The 21st CenturyTech Project – 2015/2019

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Abstract - The differences between ET and traditional engineering programs are not always obvious. There is a great overlap between the two fields of study. In most engineering schools, both types of engineering programs strongly emphasize mathematics and science, especially physics and calculus. While the main topics in both programs appear similar, ET content emphasizes the application of engineering techniques and traditional engineering content will focus on the development of concepts, it is what is called design engineering. ET graduates and traditional engineering programs complement each other in skills and interests. Application engineers work with technicians and design engineers to form technological teams that produce the technological advances we see in the present. The available and increasingly powerful and affordable technologies have been a big boost for small businesses. This also means that business owners need to choose from a huge amount of options and find the best ways to use technology to achieve their goals. Entrepreneurs face a variety of technological issues while developing their business. It is often interesting to have at disposal the possibility of a serious organization to help when problems come up. Thinking about this a private engineering school has established an office that provides engineering technology consultancy for small business companies, for reasonable prices providing also the experience that engineering students need before facing the new challenging work market. It has been working for twos years and so far it has positive results both for students and companies. The office has been named as 21st CenturyTech.

ENTERPRISES AND ENGINEERING

Science, Engineering and Technology permeate nearly every facet of modern life and as problem solvers, engineers are perfectly capable of managing entrepreneurial activities mastering innovative ways of business development once they spend time and efforts understanding and acting in the field. Engineers rely on science and methods for analysis to ensure the quality and liability of design; nevertheless a pinch of creativity is required in order to find innovative solutions for economic and entrepreneurial problems. So at the present engineers with technical skills must also learn how to work in interdisciplinary teams, how to develop designs rapidly, how to manufacture sustainably, how to combine art and engineering, and how to address global markets. Providing future engineers opportunity in the work market has become now part of university formation, as a way to assure also the future competitiveness of university.

Enterprises and universities have still in many places difficulties in working together, it is up to the engineering schools and universities to have the initiative to enhance their programs, to assure the proper formation for future professionals that can perform in this mutant work environment of 21st Century. In accordance with the National Academy of Engineering, USA report "The Engineer of 2020" paints a picture of a dynamically changing and evolving world: "The successful future engineer will need strong analytical skills, practical ingenuity, creativity, good communication skills, business and management knowledge, leadership, high ethical

standards, professionalism, dynamism, agility, resilience, flexibility, and the pursuit of lifelong learning", the report says.

Currently the opportunities for professionals seem to be very narrow once economic crisis is impacting countries and communities worldwide, as the result of a natural cyclic wave of economy until a new economic model starts to work somehow. To provide future professionals an opportunity in the work market has now become part of university training as a way to assure the future of university.

COPEC – Science and Education Research Council education research team has designed and implemented a program for engineering students which is called "Working with Enterprises Course", providing 3rd year engineering students the chance to work with consultancy for the entrepreneurial community in the city. The goal is to offer a space that has been named "Creative Engineering Office", which local entrepreneurs can refer to with a problem or project to discuss and to find sustainable solutions.

It is a very good opportunity for students once they work using their creativity to design and present solutions within the constraints of ethical practice grounded in science and engineering methods and standards. The process involves face-to-face meetings and discussions with entrepreneurs of the city, from the presentation of the problem until the delivery of the plans. Once engineers are part of society it is important that they have a stronger interaction with the wider public. So the goal of including this course in the program is to provide students the opportunity to work closely with the real local entrepreneurship environment. Apart from this, engineers need to develop broad fundamental understanding of their professional responsibilities as well as the need to be entrepreneurial in order to understand and contribute in the context of market and business pressures. If engineers can work with the public to explain how engineering can help address their problems, and to help them to decide which are the most effective and affordable ways to address their concerns, the community can make great progress and improvements. It will surely be a great acquisition for the city business community as well as for the students themselves, once they can get a glimpse of what it is to engineer in real world.

This project is being developed in partnership with a City Hall (of a region where there are many industries) as a way to improve entrepreneurship in the region, aiming at fostering employment and private initiatives to change the community's profile.

COPEC ORGANIZATION

COPEC – Science and Education Research Council is a multi-disciplinary organization that is a leader to advance science and its application to the development of technology serving society. It started its activities sixteen years ago and since then this organization has made a major contribution to the development of science and education working to increase the best practices in several research fields.

Integration activities promoted by COPEC provide a qualified coordination and building partnerships because COPEC is a organization that brings together scientists who share the mission of promoting and developing science, technology and education.

The objectives of COPEC are to promote professionalism, integrity, competency, and education; foster research, improve practice, and encourage collaboration in the different fields of sciences.

Contents, tools and services provided by COPEC, through courses, publications and consultations with national and international experts contribute to the promotion of the professional who wants to be privy of the new achievements and the service of man to technology.

COPEC enjoys respect and recognition internationally characterized by the open discussion, the free exchange of ideas, respectful debate, and a commitment to rigorous inquiry. Its IIE –

International Institute of Education is a bold and resilient source of innovation in higher education [1].

EDUCATIONAL ASPECTS OF CONTEMPORARY HIGH EDUCATION

No doubt that work environment has been changing drastically and it takes place worldwide and today millions of professionals are also unemployed, even in advanced economies. On the other hand, businesses in advanced economy countries claim that they often are not able to find workers with the required skills. It is a fact that this is a symptomatic dysfunction due to the structural changes that are transforming the nature of work and reshaping employment opportunities. This shows that organizations and policies are not keeping up with the changes in business practices and new technologies that are defining what kind of jobs will be created and where they will be located. So there is a need for companies to redefine how and where different tasks have to be carried out requiring new skills and new employer and employee relationships [2].

It is very important to attempt that the possibility of international careers for engineers has been expanding access to low-cost talent professionals and creating a greater need for workers with higher levels of education and specific skills in order to perform in advanced economies. Under skilled workers are disappearing due to automation and low-cost labor market abroad. In this world scenario, education and training should be seen as vital economic priorities by governments. However, it is still possible to observe the neglect of some nations, perhaps due to lack of political interest other than electoral. Although governments need to invest in the entire system that builds workforce skills, in some places it is up to private initiatives to offer opportunities for young ambitious talented professionals, who can cooperate for a better future of generations to come. There is no better place than universities to offer these opportunities, pushed by the enterprises. It is important for nations to train highly skilled native-born citizens as well as to attract highly skilled immigrants in order to be competitive in a global scale and assure a future for the people [3].

Besides govern agents should be aware of the fact that if there is no production system there will be no financial resources to maintain social assistance system. This idea of an Tech Project will help generate more quality services for the betterment of service industry as well as the productive system generating opportunities and generation of jobs, which is a need everywhere in the world today [4].

THE "TECH PROJECT" ASPECTS

In fact it is the evolution of another project developed for an engineering program that worked very well and so the team decided to enhance the project and rename it as the "Tech Project once it involves a lot of technology principally targeting the development of engineers suitable to work in industrial environment. It fits the region needs once it has a lot of industries and big enterprises. The students are from the Electrical and Computer Science Engineering programs.

As the previous one every student who is interested in the project register for economics classes. After three weeks of classes they take part in a training class in order to learn how to cause a first good impression with their future clients. This is followed by a period at The Tech Project, in the City Hall. Their work starts when they register for the project, which is an opportunity of intensive internship early in the program.

The first idea was to offer an extra course and invite students to enroll the course. However as it had in a first moment a low number of interested students the coordination of the project decided to offer also as internship opportunity. This idea reached the desired goal and a larger number of students enrolled the course/internship opportunity.

There are some "soft skills that are required once the students will be facing a real working place. A positive attitude because it is a valuable interpersonal skill. Writing well is another one,

as well as leadership and responsibility; take action and network with colleagues and enterprises, besides computer skills, planning and organizing.

An interesting challenge provided by the project development is that students have to be committed with sustainable and feasible simple solutions for medium and small business problems and as low cost as possible. These are the headlines and main idea of the entire training that they have prior the practical period.

Bellow is the picture of a meeting of a team of students:

Fig. 1 Meeting

Once at The Tech Project, for a period of at least four months, students have to establish goals and work towards achieving them. Students are challenged to start a professional relationship with a possible client, leading them to be open and honest. They will start identifying a problem, and then find a theoretical background and a methodical approach to solve the problem within a realistic time frame towards the completion of the project and at reasonable expenses. This is followed by the implementation period and the refinement of procedures in order to solve the problem and deliver the project.

The students are volunteers however they get paid a small amount in order to cover the expenses with transportation and one meal. It's almost important to point out that students are not doing lots of work, once volunteer/internships are not unpaid labor. The whole point of the volunteer/internship is to gain experience, make contacts and gain references.

Work experience seems the obvious answer and that is where internships can come in handy. Whereas general work experience can be any kind of employment where future engineers can gain valuable transferable 'soft' skills such as communication and organization, among others. So internships tend to be more structured and in the field that eventually students want to move into.

After the accomplishment of the project, students send a report to the Head Director of The Tech Project to be included in both the program's and the students' portfolio [5].

PROJECT DEVELOPMENT METHOD

The entire process has been developed in steps and it required a person in charge of the project, which in this case is the professor specially hired as the Head Director of "The Tech Project" since the very beginning. The Head Director will keep the project working and collect all data for enhancement of the process throughout its development.

The project starts with adding a course named "Introductory Economics Topics" which may include an overview of: economic theory, econometrics, macroeconomics, microeconomics, economics research methods, economic policy, game theory and mathematical methods for economic analysis. The main goal is for students to have a glimpse of economics aspects necessary to understand and boost the economic commonwealth of the region. The hired teacher is a professional who is also prominent in his field in order to attract students and enhance the quality of the program. The model chosen is the one-week intensive class about the topics, in order to provide them the basic knowledge and the means to research further information when

necessary. This step will take nine weeks before the students can start their journey in the project.

The legal aspects are up to the consultancy of law office of City Hall in order to assure that some other issues related with legal actions and measures are avoided.

The research team proposes to offer this course for all engineering programs of the Engineering School of the university involved in the project, to have a critical mass of specialties to perform in the consultancy field for the community. However students are invited to join the project, which in fact reduces the number of interested students. The key is to have really interested students involved in a first stage, so that it can be expanded to all school programs as a way to increase the quality of the program [6].

Bellow is the picture of the office:

Fig. 2 Workspace

Once the number of students interested from all the programs of the referred engineering school is established, the next step is to hold a meeting with students and define a schedule for the activities to be held at the office, located in the City Hall building which is offering this service to the community. The workspace is basically a clean, neat room with tables, chairs, computers and a telephone line.

It is up to the City Hall to advertise the service offer "The Tech Project" to the local community. The university is responsible for providing the students and the necessary laboratories. In case a laboratory is used, a fee is charged to the consultant to cover basic material and energy. There is another professor in charge of mentoring the students' team for a determined period as volunteer work, in order to help refining their proposed projects to their clients.

Next step is to have students working in teams at the offices, available to receive possible clients. The students welcome the client that in many cases is from a considerable size enterprise; start a professional relationship and work in order to solve the presented problem.

Their work starts with a visit to the enterprise where the business takes place, collecting all data, followed by the search for ways to best solve the client's issue. This means that they have to work hard in teams to find out "The Best Solution" for the presented problem in a "Certain Period of Time", which the team can establish and must honor. It is a simple concept that works because of the commitment of all people involved in the process.

Both the university and the City Hall are committed to provide this service for a determined period of time in a first moment and the enlargement of this service, if there are conditions for it. An agreement is signed between both organizations for a certain period, which can be terminated by mutual decision. The implementation of the "Tech Project" started in 2014 and the activities started in March 2015 as the enlargement of a previous project with the particular City Hall.

SCHEDULE FOR 2016/2017

The maximum number of groups per period is 5 with an average of 4/5 students each. Each group can work with maximum 2 clients in order to have a good performance once it is

submitted to the availability of the students because of the classes and studies in the university. The project must be delivered at least before the end of their period at the office.

Bellow is the schedule organized for 2015/2016:

1st period	March/April/May/June	4 groups with 4 people
2nd period	July/August/September/October	5 groups with 3 people
3rd period	November/December/January/February	3 groups with 4 people

Fig. 3 Schedule

It is important to have the office working all year round, so that students can choose the best suitable period. In any case, the schedule is up to the Head Director of The Tech Project to set it together with the students.

PROJECT OBJECTIVES

The project objectives are essentially the development of engineers with skills to perform in the future work market especially in industry, as high skilled professionals are a demand in every country, which widens their job opportunities. The following skills are important once they are already required:

1. Broad knowledge of different fields in economics;
2. Enhanced research skills for researching for clients;
3. Entrepreneurial skills;
4. Knowledge of theoretical and empirical approaches to economics;
5. Management skills;
6. Solid understanding of economic practices, principles and theory;
7. Strong command of economic models, tools and techniques including particular statistical techniques;
8. Strong numerical and analytical skills;
9. Strong oral and written communication skills, including preparation and delivery of professional, technical and non-technical reports and presentations;
10. Time management skills.

At the end of the period the students will be able to understand the real economic and social impact of engineering in this century. Another target goal to be achieved is to foster among them the entrepreneurial mind to pursue other opportunities than find a job in a company. For the university the final goal is to attract more students and enlarge the number of students in engineering programs. Besides by law the universities should to provide services to the community, what serves for both student's practical period and society access to consultancy in engineering that is very expensive otherwise. For the City Hall, this is another community service funded by federal government, which could be turned into votes for future elections.

STATUS OF THE PROJECT

The groups and the director of the project are doing the assessment of the project as a type of swot in order to identify the weak and strong points with the goal of making adjustments for future activities.

So far the project has worked relatively well. Student groups are working hard and the results have been positive. Customers of the office present a high level of satisfaction. This information is based on the result of a survey that is completed at the end of the project close to the participant companies.

The students claim that the project is a very good opportunity to know their own limits and capabilities. The difficulties they face are related to the fact that they have to combine the project work with studying hard to accomplish the engineering program.

They have provided good feedback and are working hard to finish the engineering program, certain that engineering is what they want to do in life.

The City Hall evaluates it as a good service offered to the community and intends to keep "The Tech Project" open for another year. The constrains are related to the political environment, meaning that the project will last as long as there is political interest by the current government bodies at least until 2016 [7].

Statistics and numbers details will be available in a couple of months when it is expected a coordination between the engineering team and city hall coordinators meeting around august 2017 to establish the future of the project.

CONCLUSIONS

One of the best outcomes of the project is the skills that the students develop along the process in the "Tech Project", is the perception that they have to take risks and turn today's failures into the seeds of tomorrow's successes.

Another result seen during this process is that the project helps the students to experience what it is to be an engineer early during their studies.

A relevant conclusion is that in the process the students can evaluate their own performance and make adjustments. Furthermore, they develop skills such as human interaction, work in team, work under deadlines and how they can really engineer for sustainable, feasible solutions.

Some important pedagogical aspects of the program are the key factor for its success, which are the extra courses of economics taught by specialists and the research practice that students have to develop in order to get the basis for project development.

The partnership with local enterprises has enriched the experience for the students; the teachers and the enterprises strengthening the relations and students quality project development.

It has been a very rich experience for students and shows them that they need to be very much self disciplined and to avoid procrastination.

ACKNOWLEDGMENT

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