

Capstone Design Courses Managed in an MS Teams Framework

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Dr. Andy Pardue oversees the 2-semester Senior Design Courses for the Mechanical Engineering department at Tennessee Tech University. He worked in industry for 24 years in product development in several companies/sectors before his current teaching role. Dr. Pardue spent 11 years in the Automotive industry with Cummins and, while there, was chair of the SAE filtration standards committee and a member of the corresponding ISO TAG. He was also the Director of Research and Advanced Product Development for the Filtration Business Unit. Dr. Pardue then spent 7 years as a consultant for several companies working on new product development. The final 6 years of his industrial experience was serving as VP of Research for IEM in the area of power distribution in data centers. In his role in the ME department, he has overseen 139 student projects. He has also been working with the other Senior Design instructors to have joint projects with ME, ECE, and CS teams working together, which would more closely resemble the industrial product development process.

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Abstract

The work in progress will outline using Microsoft Teams to manage a Mechanical Engineering capstone program with 120 to 140 students and 25 to 30 projects. The MS Teams project site becomes the central repository for all the information regarding the student's work on their project. A focus of the design of the project site has been an effort to effectively determine the individual contributions of a student versus the overall project outcomes driven by the team. Aspects of the project that may have been captured in physical notebooks are now collected in OneNote notebooks with tracking of students' assigned tasks. All CAD and data files are stored on the site, which becomes an archive for departmental evaluation and a resource for future teams if the project continues. The project site provides a good overview of the team's project efforts and allows the instructors and faculty mentors to see the status of a project almost continuously.

Introduction

The author has been teaching the two-semester senior capstone design course since the Fall of 2018, and the management structure presented in this paper has evolved over 11 design cycles. The first goal was to capture all project information electronically and in a single location. Previously, the primary student artifacts for the course were comprehensive final reports submitted as paper copies with no capture of the in-process efforts. Any electronic artifacts were stored on student-owned sites on various platforms. This resulted in losing project information and limited ability to continue projects with new teams.

The only source documentation tool available on campus in 2018 was Microsoft SharePoint, which was adopted as the first-generation electronic system. While the use of SharePoint accomplished the goal of capturing all of the information electronically, the students found it cumbersome and tended to upload only the required project information. We still needed to capture electronic discussions about the design in group chats. The student teams used various tools for electronic discussions that captured the information about the design decisions not present on the Sharepoint site.

In Fall of 2020, Microsoft Teams became available as a tool on campus. We moved to this platform due to the ease of use and availability on several platforms. The students found the MS Teams tool much easier to use, and the chat features captured the electronic chats that had been missing in Sharepoint. MS Teams has continued to add features, allowing us to capture more information about the flow of the projects.

As more information was gathered about the projects, it was apparent that better tracking of individual efforts and project contributions was needed. Projects would have successful outcomes, but it was obvious from interactions with some of the teams that one or more team members were not contributing equally to the project. If a project had lower-than-expected outcomes, we surmised that was due to some members not contributing or all members needing to put forth the required or expected effort.

The management structure presented in the following sections describes an evolution of collecting project process documentation and then discovering that we need to capture more detailed information or information in a different form.

Course Timeline and Structure

A detailed two-semester Gantt chart is presented to the students at the beginning of the course sequence. This gives the students a clear understanding of the course expectations as a team and individual. The course timeline also begins the course discussion on project planning and tracking. The first semester focuses on team formation and project planning, while the second focuses on project execution. At the beginning of each semester, the students are assigned several LinkedIn Learning modules to complete as self-paced learning. The first week of class focuses on team formation, and projects are assigned by the end of the third week of the first semester.

The large class is broken down into 4 team cohorts by the 4th week of the first semester, which becomes the class meeting unit outside of presentations at the end of each semester. At each cohort meeting, the teams discuss their project and current status. The students start to present their updates using the project summary sheet (Figure 1) from the middle of the first semester to the end of the course. These summary sheets give a high-level view of the project's evolution and provide students feedback on their projected completion versus actual completion. The cohort format allows the teams to learn from one another and see how other teams progress.

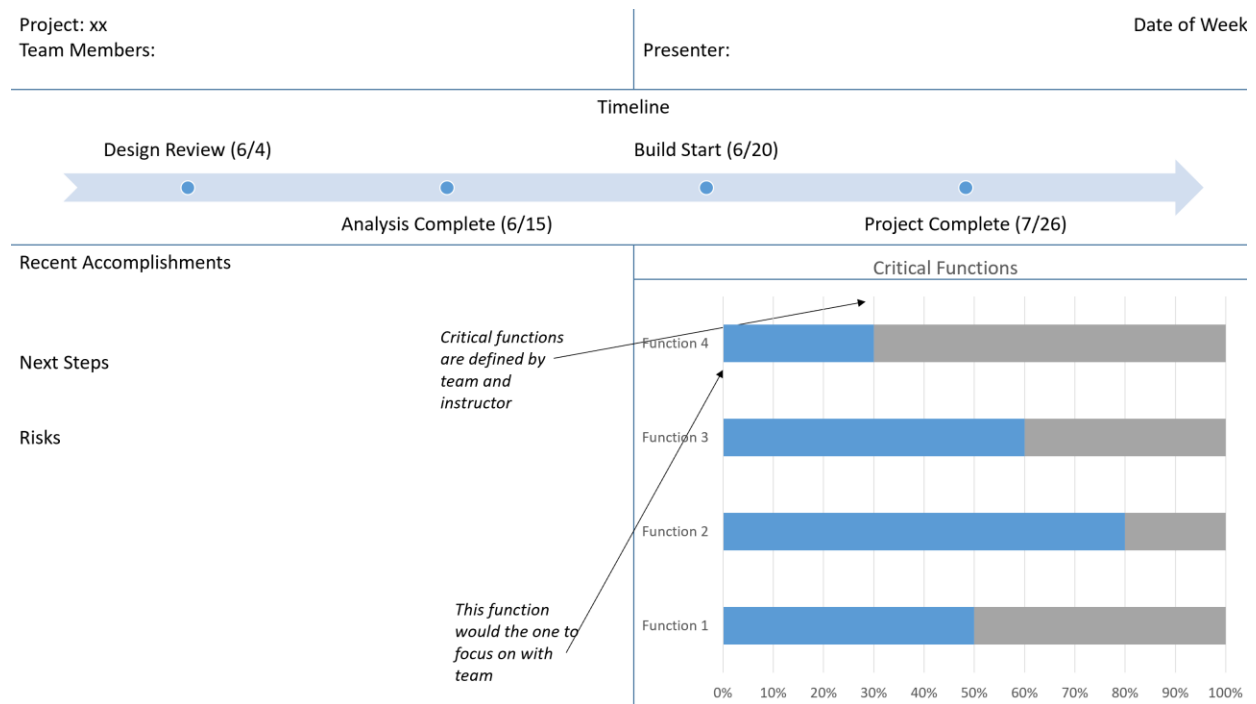


Figure 1. Project Summary Sheet

Team Formation

The project teams are formed using CATME Team-maker[1] to be random with weighting for similar weekly course schedules and no isolation of female students. This process allows the teams to be quickly formed after the students complete the information surveys. Once the teams are formed, the first task is to develop a teamwork contract. Research has shown that this contract is essential for the team to establish roles and expectations[2][3]. To ensure that teams have a starting point on best practices in teaming, we use the POGIL strategy[4] to establish team roles of Manager, Recorder, Presenter, and Strategist. During the 2nd week of the first semester, students are introduced to the nature of the roles and encouraged to develop a rotation schedule for all team members to experience each role throughout the project's life.

As part of the teamwork training, we have students use a standard team meeting template. The template asks the students to plan all of the time during the meeting with an agenda and capture the action items from the meeting. The meeting minutes are captured in a OneNote notebook on the MS Teams site.

Individual Tracking

One of the significant issues with group project work is separating individual effort from the group's work. In the past, this was assessed with student surveys at the end of the course, which did not allow for corrective action during the course. We started with multiple surveys in CATME that indicated team conflict or lack of student performance during the course. Still, these rely on student opinions, which can be problematic if there are personality conflicts. We now require students to log their hours of effort with an MS Forms survey and write a weekly journal to describe their efforts during the week. The students' journals are part of the OneNote project notebook, and the journal entries are part of the course grade. The time tracking has proven to be a rich source of data and insight into team performance. The data analytics allow tracking of individual efforts on the team (Figure 2). The data in the figure shows that 2 of the team members seem to be doing most of the effort and that one team member is not contributing. The time entries have to be justified in the corresponding journal entry. The time data and journaling have allowed the course grade to reflect more individual effort versus being driven by the team results.

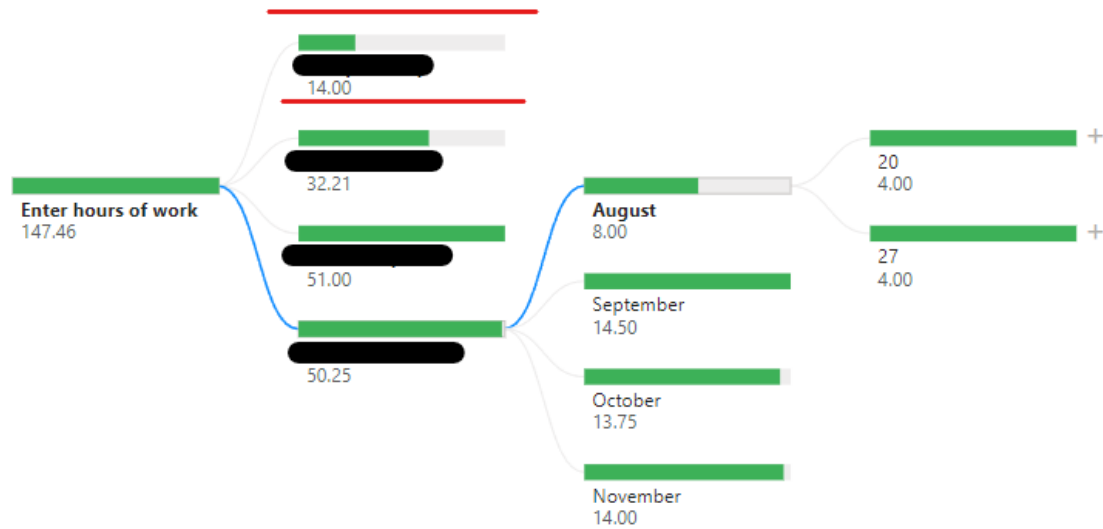


Figure 2. Example Student Hours Analysis

Project Data

The initial purpose of the MS Teams site was to capture all project data in one location. This has worked well but does require that the students are measured on the organization of their site. The sites have made multi-generational projects easier to manage. It is easier for the new teams to learn about the efforts of the previous teams and build on that work. The faculty mentors can also view the team's effort and ask questions in the chat. A general observation is that students struggle to keep the task list populated, an area we will focus on in the subsequent course offerings.

Conclusions

The project to move to MS Teams for the senior design was initially focused on capturing project and paperless reporting, but it has proven to be much more. A process of time collection and journaling has been added to track the team members' individual contributions. In most cases, the time data confirms the qualitative performance you suspect from interacting with the team. Also, at the programmatic level, we see trends in what teams struggle with that need to be addressed.

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