International Profile of a Global Engineer

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Abstract — A lot has been written, discussed, and argued about what the ideal profile of a global engineer looks like. The author's experiences reflect that the way to educate the new generation(s) of professional engineers is to develop their international profile in what we call a Natural EcoSystem™. The global engineer must be aware of, and be versed in, what it takes to create, operate under and operate inside a Natural EcoSystem™; that is, gain an understanding of how markets, capital, services, intellectual property, R&D, education, policies, venture funds and nonprofits, industry and utilities, academia, small businesses and startups, government and state entities, social responsibility, and international collaboration fit together. All these pieces of a Natural EcoSystem™ are needed for sustained growth. This is extremely important so that the growing gap between engineers in developed and developing nations can be minimized, at least, in the quality of education and innovation.

Keywords: internationalization, innovation, diversity, accreditation, quality, ecosystems, complex systems.

I. Introduction

The world-renowned universities educate their students with a global perspective. Many of these universities, especially in the USA, have large endowments that enable them to attract the best talent from the world and to invest in the creation of new R&D centers of excellence and other conventional efforts. In addition, they invest in stock markets or other investment vehicles to grow and sustain their endowment, including the interesting concept (mostly concentrated in US) of alumni donations to their alma mater. These universities have an international reputation in education, attract world renown faculty and researchers, attract the most competitive undergraduate students in the international market, recruit top international graduates and postdocs, and they offer a variety of mobility opportunities with operations in foreign countries - all based on their ability to obtain resources.

For academia in the rest of the world, a new "quality" educational and research model must be created that fosters open and flexible curricula, fosters living with diversity, and encourages intercultural activities to graduate global professional engineers - just in the hopes to minimize the growing gap between developed and developing nations. All stakeholders must be aware and understand the importance of the different parts that form a Natural EcoSystem™.

Another question is "how to create a wave" with an exponential growth of a technology, and dealing with (and solving) complex systems and problems? The authors believe that faculty must be in the vanguard of knowledge changes (incremental or big), in pedagogy, technology, innovation, transparency, ethics, and possess global business acumen. It is important to realize that the "global profile" of the engineer must occur in the local classrooms as a common space where learning, teaching and research opportunities are available. To start a wave or a create a Natural EcoSystem™, quality research is paramount, along with fostering creativity, experimentation, local and international collaboration, multi-lingual and cultural spaces (on-line, in-class, hybrid). That is, an open-minded space where diversity is highly respected, and ethics is valued by faculty, staff, administrators and students. For all of this to exist, the concept of internationalization in higher education must change and break away from the old models locked in student exchanges, learning of a second language, agreements between institutions, international and external accreditations to take a step forward to horizontal internationalization, and a comprehensive, innovative and disruptive methodologies. This new global engineer profile needs to be measured by looking at ***impacts*** in education, innovation, intellectual property creation, quality of research and papers, social responsibility, and job creation and not just quantity. Independent of any of the international rankings presently used, if any academic institution wants to be part of a ranking, the number one issue to prioritize is "quality of research".

II. A Natural EcoSystem™ for the Internationalization in Higher Education

What is required in a Natural EcoSystem™? The global engineer must be aware of, and be versed in, what it takes to create,

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operate under and operate inside a Natural EcoSystem™, that is, gain an understanding of how markets, capital, services, intellectual property, R&D, education, policies, venture funds and nonprofits, industry and utilities, academia, small businesses and startups, government and state entities, social responsibility, and international collaboration fit together. All these pieces form a Natural EcoSystem™ that is needed for sustained growth. Figure 1 depicts a Natural EcoSystem™.

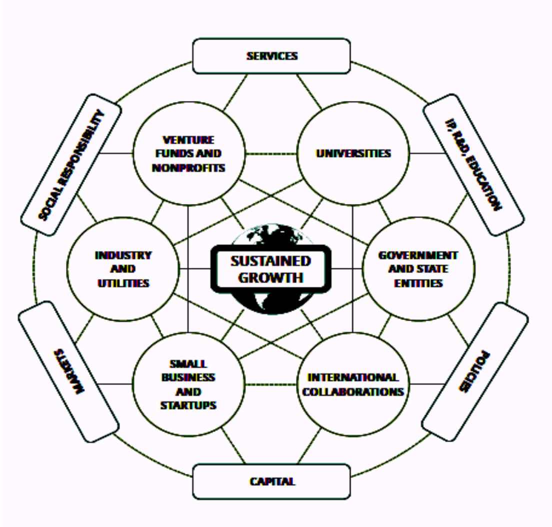

Figure 1. Natural EcoSystem™.

A. Why is Important to Develop a Natural EcoSystem™: Challenges and Opportunities

Let's first identify the many opportunities and challenges that Globalization or Globalism has brought. Students are entering a new era whereby there are two opposing factions: those who favor globalization and those that will fall into protectionism. For developing countries Globalization is a fact and several challenges need to be addressed. Some of those challenges are: 1) Internationalization; 2) Social responsibility; 3) Energy; 4) Culture; 5) Mobility (students, staff, faculty, businesses); 6) Culture of quality; 7) Religion; 8) Ethnicity; 9) Food security; 10) Climate change; 11) Sustainability; 12) Corruption; 13) Connectivity; and lastly 14) Diversity in a very ample context.

Let's look at the opportunities. All developing nations have seen several "revolutions or waves" in the past and not capitalized on the opportunity. Some examples are: 1) Industrial revolution (steam, electricity); 2) Personal computer; 3) Internet; 4) Telecommunications; 5) Biotechnology.

There are new revolutions and waves forming in the horizon, some of them are: 1) Food security; 2) Smart cities; 3) Internet of Everything (4th Industrial revolution – computing, communications, sensors, big data, data analytics, innovative business models; 4) Climate change and water; and 5) Healthcare. The question then is "Can Developing Nations Create or Ride a Wave?"

The authors have seen throughout the developing world a market situation that can be summarized as follows. Entrepreneurial teams in emerging economies face many challenges to the advancement of their businesses. Some of the known challenges are: (Jordan, R., 2016b)

- Lack of Innovation and Technology, due to
  - Lack of advanced technological entrepreneurial culture
  - Limited or no entrepreneurial education
- Lack of Capital Resources, due to
  - Lack of internationalization
  - Limited or no regional venture capital and credit systems
  - Limited seasoned entrepreneur and risk capital networking opportunities
- Lack of Policies, due to
  - Weak IP protection system
  - Lack of policies to promote entrepreneurship and R&D funding

Another issue that is encountered is Collaboration Challenges, because academia especially reacts adversely to change. The authors have developed an equation that summarizes (1):

$$\underline{\textbf{Collaboration} \propto \mathbf{T * 1/d^n}} \qquad (1)$$

- T = tropicalization = each country/region is different, **d** = distance, **n** = bureaucracy

This states that functional collaborations are proportional to tropicalization (which we define as the "way we do things"), while being inversely proportional to distance between collaborators to the nth power of bureaucracy. Clearly the closer in distance you are, and with bureaucracy being such a strong influence, it may be more beneficial to collaborate with a team a continent away (Jordan, R., 2016b).

Another challenge encountered is in Synergy Challenges. That is, innovative/creative leaders cannot pass execution because of bureaucracy. To start a company and protect its IP can be a daunting task in different parts of the world. Different places need to deal with the lack of transparency, lack of efficiency, lack of effectiveness, lack of professionalism, lack of knowledge, lack of trust, must deal with KNOW-WHO vs. KNOW-HOW, and corruption.

In most academic institutions, there is also a lack of feedback, which we refer to as a continuum feedback loop below in Figure 2, which is where a lot of opportunities exist. The complete loop is as follows: students are educated and taught to innovate. Then they innovate. Generally, whatever they develop causes damage, and then they are called to repair it. Presently, in most academic institutions the loop from repair to educate is not closed, which is not something economists like to deal with. Clear examples from this feedback loop are the combustion engine (pollution). Combustion engine revolutionized transportation (educate and innovate). However, it created so much pollution that created significant healthcare expenses (damage). Students were called on the repair and various technologies were now developed (biofuels, catalytic converters, electric vehicles, etc). However, there is no closed loop review of the unintended consequences of the innovation. Other examples are data centers for IT (extraordinary energy consumption) and the cellphones (excessive waste in landfills).

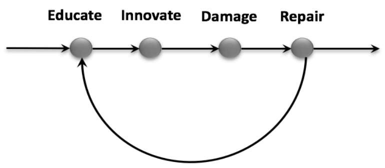

Figure 2. Continuum Feedback Loop.

Lastly, the challenge is defining a Return on Investment (ROI) for higher education. This is the indicator that differentiates universities. The authors believe this is applicable worldwide and is depicted in Figure 3. Whether we encounter a private or a public institution with high quality rankings, the admissions process for students is made extremely challenging. Around the world, we encounter the best public universities that have entrance examinations where only students that score above 95% (in some cases) get admitted. In developing nations, since these students usually come from private high schools, there is an inherent economic bias, where wealthy individuals are receiving a "free" education because governments subsidize most public universities. In this situation, top students from public high schools must go to private universities to get an equivalent education. Top ranked universities, whether public or private, admit students that are brilliant and educate them to be exceptional. However, in the US, most state "funded" institutions must admit students that are below the basic knowledge and skill sets and provide remedial courses to turn a below average student into an exceptional professional. Clearly the ROI is a lot higher for these types of institutions. Only these two models of higher education institutions are mentioned, there are many more around the world.

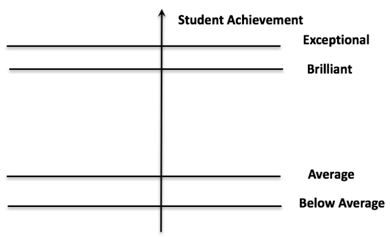

Figure3. ROI in Academia

Having presented the challenges and opportunities, and for developing nations to close the gap, they should invest and develop their own Natural EcoSystem™ to be globally competitive. International partners are extremely important and can bring the quality of education and research needed. As was mentioned above, the single most important item to prioritize, and be ranked in, is "quality of research". This implies that to have impact, students, staff, authorities and faculty must grasp the importance and the interrelationships of the components of a Natural EcoSystem™ system. The global engineer must be aware of what it takes to create and operate in a Natural EcoSystem™. It is about working in a trans-disciplinary and international environment, it is about creating a wave, having global impact, raising the quality of life and taking care of the planet.

Natural EcoSystem™ is not referring to clusters that are common in the US, like Silicon Valley, Silicon Beach, Silicon Hills, Silicon Slopes, Boston Corridor, and other similar locations where there is a single focus, and the economies depend on these single-minded innovations. The experience of the authors addresses new opportunities where a Natural EcoSystem™ arises due to the necessity to solve complex problems like air quality, water contamination, healthcare, food security, personal security - in short complex problems that touch every person worldwide.

Academic institutions must have a leading role in creating and sustaining a Natural EcoSystem™ and in the trans-disciplinary education of global engineers.

III. International Universities and A global profile of the engineer

Academic internationalization has been traditionally defined as an inclusive process of internationalization in teaching, R&D and extension processes to form professionals capable of working in a global environment. This was conceived as a response to Globalization. Academia is an international entity, or an entity that promotes internationalization, as is defined in the original model of academia in the Middle Ages in Europe. This model was conceived from its inception as an international institution whose mission was the fostering and creation of universal knowledge. (Gacel - Ávila, 2003, pg. 62).

Presently, as defined by the International Association of Universities (IAU), internationalization of academia is a transversal process, it is strategic, it is tactic, and comprehensive with an objective to contribute to the "education" of its students to achieve a long-term goal of a more peaceful world. This can be achieved by solving relevant international problems that affects us all. It depends on international cooperation for the solution of complex problems that touch the quality of life of citizens, and must provide sustainable economic, social, and cultural development. Researchers can rely on evaluation models for internationalization of academic institutions to establish what is an international academic institution or what it should be.

The Project Indicators for Mapping & Profiling Internationalization (IMPI), is probably the most recent revision of experiences worldwide on measuring internationalization of higher education institutions. As an outcome of this effort, a toolbox was developed with close to

500 indicators (qualitative and quantitative) that enables us to compare Higher Education institutions in internationalization. Among the many compiled models, it is worth mentioning four: 1) the International Quality Review Process (IQRP) model designed by the OECD in 1999; 2) the model proposed by the Center for Higher Education (CHE) of Germany in 2007; 3) the model proposed by the Center for Studies of Higher Education (CSHE) of Japan in 2005; 4) the model proposed by Red Colombiana para la Internacionalización de la Educación Superior (RCI) and the Colombian Universities Association (ASCUN) in 2004. According to this effort, it can be deduced that an academic institution is international if the institution has well established institutional policies on internationalization, offers programs of study with international curricula, has mobility programs for students and faculty, has a campus that supports internationalization, and a support infrastructure that facilitates international relations and cooperation programs. None of the above proposals links internationalization in a Natural Ecosystem.

Bothwell, E. (2017) performed an interesting analysis of the more international universities. These institutions have strong metrics in the following factors and are reflected in their rankings: international staff, students, co-authors, quality of research, and a measure of universities' international reputations. Two Swiss universities lead this list followed by universities from Asia. "The US is less prominent in this ranking than it usually is in international league tables, possibly reflecting the fact that its size makes it less reliant on immigration to supply it with top student and academic talent." Interestingly, there are no Latin American universities in the world ranking of the 150 or more international universities.

International universities educate global professionals. Researchers of higher education internationalization and of curricula, academic associations by schools or departments, multilateral organizations, innovators in pedagogy and curricula, all continue to propose international profiles for the future professionals. There are many proposals for a general profile as well as for specific profiles like Engineering. The proposals by Rajala, 2012; Watson & Cook (no date); the National Academy of Engineering, 2004; the Canadian Engineering Accreditation Board, state the necessity to educate in the specific discipline but they must also be open to other skill sets. "While strong technical skills will continue to provide the foundation for all engineering disciplines, engineering graduates will need to demonstrate effective communication, creativity, entrepreneurial thinking, teamwork, and understand business in global context". (Rajala, 2012, p 1377)

Discipline Training: Master of Sciences that are fundamental for Engineering like skills to integrate engineering with other disciplines like medicine, art, philosophy, economics. Knowledge of new scientific disciplines like biology, computational social science, climate change, knowledge of complex systems, global markets, international entrepreneurial activities, international cooperation and R&D are all needed in next generation Global Engineers.

Intercultural Competences: Respect ("valuing of others", self-awareness/identity ("understanding the lens through which we each view the world"), seeing from other perspectives/world views ("both how these perspectives are similar and different"), listening ("engaging in authentic intercultural dialogue"), adaptation ("being able to shift temporarily into another perspective"), relationship building (forging lasting cross-cultural personal bonds), cultural humility ("combines respect with self- awareness") are also important (UNESCO, 2013, p 24). These can be included in a global topic of emotional intelligence.

Applied Knowledge: capacity to innovate, create and invent from interdisciplinary knowledge, understand global business or social entrepreneurship to establish global enterprises that are social responsible and sustainable and strategic thinking in changing environments play key roles.

Soft Skills: teamwork, adapt to change, attentive and listener, life-long learning, self-knowledge and self-monitoring, assertive communication, problem solving, tolerance to high pressure situations, active listener, capacity for reflection are also needed. (Yamazaki, Y., & Kayes, D. C. 2004).

Values: alterity, openness, authenticity, civility, flexibility, empathy, respect, responsibility, compassion, sociability are the cornerstone needed to build the next generation global engineer.

At the end of the day, we must teach the next generation engineer to "think globally" but "act locally," while acquiring the wisdom to differentiate the two.

The "global profile" of the engineer must occur in the local classrooms as a common space where learning, teaching and research opportunities are available, and in the context of universities been part of an international Natural EcoSystem™. The academic ecosystems for internationalization must have organizational cultures that are flexible and open, where inter-cultural values are accepted where innovation and creativity is fostered. Academic institutions must have faculty with an international profile, that is, people with a global vision and sensitivity to other cultures that are citizens of the world, have the skills to propose global solutions and who can perform in different contexts. These institutions offer international curricula that are open and flexible where students can design their own program of studies, and who have moved beyond the myth that student mobility as internationalization and will prepare them to be global professionals. (Aponte, Botero, Aristizábal, Arroyave, Cuevas & Muñoz, 2014).

The gaps in the formation of global professionals will continue to widen if the internationalization processes are being isolated activities and not as a part of an international network. The same will be true if a Natural EcoSystem™ is kept local. Furthermore, the concepts of a Natural EcoSystem™ must be disseminated in the classroom.

IV. Case Study

It is possible to foster a Natural EcoSystem™ that is capable of influencing developments in engineering disciplines to educate global engineers. An example is the experience of the Ibero-American Science and Technology Education Consortium (ISTEC).

Let us address where all this happened. Created in 1990, ISTEC is a multinational U.S. 501c3 (Jordan, R, 2016) non-profit organization comprised of educational, research, industrial, and multilateral organizations throughout the Americas and the Iberian Peninsula. ISTEC is the outcome of an Engineering Education research effort sponsored by Motorola, Inc. The key question in 1990 was whether Science and Technology was part (or should be included) of the economic and social developing plan for the countries in Ibero-America.

ISTEC, in its 27 years of experience in Ibero-America operated under four Initiatives, one of which is Los Libertadores. (Jordan, R., 2015) The Los Libertadores initiative was created to foster innovation, creativity and entrepreneurship. To improve international collaborations in Science and Technology and to use the language of science to facilitate collaboration. In mid 1990 personnel from the University of New Mexico visited countries in Latin America to identify and evaluate opportunities for successful collaboration in science, technology and education. Meetings were held with officials from various governments, educational institutions, research facilities, and industrial firms to gauge interest in establishing efforts for international cooperation in technical fields. The meetings resulted in the identification of areas of common interest for employing hands-on education, research, and technology transfer in state-of-the-art technology and science. Because of these visits, an organizational meeting was held in December of 1990, at the University of New Mexico, involving personnel from universities, industries, governments, and foundations throughout Ibero-America. These discussions, which resulted in the creation of the Ibero-American Science and Technology Education Consortium (ISTEC), identified several obstacles that need to be addressed immediately:

- Lack of current information for planning and developing technology
- Lack of expertise in the use of information
- Lack of international cooperation in developing the critical mass needed for projects and joint efforts
- Lack of interaction and confidence among universities, industries, governments, and multilateral agencies
- Lack of the availability of technology
- Lack of entrepreneurship to bring technology and intellectual property to the marketplace

The above difficulties are aggravated by the lack of awareness of the simultaneous existence and interaction of the above obstacles. It was imperative that efforts be made to address these issues concurrently to further the scientific and technological development of Ibero-America. It was the consensus among the participants in the meeting that traditional mechanisms for cooperation are not sufficient, and new, more effective mechanisms are needed. Interesting to observe that the issues identified in 1990 are still applicable today.

Founded in 1990, ISTEC has served as a catalyst to promote strategic alliances between Academia, Industry, and Government to incite social, cultural, political and economic development. Here are some statistics about the work that ISTEC has done in the last 26 years:

i) Collaboration: in 18 years of collaboration with the OAS over 500 scientist and engineers trained in the areas of Digital and Image Processing; over 500 software laboratories implemented using KHOROS; developed prototype of the Educational Portal of the OAS.
ii) Co-creation: Participated in the creation of the Center de Excellence in Digital Content at the Universidad de Monterrey; in 2000 participated with Motorola in the creation of CEITEC (Center of Excellence for Semiconductor Industry): Porto Alegre, Brazil (http://www.ceitecmicrossistemas.org.br/portal/home.php); partner in the creation of an Economic Development center "La Plazita" in the South Valley of Albuquerque (Jordan, R., 2016a)
iii) Creations: Scientific Publications: Journal of Computer Science and Technology (http://journal.info.unlp.edu.ar/journal/) and Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología (http://teyet-revista.info.unlp.edu.ar/); over 15 training events per year.
iv) Strategic alliances: over 100 active university members in the IEEE Latin American and Iberian Peninsula Regions; with multilateral organizations and professional societies such as: Organization of Americas States – Engineering for the Americas (OAS-EftA), American Society for Engineering Education (ASEE), Institute of Electrical and Electronics Engineers (IEEE), International Federation of Engineering Education (IFEES), Banco de Desarrollo de América Latina (CAF), Interamerican Development Bank (IADB), United Nations Educational, Scientific and Cultural Organization (UNESCO), Latin American Technological Information Network (RITLA); 10 IT Challenge forums to create awareness, analyze existing ICT models and develop an ICT regional agenda;
v) Memberships: Member of the Advisory Board of Engineering for the Americas (EftA). The EftA is an Initiative at the level of all Heads of State of the Region that proposes a change of paradigm, wherein engineering provides a basis for broad, sustainable improvements throughout the Americas. Engineers, whose degrees are based on international standards of quality, are critical to provide an essential skilled workforce to compete with Asia, India, and the European Union. By seeking to improve engineering education and apply quality assurance, mobility of both work and workflow can open

new doors, drive organic creativity, create jobs and foster economic and social growth. EftA has three primary objectives:

- Improve the quality of engineering education
- Foster mechanisms for regional accreditation of engineering degrees
- Stimulate job creation through better linkages between universities and industry

vi) Culture of Quality/Innovation: the GRANA software platform was designed to offer academic institutions an opportunity to develop a strategic plan leading them to an international accreditation of academic programs. The platform also has content to train individuals in becoming evaluators. CISCO Systems "Growing with Technology Award 2004" was given to ISTEC in recognizing Innovative Companies that Are Networked for Growth.

vii) Partnerships: Global Innovation Network for Entrepreneurship and Technology (GINET LLC); Corcel/Steed Ventures LLC (Partner and founder); Gridline Communications Holdings, Inc.; more than 15 corporate partners actively collaborating with academia; Founding member of International Federation of Engineering Education Societies IFEES, 2006-Present.

viii) Infrastructure: installed the first Cray Research Supercomputer in Latin America at UNAM; developed regional information networks in Brazil, Bolivia, Colombia, Mexico, Ecuador, Venezuela, and Argentina; developed hands-on laboratory manual in Software Design Radios (5G) in partnership with National Instruments; first IEEE ComSoc hands-on manual; working with Quanser in developing APPS for experiential learning and R&D using the QDEX environment.

ix) Advising: helped developed the new S&T legislature of Brazil. Advised United Nations Latin America ambassadors in S&T. Innovation plans?

x) Knowledge Sharing/Laboratories: Over 70 academic libraries sharing information in real time within the ISTEC Digital Library Linkage Initiative; On average 15,000 documents are transferred annually within the DLL network, with an annual average savings of $150,000 for the region; over 172 R&D labs in 17 countries (mostly in digital signal processing, microcontrollers, and embedded systems); More than 600,000 students have been trained in the past 10 years: More than 3000 engineering equipment donations; over $5 million on equipment donations from Motorola, Hewlett Packard, Nortel Networks, Microsoft, Sun Microsystems, National Instruments, Xilinx, and Intel.

In particular at the University of New Mexico, Electrical and Computer Engineering Department (UNM-ECE), in 2011, created and equipped The Innovation-Plaza (Corporate sponsors Quanser & National Instruments). The Innovation-Plaza helps bridge the gap connecting Math, Physics and Chemistry to Engineering at a very early stage by linking theory to real world experience. The Innovation-Plaza realizes the creativity and innovation of students, improves retention and graduation rates and fosters entrepreneurship. Through the Innovation-Plaza, thee undergraduate teams have won annual UNM Business Plan Competitions and some student projects have been integrated in commercial products. The intent is to follow the model of the microprocessor and Khoros labs and deploy and connect these labs throughout Ibero-America. (UNM-ISTEC).

The idea was to create a program that integrates enhanced curricula and educational outreach with an open, globally connected, interdisciplinary lab for hands-on experiential learning and interdisciplinary collaboration – an Innovation-Plaza, Figure 4. Through the Innovation-Plaza, students from high school and university undergraduate and graduate programs have the opportunity to actively interact and collaborate with industry and research institutions, and ultimately produce world-class, functioning projects as part their Senior Design course. The Innovation-Plaza trains students to become proficient using the tools currently employed in industry and research, and facilitates long-distance and off-site local and global collaboration with connected satellite laboratories.

Figure 4. Innovation Plaza

The current approach consists of integrating information from several classes into a "big" picture that ties ideas to real world outcomes. Fostering the ability to acquire new knowledge through careful experimental design and analysis. Encouraging leadership, entrepreneurial, and coordination skills needed to collaborate, innovate and be successful in a global work environment – act locally, think globally. All of these concepts form part of the Natural EcoSystem™. UNM-ECE are currently working on enhancing this concept in another concept called the WHY lab. The UNM-ECE WHY lab is the place where Freshman students come to grips with their new engineering reality. WHY stand for WHAT do Engineers do? HOW the heck do you do that? and WHY am I taking this course?

V. Reflections

- A Natural EcoSystem™ is a complex system that is necessary to create an optimal environment for the formation of global engineers. The knowledge of a Natural EcoSystem™ must be taught in the classroom. Are academic institutions creating Natural EcoSystem™ environments and teaching their students to live in them, building competences for them to be part of these complex systems?
- Academic institutions that understand that internationalization is a transversal process; it is strategic and disruptive and having the capacity to become part of or the creation of a Natural EcoSystem™, and that they can create waves and form global professionals. Which universities have achieved creating a transversal internationalization process, that is strategic and disruptive, that can quickly create or accept a wave and form professionals for the future?
- Engineering is key for socio-economic development. Educational systems and academia have the responsibility to foster the education of engineers, increase recruitment and retention, and deliver to society global engineers that can work in challenging global problems. What strategies are educational systems and academia implementing to address their responsibility with society?
- A global engineer is a professional who has a balanced profile with a deep knowledge in the basic sciences, can integrate multiple disciplines is his/her work and in R&D, has developed intercultural competences, and can apply his/her knowledge in problems that affect humanity. Are schools of engineering forming global professionals with these characteristics?

What we have outlined here is a new formulation for the education of the next generation global engineer. The formulation is seeded in collaboration, both locally in a Natural EcoSystem™ and globally (internationalization) and in the broad versatility of the new global engineer. The task is not simple, nor is there a pre-determined user's manual. What is needed, however, is the ability to educate solution driven students who can engineer solutions to extremely complex problems with the goal of engineering peace (i.e. Peace Engineering). **Peace Engineering** is a trans-disciplinary program that emphasizes innovation and creativity, while stressing the importance of the application of science to solving practical problems that will contribute to social justice and sustainable social, economic, and environmental solutions. In addition to mathematics and the hard sciences, Peace Engineering encompasses the fields of Financial Engineering, Social Engineering, Cultural Engineering and Infrastructure Engineering (Physical, Technological), among others.

By focusing the development on key best practices, measuring the outcomes and focusing on impact, the world can be made into a better place, through the language of science and technology.

VI. Acknowledgements

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VII. References

Aponte, C., Botero, L. H., Aristizábal, M., Arroyave, J. J., Cuevas, M. P., & Muñoz, S. (2014). Currículo internacional: dimensiones para la formación del estudiante. Colombia: Ediciones Universidad de Medellín.

Bothwell, E. (2017). The World's Most International Universities 2017. https://www.timeshighereducation.com/features/worlds-most-international-universities-2017.

Gácel-Ávila, J. (2003). La internacionalización de la educación superior, paradigma para la ciudadanía global. Guadalajara, México: Universidad de Guadalajara.

Jordan, R. (2015, November). ¿What is the Ibero American Science and Technology Education Consortium- ISTEC?. Políticas Públicas y Carreras de Ingeniería. Lecture conducted from XXXVII Reunión Comité Ejecutivo ASIBEI Ushuaia, Argentina.

Jordan, R. (2016a, March). Innovation Plaza: Experiences and best practices in sharing hand-on education materials globally. Global Engineering Education. Lecture conducted from XXXVII Sixth International Conference on Industrial Engineering and Operations Management (IEOM), Kuala Lumpur, Malaysia.

Jordan, R. (2016b, October). Experiencias innovadoras en Facultades de Ingeniería. Innovación en Facultades de Ingeniería. Lecture conducted from Global Engineering Deans GEDC-LATAM, Cartagena, Colombia.

Jordan, R. (2016c, November). The Global University to the challenges of local development: the role of internationalization of higher education. Hacia una política de internacionalización de la educación superior de impacto: vinculación global, calidad, pertinencia y competitividad. Lecture conducted from 8th Latin American and Caribbean Higher Education Conference- LACHEC, Bogotá, Colombia.

National Academy of Engineering. (2004). 4 Attributes of Engineers in 2020. The Engineer of 2020: Visions of Engineering in the New Century. Washington, DC: The National Academies Press. doi: 10.17226/10999.

Observatorio Colombiano de Ciencia y Tecnología. (2014). Reflexiones para una Política de Internacionalización de Educación Superior en Colombia. Bogotá.

Rajala, S. (2012). Beyond 2020: preparing engineers for the future. IEEE, vol 100. Pp 1376- 1383.

United Nations Educational, Scientific and Cultural Organization- UNESCO. (2013). Intercultural Competences. France.

Watson, A; Cook, A. (sf). Engineering skills for the future. Retrieved March 27, 2017. http://semta.org.uk

Yamazaki, Y., & Kayes, D. C. (2004). An experiential approach to cross-cultural learning: a review and integration of competencies for successful expatriate adaptation. Academy of Management Learning & Education, Vol. 3, No. 4, 362–379.