

DOCUMENT RESUME

ED 454 075

SE 064 947

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TITLE Industry-Supported Team Students' Projects.
PUB DATE 2000-07-00
NOTE 5p.; Paper presented at the International Conference on Engineering Education (Taipei, Taiwan, August 14-16, 2000).
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cooperation; *Engineering Education; Experiential Learning; Higher Education; *Industry; *Partnerships in Education; Professional Development; *School Business Relationship

ABSTRACT

The industry-supported team students' project enhances professional, intellectual, and personal development of students while addressing the needs of local industry. In addition to achieving academic excellence, the students are exposed to industry requirements, and excel in effective oral communication and cooperative teamwork. The teamwork environment drastically improves the students' leadership ability both inside and outside of the classroom and their opportunity for successful carrier in engineering. This presentation is devoted to the senior project, "Improvement of Hydra-Cadence Prosthetic Limb", which was carried out by a team of six students during the 1999/2000 academic year. All work has been performed with continuous industry involvement, including sharing of all related information, review of students' work by the industry representatives, manufacturing and testing of the prototype, and evaluation of data. (Author).

Industry-Supported Team Students' Projects

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This presentation is devoted to the senior project, "Improvement of Hydra-Cadence Prosthetic Limb", which was carried out by a team of six students during the 1999/2000 academic year. All work has been performed with continuous industry involvement, including sharing of all related information, review of students' work by the industry representatives, manufacturing and testing of the prototype, and evaluation of data.

Keywords: team, industry, project, collaboration, partnership

1. Introduction

The motto of engineering education in California State Polytechnic University, Pomona, is "learning by doing". Students' team senior projects, as well as other team projects, sponsored by industry, represent a crucial aspect of their engineering education. Student team projects provide an innovative capstone educational experience that integrates the students' theoretical and experimental work with the needs of local industry.

The presentation is devoted to the senior project "Improvement of Hydra-Cadence Prosthetic Limb" carried out by a team of six students during three-quarter period of 1999/2000 academic year. All work has been performed with continuous industry involvement, including sharing of all related information, review of students' work by the industry representatives, manufacturing of the prototype, comprehensive testing of the existing prosthetic and the prototype, and evaluation of data.

The presentation concentrates on building and monitoring a high-performance team of students working together to achieve a common goal. The industry-supported team project enhances professional, intellectual and personal development of students while addressing the needs of local industry. In addition to achieving academic excellence, the students are exposed to industry requirements, and excel in effective oral communication and cooperative teamwork. The teamwork environment drastically improves the students' leadership ability both inside and outside of the classroom, and their opportunity for successful carrier in engineering.

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2. University and industry interaction

California State Polytechnic University, Pomona, produces a substantial number of engineering workforces in California. One of fourteen engineers in the state is a graduate from our university. The university is located in a highly developed industrial area, and more than 80% of our students work with the local industry in the areas related to their future profession. This environment generates solid basics for the university to establish and maintain close ties with the industry. The connection between the university and the industry is, in part, enabled through various students' projects performed in support of industry requirements and with the industry sponsorship.

During the past ten years the College of Engineering of the university has operated the Engineering Interdisciplinary Clinic [1], which successfully conducted 58 projects for 19 different clients. All projects have been performed based on contractual agreements and have resulted in a positive learning experience for both, the participating student and faculty. Through this experience, students were able to develop an understanding of client requirements and appreciate the need for an effective client-team communication. The students also developed important project planning and implementation skills. The industry clients benefited as well through the services provided by well-trained university teams.

The other avenue of university-industry interaction is the professional practice of the students. The students who work in technical capacity in the industrial enterprises for at least 20 hours per week for one year may summarize results of their work in lieu of a senior project. The students' work must have a solid technical content and must be summarized in three quarterly reports, which are reviewed and approved by a university adviser as well as an industry manager.

Another critical aspect of the industry-university interaction is the industry-supported projects conducted directly between a business enterprise and a team of students with an adviser on a "pro-bono" basis. This type of project does not include contractual agreement with the client, but all work is expected to be carried out with continuous industry involvement. This involvement includes collaboration and sharing all related information, review of the students' work by the industry representatives, manufacturing of the prototype, test set-up, and data evaluation. This presentation is devoted to this type of project.

3. Project selection and requirements

The students team worked on the industry initiated and supported senior project "Improvement of Hydra-Cadence Prosthetic Limb". The project has important social value and broad application to individuals who have lost legs because due to an illness or an accident. The project was initiated by a client, who was pleased with an overall product performance, but was unsatisfied with technical and business aspects of the product caused by kinematics problem and hydraulic system deficiency. The prosthetic has been designed 50 years ago and has not been upgraded to meet the modern requirements. Outdated manufacturing technology and materials made the product expensive to make, and extremely difficult and time consuming to adjust to a particular individual. The Hydra-Cadence Prosthetic Limb was bulky, heavy, and yet limited to be used by the individuals up to 200 pounds. On the other hand, the project was not on the client's critical path, which allowed sufficient time for the team students' work through three quarters of an academic year.

The project had all desired elements of the team student's work: it included research of existing solutions and constructions, design and manufacturing of prototype, and subsequent testing and prototype modification. The project deliverables included a complete set of detailed drawings for the new product with the supporting technical report.

One important feature of the project was its extensive communication requirements, including written reports (technical reports to summarize all projects findings and results), graphical documentation (two sets of drawings for a prototype of a new proposed prosthetic limb), and oral communication (several presentations of the results to the students, faculty, and industry representative).

4. Building the student team

Building a high-performance students' team is essential to the success of the project. Team selection and training was based on a procedure developed at our university by the Engineering Interdisciplinary Clinic [2].

A successful team composition should ensure synergy and the team's ability to produce an outcome that is greater than the sum of individual efforts. The project team included students with diverse technical backgrounds, interests, and capabilities.

The team members should be committed to work hard and collaboratively. Therefore, the selection of project team members was started with the student applications, followed by screening of their resumes, and a review of their previous performances, leadership and communication skills. The selected team members had to have a GPA above 3.0, as well as strong core values, sense of purpose, creativity, and right mix of technical, management and interpersonal skills.

The team did require the sufficient time to develop the appropriate design changes and finalize decisions. The team also required a significant effort from its advisor to ensure that all critical aspects of the projects were appropriately addressed. However, the impressive results from the project justify the additional support from the team's adviser.

5. Project implementation

The project has been carried out through three quarters. The first quarter was dedicated to review, analysis and evaluation of existing constructions and overall trends in the field. The main design goals and a detailed work schedule were also established during the first quarter. During the second quarter, the new design of modified prosthesis was developed by the team, and reviewed and approved by the industry representative. Prototype was also manufactured during the second quarter. The third quarter was dedicated to the prototype assembly, testing and adjustment. The team also formalized the project findings and presented the results to the university community and the industry.

Throughout the project, the adviser has been in constant contact with the team as a whole and with each team member individually by conducting weekly formal review and holding informal meeting as needed. The adviser provided the overall direction to the project and played a critical role as a main liaison between the team, industry representatives, production facilities, and university.

The client also played a critical role in the success of the project. The client must be an active participant in all steps of the project execution by supporting regular design reviews and

providing regular feedback on the team's performance. At a minimum, the client should support formal team presentations at the end of each quarter.

6. Conclusion

The industry-initiated and supported students' team senior project "Improvement of Hydra-Cadence Prosthetic Limb" has been successful from the technical and business point of view. The project resulted in a positive learning experience for the students and faculty. The team member developed an understanding of real life requirements and challenges in an industry. The team also learned the importance of effective communication with the client, manufacturing operations, and test facilities -- a critical requirement to build and execute realistic project plans.

The industry-supported team project enhances professional, intellectual and personal development of students while addressing needs of local industry. In addition to achieving academic excellence, the students are exposed to industry requirements, and excel in effective oral communication and cooperative teamwork. The teamwork environment drastically improves the students' leadership ability both inside and outside of the classroom, and their opportunity for successful carrier in engineering.

The client benefits as well from the collaboration with the university. In this example, the client was able to obtain an innovative, cost-effective solution, which resulted in a substantially improved product.

Successful execution of the students' team project strengthens industry and university partnership and facilitates industry support to the university.

7. References

- [1] Engineering Interdisciplinary Clinic, <http://www.ent.csupomona.edu/eic>.
- [2] Christopher L. Caenepeel, Cheryl Wyrick, "Strategies for Successful Interdisciplinary Projects - A California State Polytechnic University, Pomona, Perspective", Presented at Harvey Mudd Design Conference, April, 1999, Claremont, CA

8. Acknowledgment

I would like to thank Dr. Chris Caenepeel, Director of Engineering Interdisciplinary Clinic of our university, for sharing with me his invaluable experience in the students' team projects implementation.



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