The Anglo-Saxon Model for Engineering Education: A Feasible Alternative for Colombia?

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Abstract

The Bologna Declaration on the creation of the European Higher Education Area in 2010 has given rise, in that continent, to a process that favors the convergence of various educational systems in order to achieve greater transparency and compatibility for study programs and degrees. This process has certainly had a large repercussion worldwide.

The European Community’s adoption of a higher education system essentially based on two main cycles — undergraduate and graduate — strengthens the widespread tendency towards the Anglo-Saxon educational model (BSc (4 years) / MSc system), particularly in the case of higher education programs in Engineering. Even though in Colombia we also have an undergraduate-graduate system, the problem lies in the length and scope of study programs in the undergraduate cycle. In the field of Engineering, majors last 5 years, which is enough time for students to be granted the professional license required to practice their profession.

This alternative should be analyzed in order to identify the positive and negative aspects of the model, and to make the most convenient decision based on the analysis of intervening factors and on the evaluation of the repercussions and social impact that an eventual change in the Colombian model might have. Any proposal for curriculum changes in Engineering programs should be inspired by basic agreements on which kind of engineers should be educated in universities, and the competences they should have as professionals, always acknowledging differences between engineering disciplines. The analysis should not only include worldwide trends in a context characterized by globalization, competitiveness, quality assurance, and mobility of students and professionals; it should also take into account the articulation of the higher education system within the general Colombian educational system, graduates’ performance on the job, the reality of the national productive sector, financial opportunities and students’ equal access to graduate programs, as well as the relationship between formal university education and technical and technological education.

Greater efficiency in the time required to educate engineers should be the result of a series of strategies and adjustments in terms of pedagogy, evaluation and learning, flexible curricula,
optimization of academic periods, and the application of ICTs. All this without risking the quality of engineers’ education that should be assured in engineering schools.

By virtue of the similarities of the region’s conditions, this analysis is relevant for all countries in Latin America.

Introduction

The World Conference on Higher Education (WCHE) organized by UNESCO in October 1998, remains to date the largest international gathering devoted to discuss the place, role and function of higher learning and research in modern societies. The final document it adopted, namely the World Declaration on Higher Education for the Twenty-first Century: Vision and Action and the Framework for Priority Action for Change and Development of Higher Education, outlined a conceptual frame and the line of action towards renewal and reform in higher education, based on commonly agreed upon principles regarding the broadening of access and securing the development of higher education as a key factor of development, as a public good and as a human right; promoting renewal and reform of systems and institutions with a view to enhance quality, relevance and efficiency through closer links to society, notably to the world of work; securing adequate resources and funding; fostering international cooperation and partnerships.

Five years after the event, UNESCO made a Synthesis Report on Trends and Developments in Higher Education since the WCHE. The report has served as input for discussions at the Meeting of Higher Education Partners that took place in Paris, between the 23rd and the 25th of June, 2003. Economic, political and social changes continue to present major challenges to higher education everywhere. Current concerns are dominated by the search to secure adequate funding and other resources to facilitate expansion in response to increased pressure for more and better higher education. This goes hand in hand with the seeking ways to solve the quantity/quality dilemma, to cope with increased responsibilities of higher education in knowledge-based society, to make full use of ICTs, which are at present a major driving force of change in higher education.

At the present time, a number of major developments and trends at the world level can be identified from a UNESCO perspective, some which have a direct influence on higher education and sets direction and pace of change. These are: the impact of globalization on higher education; new roles of higher education and research in the knowledge society and its vital role in bridging the knowledge gap; the impact of ICTS on higher education; the evolving relationship between higher education, the State and the market; and the world demographic trends and their impact on higher education.

In response to all the tendencies and developments listed above, higher education all over the world is undergoing a series of diverse changes, not only regionally but nationally. These changes vary in rate and scope according to specific circumstances. The most important changes are:

- Meeting the demand for increased access to higher education
- Funding higher education
In recent times, the way that universities, and therefore higher education in general, has become a part of an increasingly globalized world, has changed. In this new scenario it is possible to single out the processes that tend towards the internationalization of higher learning. The constant and growing amount of exchanges amongst researchers and scholars, the many joint projects undertaken by international groups and the mobility, real and virtual, that undergraduate and graduate students have are just some of these processes, as are the bi and multilateral free trade agreements that countries have signed over the years, particularly the General Agreement on Trade in Services (GATS). The GATS establish a set of legally viable rules, designed to provide more freedom to international commerce and include education a tradable service. Trade in transnational higher education is currently not only an issue of heated debate, but also a matter of concern for many governments, for institutions of higher education and for the academic community in general. Trade in higher education is a reality. However, there is a general consensus that higher education cannot be traded just like any other good.

From UNESCO perspective, the increasing international dimension of higher education and the on-going major reforms regarding innovative approaches to content, practices and methods in higher education, stress the trend towards a future World Higher Education and Research Area.

Many events confirm de rapid onset of the internationalization and globalization of higher education, such as the Declaration of Bologna and the Creation of the European Area for Higher Education in 2010, preliminary talks for creating a similar Area for European-Latin American Higher Education, the addition in 2003 of Germany, Malaysia and Singapore as new – provisional- members of the Washington Accord, and in November of 2002 the signing of the Memorandum of Understanding by the organizations in charge of accrediting Engineering in the three NAFTA countries: Canada, United States and Mexico.

Innovative approaches to the internal functioning of higher education are implemented through two independent processes: curriculum reform and the use of ICT. Regarding the first, common core structures of study programs, modularization and the adoption of the credit system, are emerging as the most important tools to achieve that goal. Besides, these tools have several potential benefits in terms of mobility of students, flexibility of higher education programs, and international recognition of studies and qualifications.
Models for the Training of Engineers

Before analyzing the alternative of the Anglo-Saxon model for the training of our engineers, it is convenient to make a brief overview through history of the different schools for the training of engineers around the world in order to identify the model we have adopted for engineering education in Latin America. The four models are:

- The Humboldt style university
- The Napoleonic university
- The great Polytechnic institutes
- The North American School

The Humboldt style university distinguished itself for being rigorously scientific, academic and thoroughly committed to the advancement of science. The pillars upon which Humboldt based the structure of his model were Investigation and Teaching, and with them he intended to replace the medieval university. This model is the epitome of the classic humanities and spiritual sciences university, where the main goal was pure and abstract investigation and the training of human resources to that end. Its mission is to train investigators, using teaching methods to create spaces for analyzing and reflecting upon the mankind’s broadest issues, the great problems of culture and human existence.

The French Napoleonic University of 1806 had a clear objective of obtaining professional quality by way of a high intellectual level. This model substituted the universities France had at the time, which were then based mainly on theology. The so called “grands écoles” –the basis of some of the most prestigious engineering schools in that country- were prior to the Napoleonic university and found trouble once the Napoleon Law set in, to which they had to adapt.

It is interesting to point out that English universities appeared after the first French universities did. Oxford and Cambridge arose from students who parted from the University of Paris while Oxford adopted some of the trademark characteristics of the University of Bologna, in Italy. The Napoleonic model is the symbol of a University at the State’s service, concerned with transmitting knowledge in order to provide high-level human resources. Applied investigation is practiced with a strong scientific content.

The great German, Italian and Central European Polytechnic institutes were the continuation of the early crafts schools. Primitive European universities did not train engineers. Polytechnic Institutes were motivated by concrete labour. Today, these institutes in many cases compete with classic universities in their countries in the training of engineers, although each has their own style. There are many models, but all show a heavy influence of the German “Hochschule” and “Fachhochschule”. Study methods in the polytechnic institutes are usually mixed; the student must complement formal academic studies with real life work experience as a trainee or intern in a company or industry of some sort in order to complete his or her training. This model symbolizes the pure engineering school, characterized by a close knit and solid relationship with
the professional working world. Its investigation systems differ from those of classic universities as they focus on finding solutions to concrete problems.

The North American school for the training of engineers works within universities and technology institutes; it is characterized by three level academic grades, a procedure based on credit acknowledged studies, great curricular flexibility and strong incentives for basic and applied investigation. In this model, the productive sector takes on an important role in the engineer training process. There is also a great deal of support from the government and the industrial sector given to the universities to strengthen investigation, development and innovation around the country.

**Model for the Training of Engineers in Latin America**

For over a century we, in Latin America, have taken the Napoleonic University as the model for engineering majors. In most South American countries engineering studies generally take five years to obtain the degree. Engineering schools are part of universities in which the German Humboldt influence has consolidated over the years. In courses for engineering major, the scientific rigor of the Napoleonic tradition has proven to produce engineers with solid knowledge. The particular situation of Latin American countries requires engineers that quickly join the workforce, which is why the universities there have much likeness to the great European polytechnic institutes.

**The Bologna Declaration and its impact on the models for engineer training**

The Bologna Declaration in 1999 is in fact an actual strategic plan for achieving the integration of all the higher education systems in the European Union by the end of the year 2010. That’s what has been called the European Higher Education Area. Its goal is to coordinate the diverse higher education systems that function in the different member countries so that they work in sync while respecting the cultural diversity and autonomy of each university. This model favours not only a common credit system that allows an easy homologation that promotes mobility amongst undergraduate and graduate students, but the proposed system converges towards the Anglo-Saxon model, where the titles are denominated Bachelor, Master, and Doctoral degree.

Due to its possibly global impact, the convenience of adopting a similar model for the training of engineers in Latin America has been greatly debated. In the continent in general and Colombia in particular we also have undergraduate and graduate programs, but the trouble is that the duration and scope of the undergraduate programs does not match those of the Anglo model.

In no way has this presentation been intended to promote the simplistic adoption of North American standards for Latin American engineers without conducting a thorough analysis of each and every implication, positive and negative, that this alternative may bring. Cultural differences are themselves tough obstacle to over comes to begin with. The intention is to contribute with some reflections to the academic debate that must be had regarding this matter in order to make the most pertinent decision. Although the context of engineer training is similar in
other Latin American countries, the ponderings offered henceforth belong specifically to engineering majors in Colombia.

Is the Anglo-Saxon model a valid alternative for the training of engineers in Colombia?

So many diverse factors must be analyzed, taking into account the strategic repercussions and social impact that may come from a possible change. Any curricular modification proposal for engineering majors in Colombia should be based on fundamental agreements regarding the kind of engineer that we should be training in the universities and the skills he or she must have in order to have a good professional practice, while acknowledging the diversity that may exist amongst different engineering disciplines.

For the analysis to be complete it is necessary to not only consider international tendencies in the training of engineers in a context of globalization, competitiveness, quality assurance and mobility of students and professionals, but also the specific aspects of the country, such as how the higher education system fits into the national education system, the performance on the job of former alumni in regards to company type and size, financial possibilities and equal access for students to join post graduate programs and the comparative differences between training on a professional level in a university versus technical and technological training elsewhere.

In addition, it is necessary to evaluate the possibility of implementing pedagogical strategies, make adjustments in the teaching and evaluation areas, flexible curricular designs, a unified credit system, optimize academic study periods and using information and communication technologies (ICTs) within our own universities in order to be more efficient in terms of the time required for the training of engineers. Quality and efficiency are fundamental for any training process.

Globalization

In September of 1999, several universities of the United States and Europe sent their governments a message containing a proposal quite different form the one made by the World Trade Organization “to include higher education” amongst the twelve service sectors listed in the General Agreement on Trade in Services (GATS). In February 2002, during the Social Forum of Porto Alegre, the participants of what was called the session for “Science and Technology, an Instrument for Peace in the XXI century”, adopted a resolution and proposed a global pact that would ensure the consolidation of one of the principles approved by the WCHE organized by UNESCO in Paris in October of 1998 and the exclusion of higher education from the GATS. In April of 2002, again in the city of Porto Alegre, the presidents of the universities that participated in the III Latin American Summit of Presidents of State Universities discussed the subject and approved a declaration stating the same position.

The development of new technologies, particularly since 1995, had made the commercialization of higher education reach new heights. Some countries, like New Zealand and Australia, adopted an aggressive approach and the export levels for their higher education services have grown significantly. For the United States, this rubric of the economy represents a sizeable percentage. Many different international magazines and newspapers have advertisements that
announce the option of higher education that can be accessed by means of new technologies. Some journalists point to the dangerous possibility that traditional schools may disappear because of the Internet, while others discuss the internationalization and Americanization of the contents of some programs. The main concern is that the standardization of educational systems may overlook the cultural diversity of the countries and, therefore, be insensitive to their specific local or regional needs. The fact that the offer of transnational education has economic interests behind cannot be ignored.

The problem, undoubtedly, is a serious one. There are universities everywhere that are good and efficient, as opposed to others that are unable to guarantee a minimum training for their students. It is therefore necessary to reach international agreements for quality assurance, accreditation and recognition for programs and titles that reduce the risks generated by globalization and insure quality in the educational offer wherever it may come from. This has been proven in recent experiences in Mexico and Chile, both of which countries have bilateral agreements of free trade with the United States.

The idea of mutual recognition of national systems of quality assurance is important and essential. During the inaugural lesson he gave at the opening of the academic course for 2003/2004 for the Catalan university system in Spain, Marco Antonio R. Dias, former director of the UNESCO Division of Education and current international consultant for the United Nations University, warned that “… there lies at basis of all efforts of reflection upon the identification of what actions should be taken the fact that there cannot be higher education without quality, and that there is no quality without pertinence”\(^5\)

The internationalization process for higher education, as well as any change, is full of threatens but also offers many opportunities that can turn into advantages for the country. It is necessary to not exaggerate the impact of GATS. The commercialization of higher education had already been around for a long time, both inside and out of the commercial agreement arena. Nonetheless, it is also critical not to underestimate the potential implications of the GATS. Free trade is not a trade in absence of quality standards\(^6\).

From what has been explained above it is evident that, due to the rapid growth and expansion of higher education, it is urgent to establish world-renowned mechanisms for quality assurance in the sector\(^12\). The challenge is to seek the best way to maximize benefits and minimize the dangers of a global higher education system.

**European Higher Education Area 2010**

The process of building the European Higher Education Area by 2010 is slow but irreversible. During the European Ministers of Education Conference, held in Berlin last September, those responsible for higher education in 33 countries, committed to reaching concrete objectives by 2005, date of the next Ministers conference, to be held in Norway\(^3\). Those who signed the Bologna Declaration should introduce the European Credit Transfer System (ECTS) within the next two years in order to facilitate the recognition of titles and study periods, speed up the
establishment of two levels of study (graduate and postgraduate) and also further the process of quality assurance.

At the Berlin Conference, it was agreed to include doctorate degrees as the third level or cycle in the Bologna process so that the European universities would appeal more to researchers all over the world.\textsuperscript{13}

The convergence of higher education in Europe is now gaining way, even with all of its uncertainties and challenges, its difficulties and appeal, thanks to the crucial help of universities, academics and students that have joined in the struggle after the initial stage, during which decisions were made on a political level. In regards to creating two level structures (undergraduate and masters) to replace long term majors (five or six years), there are three problems arise when considering the title of the first cycle should be relevant for the labour market, that is, a useful title to have when actively searching for employment after graduation:

a) What is needed for this first cycle to offer training that will enhance job performance?

b) The main concern would be the possibility of lowering quality standards due to the reform requiring a reduction of the content levels.

c) How to clearly differentiate these new titles from the ones already being offered in technological or similar level programs?

Along with reforming the structures of existing titles, the content of study programs must also be pondered. A curricular reform per discipline is therefore irreversible. In this context, the greatest challenge is figuring out how to go from teacher-focused learning models to student-focused learning models.

According to the recently released document Trends 2003-Progress towards the European Higher Education Area\textsuperscript{7}, published by the European University Association (EUA) with the support of the European Commission, regarding the introduction of study structures based on undergraduate and graduate tiers, important progress has been made in legal reforms. Today, 80% of the Bologna countries either have the legal possibility to offer two-tier structures or are introducing these.

Regarding undergraduate degrees, across Europe, there is a clear trend toward assigning between 180 and 240 ECTS credits, equalling 3 to 4 years full-time study, while graduate degrees at Master level normally carry 60-120 ECTS credits. As the length and the content of Bachelor degrees vary, there is a need to have similar flexibility at the Master level. The most common pattern appears to be: 180 credits Bachelor+120 credits Master\textsuperscript{15}.

CESAER, the Conference of European Schools for Advanced Engineering Education and Research and SEFI, the European Society for Engineering Education, in a joint communication\textsuperscript{4} on the Bologna Declaration, in February 2003, recommended in the context of the new first and second cycle degree structures, that in order to attain a high level of scientifically oriented competencies, engineering graduates need to be educated to a level corresponding to second cycle Masters level degrees. Over time it has been defined that Europe has offered two distinct types of engineering curricula, one longer, more scientifically oriented and the other shorter,
more application or vocationally oriented. Both have been developed to respond to particular needs and are well accepted by the job market.

This characteristic makes even more evident that the Bologna Declaration is not just about changing administrative systems, but rather proposes an unprecedented cultural change, mainly of values, surrounding society as well as the individual.

**Articulation of the higher education system within the national education system**

Despite important efforts within the educational system, many deficiencies persist that keep the National Education System to develop smoothly in Colombia. The link between higher education and elementary and middle school is weak. There really isn’t an education system that integrates all the learning-teaching processes from preschool, through grade school and middle school, all the way to high school and then higher education. It is necessary to acknowledge that these, the fundamental components of the educational system, develop independently from one another as well as from the nation’s social reality. All this reflects upon the problems that higher education must deal with when a poor student, ill prepared and lacking basic skills arrives, leading to high desertion rates or else, extended periods of study before graduating and become, alas, mediocre professionals. Hopes of remedying this situation have given rise to proposals to extend middle or high schools one more year, as a sort of pre-university year in which students can strengthen specific skills and enhance their knowledge of specific areas. Proposals have also been made for universities to assist in the training of students by offering vocational programs that can be taken along with formal subjects, in order to, in some way, bridge the gap that exists between the primary and secondary schooling years and higher education.

**How professional training on a university level relates to technical and technological training.**

Unfortunately, there is also a gap between technical and technological education within the higher education system. There is also a poor social, educational and labour stigma attached to technological and technical education that reflects upon the low status people that graduate from these types of institutions have, which means low salaries for jobs that require this level of training. President Uribe’s 2002-2006 administration intends to expand enrolment in technical and technological courses. According to a recent World Bank Study, Tertiary Education in Colombia – Paving the Way for Reform, April 2003, there are 900,000 students enrolled in higher education, of which only 150,000 are attending technical-technological institutions.

Due to the new legal dispositions that regulate formation by cycles in Colombia, the prospective reduction of the engineering majors would cause that engineering professional degrees will be similar to degrees given by technological institutions. This undeniably inconvenient situation means that we need to rethink technological education in our country. It is unclear how this type of education could be considered as the first cycle of an engineering major. Were it so, agreements would be need to be reached in order to decide upon a common education regarding basic sciences so that the students of these technological institutions would be able to continue their studies in a second cycle as engineers. A common education in basic sciences is not easy to
achieve when considering that the purpose of the training of engineers is very different from that of a technician and, therefore, the specific educational processes are different also.

For Colombia, which in any case needs to broaden it’s higher education outreach, short majors are a valid and pertinent alternative, so long as a difference can be made in regards to the social, economic, educational and job market value given to technological professions. Otherwise, we will continue to have first and second class careers. The main task that we must undertake in this respect is the consolidation and identity of a modern, first class technological education that qualifies young men and women to be competitive in the workplace and to be able to continue their studies at a higher level. This education is key to the development of productive forces and the modernization of our country.

The professional practice of Engineers in Colombia

The manner, in which the engineering profession is practiced, not only in Colombia but also in all of Latin America, is tied to the type and size of the main companies in those countries. The reality of the productive sector of each country cannot be overlooked when thinking of the kinds of engineers such companies will require.

Most Latin American nations have modest economies and, thus, a productive apparatus made up of small and medium sized companies. Large companies are few and usually belong to multinational corporations that have invested in the country. This scenario places us in a very different standpoint in regards to other countries, which generally think of providing human resources for large corporations. Being an engineer inside a large multinational is very different from being an engineer in a small company

The engineer that goes into a large company has a very structured career ahead of him, with a growth process that has been well planned within the company, and that includes specific training stages and precise job description limits. His personal traits are usually “diluted” within a system that is indifferent towards the individual. His work is evaluated by sophisticated grading systems.

In small and medium size companies, however, the engineer has a rather flexible career in store, where personal traits are quite noticed. The engineer that works in this type of company must be versatile, have some executive capacities, be able to adapt to the most bizarre circumstances. His career depends largely on his personal qualities and initiative spirit because, due to the size of the company, he personally shares much of the risk involved in the company’s failure or success. His work status is never protected by an international structure that offers multiple development opportunities. He will most likely, in addition to duties pertaining to his training and job description, have to help solving technical, administrative, human relation, legal and banking problems often unrelated to his chosen field.

Given the above, it is understandable that unions, professional associations, employers and the Colombian society in general, express their deep concern and disagree with the possibility of shortening engineering majors. In this sense, it is important to remember the position that the ASCE (American Society of Civil Engineers) has taken on the matter by proposing that a master’s degree or equivalent in knowledge be demanded from those who wish to practice civil
engineering. Shirley Ann Jackson, President of Rensselear Polytechnic Institute, in her speech during the opening of the last ASEE Annual Conference held in Nashville, commented on just that: “we must move to a graduate degree as the first professional degree”

Supply and access to postgraduate programs in Colombia

Access to postgraduate education is restricted in a country like Colombia. Only a privileged minority can benefit from this level of higher learning. Enrollment in Colombian Tertiary Education is strongly biased towards undergraduate programs, while graduate and postgraduate programs accommodate only a small fraction of the student population. In 2001, the undergraduate programs accounted for 94 percent of enrollments, while only 6 percent of enrollments were in graduate and postgraduate programs.

There are several reasons that explain this phenomenon. On one hand, many students that finish their bachelor’s degrees are in great need of immediate work, some because they have financial obligations directly pertaining to the payment of their studies. The lack of economic resources makes access to postgraduate programs even more restricted, especially to those offered by private universities. These programs have a significantly high tuition fee. And finally, the lack of alternatives for payments and grants or scholarships offered to students with rich academic skills but poor economic resources.

Knowledge in the training of engineers and curricular content

Engineering must be viewed as a whole, as more that just a list of disciplinary know-how. It is a way of solving problems, a way of thinking, analyzing and acting. This ability to solve problems stems from rigorous training in logical mathematics, a solid knowledge of the laws of nature, an efficient management of theory when pit against empirical knowledge and an awareness of the weight of socio economic factors on the outcome of human enterprise. The merit of a solution offered by engineering to any problem that may arise lies not in its universality, but in the bigger picture, the cost-benefit relation associated to them. The right combination of science and pragmatism are an engineering imperative.

At present, the spectre of knowledge, technique, theory and problems that engineering is exposed to is gigantic and growing. We can be completely sure today that an undergraduate program, no latter what the discipline, will never be able to cover all the possibilities unless we turn it into some kind of learning marathon. The situation is far removed from what it was 50 or 60 years ago.

The explosion of technological knowledge forces us to precisely distinguish the fundamental form the instrumental. When “everything” could fit into five years of studying, it wasn’t necessary to make a huge effort in terms of curricular efficiency. You just taught everything. However, today it is evident that “everything” is by far more that can be learned in one degree and all the teaching energy for that first degree must be focused on developing concepts, skills and abilities that will allow the student to successfully approach the perhaps never-ending path of study. It is ever clearer that technological specialization is imminent and that said specialization
requires a time, a space and a student very different from those found on an undergraduate level.

The engineering academic community has reached a consensus when it comes to the curricular design that engineering major requires. The program must be composed of four segments or cycles of training that need not be sequential; they can be parallel. The first two constitute basic training, the first of all being oriented towards developing skills in science and math. The second is aimed at the human and socio-economic formation. The final two segments or cycles are concentrated on engineering. The first of these two is dedicated to the so-called engineering sciences, that is, applied mathematics and analysis tools that belong to engineering and science applied by areas. The second segment or cycle, which is predominantly elective and selective, is designed to expose the student to problems pertaining to engineering and its professional practice in a real setting.

This curricular organization for an engineering program is common in universities in England and the United States and are administered in four years with a subject load of no more that 5 per semester and a required presence of less that 18 hours a week. As a result of the Declaration of Bologna, the programs in continental Europe are aiming heading for the same direction.

In terms of hours taught, these programs have an amount of 2,300 hours, distributed in 1,800 hours of theory in class and 500 of practice in a laboratory. Our programs last over 2,700 hours in total, and in some cases reach 3,000. The excess focuses on professional engineering courses.

Conclusions

As university men, one of the most important questions posed today is whether or not we are really willing to change, to adapt to the changes happening in the world and in our society, changes which, in turn, will demand that we reform the teachings we impart, the investigations we develop, the services we render.

It is the adaptation, rather than the adoption of the Anglo-Saxon system that we can benefit from, so long as organization methods and structures are adopted for academic programs without transplanting contents that have been designed for a very different social and cultural reality.

The explosion of scientific and technological knowledge does not necessarily have to mean that engineering programs have to grow in response. On the contrary, what should be revised is the very scope of the undergraduate major by offering training less professional-oriented and transferring the specialization process to higher degrees. This review of the scope of the undergraduate program could even justify its reduction, as it has elsewhere.

The reduction of majors can be interpreted as lowering the standards of quality, seriousness and rigor of the programs and can affect the status of the professional program as it brings it closer, in extension at least, to the technological and technical ones. However, length is not always synonymous to quality, rigor and seriousness. There are other more fitting mechanisms in Colombia’s quality assurance higher education system as guarantee the quality of a program and of its graduates.
In case of a reduction of our programs it might seem that we were going against our obligation to help the student mature during his training at the university, which in more industrialized countries is achieved by the very practice of the profession or through training provided by the companies who hire them after graduation. On this regard it would be opportune to establish which academic factors determine professional success. At any rate, it is difficult to distinguish between the key elements that make a good engineer. Nonetheless, it can be said that in the correct practice of engineering, a solid training in basic sciences and exposure to challenging problems that form the mind for the decision making process are more important than the credits of professional engineering courses at the end of the career that someone took to get their major.

It is no easy task to get the teachers of well-established engineering schools with a long and solid track record and renowned programs to even consider the possibility of changing and transforming the curriculum to fit current circumstances. Why change if we have done so well until now? No doubt there are plenty of valid reasons to keep the current models. But, how else will we now if we could be doing better? The only alternative is to give ourselves the time and space to be critical, to objectively revise the programs in depth to be fully convinced that it is not convenient to change.

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"Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition
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