Formation of Interdisciplinary Teams in Engineering Capstone Courses using a Project Fair Format

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The process for identifying prospective interdisciplinary capstone projects and aligning them with an appropriate mix of student teams requires a large coordinated effort among multiple departments. To address this challenge, the engineering departments at the University of Idaho have implemented a project fair format to introduce project options to the students and facilitate the team formation process more efficiently. Sponsored projects are recruited from both internal and external clients while capturing the projects' interdisciplinary needs. Students attend a one day Capstone Project Fair event at the start of the semester to research each project option and subsequently submit their respective project preferences. Team formation is conducted by faculty to align student preferences with the interdisciplinary needs of each project. The Project Fair successfully reduces the time required for the team formation process, while several other benefits for both the students and the projects sponsors are also observed.

Keywords: interdisciplinary, student team formation, sponsored projects, project fair

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Introduction

One of the over-arching goals for engineering capstone design programs is to emulate the real-world environment through executing authentic engineering team projects with teams of people with diverse backgrounds and engineering disciplines. Capstone design programs which offer an interdisciplinary mix of students can greatly enhance the student experience, while also producing more comprehensive solutions to meet industrial challenges[1,2]. However, the process to solicit projects and form interdisciplinary teams to execute capstone projects requires a large coordinated effort between multiple engineering departments.

Several approaches are used by different institutions to address the challenge of aligning projects with interdisciplinary teams. Ardis, et al.[1] have piloted an online marketplace to facilitate project solicitation and dissemination to students, with a goal of linking multiple schools in addition to multiple disciplines. Frank, et al.[2] outline a more direct approach, where faculty lead the effort to assign teams. At Louisiana State University, although not an interdisciplinary program, the mechanical engineering department conducts a 2-day Project Fair event for sponsor-student interaction and project formation[3].

The objective of this manuscript is to outline a coordinated approach implemented at the University of Idaho (UI) for systematically forming student teams and matching them with sponsored capstone projects. The following sections will describe the three major phases of this process: a) recruitment of sponsored projects, b) project introduction to students, and c) assignment of student teams.

Methodology

The interdisciplinary engineering capstone program at UI is a collaboration between four separate departments: a) mechanical engineering, b) electrical and computer engineering, c) computer science, and e) biological engineering.

Recruitment of Sponsored Projects

Solicitation of projects from both internal and external sponsors begins months before the beginning of the 1st semester in the Capstone sequence. Projects may come from a variety of sources, typically through the collective professional network of the capstone faculty and staff. Projects may be sponsored by: a) industrial partners, b) internal departmental research, or c) on-campus departments outside of engineering.

As potential projects are collected, the interdisciplinary faculty estimate an ideal size and mix of interdisciplinary students to successfully execute the project objective. A running tally captures the total number of projected students needed from each discipline for all of the projects. This total is compared to the student enrollment for each discipline. Table 1 summarizes the initial project recruitment for the 2017-2018 Capstone Design sequence. A total of 42 potential projects were identified as candidates for the program,

with 25 of these projects providing spaces for students from multiple disciplines. The total projected student need exceeded student enrollment by 16%.

Table 1. Summary of project recruitment for UI 2017-2018 Interdisciplinary Engineering Capstone sequence.

-	ME	CompE	EE	CS	BE	Total
Total # of Projects	42					
Total # of Interdiscipl. Projects	25					
Projected Student need	69	17	40	33	14	173
Enrolled Students	58	6	33	32	11	140
% Over-projected	19%	183%	21%	3%	27%	16%

Keeping a running tally of student discipline needs provides guidance for the project recruitment efforts, prioritizing projects supporting under-served disciplines. As a general rule, student discipline projections are done such that no project contains a single student from a given discipline, ensuring students are not isolated from their respective discipline peers on any project.

Project Introduction to Students

Once the list of candidate projects is identified for a given capstone sequence, a 1-2 page synopsis for each project is provided to the students which outlines the following: 1) project objective, 2) required deliverables, and 3) project budget. Students are also provided with the disciplinary needs of each project to prioritize their evaluations of each candidate.

Historically, the capstone instructors have arranged for a representative from each project sponsor to orally present a brief (~5 minutes) overview of the project synopsis to the class. In this model presentations were spread over three separate class sessions, occupying ~1.5 weeks of semester time. Meanwhile, every student attends every project presentation, regardless of whether the project involves their respective discipline. Although this process provides broad perspective of many project options, it is an inefficient use of time and limits opportunity for any in-depth discussion and personal one-on-one interaction between students and prospective sponsors. As a result, a new strategy was implemented for the 2017-2018 cycle.

For the current academic year, the UI program hosted its first annual Interdisciplinary Capstone Project Fair. At this one day event, each project was assigned a booth within a large venue in a layout similar to a traditional career fair. A representative for each project was asked to attend the fair to informally present, discuss, and answer questions about the project using visual aids such as posters, videos, or physical hardware. Students were required to attend the fair, with the goal of visiting project booths that align with their disciplines and personal interests. Prior to the event, all students were instructed to plan ahead for the event by: 1) previewing the synopsis of each project, 2) identifying the projects which engage their interests, and 3) compiling a list of questions for each sponsor to help them narrow their search of projects.

For external sponsors, the fair offers an opportunity to interact with prospective graduates, serving as an initial touch point for new-hire recruiting. For students, the fair is an opportunity to take ownership of their project pursuit and seek answers to their questions.

Formation of Student Teams

Following the Project Fair, each student was instructed to submit their personal Project Bid Portfolio, including the following: a) their ranked top four project preferences, including a brief rationale for each choice, b) a one-page resume, and c) relevant personal information, including teammate preferences or potential conflicts.

Using the input from each student's Project Bid Portfolio, the interdisciplinary faculty collaborated to assign student teams for each project. This was an iterative process that involved balancing the expected disciplinary needs of each project and the corresponding project preferences of each student. Each project was also assigned a departmental faculty member as the lead instructor for the project team. Once formed, each team was audited by the lead instructor to ensure the mix of students will succeed and any interpersonal conflicts are averted. The process is reasonably transparent to students, and consistent across disciplines.

Once all of the project teams were formed, the students were reconvened and project teams were formally announced. The students were introduced to their lead instructor and their teammates as the projects were formally initiated. The entire process involving project introductions, the Project Fair event, student Bid Portfolios, and formation of teams encompasses about 1.5 weeks at the beginning of the first semester.

Finally, with all teams in place, formal agreements are initiated with industry sponsors to collectively capture student accountability for confidential information and the rights to intellectual property developed[4].

Implementation

For the 2017-2018 academic year and capstone sequence, a total of 42 potential capstone projects were recruited. Of these, 25 of the projects (~60%) anticipated a multi-disciplinary mix of students to complete the objective (Table 1). The majority of the projects were recruited through external networks (~67%), while the balance were from internal sponsors within UI departments.

The Capstone Project Fair was held on August 29th, 2017 on the University of Idaho campus and was 1.5

hours in duration (Fig. 1). Out of the 42 projects presented, 21 of the booths (50%) were represented by individuals directly affiliated with the sponsor. However, for industrial sponsored projects, only 39% (11 out of 28) of the projects had specific sponsor representation. The remaining projects were presented by departmental members familiar with the project background and objective. Given that many industrial sponsors are located 300-600 miles away from the UI campus, this rate of external participation in the event is not surprising.

Figure 1. Interaction between students and project sponsors at the Capstone Project Fair at UI.

Following the Project Fair, each student submitted their own Project Bid Portfolio, outlining their ranked top four project preferences. Upon completion of the project team assignments, every student was awarded a project within their top four ranking. A total of 34 capstone projects were assigned teams, with 18 of the projects (~53%) containing an interdisciplinary mix of students. A summary of projects recruited and assigned with a breakdown of project types is illustrated in Fig. 2. Fourteen lead instructors from different departments were allocated to provide guidance and assessment of their assigned teams.

Discussion

For the UI 2017-2018 engineering capstone sequence, the new process integrated into the program is the Capstone Project Fair. This event offers opportunity for personal interaction between project sponsors and students early in the process, which did not exist in prior UI capstone courses. The following sections will review the effectiveness of integrating the Project Fair into the overall team formation process.

Sponsored Projects

The number of potential projects collectively recruited, along with the number of projected students required for the projects are intentionally in excess of the expected student enrollment in each discipline (by ~16% overall - Table 1). The over-recruitment of projects offers several benefits to the overall program.

First, with a larger number of projects available, students have more options to evaluate in forming their rank of top four project preferences. With a variety of projects options, students are empowered to seek projects which complement their interests and provide direct input into their project assignment. One prior study has demonstrated higher rates of project satisfaction, group satisfaction, and project impact when student preferences are incorporated into the project assignment process[5].

Second, the surplus of available projects provides greater flexibility for interdisciplinary team assignment. For example, popular projects may receive more bids from students than are positions available, or may exceed the ideal interdisciplinary mix of students. Similarly, unpopular projects may receive few or no student bids. In such cases, the wider range of available projects enables team assignments which more closely match the project needs, while also ensuring each student is assigned to a project in their respective top four ranking.

Finally, the competitive nature of student project bids provides incentive for potential sponsors to present meaningful projects which generate student interest. If project proposals do not produce sufficient interest from the students, the projects will not be picked up and executed in the capstone sequence. One possible consequence of this approach is that sponsors may become discouraged from future participation in the capstone program if their respective project(s) are not consistently assigned to capstone teams.

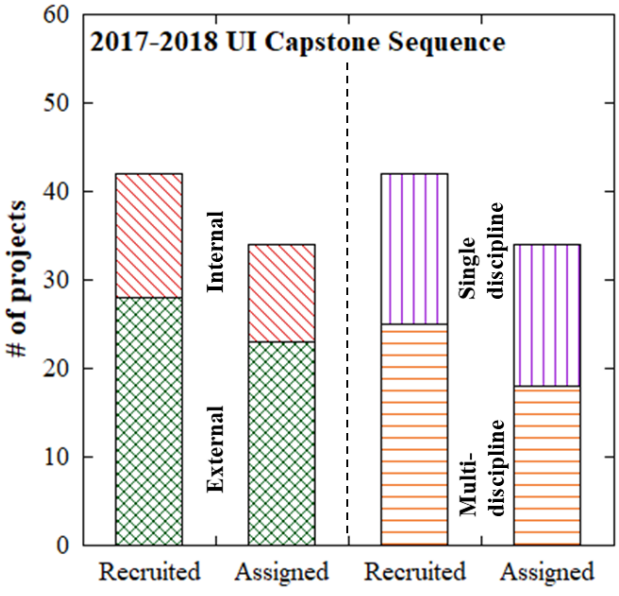

Figure 2. Summary of recruited and assigned projects for the UI 2017-2018 Engineering Capstone sequence.

Project Fair

The interactive nature of the Project Fair offers many positive attributes. Fundamentally, it flips the student experience from passive listening in a classroom to active engagement and ownership of the learning experience as they evaluate potential projects. Many studies have shown how active student engagement in the learning process have a positive influence on student performance[6]. The format also sets an expectation for subsequent Snapshot Day events[7], in which students present the status of their projects in a similar format.

Informal feedback was sought from students regarding the Project Fair experience. One common response is that the duration of the project fair was too short (~1.5 hours), limiting time for students to adequately visit all of their targeted project booths. A second common response from students involved requests for more external sponsor participation in the Project Fair. From Fig. 2, 28 of the recruited projects were sponsored by external industry partners. However, only 12 of these projects (~43%) were presented at the Project Fair by representatives from the external sponsor (Fig. 3). A higher percentage of projects with external representation at the Project Fair were awarded teams (~91%), while only ~81% of the proposed projects without external representation were awarded. Having external industry participation in the Project Fair appears to increase the likelihood for student interest and bids for prospective projects.

Conclusions

For the 2017-2018 Engineering Capstone sequence at UI, a project fair format was used to introduce students to various project options and more efficiently facilitate the project team formation process. Based on this inaugural experience, the following key observations are made:

- Implementing a single-day project fair event, instead of a historically used in-class presentation format, successfully shortened the team assignment process by one week. This gave students more time to initiate and execute their assigned projects.
- The project fair format offers more opportunity for early networking between students and project sponsors. External industry sponsored projects with client representation at the Project Fair achieved a higher rate of student interest and team assignments.
- The recruitment of a surplus of potential projects helps maximize the flexibility in matching interdisciplinary student teams with project needs. It also ensures students are assigned projects for which they specifically expressed interest.
- For future project fair events, more time for the event is recommended (up to 2-3 hours). This will enable students to meet with more project representatives and thoroughly evaluate their options.

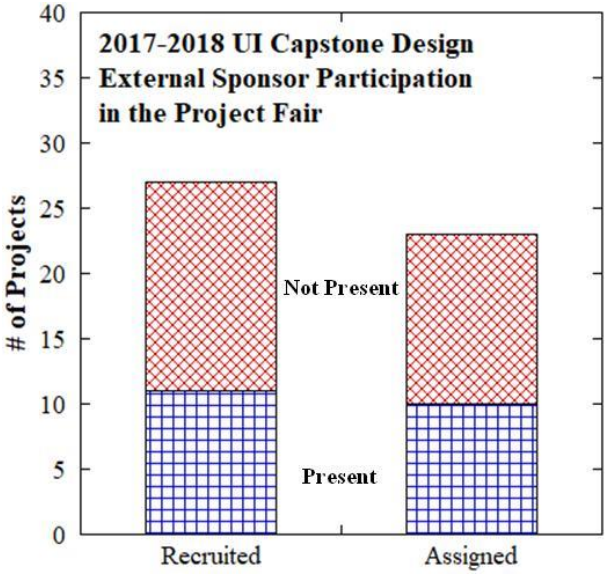

Figure 3. Summary of external sponsor participation in the Project Fair and the resulting assigned projects for the UI 2017-2018 Engineering Capstone sequence.

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