Engineer for the Americas

Luiz C. Scavarda do Carmo, Catholic University of Rio de Janeiro, scavarda@ puc-rio.br
Lueny Morell, Hewlett Packard Company, lueny.morell@hp.com
Russel C. Jones, World Expertise LLC, RCJonesPE@aol.com

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ABSTRACT

The globalization process has been an important mechanism for wealth creation in the world, but it has been a modest mechanism for wealth distribution in the developing world. The formation of a workforce with a strong technical base, but with specific competencies on non technical subjects, is fundamental to launching the developing world in a virtuous cycle within the globalization process. In this context, modern engineering education becomes a basic tool for social and economic development, provided that stakeholders like the private sector, government and schools of engineering collaborate in innovating and reforming engineering education to address present and future needs of a globalized economy. The present process of globalization seems to be ripe to foster the formation of regions of deeper economic integration, one of them being the Hemisphere of the Americas. The Engineer for the Americas is an initiative now under the umbrella of the Organization of the American States that aims to develop a professional that could foster social and economic development in a local base, besides contributing to the overall increase of the continental competitiveness on a global scale.

KEYWORDS — Engineer for the Americas, International Accreditation, Engineering Education, Regional Development.

INTRODUCATION

The Hemisphere of the Americas is now being challenged by the need for a more homogeneous economic and social growth. The eradication of poverty and the setting of conditions for social and economic development are timely issues that have been deeply associated to the building of indigenous capacity for self growth. Most of the preconditions for such development are partially defined by the United Nations WEHAB (Water, Energy, Health, Agriculture and Biodiversity) [1] millennium development objectives, which cannot be reached without engaging engineers in the process of designing, planning and even in the decision making process. Many actions in the WEHAB objectives have been treated only under the necessary, but insufficient, economic and political aspects. Moreover, engineers are crucial in dealing with emergencies, disasters and post-conflict situations.

Further development beyond the WEHAB basics cannot be reached, in a moment of accelerated technological changes, without the presence of high tech industries, which could foster a second thrust for development, characterized by a more sophisticated market for products and job opportunities. In the knowledge society that characterizes the technological revolution of the beginning of the third millennium, engineers are essential in bridging the knowledge divide between developing and developed countries, and, inside the social fabric of every nation, the exclusion among those that do command a modern set of information and information retrieval mechanisms and those that do not.

The Hemisphere of the Americas has a homogeneous origin, being the result of a European layer of conquerors that initially subdued local peoples and later drove a massive process of migration of population from all over the world in a complex melting of ethnic and cultural diversity. In contrast with the rest of the world, a Babel-like society was not established. Although many languages participate on the rich cultural diversity of the continent, like French, Dutch and indigenous languages, most inhabitants are native speakers of three languages – English, Spanish and Portuguese – the last two sharing a common Iberian root.

The economic development of the region, nevertheless, has been very much asymmetric, with Latin America and the Caribbean in a stage of developing their industrial strength, and, North America in a stage of leadership of the world in economy, technology, culture, and sciences. Contrary to several other places in the developing world, Latin America and the Caribbean have already established several nuclei of technical excellence, which may be easily observed by several cultural and technological achievements, which include the existence of leading universities and several very good schools of engineering. These nuclei of modern culture are important seeds to bridge the knowledge divide, and, in particular considering the Schools of Engineering, these nuclei may play an important and leading role in the process of fostering a high-tech industry led economic and social development. Technical education is the mechanism to reduce the knowledge divide among nations and the internal social exclusion. In this context, Latin America and the Caribbean show areas where the development processes are connected to the WHEAB objectives and areas where a second stage development driven by hi-tech industry is ripe. In both cases a competent work force of professionals in engineering is needed.

The globalization era has been characterized by technological breakthroughs, mostly in the areas of telecommunications and information. Although the globalization process may represent new opportunities, the related generated wealth has not been evenly distributed, bringing to many a negative reaction toward the internationalization of the productive processes and markets. Further economic integration cannot be done without a more extended participation of nations and their people.

Another moment of large scale globalization will probably follow the establishment of stronger supra-national regions. Nevertheless, in this specific moment, the world has its markets, supply and demand industrial chains mostly organized in three regions: The Pacific Rim, Europe and the United States. Latin America and the Caribbean do not have the internal energy to become a region by itself although several initiatives of regionalization like Mercosul (Brazil, Argentina, Uruguay and Paraguay) have shown very positive economic results. Following its cultural roots, economic practices and industrial integration, sooner or later, this region will integrate with the US within the Hemisphere of the Americas. Although ties with Europe will always be of great relevance for North and South America, it must be taken into consideration that the European Union is now in an important moment of integration with Eastern Europe.

In order to become nuclei for regional integration that will lead a virtuous process of development, the schools of engineering of the Hemisphere must be part of a strong leader in bringing all stakeholders to the process. Thus, engineering schools, the private sector, professional organizations, accreditation bodies, and the governments must partner to engage in a set of concerted set of actions.

ENGINEERING FOR THE AMERICAS TASK FORCE AND INTERNATIONAL BODIES

The Engineering for the Americas Task Force is comprised of a set of champions characterized by volunteer work. This Task Force is engaged in two principal initiatives: a set of bottom-up

actions based on pilot projects involving specific stakeholders of this process, and, a set of top-down political actions involving such organizations as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organization of the American States (OAS), the Inter-American Developing Bank (IDB), the "Unión Panamericana de Ingeniería" (UPADI), the Pan-American Academy of Engineering (API), and the World Federation of Engineering Organizations (WFEO) among others. These top down actions may set a political agenda for the governments of the Hemisphere of the Americas and may catalyze the necessary financing to back the grass root activities.

The use of external aid to developing countries has been tried for several decades during the Twentieth Century. This expensive and also commendable effort, nevertheless, had positive but modest results by not taking into consideration that "people respond to incentives". [2]

The Secretary-General of the United Nations, Kofi Annan, stated: "Let me challenge all of you to help mobilize global science and technology to tackle the interlocking crises of hunger, disease, environmental degradation and conflict that are holding back the developing world" [3]. Inspired in such vision, recognizing the necessity to set incentives and challenges to the developed and developing countries and in the recognition of the importance of engineering to promote sustainable development, there is now being proposed a UNESCO Program called "Engineering for a Better World", specifically designed as a proposal to promote human and institutional capacity building in the developing countries. Besides, the UNESCO Executive Board adopted a resolution of the "Creation of a Cross-Sectoral Program in Technical Capacity Building", aiming to strengthen and expand technical capacity building and engineering activities within the UNESCO structure.

One of the authors of this paper (Russel Jones), now chairing the international committee on capacity building of the World Federation of Engineering Organizations (WFEO), participated on the efforts with the Executive Board of UNESCO. This international effort will focus on the need for:

- Strengthening engineering education, training and continued professional development;
- Standards, quality assurance and accreditation;
- Development of curricula, learning and teaching materials and methods;
- Distance and interactive learning (including virtual universities and libraries);
- Development of engineering ethics and codes of practice;
- Promotion and public understanding of engineering and technology;
- Development of indicators, information and communication systems for engineering;
- Addressing women and gender issues in engineering and technology;
- Inter-university and institutional cooperation, including fellowships;
- Development of engineering and technology policy and planning to promote the above.

Besides UNESCO, the OAS hosted meetings of members of the committee on capacity building to set an agenda for the governments of the Hemisphere of the Americas, especially the ministers and secretaries of Education and of Science and Technology, considering mechanisms for accreditation of the Schools of Engineering of the Hemisphere and their curriculum for the future engineers. In November 2004 Ministers and High Authorities of Science and Technology signed the "Lima Declaration" [4] that states that:

- Scientific, Technological and Engineering Capacity building is a priority
- The struggle against poverty and inequality is essential to promote and consolidate democracy
- Science, Technology, Engineering, Innovation and Technical Literacy are fundamental to the creation of jobs and the strengthening of democracy

Finally, UPADI and API endorsed the concept of Engineer for the Americas in October 2005.

INTERNATIONAL EXAMPLES

One important example of the relevance of internationalization of higher education is now being presented by the European countries in their move toward political unification. Europeans decided to give a higher degree of compatibility in their system of higher education. The main arguments for such complex move in a continent with deep roots in traditional and distinct mechanisms for higher education were the need for professional mobility, an expected overall increase in the competitiveness of the European Union as compared to other regions of the World, and a desired increase of the attractiveness of the European higher education system to non-European students. All these aspects are also valid for the Hemisphere of the Americas.

Among the several courses taught in universities, engineering represents the logical body of knowledge directly involved in the fast creation of new technologies and products, as in the internationalization of the productive process, and even on the development of more sophisticated markets and professional opportunities adjusted to the modern industrial processes. Knowledge is now being viewed in Europe as a very important social and economic asset. As stated in the Bologna Declaration "A Europe of knowledge is now widely recognized as an irreplaceable factor for social and human growth" [5]. The European move is a clear political decision. The Bologna Declaration is a document that is signed by the Ministers of Education of all the State members of the European Union.

A second example of international involvement of engineering education and professional practice is the Washington Accord. Contrary to the European highly political move, this accord is an agreement among institutions in English speaking countries, recognizing the substantial equivalence of the engineering accreditation systems of the organizations holding the signatory status, and the engineering education programs accredited by them.

The Hemisphere of the Americas is far from a situation of political unification or even far from having accreditation organizations ready to sign an agreement. Even in this distinct situation, relevant steps toward a collective improvement of engineering education with a vision of the betterment of the economic and social conditions of the continent can be taken, by using the two above mentioned examples.

The Bologna Declaration and the Washington Accord may give examples of strengthening international ties within a region. Contacts of North America and Latin America and the Caribbean with European countries led to important mechanisms of improving engineering education. Examples are dual degrees now being practiced in American countries, involving, in Europe, particularly France and Germany.

The present level of interaction in the Hemisphere of the Americas in the area of engineering has been very strong in the scientific aspects represented by Ph.D. exchanges and sandwich programs, but have shown poor results in areas directly involving industry. Any Bologna-like declaration or accord to be effective in the Hemisphere of the Americas must include the industry, both in manufacturing and service sectors.

THE PROFESSIONAL PRACTICE AND THE EDUCATIONAL ASPECT

The professional practice in the Hemisphere of the Americas of an Engineer for the Americas is characterized by a profound knowledge of the needs of the Hemisphere and ability to take advantage of the rich aspect represented by its cultural diversity.

The professional practice will be observed by national professional associations able to instill in the professional engineer the habit of generating local solutions to international problems,

probably being even able to help or to participate in out-sourcing to the local small business and engineering consultant firms part of the responsibility of the new products design and manufacturing, so becoming members of the complex demand and supply chain of the already established and the attracted high-tech industry.

The mobility of the Engineer for the Americas professional, as well as of the work flow represented by the opportunities set by the international industries, will demand knowledge of at least English and another Hemispheric main language (Portuguese or Spanish), most probably the ability to at least understand all the three languages.

The daily cultural life of such professional will presuppose the acceptance of the multicultural environment of the Hemisphere and the recognition of the enriching aspect of its diversity.

The technical and scientific daily life will demand up to date knowledge of the specific area of professional practice, which will require continuing education and life-long learning.

The challenge to form a professional with Hemisphere-wide vision, entrepreneurial behavior and leadership only can be solved by an international mechanism of education, with a strong presence of the industry with Hemisphere-wide interest, within a broader curricular context.

In order to realize the important steps to form this breed of professional, we present, as an example, the typical ABET a - k criteria [6]:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Although reasonably general, the above mentioned criteria are not enough to form an engineer that is able to tackle the complex problems of the Hemisphere of the Americas, mostly if engaged in the local problems of a developing country. Curricula and educational modifications must be adapted to form a professional that:

- has the right skills and entrepreneurial behavior to promote local development
- has the ability to foster the development and internationalization of industries started in Latin America and the Caribbean
- is a basis to attract the high-tech industry willing to help to locally aggregate the invaluable value of knowledge to international products
- has the right international contacts to help in keeping up-to-date technical knowledge and maintain life-long learning practices
- has the knowledge of the Hemisphere and the necessary contacts with the industry to help to evaluate the strength and weakness represented by the formation of enlarged demand and supply chains that are necessary to effectively increase the overall continental competitiveness.

CONCLUSIONS

The Engineer for the Americas concept is tuned with present necessities of the Hemisphere of the Americas. Nevertheless, although taking into consideration a similar program in Europe, it must be emphasized the deep asymmetric economic conditions of Latin America and the Caribbean as compared with North America.

The European concept of mobility must be translated and adapted to the Hemisphere of the Americas taking into consideration the profoundly different political reality. The extension of the concept of mobility goes beyond the movement of well prepared professionals, but encompasses also the southbound movement of high tech industries that are willing to establish their factories and laboratories along the whole Hemisphere and the northbound movement of industries that are indigenous in Latin America and the Caribbean. The present concept of engineer basically aims to generate a local workforce condition that is attractive to the establishment of high tech industry and for further development of endeavors started in Latin America and the Caribbean, facts considered not only as very important vectors for local development, but also as a clear positive movement towards an overall growth on the competitiveness of Latin America and the Caribbean, as well as North America, trade and market increase and enlargement of sophisticated professional opportunities.

The technological, scientific and economic improvements that could be set by the well prepared workforce represented by the Engineers for the Americas, nevertheless, will only make sense within a strong partnership represented by the several stakeholders of his process, like the schools of engineering, the students of engineering, the governments, supra-national organizations (OAS, UNESCO, IDB), the professional associations, the accreditation boards, and fundamentally by the industries with Hemisphere-wide presence. [7]

The authors consider that the establishment of a local workforce and the consequent migration of jobs toward Latin America and the Caribbean will offset the tendency of the northbound brain drain represented by the existence of well prepared engineers. The authors also consider that this enriched local workforce will contribute to the betterment of job creation in North America, represented by the overall increase of the Hemisphere of the Americas competitiveness.

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