Collaborative Environments for Managing Industrial Projects

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Abstract
Embedding industrial projects into engineering education is becoming popular in engineering schools. The logistics involved in sending students to companies to work on projects is complicated and time consuming. Therefore finding an effective way to monitor and manage industrial projects is crucial for faculty to gain long-term success in implementing industrial projects in an engineering curriculum. This paper focused on one of the major burdens in offering industrial project experience to engineering students, the handling of communications among project teams, industrial partners, and supervising faculty. In this paper, the approach of using collaborative environments is proposed for the reduction of some communication related problems in industrial project implementation process. WebCT and a low cost web-based collaborative environment are the tools suggested for managing industrial projects. The purpose is to use available tools for managing projects that can reduce the complexity involved in monitoring industrial projects.

Introduction
Today’s engineers and managers often are in charge of various engineering design, improvement, and implementation projects in their companies. Managing and handling projects is an essential part of work for most engineers and engineering managers. Because of this trend, most engineering programs have some kind of industrial project format embedded into their curriculum. So it is desirable for programs to include industrial project experience in the undergraduate and/or graduate curriculum.

Teng and his colleagues offered a Teaching in the Factory approach which provides engineering students team experiences in industrial settings. The industrial settings include the working environment that an engineer may encounter, such as a manufacturing facility, an operations facility, or an office environment. This approach provides students the opportunities to work with industry on projects in a real operational environment. These experiences give students solid technical education, strengthen their project management skills, and expose them to significant engineering challenges found in real industrial settings.

Lenoir presented guidelines for success for capstone projects. Moore discussed issues involved in externally sponsored senior projects. Jordan and Schell pointed out some legal
issues involving industry sponsored design projects. Hight\textsuperscript{13} presented the issues in the senior design projects that include projects from industry and government. Based on these discussions and authors’ experience, there are some common challenges that students may encounter while working on a real world industrial project. These challenges include gathering technical information from the company, selling their ideas to the company, motivating individuals in the project team, working with many personalities from both the project team and the company, holding team members and company collaborators responsible for their work, allocating of human and non-human resources, budgeting financial resources, and managing time. The experience in managing these projects related issues could improve students’ engineering, management, and project management skills that are crucial for success in their professional careers.

The benefits for industry in providing industrial projects for engineering programs include getting fresh engineering minds and out-of-box perspective to solve design, operation, and implementation problems, obtaining expertise in technical and systematic problem solving and project handling, acquiring help to do projects while there is a manpower shortage, and providing employee education through project collaborations.

For faculty members involved in managing industrial projects, the benefits in working with industry on research and application oriented projects are attractive since faculty need industrial partners for research projects. Industrial projects also provide faculty the tools and environment to teach students engineering concepts, principles, and practices.

With the pros discussed above, the cons of working on industrial projects are what discouraged some faculty from becoming involved in these projects. The potential problems may include the following points:

1. Lots of time and effort required from faculty to guide and manage these projects,
2. Students’ workload increased significantly due to project work,
3. Logistic and scheduling problems may be very significant,
4. Communications among all project parties may be difficult and time-consuming, and
5. Engineering program’s reputation may be hurt if projects are not adequately completed.

This paper deals with the major issues in effective monitoring and management of industrial projects so engineering programs can ensure the successful implementation of industrial projects in their curriculum.

**Increased Workload for Faculty and Students**

The workload involved for both students and faculty in industrial project work includes the technical issues involved in the project work, the understanding of project environment and status, project related company issues, and the constant changing environment for project implementation. The major difference in workload between a laboratory project and an industrial project is that the issues involving project, company, and changing environments would significantly increase the load of the industrial project for both students and faculty.
Logistic and Scheduling Problems

An industrial project often involves a group of people at different sites which include the on-campus team, the on-site team, the project associated personnel in the company, and sometimes the supplier(s) or customer(s) of the company. This arrangement created a problem not found in most of the laboratory projects. It is the difficulty in scheduling project meetings and activities and in having all parties in the project together for discussion or meeting. The ability to deal with this problem will influence the project workload for both students and faculty.

Communications Between Project Participants

Since an industrial project involves several parties, communications between project participants are more complicated than a laboratory project. Figure 1 shows the simplest structure of communication channels for a project: two-way communications among industrial advisor, the faculty advisor, and the project team. This simple structure may work well if the project is totally controlled by the industrial advisor since the communications required for project activities are not complicated.

However, projects often are more complicated so students working in a project have to consider the feasibility of their ideas with the constraints of the company culture, the system, the budget, the hardware and software implicated, the personnel involved, the market condition, the time required, the project ownership issues, and the potential changes in technical methods and process environment. Figure 2 demonstrates a more realistic view of the communication structure for an industrial project. A project usually involves several parties of personnel during the project period. These groups include the project team, the faculty advisor, the industrial advisor and sponsor, other on-site personnel, and other faculty acting as consultants to the project.

![Diagram of project management and communication structure](image-url)
Figure 2. A Comprehensive Project Management and Communication Structure for Industrial Projects

All communication channels should be two-way channels. Because of the parties involved, it is not easy to have efficient and effective communication channels if a simplified process has not been established for project communications and management.

Since working on a project involves countless hours of on-site work and on-campus work, commuting between the project site and the campus may consume a large amount of time for the project team, especially if the project site is not within a short driving distance. Another time robber for the project team is the effort required in scheduling meetings, on-site visits, and discussions of project activities. To monitor and manage a project, the project team and the industrial and faculty advisors need to have constant communication with each other and with the on-site personnel. It becomes more expensive in time if individuals are searching for each other when some information, thoughts, and/or project work need to be exchanged. So finding a simple way for project communication with secured connections is critical in the successful management of a project.

It is necessary for faculty members to streamline the monitoring of industrial projects and the management of multiple projects at the same time. Therefore, the monitoring and management of activities actually are a project itself for faculty members. A key for the success of this project is to have an effective and efficient communication process so faculty can be certain that no time is wasted on meaningless communication process, such as leaving messages on each other’s voice mail again and again.
Influence of Project Results to Engineering Programs

The results of industrial projects have a great effect to the reputation of the engineering program. The usefulness of project results to the company, the work ethics of students during the project period, and the professionalism of the faculty and students in project activities and project communication processes can provide industrial sponsors the impression about the engineering program that sends students to the company. A few bad apples may give a company the perception that all students in the program are not professional enough to work on the company's projects. This problem again emphasized the importance of communications between the project sponsor, the faculty, and the project team during the project period. With good interactions between all project parties, any potential troubles can be corrected or prevented during the project period instead of at the end of project period. It would be too late to have any corrective actions at the final stage of the project.

The Use of WebCT for Project Communication

A useful tool, that could be available to all parties of project participants, needs to be low cost and easy to use. It should be available at all sites that have project activities and personnel. One common tool available to most companies is the Internet connection at project sites. With available Internet connections, a common class instruction tool called WebCT that is available at most academic institutions can be used for project management and communication. Since faculty can set up the WebCT course account for project participants, all project personnel can use WebCT as the communication platform by logging in their WebCT account. Inside the WebCT account, faculty can set up groups for projects and allow project team members and participants to use this common platform for communication and project management.

Figure 3 shows a WebCT site for an Advanced Project Management class in the Engineering Management Graduate Program at University of North Carolina at Charlotte. This web site allows project teams and their participants to use some of the features for project communication and management. The WebCT Mail, Discussion, Chat, Whiteboard, and Calendar sites can all be used for project communication after the account setup is done for project participants at project sites. The only required capability for on-site project personnel is the ability to connect to Internet on site. With Internet connection, all project participants can communicate with each other at various sites at the same time. Discussion of project work can be done through these sites and information and electronic files can be shared in the same fashion. The benefits of using WebCT include short learning time, no extra cost to the project sites, secure communication platform, easy setup at the beginning of the project, minimum maintenance and organizing efforts required for faculty during project period, and potential reduction of unnecessary meetings due to constant communication.

The Use of Low Cost Collaborative Environment for Projects

Although Internet is an integral portion in most collaborative environments, most collaborative environments today can only be performed between companies with special technologies or facilities. If this is the case, then it is difficult for project participants to use collaborative
environment for project activities, especially for small to medium size companies that do not have financial support to participate in such collaborations. Most companies working with academic institutions on industrial projects often provide very limited resource except for the agreed project funding. It is difficult to install new software on the project site for the purpose of project activities and communication. Therefore, a simple and low cost method should be pursued if the project team wants to establish a collaborative environment to relieve the burden of frequent meetings and fruitless on-site visits.

Liu and his colleagues\textsuperscript{14,15,16} have proposed a low cost approach for small to medium size companies to have virtual design capability under a collaborative environment. The collaborative environment they proposed for product design is with the combination of 3D CAD software, the Internet, and simple virtual reality and could be easily used with less cost, especially for small and medium size companies and their clients. The purpose for their application in collaborative environment is to reduce cycle time, lower cost and raise quality through a virtual communication between all parties involved in a design project. Through this work they have also found that this collaborative engineering tool can be used for effective project communication with minimum cost.
Two approaches have been used to create the collaborative environment. The first approach utilizes a combination of Virtual Reality Modeling Language (VRML), JavaScript, and Hyper Test Markup Language (HTML) for project sites that do not work with any 3D CAD software. The second approach utilizes a combination of 3D CAD software, VRML, JavaScript, and HTML for companies that already have 3D CAD software so that they can export their designed objects into VRML files directly. The difference between these two approaches is that the latter one builds designed objects in a 3D CAD software rather than in VRML. The project team can select the approach based on the capability or preference of project site(s), cost, and/or convenience. Figure 4 shows the steps for establishing the collaborative environments in these two approaches.

Figure 4. Steps for Establishing the Collaborative Environment

The first approach is a combination of VRML, JavaScript, and HTML. It uses VRML to create the design object; uses JavaScript to create the function of verifying the password, getting the input data, generating the new design, and feeding the new design data back; and uses HTML to create the web page where the original and new designs are displayed and reviewed. The second approach uses 3D CAD software to create the design object first, and then exports this object as a VRML file. Except for the creation of the design object, JavaScript and HTML played the same roles as in the first approach.
Figure 5 shows the working steps at the project sites in this collaborative environment. The communication process is the same if there are other objects for discussion other than design objects. For opening the desired VRML file and the object, the on-site project participants have to install and use a free VRML plug-in, called Cosmo Player, from Silicon Graphics in their Internet browsers. It is a three-dimensional viewer for the World Wide Web. With Cosmo Player, project participants can easily navigate and manipulate 3D scenes created in VRML. VRML instructions can be typed in any word processor such as Notepad, WordPad, or Microsoft Word.

On-site project participants could check the design provided by the project team virtually. To submit the new data automatically, the project sites have to configure the Mail option in their Internet browsers. This configuration allows project participants to open a mail window automatically after they clicked the “confirm” button, and directly send an email to the project team’s mailbox when they clicked “send” in the mail window.

![Diagram of working steps]

**Figure 5. The Working Steps for Clients**

**Conclusion**

The collaborative engineering approach provides engineering programs and companies a low cost solution to the project communication, implementation, and management problems. It allows project participants to use web-based collaborative environments for project activities involving design, technical discussion, and simultaneous communication with several parties.
The use of WebCT allows the project team to have secure communication with all project parties and to share information in a more effective way. For faculty who are monitoring multiple industrial projects, WebCT and the proposed collaborative environment for design offer an efficient way to monitor the progress of projects, to communicate with all project participants, and to provide technical input to the project teams. This approach also provides companies and project participants an easy way to work with the project team and the faculty during the project period and to save tremendous amount of time in project communication and management.

One important key to this approach is the low cost required for its implementation. This makes the proposed approach more attractive to both engineering programs and companies since cost and effectiveness are always an issue for companies whenever they fund projects for engineering programs. With the use of this approach, the faculty, the project team and all the project participants can significantly reduce the time required for meeting, communication, transportation, and scheduling of project activities. Because of this reduction in activity time, the potential problems in implementing industrial projects can be minimized so it is more feasible for engineering programs to add industrial projects into their curriculum.

Bibliographic Information


Biographical Information

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