessary forerunner to such economic development; and technically competent and current faculty members are key to providing high quality engineering education programs. In addition, quality assurance systems such as peer review based accreditation are needed to promote such high quality education programs. Such quality assurance systems can then provide the basis for cross-border recognition systems, permitting the flow of services and goods across national boundaries.

Capacity building is a dedication to the strengthening of economies, governments, institutions and individuals through education, training, mentoring, and the infusion of resources. Capacity building aims at developing secure, stable, and sustainable structures, systems and organizations, with a particular emphasis on using motivation and inspiration for people to improve their lives.

What outcomes are desired?

- Technical capability is needed for developing countries to engage effectively in the global economy.

- Indigenous science and technology capacity is needed to insure that international aid funds are utilized effectively and efficiently – for initial project implementation, for long-term operation and maintenance, and for the development of capacity to do future projects.
- In order to stimulate job formation, a technical workforce pool is needed, made up of people who are specifically educated and prepared to engage in entrepreneurial startup efforts that meet local needs

Two complementary approaches are being pursued in parallel to achieve these desired outcomes:

- UNESCO “Cross-sectoral activities in technical capacity-building” decision, to enhance engineering programs within that organization
- WFEO Committee on Capacity Building, to provide an action oriented program for forward motion

UNESCO plans for capacity building

In 2003, the United States of America rejoined UNESCO after an absence of 18 years. The US government indicated to UNESCO that it wanted a significant portion of the increased funds that it would provide to its budget to be allocated to enhancing its programs in engineering and engineering education. A major proposal on how to mount an enhanced program, entitled “Cross-sectoral activities in technical capacity-building”, was developed and submitted to UNESCO for consideration. This effort, to be housed in the science sector and reporting directly to the Assistant Director General for Science, will focus broadly on building personal and institutional capabilities in developing countries to address poverty reduction, economic development, and related issues. Presented by the US Ambassador to UNESCO at the April 2005 meeting of the UNESCO Executive Board, this approach has been adopted and referred to the UNESCO Director General for implementation.

WFEO Standing Committee on Capacity Building

Motivated by a renewed interest in engineering and engineering education at UNESCO, at least partially driven by the decision of the United States of America to rejoin UNESCO after an 18 year absence, the World Federation of Engineering Organizations (WFEO) Moved in October 2003 to establish a new Standing Committee on Capacity Building, with the United States as the host of the international organization.

Following is a list of the activities being pursued by the WFEO Committee on Capacity Building:

- Engineering for the Americas – capacity building throughout Latin America and the Caribbean, utilizing both a ‘bottoms-up’ approach involving initiatives for engineering educators and a ‘top-down’ approach with policy level decisions at the Ministerial level of government. The Ministers of Science and Technology of

the Organization of American States have endorsed this program in their November 2004 “Lima Declaration”, and a major symposium of government, academic, industry and NGO leaders was held from 30 November through 2 December 2005 in Lima, Peru.

- African initiative – development of programs for the enhancement of engineering education and its quality assurance in six countries which currently have major foundation grants to improve their overall higher education. Efforts include engineering education workshops, accreditation system development, teaching of entrepreneurship to engineering and business students, and internship programs with multi-national companies.
- Virtual exhibit, e-conferences – capturing of exhibits at a major engineering education conference (book displays, equipment demonstrations, hardware and software products, information services, etc.) to make available on a cd-rom to engineering educators in developing countries; planning and conducting of electronic conferences, such that engineering educators in developing countries can participate in virtual meetings even though typically unable to travel to live conferences
- Entrepreneurial conference – planning for an international conference on teaching entrepreneurship to engineering students
- Black Sea University Network workshop – planning for a workshop on best-practices in engineering education, to be held in Moldova for the dozens of engineering schools within the 100-member Black Sea University Network
- Gender issues – collaborating with two major international organizations concerned with gender issues in engineering education, to assist in getting more appropriate women into the engineering education pipeline, and on into engineering practice
- South-south interactions – collaborating with a moderately developed country to provide programs that have such countries utilize their expertise to assist lesser developed countries
- Engineers without borders – collaborating with younger engineers involved in the growing ‘engineers without borders’ movement internationally
- FIDIC collaboration – working with the international organization of consulting engineers to promote establishment of indigenous consulting firms in developing countries
- UNESCO/WFEO Expert Conference – Planning a major international conference on aspects of engineering education relevant to capacity building and poverty reduction, to be co-sponsored with UNESCO

“Cross-sectoral activities in technical capacity-building” is a call to action from the United Nations. The WFEO Committee on Capacity Building is the response of the engineering profession throughout the world in the form of a strategic action agenda.

Faculty updating

Given the importance of technically competent and current engineering faculty members in developing countries, capacity building efforts in those countries must address the needs of such faculty members as part of their overall strategies. Following is a list of mechanisms that can be utilized in such efforts.

- *Graduate study in developed country* – The most effective way to get potential faculty members for engineering schools in developing countries up to initial speed is study abroad in a well developed country – at least at the graduate level. Programs to facilitate such opportunities are well developed and utilized, and provide the springboard for well educated engineers to return to their native countries and become engineering educators.
- *Regional conferences* – Organizations such as the UNESCO International Center for Engineering Education (UICEE), hosted at Monash University in Australia, conduct conferences on development in engineering education at several regional locations around the world, offering the opportunity for engineering faculty members who may not have the resources to travel to major international conferences to participate closer to home.
- *Regional workshops* – As noted above, the WFEO Committee on Capacity Building will conduct regional workshops on how to enhance engineering education and how to develop appropriate quality assurance systems, with initial focus in Sub-Saharan Africa, Eastern Europe, and Latin America and the Caribbean.
- *Electronic conferences* – Organizations such as the American Society for Engineering Education (ASEE) and the European Society for Engineering Education (SEFI) have conducted electronic conferences in conjunction with their major international meetings. Engineering educators in developing countries are encouraged to write papers for posting on the World Wide Web for several months before the major conference, and the pool of authors and members of the organization are encouraged to read and discuss those papers. At the major live conference, summaries of the papers and discussions are presented at a plenary session, with the opportunity for live discussion by conference participants. The results of the live session are then recorded for delivery back to the authors – allowing them to have the benefit of having participated in a conference, albeit remotely.
- *Conference proceedings and publications* – Major conference proceedings volumes today are typically presented in electronic form, with all the papers presented at the conference provided in cd-rom form at the conference, and posted at the organization's web site afterwards. Engineering educators in developing countries can thus readily read or download papers of interest over the Internet. Typically some form of membership in the organization is needed to get access to such papers, and special rates are available for electronic-only membership. The Global Online Membership of ASEE, for example, gives access to its monthly

magazine, annual conference proceedings, scholarly journal, and e-newsletters for the nominal annual fee of \$39. GOM is not available to US or Canadian educators, and is clearly appropriate for engineering educators in developing countries.

- *Electronic continuing professional development* – Courses for ongoing professional and technical development of engineering faculty members are available via distance education programs from a variety of sources, including the Open University of the United Kingdom and the All Engineering Schools network in the US. Costs may be an issue, but scholarships and other forms of financial aid may be available. The major engineering professional/technical societies also provide appropriate continuing education courses in electronic forms – see, for example the offerings of the IEEE.
- *Open courseware* – The Massachusetts Institute of Technology (MIT) has made a major commitment to sharing its expertise in engineering education by posting on the web materials from each of its courses, in its OpenCourseWare project. Materials posted for each course typically include syllabus, readings, calendar, lecture notes, tools and projects. Downloading of appropriate materials and adaptation to local needs can be a significant aid to engineering faculty members in developing countries.
- *Virtual exhibit* – As noted above, the WFEO Committee on Capacity Building plans to capture on video the exhibits at a major engineering education conference (book displays, equipment demonstrations, hardware and software products, information services, etc.) and make the information available on a cd-rom and on the web to engineering educators in developing countries. So when resources do become available, such educators will have up-to-date knowledge of what is available for acquisition.
- *Publications over Internet* – Technical organizations often make their publications available free over the Internet, at least after an initial period. One major source currently available is the posting of over 1000 publications by the US National Academy of Sciences, available free to readers in developing countries.
- *Exchange programs* – Student exchanges, either one way or two way, can greatly enhance engineering education – and enrich the knowledge of engineering faculty members at both ends of the exchange. Direct faculty exchanges, again either one or two way, can also be beneficial to faculty members – at both ends of the exchange. The Institute of International Education in the US facilitates several such exchange programs.
- *Joint research or design projects* – Collaborations at a distance between faculty/student groups in developing and developed countries can be mutually beneficial. In the US, the National Science Foundation supports programs for

such international collaborations that are extensions of funded research projects. Several universities are using electronic communications between campuses – often with one in a developing country and one in a developed country – to allow student groups to collaborate on senior design projects, to the mutual benefit of both groups of students.

- *Accreditation visits* – Quality assurance in engineering education is extremely important, and internationally recognized accreditation standards are currently being promulgated throughout the world, and mobility of engineers and technical work flow become commonplace. Accreditation bodies in developed countries, such as the Accreditation Board for Engineering and Technology (ABET) in the US and the Canadian Education Accreditation Board (CEAB) in Canada have developed mechanisms to assist developing countries in developing appropriate quality assurance systems. ABET also offers direct quality evaluation visits to individual universities outside the US.
- *Industry experience* – Faculty members everywhere can benefit from time spent in industry – full time periods of total immersion, summer positions, or part-time consulting can all be effective. Engineering educators in developing countries should explore such experiences, particularly with multinational companies which work at the state-of-the-art of current technologies.

Conclusions

Technical capacity building is a necessity in developing countries if they are to be able to join the technology-based global economy of the 21st Century. Engineering educators in such developing countries are key to such capacity building – preparing future generations of qualified engineers, providing research and development results to fuel local industries, and consulting for the productive sector and local governments on technical issues.

With the information and communications tools currently available, and becoming more readily available in the developing world, a wide variety of mechanisms are available to assist engineering educators in developing countries to update their knowledge and skills for lifelong effectiveness.

This paper has provided a resource to engineering faculty members in developing countries, by outlining various options for their continuing professional development and providing pointers on how to access them. In addition, it has provided rationale to providers of continuing education in the engineering field that a potential audience may be being underserved. It is hoped that such providers will advertise their offerings to engineering educators in developing countries, and offer them at prices that are affordable to that audience.

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