

2006-367: IMPROVING PERFORMANCE AND REDUCING PROFESSOR WORKLOAD IN A CAPSTONE DESIGN CLASS USING PROJECT MANAGEMENT SOFTWARE

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Improving Performance and Reducing Professor Workload In a Capstone Design Class using Project Management Software

Abstract

In the past ten years, many varieties of Project Management (PM) software have become available, most notably Microsoft Project. However, such software can be difficult to implement, requiring dedicated time from an IT professional, and a server that also requires maintenance. Further, the instruction burden of delivering software skills to students coming into the course adds another hurdle that must be overcome each semester. All this adds up to enough institutional and educational friction that doing electronic project management is usually foregone.

In this paper, the authors explore and develop an approach that abolishes all of these problems, by using a Web-based platform that can also serve e-portfolio needs. The commercial product selected for experimentation is called Basecamp, and has the advantages of being web-based, easy-to-learn with a relatively complete feature set, and is available for a nominal monthly fee. Basecamp also provides an archival record of class activity that can be used for accreditation purposes, and as such, serves as an assessment tool for the Capstone experience. The software offers project sponsors an opportunity to participate easily with helping students manage schedule and timing of deliverables, and serves as a platform for discussing student performance and work habits over time.

Evaluation of student Basecamp performance is done in a variety of ways. Average frequency of student entries vs. promptings by the class professor is plotted, and other measures of interaction frequency are explored. Additionally, students are interviewed at the end of the semester for their views and reflections on the utility and ease of use of the software.

Introduction

In order to fulfill ABET certification requirements, a Senior Capstone Design class must be taught that integrates students' experiences gained over an entire course of study in the mechanical engineering discipline. The design and management of the class, including structured fundraising, was discussed in detail in the paper presented in the 2004 ASEE conference proceedings, titled "Managing a Capstone Design Clinic—Strategies for Pedagogic and Financial Success."¹

To recap, the basic structure of the class is as follows: over the course of a semester, students must complete a deliverable paid for by an industrial sponsor who serves first as a customer, and secondarily as a mentor for a group of 4-6 students. For each project, the group must:

1. Visit the company, tour the facilities and discuss the project and deliverables with the industrial sponsor.

2. Prepare a specification document that must be approved by the industrial sponsor and utilizes a Quality Function Deployment/House of Quality approach⁴.
3. Prepare multiple concepts for a design solution that is subject to a design review toward the middle of the semester.
4. Execute a final design that is then approved for construction/manufacturing.
5. Benchmark performance of the final design, and present the project sponsor with an oral presentation and final report, along with the delivery of any apparatus to be constructed, as agreed upon in the specification document.

A strong emphasis is delivered to the students regarding customer satisfaction. The industrial sponsors pay a fee to the clinic that is usually 2-3 times the actual project expenses, and in order to show value to their management and continue the relationship with WSU, the students must deliver the value and more back to the customer. The clinic has a strong legacy of doing just that, and has grown into a stable funding source for needed lab equipment in the School that benefits the class directly, by subsidizing high-quality facilities necessary to execute even more extensive, challenging projects.

The clinic director is responsible to all the students for locating suitable, well-scoped projects, as well as dealing with the bureaucratic overhead associated with setting up contracts and providing some oversight. Students do use other professors in the School for technical support, but unlike many programs, an individual professor is not assigned to a project group for direct supervision. The success or failure of the clinic is shared equally between the clinic director and the students. The students provide technical design work, with the clinic director providing review and assuring that a steady stream of money comes into the clinic.

While many professors in U.S. universities are skeptical of students assuming such a large self-directed role, the benefits to the students of being responsible for project accrue back to the students. More than anything else, students acquire a sense of confidence, responsibility, and intellectual and emotional independence from the supervising professor. This is not only appropriate—it is vital. The students will be taking jobs after the class ends—most students take the class in their final semester—and their success as engineers depends on them being able to initiate their own tasks, complete them and hold themselves and their peers accountable for the quality of the execution. A question I ask every class at the beginning of the semester is this: “how many people in this class believe that most of what they do in life will be a success?” At the beginning of the class, few, if any raise their hands. By the end of the semester, virtually all do.

The Problem

While the notion of intellectual and emotional independence is an attractive one, the reality of such a class is that the Clinic Director is out negotiating small contracts with lots of companies—and these companies expect results. One of the areas identified for improvement by myself as Clinic Director was the ability to report group progress accurately in my conversations with project sponsors. Since there are often up to eight groups working on different projects at any time, I also wanted to be able to see clearly

where groups were in the design process, so that I could provide appropriate resources and motivation ‘just-in-time’. Finally, the end of the semester is always a hectic time in the class, and being able to step into a group and give ‘nimble management’ while at the same time fostering students’ independence was important to me.

The obvious answer was to adopt a computer-based project management solution. The problem was that any of the typical solutions either required set-up on a server, or large per-user fees for remote support. Students would also have to be educated on use of the system. Additionally, as clinic director, I would have to assume a start-up burden in finding and updating my own knowledge. Because of the overhead involved, a traditional, in-house software application was never going to get done.

Solutions

Web-based applications are one of the fastest growing market shares in the software industry. Application Service Providers (ASPs) offer advantages to the computationally terminally out-of-date by taking care of the issues regarding matching operating systems to applications, backing up data, or any of a plethora of tasks associated with managing a small company—which is what the Industrial Design Clinic fundamentally is. The upsides to considering a web-based application for project management are the following:

1. No IT overhead. All IT overhead is handled by the company that provides the service.
2. Simple user interface. Web-based applications all come through a browser portal, so all students need to use the PM software is a computer with a web browser.
3. Robust set of functions. Since the executing software resides off-site on the computer of the service provider, it is their problem if the software doesn’t work correctly. Student use is enhanced because the functions work as they are intended.
4. In the case of Basecamp, the interface is simple. Simple means that no time need be expended in software training. Since there is already an anathema toward teaching students how to use software already in academia, such a characteristic is a real asset.
5. In the case of Basecamp, archiving services are also offered. Students store their reports electronically on a local file server through Basecamp, making them available for any program review or ABET requirement.

The only disadvantage is that the feature set is more limited than a locally-based PM solution such as Microsoft Project. Any application must be web-executable, and as such, this limits complex functionality.

Basic Feature Set

Basecamp has a relatively simple feature set that is adequate for student projects.

The following functions are provided:

1. File upload/download.
2. Message board.
3. Writeboard
4. Milestone establishment and calendar.
5. To-do lists.
6. Time tracking.
7. People directory.

The File capability functions as an abbreviated e-portfolio application. Students can title and describe files, though unlike a true e-portfolio application, editing/commenting must be done with the original application that a document was created. File and project archiving is offered.

The message board functions like any web-based bulletin board function. One of the nicer features is that company sponsors can also be enrolled on the Basecamp site, and comment on student work. Students can also hide certain responses from project sponsors if they elect to do so, making their project execution more like a professional work environment. The client is enfranchised into the project, but inter-company communication can also occur without the sponsor being aware.

The Writeboard, a group-editable web page that group members can use as a shared document generation space. Since there is a wiki—a group-editable website designed to facilitate collaborative content development-- already associated with this class, students are less inclined to use this feature than they would be otherwise. See also ³ for a more sophisticated use of wikis in concept generation.

Milestones can be established for individual projects by the students, or for individual projects or the entire class by the clinic director. The clinic director sees an interface that has all the milestones present for all the projects, giving the requisite “big view” that a project manager needs to understand the progress of the workgroups.

To-do lists can be established by students, the clinic director, or if elected, the project sponsor. These lists are used in the context of the design clinic in understanding work that needs to be done, as well as giving groups individual accountability with their members. One of the biggest complaints regarding group work is equality of work share. With readily accessible to-do lists, as well as the time tracking function, this becomes relatively easy to document, as well as correct if you have a group member not doing anything. The other thing that is well served is such To-Dos give the clinic director some objective information to arbitrate disputes over work percentage. When To-Dos are completed, they are checked off and archived, making it easy to tell exactly what effort an individual has been putting into any given project.

Lastly, the People directory serves as a group phone book. All phone numbers, instant messaging, e-mail and FAX information is available on one web page.

More information can be found on their website:

<http://www.basecamphq.com>

Usage Statistics

In order to get a sense of how well Basecamp actually worked in the one semester that it was used in the class, Table 1 gives a glimpse.

Average Weekly Values

Messages Posted	3.1 +/- 1.12
To-Do Lists Posted	.73 +/- .29
Milestones Posted and Completed	1.0 +/- .30

Table 1

Though the number of groups participating in this first-time experiment was relatively small, including results from six individual groups, project sponsor participation in using the messaging functions did not appear to be critical to the students' use of the function. Of the six groups that used Basecamp, two had little or no communication with their project sponsors through Basecamp. One used the tool extensively—the other used it only when requested.

Qualitative Analysis

A focus group of 18 students out of a total of 25 students in the class was conducted regarding the use of Basecamp in the class. Students all agreed that Basecamp was easy to learn, and provided a central location for all communication for the class. Students agreed that the learning curve was very flat, and that the software filled an immediate need.

Students also developed a wiki (http://wiki.wsu.edu/index.php/ME_416_Pezeshki) of various aspects of the Capstone experience and were asked to compare Basecamp to posting information on the class wiki. Students agreed that the wiki was a worthwhile endeavor, but they believed that the benefit of the wiki would be seen primarily by those participating in the Clinic next semester.

From the Clinic Director's perspective, Basecamp made the following improvements possible:

1. It made the class virtually paperless. Students could communicate with and each other quickly and easily. It was easy to specify the format (e-mail, memo, formal report) and have whatever was asked for delivered to an on-line receptacle where it would not be misplaced.

2. It made tracking student effort extremely easy. Often in project classes, professors really cannot know what is going on in individual groups. Basecamp lets you see exactly what individual students are doing in the group dynamic. In addition, Basecamp has a feature that shows the last time an individual logged on to the system. Inactive members fall to the bottom of the pile quickly, with actual evidence .
3. When used, it satisfied the project sponsor's need for involvement with student activity. In particular, project sponsors that desired a very active role could have a place on the Web where they could always locate the students quickly and easily.
4. It facilitated outside phone communication. While it may seem trivial, having an on-line phonebook of students is a real asset when students are tasked to complete real work. Results matter when real deliverables are at stake, and being able to have student contact information readily available was a real aid during periods where the Clinic Director needed to travel.
5. It is providing an archive for ABET certification that is easily retrievable at the appropriate time. Instead of storing stacks of student work in my office, everything is on-line.
6. It provides an instantly compatible software base across both project sponsors and students, since the software is web-based. This eliminated the constant worry when dealing with different companies of coordinating compatible software titles.

Furthermore, for providing this level of service, Basecamp is relatively cheap. There are different usage plans available. The cost for supplying PM services to a typical design clinic runs at \$50/month. Considering that 80 students/year are processed through the class, this results in a per-student software and software maintenance cost of \$7.50/student. Additionally, since Basecamp is web-based, one does not have to worry about the physical location of the software, or any piracy issues. The Design Clinic is buying a service, and that service is physical location-free. When one considers that the project sponsors also use Basecamp to manage the students, the per-seat cost reduces even more.

Further Insights

The experience with Basecamp has given us important insights as far as the future of academic computing, and the future adoption of web-based computing solutions at WSU.

These are:

1. Professors do not want to give credit to students for software instruction, save maybe for an introductory drafting class. This means that any software used by the students must be able to be self-taught.
2. While some schools have a more coordinated engineering academic computing environment than WSU's, there are still issues surrounding selecting student editions of the various software applications used that cost hundreds of dollars.

- Buying web-based applications, when possible, can lower the cost that students are required to spend on software.
3. Web-based applications eliminate software piracy concerns. Because the academic unit is buying a fixed-price contract of given size, software administration is done by the people who developed the software.
 4. IT personnel and their time are at a premium in the university environment. Often a professor teaching a particular class must provide software support, as well as instruction for the class. As such, any software application serviced remotely is one more burden off the supervising professor's back. In the increasingly time- and resource-constrained environment, web-based applications can increase academic productivity.

Conclusions

Web-based applications allow migration to a paperless environment, with the benefit of PM services, with little start-up training. It also provides academic benefit to the students. Basecamp, though limited in feature scope, allows sophisticated, individually tailored team management that replaces paper and increases accountability among students and professors alike.

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