Teaching a Project Management Fundamentals Course to Working Professionals

Eldon R. Larsen, Ph.D.
Marshall University, College of Information Technology and Engineering

Abstract

Project management has become very important in today’s business world. Yet, most working professionals have had to learn project management skills almost entirely by experience, with little formal college training in this field. At Marshall University, the Master of Science in Engineering degree program includes an emphasis in Engineering Management, of which Project Management is an important part. The majority of the students in this program are employed full-time as engineers in the business world. They want a course they can use right now. This paper presents a summary of the material taught and the techniques used to teach project management to these working professionals.

Introduction

Project management has become very important in today’s business world. Yet, most working professionals have had to learn project management skills almost entirely by experience, with little formal college training in this field. Businesses are increasingly recognizing the need for formal project management training and are increasingly organizing their business efforts in a project structure. The number of project management courses being offered at universities has been increasing rapidly over the last 10-15 years to help meet the need for more training.

Project Management is one of the core required graduate courses for the Master of Science in Engineering (MSE) degree at Marshall University.† Because the majority of Marshall’s MSE students are employed full-time as working professionals, they want a course they can use right now. They don’t want theories that are impractical and interesting tools that they will rarely use. They want information that is practical, useful immediately, and that has broad applicability to the project management demands of their jobs. This paper presents a summary of the material taught and the techniques used to teach project management to these working professionals.

Course Overview

Marshall’s graduate Project Management course takes a very specific pedagogical approach: It teaches a specific principle, gives multiple application examples, then requires that the students apply the principle to one or more real situations, not imaginary ones. Then, it
The Principles and Their Applications

Project management involves many important principles, concepts, tools, and techniques useful to practicing engineers. Of these, principles are the most important because they are foundational truths that do not change—they will always be true, though their applications may change according to various needs and situations. Principles are essential for a student to learn deeply.

The three most important principles and concepts of project management are (1) the importance of people, (2) the importance of setting good project objectives, and (3) the importance of good planning. In this paper we will call these the Vital Three principles. These principles and concepts are the foundation of Marshall’s graduate Project Management course. Of necessity, other important concepts, tools, and techniques are taught in the course, but these are all founded upon or are outgrowths of the Vital Three.

Vital Principle One: The Importance of People

Experienced, practicing engineers respond quickly to the concept, “People aren’t just important in project management, they are project management.”^4 Although engineers are not always known for their social abilities, they do regularly participate on or lead many project teams. They know by experience that unhappy human relationships can cause more hindrance to the success of a project than anything else. Various examples from the instructor’s experience are given to show the students how the principle applies to real life. These examples are from industrial, home, and other real-life situations. The students are encouraged to share their own experiences. The students are given an essay assignment to evaluate how they have experienced this principle in their lives, that people are project management.

The importance of people is often experienced through communication, good or poor, or the lack thereof. Communication can be effective, ineffective, or lacking, but it always affects the success of a project. Someone once said, “I know that you believe you understand what you think I said, but I am not sure you realize that what you heard is not what I meant.”^5

Although there are various dictionary definitions in of the word communication, most of these do not fully capture its Latin root meaning. The fundamental meaning^6 of the word is:

“Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition
Copyright © 2004, American Society for Engineering Education”
Communication = The process of becoming “like one” or “as one.”

Communication is not just sharing or transmitting information. By the root-word definition above, communication almost always must be at least two-way and often needs to be very interactive and iterative.

After learning this true understanding of what communication really means, our working professionals latch onto it almost immediately. It is a paradigm shift. They can immediately begin using it in their workplace and their lives. It changes the whole picture or vision of what they are trying to accomplish. With this new vision, they are now ready to realize that their very motivation in communication must change. Communication involves other people from a whole new perspective, not just our own perspective, and for a whole new purpose. How will we start communication anew with this new paradigm?

Various examples from the instructor’s experience in communication are given to show the students how the principle applies to real life. These examples are from industrial, home, and other real-life situations. The students are encouraged to share their own communications experiences. Then they are given an essay assignment to help them see how this principle applies in their lives.

One very important, prominent application of Vital Principle One, and the associated concept of communication, occurs when we have a meeting as a team or one-on-one. Good meeting management is a tool toward achieving effective communication and toward applying the principle that “People are project management.” Good meeting management greatly facilitates successful project management. The students and instructor interactively discuss what makes a good meeting versus a bad meeting. The students are given two essay assignments to help them evaluate how they have experienced good and bad meeting management and what specifically they should do to make positive changes in their future meetings.

Example Assignments for Vital Principle One: The Importance of People

Following are several example assignments to help the students to apply Vital Principle One—The importance of people.

Assignment 1: Write an essay on the principle that “People are Project Management.” Tell what this principle means to you; tell how important is this principle from your experience; and, most important, tell very specifically how you can personally better apply this principle in the future in your own life, whether at home, at work, in the community, at church, or other—give at least two specific examples of what you will do.

Assignment 2: Write an essay on the principle that “Communication means the process of becoming like one or as one.” Tell what this principle means to you; tell how important is this principle from your experience; and, most important, tell very specifically how you can personally better apply this principle in the future in your own life, whether at home, at work, at church, or other—give at least two specific examples of what you will do.
Assignment 3: Tell about a single “good” meeting you have attended. Tell what made it a good meeting. Give at least three specific examples of how you can apply these observations in future meetings in which you might be involved.

Assignment 4: Tell about a single “bad” meeting you have attended. In the role you had at the meeting, tell specifically, with at least three specific examples, what you personally could have done to change it into a good or much better meeting—Please don’t say you couldn’t have done anything.

Vital Principle Two: The Importance of Setting Good Objectives

Effective project objectives are vital for successful project management. They tell us what we want the end result of a project to be. Surprisingly, most project management texts go little beyond acknowledging the importance of good objectives. The “How to” is either missing or given very brief discussion. Yet, clear, specific, effective objectives give us the best picture of a project’s desired destination. One very helpful tool for developing effective project objectives is the acronym SMART, described in Figure 1. It is based on a seminar by Larry Smith, but the author has expanded the definitions for clarification. Project objectives need to be specific, measurable, agreed-upon, realistic, and time-oriented.

<table>
<thead>
<tr>
<th>Specific:</th>
<th>Targeted, focused, clear, concrete, understandable, documented, not abstract, not general, not overly complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurable:</td>
<td>You can tell when you’ve reached it; targets are clear, tangible, verifiable, and quantified if at all possible</td>
</tr>
<tr>
<td>Agreed-Upon:</td>
<td>Everyone involved is aligned; owner, senior management, project leader, project team, and other key people have approved and committed, preferably in writing</td>
</tr>
<tr>
<td>Realistic:</td>
<td>Challenging, but attainable; not impossible to achieve nor viewed that way; consistent with resource and time constraints; not too rigid to accommodate changing priorities</td>
</tr>
<tr>
<td>Time-Oriented:</td>
<td>Clear time frame for project completion</td>
</tr>
</tbody>
</table>

Figure 1. Objectives Should Be SMART

Another important concept and tool is that of the triple constraints, illustrated in Figure 2. A constraint is something that imposes a limit or boundary. In project management, we normally speak of three major constraint criteria: *time*, *resources*, and *performance* criteria. Each of the triple constraints is thoroughly discussed interactively with the students to ensure a clear understanding of what the triple constraints entail and how they are used in project management. We also discuss how the triple constraints are not totally independent of each other and the resulting consequences of this interdependence.

There is often a general understanding of the triple constraints by many project managers, but one of the most important uses of the triple constraints is often either unrealized or neglected:

“Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition
Copyright © 2004, American Society for Engineering Education”
the concept of the triple constraints being the project drivers. By drivers we mean: Which one of the triple constraints (time, resources, or performance) is most important, i.e., the primary driver; which one is least important, i.e., the weak driver; and which one is in the middle, i.e., the middle driver? Do we really need to care about this? Aren’t time, resources, and performance each important? Do we really have any choice? The answer to all of these questions is, “Yes.”

![Figure 2. The Triple Constraints](image)

The crucial question to understand when discussing the driver importance is: “Why do we care?” We care because at some point in the project we are going to have to make important decisions with respect to the project, and the correct decisions are going to depend on the driver priority or importance relationship. All three of the triple constraints are important for all projects, but they are not all three equally important in any project! The trick is to determine which constraint is most important, which least important, and which is in the middle for the particular project concerned. These concepts are discussed at length with the students, the instructor and students sharing actual experiences to show their importance. Then, the students are given an assignment in which they need to determine and justify the drivers on a real project.

Another important concept we teach the students is that of project tolerances. This is best illustrated by the tolerance diagrams shown in Figures 3 and 4.

Let’s look at an example. Suppose our only family car has broken down and this time it really is just not worth it to get the car fixed—we need to purchase a replacement. We have certain limitations or constraints, one of which is the money to purchase a car. It would of course be nice to have a new red Ferrari, but the cost is out of the question—it would cause failure in our credit rating within a couple of months. What we need is a car that will reliably start and will get us to work each day—this we must have. After some financial figuring and some emotional stretching, we decide that we would like to spend less than $5,000 on the car—this is our ideal target, a cost less than $5,000. We also decide that if we really can’t find a car for a cost less
than $5,000 that meets some minimum reliability standard (reliability is a performance constraint), we would be willing to go as high as $7,000, but absolutely no higher. Our acceptable compromise for the money constraint is therefore a cost that is between $5,000 and $7,000. Failure is to have a cost greater than $7,000.

Figure 3. A Simple Tolerance Diagram

Figure 4. Two-Sided Tolerance Diagram
Figure 3 is a one-sided Tolerance Diagram, meaning that going from best to worst is one-directional. Rather than the simple one-sided Tolerance Diagram, some project specifications require a two-sided Tolerance Diagram, as illustrated in Figure 4. In this case the ideal target is a range in the middle of a project specification or constraint. On either side of this ideal target range are ranges, which are still acceptable, but not ideal, giving therefore two acceptable compromises. Going outside of these two acceptable compromise ranges causes the project to move into unacceptable ranges, which again we call failure.

Many people, whether boss or student, are hesitant to discuss project tolerances. Usually this reluctance is due to a lack of trust. Reality is that there are almost always tolerances, or we would rarely see projects run over budget or past original schedule—yet it happens all the time. But “How far can we go and still succeed?” and “What will be the consequences or penalties?” are the questions we have to face. It is best to face it early, rather than later if we want success.

This concept is usually new to the students, but after a few examples both from the instructor and from experienced class members, the light starts to go on. This is also a very good time to reinforce the true meaning of communication discussed above, because managers and team members must “become as one” if a trust is to develop to the level that the project tolerances can be honestly discussed. Again, an assignment is given to the students to help them to apply this concept to a real project.

**Example Assignments for Vital Principle Two: The Importance of Setting Good Objectives**

Assignment 5: Identify a project that you would like to do sometime in the near future. Write SMART objectives for this project.

Assignment 6: For the project in Assignment 5, as part of the project objective definition, include a discussion of the triple constraints. Identify the primary driver, the middle driver, and the weak driver, and justify why you have chosen them this way.

Assignment 7: For the project in Assignment 5, as part of the objective description, clearly describe in writing the Tolerance Zones (i.e., the “Ideal” zone, the “Acceptable Compromise” zone, and the “Failure” zone) for each aspect of the Triple Constraints. Note that one or more sides of the Triple Constraints could have several aspects which each need Tolerance Zone descriptions.

**Vital Principle Three: The Importance of Good Planning**

Planning is probably the most focused-on subject in project management training available today. This is for a good reason: it is vital. One misstep in planning might even prove disastrous, as for example when a probe sent to Mars fails to perform due to a miscommunication on measurement units in the design-stage. Even when we make small planning errors, or even when our plans really are essentially error free, “things happen” in almost every project that causes the need for continual planning and re-planning. Planning and re-planning are a way of life for project managers.
Because most of the tools and techniques for project management planning are so well known, we shall not go into them here other than to say that we teach the techniques of work breakdown structures, network diagrams, Gantt charts, project crashing, and so on. Materials for these concepts and tools are available in most project management texts. However, we do all we can to use real-world experiences as we discuss and teach these tools and techniques. Assignments are given for the student to practice these techniques and tools.

There is one tool directly related to planning that we do teach that bears mentioning. Most project managers have real struggles in the area of time management. Many of them in our interviews have indicated that they do not have enough time, especially for their families and personal life. Because this is such an important issue, we teach our students the valuable lessons in Quadrant II Management as taught by Stephen R. Covey in his book *The Seven Habits of Highly Effective People*. More information may be found in that book.

**Example Assignments for Vital Principle Three: The Importance of Good Planning**

**Assignment 8:** For at least four days, try increasing your ability to manage your life more in Quadrant II (based on the class discussion about Quadrant II Management). Be careful not to get reckless or offensive to other people—remember that the basis for the phrase “People are Project Management” applies to all aspects of your life, so be considerate of other people as you try to implement more the concept of Quadrant II Management. Then, write an essay telling about your experience using this time management technique. In the essay, give at least four specific examples of what you did to increase your use of Quadrant II Management and what was the result for each example.

**Assignment 9:** For the project in Assignment 5, make a pictorial version and a list version of a work breakdown structure (WBS) that includes at least 30 lowest-level tasks (tasks not divided) for this project. Base the WBS on the SMART objectives you wrote earlier for this project, including the description of the Triple Constraints and the Tolerances—improve the objective if you need to do so to complete this assignment.

**Assignment 10:** Construct a network diagram for each of the following two projects, given the task names, durations, and predecessors below. Identify the critical paths and give the durations for each project. For each task, calculate and show the early start, early finish, late start, late finish, and slack. (Task names, durations, and predecessors are given for each project.)

**Assignment 11:** For the following project, and using the information in the given table, identify the project duration which allows the project to be completed as early as possible while staying within the cost constraint that the project must cost no more than $50,000 or it will be considered a failure. Plot the project total cost versus time for each step in your crashing process to show that you have followed the proper crashing procedures. Show all calculations for each crashing step. (A table is given which show the normal duration and cost for each task in the project and the cost and duration of each task if that task were to be crashed.)

**Assignment 12:** For the same project as that in Assignment 11, and using the information in the table, identify the project duration which allows the project to be completed with the least
possible cost and still achieve all cost and time objectives for the project, while not compromising on the project performance standards and scope. A penalty cost of $5,000 per week over eight weeks is to be assessed if the project takes longer than eight weeks to complete. (A table is given which show the normal duration and cost for each task in the project and the cost and duration of each task if that task were to be crashed.)

Assignment 13: For the following project, construct the network diagram. Then, for each task calculate and show the early start, early finish, late start, late finish, and slack. Using the given resource assignments to the various tasks, construct a resource histogram showing the needed total resources for each week in the project. Standby time is that time a worker is assigned to the project and could be working, but there is not work for him or her to do, so he or she is idle. If a worker is no longer needed on the project, he or she must be assigned to a different project. There are ten workers initially assigned to this project and those ten workers must each be paid at a rate of $400 per week for every week he or she is assigned to the project. On the resource histogram, show the standby time and overtime periods. Calculate the total standby time cost. Calculate the total overtime cost. Overtime is to be paid at 150% of the normal weekly rate. (Task names, durations, and predecessors are given for the project.)

Assignment 14: For the project in Assignment 13, level the project work so that the total project cost is minimized. Assume that material costs and manpower cost rates are fixed. This means that you are trying to minimize the overall combination of the total standby time cost and the total overtime cost. When leveling, use the following constraints. (1) No one task may be split in its duration and resource requirements. For example, if a task takes four people three weeks to complete, those parameters cannot be changed and the three-week block must be continuous. (2) A task on the critical path cannot be moved in the schedule. (3) The sequence in any path cannot be changed; in other words, the given predecessors must be maintained.

Assignment 15: For the projects in Assignments 10 and 13, construct the Gantt chart for each project (a total of three). Show the critical path(s) task bars in a different color and pattern from those tasks not on the critical path(s).

Putting It All Together

To help our students put all of their learning together in a coherent picture and to help them internalize the principles and concepts of good project management, we give the students three final assignments. The first assignment, a project manager interview, serves the purpose of having each student hear first-hand from a practicing project manager of his or her choice. Our students feed back to us that this is a very valuable experience and that it reinforces the principles, concepts, and tools they have learned in class.

The other two assignments have to do with a final team project in which the students set objectives for and plan a real project of interest to the team members. Because of the foundation principles taught throughout the course, the students frequently tell us that they have never had a better team experience either in college or at work. The team project helps the students further to learn and apply firsthand the teamwork skills they have been learning throughout the course.
Example Assignments to Help the Students Put It All Together

Assignment 16: Interview a person who manages projects. You should not interview someone from this class—branch out and learn from other people. Ask the questions listed—the students are given a list of four questions regarding how project managers feel about their job, what they would recommend with respect to training, and what advice they feel is essential for success as a project manager. Also, devise at least five questions of your own that are important to you. Ask the person you interview please to avoid giving you any confidential information and not to give you any information that might be used in a negative way toward any specific person or specific organization. List each question and the response. If a response is not in depth, ask for more detail. Get as much out of each question as is possible while still being polite. At the end of the report, summarize your feelings about the interview and tell what you learned specifically that will be useful for your future work on projects, either as a project team leader or as a project team member.

Assignment 17: Team Project Proposal—Write a proposal for a project to be worked on by a team to which you will be assigned. The project should be an actual, real one that you would like to accomplish within the next 3-18 months. It should not be one that you have already done or that you are currently working on. It can be a project at home, work, or other. It should be a project worthy of a final team project for this course—worth up to 30% of your grade. The proposal should include a title for the project, the SMART objectives, and a brief background and introductory explanation to the project. Make seven copies of this proposal—one to give to the instructor and the rest to give to your team for discussion during the class period on the due date.

Assignment 18: Team project—This is a four-to-six member team project consisting of a real project chosen by the team from among the team members’ proposals, and approved by the instructor. The team spends the last four weeks of the semester working on defining in detail the project objectives, planning all details of the project, defining all task durations and costs, planning for and defining all contingencies, and so forth. The teams meet during class time in regular team meetings, for which they record and report the meeting minutes. The team submits a final report. The team members also grade each other’s participation and contribution toward the report. Each individual’s final score for the report is based on the project report score weighted by the average team members’ evaluation scores.

Conclusion

Because the majority of the students in the graduate Project Management course at Marshall University are working professionals, they want to be taught material that they can use right now. They want to know the value of what they are taught and how to apply it.

To meet this need the course material in the Project Management class comes from real-life experiences from instructors who have industrial experience and who are focused on what really matters: the fundamental principles which lead to success, and an understanding of how to apply these principles. Critical thinking writing exercises are used to aid the learning process.
As a result the Project Management course is one of the most attended courses in the graduate MSE program in Marshall’s College of Information Technology and Engineering. Students enroll in the class not just from this college, but many students from the College of Business and other colleges also take the class as an elective. The feedback from the classes at the end of each semester is very favorable and indicates that we are providing a valuable and immediately useable service to the students.

Bibliography


Author

ELDON LARSEN is Professor of Engineering and coordinator of the Engineering Management graduate program at Marshall University. He has undergraduate, masters, and doctoral degrees in Chemical Engineering, and extensive experience in project management principles and application. He chairs Marshall University’s Graduate Council. He is a member of ASEE, AIChE (2nd Vice Chair, Management Division—national level), ASEM, and PMI.