

Critical Mass for Sustainable Corporate Capstone Courses

Lou Reifschneider
Illinois State University

The decision to implement a corporate sponsored capstone course involves passing some preliminary hurdles. Are small programs precluded from implementing a corporate sponsored capstone because of their small size? Can they develop a critical mass of funding to sustain a capstone coordinator or support a dedicated design studio for customer projects?

Corresponding Author: lgreifs@ilstu.edu

Introduction

While attending a panel session during the 2010 Capstone Design Conference that addressed corporate sponsored capstone issues, I was fascinated by the promise of implementing such a course at my modest engineering program. However, while listening to the exchange between the panel members and the audience, I had a difficult time putting some of what was said into context, because I did not currently teach a corporate sponsored capstone class. I thought how nice it would be to have a session at a Capstone Design Conference in the future with the theme: *How to Start Your Own Corporate Capstone Following These Easy Steps*. One of the first publications in the engineering education literature to address creating a senior capstone course that relies upon corporate sponsored projects was written by Todd, Sorensen, and Magleby.¹ The authors made a strong case for the need of such programs and laid out a robust course design that has proven to be one of the most successful formulas for corporate sponsored capstone courses. This is evident by the history of the Brigham Young University capstone program.²

The theme of the 2012 Capstone Design Conference: Industry Involvement in Capstone Design³ focuses on issues for programs that already have corporate sponsored capstone courses up and running. The topics are good ones, but address more the tweaking of existing programs and not what is needed to make the transition from an internally-sourced capstone course to a corporate sponsored and corporate funded capstone course.

More importantly, however, I question if there are preconditions that favor the implementation of a corporate sponsored capstone course? Does size of the program matter? Related to size, does the department culture affect the number of teaching cohorts available to support the teaching/mentoring demands? Does the physical plant available to house corporate sponsored

projects matter? Is there a checklist that one can read and, depending upon the boxes checked, decide that in spite of the attraction, a corporate capstone may not be for you? These are the issues addressed in this paper.

Hurdles for the Small Programs

What is not to like about a corporate sponsored capstone course? Students work on industry-relevant problems, students learn communication protocol with working professionals, faculty keep up-to-date with industry wants, and the program benefits through funding provided by sponsoring companies. This latter benefit is especially valued during the difficult state funding times we face today.

However, migrating toward a corporate sponsored capstone class presents challenges that go beyond the logistics of finding and screening suitable projects. My thesis is that the size of the academic unit attempting to make the shift toward a corporate sponsored capstone is the challenge imposing the greatest difficulty. Three factors related to size are identified as critical for successful corporate sponsored capstone classes:

1. Capstone coordinator required to solicit projects.
2. Faculty collaboration required to mentor projects.
3. Capstone projects require studio space.

Programs that have corporate sponsored capstone classes tend to have a dedicated person responsible to solicit companies to participate. Funding for this capstone coordinator position is sustained through a critical number of funded projects that generate a significant amount of sponsorship funding. Sponsor funding per project will tend to increase with more complex projects. Complex projects will require more attentive mentoring by suitable faculty advisors. Thus having a good number of departmental faculty collaborating with the capstone class will help ensure

the likelihood of a successful design project for a sponsoring company.

References readily exist in the literature to support the first tenet of the size thesis. The need for a full time industry contact person, or capstone coordinator, has been identified by Lamancusa, Soyster, and George⁴, Peterson⁵, and Chang and Townsend.⁶ This is the practice at the University of Illinois⁷ and Brigham Young University.² It is interesting to note that the corporate sponsored capstone program at Brigham Young University¹ began small with Todd, Sorensen, and Magleby in 1990 but quickly grew to involve a large number of faculty and numerous industry sponsors.

Others have shown that corporate capstone projects are helped by having available a studio space in which the student teams can lay out designs and build prototypes. This need is indicated by Lamancusa et al.⁴ with their idea of a learning factory for the project teams and Chang and Townsend⁶ when discussing facilities. This is also the practice at the University of Illinois in their Senior Engineering Project.⁷ When I contacted companies about the prospect of initiating a corporate sponsored capstone program, the issue of a secure laboratory space was mentioned by a willing company sponsor. However, there is no such space readily available in my department. Larger programs are more likely to have some laboratory spaces that could be configured for design studio.

Also related to the department size is the teaching culture that will affect the likelihood of attracting faculty to help with the mentoring demands of a corporate sponsored capstone class. In my experience, coming from a small teaching-centered program, expecting other faculty to share in the teaching of the capstone course would be viewed as a teaching overload. If I were in a larger research-oriented program, then taking on a project team as a mentor may be welcomed, as this would satisfy some of the teaching obligation without the responsibility of a full-blown course. However, it is not possible to delineate data from published reports to support this thesis.

Data Supporting the Size Thesis

Unfortunately, there is no good data to illustrate a correlation of the size of an engineering program and the presence of a corporate sponsored capstone class. The most comprehensive study done on statistics about capstone courses by Howe⁸ does not specifically mention number of faculty in programs that offer corporate sponsored capstone courses. However, one may conclude by reviewing the section of Howe's report⁸ addressing Industry Sponsors, that only about one half of programs that offer capstone courses are

corporate sponsored courses: 235 of the 444 survey respondents said they had external sponsors.

Other data suggesting that department size may be a factor in implementing a corporate sponsored program is shown in Figure 7 of Howe's Focused Follow-up to 2005 National Capstone Survey¹⁰; the 2005 National Survey of Engineering Capstone Design⁹ did not contain this data. Refer to Figure 1 below, which is a recreation of the data in Howe's Figure 7. The black diamonds represent the data in Howe's Focused Follow-up¹⁰ and indicate the correlation of how many faculty are involved with the capstone course compared with the number of faculty available in the department.

The following argument assumes departments offering a corporate sponsored capstone rely upon a funded capstone coordinator, the first size-related factor identified earlier. If only one or two faculty are involved with a capstone course, then it is likely that corporate sponsored design teams are not involved. There would not be a critical mass of funded design teams. When more faculty are involved, two things happen. First, a critical mass of funding is generated to sustain a full-time capstone coordinator and second, the mentoring load of those faculty involved is reduced, enabling them to teach the other critical subjects in the department. This analysis is depicted as the dashed curve in Figure 1 that denotes a division between the likely internally sponsored capstone courses from the corporate sponsored domain. The area of likely corporate sponsored capstone programs represents approximately 50% of the dots in the graph which is consistent with the finding in Howe.⁸

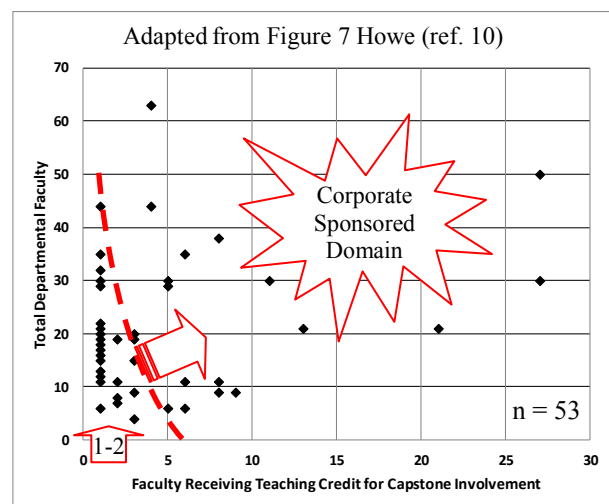


Figure 1. Corporate Sponsored Capstone Domain

An interesting graph to see, that could be produced by Howe's dataset¹⁰, would be the correlation of Sponsor Financial Support per Project (\$) vs. Faculty Receiving

Teaching Credit for Capstone Involvement. Assuming the hypothesis that the size of a capstone program predisposes it to corporate sponsorship is true, I mapped the dollar amounts of sponsor financial support per project from figure 9 of Howe¹⁰ to the number of faculty receiving teaching credit for capstone involvement from figure 7 of Howe¹⁰. The mapping was done by taking the series of dollar amounts in the order they were displayed from figure 9 and associating them with the markers indicating the number of faculty receiving teaching credit. In both cases the mapping is made by starting at lower values and moving higher. For example, the 12th marker of a dollar amount figure 9 of Howe¹⁰ was mapped to the 12th marker of faculty receiving credit. It should be noted that both figures 7 and 9 are scatter plots so there is no way for me to know which dollar amount directly mapped to which number of faculty teaching. Thus the graphic in Figure 2 is not a plot of survey data from Howe¹⁰, but a hypothetical correlation. The other implicit assumption in Figure 2 is that having more faculty receiving credit for teaching some aspect of the capstone course correlates with larger programs.

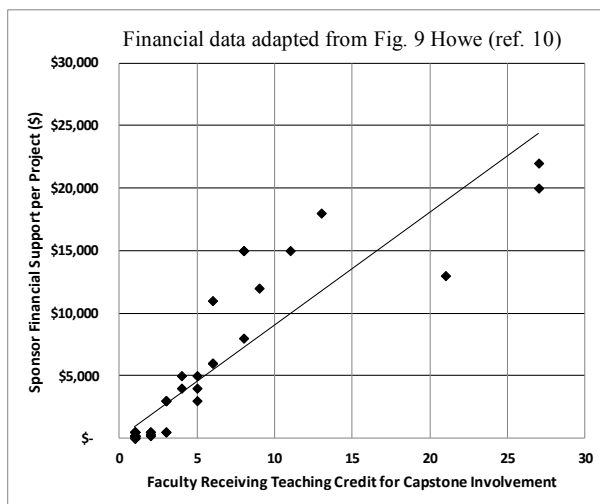


Figure 2. Hypothesized Funding vs. Program Size

In conclusion, although the benefits of a corporate sponsored capstone course are very attractive, making the transition may prove to be too big a hurdle for a small engineering technology program to jump. However, because the size of a program likely has a significant effect on the success of a corporate sponsored capstone class, perhaps this should be a topic in a future Capstone Design Conference. Maybe there will be a step ladder of good ideas being shared at the 2012 Capstone Design Conference.

References

1. Todd, R.H., Sorenson, C.D., and Magleby, S.P. (1993). Designing a Senior Capstone Course to Satisfy Industrial Customers. *Journal of Engineering Education*, 82 (2), 92-100.
2. Brigham Young University Capstone, <http://capstone.byu.edu/> accessed December 2011.
3. Capstone Design Conference 2012. <http://www.capstoneconf.org/callforpapers/index.html#papers> accessed November 2011.
4. Lamancusa, J., Soyster, A., and George, R. "Industry-Based Projects in Academia - What Works and What Doesn't", *Proceedings of the 1997 ASEE Annual Conference and Exposition* (1997).
5. Peterson, J. "Experiences in Capstone Design Projects: Partnerships with Industrial Sponsors", *Proceedings of the 2000 ASEE Annual Conference and Exposition* (2000).
6. Chang, M. and Townsend, J. "A Blank Slate: Creating a New Senior Engineering Capstone Experience", *Proceedings of the 2008 ASEE Annual Conference and Exposition* (2008).
7. University of Illinois Industrial & Enterprise Systems Engineering, Senior Engineering Project 494. <http://ise.illinois.edu/ge494/> accessed November, 2011
8. Howe, S. (Spring 2010) Where Are We Now? Statistics on Capstone Courses Nationwide. *Advances in Engineering Education*. Retrieved from <http://advances.asee.org/vol02/issue01/03.cfm>
9. Howe, S. and Wilbarger, J. "2005 National Survey of Engineering Capstone Design Courses", *Proceedings of the 2006 ASEE Annual Conference and Exposition* (2006).
10. Howe, S. "Focused Follow-up to 2005 National Capstone Survey", *Proceedings of the 2008 ASEE Annual Conference and Exposition* (2008).