AC 2007-835: SERVICE-LEARNING AND INTEGRATED, COLLABORATIVE PROJECT MANAGEMENT

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Service-Learning and Integrated, Collaborative Project Management

Abstract

This paper describes the introduction of service-learning into an undergraduate course on project management. At ECU, engineering courses are taught in an integrated and collaborative education environment. The core curriculum requires junior level students to complete a course in project management as part of the program's commitment to industry to supply immediately productive, contributing new employees. The project management course is traditionally structured around system needs and analysis identification, functional requirements analysis, project timelines, network analysis, and project progress metrics. Introduction of service-learning projects was embraced as a pragmatic approach to encourage students to commit to service to the community and to provide a "fast-track" application of the project management course concepts. Service-learning emphasizes problem solving, experiential education and civic responsibility while simultaneously providing opportunities to develop human relations. The paper describes approaches taken to, and early successes of, introducing service-learning projects into this project management course to students without project management and service learning experience, and into an engineering program in its development stage.

Introduction

With growing pressures within the university setting to feature the engaged approach of working with adjacent communities, emphasis on town-gown collaboration is being touted as a retention enabler[1]. One technique for melding these interests is the extension of case study type problem based learning[2]. In this approach students are encouraged to develop a team approach to problem resolution in order to promote an appreciation for diversity, communication skills and self-esteem through collaborative problem solving. This approach builds on traditional basics such as research related reading, reflective report oriented writing as well as science, mathematics and calculus.

Service-learning is community centric problem based learning where students are addressing real community issues and problems. Real problems mean real customers, clients or beneficiaries as well as real risks and real requirements and therefore carry the weight of real engineering experience. This form of service-learning is similar to university/industry partnerships[3] for student projects with the exception that service is provided to a community organization that is government or non-profit thereby providing the students with a "gift of giving" that is to often lost in more quantitatively oriented environments. The challenge is to move the service-learning experience from collaboration-where group accountability is paramount-to cooperation-where individual accountability is carefully structured[4], i.e., an experiential learning environment. The solution proposed here is the application of the tools of project management[5].

Learning project management skills is a trial and error process. Academic courses can teach all the tools that the PMBOK define and reference but to learn it, students have to use it. The challenge for undergraduates is to learn how to learn, to learn and to learn in a way that doesn't cause harm. Providing that kind of opportunity for undergraduates requires hands on tools and

hands on opportunities, i.e., live, real time case studies[6] or projects. Live, real time case projects imply opportunities for project success and opportunities for project failure where potentially the most learning may occur. This is sometimes referred to as situated learning[7]. When project management is tied with experiential learning and service-learning the curricular design provides for retained learning from several theoretical processes.

East Carolina University (ECU) has initiated an engineering program based on the concepts of integration and collaboration. As with many undergraduate engineering programs, the curriculum includes a three semester credit hour course in project management. The Engineering Department is now in its third year and has initiated its inaugural offering of *ICEE 3300, Project Management* during the spring 2007 to the junior class. The course goal was traditional; the need for integration and collaboration was a programmatic mandate with minimal supporting infrastructure. At the approach of the course's inaugural offering, instructors sought to amplify the collaborative team aspects of the program with the integration of project management process theory simultaneously with application.

The Challenge

Collaboration and integration are noble curricular efforts of themselves but generally lack the raw-knuckle context of real world project management that veterans of the competitive wars of industry have experienced. The desire of new faculty was to bring real world intensity to the course in the form of student projects. Since the program is only in its third year of existence, the lack of a departmental reputation hindered liaisons with industry partners, i.e., industry has been slow to offer student projects.

Traditionally, in the geographical region around *ECU* service-learning has been based in humanities programs that have been the University's forte since the school's founding 100 years ago. The advent of an engineering program has required a significant shift in paradigms for a wide portion of the University's faculty and administration as well as the region's industrial and service communities. The humanities programs have a proud record of service-learning cooperation with community partners in an hours-per-semester mindset within participating courses. When the initial inquiries were made as to what projects were available for engineering students, there were always two questions in response: How many hours per semester do you expect of your students; and, What is an engineering project? These questions came consistently from the University's service learning staff and from the community partners. The need in the ECU engineering curriculum was not in student time-keeping exercises but rather in completed projects. In order to influence the prevailing paradigms, many discussions were held with support staff, and briefings, white papers and communiqués were exchanged. The exchanges have culminated in eight semester-long projects that will result in assignments for aspiring engineers to demonstrate their engineering prowess and more importantly provide an opportunity for those highly valued live, real-time case studies.

The Solution

To meet the challenge the Project management faculty at *ECU* has designed an undergrad project management curriculum that incorporates service-learning within a 3 credit hour for junior

engineering students. This class is designed to be as close to real life as possible for the students and instructors. The class is structured as an organization, a learning organization and a learning centered education environment. The organization's primary mission is simply that students learn project management theory and application in a contemporary organization structure. A secondary product is delivering a completed project to community service-learning partners. The secondary product uses service-learning as a medium for students to apply the project management process body of knowledge to live, real-time projects. Each student is considered a member of an organization and has a collaborative role in establishing the organization structure, culture and productivity.

In order to accomplish the course objectives within the semester calendar, the students are organized as a matrix organization (Figure 1). The matrix organization consists of 8 teams and four departments. The matrix learning organization requires each organization member to have a role in two areas: a department team (responsible for the functional expertise, i.e., course "ABET" objectives) and a project team (responsible for demonstrating "ABET" objectives). Experiential learning occurs on a departmental level where the departments are responsible for first learning and then teaching the other departments a set of required topics that address the course learning objectives. The learning organization was designed to require a high degree of self-motivated learning (a prelude to life-long learning) which is then extended to sharing that learning to the organization, i.e., presenting new material to the class and helping teach classmates what the department members have learned and applying the learning to the service-learning projects. This methodology was selected so that each of the project teams would get at least some level of knowledge of the project management process topics early in the semester.

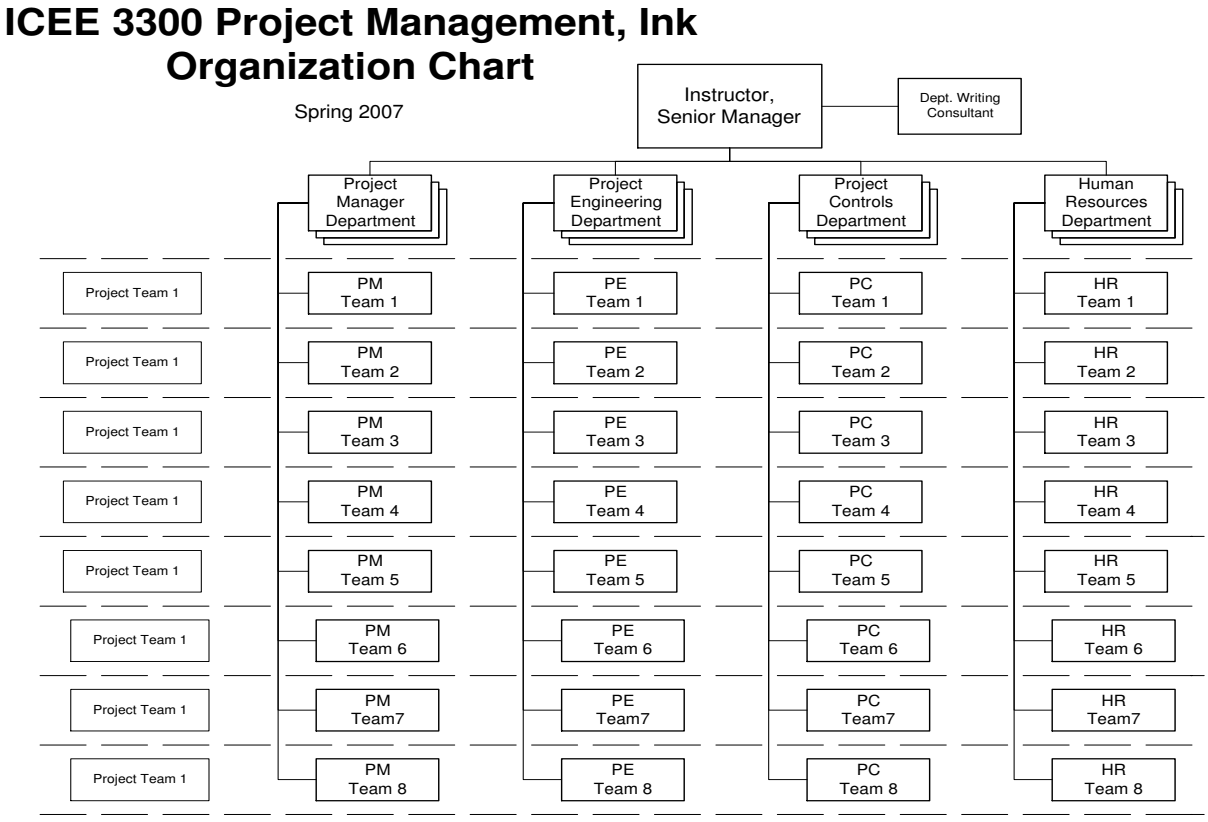
Project teams complete service-learning projects to demonstrate theory application according to the course format. Each student is required to participate as a member of a team that is assigned a service-learning project. Participation in a project is not voluntary; it is a course requirement. Each project team is required to establish a specific scope of work agreed upon by the team and the community sponsor—a demonstration that the concept of a project charter is understood. Project team progress is monitored by milestones defined in the project charter, project baseline schedule and earned value analysis—again, a demonstration that these topics are understood. Meeting the project milestones ultimately means the project meets the need of the sponsoring client. Throughout the project, project team members write (for review/ranking) a weekly progress memo indicating both personal progress on project responsibilities and progress on learning related to the course objectives. These memos are peer-reviewed and peer ranked as part of the process for evaluating course objective completion.

The Projects

As the course design evolved from instruction centric to learning centric, the university's Volunteer and Service-Learning Center was invited to participate in course development with the expressed of identifying suitable projects for engineering students. Traditionally, the center has provided assignments where students are assigned to a community partner in order to meet a specified number of hours. The project management course required an understanding with community partners that resulted in a project charter or statement of work and a scope that was achievable in a single semester and having achievable objectives and milestones.

The Center proposed 7 projects; eight were required for the class enrollment, the last being provided from a for-profit industry (Appendix 1). The nature and scope of the projects (Table 1) ranged from database development to materials management systems and electro-mechanical controlled seating. Community partner representatives were invited to a class meeting to introduce their projects and invite students to participate in their sponsored projects. The projects are scheduled to complete in April 2007.

Figure 1. ICEE 3300, Project Management Ink Organization Chart



Methodology

Project Management Process Theory. In order to enhance the organizational feel of the class and its structures, the functional departments were delegated responsibility for topic presentations throughout the semester. Each member of the organization was required to team with another member of their functional department to give one presentation so that every member had an opportunity to give part of one topical presentation. The topics were arranged so that there was a relative relationship between the departments' responsibilities to the organization and the topical material required by the learning objectives (Table 1). Topics were extracted from Grey and Larson[8]. In order to track progress with learning theory, each presenter was responsible for evaluating the entire organizations understanding of the topical material.

In conjunction with the topical presentation and as a bridge to application within the service-learning projects each project team was responsible for creating a project charter, a project baseline schedule (the organization maintained a master schedule through the Project Controls Department) using MSProject®, a Risk Analysis and Management Plan, and a project closure report and presentation. The presentations were presented to the organization and the project sponsor.

Theory Application. As a means to demonstrate the topical theory was being both learned and applied, each member of the organization was required to write a weekly report in which goals, objectives, learnings and surprises were discussed. This exercise provided students multiple opportunities to learn and hone engineering writing skills.

Service-learning. As a final component of course methodology, each student was required to make regular entries into a reflective journal in order to capture the reality of the experience of the project management class. Students were encouraged to capture not only the reality of the project centric approach but also their reaction to the whole approach from an intellectual as well as an emotional point of view.

Table 1. Required Topic Coverage

TOPICS	**Responsible Department**
Modern Project Management	HR
Organization Strategies and Project Selection	PM
Organization: Structure and Culture	PC
Defining the Project	PE
Estimating Project Times and Costs	PC
Developing a Project Plan	PM
Managing Risk	PE
Scheduling Resources	HR
Reducing Project Duration	PC
Leadership: Being an Effective Project Manager	PM
Managing Project Teams	PM
Partnering: Managing Inter-organizational Relations	HR
Progresses and Performance Measurement and Evaluation	PC
Project Audit and Closure	PE
International Projects	HR
Project Management and the Future	PE

Evaluation

Evaluation of all course work was completed on three levels. All original work (project documents, memos and journals) were peer reviewed and rank-ordered. The students were afforded an opportunity to help each other learn, to learn some basic skills in ranking project team member performance, and to learn from the mistakes of others. In parallel, the instructor also reviewed, commented and ranked each of the writing assignments. All rankings were

weighted and compiled according to a rubric the students themselves developed. Finally, sponsoring clients are being asked to evaluate the quality of the project deliverables and the performance of the students as they interacted with the sponsoring organization.

In order to provide a basis for programmatic assessments using traditional assessments, students are required to take a final exam to demonstrate knowledge acquisition. While somewhat threatening by nature, the final exam is grade-optional, i.e., for students not satisfied with the results of the peer ranking process the final exam will contribute to their final grade. Those students who accept their final grade based on ranking rubric are still required to take the final exam however their performance will be used for programmatic assessment purposes only.

While the evaluation process described has focused on the current course offering, the engineering faculty expects to offer multiple sections of the course in the future. The multiple course offerings will permit direct comparison of traditional course formats with the model described here.

Conclusion

The course structure is designed to guide the ECU engineering students through a journey of experiential understanding of the project management process via a learning centered course structure. Students are expected to begin their learning "journey" by implementing their projects "by the book" in order to understand project management theory and in support project completion. This course is being offered (Spring 2007) at the time of the development of this article and is the first time the course has been offered for the *ECU* engineering program. The success of experiential learning and service-learning methodologies in this course has yet to be determined. Editorial deadlines required by ASEE Proceedings publications would not permit a full assessment. However, course results, including student feedback, instructor peer feedback, and community partner feedback will be available at the ASEE 2007 Conference.

Food Bank of Central and Eastern NC

This project involves the assessment of the Food Banks current storage systems at their 9th Street location, which include vertical racking and pallet stacks rotated by forklift. Due to the increased need for food distribution in their delivery area (34 counties), the Food Bank needs to boost their inventory supply, but is unable do so with their current storage features. Students will be needed to evaluate the current storage systems capacity and effectiveness, as well as research load limits for new or renovated systems/floor plans. Research will also be needed to determine costs and suppliers for new equipment and necessary construction changes and result in an engineering economic lifecycle analysis. This information will be used to determine a forward path for immediate storage changes, and recommendations for future sites should the facility change locations. The students will work with the Operations Manager and Volunteer Coordinator to understand current policy and procedure for the facility, and should supply them with a detailed engineering/project report at the end of the semester.

Sylvan Heights Waterfowl Center

This project involves developing conceptual design alternatives and comparative analysis and selection recommendations for the construction of an amphitheatre at the Sylvan Heights Waterfowl Eco-Center in Scotland Neck, NC. The Eco-Center is dedicated to educating the population about the importance of conservation of wetlands and waterfowl. The amphitheatre will be used to perform bird shows and as a showcase for lectures. The project will involve the design and selection of materials to construct the theatre in a heavily wooded area, with the requirement that the construction matches the current building structures at the site. The stage must be partially covered, with a backstage area that can be used for storage of live animals, cages and equipment. Needs analysis and recommendations for outdoor audio equipment should also be considered. Students will work closely with the Operations Assistant to determine size, landscape limitations, and materials, as well as cost. The final result should be a engineering/project report that includes the above information.

The Humane Society of Eastern NC

This project requires the design of improved waste management and feeding systems for the Humane Society. The current systems include feeding animals individually by hand and cleaning cages (fenced, cement runs) with hoses. Students will work with the operations manager to determine the efficiency of the current systems, and recommendations for improvement which could include computerized systems, facility modifications and productivity. The final product should include an engineering/project report including engineering economic alternative lifecycle analysis, system analysis (operability, maintainability, reliability, constructability, etc.) and performance data for recommendations and vendor information (cut sheets) for upgrade equipment.

Give2theTroops Database

This project involves the design of a database used to track US troop assignments, deployment dates, lengths of stay, item requests and package tracking for clients of Give2theTroops. The organization currently houses information for thousands of troops on EXCEL® that is not shared

between six national branches. Students will work with the executive director of the Greenville branch to baseline current database performance, limitations and define replacement system requirements. Project deliverables include improved database design (an alternative to EXCEL® must be compatible with available equipment), installed database and basic training and operating manual designed for novice computer users. Note: Students will be required to supply their name and addresses to the Executive Director, which will be made available to the US Dept. of Homeland Security upon request. If you are not willing to share this information, do not select this project.

Give2theTroops Inventory Management

This project includes design selection for storage units in the Give2theTroops warehouse. As troop requests and donations grow, the current storage system (tabletops and storage boxes) has demonstrated inefficiency. Students will assess space and design limitations (no permanent units, no permanent alterations to the warehouse, move-able units, i.e., re-locatable) and identify efficient storage/handling system or equipment. The students will work closely with the executive director of the Greenville branch to understand cost and inventory needing to be stored. Minimum project deliverable is a engineering/project report that contains the equipment and design recommendations, engineering economic lifecycle centric alternatives analysis, recommended vendors and data (cut sheets) and an assessment of re-locatability. The report should provide a systems evaluation (operability, maintainability, constructability, etc.). If materials are available, students will be expected to assist in constructing inventory management system.

Spring Arbor Assisted Living and Alzheimer's Cottage

This project involves the design of a recliner that meets the specialized needs of Alzheimer's patients. Current models require patients to manually raise and lower the chair back and foot rest with a knob or button. It is common for patients to recline the chair, and forget how to lower it when they are ready to rise. Subsequently, they attempt to rise with the chair still reclined and fall or tip the chair. Students should evaluate the safety performance of current models, identify suitable alternatives or design a safe and cost-effective prototype if suitable alternatives are commercially unavailable. The project deliverable will include a design prototype, cost estimates for manufacturing/purchase and identification of potential manufacturer as well as a analysis of user safety and caretaker safety for available and proposed chair designs. Students will work with the executive director of the Greenville cottage.

Children's Hospital

The pediatric ward of the Pitt County Memorial Hospital provides a range of services for patients and their families. Often times the children are in the hospital for extended stays. During these stays the hospital has developed activities and services for patients and families. One of these services is a DVD library of games and movies where patients can "check-out" a DVD for viewing/gaming and then return the DVD to the library. The management of this system is labor intensive for the care-providers who are called to the patient's room, get the request, go to the library, retrieve the DVD and return it to the room. Often times DVDs are lost with the current system. The project requires development of a system that reduces care-giver direct involvement and minimizes DVD loss.

Assembly Procedures,

A local industry has been manufacturing flat-plate heat exchangers for 20 years for the food industry and the petroleum services industry. A recent focus on competitiveness has recognized the need for standard operating procedures for the assembly and test portion of the manufacturing line. A procedure format has been conceptualized. The project will require interviewing assembly mechanics and video recording actual assembly and testing of one or more models. Draft procedures will be validated by plant personnel on the manufacturing floor. Project deliverables are defined as twelve standard operating procedures.

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