

Multinational Higher Education and Certification in Engineering

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Abstract: The necessity of international education in the area of Engineering is discussed. The effects of globalization of the productive processes and the possibilities to reach distant markets with ease are analyzed, as well as the comprehension of new cultural behavior from engineers dealing with technology and production. The education restricted to local flavors, that was so successful in preparing professionals for the era of closed markets, is not capable of preparing personnel ready to look beyond the border in its daily life. The extension of the changing meaning of the career of the engineer, encompassing a broader type of activities in the new economic and social moment, is analyzed; moreover, it is commented the necessity to bring to the attention of the College of Engineering to the globalization of production and the larger geographical range of interest even for small firms. The focus on the individual, that has been stressed by the importance of the consumer and also of the entrepreneur, is taken into consideration, underlining the need for increased awareness to different cultures, as well as acceptance of the social, political, cultural and economic realities found elsewhere. The multi national education in engineering is analyzed considering the specific cases of Brazil, the US and Europe. Previous attempts of internationalization of engineering education, focusing on a few students, are commented and the difficulties for mutual certification are analyzed

We propose the double undergraduation, considering its advantages and legal difficulties.

Keywords: Global Economy, International Education, Double Undergraduation, International Certification.

1. Introduction

Objective of this paper is showing the need for a multinational education in engineering, presenting some of the related difficulties and identifying the feasible ways to be attempted in the present institutional framework. The paper is based on authors' personal experience in engineering education carried out in their respective countries. Due to both space limits and lack of complete official data, actual experiences will be briefly accounted for, without quoting full references.

Nevertheless, we trust that the set of opinions we are going to expose here, are relevant for allow us to analyze the problem versus the institutional difficulties the authors have met up to now, and to identify actions able to overcome such difficulties.

2. Effects of the economy globalization in the post-industrial society

The globalization process of world economy, along with the ease of access to fast communications, involves as a consequence that buyers and vendors have no longer to share the same geographic area. The label "Global Quality" and the increasing matching of products to customers needs, moved the sale and the design/production areas near to each other, giving engineers more and more responsibility in transaction and marketing. The arenas where negotiation happens are as many as the geographic areas and cultures involved are.

We want to point out here:

- The mix between scientific-technologic culture, which is typical of engineers, and either the philosophic-humanistic or the pragmatic-economic culture peculiar to other social categories.

- The convergence among different national cultures based upon paradigms, which differ for sales areas, services or market managing.

Moreover, multinational companies have their engineers operating in societies where the labour culture and the social representation differ sometimes, even though by a subtle difference, from the ones that are characteristic of their original culture (a forewarning view, related to the above problem in France, appeared in the work “Le Mal Français” by Allain Peyrefitte, a best seller in the seventies).

As a consequence, the understanding of different cultures, belonging either to their own society or to foreign environments, became a must for people operating in engineering areas. Besides this understanding, the need of operating in other cultural environments, in the wide sense above exposed, also became necessary.

The above situation leads to the following paradox: engineers need at the same time both a technical training, more deeply tuned on their operating area, and a new understanding of social problems, the latter being presently missing in traditional engineer education. A second paradox is the one concerning globalization: in a global economy, an individual becomes the center of attentions both as a consumer —after all, everybody buys and consumes individually in that is a wishing being —and as a entrepreneur. Business has a new engine in the individual himself who creates new market niches and gives impulse to new market developments. Therefore, a great deal of important choices involving social transformations are shifting from government to qualified individuals having both attitude to leadership and a clear view of the markets: the entrepreneurs.

Several examples can be quoted. In most job offers the main pre-requisite is the fluent speaking of a second or even a third language. The receptiveness to job experiences abroad is also often asked. The recent contracting of Brazilian engineers by German companies to operate in Africa is not just due to ethnic reasons, but mainly to the ease that Brazilian people fit in African cultures without losing their original culture.

The greater knowledge of problems of planetary importance, such as climate and environment problems, the increased concern with foreign political problems, the cultural inter-dependence produced by communication media and entertainment industries, require that engineers and politicians have a world-wide view of the problems, prone to world interests. The reason for this is not merely getting a greater economical efficiency and avoiding political risks, but also trying to respond to ethic demand of the developed societies —as it is evident in the political argumentation (not always implemented) appearing in most newspapers.

Curiously, an aspect of the above quoted paradox is that, the greater the cultural globalization, the greater the need for honoring local cultures: the creation of products and services matched to local cultures, it is often seen as opposite (and having often the opposite effect) to a hegemonic approach. As an example, observe the growing of the nationalist sentiments even though embedded in globalized principles. For a deep philosophical analysis of this subject, see the works by Allain Finkielkraut.

3. Multinational education in engineering.

Back to engineering education, the necessity for a new kind of world oriented training, open to the needs and to the diversity of people, is evident.

The problem is not just the certification, done by government (Europe) or private (USA) agencies, of the courses in engineering, around some common objectives and definitions. Giving students in engineering the opportunity of having direct contacts with other countries and cultures, or even sometimes compelling them to have such contacts, is much more important. This can be done by means of the institution of cultural bridges having also economical and political interests. The effectiveness of these contacts will be greater in that it occurs in the phase of the student training, full immersing her/him into another culture.

In Europe, France, Germany and UK have government education systems oriented in such a direction, organized around the COFECUB, the DAAD and the British Council, respectively. These systems, originally designed to collect foreign pupils for the local universities, are now changing towards symmetric interchange of students between the countries involved in the bilateral programs. Italy has begun experimenting with student mobility only in the recent years, through European programs ERASMUS and LEONARDO. Though this experience has involved a small number of students, it has pointed out the difficulties arising from the need of fitting the different education systems existing in Europe.

The GE4 (Global Education for European Engineers and Entrepreneurs) is proposing a list of multinational projects, including the recent LAE3, which involves about hundred institutions in Europe, Brazil, Argentina and Chile.

The tools used to implement this world-oriented education project can be classified as follows:

- Re-adaptation of the curricula of engineering according to international protocols. This subject, usually referred to as “certification of titles”, was discussed in the ICEE99 Conference, in Óstrava and Praga.
- Organization of fellowship programs to be developed abroad either with companies or public institutions with or without the acknowledgment and validation of the subjects.
- Validation, by the institution that grants the title in the country of origin, of sandwich curricula, that is, curricula made by developing the study of one or two periods with institutions in foreign countries. Examples of implementation of the above tool are the agreements with France and Germany, recently started by the CAPES/Brazil.
- In the case of a student spending a part of her/his course of study in a country and a part in another country, the possibility of getting a double title from both institutions. This tool gives, to some extent, a solution to the problem of the multinational certification, at least as far as the countries involved are concerned.

4. Difficulties related to multinational certification of engineering courses.

The certification through international protocols of engineering courses and curricula meets great difficulties due to the cultural differences existing among Europe, USA and Latin America, because of their different industrial development, and also due to the large cultural diversity inside Europe itself. See the text of the general speech given by Professor Georges Lespinard in the Conference ICEE99.

The governmental public education system present in most European Countries has a quality control and a certification for engineering courses which thoroughly differs from the one existing in countries where the governmental university control is weaker or non-existent.

In Brazil the profession of engineering and its practice are defined by a law that only validates those titles that are granted by Brazilian Ministry of Education and that match strict rules concerning their curricula. This rigid situation makes it impossible an automated certification system of foreign titles, since the only permitted way is the concession of a title by a legally accredited Brazilian school and after a demonstration of equivalence of corresponding subjects (school's curricula must be approved by the Brazilian Ministry of Education according to law).

The Brazilian system is quite different from other educational systems, like for instance the one existing in France and in USA. In France, the students who spent at least two years in a French school can get a regular French educational certification once the institution of origin has accepted, at its discretion, the remaining part of the curriculum which has been developed abroad. The United States of America have an even more liberal system: the engineering schools can give titles according to their own rules, without any general federal constraints.

From 1988, Italy has begun a deep transformation in occasion of its entry in Europe. Italian education system, peculiar in Europe, was in many respects, very similar to the one existing in Brazil, with courses of engineering of five years duration, having strict law constraints. According to European agreements, treated later in section 6, the Italian education system is changing towards a 3+2 curriculum, letting the individual universities compile the curricula with a great deal of autonomy.

On more difficulty related to the multinational certification of engineering courses, arises from the lack of confidence towards the quality of the engineering courses in countries where there is neither government control nor a defined and certified system of quality control of the educational product.

The above argumentation lets us understand why educational programs, involving a part of the courses abroad or a sandwich curriculum, got so much success. As an example, the Brazilian University PUC-Rio, has such kind of agreements with more than 200 universities in Europe and in the USA and makes of this one of its points of propaganda and prestige. Among these, a program of sandwich curriculum in the framework of a bilateral agreement between France and Brazil is giving excellent results.

However, these programs are expensive and get a small number of students, since they need to be funded by the governments involved. The reason for this has been revealed asking a student sample their opinion about such programs. In their mind, spending a period of training abroad, involves difficulties related to the different orientation of the subjects taught and gives no other advantages but the opportunity of good learning of a foreign language and more future job possibilities. A more serious criticism concerns the point that the involvement of the institutions taking part in the agreement is just formal, since both integrated training and integration of curricula are absent in practice. The above-mentioned agreements are just training periods, with possible and accidental exploitation of the acquired training by the institutions granting the title.

5. A possible solution: double title (multinational) in engineering.

Taking into account the institutional difficulties presently existing, a way we believe to be promising and viable is the grant of the double title by the two institutions involved with partial integration of the curricula and according to their different laws.

For instance, consider a student attending an engineering school having the duration of 5 years and spending 2 years in a French, German or Italian school of engineering. Through some curricular integration (to be analyzed later) she/he can obtain the title of engineer by both institutions with evident training and legal advantages (being allowed to practice both in Brazil and in Europe). This proposal is, as already verified, appealing for those Brazilian students having facilities to travel abroad. It is worth to observe that a student, when living in a foreign country, should have the same way of living of the other students (e. g. a temporary employment).

Unfortunately, the example just done of a Brazilian student abroad, cannot be reciprocated because of the present rigid Brazilian law which asks, in order to grant the title, for an equivalence subject by subject, in addition to a number of supernumerary subjects, specific to the country involved. If the present law is modified, according to the recent Law of Directives and Bases, the double certification of titles, for French or German students who spend two years in a Brazilian university, will be possible. In this case a full bi-national education system will be realized with European, Latin American or North American pupils studying in Brazilian universities and influencing courses and colleagues (first in Brazil, then back in their countries) and obtaining a new multi-national culture. The same argumentation is true for Brazilian students training in Europe, Latin America or United States.

The advantages given by this double title justify the greater work required to obtain it and go beyond the curricular integration and the specific cultural interchange. Being directly exposed to a new culture during the period of training, the engineer-to-be acquires a cultural open-mindedness and a view of the world that goes beyond the cultures of the countries directly involved and prepares her/his mind to face and exploit the cultural diversity of the planet.

6. The integration process in Europe

The European process has moved some very important steps ahead. As stated in the first protocol signed in Paris in 1998, "Although relevant, this achievement should not make one forget that Europe is not only that of the Euro and of the economy: it must be a Europe of knowledge as well. The intellectual, cultural, social and technical dimensions have, to a large extent, been shaped by its universities, which continue to play a fundamental role for its development."

European countries are presently going through a peculiar situation, in which educational systems have to match one another, if mobility of people is to be a priority.

Among the objectives considered of primary importance in order to establish the European area of higher education and to promote it worldwide are:

- Adoption of a system of easily readable and comparable degrees to promote European citizens' employability.
- Adoption of a system based on two main cycles. Access to the second cycle shall require successful completion of the first cycle of studies, lasting a minimum of three years. The degree awarded after the first cycle shall be an appropriate level of qualification for the European labour market. The second cycle leads to the master and/or doctorate degree.

- Establishment of a system of credits (ECTS system) as a proper means of promoting student mobility. Credits could also be acquired in no-higher education context, including lifelong learning, provided they are recognized by receiving universities concerned.

Italy, as above said, is one of the countries that have to suffer the greatest changes because of its educational system far from most of the European partners. Surprisingly, Italy now changing its traditional education system, is running along the way in the opposite direction of some important US universities (see next section).

7. Curricular integration

Curricular integration has to face some of the difficulties originating from the differences existing among the educational systems. Examples of these difficulties are:

- The North American educational system made of 3+2 years where the first three years prepare an engineer with a more technical training (Bachelor in Engineering), while the following two years (Master) provide a deeper scientific view. The system just described is complemented by a process of certification based on training periods and tests and carried out by suitable institutions (e. g. IEEE). It is worth to note that some of the most prestigious engineering schools, like MIT, already grant titles for courses having duration of 4 years, 5 years courses being in the next forecasting.
- Among European educational systems, it is interesting to mention the French system, which is based on Preparatory Periods of two years, devoted to fundamental sciences followed by an additional period of two years concerning general studies in engineering and finally a year for training and specialization.
- In Latin America, the Brazilian system is presently made of 5 years courses with many curricular limitations, in view of the legal control to be exerted over the engineering practice. Of course, the labour market is not much affected by this legal control except, either for what employment in the government machine is concerned, or in cases of concession of legal franchises (e. g. mineral research, civil construction, environment impact). In Brazil there is a trend to regulate products quality *a priori*, with discredit on *a posteriori* quality controls obtained through certification or market response.

It becomes necessary to adjust the steps in the engineering education to be over the mere acceptance of general criteria, like ABET, in order to simplify the double title system, which after all lets the engineering schools involved have the full control over educational programs.

Curricular systems 2+3 or 3+2 with a basic cycle or “Classes Préparatoires” equivalence just among schools giving only general wide-band (not mainly technical) education? Many possible options are to be discussed and many choices are to be made before true integrated programs can be implemented.

In Brazil, the liberalization of curricula, as indicated in the recent Law of Directives and Bases, which should be completed with flexible academic regulations, is essential in order that the grant of double titles can be made in a symmetric way.