

Incorporating Concrete Canoe & Steel Bridge Planning into a Construction Management Course

Brian L. Houston

University of Pittsburgh at Johnstown

Introduction

Many faculty members would agree that to promote the development of communication skills and to establish a well-rounded education, students should be involved not only in classroom instruction but also in extracurricular activities that contribute to these goals. The American Society of Civil Engineers (ASCE) annually promotes two programs that directly relate to civil engineering: the ASCE Concrete Canoe Competition and the AISC/ASCE Steel Bridge Competition. The benefits of these programs are obvious to those who have participated. Involved students have an opportunity to learn many aspects of project management, from conceptual design through construction. Previous surveys at Lamar University have shown that students who participated in these competitions perceived their knowledge in several core areas to be greatly enhanced. Significant benefits were derived in the areas of Project Management and Team Building.^[2]

Promoting student involvement in extracurricular activities is difficult at small engineering and engineering technology schools. Many factors contribute to this opposition. Engineering students tend to focus on studies first, so involvement in extracurricular activities may be viewed as a waste of time. Small schools have limited resources (both labor and funding). The small labor pool often results in excessive time commitment for those who are involved. Most of the monetary support must come from student fund-raising activities. In addition, the student body at some schools has a significant adult student component. Adult students are likely to have jobs, possibly families, and are often unable to contribute additional time outside of class. To promote and support a good program, an advisor should attempt to find ways to mitigate these factors and make involvement an easier proposition for students.

The Competitions

The Concrete Canoe and Steel Bridge competitions are well known student activities in civil engineering. Almost without exception, students who participate in these events carry away rewarding memories and reflect positively on their experiences. Another positive benefit from involvement is the ability to establish talking points during interviews with potential employers who were also involved during their college years.

Many institutions integrate the Steel Bridge competition into the design curricula by using the design phase of the competition as a project in a structural steel design course. Integration of the Concrete Canoe is more difficult, but it is possible to use the concrete mix design as a project in a construction materials course. Both of these course enhancements address the design aspect of the competition, but not the planning.

By its nature, the planning phase of any project is time consuming. This is compounded when performed by students with little or no experience in the process. One can alleviate the time consuming nature of the planning process and increase the experiential knowledge of the student by integrating the planning and implementation phases into a management course. This provides a routine, stable format for coordinating and communicating, provides recognition of individual effort and shifts the more tedious aspects of the competition away from the students' free time. By incorporating planning into a course, the instructor can provide guidance, promote participation and develop the students' project planning skills.

Purpose

There are many benefits to integrating the planning functions of the competition into a course environment. By providing a consistent, weekly planning session, the advisor can:

- promote student participation
- give credit to motivated students
- spread the workload to a larger group of individuals
- provide an opportunity to manage a project from inception to close-out
- give students experience in a large team environment
- shift some of the planning function away from the students' "free time"
- improve communication
- improve technology transfer and continuity

Due to the limited labor force for small schools or schools just beginning to develop a program, the few who do become involved are often overburdened with the tasks necessary to field a team. The students who do get involved are likely to have an unusually strong drive to excel which magnifies their burden. Other students observe the "involved" parties and can often only see the disadvantages of the project in terms of excessive time commitments. By moving some of the planning activities to a management course, many the students can get exposure to the program without the time "penalty" of being involved.

Throughout the past year, several of the students who steer these programs have indicated a desire for a course specifically addressing competitions. Most faculty members realize that it would be difficult to squeeze this type of course into what appears to be an ever-expanding curriculum. By integrating the planning process into a management course, the students whom would otherwise have had to use significant time outside of class for planning functions can now have the benefit of receiving a small amount of credit for their efforts. By keeping the actual percentage of the overall course grade low (say 5% of the course grade) the impact on course content is minimal but the perceived benefit by the student is positive.

A typical Construction Management course at UPJ has about 24 students. These students are divided between the two competition programs based on their area of interest, either in the Concrete Canoe or the Steel Bridge. The result is usually an even split with about half the class in each team. This division gives the project managers a captive audience of about twelve people to use in the planning phase of the project. In previous years this workload was shared by just a few individuals, so by moving these functions into the classroom there is an immediate increase in involvement and a decrease in the workload of the organizers.

The initial organization in class involves the development of a team structure that includes the following positions:

- CEO – This individual is the responsible team leader and must direct the team meetings, provide structure to the group and interact with the instructor. Often this will be the person who is the driving force for the program.
- Ambassador – This individual is in charge of recruiting participants which often involves making announcements at other university functions and updating information on a bulletin board to ensure communication to the student body. Since the management class is a senior-level course, this individual is essentially the information conduit to the underclass.
- Procurement – This individual is in charge of finding material suppliers, pricing, delivery lead times and developing a comprehensive bill of materials to ensure the construction of the canoe and/or bridge is not delayed due to inadequate supplies.
- Scheduler – This individual develops a timeline for the project ensuring the team is aware of ordering deadlines, submittal deadlines and recording when other meetings are occurring to assist the Ambassador in his/her efforts.
- Marketing – This individual develops letters for fundraising efforts, identifies potential donors and maintains the information of past donors for future years.
- Design – This individual is responsible for the design process for each competition. He/she may either perform the design or direct a design team.
- Construction – This individual is in charge of developing a construction plan and helping implement the plan in the following semester or briefing his successor on the plan.
- Records – This individual must document all meetings and maintain a project manual to provide technology transfer in subsequent years.

Once this group is established they must formulate a plan and throughout a 15-week term develop the plan into a viable, working project. Many of these students continue their involvement into the next term by participating in the construction phase of the canoe and/or bridge.

Typical project teams in the academic environment include 2-4 students. It is rare for most students to work in large teams, but in engineering practice large teams are commonplace. By exposing students to the large-team environment and forcing them to develop work skills that promote communication within the group, the students must face challenges that they might otherwise not encounter until they are practicing engineers or project managers. A request of

academia from industry is the need to equip students with real-world skills before they hit the job market. Students exposed to these real-world concepts early do not have to learn by trial and error later when the stakes are potentially much greater.^[1] The size of the group inherently brings many different personalities, skill sets and ability levels. Individuals accustomed to self-performing work must now learn to delegate. Communication within the group quickly becomes a major issue and the students have the opportunity to work through these real-world problems in a structured environment.

Students often view the planning phase of the project as drudgery. By incorporating the communication and planning aspects into a structured course, the seemingly disagreeable elements of the project no longer impinge on the student's free time. In addition, the students view these functions with slightly less negativity since they now get some compensation (by way of course credit) for their efforts.

The varied communication requirements become more apparent to the students by working in a large group. They can readily see the many different communication paths that contribute to success: communication within the team, communication with outside interested parties, communication with the student body, communication with outside organizations (suppliers, donors, etc...), and communication with the advisor. Each type of interaction has its own purpose and mechanism which is not easily distinguished without participating in a large group.

A major issue in previous years at UPJ and an issue observed by the author at other institutions is that of technology transfer. Students sometimes find it difficult to see the importance of documenting their work until it is too late. When the next competition year arrives they find it difficult to reconstruct the process they followed in the previous year. The records manual serves to provide a vehicle of knowledge transfer from year-to-year so future competitive teams do not need to rely on the memories of a few individuals and in essence "re-build" the program each year.

Implementation

At UPJ the Construction Management course is a 15-week course. There are two lectures per week and a 3-hour recitation period which is used for a variety of tasks. Each week 30 minutes of the recitation period are devoted to Canoe/Bridge meetings to allow a weekly forum to communicate and plan for the next week, and also to gradually develop a comprehensive plan for the entire project. A rigid time format is not necessary, but keeping the meeting to 30 minutes does teach time management to the students and also promotes the development of skills related to planning meetings, such as rules of order, record keeping etc...

In the first week the students are tasked with choosing an interest area (Canoe or Bridge). At the second meeting the teams assemble for 30 minutes to establish responsibilities for each group member and to begin the recordkeeping process. The instructor helps to guide the discussion in the beginning until management skills are refined enough to ensure that meetings are productive and documented. By about the fourth meeting the students begin to operate somewhat

independently which allows the instructor to focus on assisting individuals in refining the particular skills needed for their own area of responsibility.

Typically the Construction Management course is taken in the first term of a student's senior year. The end result of the process is a plan, including a project manual, which can be implemented in the following term by other students. This knowledge transfer is necessary since the time commitment of the senior class in spring term often wanes from pressures associated with their senior design project. Senior students typically do not renew their activity in the program until late in the spring quarter when they have completed most of the submittals for other courses.

Conclusion

As of the writing of this paper, this process has only completed one cycle. The quality of the project manual was marginal, but the result is more from the novelty of the program than from the inability of the students to produce quality material.

The students who would have been involved regardless of credit expressed appreciation for receiving some recognition of their effort. Those whom would otherwise not have participated expressed regret at not being involved in their earlier years. The challenge for the future is to develop a multi-year process to allow students to become involved early in their college careers and develop competitive advantage by retaining and passing the accumulated knowledge to future generations.

References

1. "Industry and Academics Need To Hunt for Success." Editorial, *Engineering News Record*, December 6, 2004, pg 64.
2. Koehn, E and Malani, R., "Student Competitions and Experience Enhance ABET Requirements," Proceedings, 2004 ASEE Annual Conference, Salt Lake City, UT, June 2004.

Biography

BRIAN L. HOUSTON is an Assistant Professor of Civil Engineering Technology at the University of Pittsburgh at Johnstown and Managing Partner of Roundtable Engineering Solutions, LLC. Prior to academia, he worked as a Senior Design Engineer in the petrochemical industry and is licensed in several states. He received a B.A. from Northwestern University in 1986, and a B.S./M.S. in Civil Engineering from Oklahoma State University in 1997/99.