

Double qualification, Civil Engineer – Architect. The experience of the Universidade de São Paulo - Brazil

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Abstract - Until 1954 one of the engineering degrees conferred by the *Universidade de São Paulo* was of engineer-architect. With the creation of the *Faculdade de Arquitetura e Urbanismo* in 1948 the *Escola Politécnica* ceased to confer it. Over the last 50 years, the undergraduate program in civil engineering has moved towards a formation devoted to the technological and economic aspects, moving away from humanistic; on the contrary, in the architecture and urban planning program there has been a movement in the opposite direction, combined with the development of *beaux-arts* topics. Both lost their systemic visions, contrary to the requirements of the society. As one of the possible actions trying to stop this, and based on a similar experiment undertaken in Europe, a program of double qualification was created in 2004, with a multidisciplinary and integrating view. The students of one of the establishments stay for two years in the other establishment; afterwards, they return to their original establishment, to finish their studies. This paper describes this experiment, which involves up to now 70 students, and analyzes its impacts for students and organizations. The results are excellent, the number of students is increasing, and the market has started to recognize the value of these new professionals.

Index Terms - Civil Engineer – Architect, Double qualification, Architect Engineer , Multidisciplinarity

BACKGROUND

The *Escola Politécnica de São Paulo* was founded in 1893 and initiated activities the following year with the courses of civil, industrial and agronomical engineer, plus a technical course of the mechanical arts. In 1895, the courses of architect engineer and geographic engineer and the technical courses of machine operator and mechanics were included in the curriculum. In 1934, the *Universidade de São Paulo* was founded and *Escola Politécnica* was incorporated as *Escola Politécnica da Universidade de São Paulo (EP)*. In 1948 the *Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo (FAU)* was created, and in 1949 *EP* ceased to

enroll students in the course of architect engineer and the course was disactivated after the last group of students had graduated.

The *École Centrale de Lille (EC Lille)*, in France and the *Faculté Polytechnique de Mons (FPMs)*, in Belgium have a program of dual diplomas where the students of engineering at *EC Lille* and the students of architect engineer at *FPMs* receive the diploma of engineer of *EC Lille* and the diploma of architect engineer of *FPMs* after having completed the respective course work of their school of origin and a program of studies in the other school.

Since 2002, the *EP* and *EC Lille* have had a program of dual diplomas for students of both courses. The interaction between the *EP* and *EC Lille* induced the professors of *EC Lille* and *FPMs* responsible for the program of dual diplomas to visit *EP* and *FAU* for the purpose of proposing a program of dual diplomas for the civil engineering students of *EP*, the architectural and urban planning students of *FAU*, the engineering students of *EC Lille* and those of architect engineer at *FPMs*. A commission of professors from *EP* and *FAU* visited *EC Lille* and *FPMs* with the purpose of furthering the discussion of this proposal.

The proposal of dual diplomas for civil engineering and architect and urban planning was very attractive to the directors of *FAU* and *EP*. However, after careful consideration the directors decided to create a more restrictive program of dual qualification between *EP* and *FAU* while leaving the option of a more ample and complex program with the foreign institutions of *EC Lille* and *FPMs* for a later date.

A commission was formed from each school to study jointly this internal proposal of dual qualification in civil engineering and architecture and urban planning between *EP* and *FAU*. These commissions were made up of representatives from the three departments of *FAU*, the four departments of civil engineering at *EP*, one student from *EP* and three students from *FAU* that were among the first students to participate in the program they had helped create. The two commissions undertook the study of this proposal during the second semester of 2003 and it was implemented in March of 2004 with students from *EP* enrolled in courses at *FAU* and students from *FAU* studying at *EP*. The three

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authors of this paper were members of the two commissions.

From the beginning, the course has been kept under constant evaluation. Taking part in these evaluations are those professors directly responsible for the program and students enrolled in the program. This has led to modifications meant to improve the program. The conception and present structure of the program are described in the document, Double Qualification Program FAU-EPUSP. Class of 2007 – 2008 [1].

CREATION OF THE PROGRAM

The creation and implementation of the dual qualification program originated with reflections on the present situation of knowledge production and the consequent impact on teaching, which has the planet as a context and requires a tremendous capacity of articulation in dealing with the enormous amount of information available.

According to Morin [2], in reality, the greatest challenge is in the perception and conception of the multi-dimensional character of this context, which includes historical, economical, sociological and religious dimensions as well as a complexity that mixes elements of diverse natures.

In order to understand this complexity one must not ignore a systematical thinking which, today, is a far cry from the actual production of knowledge and professional activity due to the demand for specialists that was characteristic of the last century (XX) and which, divided knowledge into segments leading toward pragmatism [3].

It was with the intention of unifying this knowledge in an effort to better solve real problems, each day more complex, multi-discipline, multi-dimensional, transversal and global that this program of dual qualification was conceived.

If we bring, from the end of the XIX century and the beginning of the XX, thoughts of Louis Sullivan, Dankmar Adler and Frank Lloyd Wright [4] regarding to the importance of technology and techniques and material advances; and thoughts of Patrick Geddes and Levis Mumford [5] with ecological and cultural concerns, we will realize that the same questions and emphasis are posed again to go beyond in terms of architecture and built environment

This was the guiding element in the formation of the program, which included two sets of concerns when choosing the disciplines to be offered:

- the contribution of *EP* for the students from *FAU* would be decidedly concentrated on technological questions, materials, construction processes and work tools (in particular, those of informatics) plus questions related to logistics and the management of projects, miscellaneous undertakings and worksites. This complementary coursework aims to enhance the creativity of the architect/urban planner in that it enables him to visualize and make viable projects having innovative non-Euclidian forms that require advanced concepts of the space and time that the context demands. More so, the administration and logistics of implementation require a minimum of understanding of the project's dimension and its economical and financial viability not only for the entrepreneur/investor, but also principally for the

economy and urban administration as regards public interest.

- The contribution of *FAU* to the students from *EP* weighed the necessity of having a broader view of the intervention into the built environment, which incorporates questions of aesthetics and the humanities assuming the local characteristics with a holistic dimension in the process of producing urban and architectonic space. To achieve this goal disciplines concerning of basic information and design concepts, building design, urban and regional planning and landscape planning were selected. A strong emphasis was also placed on disciplines covering the history of art, architecture and urban planning, including disciplines of graphic representation and environmental comfort. Undoubtedly, the political factor appeared with sufficient emphasis to interfere in the order of decision priorities and of those choices that were essentially technical.

In order to reinforce the integration of both schools it is required the students to remain two full years in the other school. This decision has the intention to provoke an immersion into the culture of the other school's environment that will help the student understand and acquire each other better.

The broad and critical character of this mixture of technique and technology is fundamental in the territorial intervention that the program of double qualification is trying to advance. It is fundamental in breaking the vicious circle which rends difficult to professionals from both the public and private sector from: acquiring a systemic thought; adopting new attitudes which would enable them to assume a more critical posture in relation to their actions; increasing their political and technical competence, while serving as agents of technological, economical, political and socio-environmental change.

CHARACTERISTICS AND IMPLEMENTATION OF THE PROGRAM

In consideration of the concerns outlined certain flexibility in the choice of disciplines was decided upon leading to the definition of optional and required courses. The resulting proposed curricula guarantee that the students of *EP* taking the required disciplines along with those of their own courses satisfy the governmental guidelines outlined in regulation n.1770-MEC of 21/12/1994, which established curricula and the minimum courses required for graduation in architecture/urban planning [6]. Reciprocally, the students from *FAU* having concluded the program satisfy Resolution CNE/CES 11, of March 11, 2002, which defined the National Curricula Guidelines for Undergraduate Courses of Engineering [7]. This permits conferring two diplomas to those students who complete both, the program and their original course.

Nonetheless, for the time being, the standing decision is to award a certificate of completion for those who complete the program and a diploma for the course of origin. Both, certificate and diploma are conferred only upon completion

of the student's original course. The criterion for establishing the credit loads was the average load for each school, which, at FAU is 32, and at EP 28. Both courses take five years to complete and offer two semesters of coursework per year.

As such, the students from FAU must take 22 required courses for a total of 76 credits. All other civil engineering disciplines at EP are optional. Of these, the FAU student must complete 36 credits for a minimum total of 112. With special permission, FAU students may take other optional courses at EP, preferably in the area of environmental engineering, and a maximum of two post-graduate disciplines.

Similarly, EP students are obligated to take 17 required courses at FAU for a total of 98 credits. All other courses are optional, of which the EP student must complete a minimum of 29 credits, totaling 127 FAU credits.

At the beginning of each year, up to 20 students from each school, having met the minimum requirements and classified according to their grades, enroll in the program. For such, the FAU candidate must have completed 90% of the total credits, required and optional, corresponding to the seventh semester and have been approved in all the required disciplines up to the end of the 6th semester. Students enrolled in the Final Graduation Work are not allowed to participate in the program. EP students must have completed the 6th semester of civil engineering and been approved in all disciplines for the first two years of the course. Candidates then take a specific abilities test, which includes the disciplines of Geometry and Architectonic Language.

The program starts at two different times for the students of the two schools. EP students initiate the program during their seventh semester and FAU students during their ninth. It was agreed upon that EP students would get more out of their last two years after having participated in the program at FAU, and that FAU students should enroll in the program in EP after having matured somewhat.

The program is optional and is not meant for all students of either FAU or EP. And those who do participate are understood to be interested in complementing their areas of study.

There is a structure of tutelage made up of professors from both schools for the purpose of advising the students in accordance with their individual objectives and to provide details of the program.

The present coordination is made up of a commission of six: two EP professors and two FAU professors and one student from each school, chosen by the participants. The main functions of the commission are to:

- define guidelines and promote the program while respecting superior decisions from the two schools and the university.
- perform academic activities (tutelage structure, propose pedagogical courses, promote student integration).
- support administrative activities (annual selective process; enroll students; propose schedules and courses; evaluation reports).
- propose indicators by which to accompany the program, establishing objectives and goals to be continually evaluated. continually propose improvements for the program.

The commission has an important role and the success of the program is a mirror of the democratic manner in which the program has been operating since the beginning. Listening and being listened to has become an important instrument for both students and professors

PROGRAM EVALUATION

The program has been quite attractive, especially for the students of FAU, as the number of participants indicates:

- 2004; 3 from EP and 10 from FAU;
- 2005; 4 from EP and 9 from FAU;
- 2006; none from EP and 20 from FAU;
- 2007; 4 from EP and 20 from FAU;

Altogether, there have been 11 students from EP and 59 from FAU, for a total of 70 students.

As the program started in 2004 the first students from FAU should graduate at the end of 2006 those from EP in 2007. Having accepted more advanced students in the first groups that were formed, 3 students graduated in July, 2006, (1 from EP and 2 from FAU); 6 others graduated in December of 2006, (1 from EP and 5 from FAU).

Although the coordinating commission has not formally created a system of indicators to evaluate those who have entered the job market, it is certain that the success rate has been positive. All who have departed are securely employed in leading companies and in functions that require multi-discipline profiles. Participants who have yet to graduate have also found positions, as interns, in similar functions and companies.

Businesses from the construction sector have already sought out those responsible for the program in search of professionals with a double qualification in architecture and civil engineering, considering this professional profile extremely adequate to their necessities. It is easy to imagine as the program becomes better known that the market will seek to contract the professionals that have received this new qualification and reward such competency in terms of salaries, most especially for recent graduates.

Accompanying evaluations of the students has proven to be quite satisfactory and shows that the principles under which the program was conceived and the goals established for the program were quite correct. Although adapting to a new school and a new system of education is not always easy, the students have come to appreciate the program due to the perception that the two areas complement each other, from a cultural point of view as well as the manner of seeing buildings and the urban system. Having been exposed to another point of view and a different academic environment has made the students more mature, complete, and secure and prepared for the professional challenges they will face.

Not only have the participating students been benefited by the program, but also, the other students and professors of the two schools. Although not supported by indicators, student and professor manifestations have at various opportunities been extremely positive in relation to the program. Among other aspects, they have pointed out the excellent academic performance and the desire to integrate

shown by the students of the program. The differing points of view expressed in the classroom and the critiques resulting from contact with a different educational system have been important elements for the schools to reflect upon concerning their systems of teaching. The contact of students and professors from one institution with students coming from a partner school has led to a better understanding, a closer relationship among the professionals of the two institutions and the destruction of barriers that existed between the two.

One concrete fact that reveals the enormous potential of this new relationship between the students of architecture/urban planning and civil engineering is the fact that groups made up mostly of students participating in the program were the winners, in both 2005 and 2006, of the Challenge Competition of the Brazilian Concrete Institute – *Ibracon*. This contest is designed for the students of civil engineering and architecture, who in groups made up of students from both areas, present an urbanistic, structural and architectonic work project. In 2005, the project was a bridge, and in 2006, it was a pedestrian bridge-square. Competing with groups of students from various regions of Brazil, the students of the double qualification program won both times they competed. Trade magazines, as well as television and radio, have given special attention to the program, commenting, discussing and reporting [8], [9], [10].

Establishment of the double qualification program, in architectural/urban planning and civil engineering, has projected *FAU* and *EP* into a world tendency, which is the approximation of these two areas, while getting ahead of even some renowned foreign institutions that are creating similar programs. Besides the dual diploma program previously mentioned between the *École Centrale de Lille* and the *Faculté Polytechnique de Mons*, the University of Sheffield, in England has, for many years, had a course of Structural Engineering and Architecture and the course of Structural Engineering with Architectural Studies [11]. Students from the Department of Civil Engineering and Construction from the *École Nationale des Ponts et Chaussées*, in France, the world's oldest engineering school, can participate in a complementary program of architectural studies at the *École d'Architecture de Marne-la-Vallée*, for one year and receive a diploma from this school after an additional two year program of studies at the institution [12]. The *École Spéciale des Travaux Publics, du Bâtiment et de l'Industrie*, of Paris, most recently, in 2006, created a dual diploma program of engineer/architect with the *École Nationale Supérieure d'Architecture de Paris-la-Villette* [13].

CONCLUSIONS

The program results have more than exceeded the founders' expectations. Up to the present, there have been no indications of any serious problems, whether on the part of the participating students themselves or the students who receive them. Nor have there been any academic problems related to performance. Nonetheless, a small, insignificant number of professors have tried to create some obstacles to the program due to personality conflicts with some of the

participants. This simply validates the idea even more and the means by which it is executed.

However, beginning in 2005, the program has received some incremental modifications, mainly in function of student feedback. Once again, this emphasizes the role that the coordinating commission plays and the value of the space it created.

The most important challenge facing the commission today is the implementation of a set of indicators, which can evaluate the program's impact on participating, and indirectly, on the non-participating students caused by the changes in the two fields involved. It is also important to evaluate the career progress of those who have already finished the program and are in the job market.

One other phase to be conquered is that of professional recognition. At present, it is not known whether the professional councils regulating the two fields will concede professional recognition of the graduate's second diploma. Although forces outside the university regulate this question, discussions concerning the matter are already taking place.

In a similar fashion, the question concerning concession of the second diploma to those students who have already finished the program is relevant in that they have fulfilled all the legal requirements.

One subject that will soon be debated in *USP* is that of recreating the 5 year program that used to exist at *EP* for architect engineer, now that the present program demands a minimum of 7 years to complete.

The curriculum structure of each field must undergo some modifications as a result of the program's learning accumulations: the civil engineering course has to become more humanistic and systemic while that of architect/urban planning must become more technological and attentive to the aspects of the economy. The objective is to produce graduates from the two schools who will become more and more involved as agents of technological, economical, political and socio-environmental change.

This on-going experience should be taken advantage of to consider the possibility of creating other types of double qualifications, involving the other fields of engineering (such as electronic/communication; electrical/architecture; mechanical/physics; materials/biology; etc.) and the course of architecture (and urban planning as is done in *USP*; architecture/sociology; architecture/design; etc.).

In closing, the authors strongly recommend that this initiative be reproduced in other educational institutions, foreign and domestic, adapting the program as need be. The possibility of establishing a dual qualification program with other countries as done in France and Belgium seems highly conceivable and should be taken under consideration.

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