Capstone Course Industry Sponsor Assessment

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The University of Florida IPPD capstone design program provides an interdisciplinary faculty-coached experience for student teams who work with industrial liaison engineers to design, build, and test solutions for the industry sponsors. As the program completes its 25th anniversary and defines its future path, this study aims to determine the needs and wants of the industry regarding project sponsoring. A survey was shared amongst past and potential IPPD sponsors, with data obtained from 20 industries representing the range of potential sponsors. Faculty and student course evaluations were also reviewed. The data includes quantitative and qualitative responses that helped redefine how IPPD will engage companies during recruitment of industry sponsors going forward, as well as how we might restructure parts of the program to increase industry participation and maximize student educational benefits. The results show that IPPD could benefit from offering sponsorship tiers with different costs and with opportunities that include sponsoring projects as a service. Additionally, the course content needs reassessment to ensure all stakeholders value it equally. These findings can help other capstone programs view the changing needs of industry sponsors and measure their satisfaction, in order to identify program improvements to increase industry participation and student benefits.

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Introduction

Involvement of industry sponsors in senior design and capstone engineering courses has become common place at universities across the United States. Of the 27 multidisciplinary programs surveyed in the 2015 Capstone Design Decennial Survey, 26 incorporate projects sponsored by industry or government[1]. The relationships between industry sponsors and universities greatly benefit the quality of students' education and preparedness toward their careers. With industry involvement in capstone design projects, students gain real world experience, while companies have the opportunity to gain solutions to complex problems, work with skilled faculty, and recruit students as potential hires. These are the common themes seen in recruitment materials across many capstone and senior design programs.

The Integrated Product and Process Design (IPPD) program at the University of Florida (UF) is in its 25th year as a multi-disciplinary engineering capstone course. The IPPD program stakeholders include UF administration, its faculty and students, and the industry sponsors. Industry sponsors play a unique role in driving IPPD's success by financially supporting the program, providing engaging projects for students, and lending their skilled engineers to work with the students to complete their projects. IPPD has been successful for all these years given its current partnership format with industry sponsors. As the industries evolve and their needs change, it is important to continue this success in order to provide meaningful and practical experiences for students.

Our goal was to identify the needs and wants of our industry sponsors to assure our program continues to provide the curriculum and structure that will best serve our stakeholders. We also studied other interdisciplinary capstone programs with different structures that included a variety of methods to educate students, and to recruit and build relationships with sponsors.

Methods

The results from the 2015 Capstone Design Decennial Survey were used as a baseline to compare IPPD to other capstone programs[1]. It also provided insight to develop survey questions for our sponsors. A survey from the University of Wisconsin – Madison was used to benchmark our classroom experience questions[2].

Industry executives from twenty companies were surveyed on a variety of topics related to the IPPD program. Survey results were collected from 11/20/19 to 12/17/19. The survey was sent via e-mail with a link for a web version of the survey. Fifteen responses were obtained with this method, with one person mistakenly closing the survey before completing the last 2 questions. Two executives from current sponsors completed a paper version during an IPPD event, while three responses were collected over the phone. Due to the complexity of some

of the survey questions, one question was omitted in the surveys completed over the phone. This is why sample sizes are not consistent for all questions.

Of the 20 respondents, 6 represented small companies, 6 represented medium companies, and 8 represented large companies, where we defined small companies as those having 1-1,000 employees, medium companies have 1,001-10,000 employees, and large companies have over 10,000 employees. Out of the 20 industry executives surveyed, 8 work for companies who are currently sponsoring, 10 work for companies who have previously sponsored, and 2 work for companies who have considered sponsoring, but have never sponsored.

The survey to industry sponsors contained the following eight questions:

1. Who is your current employer?
2. Select ALL the reasons in which your company benefits from sponsoring an IPPD project. (6 multiple choice options were listed, plus the option to write in other benefits.)
3. Select all the reasons that could prevent your company from sponsoring a project. (3 multiple choice options were listed, plus the option to write in other reasons.)
4. Rate the value of the following student experiences for an incoming engineer. (13 multiple choice options were listed for rating, plus the option to write in other student experiences and choose its rating.)
5. Would you consider committing to multiple projects over multiple years?
    6. (If the previous answer was no) Would you commit to multiple projects over multiple years for an incentive?
7. Contracts with IPPD are Unrestricted Educational Grants with the company owning the rights to the generated intellectual property. Do you think your company would benefit from providing payment as a gift, with UF, the faculty and the students owning the IP?
8. In what other ways may your company support the IPPD program? (3 multiple choice options were listed, plus the option to write in other ideas.)

In creating this survey, we also looked at the student and faculty surveys that IPPD has been administering throughout the years. Students are provided a course feedback survey and pre- and post-course skills survey. They are asked about their likes and dislikes from the course and how they rate themselves on topics such as writing skills and teamwork. Faculty who are project coaches for the course are also asked similar questions as well as any changes they would suggest. The results of the industry, student, and faculty surveys were used to determine ways IPPD can improve industry sponsor partnerships and course content.

Results & Discussion

For question 2, industry executives were asked to select or write the benefits of sponsoring a project for IPPD. The results are shown in Table 1.

Table 1. Industry Benefits to Sponsoring an IPPD Project

Sponsorship Benefits	**Respondents** (n=20)
Creative solutions to company needs	15
Owning the intellectual property generated from the project development	12
Participation of skilled faculty in project solutions	13
Student recruitment opportunities	14
Networking with faculty	14
Contribution to education and student development	16
N/A (have never sponsored)	2

Each benefit option listed was selected at a similar frequency. The most selected answer was “contributions to education and student development” with 16 out of 18 executives selecting it as a benefit. The least selected answer was “company ownership of intellectual property generated from project development” with 12 out of 18 selections. In addition, question 7 asked if they would give up the intellectual property (IP) in exchange for payment as a gift instead of a contract. In this case 14 out of 19 companies stated the IP was too valuable to give up. Out of the other five, three did not respond because they do not produce IP as a public institution and two said they would if it meant a reduced contract cost.

Since its inception in 1995, IPPD has showcased to potential sponsors the value of providing them the ownership of the IP[3]. In 2014, Rochester Institute of Technology found that providing an option for industry to keep the IP was a critical component to industry sponsor relationship[4]. In the 2015 Capstone Survey, 88% of capstone programs across the country allowed companies to keep their IP as well[1].

Question 3 asked them to select or write the reasons that could prevent their company from sponsoring IPPD. These results are summarized in Table 2.

Table 2. Reasons for Not Sponsoring an IPPD Project

Reason for Not Sponsoring	**Respondents** (n=20)
Cost	12
No project to propose	12
Providing a liaison engineer	7
Two semester duration	2
Security constraints	2

An equal number of respondents, twelve, mentioned "project cost" and "no project to propose" as reasons that would prevent sponsorship. With contribution to education being a top benefit for companies, Table 1, it could benefit the IPPD program to investigate ways to provide projects for sponsors outside their company needs. Virginia Tech and The University of Toledo have utilized humanitarian projects to great success[5,6]. IPPD could adopt a similar format to provide projects from community non-profit organizations that would be sponsored financially by industry partners who do not have a project to propose. Additionally, from question 8, 15 out of 19 sponsors stated that they would be interested in sponsoring IPPD outside of the project option, such as sponsoring an IPPD events and workshops, student supplies, mentoring, internships and job recruiting events, providing thus more evidence that companies value education and would be willing to support IPPD even without a project to propose. Nonetheless, 7 out of 20 companies stated that providing engineering personnel resources was an issue for sponsoring, thus it is possible that even with a suggested community project a company could still not sponsor due to this requirement.

Table 2 suggests past sponsors are also put off by cost before they analyze any other reason not to sponsor. While five respondents from current sponsors chose cost as a factor for not sponsoring, none of them chose cost as the only factor. In contrast, the five respondents who chose cost as the only limiting factor are all previous sponsors.

There is no correlation between the size of the companies and cost. Companies of all sizes are equally likely to choose cost as a factor. See Table 3 lists the respondents who chose cost as a limiting factor and how many out those chose cost as the only limiting factor.

Table 3. Company Profile vs. Project Cost as Limitation

Company Type (respondents)	**Cost is a reason**	**Cost is the only reason**
Small (6)	3	2
Medium (6)	4	1
Large (8)	5	2
Current sponsor (8)	5	0
Previous (10)	6	5
Never (2)	1	0

Sponsorship Cost and Value

Question 5 asked if they would consider committing to multiple projects per year and 9 of the 20 said yes. As a follow up question to those 11 who stated no, question 6 asked if they would consider committing to multiple years for an incentive and only one said yes. Therefore, while 12 out of 20 companies agree cost would prevent them from sponsoring, only 1 respondent stated that they would consider sponsoring multiple projects for a reduced cost. Given the amount of effort required to secure each sponsoring company, having a multiyear contract would greatly benefit the program. With these results, IPPD will invest the effort on securing longer commitments with those that suggested the willingness.

It was expected that cost would be a more significant factor based on the sponsorship cost for similar programs in nearby universities and those who responded to the Capstone Survey, where their results showed that we are amongst the top 24% in cost for multidisciplinary university capstone programs[1]. However, while about half of the sponsors may consider cost more likely as a factor for participating, in order to increase the number of sponsors, it would be equally beneficial to attempt to find projects for sponsors than to lower the cost.

It is also key to note that 3% of programs have no faculty receiving teaching credit and 39% of programs have 1 faculty member receiving teaching credit[1]. Currently, IPPD provides a faculty with expertise in the field of each project to serve as the project team coach. These coaches do not receive teaching credit, instead receiving financial compensation that is covered by the sponsorship costs. The course instructor receives teaching credit without further compensation. Moving forward more data will be needed to determine if IPPD should lower the cost and faculty compensation to increase sponsorship or if the cost of such a move would decrease overall program success.

The IPPD course has traditionally had a student to faculty coach ratio under 6:1. The Capstone Survey shows 65% of multidisciplinary programs have a student to faculty ratio over 10:1[1]. The lower ratio is a benefit for student academic achievement, while the individual faculty involvement is a major benefit for project success. The opportunity to network with the faculty plus the individualized attention they provide for the project is viewed as a benefit of IPPD by over half of the industry executives surveyed; see Table 1. This suggests that this benefit is worth the cost to sponsors.

Course-Content Evaluation

Question 4 was designed to investigate how the industry executives rated the value of the course content. Respondents were asked to rate student experiences as highly, somewhat, or least valuable, and also suggest other student experiences they found valuable. Sponsors selected "Developing/writing functional specifications" mostly as "somewhat valuable" and 17 out of 17 sponsors selected "application of hard skills (engineering, management, data analysis, manufacturing and budget analysis, etc.)" as highly valuable. Even though this year many of the writing assignments were reduced, as it has been in the past, a majority of current students commented on their open-ended course evaluations that the course was too heavy on writing and would have liked

more time to work on the hands on portion of their project. Two representative comments were "*less paperwork and more time allotted to project development. It allows us to fail faster and move forward"* and *"while reporting work is important, it interferes way too much with the project work itself. The writing/course material for the project should help the team, not get in the way."* Faculty have also reported the writing assignments as the least enjoyed, and in some occasions, the least valuable for students. Therefore, all IPPD stakeholders agree that the writing assignments are less valued as a skill while hard skills are the preference.

This trend is also seen across other universities. For example, LeRoux and Parmigiani received similar frustrations from their students regarding the amount of writing involved in the course to the extent that "students would knowingly produce an inferior design solution rather than implement an improvement and update the associated reports." [6] They signaled a need to potentially reduce the writing portion of the course within the parameters of the university requirements in order to allow students to focus more on the technical content. Paretti also discovered the same frustration from students regarding writing assignments[7]. They noted that adding more workplace related writing into the course material rather than academic writing may not be preparing the students in the right ways. Providing students with the purpose of these writing assignments and why they are important to the end product may help them understand how it ties into the desired project outcome. It will be important to again evaluate the writing load from the context of quantity versus quality moving forward.

Continuing with the responses on course content from question 4, overall at least 12 out of the 17 respondents chose as highly valuable the following experiences:

- Working on interdisciplinary teams
- Project management, leadership and decision making
- Industry level problem solving, design and development experience
- Engineering ethics

These results show industry still considers highly valuable these skills related to project development. In open ended survey questions, student comments reflected they were focused on producing the end product rather than the journey of the design process. Two representative student comments show they want to *"focus on satisfying sponsor needs rather than completing a series of arbitrary papers and presentations"* and how *"assignments wouldn't pertain to our project."* Therefore, a greater emphasis must be placed on explaining how the course work contributes towards their learning experience and professional development and how it prepares them for the workplace.

Conclusion and Future Work

This study showed that IPPD would equally benefit from offering industry sponsors additional project options and lowering the sponsorship costs. There appears to be no relationship between selecting project cost as a factor in not sponsoring and company size. Considering all size companies in recruitment of sponsors would be beneficial to IPPD. Therefore, providing more than one cost plan should increase sponsorship opportunities. IP ownership is still considered a significant benefit for most industries in order to commit to sponsoring projects.

Recurring industry analysis is necessary to ensure our capstone design program is successful for all stakeholders. Greater efforts in data collection methods and sharing this information amongst academia will help identify and understand the industry trends to better serve all students. Future studies will help determine what improvements can be made to help students gain understanding of the purpose of the written assignments.

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