# Post-Graduation Assessment of the Effectiveness of an Industrially Sponsored Senior Design Capstone Course

Vito Moreno, Bryan Weber and Thomas Barber
*University of Connecticut*

Results of a survey of recent graduates who completed the Mechanical Engineering Senior Design Capstone course at the University of Connecticut are presented. Student perspectives on level of effort, effectiveness of course outcomes, and value of the course in their current jobs are presented. Overall results suggest that the industrially sponsored projects together with the class lectures have provided valuable experiences. Keywords: UConn, Industry sponsorship, student input

*Corresponding Author: moreno@engr.uconn.edu*

## Introduction

The Department of Mechanical Engineering Senior Design Program at the University of Connecticut is a 2-semester course that includes the Team Project and class lectures. The classroom activities emphasize the ABET Criterion 3 Student Outcomes (a-k) and the Criterion 5 Curriculum outcome [1].

> "Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints."

Since 2000, the program has been managed by dedicated teaching faculty members (non-tenure track) who have come to the University with significant industry experience. This has enabled the program to grow rapidly, nearly doubling in both number of students enrolled and projects over the last 10 years, as shown in Figure 1. Moreover, the industrial experience of the faculty has facilitated strong collaboration on project identification and effectiveness in meeting the ABET goals. The program is well known both within and outside of Connecticut and more than 125 different companies have sponsored projects.

In an effort to ensure that the course experience remains relevant to both sponsors and students, we frequently request feedback and adjust the course focus and content based on this input. References [2] and [3] summarize input from recent sponsors and senior students who were in the course. To obtain data regarding the value of the course from a broader cross section of students, we recently sought feedback from students who had graduated up to 3 years ago and were now either working or in graduate school. This paper summarizes the survey findings.

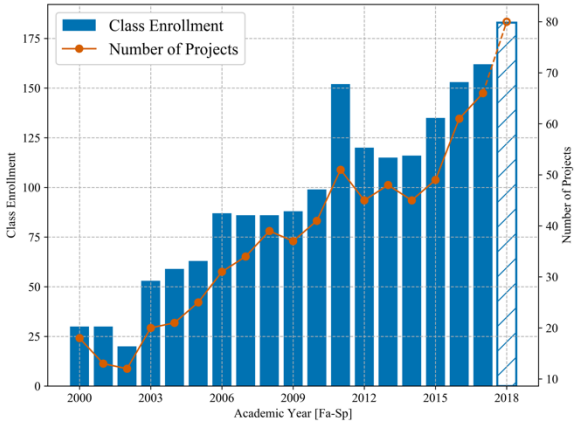


*Figure 1: Senior Design Growth History at the University of Connecticut. Note: data for AY18-19 is projected*

## Survey Structure

The survey consisted of 17 questions and was distributed using Google Forms to the students' University-affiliated email address. Students from the 2014-2015, 2015-2016 and 2016-2017 academic years were asked to participate (399 students). As of the writing of this paper, we have received a total of 70 responses. All of the questions were multiple choice questions allowing a single response, with the exception of question #5, which allowed students to select multiple responses. The first set of questions collected administrative information about the respondent:

1. The academic year you were in senior design

2. Your Team Number
3. Company and Sponsor.

The next series of questions were focused on the project selection and learning experiences:

4. Was the project one of your 5 choices?
5. What factors did you consider when you selected your choices?
6. Did you enjoy the project that you were assigned?
7. Was the project in your area of concentration?
8. What skills did you learn on the project?

The next set of questions were targeted at level of effort and support required for the course:

9. Did your teammates contribute equally to the project?
10. Were you prepared by your three previous academic years for this course?
11. Did the class lectures help you in executing the project?
12. Did your faculty advisor properly assist you in completing the project?
13. Did your sponsor properly assist you in completing your project?
14. The work level required for this project was?

The final set of questions were intended to gauge the students overall experience and perception of the course. In these questions, students were given a free-response field:

15. Did the course meet your expectations?
16. Did the project lead to a job offer with the sponsor?
17. Post-graduation, has your opinion of the course changed? If so, how?

## Results

Figure 2 shows distribution of responses by year of enrollment. The 2014-2015 class had the lowest response rate. This is likely because we emailed the survey to the students' University-affiliated email address, and it is likely that students no longer check this address some time after graduation.

At the start of each school year, students are given brief project descriptions with expected deliverables for all of the available projects in that year. They subsequently rank their top five project choices, and the faculty assign them to a project, which may or may not be one of the five. Approximately 86% of the 70 respondents were assigned to one of their top five project choices, with 5 respondents stating that they didn't remember if the project was in their top five.

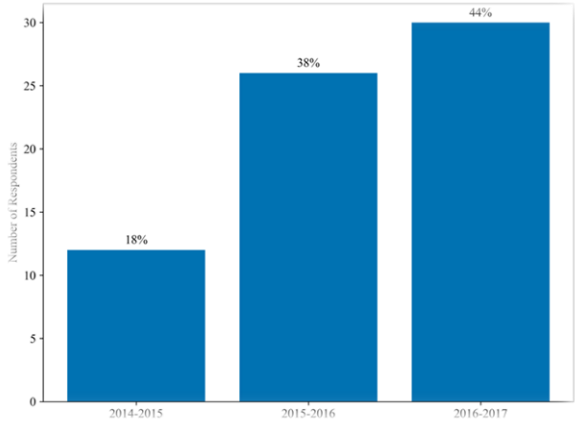


*Figure 2: Participation by Class Year*

In terms of why students selected a project for their top five, Figure 3 shows that a majority chose projects by the anticipated technical discipline (e.g., heat transfer, fluids, solid mechanics, etc.). Although the discipline was the most often selected criteria, over 55% of respondents indicated they considered multiple factors in deciding on their top five projects. Previous knowledge of the sponsor, internships, or wanting to work with specific teammates were considered less often by students. This was a surprise since seniors were typically looking for full-time jobs at the selection time frame.

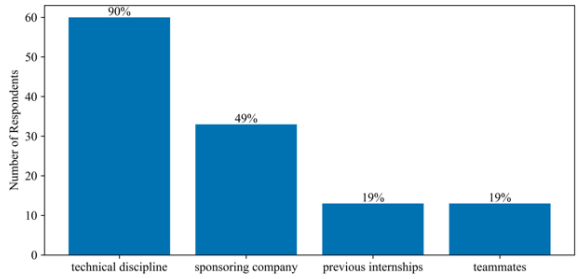


*Figure 3: Project Selection Motivation. Note that respondents could select multiple responses for this question.*

Figure 4 shows the skill sets the students felt they improved through the course (note that students could only select one of the options shown in Figure 4). Approximately 30% of the respondents felt they improved their skill using software, typically some form of finite element, finite volume, or CAD software. This aligns with the ABET criteria (k) regarding students use of modern engineering tools. Moreover, the Senior Design course is the first introduction for students to engineering analysis using COTS software, so it is encouraging that many respondents felt this was the skill set they improved.

In addition, more than 55% of the respondents felt they improved their skill sets in one of teaming, communications, or dealing with customers. This is a primary focus of the class lecture portion of the course.

**Expand above, ABET goals**

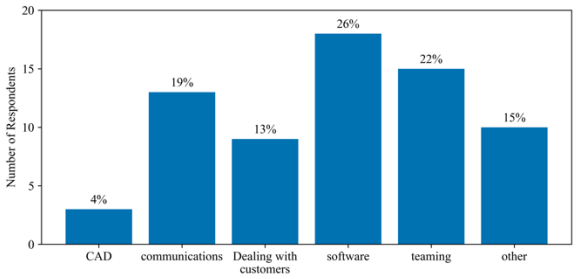


*Figure 4: Skill Set Improvement Areas*

As shown in Figure 5, a large majority of students felt that their previous course work provided them with the fundamental basis for executing the project. Similarly, as shown in Figure 6, the majority of students found the class lecture content valuable. Class lectures focused on project management, communications, effective team building, preparing and giving technical presentations, technical writing, and ethics, among other topics.

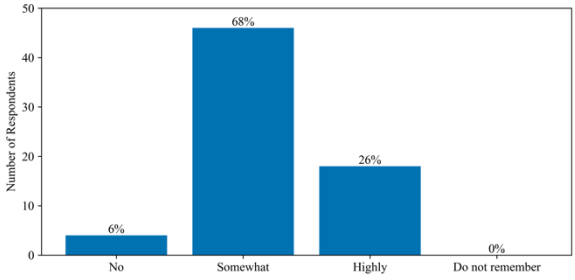


*Figure 5: Prepared by Previous Course Work*

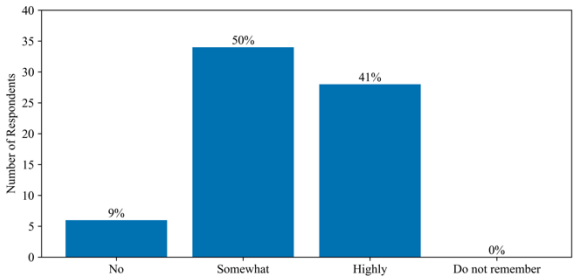


*Figure 6: Class Lectures Provide Useful Information*

The faculty work with sponsors to scope projects for approximately 1200 student-hours over the course of the 9-month academic year. Subsequently, during the lectures, students are told that they will spend ~500 hours per person over the 2 semesters. Figure 7 shows that nearly 70% indicated that the time required was about what they expected while 30% spent more time than expected.

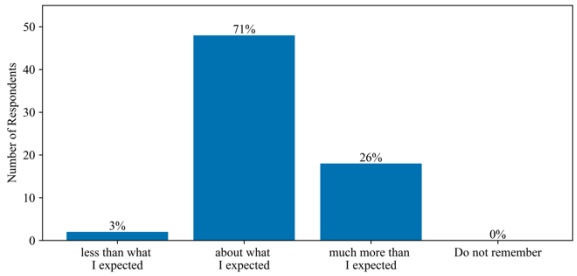


*Figure 7: Work Level Required for the Project*

In terms of meeting expectations, many of the students answered yes. Some insightful comments included:

*"Yes, the course had real world applications which I use day to day now. It was a challenge at times, but in the end the results were worth it."*

*"Yes, and it helped a lot with team building/management and time management."*

*"No, but could have if on a different team with a different sponsor working on a different project"*

*"Kind of, I was a little disappointed in the lack of help from the project sponsor and faculty advisor. However, I was surprised how helpful and approachable the senior design professors were."*

*"Yes, this was one of the most beneficial classes I took in college."*

The final question, "Post-graduation, has your opinion of the course changed? If so, how?" provided the opportunity to reflect on the experience and provided some interesting comments.

*"Since graduation, my job has me dealing day to day with clients, and this makes me appreciate how we had to work hand in hand with the sponsor, even if they were not cooperative at times."*

*"I think it was helpful in preparation for a real manufacturing environment because it dealt with a seemingly simple problem with a much more complicated solution and also forced creative thinking. I think the course is also good in honing presentation skills (i.e. oral reports) because no other course does (balancing speaking with feedback, etc.). Overall it was challenging and much more beneficial than a lot of*

*other courses at UConn because it was very practical; none of the problems could simply be approached with the textbook method."*

*"I got to be a sponsor for another senior design team in my current job and it really gave me a different perspective, both of the potential the course can have and the deficiencies that currently exist, really all senior design projects should get CAD experience, machine shop/manufacturing experience, and computer analysis experience"*

*"I think the course was more relevant to real world engineering than I originally thought."*

*"The feedback you will receive will depend mostly on the sponsor and sponsor contact's relationship with the student group. I had a poor sponsor experience due to overall lack of interest from the sponsor and low priority given to us by the sponsor contact. My experience could have been completely different. This is an impossible factor to control. This course should remain unchanged. Since graduation, I have only become more understanding of my sponsor's contacts seeming disinterest in putting aside his tasks to work with three undergraduates on a "backburner" project."*

*"Yes, I have become more grateful for some of the skills the class taught me (project management, how to work in a team, and especially public speaking)."*

*"Yes - a lot of the prep work for the course has been highly valuable in my job after graduation. Making presentations and being able to properly convey technical knowledge was something I improved at during the course, and it has been very beneficial."*

*"There were certain management tools that we learned in this class that I didn't think were very practical or useful. I assumed I would never use them in the real world but I have used many of them in my job. I still think that most of them are a waste of time but at least I knew what a risk cube was when I saw it at work for the first time. The course ended up giving me a very realistic experience of what working for an engineering company was actually like and was by far the most important class I took at UCONN."*

## Summary

In reviewing all of the student responses, we were gratified to see that many of the concepts we strive to emphasize in the course were identified as positive experiences by the students. This includes communication, teaming, scheduling and project management, and application of fundamental engineering concepts to projects. While we need to constantly strive to improve the course, in terms of more effective methods of presentation of relevant topical material, we feel that the fundamental basis of the course is sound.

## References


[1] Accreditation Board for Engineering and Technology, "Criteria for Accrediting Engineering Programs 2016-2017."

[2] Moreno, V., Cutiongco, E., Patel, V., "An Industrially Sponsored Senior Design Capstone Program – A University and Sponsor Perspective" IMECE2016-66076

[3] Moreno, V., Ferreira, M., Malicki, P., Morris, S., DePasquale, J., Schier, L., Smith, H., "Leaning Experiences from an Industrially Sponsored Senior Design Capstone Program – A Student Perspective" IMECE2017-70916.