A Course Model for Information Technology project management instruction based on the Project Management Institute's body of knowledge.

Jeffrey L. Brewer
Computer Information Systems and Technology, Purdue University
West Lafayette, IN 47907-1421, USA

Abstract

This paper describes our capstone course for Managing Information Technology (IT) projects. All students regardless of technology track, systems analysis and design, database, telecommunications and network design, and software development take the course in their 7th or 8th semester. The course model is based on the project management body of knowledge created by the Project Management Institute (PMI, 2000). The course also follows very closely the guidelines presented in the IS'97 curriculum document (ACM, 97). This paper describes the dire need for skilled IT project managers, a brief explanation of what a project is, our curriculum and where this course fits into it, an outline of the course content and sequence of topics presented in a 15 week semester, and future directions for the course.

Keywords: Project Management, PMI Body of Knowledge, Triple Constraint, Knowledge Areas, Project Life Cycle

1. INTRODUCTION

Project Management (PM) for all organizations continues to grow in importance each year. PM has been around for many years in all disciplines but for many reasons has only recently gained a strategic role in the Information Technology (IT) sector. I like to compare the recent surge in importance to that of the systems analyst. During the 1960's and 1970's, the computing industry had position titles such as: programmers, operators, and managers. As time progressed, organizations discovered the need for someone who could talk to the users, understand their language and then talk to the technical staff and convert the business speak into technical specifications. Schools and organizations across the globe began to understand that this required a different individual with different skills. The idea that we could create a systems analyst by simply promoting the best programmers didn't work. We needed to create a separate curriculum track and build systems analysts. We are now in a similar situation with project managers. We can't just assume that a good systems analyst will make a good project manager, especially without specialized training.

IT is relatively new as a discipline and relatively new to adopting the concept that project managers need special training and that it is a unique, important, strategic role in the organization. In a study by the (Standish Group, 1995), "a huge portion of the more than $250 billion spent annually on IT application development is wasted because companies fail to utilize effective project management practices." The study goes on to mention the following discouraging statistics:

- 31 percent of all projects are canceled before completion
- Success rate for IT projects is at 16.2 percent
- 88 percent of projects run over schedule, over budget or both, costing $59 billion
- Cost of failed projects, $81 billion
- For every 100 projects started, 94 restarts occur
- Average cost overrun per project is 189 percent of original estimates
- Average time overrun per project is 222 percent of original estimates.

In a follow-up study done by the (Standish Group, 2001) several key measures improved:

- Cost of failed projects down to $75 billion
- Cost overruns down to $22 billion
- Success rate for IT projects up to 28%
- Average time overrun per project is 63 percent of original estimates.
- Average cost overrun per project is 45 percent of original estimates
- Meeting required features and functions estimated at 67%

The authors concluded that better project management was one of the key factors responsible for many of the significant improvements.

When you look at how these distressing statistics were improved and read about some of the tremendous project disasters (Bailey, 1996; Gibbs, 1994; Lucas, 1995), it becomes apparent that we need to start creating better project managers. This information led us to create a senior level introductory course in IT project management. The model we chose to follow is defined in the body of knowledge created by the Project Management Institute (PMI, 2000). This paper will present a background and definition of project management: review our course model, learning outcomes, and future directions.

2. IT PROJECT MANAGEMENT

Project management is "the application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements" (PMI, 2000). Kerzner (2001) defines project management as "the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives."

To better understand project management one must first understand the definition of a project. A project exerts the following characteristics (Schwalbe, 2002):

- A project has a unique purpose. Each project should have a well-defined set of objectives that once met constitute the end of the project.
- A project is temporary. Projects must have a definitive begin date and end date.
- A project requires resources. In order to meet required objectives, projects require resources, which can be either people (inside or outside the organization and across departments) or other objects (hardware, building space, utilities, etc.)
- A project should have a primary sponsor or customer. An individual or department must be the primary source of need to instigate a project. They can become the focal point for funding and key requirements.
- A project involves uncertainty. Due to the nature of a project - unique purpose, never been done before - projects present risk to an organization.

All projects are constrained by four goals or project requirements: scope, time, cost, and quality. All four constraints must be addressed to have a successful project. The goal of project management is to meet stated objectives while keeping these four constraints in balance. When a project begins, hopefully, and this is a big hopefully, the scope of the project is well defined, the time frame for delivery of each objective is set and communicated, the cost to deliver the objectives in the stated time frame with stated scope is established and all of this must operate within set quality standards, see Figure 1.

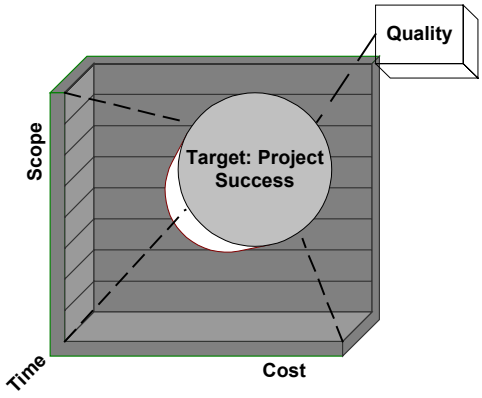

Figure 1. **Triple Constraint Balancing Act**

As Figure 1 illustrates, if one constraint is changed then all other constraints must be changed to hit the target of project success. If for example, a project manager is told he/she must deliver the project sooner reducing the time constraint, one of the other constraints must also change. The target circle will shift if only one constraint is changed and this must be communicated to all stakeholders. To keep the target circle in place, one or more of the other constraints must change. Some examples of what must change are: costs can be increased to allow more resources to work on the project, quality can be reduced meaning less testing, the scope can be reduced to shorten the amount of work. We spend a lot of time in class examining this diagram because too many times in the past, we as project managers didn't understand this balancing act and when management came to us with changes we didn't know how to respond in order to insure the project's success.

3. REVIEW OF CURRENT CURRICULUM

Our curriculum is divided into four separate tracks, software development, systems integration, database management, and telecommunications and networking technology. The students are required to declare an emphasis area by the end of their 4th semester. With the exception of one class in our networking track, all students regardless of emphasis take the same core set of classes during their first four semesters. The students are allowed to move from one track to another but are required to take all required courses in the new track. In the next several paragraphs are the track descriptions excerpts taken from our web site.

In the Software Development track, students learn how to apply contemporary technologies and techniques to develop and maintain small, medium, and large application software. The computing courses focus on using programming languages to construct these software applications for a variety of hardware and

software platforms and networks (including the Internet and intranets). Courses in interpersonal communications, business, and liberal arts are also required. Students work individually and in teams using state-of-the-art computing laboratories to complete assignments.

In the Systems Integration track, students learn how to develop and integrate unique information systems solutions such as e-business, enterprise applications, and all types of information systems into a business. Emphasis is placed on systems thinking and problem solving. Technical courses emphasize systems analysis, systems design, IT hardware and software procurement, outsourcing, prototyping, application development, systems integration, and systems implementation. To complement the computing courses, courses in interpersonal communications, liberal arts, and either business or manufacturing are required. Students work in state-of-the-art computing laboratories to complete their assignments.

In the Telecommunications and Networking Technology track, students learn how to design, construct, troubleshoot, and manage sophisticated voice, video, and data networks. This unique curriculum emphasizes data, image, and voice communications using telecommunications technology. The networking courses focus on subjects such as digital communications, local and wide area network design, wireless networks, system administration, network security, and network planning and management. The ability of graduates to communicate with application and database professionals is enhanced with courses in application development, database design and administration, and systems analysis. To complement the computing and telecommunications courses, courses in interpersonal communications, business, economics, liberal arts, and electrical engineering technology are required.

In the Database Management track, students learn how to analyze, design, construct, and implement sophisticated database and data warehousing systems for business transaction processing and operations, management information, and decision support. The technology courses focus on subjects such as database analysis and design, data and database management, database programming and database administration. To complement the technology courses, courses in interpersonal communications, liberal arts, and business are required.

Team-based instruction techniques are used in each track to enhance the student learning experience. The students are introduced to project management in their 4th semester but the topic is given one lecture period at most. The students learn how to enter a few simple tasks into a software project management package and produce a Gantt chart. This is not an adequate introduction into the field of project management. The class described in this paper was recently added to all 4 tracks to be taken in the student's 7th or 8th semester as a required capstone course.

4. COURSE BACKGROUND

This course, Managing IT Projects, introduces the application of knowledge, skills, tools, and techniques that project managers use to plan, staff, estimate, and manage information technology projects. Special emphasis is placed on learning and applying the concepts of managing scope, risk, budget, time, expectations, quality, people, communications, procurement, and externally provided services. Students will apply project management technology and techniques to business problems. A key goal is to introduce the students to a new set of terminology and help them understand how the project life cycle works to manage IT projects.

The course is taught during a student's 7th or 8th semester so that the student has obtained: a better understanding of related subject matter, experience working on class projects and hopefully industry projects during internships, and an advanced knowledge of their chosen technical track. This also follows the guidelines established in the IS'97 curriculum (ACM) document supported by the ACM, AIS, and AITP organizations. In the IS'97 document, project management is positioned after students have completed their course work in IS'97.7 Analysis and Logical Design, IS'97.8 Physical Design and Implementation with DBMS and IS'97.9 Physical Design and Implementation with a programming environment.

Project leaders need a variety of skills to be successful. To get the most from this class, we felt it important that they had already obtained a background in communications (both written and oral), human resource management, team participation and team building, basic accounting and finance. When these items are referenced in class, the instructor can concentrate on how these areas affect project management and best practices of each. The students can participate more in class by sharing their experiences of working on previous projects. When we discuss best practices and major errors to avoid, we can use the actual experiences of the students to make the point and make it more understandable for them.

The idea that project managers need an in-depth technical background to manage a technical project has been argued on both sides. I have found, from my 20 years of industry experience as a project manager that it depends more on the individual and the type of project, than on some hard and fast rule. The one principle that is consistent across all schools of thought is that the project manager must learn to delegate. They cannot be the chief programmer, chief network analyst, or chief

database designer and still run the project. Current literature is filled with examples of failed projects due to the project manager getting so wrapped up in the specific technical challenges that all of the tasks of project management were forgotten and consequently the project suffered. Schwalbe (2001) tells the story of a project that was behind schedule due to a new set of technologies not working. The project manager who was recently promoted into the role from a highly technical position decided that the job wouldn't get done unless he stepped in and resolved the crisis. He was ultimately successful in fixing the technical problem but the rest of the project suffered greatly. The key stakeholders were upset because all communication about the project had stopped. The project manager had no time to devote to communication. The project succeeded technically but was perceived as a failure.

Yourdon (2002) makes the point that project managers need some technical expertise, especially in today's internet development environment, the manager must be able to evaluate the hardware/software environment alternatives presented to him or her from the technology folks in order to make or present the information to those who will make the purchasing decisions. He or she must be able to balance the "excessive optimism" of the technologist with reality of what is the best way to spend the company's resources.

Course Outline

The project management course is 3 credit hours, consisting of two one hour and fifteen minute lectures and a fifty-minute lab. The lab uses business case studies to aid in the instruction of using a project management software package. The background of the case study is presented and each week sections are added to the case study and assignments given to reinforce that week's concepts in the sequence required to follow the project life cycle described in the next section of this paper.

The project life cycle consists of the following phases: initiation, planning, executing, controlling, and closing (PMI, 2000). How these phases interact in an iterative/incremental methodology is illustrated in Figure 2. The course reviews several different methodologies; waterfall, spiral, etc., but spends most of the semester talking about an incremental approach. Using an incremental approach, the system is delivered in small/short increments with each successive iteration delivering more of the requested functionality and the incorporation of changes. The review of methodologies is outside the scope of this paper but for more information on this approach to delivering systems see Scott Ambler's web site at www.agilemodeling.com or Martin Fowler's at www.martinfowler.com.

In figure 2, after the project initiation activities occur, the planning, executing, and control phases transpire for each iteration/increment of the system. Each iteration/increment also contains a closeout process. After release N of the system, all requirements that are going to be delivered from this defined project have been delivered, a final project closeout process occurs.

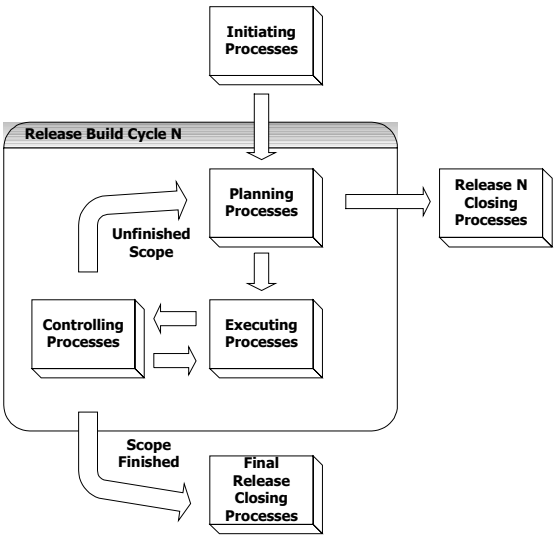

Figure 2. Project Lifecycle

We try to stress during the class that project management is a career choice with a separate set of skills necessary to be successful. Many of the skills are shared with other disciplines: general management, systems analysis, and quality assurance to name a few. But it is our contention along with others that the combination of all the skills listed below makes a project manager a unique animal. The skills are grouped under these headings: Personal, Technical, Management, and Coping (Murch, 2001).

Personal

- Manage by example; honest, direct, straightforward, and knowledgeable
- A positive attitude especially when faced with adversity
- Ability to communicate expectations to team members
- Considerate and respectful

Technical

- Varies widely with the type of organization and project but a basic level of technical knowledge can't hurt
- For very large projects, impossible for the project manager to understand all aspects of the technologies involved
- Some schools of thought suggest that the project manager not be technical for fear they will get too involved in the technology and not in the management of the project

Management

- Recruiting the right people and matching them to the right task
- Project planning, initiation, and organization
- Mastery of software project management support tools
- Communication of complicated information, dynamic presentations
- Effective problem management
- Managing change
- Managing risk
- Understand the organization and the business
- Ability to delegate

Coping

- Flexible
- Persistent and firm when necessary
- Creative
- Patience
- Stress management

Table 1 is an outline of the topics covered in lecture and lab. The sequence of topics differs somewhat from the course text in that we followed the project life cycle and not the nine knowledge areas as defined by PMI (2000). The topics are studied, as they would unfold during the project beginning with project initiation and ending with project closeout. The text, like most I found, was structured around what PMI calls knowledge areas. The knowledge areas are broken up into three categories: Core functions, Facilitating functions and Integration. The four core functions are: Scope, Time, Cost, and Quality Management. The four facilitating functions are: Human Resources, Communication, Risk, and Procurement Management. Project Integration Management is the ninth knowledge area that ties it all together. Each chapter covered a knowledge area, for example Scope Management, from initiation through to closeout. I found this a difficult way to teach the students about the project life cycle and have the lecture material follow the case study.

Table 1. Course Schedule

Week	Lecture 1	Lecture 2	Lab
1	Introduction, review syllabus	PM Definition and History	None
2	Profile of a Project Manager	PM Context & Processes (Lifecycle)	None
3	Context & Processes Continued	Project Selection	Intro to Microsoft Project 2000
4	Project Initiation	Plan development, building the WBS	Introduce Case Study; begin WBS
5	Time Management Planning, Activity definition & sequencing	Duration Estimating	Continue working on WBS add durations
6	Schedule Development	Exam 1	None
7	Cost Management & Resource Planning	Cost Management & Resource Planning Continued	Add resources to the WBS
8	Quality Planning	Organizational Planning	Add cost, resource leveling and set baseline
9	Communications Planning Risk Management	Risk Management continued	Use software to aid in communications
10	Procurement Planning	Quality Assurance, Team Development	Fine tuning the project
11	Information Distribution, Contract Management	Exam 2	None
12	Change Control and Scope verification	Schedule Control	Using Software to aid in keeping project on track
13	Cost Control	Quality Control, Risk Monitoring	Project Reporting – Earned Value
14	Project Closeout; Iteration, final and contract	Individual Research Presentations	
15	Presentations	Presentations	

5. FUTURE DIRECTIONS

We currently have no plans to introduce live projects into this class for many reasons. Mainly we want the students to learn to be project managers not project team participants, programmers, or systems analysts. What we have discussed is setting up an environment in which a member of this class becomes the project leader for another class that is doing live or case study based projects. For example, a member of the project management class would be assigned a team from one of our advanced software development classes. They would participate on the team as purely a project manager. The rest of the team would be made up of students who are taking the software development class.

This model has several benefits: the software development class team can concentrate on building their technical skills and the project managers can then concentrate on building skills directly related to running a project. We can also better demonstrate a real-world scenario in which project teams are made up of individuals with many different backgrounds and skill sets.

We have recently added a graduate program that contains an emphasis in IT Management of which project management is a key component. This course is being used as an entry-level course for those who choose this option. Our graduate courses can then explore, at a much finer level of detail, specific knowledge areas knowing that the students have the basics.

The project management body of knowledge presented by PMI and others needs to be expanded to include virtual teams in multiple countries and cities (Jones, 1999). We are planning to expand the format of the class to facilitate distance learning. We recently received a grant to enhance one of our labs to include cameras, plasma flat-panel monitors, microphones, and other equipment to allow us to offer our courses via distance learning. The students will get the opportunity to experience virtual team management and some of the unique problems this environment creates.

6. CONCLUSION

It has become apparent that the industry is in need of qualified project managers. During recent campus career fairs, we asked many of the attendees what programs or special training they were using to build project managers. Many responded that they had developed their own mini-training camps because students didn't have the needed training coming out of school. They have recognized that project management is a separate discipline and one in which specialized training is essential to be successful.

We have added a thorough, skill-building course to our curriculum to help prepare students to start a career as a project leader.

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