The Engineer of the Americas

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Abstract

The concept of Engineer of the Americas was conceived to foster professional mobility within the Hemisphere of the Americas and also to generate a local workforce that stimulates the economic development of each country through the presence of multinational industry. The development of supra-national economic regions with strong internal ties is a reality of the present days and introduces a new vision for human resource development, particularly in the area of engineering. In this paper we discuss the competencies associated with engineers who pursue local development as a professional task, and by doing so contribute to an increase of the overall regional competitiveness. Several stakeholders of the process of creating a new breed of professional engineer are presented, starting with the students and the schools of engineering, followed by the industries, the professional organizations, accreditation bodies and the governments.

This paper presents efforts being developed by a set of professionals who comprise a task force to better define the Engineer of the Americas and start a pilot project involving a few schools of engineering and interested industries. Some mechanisms to facilitate the establishment of the Engineer of the Americas are also presented. They are analyzed within the framework of regional accords that facilitate grass root, bottom-up, actions like a pilot project, but also lobby for political declarations, like the Bologna Declaration and others in Europe, where top down measures are discussed based on ministerial decisions. The authors advocate a blend of bottom-up and top-down actions that take into consideration the reality represented by the economic asymmetry within the Hemisphere of the Americas, its very early and feeble stage in the process of a deeper political agreements, and also the present controversial but apparently unavoidable process of job migration.

Introduction

The hemisphere of the Americas is a rich, complex melting pot of ethnic and cultural diversity. Over time, regional economic development has been asymmetric, with Latin America and the Caribbean in a stage of developing their industrial strength, and North America in a stage of leader 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.

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) 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 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 indigenous 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. Even so, and in contrast with the rest of the world, most inhabitants of this continent are native speakers of only three languages – English, Spanish and Portuguese – the last two sharing a common Iberian root.

The economic development, 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 leader 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 a new moment of opportunities, the related generated wealth was not 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 population.

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 does not have the internal energy to become a region by itself although several initiatives of regionalization like Mercosul (Brazil, Argentina, Uruguay and Chile) 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.

The schools of engineering of the Hemisphere, in order to become nuclei for regional integration that will lead a virtuous process of development, must be part of a strong movement of partnership among the several stakeholders of this process, here taken as: the students of engineering, the schools of engineering themselves, the industries, professional organizations, accreditation bodies, and the governments. All these partners must engage in a set of concerted set of actions.

Engineering of the Americas task force

The Engineering of the Americas task Force is comprised of a set of champions of this concept from academic institutions, industry, government and non-governmental organizations, characterized by volunteer work. This group is engaged in facilitating several actions of two natures: 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), 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 mere use of external aid to developing countries has been tried for several decades during the Twentieth Century. This massive, expensive and also commendable effort, nevertheless, had positive but modest results by not taking into consideration that "people respond to incentives".

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*". 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.

One of the authors (Russel Jones) is now chairing an international committee on capacity building for the World Federation of Engineering Organizations that 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.

This committee, formed partially by members of the Engineering of the Americas task force, is now taking such concept as a proposal under the umbrella of the UNESCO based on the above mentioned needs.

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 three 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".

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 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 an important example 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 practices in several American countries, involving particularly France and Germany.

The present level of interaction in the Hemisphere of America 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 industry, both in the manufacturing sector and in the service sector.

The professional practice aspect

The professional practice in the Hemisphere of the Americas of an Engineer of 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 possibly 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 attracted high-tech industry.

The mobility of the Engineer of the Americas will demand knowledge of at least English and another hemisphere 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 this diversity.

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

The educational aspect

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, and within a broader curricular context.

In order to realize the important steps to form this breed of professional, we present, as an example, the outcomes criteria of the US Accreditation Board for Engineering and Technology:

- 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
- 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.

Government action

Through the good offices of the Office of Education, Science and Technology of the Organization of American States, a Hemispheric Initiative entitled "Engineering for the Americas" was prepared in 2004 and presented for action at the Meeting of Ministers and High Authorities of Science and Technology of OAS in November 2004 in Lima, Peru. This "top down" approach complements and strengthens the "bottoms Up" approach of the Engineer of the Americas task force.

To promote innovation and economic development, it is necessary to increase engineering capacity and engineering participation in innovation processes. The first step in accomplishing this is to increase the quality and quantity of engineers in all countries of the Hemisphere. The preparation of this engineering base should include, among others, elements of mobility, shared curricula development, inter-institutional collaboration, joint degrees, enhanced science and technology infrastructure, and accreditation. It is understood that these activities need to have a significant increase of resources, from both the public and private sectors. One of the major contributions of the public sector is the establishment of incentives to encourage the private sector to invest in innovation. There must be a strong commitment on the part of governments to facilitate this.

Activities to be undertaken to implement the Minister's plan of action include:

- Development of mechanisms for quality improvement of initial engineering education throughout the Hemisphere, including shared curricular development, inter-institutional collaboration, mobility schemes, and integrated programs of study, training and research.

- Development of mechanisms for the continuing professional development of graduate engineers, including advanced delivery systems within countries and across national borders.
- Development of a system of compatible engineering degrees and systems of credit transfer to promote widespread student mobility throughout the Hemisphere.
- Building of support mechanisms to foster innovation in existing local companies, and to promote the creation of new companies oriented to knowledge based production.
- Conduct a workshop with all of the countries of the Hemisphere during 2005 to address how to effectively implement these proposed actions.

Conclusions

The Engineer of the Americas concept is tuned with present necessities of the Western Hemisphere. 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 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. The present concept of engineer basically aims to generate a local workforce condition that is attractive to the establishment of high tech industry, a fact considered not only as a very important vector for local development, but also as a clear positive movement towards an overall growth on the competitiveness of Latin America and the Caribbean, 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 of 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.

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 Western Hemisphere competitiveness.

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