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Success Factors in a Project-Based Industrial Engineering Senior Design Capstone Course

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Assessment of Factors Affecting Student Perception in a Project-Based Industrial Engineering Senior Design Capstone Course

Abstract

The focus of our research is a project-based Industrial Engineering senior design capstone course. Project-based learning in engineering courses, including the capstone course, provides an opportunity for students to apply the body of knowledge in their respective disciplines and further prepare them to begin their careers in the professional practice of engineering. In addition, these courses provide an opportunity for students to improve their ability to function effectively on a team. Current research explores the key factors that affect outcomes in capstone design courses. However, few, if any, investigate the association between course attributes (factors) and course outcomes. The current literature focuses on factors or models of implementation without emphasizing how those factors could impact the overall course or student success. There exists an opportunity to more comprehensively study the factors related to specific disciplines and Industrial Engineering in particular. This paper summarizes an initial investigation into the significance of key factors that affect outcomes in an Industrial Engineering senior design capstone course. As a discipline, Industrial Engineering is more focused on the design of processes and systems and less on the design of products or construction of physical structures, as might be the focus of a Mechanical Engineering or Civil Engineering capstone course.

This research provides initial insights into the factors that affect outcomes in a project-based Industrial Engineering senior design course. Survey data collected before and after two semesters of an Industrial Engineering senior design capstone course serve as the basis of the summary data. In this paper, we focus on student preferences of project topics before the start of the course as a key factor and the corresponding perception of the course at its conclusion as measures of the course outcome. While left for our ongoing research and data collection, the following are examples of factors that we plan to evaluate for potential significance to course outcomes: measures of team dynamics collected during peer evaluations throughout the semester; student personality traits determined by a DiSC® assessment completed by each student; student preferences for subject areas and team composition as compared to the project to which they were assigned; self-assessments of skill levels within a particular topic; previous work experience; and prior coursework including areas of concentration and elective courses completed. In addition, we also plan to investigate factors related to the project itself, such as the project topic and technical relevance to the field of Industrial Engineering. Data used to define these and other factors are collected primarily via surveys explicitly designed for the course. At the time of this paper, the population of responses associated with some key factors was not sufficient to include and, thus, is not presented here. However, we recommend exploring these factors in future research. A review of the recent literature on industrial engineering capstone courses and success factors in capstone courses, in general, is included to discuss existing research results related to these types of success factors in our research.

Introduction

The Industrial Engineering Senior Design Capstone Course at the University of Pittsburgh is a semester-long project-based course. Students take the course in their senior year of the undergraduate program. The course consists of four formal class meetings at the beginning of the semester to announce team assignments, provide an overview of the course, and discuss subject matter relevant to project-based learning, such as teamwork, leadership, communication, and project management. In addition, teams present the progress of their projects to the class on three occasions. Companies sponsor projects in a variety of domains representing the Industrial and Systems Engineering (IISE) Body of Knowledge (BoK) [1] (see Table 1).

Table 1. Body of knowledge areas as defined by IISE.

1. Work Design & Measurement	8. Supply Chain Management
2. Operations Research & Analysis	9. Engineering Management
3. Engineering Economic Analysis	10. Safety
4. Facilities Engineering & Energy Management	11. Information Engineering
5. Quality & Reliability Engineering	12. Design & Manufacturing Engineering
6. Ergonomics & Human Factors	13. Product Design & Development
7. Operations Engineering & Management	14. System Design & Engineering

Students are assigned to teams and matched with company sponsors based on curriculum requirements that must be met. In addition, each team consists of a faculty member that serves as a mentor. Team assignments are based on students' responses to a survey (Team Matching Survey) distributed before the beginning of the semester. The survey consists of project topic preference, access to transportation, prior course performance, and team member conflicts. Students are made aware of their project and team assignments during the initial class meeting during the first week of the semester.

Students are asked to provide feedback both formally and informally through ad hoc, open-ended surveys throughout the semester. In addition, after the course, students are asked to provide formal feedback via a survey (Outcome Assessment Survey) on the course to understand their preferences and perceptions better and provide insight into opportunities for continuous improvement within the course.

The method of assigning students to project topics is an area that has received consistently mixed feedback over the past several years. The research described in this paper aims to understand better the relationships between the key factors associated with team assignment and the resulting perceptions of students after the course. To illustrate these points, we summarize data collected during the Spring 2021 and Fall 2021 semesters to develop hypotheses to inform our ongoing data collection, survey methods, and research.

In the following sections, we review the current literature that investigates the influential factors associated with successful undergraduate engineering senior design capstone projects. Next, we outline our methods for data collection, analyze the data collected, and discuss the results. Lastly, we draw conclusions and make recommendations for future research directions based on this work.

Literature Review

Industrial Engineering is a discipline that incorporates a systematic approach to design projects and a multidisciplinary approach to solving problems. This section synthesizes the most prevalent findings from a literature review spanning from 2014 to 2021 and identifies influential factors associated with a successful senior project in the engineering discipline. These factors include team formation, instructor role, project topic, peer review and evaluation, and previous work experience.

Team formation is a key factor in senior engineering capstone projects, and its implementation can lead to a better learning experience for students if done well. The challenge is that teams are formed differently, ranging from self-selecting classmates to randomly assigned groups [2]. Data from 2015 shows that the most common way of assigning teams was student choice, followed by instructor choice [3]. On the contrary, the least common way was by personality test methods (e.g., MBTI). In a meta-analysis study, D'Innocenzo et al. [4] concluded a strong positive relationship between shared leadership and team achievements [5]. Fausing et al. [6] took this further to point out that the interdependence in the team was a strong predictor of the level of shared leadership in a project. Therefore, a systematic approach to forming capstone teams that considers personal attributes and characteristics can help yield a team able to achieve authentic team cohesion, constant collaboration, and seamless team dynamics [2]. By implementing this approach, the interactions and behaviors that occur in teams will result in better outcomes for the capstone project as every member can participate in leadership responsibilities and team development [5]. The team matching process is an element of team formation and is explored in the research contained within this paper.

A second key factor in the success of a capstone project is the instructor's role. Publications have reported that coaching rather than lecturing supports design processes and teamwork skills [2]. Many U.S. engineering faculty members teaching senior design courses bring solid experience from previous involvement in the engineering industry or government [2]. Instructors for a senior design course are strongly encouraged to employ teaching strategies that help with issues related to the design process but leave decision-making matters to the team. In the course that is the subject of this research, the instructor and the faculty mentors subscribe to a coaching style. However, lectures are incorporated to provide a consistent framework and assist students with issues related to the design process and project management. We analyze student feedback and perception of this approach.

Research also suggests that project selection critically impacts student motivation and drive during the capstone term and can contribute to better outcomes. ABET provides some guidelines for what projects should look like, such as allowing student creativity, fostering design methodology, and use of open-ended problems [7]. However, when special attention is dedicated to topic selection, students are better prepared for the challenges and obstacles a senior design capstone entails [2]. This idea is supported by Tsenn et al., who explored how self-efficacy relies on motivation and outcome expectation and correlated motivation to the number of times students spent on the project [8]. Bracken et al. looked at the perceived value of the project, relevance to engineering discipline and tasks, and the use of "cool" technologies as factors that students considered in the project selection process. This point again touches on the idea that by bringing together motivation and interest in the project, the learning experience, responsiveness to challenges, and overcoming obstacles will improve throughout the project. Therefore, through these two mechanisms of interest and motivation, a clear link between project selection and a successful senior design project outcome can be drawn. We explore the notion of a student's perceived value of the project and the relevance to the Industrial Engineering discipline as a key factor associated with the success of a project.

A fourth key factor in capstone outcomes relates to the topic of peer review or a similar type of team evaluation opportunity. Peer reviews have most commonly been performed at the end of the term to gauge understanding of performance. Still, research suggests that peer reviews will have a much more positive impact on outcomes when they are performed periodically throughout the senior design course progress. Such peer reviews increase team awareness, enabling sufficient time for self-correction [2]. If students can easily recognize skills and competencies that are continuously needed for their project, then it is best to allow them the opportunity to communicate that. The peer reviews serve as a self-assessment to see where the team and project stand and how the team members want to proceed for the remaining time allotted. Even if the peer reviews are done at the midpoint of the semester, teams can still reap the benefits [9]. While peer reviews are conducted, and subsequent feedback is provided at the midpoint of the semester and at the end of the semester in the course that is the subject of this research, we leave the key factor of "peer reviews" as an opportunity for future research.

Prior research also investigates how co-curricular experiences can affect the results of a senior design project. By previously being involved in industry work, whether through an internship or co-op, students come into the capstone course with experience that helps them better understand the scope and goals of the design project [10]. Students can also appreciate the experience more because although they have already been exposed to design aspects, they can participate in more phases of the capstone project by seeing it from beginning to end [10]. Students inherently will also have had the opportunity to familiarize themselves with standards and regulations for engineering practices. Goldberg explains that students reinforce methods and practices from their industry experiences or supplement those with the new skills they learn during the capstone project [10]. Whether for ABET accreditation or general curriculum concerns, it is beneficial to keep these two opportunities separate [10]. An incorrect assumption might lead one to believe students can learn everything about design in a co-curricular experience. However, as previously explained, the work in co-curricular experiences often does not prepare students to work on and lead an entire design project on their own. Therefore, a student's work experience is assessed as a factor in this research.

The literature on the key factors that affect senior design outcomes is a good foundation for our research to understand the key factors that lead to a successful capstone result. The following sections of this paper explore the key factors of team formation and matching, the role of the instructor, a student's work experience, and project topics concerning their impact on an Industrial Engineering senior capstone course. Finally, we leave the peer review process as an opportunity for future research and identify other factors worth exploring in the future.

Method

The data summarized in this paper was collected during the Spring 2021 and Fall 2021 semesters via surveys developed by the course instructor using Qualtrics^{XM} online survey software. The data discussed in this paper was collected from two surveys – the *Team Matching Survey* and the *Outcome Assessment Survey*. In addition, metadata regarding a students' team assignment is also used. Because of the nature and use of the data from the Team Matching Survey, student names are collected. However, students respond to the Outcome Assessment Survey confidentially. To ensure confidentiality, a randomly generated numeric code was provided to students by a member of the research team acting as an honest broker. The resulting de-identified data was given to other research team members (including the instructor). An application to the University of Pittsburgh’s Institutional Review Board (Study 21110132) is underway.

The Team Matching Survey is administered before the start of the semester, includes questions that include text, multiple-choice, and Likert scale responses. The purpose of the survey is to collect information relevant to the team assignment process. Overall, the survey includes 27 questions related to preferences for a project topic; contact information; subject matter interest; plans following graduation; performance in courses completed; pursuit of concentrations, certificates, or minors; technical electives completed; work experience; and access to transportation for travel to companies in the surrounding area. The data summarized in this paper and used to assess a students' preference for team formation results from one specific question that asks students to "Please describe [their] preference for the following [Industrial Engineering] domain areas." The domain areas listed are defined by the IISE BoK (see Table 1). In addition, students are asked to respond using an ordinal 5-point Likert scale to indicate their preference for each of the 14 domain areas.

The Outcome Assessment Survey is provided to students at the conclusion of the semester to gather student perceptions of the course with respect to the course objectives, Accreditation Board of Engineering and Technology (ABET) criteria; course framework; team performance; project success; team assignment; project assignment; and overall effectiveness of the course in helping students attain their goals. The survey consists of 20 questions that elicit responses via text, multiple-choice, and Likert scales. Table 2 includes a subset of the questions and corresponding response choices from the Outcome Assessment Survey analyzed in this paper.

Table 2. Outcome Assessment Survey questions used to assess student perception and analyzed in this paper.

Question	**Possible Responses**				
A. How relevant was this course in preparing you for a career as an Industrial Engineer?	Completely Relevant	Mostly Relevant	Neither Relevant nor Irrelevant	Mostly Irrelevant	Completely Irrelevant
B. Which of the following team formation methods would you most prefer?	Student Choice		Instructor Choice		Personality Test
C. How would you rate your team's performance overall?	Excellent	Good	Neither Good nor Poor	Poor	Extremely Poor
D. How would you rate the success of your project?	Completely Successful	Mostly Successful	Neither Successful nor Unsuccessful	Mostly Unsuccessful	Completely Unsuccessful
E. How would you rate your mentor's performance overall?	Excellent	Good	Neither Good nor Poor	Poor	Extremely Poor
F. How satisfied are you with the topic of the project to which you were assigned?	Completely Satisfied	Mostly Satisfied	Neither Satisfied nor Dissatisfied	Mostly Dissatisfied	Completely Dissatisfied
G. How relevant was your prior work experience (co-op, internship, etc.) in contributing to the success of your project?	Completely Relevant	Mostly Relevant	Neither Relevant nor Irrelevant	Mostly Irrelevant	Completely Irrelevant
H. How relevant were the course lectures in contributing to your success?	Completely Relevant	Mostly Relevant	Neither Relevant nor Irrelevant	Mostly Irrelevant	Completely Irrelevant

Upon completion of the semester, the instructor selects one primary IISE BoK area to categorize each project. Projects are categorized based on the overall project topic, problems to be solved, and Industrial Engineering tools used to solve the problem. Overall, 19 projects were included in this study, with 11 completed by student teams in Spring 2021 and eight completed in Fall 2021. Figure 1 illustrates the distribution of projects across each of the 14 IISE BoK areas. The Information Engineering area, which includes projects focused on data analytics, had the greatest frequency of projects (7). No projects were categorized in the areas of Engineering Economic Analysis, Ergonomics & Human Factors, Supply Chain Management, Safety, Design & Manufacturing Engineering, or System Design & Engineering. While difficult to control since the specific project domains are generated from industry problems, a better understanding of student preferences related to specific domains helps inform the course instructor of types of projects to focus on for solicitation from industry partners.

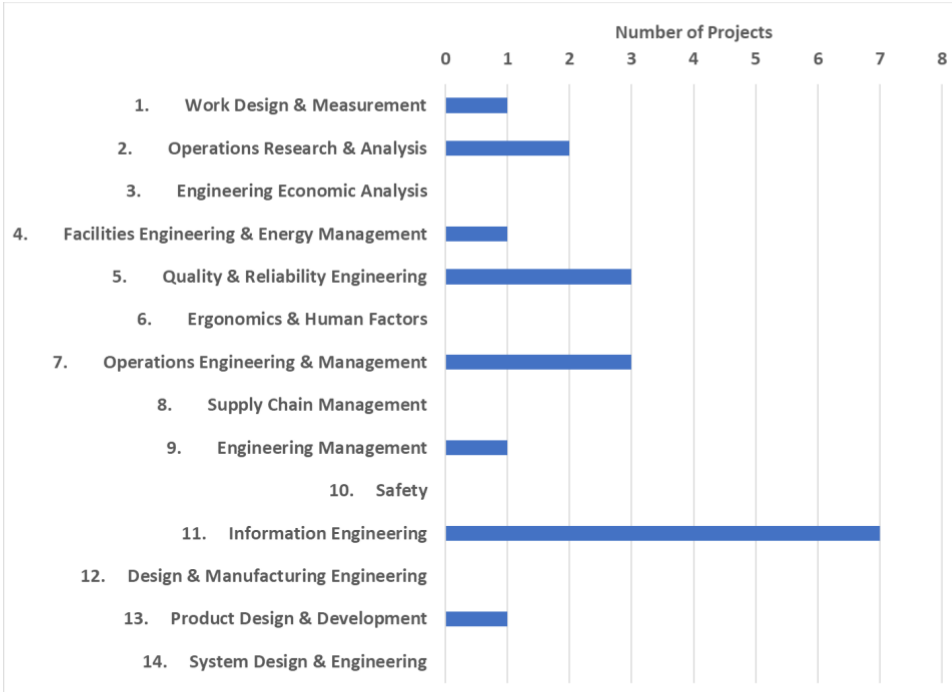

Figure 1. Distribution of projects within IISE BoK areas.

While not always possible due to other constraints, the objective team size is four students. The 19 projects included in this research had an average team size of 3.84 students (standard deviation = 0.69) and included 73 students. Table 3 summarizes the number of projects, number of students, and team size distribution for each semester. Although traditional hypothesis testing methods for proportions and frequencies were applied to the survey data, the conclusions could not be statistically validated because of the sample sizes of survey responses and the resulting sparse subsets of data. Summary results are included in the following pages to provide initial insights into the factors that affect the outcomes in a project-based Industrial Engineering senior design course and develop hypotheses to continue this research.

Table 3. Summary of class and team size by semester.

Semester	Number of Projects	Number of Students	Distribution of Team Size		
			3-student teams	4-student teams	5-student teams
Spring 2021	11	47	--	8	3
Fall 2021	8	26	6	2	--
Overall	**19**	**73**	**6**	**10**	**3**

Results and Discussion

In the Team Matching Survey, students are asked to "Please describe [their] preference for the following [Industrial Engineering] domain areas" by rating each of the 14 IISE BoK areas on a 5-point ordinal Likert scale that included the choices *Prefer a Great Deal* (5), *Prefer a Lot* (4), *Prefer Moderately* (3), *Prefer Slightly* (2), *Do Not Prefer* (1). To better understand differences in student preference for project areas across the two semesters, a Mann-Whitney nonparametric test of group medians was conducted for areas represented in the Spring and Fall 2021 semesters using the numerical equivalents (1-5) of the Likert scale choices. The Mann-Whitney test was chosen since the Likert scale data are ordinal, not continuous, and do not follow a normal distribution. The p-values and summary statistics for this analysis can be found in Table 4 and indicates that there was no statistically significant difference in the median preference for each of the IISE BoK areas between the two semesters at a 95% confidence level. The variation in p-values results from the distributions in the underlying data. For example, while the median of the distributions of the two sets of data being compared may not differ significantly, one distribution may be skewed and another not. This phenomenon occurred in the IISE BoK area Operations Research & Analysis (p=0.059), where the median responses for the Spring 2021 and Fall 2021 semesters were 3. However, the Spring 2021 response distributions were left-skewed, whereas the Fall 2021 response distribution did not show significant skewness (see Figure 2). By inspecting the means of the two populations of data ($\mu_{Spring\ 2021} = 3.422, \mu_{Fall\ 2021} = 2.808$; using the two sample t-test (p = 0.038), we also observe this phenomenon. Based on the Mann-Whitney tests performed, the median student preferences, in general, did not change between the Spring 2021 and Fall 2021 semesters, suggesting potential stability in student preferences for IISE BoK areas.

Table 4. Comparison of student preferences between Spring 2021 and Fall 2021.

IISE BoK Area	Spring 2021		Fall 2021		Mann-Whitney p-value*
	Median	n	Median	n	
1. Work Design & Measurement	3	45	3	26	0.663
2. Operations Research & Analysis	3	45	3	26	0.059
4. Facilities Engineering & Energy Management	3	45	2	26	0.779
5. Quality & Reliability Engineering	3	45	3	26	0.720
7. Operations Engineering & Management	4	45	4	26	0.756
9. Engineering Management	4	45	4	26	0.204
11. Information Engineering	3	45	3	26	0.364
13. Product Design & Development	3	45	2	26	0.478

$*H_0: \eta_{Spring\ 2021} = \eta_{Fall\ 2021}, H_A: \eta_{Spring\ 2021} \neq \eta_{Fall\ 2021};\ \alpha = 0.05; where\ \eta\ is\ the\ median$

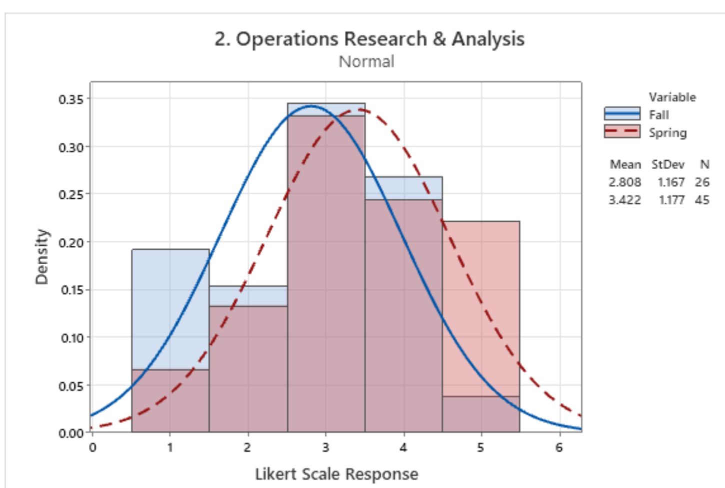

Figure 2. Example comparison of the distribution of responses between semesters.

Further inspecting the responses of student preferences of each of the IISE BoK areas by response frequency shows the distribution across the Likert scale choices in greater detail (see Figure 3). Overall, students had the highest preference (considering the combined proportion of responses *Prefer a Great Deal* (5) and *Prefer a Lot* (4)) for Operations Engineering & Management (58% and 65%) and Engineering Management (51% and 58%) in both the Spring 2021 and Fall 2021 semesters. Alternatively, students had the least preference (considering the combined proportion of responses *Prefer Slightly* (2), *Do Not Prefer* (1)) for Facilities Engineering & Energy Management (44% and 54%) and Product Design & Development (44% and 54%) in Spring 2021 and Fall 2021.

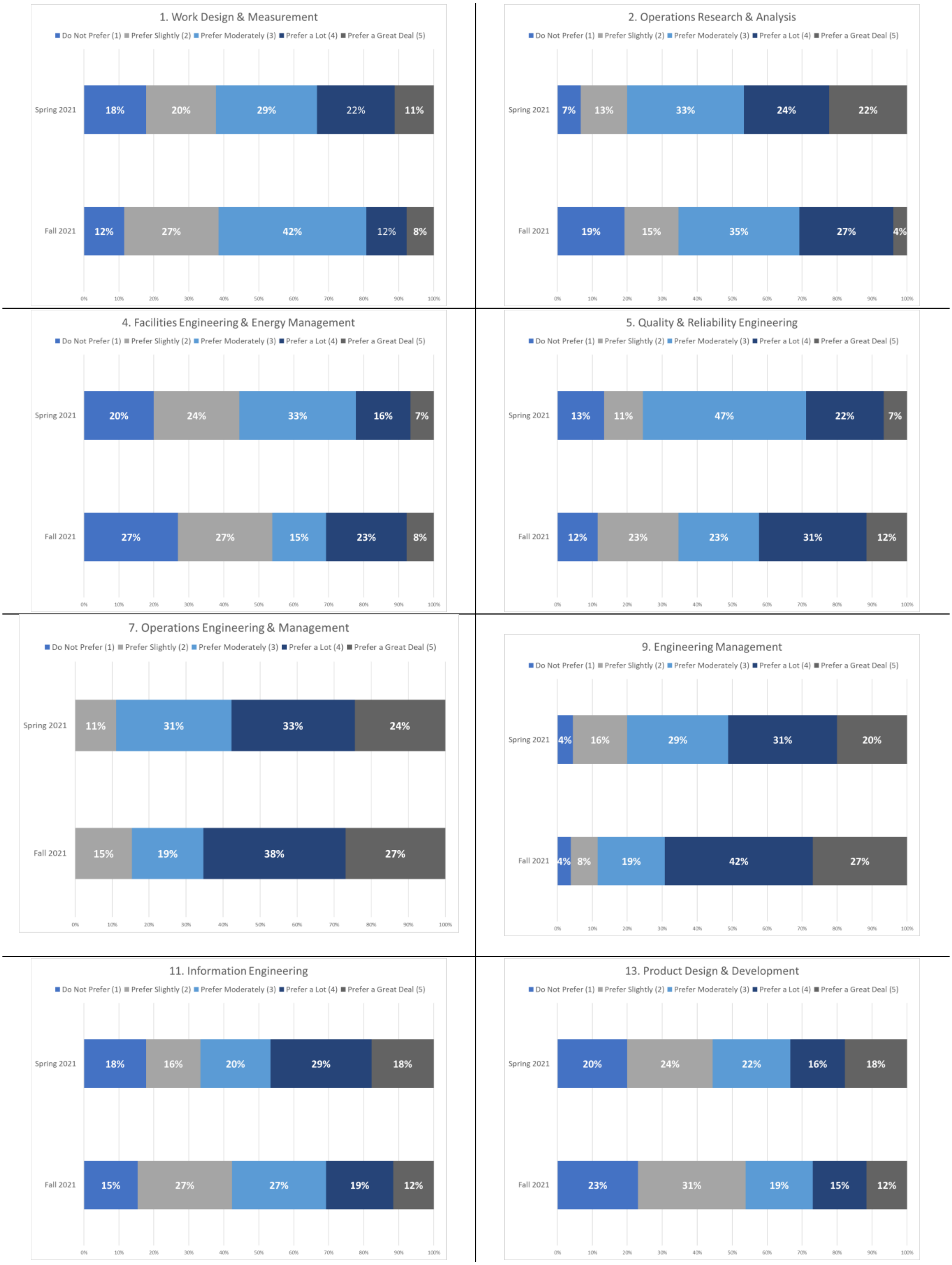

Figure 3. Student preferences for IISE BoK areas.

Next, we consider student preference for a project topic compared to the project they were assigned and find that eight of the 14 IISE BoK areas are represented in actual projects (see Table 4 and Figure 3). Table 5 illustrates the preferences for projects that students indicated for the IISE BoK during the Team Matching Survey and to which they were ultimately assigned. Please note that of the 47 students enrolled in the class in Spring 2021, only 45 completed the team matching survey. Across the Spring and Fall semesters, 52.1% of students were assigned to a project that represented an IISE BoK area that the student indicated as *Prefer[ring] a Lot (4)* or *Prefer[ring] a Great Deal (5)*. Overall, more than 76% of students were assigned to projects that represented IISE BoK areas that they at least *Prefer[red] Moderately (3)*. In the Spring semester, 69.2% of students were matched to projects in areas that they at least *Prefer[red] Moderately (3)* compared to 80.0% of students in the Fall semester.

Table 5. Percentage of students assigned to IISE BoK area preference indicated in Team Matching Survey.

Semester	Number of Students	Percentage of Students Matched				
		Do Not Prefer (1)	Prefer Slightly (2)	Prefer Moderately (3)	Prefer a Lot (4)	Prefer a Great Deal (5)
Spring 2021	45	8.9%	11.1%	17.8%	37.8%	24.4%
Fall 2021	26	7.7%	23.1%	34.6%	19.2%	15.4%
Overall	**71**	**8.5%**	**15.5%**	**23.9%**	**31.0%**	**21.1%**

To better understand if the IISE BoK area to which a student was assigned was a factor in their overall perception of the course, students were asked Questions A-H (see Table 2) in the Outcome Assessment Survey. Although the authors initially intended to determine if there is an association between the preference for the project area assigned and the responses to Questions A-H using statistical tests for significance, the results were not valid because of the sparseness of the underlying subsets of data needed to complete the analysis with one exception where an association between variables was statistically significant based on Fisher's Exact Test. To increase the density of the data, we combined some categories of responses and found that there is a statistically significant association (p = 0.0498, 95% confidence level) between a student's perception of their team's performance as "good" (not "excellent") and the student's preference as "slight or moderate" (not "strong") for the project topic to which they were assigned (see Table 6). Therefore, we can infer that a lesser preference for project topics may result in a lesser perception of the team's performance. However, further data collection is required to substantiate this inference. The authors plan to continue this study and collect additional data to increase the sample size to a level that yields valid statistical results.

Table 6. 2x2 Fisher exact test for association between combined categories.

Preference for the IISE BoK area	How would you rate your team's performance?	
	Excellent	**Good**
Slight/Moderate	3	8
Strong	6	1

The Fisher exact test statistic value is 0.0498. The result is significant at $p < .05$.

Instead of statistical tests to assess the significance of the relationships between project assignment and student perceptions (as indicated in Questions A-H), responses are summarized (see Figure 4), and results are discussed. Overall, 65% of students who at least moderately preferred the topic of their project indicated that the course was either completely relevant or mostly relevant in preparing them for a career as an Industrial Engineer (see Figure 4, Question A). More than 60% of students preferred that teams be formed by student choice, with 50% of respondents not preferring, slightly preferring, or moderately preferring the IISE BoK area of the project that they were assigned (see Figure 4, Question B). Thirty percent of students indicated a preference for personality tests determining teams, and 10% preferred instructor choice (see Figure 4, Question B). Students were balanced when assessing their team's performance, with 50% indicating their team's performance as excellent and 50% of respondents indicating their team's performance was good (see Figure 4, Question C). When rating the project's success, 95% of respondents indicated either completely successful or most successful, with only 5% feeling their project was mostly unsuccessful (see Figure 4, Question D). Although not verified statistically for the reasons stated above, students' perception of team performance and project success appears to be independent of their preference for the IISE BoK area of the project to which they were assigned. Sixty-five percent of respondents indicated that their mentor's performance was excellent, with only 5% indicating that their mentor performed poorly (see Figure 4, Question E). The one student (5%) who indicated poor mentor performance was also assigned to a project representing an IISE BoK area that they did not prefer, whereas all students who perceived excellent mentor performance at least slightly preferred their project area. Overall, 65% of respondents indicated that they were mostly or completely satisfied with the topic of their assigned project and previously responded that they at least moderately preferred the IISE BoK knowledge area that their project represented (see Figure 4, Question F). Seventy percent of students felt that their prior work experience was either mostly relevant or neutral (neither relevant nor irrelevant) when it came to the success of their project (see Figure 4, Question G). Forty percent of students indicated that the course lectures were either completely or mostly relevant in contributing to their success, whereas 15% indicated the lectures were mostly irrelevant, and 30% believed they were neither relevant nor irrelevant (see Figure 4, Question G).

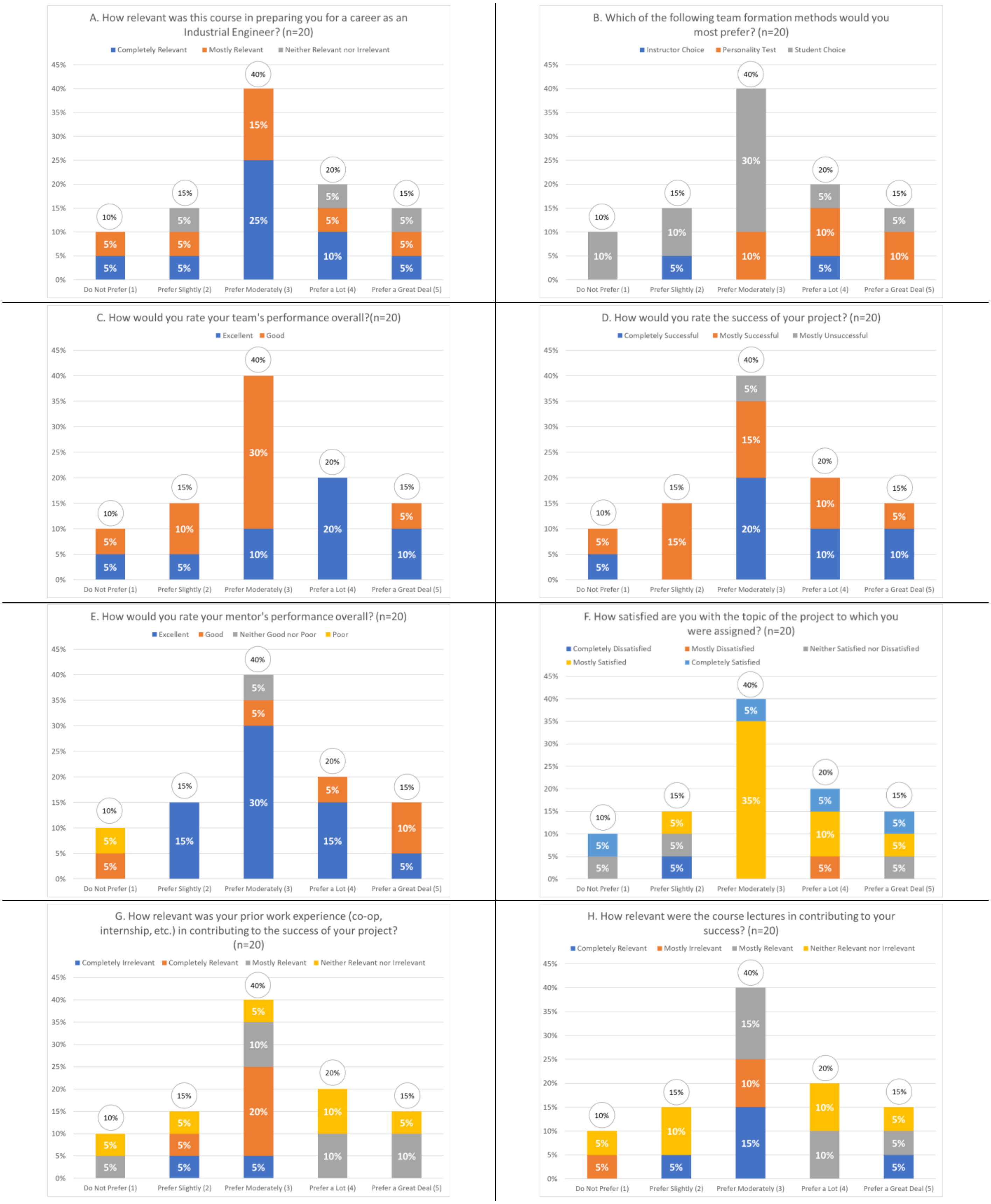

Figure 4. Student preferences for IISE BoK area of assigned project as a function of perception.

Conclusions and Future Work

The work summarized in this paper is an initial study investigating the key factors that affect a student's perception of an Industrial Engineering Senior Design Capstone course. Here, we summarized data collected via two-course surveys, one before the start of the course and used for team matching, and a survey administered at the conclusion of the course used to assess students' perception of the course. We also examined student perceptions as a function of their preference for the project to which they were assigned based on the IISE BoK area that described the project best. From this preliminary work, we can conclude the following:

- Students consistently prefer projects that align with two IISE BoK areas: (1) Operations Engineering & Management and (2) Engineering Management. In addition, these results provide some indication that students prefer projects that include either data analytics or management practices to a larger extent.
- Students appear to prefer to a lesser extent, consistently the two IISE BoK areas: (1) Facilities Engineering & Energy Management and (2) Product Design & Development.
- Projects focused on the IISE BoK area of Information Engineering occurred more frequently than any other IISE BoK area.
- Although more rigorous statistical analysis is required, there were no strong indications that a student's preference for a particular IISE BoK area had a relationship to their perception of the course as defined by a set of eight posed questions. However, in one case, a statistically significant association may suggest that students assigned to projects with topics that are less preferred may result in a lower perception of the team's performance.

In addition to continuing the data collection as described herein, we also plan to continue extending this work and analyzing additional data being collected as part of this ongoing study to improve the student experience. Research questions that we plan to pursue as part of future work include the following:

- Are student preferences for IISE BoK areas (and extensions) and the project to which they are assigned associated with their perception of the course?
- Do team dynamics influence student perception of the course?
- Are student personality traits (determined by DiSC® assessment) associated with student preferences or perceptions of the course?
- Is a student's area of curriculum concentration associated with their area of preference or perception of the course?
- How can feedback loops between clients, students, and mentors be improved to normalize perceptions of performance?
- Is student GPA a predictor of team performance?

Lastly, we will continue to pursue improvement in the course by better understanding student perceptions and perspectives with a specific emphasis on the following areas:

- **Course lectures**. We will continue to evaluate student perspectives on the value of the current lecture topics, format, and whether other topics would be more beneficial to the student experience.
- **Team formation**. We will continue to explore and test different ways to form teams, emphasizing the effect that self-selection may have on a student's perception of the course.

- **Project topic options**. Although we always seek to provide a distribution of project topics that align with all of the IISE BoK areas, we will work to improve offerings that have been offered historically with less frequency.

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