Cloud Based Mobile Tool to Enable Collaboration and Mentoring Opportunities in the MIME Capstone Design Class at Oregon State University

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Abstract

The school of Mechanical Industrial and Manufacturing Engineering (MIME) at Oregon State University (OSU) teaches a Capstone Senior Design Course aimed at preparing students for real world engineering problem solving through group collaboration. In each class, there are approximately forty groups of three undergraduate engineers that work together and use their understanding of engineering concepts to create processes and products. The class model hinges on communication between the team sponsor, advisor, instructor and students. In the past students were tasked with much of this information transfer. Communication breakdown was a result. Advisors were unaware of due date changes or modifications of requirements given by the instructor. At the same time, instructors were unaware of specific changes that the advisors were requiring the students to make. At some points this actually caused the students to get direction from one party that was directly contrary to the other. The objective of this project was to create a better communication environment for these groups, their advisor and the instructor of the class. Solving the problem required a virtual environment where each individual group could store their data and communicate with their team sponsor, advisor and instructor at the same time. By using a combination of data mining and survey the tool was analyzed and iterated upon in order to increase its usefulness to all parties.

Keywords
Engineering Management, Engineering Education, Industrial Engineering

Background

In the school of MIME, the capstone design projects have been defined by Hyder et al. as “[an] assessment system based on written reports and the quality of deliverables of the prototypes designed by students”[1]. The capstone design class spans two academic terms (for instance a class would run through fall and winter term) and provides a ‘near’ real world working experience for students. It bridges the gap between real applications and classroom outcomes. Many schools in the United States and abroad have implemented some variant of a capstone design course as part of their engineering degree programs. Students choose from projects that are both internally and externally sponsored. Externally sponsored projects are defined as requests from companies who have a social commitment and need help solving a particular problem while internally sponsored projects are projects originating from within the department of MIME [1-3].

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This communication problem is just beginning. The old method worked for small groups because the instructor can communicate directly with each advisor on a usual basis to make sure that they are up to speed on all classroom
changes. As class sizes increase this is not the case. In order to counteract this issue, the instructors at OSU have tried to implement virtual methods to increase communication. These fixes include mass email, Blackboard’s class sites as well as Graduate Teaching Assistants (GTAs) for communication tools. These methods were functional but did not work well enough to fully fix the issue.

The larger impact of the communication issue is that it directly impedes the speed at which the students learn. Since the assessment of the current state of the project and a basic direction to start working need to be gathered within the first few weeks of class, the students are in a ‘drinking through a fire hose’ state. They need to be able to assess the situation with the help of the instructor, sponsor, and advisor. If these parties are able to correctly manage and promote the students, the information will be easier for them to gather and learn. However, if the communication is poor it dramatically slows this process[4],[5].

The capstone instructors believe the best path to solve this is to fix the root problem, by allowing advisors, students and the instructor to all use the same location for data transfer. This will increase transparency between instructors, advisors and students. While having a physical location is feasible it is by no means practical because a physical location is easier to manipulate and may in some ways be considered an invasion of privacy by the Family Education Rights and Privacy Act (FERPA). This leaves a virtual environment.

Proposed Methodology
Services like Blackboard provide certain benefits that have to be mirrored on the website. The most important part for instructors is that they have one place where they can upload documents and information to allow students to complete the tasks they are given. The students have one location where they go to get that information which reduces confusion and the chance they will miss something. It also submits to all FERPA requirements by providing the students anonymity between each other.

In order to improve on this structure the capstone instructors decided to use Google sites for a foundation. Google was the best option for the site as Oregon State University has recently upgraded their IT infrastructure to incorporate many of Google’s web applications directly into the OSU Network ID system. This allows Oregon State user names to be used for permissions and file storage. Every team can therefore have their own website that they can use and improve as the project progresses. This website has a scaffolded structure based off of teamwork literature[6]. Each site will have a preformatted structure. The pages in this structure are:

- Home (Main startup page for the sites)
  - Has an event cool down which shows when important due dates are
  - Class Announcements
- The Team and Project Requirements (advisors, sponsors and instructors get to know the students names and strengths and weaknesses.)
  - Students will upload their picture, name, area of expertise and some interesting information about themselves.
  - Students take and upload their Myers-Briggs Type Indicator (MBTI) to help them understand their team mates personalities and help avoid conflicts.
- Team Charter (Document that is developed to clarify the team direction, boundaries and goals.)
  - Created very early in the class and evolves over time
- House of Quality (HOQ) (Diagram used for defining the relationships between customer desires and the finished projects capabilities)
- Team Project Documents (Folder with all of the documents created for the teams project)
- Team Communication (Announcement/Post page for the team members, advisors and sponsor to communicate quickly and efficiently with each other)
- Class Calendar (Has a calendar with all class and assignment due dates and times)
- Course Documents (Folder with all of the documents created for the class by the instructors)
- Contact Instructor (All instructor information)
- Site Feedback (Google Form for feedback on the site)

Each of these sites has to have the same information from the instructors in order to mirror a Blackboard site. It also has to have one place to input that information, as updating 20 sites welcomes errors and is extremely time consuming.
In order to accomplish this, the Class Announcements were done as a Google Doc (Google’s online version of text editor) and a folder was created in Google Drive (Google Drive is an online file storing program much like Dropbox or SkyDrive). Whenever an announcement needs to be added, the text of the announcement is appended to the top of the Google Doc. All websites will auto-update with the new information. The same thing works for the Course Documents folder. When a new file is input into the folder it will automatically show up in the Course Documents page of all of the websites.

Although the above works sufficiently to have all information for the students appear in one place, the Google Sites created take the idea one step further. In previous classes, all of the files for each team (presentations, team charter, House of Quality, Reports etc.) were kept by the team until they were turned in and then were given to the instructor. This made it harder for the advisor and the sponsor to maintain oversight over the team’s progress. In order to alleviate this the team charter and HOQ were posted directly into the website[7],[8]. They work similar to the Class announcements although since these are updated by the teams instead of the professors the automatic updates are less important. The main benefit over the Blackboard site is seen in the Team Documents page. This works similar to the Course documents. As the teams upload new files, they are shared with everyone that can view the sites (advisor, instructors and the sponsors). It allows the advisors and sponsors to keep up to date and lets digital versions of files be quickly retrieved for meetings and presentations.

The most technical part of the site is making sure that student privacy is maintained. Many of our projects are also from private industry which adds to the need for a private site. Each site and folder must therefore be set to private and permissions have to be manually input for each site and folder. As one might expect this becomes very time consuming when you have 160 students, 4 instructors, and 30+ advisors and sponsors (input once into the sites and another time into the folders). A “trickle down” structure was therefore created for permissions.

Google Groups allowed the creation of a group for each team as well as a “master group” for the instructors which would be able to view and modify all folders and sites. These groups can then be added to the permissions for the site and folder so that all people need to be added only once. The main benefit of this structure is that Google Groups can be manipulated by the Google Application Programming Interface (API) which allows all the groups to be modified from a single spreadsheet running a combination of the JavaScript programming language and Google Script (Google’s proprietary code that is used to modify their online applications). This same API can then be used to add permissions to all of the folders and sites automatically. This dramatically reduces the setup time of these sites.

Since Google Folders pass on their permissions to all folders and files inside them, a special setup is used to maintain an orderly folder structure as well as to reduce redundant permissions additions. The “master group” is added to the “Capstone Folders” folder seen in Figure 1. This gives them view and edit access to all of the folders. Next each team is given view privileges to the useful links folder where all of the documents for the class will be. This is the folder that will be put into the course documents for each site (“winter useful links” is the folder that will be in the course documents for the Senior Project Course that starts in winter). Lastly, each team is given view/edit privileges to their particular project folder as shown in Figure 2. All of the permissions can be added via code as stated above.

Figure 1: Base Folder Configuration in Google Drive
With all of the code in place a single Google Spreadsheet will be able to control most of the system. The whole setup process will look like Figure 3.

The website is currently in an alpha version. An alpha refers to the first phase of software testing before the software is considered feature complete. Some automation and functionality have yet to be added to the site, such as project management tools. As results are collected over the course of the next several months from the fall and winter versions of the class the site layout and code will be updated to tailor better to user needs.

Google forms and spreadsheets have been able to gather feedback data indicating areas for improvement and potential bugs. This form is attached to every site and students have been encouraged to give regular feedback so that the product can be polished.
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The end result will be a tool that can create the website, folders and calendars for any class that desires websites for team use. This tool should allow the instructor to control all of the websites with a few Google documents.

**Site Data Collection and Perceived Benefits to the Class**

Mentoring in the class is important to not only insure the success of the project but also increase the learning opportunities and impacts for the students[4]. Instructors, advisors and sponsors are all important sources of this mentoring. Data collection can be used in order to gain feedback on this input to the teams. The data can be analyzed for patterns in order to bolster weaker areas of the class as well as try to emphasize the strengths. Website usage, Google document revision tables and team-sponsor communication will be some of the data gathered.

Data is also being gathered directly from the students by using surveys. These surveys will be analyzed using subjective analysis tools in order to discern connections between project success and mentor involvement and feedback. This should net better overall projects as well as a better student experience.

A preliminary survey taken resulted in 33 responses to 9 questions directly pertaining to how useful the website was. Each question with the percentage of the student’s responses is shown in Figure 4 and 5. The top 3 categories (slightly agree, agree and strongly agree) made up 60% of the responses. Considering that the website is still currently in alpha (meaning it was not completely optimized and had a myriad of bugs), this information is incredibly positive. It means that as the website is iterated upon that it could truly become substantially better that the previous Blackboard system that was used.

![Website Satisfaction Questions](image)

Figure 4: Website Satisfaction
The subjective portion of the survey supports the idea that the website is successful in its main goal of increasing team communication and better incorporating sponsors and team advisors into the process. Several quotes are listed below:

- “I enjoy the usability of the site and the platform it provides for communication between important parties.”
- “It is easy to share information among team members. With a team of 12 people that is helpful.”
- “The actual site is most useful for keeping track of upcoming deadlines. The Google drive provided through the site has been extremely useful for both the design and manufacturing stages of our project.”

Furthermore, anecdotal evidence from students, mentors and instructors reinforce the notion that the engineering design process, in such large classes, has been made more efficient and easier to follow. Tracking progress with student teams has been streamlined and some opportunities for identifying tacit knowledge gaps have arisen.

All of the data from the survey and the website will need to be quickly and easily understood at a glance. As the number of groups grows the instructor will have less time to view each group’s specific data. This platform allows for an interface to be created in order to alert an instructor to potential problems in a specific group. These problems can then be addressed quickly and before they cause negative consequences.

**Conclusion**

Overall the change from the Blackboard system to the Google site has been a positive one. While the current setup of the sites is by no means perfect there is large space for improvement unlike the restrictive nature of the Blackboard system. As more data is collected on the feature and page usage, better systems will be implemented. Feedback from the students has already lead to several change, such as the inclusion of instruction manuals for the site and a modified system for granting access to their site folders. Ideas from the feedback form will bring about many other changes when we transition to version 2 in the summer.

This scaffolded structure for multiple teams may also eventually be useful outside of the capstone class. Other classes could use a similar structure for larger projects as well. It also may eventually become useful in industry for a similar multi-team structure.
References