

Center for Collaborative Product Design and Development

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ABSTRACT: *The Center for Collaborative Product Design and Development provides a framework in which students in engineering can work in a technology based collaborative environment with Engineers from small to mid sized companies in all aspects of the product design and development process. It is becoming increasingly clear to small and mid size companies in the California State Fullerton service area that drastic reductions in time to market products does not allow for in company post graduate mentoring and training in company product development processes as has been customary in the past. It is well known that successful conceptualization, design, manufacture and marketing of new products requires close coordination of these activities. After all design decisions directly influence the costs and efforts related to manufacturing, assembly, marketing, distribution, maintenance and life cycle of products. Given the budget constraints in a state supported university it is well near impossible to provide courses that teach students all aspects of current product design and development processes. This paper will describe the role of the Center for Collaborative Product Design and Development (CCPDD). In not only providing experiential learning in a technology based collaborative environment but also providing companies that participate with a mechanism for evaluating their own processes for the recruitment of engineers trained in company practices. The technology used, the costs and benefits and the scalability of the Center's programs will be described and examples will be provided.*

1 BACKGROUND

Faculty and Students in engineering at CSU Fullerton have a long history of collaborative activities with small and medium sized companies in the local area. These activities have provided support for projects in the capstone design courses and other senior/graduate level courses that have a design focus. Project sponsorship by companies has enabled students to acquire skills in general aspects of the product design and development process. For the most part this sponsorship has been the result of Faculty/student initiatives to augment the very limited support provided by the university. While there have been exceptions for the most part the type of sponsored projects have been projects which are in the "back burner" of company priorities. These projects have no immediate effect on the processes used by the sponsoring Company. The CCPDD has been formed with a view towards promoting proactive collaboration between targeted companies and the university in jointly working on the design and development of products that are very much part of current company priorities.

2 INTRODUCTION

The Mission of the Center for Collaborative Product Design and Development is the promotion of active technology based collaboration between the Faculty and Students at the University and Engineers in targeted Companies using appropriate projects of current interest to the companies.

The Goal of the CCPDD is to integrate Company sponsored projects into appropriate courses in the engineering curriculum.

The Objectives of the Center are:

- Provide Students with hands on experience in all phases of design, development and project management of products, services and processes used by targeted companies
- Provide targeted companies with access to Students with the knowledge and skills required to accept responsibility for job related tasks without the need to provide in company training.
- Collaborate with Companies to develop appropriate projects that meet company time schedules and university course schedules.

- Collaborate with Companies to develop awareness programs in the area of contemporary Design and Development practices to address the education “pipeline” issue.
- Promote utilization of advanced computing and communication resources to enable and enhance technology based project implementation activities.
- Provide Consulting services and training for Companies in the use of contemporary design and engineering tools.

3 COLLABORATION INFRASTRUCTURE

The Learning Management Software Blackboard was used as the infrastructure to promote asynchronous communication between students, faculty and participating engineers. This industry leading learning management system provides for course content management, topic and group based discussion boards with opportunity for file exchange and sharing, a virtual classroom tool enables real time communication and collaboration.

Formal voice enabled communication was provided through the use of Centranow software. The setup of a Centranow enabled classroom allows for real time two-way audio communication and real time sharing of desktop applications.

Solid Freeform Fabrication of design models was made using the services of the Center for Visualization of Prototypes at the San Diego Supercomputer Center. Students gained hands on experience in translating design models for visualization hardcopy.

4 TARGETED COURSES

The courses in the engineering curriculum targeted for enhancement to include technology based collaboration activities are all courses with an engineering design component.

- EGME 102 is the freshmen Graphical Communications course, which has a component of 3D visualization skills development and hands on experience with AutoCAD. The enhancements in this course included the use of a Blackboard based Course site for collaboration between the students, Instructor and the Engineers at the Center for Visualization Prototypes. The course content was adjusted to include time for learning the basics of parts modeling and design documentation using the parametric solids modeling software Pro/ENGINEER.
- EGME 322L is a Junior/Senior Introduction to Computer Aided Design required course for Mechanical Engineering majors and an elective course for Computer Science majors. Projects in this course include working collaboratively with Engineers in target companies on design and modification of product parts and assemblies. Communication and Collaboration was enabled using the Blackboard course site created for this purpose. Analytical models for verification of structural integrity of designs were created using the software Ansys. The intent is to use the local desktop to create the model and post process the results obtained from processing done using the software resident on a remote Supercomputer. This is an ongoing effort. There have been software administration responsibilities related to licensing of the software for installation on the Supercomputer.
- EGME 422 is the Mechanical Design using Pro/ENGINEER elective course for Mechanical Engineering students. Students in this class have the experience working on collaborative projects in the Introduction to Computer Aided Design class. The use this experience to work on collaborative projects, which involve major design modifications or new designs using parts from current inventory. Here again the enabling infrastructure is a Blackboard course site.
- EGME 414 and EGME 419 are the two courses that form the capstone design experience for senior students in Mechanical Engineering. Students in this course sequence working in teams participate in the process of conceptualization, design, documentation, analysis, fabrication and testing of design prototypes
- EGME497/EGME597 are independent project courses that do not require formal course instruction and which do not need time schedules to align with university semester schedules.

5 TARGETED COMPANIES

Companies that subscribe to the Center's mission and goals are invited to become sponsors of the Center by providing a pledge to donate a minimum of \$10,000 per year for a minimum of 3 years. Additionally the Companies are encouraged to identify Engineers who would work with the students on projects and are available to perform Design reviews and also serve as mentors for the students. The designated company Engineers will be provided training in the use of the Blackboard and Centranow tools used for collaboration with the students. The Companies would be expected to share their design processes and best practices with the participating students. The Center will in turn work out the mechanisms needed for non-disclosure agreements as required. These requirements have yet to be formalized. However a number of Companies have been working with the Center in promoting its Mission.

A listing of these Companies is given below and as can be readily seen there is quite a range of contributions to the collaboration effort.

- Addicks Engineering and Product Development Company has nearly three decades of experience in producing injection molded parts. They have a domestic manufacturing operation as well as overseas operation in partnership with several companies in Asia. Addicks has worked with the students in the EGME332L and EGME 422 classes on a number of projects. The owner of the Company as well as the project manager has collaborated with the students online as well as in person. They have a relatively small design organization in house and work with designers offshore. The Center has provided training for their design engineers in new design software.
- RazorUSA is a company that has pioneered the development of manual and motorized scooters. The company identified one of their Designers to work with the students in the EGME 422 course to design a four wheel multi purpose four wheel cart using parts from their existing two wheel scooter. The Designer and the students worked collaboratively to design and document the new product.
- Center for Visualization Prototypes at the San Diego Supercomputer worked with the students in the freshmen EGME 102 class to translate models created by the students using Pro/ENGINEER into a file format suitable for error checking and fabrication of the model at their facility
- CADTRAIN is a company that develops training materials for users of the Pro/ENGINEER software. The Company identified one of their Engineers to help the Center port these materials into the Blackboard course site for each of the targeted courses. They also participated in the review of the effectiveness of the Centranow based virtual classroom.

6 ORGANIZATION AND THE FUTURE OF CCPDD

Currently the Center operates with a Faculty member teaching the target courses taking on the responsibility for identifying suitable companies to participate with general supervision provided by the Chairman of the Engineering Division. It is anticipated that once the Center operations are formalized it will function under the leadership of a Director working with an Advisory Board consisting of benefactors, sponsors and contributors to the Center. General overall supervision will continue to be provided by the Chair of the Division of Engineering. There are a number of issues that must be addressed as the number of sponsors increase over time.

- Software compatibility between the commercial versions used by the company and the educational versions used by the University. One possibility that is being pursued is the idea of inviting the software vendor to be a sponsor and taking advantage of a natural access to the companies participating and the availability of mechanisms for benchmarking.
- Under current budget constraints there is little expectation that the university can absorb the administrative costs of the Center. The Center has to be a self-supporting entity with the Division of Engineering providing overall direction.
- The issue of cost per project needs to be addressed. Currently once Sponsors commit to 3 years there is no limitation on the number of projects. As the number of projects increase there has to be a mechanism for charge back. Among the objectives of the Center is education and

training outreach and it is clear that funds for this activity have to come from the sponsorship moneys generated.

- The cost of remote access to the content posted at the course website beyond the time duration of the course is an issue that needs to be addressed. Thus far there has been no charge for the commercially developed material posted at the course sites.
- Conflicts between Company schedules for project completion and the University course schedules have to be resolved. The courses EGME497/EGME 597 being geared towards individual students somewhat allow for flexibility in time schedules. However the Curriculum has to be adjusted to allow for these courses to serve as replacements for formalized courses like EGME322L, which are required courses in the curriculum.

7 CONCLUSION

The experiences of the students and the participating companies to date have shown the feasibility of a Center that provides a mechanism for providing experiential technology based collaborative learning. The students graduating from this program will be ready to take on responsibilities for design tasks related to specific practices used in the company. The companies in turn will learn to enhance their own practices with the experiences gained by participation.