A Case Analysis of Real-World Systems Development Experiences of CIS Students

Terry L. Fox
Terry_Fox@baylor.edu
Department of Information Systems, Baylor University
Waco, Texas 76798 USA

ABSTRACT

As effective as an instructor may be, a classroom setting simply cannot offer information systems students the benefit that actually working in a real-world environment can offer. Internships can benefit a few students, but a course in which all the students are provided with the opportunity to develop systems, working with real-world clients, and where the final solution is not known until the project is completed, can also be extremely beneficial. This paper presents a case analysis of several real-world projects undertaken by students, and provides a discussion of the "lessons-learned" from the projects, which include communicating with teammates, communicating with clients, communicating with the instructor, project management issues, as well as lessons learned by the instructor.

Keywords: Information Systems Student, System Analysis And Design, Lessons Learned

1. INTRODUCTION

Providing students with real world experiences is one of the best methods to prepare them to be successful in their careers. Regardless of how many lectures they attend on systems analysis or database theory, or how many end-of-chapter projects (where the answer is already known) are completed, there simply is no substitute for a hands-on, real-world experience.

This paper presents an summary analysis of eight projects completed by Computer Information Systems (CIS) students enrolled in a senior level capstone course and represents the work from three different class sections. The course is typically taken during the student's last semester, and requires as a prerequisite the successful completion of courses in systems analysis and design, database, and six hours of programming. Most students will have also taken six or more additional hours in programming, as well as courses in telecommunications and operating systems. A favorite text used in this course is *The Mythical Man-Month* by Fred Brooks, Jr. The overall objective of the course is to prepare CIS students to "hit the ground running" when they graduate and begin their careers. Many of the companies that hire these students acknowledge the importance and usefulness of this course because of its real-world application.

The outline of this paper is as follows. First, a review of relevant literature is presented that encourages this approach in student learning and indicates the need for further discussion of this topic. The next section offers a discussion of the objectives and requirements of the project, and includes a summary of the individual projects. This is followed by an analysis of the real-world "lessons-learned" that resulted from these projects, and the conclusion.

2. LITERATURE REVIEW

Several articles have appeared in the literature that suggest the importance of this type of course and approach. Gunn (1983) states that "students must experience a situation to truly learn. Merely being told how to do something through a lecture is no substitute for actually doing it" (p. 23). Similar, client-sponsored project courses offered in the marketing area have been shown to be a very valuable technique not only for the student, but also the client, the instructor, and the university (Clark and Kaminski, 1986; de los Santos and Jensen, 1985). Elbert and Anderson (1984) determined that students are more interested and motivated when

working on a project concerning a local company than a classic textbook example. Kesling (1989) describes similar projects where students work with community organizations to recommend computing equipment and comments that the approach has received very favorable feedback from both students and the organizations.

Harris (1994) presents an outline of the mechanics of this type of real-world, systems development course, and suggests that not only can this be the most important course in the IS major's program, it also offers opportunities to strengthen oral and written communication skills. Cougar (1995) further emphasizes the importance of this type of course and approach in his discussion of the importance of improving creativity in systems analysis and design. He states that the highest level of knowledge or understanding attainable in an academic setting is that of application and encourages applying creativity techniques in a comprehensive systems analysis and design class project, such as one for a local company. Schuldt (1991) also discusses the importance of real world projects in a systems development course, and comments on the students' perceived value of the project and the potential for creating a positive university-community relationship.

Further studies have addressed issues such as team effectiveness, performance, and satisfaction (Werner and Lester, 2001) and the importance of peer review (Dyrud, 2001). Tanniru and Agarwul (2002) examined student team project success factors such as project complexity, team experience, and coordination and stress the importance of providing opportunities for students to work on real projects with real companies.

Additional topics such as group dynamics and interpersonal and team skills as they apply to technology have been addressed in the literature (Rooney, 2000; Jessup, 1992, Jessup, 1991). Recent studies specifically focusing on team projects have examined issues such as managing interpersonal conflict (Barki and Hardwick, 2001) and cross-functional teams (Sethi, Smith, and Whan, 2000; McDonough, 2000), but these addressed professionals rather than students. One recent study of graduate students involved in a software project examined perceptions of their contribution to the project (Rajlich, Syed, and Martinez, 2000). Watson, Johnson, and Merritt (1998) examined various issues pertaining to diversity in student teams, but not with a systems development project.

While it is evident that there has been work done in the area of student team projects for systems development, more empirical study and research is needed. Studies that describe specific opportunities for real-world student projects are beneficial for the educator, and additional discussion specifically focusing on problems encountered and lessons learned is necessary to understand and develop this approach successfully.

2. THE PROJECTS

A summary of recent projects completed by CIS students is presented in Table 1. Specific identifying details are withheld to protect the identity of the organizations. A representative screen sample from one of these projects is shown in Figure 1. These projects were diverse and offered significant opportunities for interaction with real-world users. The projects also provided multiple challenges in the students' attempt to successfully complete them, as will be discussed in the Lessons Learned section.

The systems were created using Microsoft Access with embedded Visual Basic code, and were installed either on stand-alone microcomputers or on small peer-to-peer networks.

3. REQUIREMENTS

From the beginning, the students were informed that in order to successfully complete their project required final acceptance by both the client as well as the instructor. The final product consisted of a working system, implemented and fully documented, and included a training session for the users. A lower grade would not be given simply because the students had reached the end of the semester and weren't quite finished. No grade would be given until the project was completed. As is discussed in the following "lessons-learned" section, one team discovered this firsthand.

Milestones were established throughout the semester to avoid the potential of procrastination. Within just a few days after the semester had begun the students were required to make contact with their client and schedule an initial meeting that the instructor also attended. Generally within a week after the initial meeting, the team was required to complete a preliminary project understanding document, outlining the user requirements and their suggested approach to creating the system. The subsequent sequence of milestones included a preliminary analysis documenting the current system, entity-relationship diagrams and use cases or data flow diagrams, preliminary screen and report designs, physical database specifications, working prototypes of screens and reports, the completed system, documentation, training, and implementation. The milestone approach helped alleviate the potential for procrastination, but, for the most part, the students were highly motivated to complete these projects.

Regular meetings with the client were held in order to

present the prototypes and receive feedback. The projects were to be completed the week *before* the semester ended for two reasons: first, to allow for a little extra time if necessary, and second, more importantly, if the client had any changes that needed to be made early in the use of the system the students would be able to incorporate them.

4. LESSONS LEARNED

The primary goal of the students was the successful completion of the project. Project success has been defined many times in the literature as a project that is completed on schedule, within budget, and which meets user expectations. Bubshait and Farooq (1999) suggest that a fourth dimension, often overlooked, is the people factor. Factors contributing to successful project completion include user satisfaction and involvement, coordination, communication, cross-functional teams, team size, experienced project managers, and project scope (Tanniru and Agarwal, 2002). Achieving success on a real-world student project requires much the same focus on these factors as does a project undertaken by an information systems professional. User satisfaction was a predefined requirement, and the involvement of users in the design and implementation of the projects was essential. Coordination and communication were paramount among the team members and between the team and the client, as well as the instructor. Team size was a slightly less important factor, although it was necessary to restrict the number of students in each team to no more than five to aid in the coordination of schedules. An experienced project manager, or program manager in this case, was also a key to the successful completion of the projects. This role was played by the instructor, and requires a significant level of effort to ensure the final systems are operational and that expectations are managed. Lastly, as these projects had a fixed due date, the scope of the project had to be addressed early and managed throughout the semester.

Building on these success factors, the following is a culmination of lessons learned not only by the students, but also the instructor. The first and foremost lesson learned by the students was with regard to communication – communicating with teammates, communicating with the client, and communicating with the instructor. Lessons learned in the area of project management, and lessons learned by the instructor are also discussed.

4.1 Communicating with Team Members

Issues relating to team dynamics arose in a few groups. Many of these issues came about through an inability to effectively foster communication among the team members. The two most severe and prevalent issues were with respect to first, a freeloading team member, and second, to handling differences of opinion.

There were instances in which a team member, for various reasons, failed to contribute much, if any, to the project. This is a fairly common problem with group projects in an academic environment, and occasionally in an business setting. The course syllabus clearly specified a process which would be followed in these situations, the final resolution being the instructor's option of reducing that one team member's grade accordingly or totally removing them from the project, resulting in no grade being received for the project. Robbins and Finley (2001) agree when they refer to this type of team member as the "brat". In the unfortunate situation where a team has a "brat", the team can only be rescued through effective leadership, creating pressure to perform and achieve a specific outcome, and making the team feel that their work is important. If this individual's attitude cannot be adjusted, they must be replaced (Robbins and Finley, 2001).

A different issue arose when two strong and outspoken personalities ended up on the same team. Referring to Bubshait's and Farooq's (1999) five stages in the team development cycle, it is evident that this particular group remained primarily in the "storming" stage where "members challenge the views of others and express their own, finding areas of disagreement … [causing] both the motivation and effectiveness of the team to fail" (34). It became difficult for this group to reach consensus on various design issues, and as a result this team did not complete their project by the end of the semester. The project they were working on was not overly difficult, the support provided by the client was adequate; the ultimate problem was the inability to work *as a team*. Neubert (1999) suggests that this is not uncommon, in that "teams with one or two informal leaders may encounter performance problems related to restricting information exchange" (638). This was the only project that was not completed by the end of the semester. It was finally completed almost two months after the semester was finished – with the team's project grade adjusted accordingly. Suggestions on dealing with this situation include using various group decision and consensus building techniques. A more formal process of submitting suggestions and allowing the group to vote on the outcome, with all members agreeing to support the final decision, can be extremely useful.

4.2 Communicating with the Client

Communication with the client was also a new concept to the students that had to be learned rather quickly. For the most part, the clients were very open and receptive to the students. Obviously they were benefiting from the projects in the form of a "free", custom-developed system, and were motivated to help. The clients, as a

whole, provided a spectrum of examples of what the students will encounter when they begin their careers. Class discussions were held during which the teams reported on the status of their project and related several good examples of what to expect from a client.

Several of these clients could be referred to with the following descriptors. *The Talker* – once this person got going, it was very difficult to get him to stop. Not only did he talk about the system requirements, but also anything else that might come up. The students quickly realized that they needed to plan on at least a two-hour meeting out of which they might get 20 minutes of useful, project-related information. One suggestion to work with this type of client is to establish an agenda and a set of objectives that must be accomplished during each interview. You can't be rude to the client, but it is important to pull them back on topic. *The Over-Accommodator* – this client did not provide any real clear direction, but rather was happy with anything the team suggested or produced. This can lead to disagreement among team members with respect to requirements, and the client being provided with a system that does not really meet their needs. In this case, however, the client was pleased with the final result. A suggestion in working with this type of client is to have the client actively participate in developing prototypes of screens and reports, and asking specific questions as to what they would change or what they are missing in their current system. *The Undecided Argumentative* – this was actually a small group of client representatives that constantly bickered about what was or was not important and what did or did not need to be in the system. Each meeting with the client resulted in changes, often reversals of decisions made at a previous meeting, and the subsequent immense frustration on the part of the project team. This particular project was never completely implemented, but the students did do a remarkable job developing the system and received a grade for the course. When working with clients who find themselves embroiled in this situation, one solution is simply to walk away until the client is ready to work out the differences and gain a consensus as to their needs and requirements apart from the analyst. This can, of course, cause a problem when the system is a class project that must be completed by the end of the semester. A final client type was *the Add-On* – this client, while very pleased with each iteration of the system, continued to find something else that just "had to be there". Eventually the team realized they had to control this scope creep or they would never get finished, and encouraged the client to focus on prioritizing the system requirements. The potential for additional work after the initial project can be fostered by the project team or the instructor.

4.3 Communicating with the Instructor

Communication with the instructor was also paramount. Each team was required to meet with the instructor at least once each week to provide feedback and resolve issues. The instructor reviewed their progress on a regular basis and always before the team met with the client. The instructor assumed the role of program manager, overseeing all projects, and also provided technical expertise. Often, near the last two or three weeks before the project deadline, the teams would have a series of technical questions as they completed the "easy stuff' and were left with a few aspects they needed additional help with. One team adopted the philosophy that they shouldn't "bother" the instructor and tried to resolve difficult technical issues on their own. As a result, they had great difficultly completing the project on time. What they learned too late was that making full use of all resources – technical and otherwise – is much more important than trying to make it on your own. There is no excuse for not communicating, regularly and liberally. It is also imperative that the instructor be available beyond normal office hours.

4.4 Project Management Lessons Learned

As stated above, a successful project requires careful attention to the schedule, the budget, the quality, and the people. Project management lessons learned related to these four factors were very beneficial to the students. The people factor has already been addressed in the previous sections, primarily as it relates to communication. The budget was not so much a factor to be controlled, but simply acknowledged, in that the clients were not actually paying for the completed system.

However, the budget is closely related to the schedule, which did have to be controlled. The students had to adequately manage the schedule and time demands. They were required to work out their schedule as to when they could meet and collaborate, and what aspects of the project could be divided and worked on individually. The students were also required to keep a time sheet, noting how many hours they spent on which tasks. Some of the groups were required to provide an initial estimate of time required to complete the project, and compare the actuals to this baseline. While a few groups reported small variances, other groups discovered rather large variances. A class discussion was held regarding the danger of initially estimating either too high or too low. Having actually experienced this, the students could appreciate the concept more fully.

Lastly, quality was to be maintained throughout the project. The instructor examined every aspect of each system and also acted as an independent tester. The final requirement before a grade was assigned was that

the client was fully satisfied. This required an extensive walkthrough with the client when the system was implemented, which the instructor attended. As the students had a personal, vested interest in the outcome of the projects, they were, for the most part, highly motivated to provide a product of the highest quality possible.

Configuration management was also extremely important. Most teams adopted the approach of each member having a working copy of the system to make their changes, and then re-incorporating the changes the next time they met as a group. On a few occasions, the re-incorporation process resulted in changes being overwritten by a previous version. Day and time stamps became very useful tools. Relegating the responsibility for configuration management to one team member generally worked best.

4.5 Instructor Lessons Learned

The instructor, also, learned a few lessons and confirmed previous presumptions. The first is that you can't manage what you don't understand. The instructor has to be involved with the projects to the extent that he or she understands the client's needs as well if not better than the students. Furthermore, the instructor needs to have the technical expertise to help the students resolve difficult technical issues. Furthermore, don't attempt to handle more than five or six projects per semester. The workload and trying to remember the requirements of a diverse group of clients will become quite difficult. Lastly, it is a good idea to allow the students class time to meet, and preferably *in the classroom*. This provides the instructor with the benefit of seeing how the team members are relating to each other, how they are approaching the project, and what progress is being made. Being accessible to the students is also very important, particularly towards the end of the project.

Identifying appropriate projects can occasionally prove to be a challenge. Personal contacts often work best, either through the instructor or a colleague, or through the students. Many potential projects can be identified simply by making small business owners aware of the availability of local university students who need to develop systems at little to no cost to the business. Additional opportunities can be discovered by making use of Small Business Development Centers, Business Research Programs, and the local Chamber of Commerce (de los Santos and Jensen, 2001; Clark and Kaminski, 1986). Once the program becomes known, what can often happen is that there are too many projects to work on during a given semester. The instructor then has to develop a set of criteria to use in evaluating each potential project.

5. CONCLUSION

There is often a great deal of apprehension on the part of a student who, having just graduated, is embarking on a new career but is unsure of what to expect of the real-world and whether they are even ready. A course such as this, with the opportunity to participate in a systems development project from the initiation through implementation, and working with real clients who need and will use the new system, is an excellent way to prepare the student and increase their confidence. Feedback from employers indicates that these students are much better prepared than their counterparts at other universities who do not have this opportunity. Feedback from the students indicates that this is one the most useful and interesting courses, albeit challenging, that they take. While requiring an additional level of "teaching" for the instructor, this approach also offers a useful opportunity to build and strengthen relationships with the business community. Book learning is necessary and useful; providing real-world experiences within an academic setting can be invaluable.

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AUTHOR BIOGRAPHY

Terry L. Fox, PhD, CPA is an assistant professor of Information Systems at Baylor University. He has several years of industry consulting experience, and has published a number of articles appearing in journals such as Information & Management, Journal of Computer Information Systems, Project Management Journal, Review of Business Information Systems and the Journal of Accountancy. His research interests include cognitive style and information systems use, and project management.

Figure 1 – Representative Screen Sample

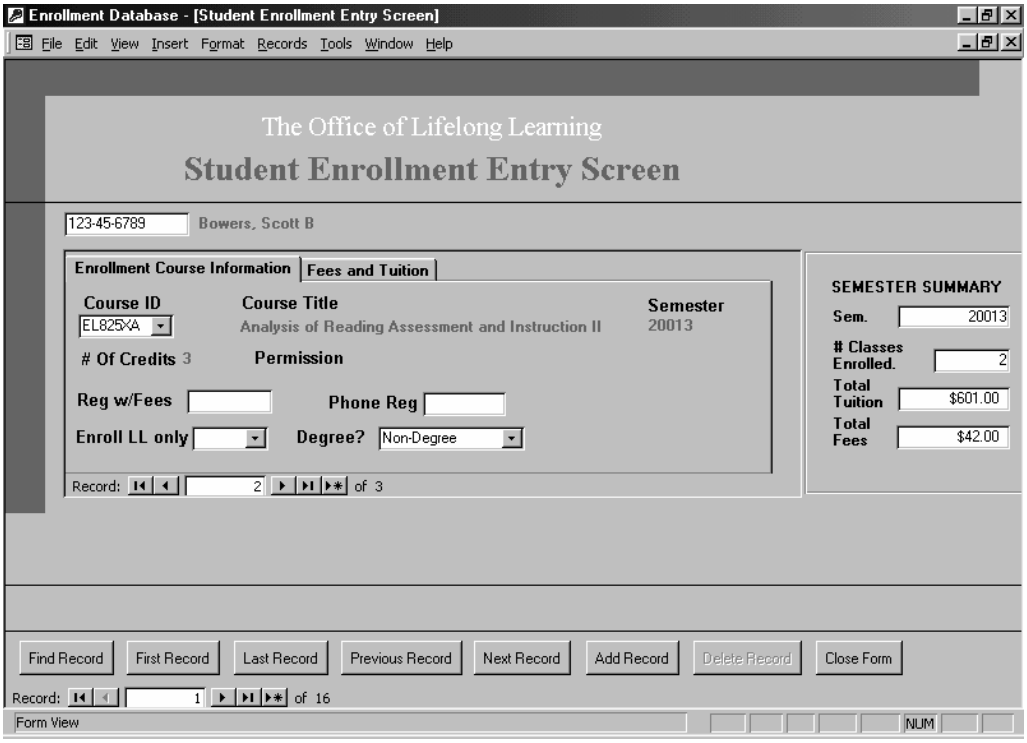

Table 1 – Summary of Student Projects

Project Title	Description of System Features	Comments
County Attorney's Office – Juvenile Offender Intervention Program	• maintain information on juvenile offenders nature of crime, court appearances, sentences and restitution • manage required legal documents - complaint, summons, subpoenas, victim advocate notices	• required several meetings with user to understand the legal processes involved and to ensure that reports contained the proper legal wording
Family Pregnancy Center	• track each client, noting when and what type of services were provided • manage volunteers schedule and hours • manage donor information: names, dates, items donated, thank you letters • generated several management reports	• non-profit organization did not have the funds for an automated system, but did not have the time or resources to adequately track the information manually
Vending Machine Company	• track weekly sales by machine • summarize this data by client, route, driver, city, and county • calculate sales tax by city, county, and state • generate reports to assist in management and sales tax remission	• existing system was not Y2K compliant and would not be upgraded • complex data relationships presented a challenge
Safety Equipment Company	• track sales of safety equipment, primarily for hospitals and nursing homes; included fire alarms, smoke detectors, fire extinguishers, nurse call alarms • track monitoring and service contracts • develop various management reports	• existing system was obsolete and written using a package no longer supported • large number of data elements required considerable investment of time
Piano Tuning and Repair	• maintain information on over 2000 clients statewide • track information on piano type, type of service performed, humidity and temperature at site • produce reports including customer listing and invoices	• owner previously used a manual system of little black books and his memory
Elementary School – Intersession Program	• develop and print a course catalog • process enrollment data - student, course, time, location, fees • generate invoice, paying attention to family multiple-student discounts, fee options • produce class roster, individual student schedules	• previously all work was done manually by volunteers, very time consuming
Department of Athletics	• track athletes for each sport, allowing for multiple sports • maintain information on scholarships for tuition, room, board, books • generate reports and letters to facilitate communication with students, e.g., National Letter of Intent	• required understanding of and adherence to NCAA regulations • strong disagreement among users resulted in a system that did not meet user expectations
Department of Lifelong Learning	• maintain information on courses, students, faculty, and facilities • support student enrollment and fee calculation • generate various reports for course management	• complex relationships among the data elements proved challenging • geographical location was convenient

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