Experiences in Capstone Projects for Industrial Designers

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This paper is intended to share the experiences in developing Capstone Design Projects for the final year of education of Industrial Design Students at Tecnólogico de Monterrey, Campus Querétaro. The process of planning, operating and developing industrial design real projects by the students, has proven successful with the integration of relevant methods and strategies to achieve both the goals of the school and those of the students in the context of their career ending courses. Professional insertion project is the course that allows them to practice at a professional level to experiment and develop further their designer's skills, test their knowledge and exercise their professional practice based on their competences; applied in the various fields of product design, strategic design and project management. This training approach for undergraduates is not a common practice yet in Mexico. The School of Design and Architecture at the Tecnológico de Monterrey considers that Capstone Design -Professional Insertion Project- in the past nine years has innovated and challenged the future of designers' education in a context in which entrepreneurship and competitiveness are fundamental for the future of the Design professionals. Given the vast and diverse industrial-sponsored projects, those faculty or student-sponsored projects, the Professional Insertion courses have been in a permanent struggle to reach the expected outcomes and to establish a systematic pedagogical approach, nevertheless, in sharing this experiences we are willing to have better understanding of the contextual scenarios that will be useful for the new educational model at the institution, in which Industrial Designers education is based on a commitment to relevant issues in the economic development of Mexican Industry, and above all a contribution to the quality of life of Mexican people.

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Overview

Industrial Designers competences are key factors to determine the conditions and quality of their insertion in the professional world. In a competitive environment and within a professional practice that has not yet acquired the status of a fully recognized profession in Mexico, that is Industrial Design; the relevance of participating in a capstone project before leaving design school as an undergraduate is enormous. It does make the difference, since we can simulate their future professional design practice, as well as encourage them to use the skills they will apply in their future design projects. At the same time, the students get to know first-hand the diverse clients -academic partners- in the region and the kind of approaches and strategies they have to apply to design problems in real contexts. We have made possible through real projects the opportunity for students to experiment and manage the design process, the human resources, the technologies available, manufacturing capabilities of their clients, as well as, the social and economic factors involved in the problem. The students get to develop their skills in Industrial Design in all its facets: product design, strategic design and technical issues involved, to face the market and sustainability challenges, while still getting the academic support: the theoretical and technical tools provided by the School and the guidance of tutors.

All projects that are assigned to the students undergo a process of scoping and selection. Those that are proposed by private and public sectors organizations, industrial and commercial enterprises, student and faculty-sponsored projects are carefully analyzed and studied before they are assigned to student teams in the Professional Insertion project course (PI) an Industrial Design exclusive course for the undergraduates. All this work, previous to the semester course, is done by the Capstone Project Committee, that includes the Faculty, the Professors in charge of the PI course, the Capstone Projects Coordinator, who does the scouting and establishes the liaison with the organizations that we refer to as Academic Partners.

The Capstone Project Committee is responsible for those Industrial Design projects assigned each semester. This academic group has been working for the past nine

years in ascertaining the program and scope of the Capstone Design courses as well.

Professors or tutors of the Professional Insertion project course at this point act as advisors of students and at the same time judge and define the basic design brief of each one of the projects, analyze the terms of reference, scope of work and establishes in general terms the competences involved in each project to be assigned to student teams. The Professor then develops a general program for the all selected and asigned projects as well as the rubric for the partial and final assessment of the students. We shall examine the rubric based on competences that have been recently developed.

The Capstone Project Coordinator has a fundamental role as the liaison with the Academic Partners, that is: industries, private or public organizations, institutions or agencies. All logistics and legal matters in relation to the Capstone Projects selected are part of his responsibility. He also coordinates all the activities of the students -Design Teams- and shares them with their Academic Partners (Students Clients). He follows up with the students both at the individual and group levels.

The Professor role in the Professional Insertion project course is to advise, organize and assist in Industrial Design technical and methodological matters. Basically in charge of making things happen within the students working teams. Discussions with the student project teams are happening at all time, dealing with the definition of design goals, technical and creative advisory, counselling in manufacturing and strategic subjects related to their design project. The course is based in Capstone design, within this framework, the activities of the tutor in charge is to follow up the application of the industrial competences by the students, so they can model their professional skills and knowledge through the development of the specific project asigned to them. A weekly session with all the student project teams is completed based on the programmed sixteen weeks that the course lasts.

Experiences

Experience in scoping and selecting Capstone Projects for Industrial Designers at Tecnológico de Monterrey has to take into account from those projects, not only their contribution to the academic process of industrial designers, but also the nature of the design project and pertinence to the design process and competences involved, also to respond to the requirements of the Academic Partner, timetables for the organization and the University, fulfilling the needs of the end user of the product or system designed, to be congruent to the business model and entrepreneurship aims, and meet the proper deliverables. The criteria and visions of what are the best capstone projects have undergone constant discussion. Ultimately a lot of experience is gained for all involved in the process: students, professors and academic partners.

The following list of projects and their academic partners -student teams clients- can give an idea of the variety of the industrial design projects assigned to students in the recent years at Tecnológico de Monterrey Campus Querétaro. These are a only a few that comprise both the successful capstone projects, that were able to address the requirements of the Academic Partner and those of the Professional Insertion course.

Examples of Projects and Academic Partners

• Design of Knock-down Sustainable Home refrigerator. MABE Querétaro. 2012 Honorable Mention at PREMIO QUORUM 2012, Mexico City. Was shortlisted in Red Dot Concept Design Award 2013, Singapore.

• Design and development of a System for reading ID Cards. NIKAN Querétaro 2014. Part of NIKAN incubation projects now in a process of prototyping.

• Design of Urban Furniture for Micro Arquitectura Mx 2014 Applied in an Urban development in Cancun, Mexico.

• Infants Bicycle Design and Prototype, Central Bike, Querétaro, 2013 Prototypes been tested by the company.

• Product Design for Progressive Stamping Mexico, a product line for diverse markets applying micro stamping process. 2015 Implementation of designs in progress, stamping molds under fabrication.

• "The Kitchen of the Future". Concept and Design Proposals for MABE México, 2014 Prototype to be presented at the 70th Anniversary of the company in Mexico City Showroom at their corporate headquarters.

• Design and feasibility study of Heating devices to be produced with local suppliers. TUBOSOL Heating, Querétaro and Buenos Aires, Argentina. 2015

• Design of a Mobile Unit for Producing "Tortillas", Grupo Alimenticio del Bajío SA 2012

• Sustainable Educational Material for Primary Schools. Innovación y Proyectos Bambu SC Querétaro, México 2012.

• Recycling Wood for alternative sustainable furniture. Carpicentro. 2015. Furniture being manufactured at Carpicentro's Workshops distributed by their shops.

• Cutlery for Children with Cerebral Palsy, APAC an ONG in Mexico, dedicated to children with this desease. Prototypes of Forks, Spoons and Knifes for infants in 3D printers.

• Low cost furniture for low income families. Design and commercial strategies. EDITORA de DISEÑO. Querétaro 2014.

• New approach for Kitchen Stove accesories. Concept and Design Proposals for MABE México, 2013 Will be launched as a new component of the Kitchen range this summer.

• Design of a Tourist Sightseeing Transport vehicle. Secretary of Tourism, State of Querétaro, 2007. Two Units have been produced by local industry, are being in use since 2009 in downtown Querétaro.

• Supermarket Cart, Design and manufacturing feasablitiy studies, for a plastic manufacturer. Plásticos Técnicos Mx, Querétaro. In progress.

We now have nine years of experience in applying Capstone Projects for industrial design students in their last semesters in the design school. More than one hundred and ninety capstone projects have been developed. Most of these projects are originated in the Region, that is within 50 miles from the university campus. With a variety of themes and design subjects. Although we have a large number of projects proposed each semester for capstone designed courses: Profesional Insertion Projects for Industrial Designers; we have to make a shortlist from them, in order to have the most pertinent and purposeful for each academic period. In our presentation we will be able to show and describe the typology of projects, the diversity of academic partners we have had, and those we still wish to receive. But more interesting to see and analyze, will be the results obtained by students with their deliverables on the capstone projects. As well as the feedback we have from industry and institutions, our academic partners.

Typology of PI course Projects

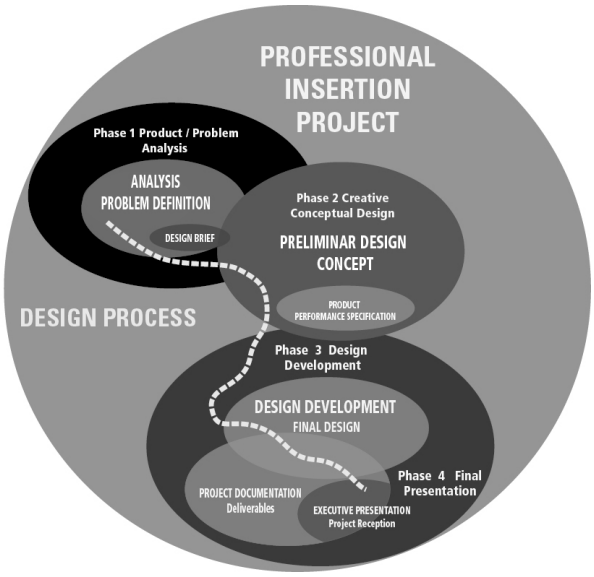
Querétaro is actually a fast growing city, originally a colonial city with agriculture on its sorroundings. Now is a vigorous industrial city with one million people, in the center of Mexico. Agroindustrial parks, as well as large Industrial parks have made the regional economy grow based on diverse categories and industrial sectors. An Aeronautical cluster has been established as one of the hubs for new opportunities and is a world wide reference nowadays. Autoparts, Furniture industries and Agroindustrial products from Diary and Vegetables flourish in this part of central Mexico. Therefore a large roster of prospects for Capstone designed courses.

These facts mentioned are opportunities for future of practicing Industrial Designers studying at Tecnológico de Monterrey Campus Querétaro. Our Capstone Design course for Designers: Professional Insertion Project has all these assets taken into account; plus the Public Sector needs for Design, Government Agencies have asked to participate in various Capstone Projects. Also in this city there are many social organizations that have touch our university for various projects, not only in Design but for many other carreers and disciplines. So we live and cope with diversity and variety of projects so the typology of them is as big as Queretaro and the Region needs.

Model

The model for capstone projects for industrial designers is based in the Design Process. We have divided the development and operation of the capstone project into four phases, the same way that we divide the design process. Starting the first phase with Project Analysis (Design Brief). A second phase Preliminary Design (Concept Development) the third phase: Project Development, and the fourth (Project Documentation and Final Presentation).

DIAGRAM of the Capstone Project: Professional Insertion Project



Projects are to be developed in a sixteen weeks semester. In the first phase of the course the selected projects are assigned to the different student teams. Each team is responsible for their project development and once they established contact with their academic partner they will program their activities and set up the initial design brief. The Professor has no direct relation with the Academic Partner, the students and the teams by themselves will build up their scope of work and their agreements with their clients (Academic Partner).

The Capstone Project Coordinator register and supervise the students project teams in order to have control of the administrative matters: the contract, the confidentiallty letter, the programmed sessions and both the student teams and academic partner rights and responsabilities throughout the process. Most of the Capstone Project Coordinator tasks deal with logistics and institutional relations with the organizations that take part of these academic program, this coordinator does not belong to the Design Faculty, they belong to the Academic Links Office of the campus and support various Departments.

Each project and their correspondent student team have to agree and define their scope of work, the deliverables that are particularly defined, mostly depending on the type of design project. Each team has the responsibility to agree upon meetings and data collection, visiting to their client premises or investigating the conditions of the problem, the market and stakeholders. One important feature is to establish the *business model* as well as the *design brief*. Both documents are relevant to the capstone project, since they define the goals, actions, requirements and parameters around the industrial design project.

In the second phase, based on the agreements stated in the *design brief* between client and students; the student design teams shall work in the conceptual design, approaching the satisfying the project design and strategic requirements. A product performance specification will end this phase to continue in the third and conclusive phase of the design process, with the design development, in which the technical matters and specifications must be attained. Documentation and visual models and in some cases scale models or prototypes are completed in this crucial. phase of the Capstone Project. In the fourth and final phase a formal presentation of the design results is made to their clients (Academic Partners). This executive presentation normally is accompanied with all the documents, drawings, renders, images and materials that are part of the deliverables; generally a poster presentation prior to the formal presentation is delivered by each team for their records and also for the Design and Architecture School records.

Throughout this process, tutor and coordinator register the development of the designs and strategies. The coordinator remains in contact with the client-Academic Partner for the follow up of the project, solving logistics and conveying information between student teams and client, there are scheduled meetings with the Capstone Project Coordinator. Meanwhile, the Tutor (Professor) works with the teams on a weekly session throughout all design process, activities and support the particular requirements of each design team. These counselling-coaching sessions are relevant for the Design and also for the Management of the Project itself. A record of the project activities, produced by each design team, remains as a permanent report of the achievements of individuals and teams for evaluation and support purposes. A rubric based on competences is applied for their final accreditation.

Regarding the improvements needed to the present model Capstone Project for Industrial Designers are the transparency and consciousness of the competences and skills applied by students in their project development. In the paper (poster) to be presented at the Capstone Design conference we will be addressing the issues that we consider extremely important for the educational process and individual results. This is also relevant for the assessment of the student work as well as for the project itself.

As this educational model evolves, the design students and Academic Partners will appreciate and obtain the benefits in their respective roles, needless to say the responsibility acquired by tutors and coordinators, and at the same time a better understanding and effectiveness in their duties.

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