

Project Management Principles for Engineers: A Course Module

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Project Management Principles for Engineers: A Course Module

Abstract

Project engineers should have the appropriate technical and non-technical soft skills to produce the desired project outcomes. The Project Management Institute's Standard for Project Management in the *Project Management Body of Knowledge (PMBOK®) Guide – Seventh Edition* includes 12 principles to guide the behaviors of project practitioners toward successful project deliveries that create value. Introducing the project management principles to engineering students will enhance their career skills by guiding the behaviors in future project environments. This one-week module was created to better equip engineering students with project management competencies within an undergraduate three-credit hour project management career skills course. The module includes a lecture on the 12 guiding principles from the *PMBOK® Guide – Seventh Edition*, a case study, a homework assignment, and an exam essay question. The module can be modified for a graduate-level course.

Keywords

Project Management Principles, Project Engineers, Non-Technical Skills, Project Management.

Introduction

The purpose of this module is to improve the content of Week 14 of a 15-week PMGT 401 Project Management Career Skills course offered at The Citadel Military College, in Charleston, South Carolina. The *PMBOK® Guide – Seventh Edition* includes The Standard for Project Management which identifies the 12 project management principles that guide the behaviors of project practitioners, which includes project engineers, across all industries and varying organizational sizes ^[1]. The guiding principles encourage project stakeholders to establish behaviors that enhance non-technical skills which will aid strategic planning, decision making, and problem solving ^[1]. Engineering graduates often lack non-technical skills due to the gap between education and practice ^[2]. In the past, there has been vague guidance surrounding the non-technical competencies that engineering graduates need to create a superior performance through a competitive advantage ^[3]. The goal of this module is to compel engineering students to adopt the 12 principles of project management to complement their technical skills, and display competencies of effective human behaviors to increase employability.

Course Background

A project management career skills course is currently offered in-person in the Spring and Fall semesters in the School of Engineering at The Citadel Military College to academic Juniors and

Seniors as a three-credit hour course. The objective of the course is to strengthen employability after graduation through the application of technical project management. The course was created to focus on project integration, planning, scheduling, quality, risk, stakeholder management, and the role of leadership regarding projects. The course equips students with the knowledge and practice of technical project management through lectures, facilitated discussions, assignments, and a group project. The required text for this course is *Successful Project Management - Seventh Edition* by Jack Gido, Jim Clements, and Rose Baker published by Cengage Learning. The *PMBOK® Guide – Seventh Edition* is a supplemental text for this course.

From a non-technical perspective, the course highlights the importance of ethical behaviors throughout the course and in the Week 14 lecture entitled Project Ethics. The Project Management Institute requires that project practitioners follow the *Project Management Institute (PMI) Code of Ethics and Professional Conduct*. The code of ethics provides guidance for moral behaviors distinguishing right from wrong, and good from bad, not strategy, stewardship, and managing change in dynamic environments^[1]. The code of ethics promotes the values of responsibility, respect, fairness, and honesty which complement the principles^[1], but good morals alone are not enough to engage in sustainable and successful project practices. Therefore, developing non-technical behaviors, and project management as a non-technical soft skill in dynamic project environments is critical. Some employees view project management as a soft skill that provides the appropriate elements to effectively, profitability, and safely collaborate with stakeholders to achieve desired outcomes^[4].

The *PMBOK® Guide – Seventh Edition*'s 12 guiding principles of diligent stewardship, fostering a collaborative team environment, proactively engaging stakeholders, aligning business objectives and value, employing systems thinking, effective leadership, tailoring, building quality into processes and deliverables, navigating complexity, optimizing risk responses, embracing adaptability and resiliency, and enabling change can help project engineers shape the appropriate mindset and behaviors of mature project practitioners. These 12 project management principles were introduced by The Project Management Institute (PMI) in the 2021 publication of the *PMBOK® Guide – Seventh Edition*, therefore, it is appropriate that the course providing project management career skills educate students with the most up-to-date industry-led guidance and practices. Table 1 provides the course module topics by weeks.

Table 1. PMGT 401 Module Topics.

Module Topics by Weeks	
Module 1: Project Basics	Weeks 1-3
Module 2: Initiating a Project	Weeks 4-5
Module 3: Planning, Performing, Controlling, and Closing the Project	Weeks 6-13
Module 4: Project Management Principles	Weeks 14-15

Module Lecture

Two of the ten previously established course learning outcomes are addressed in this module. The two course learning outcomes are (a) CLO2: Evaluate the concepts related to setting goals and self-management and (b) CLO 10: Discuss the importance of ethics and professional responsibility in project management. The module lecture is a PowerPoint presentation which includes the importance of project ethics, a thought exercise, an overview of each of the 12 project management principles from *PMBOK*® *Guide* – Seventh Edition, and a conclusion that conveys the need for the guiding principles and ethics to accompany hard or technical skills. The review of project ethics is to reinforce to students the consequences organizations face when project ethics or morals are compromised. To transition from project ethics, the thought exercise prompts students to think of other behaviors that are needed to accompany ethical actions to optimize project success. The goal of the thought exercise is to evaluate the need of additional behaviors to achieve project objectives. The additional behaviors discussed in the module are the 12 guiding principles. Principles are the foundation of beliefs, actions, and practices ^{[1],[5]}. The principles are internally consistent, overlapping, does not contradict, and without a weighing order ^[1]. Slides are dedicated to each principle to explain the key points and actions to demonstrate the appropriate behaviors in given scenarios. The presentation concludes with a slide of how the project management principles shape behaviors to develop employer desired non-technical skills. Table 2 provides the Project Management Principle Labels that provides a description for each guiding principle. Figure 2 provides a sample slide from the Project Management Principles PowerPoint lecture on the stewardship guiding principle from The Standard for Project Management found in the *PMBOK*® *Guide* – Seventh Edition.

Table 2. Project Management Principles Labels ^[1].

Project Management Principle Labels	
Be a diligent, respectful, and caring steward (<i>stewardship</i>)	Create a collaborative project <i>team</i> environment.
Effectively engage with <i>stakeholders</i>	Focus on <i>value</i>
Recognize, evaluate, and respond to system interactions (<i>systems thinking</i>).	Demonstrate <i>leadership</i> behaviors
Tailor based on context (<i>tailoring</i>)	Build <i>quality</i> into processes and deliverables
Navigate <i>complexity</i>	Optimize <i>risk</i> responses
Embrace <i>adaptability and resiliency</i>	Enable <i>change</i> to achieve the envisioned future state

Figure 1. Sample PowerPoint Lecture Slide of the Stewardship Guiding Principle.



Case Study

Case studies are an effective tool for project practitioners to learn how to manage projects through evaluating project scenarios and extracting lessons learned [6]. Kombs Engineering is a case study from Dr. Harold Kerzner’s *Project Management Case Studies - Sixth Edition* [3]. This case study is recommended to be used for the class discussion for this module. The case study provides a situation when project management as a non-technical skill was as important as the technical ability within the firm.

According to the Kerzner case study, Kombs Engineering won their first two Department of Energy (DOE) contracts totaling \$250 million in 2008. Later in 2013, the time came for Kombs Engineering to compete amongst other bidders in the hopes of winning the follow-on contract from the DOE. However, there was a new requirement for bidders. The new requirement was that bidders must provide a complete description of how the project management system would function. Unfortunately, Kombs Engineering did not win the contract because the DOE did not have faith in their project management system only in their technical abilities to deliver [6].

After reading the case study individually, students will answer questions 1-3 from *Project Management Case Studies - Sixth Edition* [6] and the three supplemental questions provided in Table 3 which were created to facilitate the evaluation and discussion to encourage higher-level thinking skills that build project management competencies to sustain and enhance students’ future engineering careers.

Table 3. Supplemental Kombs Engineering Case Study Questions.

Supplemental Kombs Engineering Case Study Questions
1. Think about your career and the purpose of each of the 12 project management principles. Why technical skills alone are not enough to sustain your engineering profession?
2. Do you think the executives of Kombs Engineering regretted not investing in project management when they won the original bid in 2008?
3. Do you think your technical skills will be enough to sustain you in your career without growing in the behaviors that lead to diligent stewardship, fostering a collaborative team environment, proactively engaging stakeholders, aligning business objectives and value, employing systems thinking, effective leadership, tailoring, building quality into processes and deliverables, navigating complexity, optimizing risk responses, embracing adaptability and resiliency, and enabling change? Why or why not?

Homework Assignment

The homework assignment for this module is a three-part self-assessment to provide introspection and measuring of the principled behaviors demonstrated by the students in the course group project from Weeks 2-14. Part one of the assignment requires students to rank the project management principles they demonstrated most to the least, numbering them 1-most demonstrated to the 12-least demonstrated. Part two of the assignment requires students to create an improvement plan to improve the three least ranked project management principles from part one. A template will be provided. Part three of the assignment requires students to provide a minimum 5 paragraph reflection of their behavior during the group project comparing their behaviors to what they learned from the project management principles module. A template will be provided.

The goal of this homework assignment is for students to become aware of their behaviors and understand how their behaviors can positively or negatively affect project outcomes. This homework assignment is a learning activity will help students evaluate opportunities to learn from failure to create value and identify unexpected opportunities to create extra ordinary value starting with themselves. This learning activity supports the course and module learning. Table 4 displays the alignment between course learning outcomes (CLO), module learning outcomes (MLO), and activity learning outcomes (ALO). Table 4. Course Learning Outcomes (CLO), Module Learning Outcomes (MLO), & Activity Learning Outcomes (ALO) Alignment Table.

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Module Learning Outcomes (MLO)	Activity Learning Outcomes (ALO) with MLO Alignment
MLO 1: Identify and evaluate the 12 Project Management Principles. (CLO 2)	<p><u>ALO 1: (Remembering) Students will be able to identify the 12 Project Management Principles. (MLO 1)</u></p> <p><u>ALO 2: (Understanding) Students will be able to explain how each of the 12 Project Management Principles guides the behavior of project practitioners. (MLO 1)</u></p>
<u>MLO 2: Compare and contrast the alignment of individual behaviors to the 12 Project Management Principles to identify areas of improvement and areas of strengths. (CLO 2)</u>	ALO 4: (Evaluate) Students will be able to rate and assess their individual behaviors demonstrated as a project team member and student in this course to the behaviors communicated for each of the 12 Project Management Principles. (MLO 2)
MLO 3: To evaluate the positive and negative consequences of behavior during the 5 project phases of project. (CLO 2)	ALO 3: (Applying) Students will be able to identify how the individual behavior of project practitioners can positively or negatively affect project outcomes. (MLO 3)
MLO 4: Create an improvement plan to increase performance of effective project management behaviors. (CLO 2)	ALO 5: (Create) Students will be able to create a plan to improve their three lowest ranked behaviors (project management principles) to implement on future projects. (MLO 4)
MLO 5: Identify the four values of the PMI Code of Ethics. (CLO 10)	<i>The PMI Code of Ethics addressed in the PowerPoint presentation meets the CLO 10 and MLO 5.</i>

Exam Essay Question

The final exam 5-point essay question is the last assessment of students understanding of the project management principles discussed in module 4. Students will be provided with a study guide prompt to (a) be able to list the 12 project management principles, (b) know the behavioral impact of each, and (c) be able to explain why project management principles are essential for engineers to adopt.

Recommended final exam essay question:

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We evaluated the behaviors embedded in the 12 project management principles. Additionally, we discussed a case study that demonstrated a situation where engineering technical skills were simply not enough to meet a customer's requirements.

1. Explain why it may be essential for engineers to adopt the behaviors found in the 12 project management principles. Use a minimum of two project management principles in your explanation.

Instructors should evaluate each student's essay response based on the student's ability to synthesize the concepts of the project management principles observed in the course to successfully answer the question using high-level thinking skills.

Conclusion

The purpose of this module is to introduce the 12 principles of project management from *The Standard for Project Management* found in the *PMBOK® Guide – Seventh Edition* to enhance an existing project management career skills course for engineering students in the School of Engineering at The Citadel Military College Spring of 2024. The *PMBOK® Guide – Seventh Edition* is the first version of the PMBOK to shift from a process-based standard to a principled-based standard to guide behaviors of project practitioners to increase performance^{[1],[5]}. The goal of this course is to increase student employability after graduation through professional development and practices. Incorporating the project management principles into this course is a start to answer the call for balanced technical and non-technical skills in engineering graduates.

References

- 1 Project Management Institute. (2021). *The standard for project management and a guide to the project management body of knowledge (PMBOK Guide)* (7th ed.). Project Management Institute.
- 2 Flening, E., Asplund, F., & Edin Grimheden (2022) Measuring professional skills misalignment based on early-career engineers' perceptions of engineering expertise, *European Journal of Engineering Education*, 47(1), 117-143. <https://doi.org/10.1080/03043797.2021.1967883>
- 3 Parts, V., Teichmann, M., & Rützmann, T. (2013). Would engineers need non-technical skills or non-technical competencies for both?, *International Journal of Engineering Pedagogy (iJEP)*, 3(2), 14-19. <https://doi.org/10.3991/ijep.v3i2.2405>
- 4 Lyn, W., & Liu, J. (2021). Soft skills, hard skills: What matters most? Evidence from job postings. *Applied Energy*, 300(117550). <https://doi.org/10.1016/j.apenergy.2021.117307>
- 5 Blampied, N., Buttrick, R., Jucan, G., Piney, C., Stevens, C., Violette, D., and Wideman, R.M. (2023). In search of project management principles, *Project Management Journal*, 54(6), 588-606. <https://doi.org/10.1177/>
- 6 Kerzner, H. (2022). *Kombs Engineering. Project Management Case Studies* (6th ed). (pp. xiii, 35-36). Wiley.