Applied Capstone Project for Working Professionals: A Decade of Experiences in Design, Execution, and Creating Value for Employers

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Introduction

Wholesale Distribution in the United States is more than an 8.2 trillion-dollar industry, with more than 300,000 businesses that employ six million people [1]. The wholesale trade accounted for about 6% of the GDP in 2021 and is presently one of the top 6 sectors of the U.S. economy. The growth of a distribution organization does not rely solely on the distributor's geographic reach, physical assets, product selection, or access to capital. It also depends on its human capital. In fact, all organizations require human capital to accomplish their goals; therefore, the organization's ability to manage its human capital is key to its business success. Treating people as capital means recognizing people as an asset rather than as an expense.

TABLE 1
KEY U.S. INDUSTRIES SHARE OF GDP IN 2021

Finance, insurance, real estate, rental, and leasing	21%
Professional and business services	13%
Government	12.1%
Manufacturing	10.7%
Education, healthcare	8.6%
Wholesale Trade	6.2%
Retail Trade	6%

Source: U.S Census Bureau

Graduate Program for Working Professionals

While most wholesaler-distributors understand how to leverage financial and physical capital, when it comes to working with people, distribution industry leaders often find themselves struggling with three things: attracting, developing, and retaining key talent, working with and developing employees effectively, and measuring the return on their human capital investment. To develop distribution professionals, many industrial distributors who served on the Industry Advisory Board of the Industrial Distribution Program at Texas A&M University requested a graduate program for their managerial employees in 1998. Particularly, they found that many of the managers came up through the ranks of an entry-level employee to sales or operations professionals to become a manager. While they had knowledge and experience in the products, services, customers, and market, they lacked business acumen, understanding of competitive advantage, and profitability (financial). The Industry Advisory Board members also suggested that the program should be part-time, flexible and convenient for their managers as they could not leave their current job responsibilities while pursuing this degree. Therefore, in response to industry needs and advisory board feedback, the Industrial Distribution program began offering an online specialized graduate degree in Distribution starting 2001. The program is in its 23rd year.

The courses in the program provide the critical skills and knowledge necessary to be successful and gain a competitive advantage for the student and their company through the immediate application of knowledge and research directly into practice. While all the students work in distributor or manufacturing settings, each student's functional role and expertise vary, which provides students a rich and comprehensive set of classmates from which to learn. Students learn to immediately apply the knowledge they gained from the courses to everyday challenges they face in the workplace which provides instant impact.

Capstone Project Use in Engineering Courses

Capstone-type projects have existed at engineering schools for many years, providing students opportunity to solve real-world engineering problems [2]. Learners demonstrate the ability to plan, select, and locate information; engage in critical analysis; apply multilayered decision making; and generate new meaning [3]. Mosher found that the purpose of capstone programs is to give students the opportunity to apply technical tools, techniques and knowledge learned in the classroom to an open-ended, realistic, and creative problem-solving experience [4, 5, 6, 7]. In addition to the value of the application of engineering concepts, these educational experiences are lauded as excellent preparation and are strongly encouraged by industry [2]. Ha contends that a capstone project can be an extremely useful application in high demand in the real world. For that reason, capstone projects are increasingly used as a result of both ABET (Accreditation Board for Engineering and Technology) requirements and strong consensus among educators and industry that students need hands-on practical design experiences. Capstone projects may be one of the best ways to evaluate how well students have learned to apply technical competencies [8, 9]. In fact, the ability to assimilate, assess, and apply knowledge while building deeper levels of understanding demonstrates mastery [10, 11].

Although literature about capstone use in engineering confirms its usefulness in the academy there is limited studies regarding graduate-level capstone use in engineering. Reviews of prior research revealed that there are studies on instructional models and strategies for capstone design courses [12, 13] including evaluation of learning outcomes [14, 15, 16]. While this literature does inform practice, literature specific to graduate-level engineering course use of capstones is severely limited. Therefore, this paper hopes to provide suggestions and recommendations for capstone project use within graduate level online contexts.

Capstone Project Overview

Students are required to complete an individual capstone project under the guidance of an instructor and steering committee members from their company or industry in their second year. The project is a 9-month long effort to apply the key learnings from the program and bring value to the sponsor companies. The project focuses on a narrow problem in business development, operational improvement, financial or people development. The key learning outcomes include:

1. Demonstrate the systematic thought processes used in engineering design thinking and assessment of current industry practice.
2. Apply the engineering problem solving approach to practitioner problems.

3. Identify a need and define a problem, its objectives, and constraints from real-world business challenges.
4. Implement key steps in ‘engineering problem solving to evaluate possible solution taking into consideration broad problem constraints including economic, environment, social, political, ethical, health and safety, manufacturability, and sustainability.
5. Develop a detailed plan for deployment of solution and evaluate the desirability of the solution.
6. Deliver results from the study through a professionally structured document and an oral presentation based on the research to stakeholders.

Capstone Project Evolution

While the capstone project was always a part of the program for over 20 years, the structure, format, and process has evolved. The program went through a complete curriculum update in 2019-2020. Several courses were fully updated. One of the major changes in the capstone format with a unified syllabus, deliverables, and due date across all advisors. The second upgrade was the content (presentations and resources) and support system for the student. A staff capstone coordinator support was added to help manage the LMS, student support and progress tracking. These updates were based on both the feedback from students in their exit interviews, and instructor experiences during the previous years.

Rationale for Update

Rationale for updating the capstone course schedule and the accompanying capstone deliverable process is based on student feedback as well as acknowledgement by capstone faculty to establish unified standards, consistent expectations, and rubrics that clearly assess deliverables helps all students in this process. Previous formats for the course were determined by each individual instructor. This includes project due dates, assessment timelines, and rubrics despite students across all sections of instructors working on the same capstone course project. Recognizing that each individual academic capstone advisor’s subject matter expertise and course management style varies, it was evident after data analysis that students and faculty alike would benefit from a more established approach to the capstone project. Historically, capstone courses use faculty expertise and experience to provide loosely defined and vague learning objectives and goals [17]. By changing and clarifying learning outcomes faculty and students both move in the same direction in unison, which is a fundamental element of capstone courses [18].

Capstone Project Milestones

The capstone project experience involves two three-credit courses over two consecutive semesters during the second year of the program. The project starts with the development of a problem statement, then a short proposal, followed by literature review and development of a methodology in the first semester. The second semester begins with a mid-term update to the steering committee, followed by solution development, implementation plan, ROI calculation and final project presentation to the steering committee. The capstone advisors provide project

scope management, subject-matter advising, and ensuring the solutions are data-driven and practical. Table 2 and Table 3 outline the key milestones and deliverables of the capstone project over nine months.

TABLE 2
FALL – CAPSTONE I

	Description	**Points**	**Due Date**
1	Problem Statement / Proposal Due	100	September 8, 2023
2	Initial Steering Committee Meeting *[50 points for content of the presentation, 25 points for delivery & discussion]*	75	No later than September 29, 2023
3	Background / Introduction Due	100	October 20, 2023
	Recitation sessions – Literature Review		October and Early November
4	Literature Review Due	100	November 17, 2023
	Recitation sessions – Methodology		November
5	Methodology Due	100	December 1, 2023
	Mid-Term Project Reflection	25	December 1, 2023
	TOTAL	**500**	

TABLE 3
SPRING – CAPSTONE II

	Description	**Points**	**Due Date**
	Recitation Session - Data Analysis / Solutions / ROI		December, January and February
6	Critical Project Analysis Meeting *[Graded for project rigor, solution integrity, articulation and clarity of plan to wrap up project]*	75	By January 26, 2024
7	Mid-Term Steering Committee Meeting *[50 points for content of the presentation, 25 points delivery & discussion]*	75	No later than February 16, 2024
8	Analysis / Solution / ROI Due	100	March 8, 2024
	Recitation Session - Final Report		March - April
9	Final Steering Committee Presentation *[50 points for content of the presentation, 25 points delivery & discussion]*	75	No later than May 1, 2024 [Wednesday]
10	Final Project Report Due *[Graded for professional writing, correct citation, references style, grammar, and formatting]*	150	May 3, 2024
	Final Project Reflection	25	May 3, 2024
	TOTAL	**500**	

Course Assessments and Feedback

In addition to advising meetings, monthly class and one-on-one calls/meeting, the capstone project experience comprises of specific milestone, deliverable and rigorous assessment. Assessments are for the advisor (course instructor), content and capstone process, individual learning journey as well as external evaluation. The assessments include:

- End-of-course evaluations (both quantitative and qualitative)
- End-of-semester reflection (qualitative)
- Program Industry Advisory Board evaluation (both quantitative and qualitative)
- Exit Interviews (both quantitative and qualitative)

The following sections show how the data are collected, analyzed and how feedback from qualitative responses is used to generate improvement themes. Each year, the advisors pick one or two areas of improvements to implement.

End-of-course Evaluations

A key data point used to identify effectiveness of the Capstone project course is the course's average numerical evaluation across all sections. Each section is reviewed for overall weighted average for all questions specific to the course. Then these averages are gathered and averaged to find the mean score for the course itself. For academic year 2018-2019, the course averaged 4.11 on a 5 scale. This was the transitionary year. In subsequent years, 2019-2020 was 3.83, 2020-2021 was 4.03, 2021-2022 was **4.21** and 2022-2023 averaged **4.14** [Table 4]. The evaluations in 2022 and 2023 show a slight increase from 2020 and 2021. This data is crucial to understand the span of five-year influence along with identification of the average increase (or decrease) at the time the unified syllabus and Capstone coordinator and thereafter. In addition to the mean average score of the course across all sections, qualitative questions were also asked to understand the student experiences, and areas of improvement. A sample of relevant feedback from these questions is provided in Table 5. The key feedback was related to the streamlined structure, flow and deliverables.

Relevant themes of success across the years are (1) improved flow of the course over two semesters that helped students build on previous deliverables, (2) improved data collection and solution development with mid-semester critical review meetings and (3) Steering committee meetings that are critical and constructive – helped build a stronger deliverable.

Areas for improvement also exist such as (1) improving relevant literature review, (2) improvement to project ROI calculation to demonstrate value – especially intangible benefits.

TABLE 4
END OF SEMESRER COURSE EVALUATIONS

AY	AVG
2018-2019	4.11
2019-2020	3.83
2020-2021	4.03
2021-2022	4.21
2022-2023	4.14

TABLE 5
QUALITATIVE FEEDBACK ON COURSE EVALUATIONS

Resources were provided to answer most questions, this helped as most of the course I was working nights so I could receive instruction around the clock.	The capstone allowed me to show my organization that I have the ability to define a problem and effectively identify ways to implement solutions to better the business.	My capstone project taught me how to break down any problem into digestible pieces of information to research and develop solutions. I learned how to bring problems and solutions to management, set timelines, report progress, and deliver analytical solutions.
Well-structure class, excellent accompaniment during the class and most important challenging my ideas in a constructive way.	Great course, excellent faculty. All around a very educational and interesting process.	This course is very time consuming but very rewarding. It is forcing me to solve a critical problem at my company that I otherwise would not have time or the knowledge to complete.
The Sections for the Capstone were laid out nicely in order to complete the full Capstone	Stages of the course are broken down in a achievable amount. One needs to keep track, but all is doable if you are paying attention.	Very challenging and demanding course that taught real life use cases.
Stages of the course are broken down in an achievable amount. One needs to keep track, but all is doable if you are paying attention.	Communication of the expectations was clear and objective, which removed any anxiety or uncertainty and allowed me to focus on the content and the learning experience.	I now do not have a fear of projects. With the skills learned I feel like I can accomplish whatever a company needed
All feedback from grade rubrics to phone conversions to emails made this course better than expected	Greatly organized. There was never any confusion or surprises	The course helped me to research my own material and be a critical thinker.

End-Of-Semester Course Reflections

At the conclusion of the Capstone project course, students are asked to complete a final reflection about their project. The questions they are asked consists of:

1. Describe what you did and how the project unfolded for your Capstone as it pertains to challenges you faced, how you adjusted, modified, or overcame them.
2. Identify a few things you learned from doing a Capstone Project.

3. Now that you identified things you learned from doing this project, describe how you anticipate applying these things (skills) to future projects.

Relevant reflections from AY 22 and 23 were gathered to identify feedback (see Table 6). Feedback from these specific academic years is significant as it reflects two cycles of the Capstone project course that featured the unified syllabus along with the same instructors and Capstone coordinator. Common themes in the reflection were related to the ability to learn structured research process and problem solving.

Relevant themes of success across the years are (1) students learned how to conduct a structured, data-driven project, (2) improve their quantitative and qualitative data collection/analysis skills, especially interviews and most importantly (3) create practical solutions for their organizations. In many cases these recommendations and solutions were accepted for implementation as well as created advancement opportunities.

Areas for improvement also exist such as (1) defining narrow and specific scope of project, (2) conducting deep analytical analysis and (3) calculating and articulating return-on-investment of their projects.

TABLE 6
END-OF-SEMESTER COURSE REFLECTIONS

The capstone project made me realize that presenting an idea, and really creating a value to a change management proposal is more complex then [sic] just writing an email to someone about change.
I learned that I have potential beyond my perception. This project has allowed me to network at levels I once thought were unattainable, and I am excited to take on positions and problems of increased responsibility.
The capstone project helped me understand that when approaching a problem, the tools that the project provided help to understand the problem in the first place, what has been done already, and ultimately what would be the best way to solve it. Take the time to understand it all and make a concrete, sound decision.
The next major project that I take on, I will start with a better-defined process map along with all of the sub processes.
I will continue to use my presentation skills to convey complex topics, such as the technical limitations of a tool, to a non-technical crowd.
I became much more confident in my project management skills. I started identifying gaps in my current role and kicked off multiple projects to fix them. This is what led to my current promotion a few weeks ago. I am also now known as a "process improver" in the Worldwide Sales Ops department, which has opened me up to multiple opportunities.

I also learned that even with research, people will not have the same facts as you. Considering their ideas and making them feel like they helped create the process is critical to getting their buy-in.
lesson 1. Don't settle; lesson 2. You're not the first or last to figure this out * if you think you found the only way, you are looking at it wrong; reset your approach; lesson 3. When you have enough information, find just one more thing; lesson 4. In perspective, someone has always done it better, but focus on how you can be better. Don't measure your success in circumstances that don't pertain directly to you. Hit the target you set.
This project enhanced my skills in project management. I learned to be a much better researcher and to incorporate a much more diverse body of knowledge into my projects than before. In addition, by the end of the project, I had learned some new skills concerning survey design and administration that will continue to serve me in my career.
I have always needed help with grammar and writing. I took the time to look for ways to help my writing skills for my capstone. I used to have my wife review every paper before turning it in, but this semester has been all mine. I have done a better job than ever before, as I am getting excellent grades.
I also am not as discouraged to seemingly daunting life problems anymore. If you take a dedicated and consistent approach to solving the problem, it will not be as stressful, and the outcome will more than likely be reasonably attained.
I came to the MID program hoping to gain insight into negotiation, however I didn't quite expect the education in it that I received. It was even better than what I expected!

Advisory Board Review and Evaluations

The program uses an external Industry Advisory Board (IAB) to seek feedback, ideas, and support for the program growth. All the members are former students of the program in managerial and leadership roles. One of the requirements to be on the IAB is for the members to attend the final capstone project presentation and evaluate the projects. They are provided an evaluation form with categories to assess that closely reflects some of the assessment metrics of ABET and SACS accreditation metrics. The following table 7 outlines the three years of assessment from an external body of the student performance. As highlighted using the different shades, some of the feedback for improvement has been implemented that has resulted in improved assessment. Table 8 in the next page shows sample of the qualitative feedback from the IAB members over the past three years.

Rationale for Use of MID IAB Board

In 2010, in an effort to improve a capstone course, University of Wisconsin-Madison began utilization of engineering practitioners from industry, as well as members from local business community to help assess student capstone project presentations [17]. Through this process, these industry and business community members acted as "clients" to determine quality of the capstone project. In similar fashion, utilization of IAB to evaluate the capstone projects allows for feedback from program stakeholders from a variety of functional roles, experiences, and industries which provides comprehensive review.

TABLE 7
INDUSTRY ADVISORY BOARD FEEDBACK (3 YEARS)

Evaluation Metric	Academic Year Average 20-21	21-22	22-23
Rate the knowledge of the student on his/her topic with the understanding that your score of the student's level of knowledge is affected by the student's ability to properly communicate their Capstone.	4.38	4.34	4.63
Rate the competency of the student with respect to solving real world industrial distribution problems:	4.41	4.17	4.57
Rate the displayed research capability of the student:	4.1	4.09	4.48
Please rate the overall performance of this student based on this Capstone presentation:	4.19	4.2	4.61
Based on the quality of the work produced/displayed for the Capstone project, will this student be successful in distribution or related industry career?	4.21	4.26	4.65
Did this student display apparent independent, critical thinking, and life-long learning above and beyond the classroom learning (e.g., literature review, benchmarking, project analysis, etc.) ?	4.06	4.32	4.59

Color variations indicate lower to upper range of data from lightest to darkest.

TABLE 8
QUOTES FROM EXIT SURVEYS FROM AY 2020-21, 2021-22, 2022-23

The capstone really enabled me to build a project from start to finish in a formal setting. The project was running simultaneously at work which provided a great opportunity for me work both tracks. It also enabled me to build out a path to present to leadership at work to further enable project expansion at work. I have worked on other projects but never really had the structured approach like I did with this capstone.
Capstone is a huge success by making us think through problems logically and systematically.

The capstone was the highlight of the program. It ties real-world problems with our companies and helps us research a solution.
Capstone project is unique because it allows you the student to utilize their own company/organization to solve a high visibility problem.
The MID program is excellent with the knowledge that helps students build analytical skills, presentation, research, communication, pricing strategy, and the solutions root cause of the problem, which will help students succeed in their current job or future jobs.
I was able to learn to look at problems a different way. Have different ways of solving the problem. I feel more confident.
Learned how to properly initiate and finish a project.
Gained good insights into how to do research and discuss ideas.
Developed analytical skills, teamwork, and self-confidence.
Has helped me become more strategic and has aided me in communicating more effectively.
I think learning practical application for the distribution industry including pricing and customer-oriented approaches provided real-world learning measures that could be applied to almost company which was very helpful. For me, the greatest part of the program are the people that you meet and gaining experience from them along with the practical coursework applications.

Exit Interviews

At the end of the two-year program, an exit interview is conducted. The goal of this summative survey is to assess the student experiences, course content, applicability of learning to their business, instructor engagement and support as well as their capstone project experience. Questions are asked in eight categories listed in Table 9. They rank their responses on a five-point Likert scale from “extremely well prepared” to “needs considerable improvement”. The question on “capstone course prepared me for my future.”. Three academic years response are show in Table 9 below. The responses for the combined – extremely well prepared and well prepared was 97% in 2020-21, 95% in 2021-22 and 100% in 2022-23. Capstone Project is also one of the areas with the maximum positive reviews.

This exit interview responses shows the curriculum modernization of 2019-20, combined with continuous improvements in course design, advising, milestone and assessment tweaks, check-in cadence and staff support has shown improvements in educational experiences and learning outcomes. In addition, there is anecdotal evidence of students’ project impact on their companies. Many of the students used their capstone project as a steppingstone to advance in their professional career.

TABLE 9
CAPSTONE PROJECT EXIT SURVEY RESPONSES

Capstone Course prepared them for their future	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.78	0.19	0.03	0.00	0
	2021-2022	44	0.70	0.25	0.02	0.02	0
	2022-2023	17	0.82	0.18	0.00	0.00	0
An ability to identify, analyze, and understand industrial distribution and/or relevant industrial distribution problems	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.53	0.48	0.00	0.00	0
	2021-2022	44	0.61	0.36	0.02	0.00	0
	2022-2023	17	0.59	0.35	0.06	0.00	0
An ability to communicate effectively	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.50	0.43	0.08	0.00	0
	2021-2022	44	0.64	0.32	0.05	0.00	0
	2022-2023	17	0.65	0.29	0.06	0.00	0
A recognition of the need for and an ability to engage in lifetime learning	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.68	0.33	0.00	0.00	0
	2021-2022	44	0.73	0.23	0.05	0.00	0
	2022-2023	17	0.65	0.29	0.06	0.00	0
An ability to understand professional, ethical and social responsibilities	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.58	0.40	0.03	0.00	0
	2021-2022	44	0.70	0.25	0.05	0.00	0
	2022-2023	17	0.59	0.35	0.06	0.00	0
A respect for diversity and a knowledge of contemporary professional, societal and global issues	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.63	0.38	0.00	0.00	0
	2021-2022	44	0.70	0.18	0.11	0.00	0
	2022-2023	17	0.71	0.24	0.06	0.00	0
A commitment to quality, timeliness, and continuous improvement	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.68	0.30	0.03	0.00	0
	2021-2022	44	0.73	0.20	0.07	0.00	0
	2022-2023	17	0.59	0.35	0.06	0.00	0
An ability and support system to develop and use effective time-management skills	AY	N	Extremely Well Prepared	Well Prepared	Acceptably Prepared	Needs Improvement	Needs Considerable Improvement
	2020-2021	40	0.55	0.45	0.00	0.00	0
	2021-2022	44	0.70	0.23	0.07	0.00	0
	2022-2023	17	0.65	0.29	0.06	0.00	0

Key Learning Outcomes

Developing and improving an applied capstone project experience for working professionals over the past decade has provided valuable learnings. They can be grouped into six categories below:

- **Project Selection:** Helping the professional students in selecting a narrow problem statement is key to project success and impact. Often, students try to solve a very large, complex problem with broad scope. The first step is to focus on the root cause of the problem to address. Helping narrow the scope, helps to increase the depth of research, and subsequent development of practical solution.

- **Steering Committee:** To enhance the capstone experience, involvement of industry executives in the design and assessment of the project is paramount. This involvement provides a level of reliability and validity from industry in addition to faculty members. Akili suggests collaboration between engineering practitioners and faculty members can be of great importance [19]. The selection of 2-4 members for the steering committee in addition to the advisor is recommended. Typically, the student's manager, other leaders serve on the committee. Occasionally, customers or suppliers are also invited based on the project need. The steering committee is tasked to advise the student, attend three required review meetings, help with data needs, and make connections for interviews. An additional benefit for the student is that this provides an opportunity to showcase his/her abilities to management.

- **Data Collection & Analysis:** Depending on the project scope, quantitative and qualitative data collection is needed. Improvements have been made to advise the students to design the analysis, before collecting the correct data. Also, interview and survey methods to collect representative, and unbiased data. Emphasis is placed on data driven solution development.

- **Recommendation development:** Improvements in solution development, considering the alternative, budget, and company culture (openness to change) has resulted in students recommending the most practical and feasible solutions. Development of an implementation plan and return-on-investment calculation is made to demonstrate the cost vs. benefit of the project. While the students are not required to implement the project before graduation, some of the project get to proof-of-concept or trial implementation.

- **Milestone and Assessments:** Several adjustments were made over the past three years to improve the flow of the capstone experience, milestones, and assessments. The adjustments include a review period for major deliverables, where students can send their working version to get feedback and addition of reflection each semester. The designation of a Capstone Coordinator from academic department staff also provides a seamless milestone and assessment process. Following the initial design and implementation phase, ongoing support from academic department staff is essential due to the high workload associated with advising students as they, for example, write literature reviews and undertake the independent research project as well as completing the marking required for the assessment tasks [15]. Having more staff involved in the subjects was beneficial in sharing the workload and allowed for better student to staff ratios for providing feedback and marking. Detailed and clear assessment guidelines and marking schemes were written for all assessment tasks [15].

- **Impact:** The individual capstone project conducted for the student's employer, provides not only the ability to bring value to the company (as many students are sponsored by their employer), but it also helps elevate the individual by working on a high visibility project within the company. In many cases, these leads to promotion opportunities. The steering committee members are invited to campus for the final presentation.

Implications

The key learnings from the experiences of designing, executing, and improving the capstone project experience can be broadly applied for any engineering discipline at both undergraduate and graduate levels. Some of the considerations include:

- **Industry sponsored projects:** Using industry sponsored projects help students work on real world challenges, be challenged, and advised by industry professionals with experience as well as become prepared to conduct improvement projects after graduation.
- **Better Problem definition:** Capstone projects help students conduct a root cause analysis and define specific problem to be addressed. This is an important but underappreciated skill to succeed at problem solving.
- **Developing practical solutions:** The structured approach to capstone project and involvement of a steering committee or advisor helps students develop practical solutions to sponsors that fit the need, budget, and culture of the company.
- **Demonstrating value:** A aspect of presenting a solution/recommendation to a sponsor is to demonstrate the value and return-on-investment. This includes tangible and intangible benefits. The capstone project experience can help students learn how to demonstrate value in any future projects.

The capstone project structure, experience, and learnings from this paper can broadly be applied to both traditional in-person programs as well as online or professional engineering and engineering management programs to prepare students with practical problem solving skills.

Conclusion

This paper outlined the process, design, implementation, and improvements to an applied capstone project designed for working professionals. Enhancements over the years include improvement to project scoping and design, background/literature review, depth of analysis, and overall writing process. A unified syllabus for the two-semester project, deliverable spacing, rubrics, advisor check-ins, past project examples, and former student panel discussion help support student experience and project outcome. Recent addition of a Capstone Project Coordinator is designed to provide periodic check-ins, advising and project resources.

The course assessments, feedback, reflection, exit interview and advisory board evaluation all help with the feedback loop for continuous improvement. We believe that this model of an applied capstone project and the key learnings can broadly be applied to other engineering / engineering management programs designed for working professionals or with projects sponsored by the industry. This can be adopted for the undergraduate final design project with few modifications.

Several students have used their capstone project to not only bring demonstrable value and impact to their organization but has used it as a steppingstone to advance their careers.

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