IMPLEMENTATION OF THE MOBILITY ENGINEERING CENTER

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Abstract. *The paper describes the experience of the Federal University of Santa Catarina – UFSC, Brazil, in the elaboration and the implementation of the Mobility Engineering Center. Aspects related to the project and the circumstances which led UFSC to create another center outside the main campus are presented. The main reason behind this venture is the great national demand for professionals in various field of Mobility Engineering, areas such as, automobilistic, railway, mechatronics, naval, aerospace and aeronautical, infrastructure and logistic engineering. All these specializations are concentrated in the new campus which is situated in the city of Joinville which is about 180 km from the main UFSC-campus. The lessons learned from the administrative and pedagogical experiences involved in the implementation of the new Center since 2009 are discussed. Other relevant aspects will also be presented.*
Keywords: Administrative and pedagogical experiences, Mobility Engineering; administrative and pedagogical experiences; implementation of the new Center.

1. INTRODUCTION)

In 2008, as a result of a series of circumstances that motivated the decision, the Federal University of Santa Catarina – UFSC – implemented the Mobility Engineering Center in the city of Joinville. This paper reports the experience describing aspects related to the genesis of the project and the circumstances that led UFSC to expand its activities to the interior of Santa Catarina, because until 2008 its activities were concentrated in a single campus in Florianópolis. This paper describes the reasons for choosing the Mobility Engineering Center and the project proposed to implement the related Center considering technical, methodological and administrative aspects. Finally, the document presents the main results achieved with the implementation of this project.

2. THE HISTORY

The UFSC, a federal education institution, was established by the Law 3849 , December 18, 1960, through the merger of the Faculties of Law, Medicine, Pharmacy, Odontology, Philosophy, Economics, Social Work and the School of Industrial Engineering located in Florianópolis-SC. The UFSC was officially installed on March 12, 1962 (UFSC, 2009).

At that time, due to the university reform, the Faculties were closed and the University acquired the current teaching and administrative structure (Decree 64,824 , July 15, 1969). In 2008, UFSC had 57 departments integrated in 11 units. UFSC offered 65 undergraduate courses, 54 Masters and 38 Doctoral Courses (UFSC, 2009).

The Technology Center of UFSC, in particular is , a national reference in the research and engineering education, and includes 360 professors, 5100 undergraduate students and about 2,000 graduate students.

On the other hand, it must be considered that Brazil forms, each year, less than half of the engineers it needs. According to the National Confederation of Industry (CNI), Brazil has a gap that is related to the disparity between qualification in universities and the companies needs seeking professionals. The CNI estimates that the market will have a deficit of 150 000 engineers in 2012. To overcome this crisis, the country has to face the difficulties faced by institutions to create new courses and stimulate demand for engineering courses (IN, 2010).

As stated by GOULART et al (2005, p.8), in this scenario, important institutions involved are the public universities, that constitute the global and local articulation axis. Already Trindade (2000) states that the university is a central component in defining development guidelines and affirms that 90% of science and technology research take place in public institutions of higher education. Therefore, it is the University´s responsibility to translate the demands of society in education provision, such as the important deficit of engineers.

In the Education Development Plan (PDE), 2007, the government proposes changes in education, vision and action. One of the actions proposed was the establishment of the Support Program to aid the Restructuring and Expansion of Federal Universities (REUNI) through Decree No. 6096 , April 24, 2007. The program aims to create conditions to increase the University access and improve the undergraduate student retention through improved utilization of physical infrastructure and human resources existing in universities.

The project REUNI presents the following guidelines:

- Reducing dropout rates, filling the available vacancies and increasing the vacancies availability, especially at night;

- Expansion of student mobility with the implementation of curriculum schemes and systems where students can define their training routes (courses) through the use of educative credits and the student´ movement between institutions, courses and education programs;
- Revision of the academic structure focusing on the undergraduate courses reorganization and the development of new teaching methodologies and learning, seeking for the constant improvement of the quality.

Considering this context, UFSC, aware of its role in society and with a wide experience and recognition in technology, inspired by the increasing demand for engineers, and supported by the emergence of the REUNI project, decided to prepare studies to install new units in the state of Santa Catarina (until this moment, its presence was concentrated in Florianópolis) and to offer innovative courses committed to local realities.

For these reasons, in 2008, a group composed of about 40 Professors of the UFSC Technological Center developed an innovative project in the engineering field, which resulted in the Mobility Engineering Undergraduate Course (CEM) implementation. The Professors understand that this field deals with the development of technical systems and vehicular transportation infrastructure whose function is to transport people, material and information.

The city selected for CEM was Joinville, in the northern region, the third largest industrial center in the southern region of Brazil. The north region and the main city of Santa Catarina participates with 18.9% of the total GDP of the state. It is also the most populous city. The GDP of the municipality in 2008 was SR 11.4 billion, and occupied the 28th position in the ranking of Brazilian cities according to the Brazilian Institute of Geography and Statistics (IBGE, 2009). The industrial sector is formed by large industrial conglomerates in metal-mechanical, chemical, plastics, textiles and software development, making it a convenient for this technology (Municipality of Joinville, 2010).

The installation of UFSC in Joinville allows UFSC to induce a local development process. Lall (2005, p. 63) presents the relationship model between education and country capacity to develop technology and affirms that education provides "the basis for the occurrence of learning." It also states that the experience and guidance specific to the technology allow formal qualifications to produce know-how and know-why.

Thus, based on the UFSC experience, in the engineers deficit, in the REUNI proposal and in Joinville´s vocation the Mobility Engineering Center was implemented – CEM of Federal University of Santa Catarina whose technical details are described next.

3. THE PROJECT

The CEM development project, now under implementation, is innovative not only in the technical field but also in educational and organizational aspects.

3.1. Technical Aspects

The Center aims to train people for high technical competence and management, focusing on the development of technical systems in the vehicle field and in the study of scenarios and projects to solve problems in the following fields: infrastructure, operation and maintenance of transportation systems. Therefore, in terms the two major areas of knowledge focused in this course are vehicular and transport.

In the vehicular area, during the engineers education process, they must acquire knowledge and develop skills to plan, design, build, maintain and provide products and material to carry cargo and people, as described below:

- Motor systems: covers topics relating to the operating principles of thermal and electrical motors;
- Structural systems: corresponds to the structures and components that make up the vehicle body including other systems as well as directional elements;
- Navigation systems: related to the devices necessary to operate and maintain vehicles;
- Embedded systems: considers the concepts needed to understand the electronics and computing associated with the working of each system and the sub-system;
- Communication Systems: related to the understanding of the factors responsible to obtain, analyze and report information necessary to operate mobile devices;
- System accessories: corresponds to the concepts related to the vehicles comfort, aesthetics, ergonomics and safety.

In the transport area, during the engineers education process they must acquire knowledge and develop skills to plan, design, build, manage and maintain the infrastructure operational for people and material. It involves the following topics:

- Roads capacity;
- Roads and infrastructure elements, planning and design;

- Roads and infrastructure elements construction;
- Management, operation and maintenance of transportation systems;
- Performance evaluation and impacts definition of transportation systems.

Based on these technical aspects the mobility engineering course was structured on the basis of the Pedagogical Project.

3.2. Pedagogical aspects

Due to the diversity of topics related to the Mobility Engineering Center and the possibility to form bachelors in engineering, the Educational Pedagogical Policy Project was organized in three major cycles. The first corresponds to the first two years and it includes the basic content for the engineers training. The second cycle corresponds to the third year and it relates to the concepts to form bachelors in vehicular and transport area. The third cycle includes the fourth and fifth year and it is designed for specific training in each seven focus areas of engineering course: naval and ocean, space and aeronautics, automobile, railway and subway, mechatronics, logistics and traffic and transport infrastructure. This structure is presented in the following figure.

<table>
<tr><td colspan="8">Outcome 2: Engineer Graduation Degree</td></tr>
<tr><td>5th Year</td><td rowspan="2">Naval and ocean</td><td rowspan="2">Space and aeronautics</td><td rowspan="2">Automobile</td><td rowspan="2">Railway and subway</td><td rowspan="2">Mechatronics</td><td rowspan="2">Logistics and traffic</td><td rowspan="2">Transport infrastructure</td></tr>
<tr><td>4th Year</td></tr>
<tr><td colspan="8">Outcome 1: Bachelors Graduation Degree</td></tr>
<tr><td>3rd Year</td><td colspan="5">Vehicular</td><td colspan="2">Transport</td></tr>
<tr><td>2nd Year</td><td colspan="7">Engineering Fundamentals</td></tr>
<tr><td>1st Year</td><td colspan="7">Engineering Fundamentals</td></tr>
</table>

Figure 1. Course structure of CEM.

Based on these concepts and the educational law, the follow knowledge and skills necessary for each formation were defined:

- Bachelor's degree in vehicle technology and transportation technology: know the basics to operate mobility equipment and be able to plan, maintain and operate the vehicles elements and transport systems;
- Engineering degree: besides the knowledge and skills of the bachelor's degree it is necessary to design and manufacture a fixed or mobile equipment or design and build a transport infrastructure element, as well as to have knowledge in financial and environmental fields related to the mobility.

The graduation as Technological Bachelor will be granted when the student successfully concludes the third year of the course, and graduation as Engineer will be granted when student successfully completes the fifth year of the course.

The degree of Mobility Engineering is in accordance with the Resolution CNE / CES 11, 11 March 2002, that establishes the National Curriculum Guidelines for Undergraduate Engineering Course and the Resolution CNE / CES No. 2, June 18, 2007, which provides for minimum workload and procedures related to the duration of bachelors courses in the presencial modality.

In the vehicular option, the CEM will offer training to acquire knowledge and develop skills to plan, design, build, maintain and provide products to carry cargo and people. In the transport option, training will be aimed at acquiring knowledge and developing skills to plan, design, build, manage and maintain the operational infrastructure to transport cargo and people.

The course has a pedagogical policy plan that follows a correct and exclusive format and it has the following principles:

- Strengthening the students autonomy in their training, which derives in no prerequisites definition to course disciplines. However, students must be approved in all disciplines from one cycle to access the next;
- The specialties choice will be given in the second and third cycle of training, based on the students´ aspirations and qualifications that will be deferred through evaluation of multiple criteria, considering the interest of the student, of the institution and society;
- Possibility of industrial training in short periods during the holiday period, to complement academic knowledge;

- Vertical and horizontal professors integration;
- Discipline organization in knowledge;
- Organization of disciplines with cross-cutting themes, contemplating the development of various skills proposals.

All courses include a timetable for theoretical and practical activities. The theoretical classes will be for 200 students and the practical classes of 40 students. What is theorical and what is a practical classes ? For example: The study of limits in the mathematical programs: the meaning of limits and the fundamentals about limits are presented in theorical classes. How to solve limits is presented in the practical classes. These division are organized in each discipline.

3.3. Organizational Aspects

To support the Educational Policy Project, the structure of the CEM, unlike the structure of departments and coordinators of the University, was structured according to Figure 2, below.

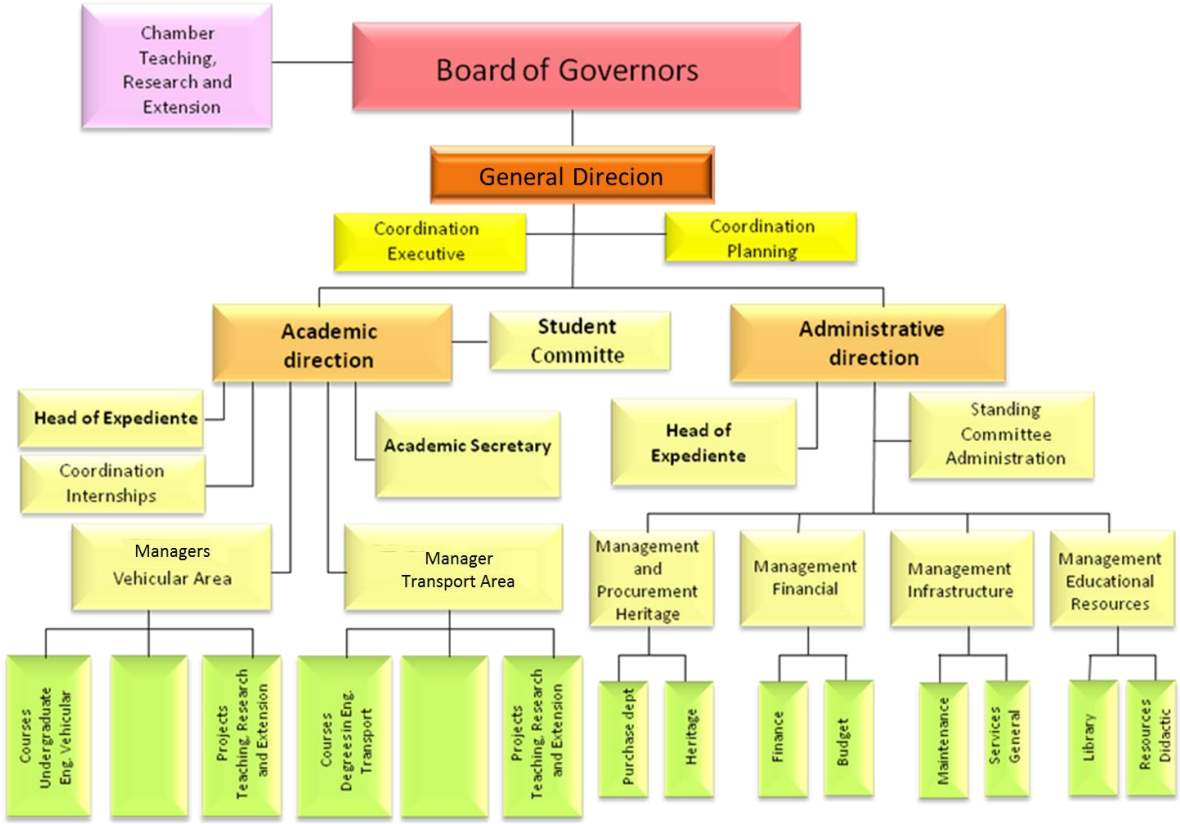

Figure 2. Structure of the CEM

In this structure, was prioritized the ends activities (Academic Direction) and administrative activities (Administrative Direction). It also highlights the Student Committee which deals with student participation in the management of the Center, especially in disciplines and revision of curricular parameters.

There are two aspects that must be emphasized in the Centre' organizational structure. The first is administrative, based on the administrative structure focused on the integration between the academic sector, the technical and administrative services. In this structure there is no existence of the Education' Departments, which is commonly in Brazilian Universities. The second refers to the integration among different initiatives. The administration board, teachers with degrees in physics, mathematics, biology and teacher with knowledge and experience in different area of engineering work together.

The main aspects of implementation are presented in the following item.

4. The Deployment

The implementation of the Center occurred in the second half of 2009 in rented premises, with the registration of 200 students per semester, while the final projects are being defined in land granted for the future campus construction.

Currently, the Center has 600 students, 22 professors (with doctor degrees) in the third phase of deployment.

Students participate in projects developed by the professor, and the Center now has more than 58 scholarships in social demands, training and research, corresponding to more than 10% of the students.

Also, CEM participates actively in the Joinville and Region Innovation Park (Inovaparq) which is the first project in Brazil with shared management of higher education institutions. This is a partnership between UFSC, State University of Santa Catarina (UDESC), University of Joinville Region (UNIVILLE) and the Institut Catholique de Santa Catarina, linked to the PUC / PR.

Finally, it is important to highlight the ongoing assessment that promotes the CEM to check the progress of its actions and fix the project's path. We conclude, so far as the administrative and didactic pedagogical model has allowed a good integration among teachers. The clearest proof of this is the structuration of Research Groups in the CNPq, contemplating all the teachers and some technics of the Center. This same integration reflected in the administration of the disciplines.

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