

# The 21st Century Engineer: A New Proposal Engineering Education

*Claudio da Rocha Brito and Melany M. C. T. da Rocha Brito*

*Department of Electrical and Computer Engineering*

*Catholic University of Santos*

*11045-003 - Santos - SP - BRAZIL*

**Abstract** - *The goal of this work is to show with some details the Project which has been developed by Engineering Faculty of Catholic University of Santos. This is a new scheme of Education that aims to form Engineers of Conception, capable to face the new global work market of next century and also capable to act effectively in the region that is very important in the national scenery. This is actually a course in which the students have to develop projects since the first year and this is what we call "Science Introductory". During the course the students are also advised and accompanied by a Professor to develop projects. The development of projects added by Lab works will provide them at least five projects of experience which means more research skills, self confidence and leadership habits. The experience has been developed for two years and has just presented very good partial results.*

## Introduction

Before discussing about the formation of the future Engineer lets meditate about the new world order, the new world market and the possibilities of the Educational Institutions presently.

Considering all these aspects and the network of interference of new technologies over the Education, lets quest and argue the main points of the process of Engineering Education.

The humanity has been living a moment characterized by high speed changes. We hardly get to assimilate a transformation and another one comes up generating an instability. The society today is dense, complex and it is in constant movement and mutation, showing the modifications in all levels of man's life, pushing and putting off those who can not go with the movement. The increasing technological invasion on culture, economy, society and science, collaborates intensively in the generation of a profusion of universes that mix themselves in several variations.

The plurality of time and space, that do not respect the geographical space and technological time come up to question the uniformity and the fixity of things.

The transport and communications approach and connect people changing the ancient state of things in a dynamic process of acceleration of communication and physical mobility.

Viewing the past and the present we all agree that Engineering has been playing an important part in the

development of technologies and so the new cultural and social world order.

Another aspect that can be observed along the years is that Engineering courses, in general can provide to the Engineers a big amount of possibilities of acting, it is not restricted only to the Engineer areas. There are in fact many Engineers working with management, social welfare and others.

To the Educational Institutions it consists in a big challenge to prepare the students to face the future and now more than ever. In South America now that the Mercosul ( The South America's Economic Bloc uniting Argentina, Brazil, Paraguay and Uruguay, in a first moment ), is a reality, the falling of the borders, the cultural exchange will rush even more the work market in many ways. Our Project was conceived from the growth need that we have seen since the beginning of this decade and this is an effort to face a situation that in many ways is changing the entire production system.

In Brazil less than 10% of students that finishes University courses belongs to the Engineering area against 50% in Japan, 60% in China and 23% in USA. It means that we are in disadvantage once Engineering is so important to the development of the country and society.

This Project that has been developed in the Catholic University of Santos has the goal to overcome the challenge to adequate the future Engineer to the new century's work market. It is a way to form the Engineers in which the students since the first year of the course have to develop projects in what we call "Science Introductory", which is a subject.

To illustrate our point of view we mention the thoughts of the great north American Philosopher, John Dewey, about Life and Education. In his own words "What nutrition and reproduction represent for physiological life, Education means for social life". He emphasizes that Life and Education should not be separated, "children are not in a moment being prepared for life and in another moment, they are living", Life and Education are the same. "The objects of Education have to be more and better Education", in the sense of a bigger capacity of understanding, planning, experimenting and checking the results. Education becomes this way, in a "continuous reconstruction of the experience". It is possible to realize this if the School turns into a small social system connected with social life in general and with the work of all others Institutions: the family, the work and religious

economical and political organizations. It has to be after all connected with life and world.

## **The University**

The Catholic University of Santos - UNISANTOS - as University is an academic community that in a critic and rigorous way, contributes to the defense and the development of human dignity, as well as to the cultural inheritance, by the research, education and services to the community. Altogether with the values in common with the entire University, the UNISANTOS devotes in a special way to the cultivation of human values and Christian ethic, for building a renewed democratic society, more fair and more equal.

It confirms the man's primacy over the things, the spirit over substance, the ethic over the technical, so that science and technical are to men's service.

UNISANTOS recognizes and defend the universal right to education and man's free choice of types of education. inserted in a pluralist society it accepts all kinds of people, with no distinction of race, color or creed, since the legal demands are satisfied and respect to the Catholic Identity of the Institution.

UNISANTOS has as one of its goal, to prepare professionals with a solid Christian formation, remarkable in knowledge, qualified to the efficient performance of their functions, with a sense of social responsibility and that they are witness in the world of their Catholic Identity.

The members of Teaching Staff of the University are chosen among people of scientific merit, technical competence, professional honesty and life probity socially accept and respect to the principles of Catholic doctrine.

The entrance and the permanence in the Teaching, Student and Administrative staff is a free and individual option, what implies as an attitude of coherence the compromise of respect to the principles that guides the Institution.

Every exercise of functions is a service to be realized with dedication to the university community.

UNISANTOS predisposes to a permanent evaluation of its performance, searching for a continuous institutional improvement and the accomplishment of its objective.

## **The Engineering Faculty**

The Engineering Faculty of Catholic University of Santos provides the students a solid professional formation allied to a humanistic formation in according to the Philosophy of the University. It has the preoccupation to make the curriculum structure adequate and suitable to assure the students a good professional performance and the ability to face the challenges of future world.

The high level of Education is a consequence of a good Teaching Staff, Researches, Technicians as well as the high level Students who are rigorously selected. Besides the good material conditions which includes Libraries very well equipped as well as the Labs, Internet access and the Professors can count with all sort of extra equipment in the classes they eventually need.

## **Engineer of Conception and Engineer of Application**

There are two types of Engineers that are named Engineer of Conception and Engineer of Application [1,2]. In the developed countries there is a clear distinction between them. The first one has an university formation and the other a superior technician formation ( not university ).

In Brazil the difference is not so clear because there is no distinction between university Education and third degree Education not university.

The Engineering Faculty of Santos and which is part of an University has the goal to form Engineer of conception. However, it is not possible to form Engineer of conception ready for the work market with the traditional under graduation course. There is the need of complementing with the skill of good practical work to the effective professional performance [3]. One solution that we have been developed is to complement the course with the necessary enlightenment to get this. It is based in projects that the students can purpose, develop and implement during the course.

## **The "Science Introductory"**

This is a process of integration of Theory with the practice because since early, in fact since the first year, the students have to concept projects. They have to propose, to develop and to get the conclusions in according to the proposition. The projects are presented in a Congress that happens every year and evaluated by some of invited Professors.

The curriculum was elaborated in a way that the experience in what we call "Scientific Introductory" is part of the course as a subject. The main objective is to decrease the conflicts between the academic learning and the use of knowledge.

This subject provides the students the theoretic and practical knowledge qualifying them to incorporate the knowledge of the areas of Engineering in the process of creation of projects.

This new scheme of Education mobilizes the whole Institution and the University has created a "Science and Technological Introductory Congress" for all students of Engineering to show their projects to the Academic / Scientific and Industrial Community [4].

With the success of the Congress, from now to the future the ideal is to open the Congress to other fields of

knowledge in the University so that all the students have the opportunity to show their projects to the community. It is part of the philosophy of integration of practice/theory for all courses of the Catholic University of Santos.

## **The Project**

Santos is a large city which has the biggest Sea Port of Latin America and it is also close to Cubatão city where is the largest Industrial Park of Latin America. This is the main aspect that makes this project so interesting to the Academic and Industrial Community of the region. In fact the Project described here comes to attend the necessity we have been feeling to transform the region called "Baixada Santista" in a Technological Park.

This Project consists of the union of a high academic process with a strong emphasis to the activities of "Scientific Introductory" offered to the students in the Labs of the University. This will provide considerable benefits not only to the students but also to the University and the Enterprises which are the main clients of the University.

As related before every project developed by the students during the year are presented in a public section and to three Professors, specialists who evaluate the works. The section is presided by the Coordinator/Professor and the approval of the work is necessary condition to the approval of the student for next year, for this subject, and the projects are also included in Proceedings of the Congress which are distributed to all University and some segments of the Academic Community.

The students are stimulated to assume more responsibilities and so they have to work hard to ensure the good score for their works. They pass the day in the University taking classes, in the Labs, in the Libraries and they have after six in the evening to develop their researches and to study.

Besides the project of "Science Introductory" the students also have the other works of the other subjects to do.

The Project, or the introducing of this new method was planned considering the following aspects:

- The Global Economy which has an incidence straight in Education, with the fall of the boundaries and the exchange of ideas, technologies and culture;
- the new work market that is emerging because of the advanced technological achievement;
- the technological transformations principally in transport and communications that are approaching the distances;
- the changes in the entire Producing System;
- the consequent changes in the work relations;
- as well as the consequent social transformations that have been promoting deep and strong changes in human relationship;

- the Educational Policy of the Country;
- the historical and political moment of the Country and the fact that we are a "developing country";
- the geographical situation of the region ( that is called "Baixada Santista"), very close to the capital city of São Paulo State; the Sea Port that is responsible for the exit of most part of the exportation of the country and the largest Industrial Park of Latin America;
- the material and human resources available in the University, which includes the good Labs and a very good staff of Professors and Technicians, and of course the students.

Although the students are selected by the "Vestibular", a selective exam to get into the University Courses, the Catholic University of Santos has the most selective one. In the Engineering Courses only 1/5 of the pupils of the first year has got approval to the second year which shows a tendency of a rigid study to make of them besides good Engineers also good researchers. In fact the Catholic University of Santos traditionally has been forming through the years leaders of the region in the several segments of Santos Community.

## **The Engineering Curriculum**

To implement the new Engineering Course, one of our preoccupation was to make the curriculum more dynamic, present and flexible, just to accompany the quickness of the changes in the several areas of Science. So it became necessary to adopt a new strategy of organization of the Engineering Courses because of the growth necessity of constant reorganization of the curriculum.

To get this goal the curriculum was created so that it is possible the constant adaptation to the necessities of the economy, industry and the society Then we have been concerned about the items listed below:

- attention to the changes of professional practices;
- the courses tend to a generalist organization so that it is possible to face the quick mutations of knowledge;
- logical coherence between the contents of basic disciplines and the specific necessities of Engineering Courses;
- and above all the radical renewal of unnecessary repetitions.

Another warrior has been the didactic adequacy of scholar practices and the conditions in which the process develops.

This adequacy was tempted by means of:

- the student has to feel himself an Engineering student since the beginning introducing technical subjects since first year of the course;
- permanent attention to the students;
- appropriate locals for studies;
- Library.

Added to this, every student has an advisor who supervises his Science/Technological Introductory project until the presentation at the Congress.

### **The Profile of the Engineer of Catholic University of Santos.**

The Engineer of Engineering Faculty of Catholic University of Santos will have a wide formation involving the several areas of technological knowledge.

The main focus of the study of these areas is to endow the future professional of a bunch of information and knowledge which will provide him to work in a consistent way in any activities of the Engineering area. His formation is Engineering so the professional will have a vast technological and scientific culture in a way that he can apply scientific information and knowledge, as well as the technological progress to realize his projects [5].

He is a highly specialized Engineer, he is used to leadership situations, with administration and management skill besides the reasonable experience in the development of projects achieved during the course.

They will be able to perform effectively in the new global work market [6].

### **Some results**

An evaluation made with the students showed that this learning process provided them more self confidence in individual work or even in group work. When the students terminate the course they will have then training and knowledge enough to face their professional life that now and to the future will be more and more competitive.

The last Congress was a success and the quality of the works has raised substantially.

This is a work that has been developed for two years, elaborated considering the present way of Education available in the country and with a view in the Mercosul. Although it is not easy to picture the future we believe that we can approach to a process that will satisfy the new South America Engineering work market.

### **Conclusion**

On the contrary of what happens to the traditional Superior Educational Institutions, the Computer Engineering Course of Catholic University of Santos offers conditions to the employers to supply the necessity of good experienced professionals hiring ours. Although they are just graduated they have a minimum of five years of experience given by the Lab Works and Development of Projects; they have just training and familiarizing with management structure. This way they

have good skills and professional maturity that naturally occurs.

What must be emphasized is the pioneer characteristic of Engineering Faculty of Catholic University of Santos in Education, looking for a way to form professionals capable to face the competitive reality of global work market, providing them a real integration between theory and practice which has been discussed but not applied [7]. Besides the Catholic University of Santos has been stimulating in a pioneer way the national research for Education because it requires the students formation the real work as researcher.

### **References**

- 1) Brito, C. da R. "Ensino cooperativo", *RIEI/RIEE Revista Ibero-Americana de Enseñanza de la Ingeniería*, México, v. 6, n. unico, 2 sem. 1993, p. 76-81.
- 2) Brito, C. da R. "A cooperação universidade - empresa na USP", In: Interamerican Conference on Engineering and Technology Education, 3., Rio de Janeiro, 1994. *Proceedings INTERTECH - 94*. Rio de Janeiro: INTERTECH, 1994. p. 286-296.
- 3) Brito, C. da R. "A aproximação do ensino da engenharia à realidade das empresas pelo disquete tecnologia", In: Congreso Panamericano de Enseñanza de la Ingeniería, 16., Acapulco, 1994. *La enseñanza global y la certificación panamericana - Summary*. Acapulco: UMAI - UPADI, 1994. p. 79-80.
- 4) Brito, C. da R. "Workshop em Engenharia Elétrica e de Computação", 1.; Santos: UNISANTOS, 1997. *Anais*.
- 5) Brito, C. da R. "An Appropriate Engineering Education Facing the New World Reality", In: Interamerican Conference on Engineering and Technology Education, 5., Rio de Janeiro, 1998. *Proceedings INTERTECH - 98*. Rio de Janeiro: INTERTECH, 1998. p. 09-13.
- 6) Chevalier, G. "La gestion opaque de la recherche universitaire", *La Recherche*, Paris, n. 306, p. 12, 1998.
- 7) Universidade Católica de Santos. "Guia Acadêmico", 1998. Santos: UNISANTOS, 1998.