

Project Management Curriculum and Resources

Volume I

GUIDELINES FOR UNDERGRADUATE PROJECT MANAGEMENT CURRICULA AND RESOURCES

15 January 2015

Volume I: The Curriculum Framework



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14 Campus Boulevard
Newtown Square, Pennsylvania 19073-3299 USA
Phone: +610-356-4600
Fax: +610-356-4647
Email: customercare@pmi.org
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A COOPERATIVE PROJECT

BY ACADEMICS, FOR ACADEMICS

The purpose of the project is to develop curricula guidelines for project management education.

The intention is to develop students' project management knowledge and skills, including teamwork, communication, leadership, critical thinking, and problem solving.

We believe that when it comes to project management education, educators should possess applied experience, a standardized set of research methods, and a uniform language of discourse.

THE TASK FORCE ON PROJECT MANAGEMENT CURRICULA

Curriculum Framework Steering Committee

Faculty Advisory Group:

Vijay Kanabar, Chair, Boston University, Boston, MA
 Vittal Anantatmula, Western Carolina University, Cullowhee, NC
 John Cable, University of Maryland, College Park, MD
 Neal Callahan, Missouri State University, Springfield, MO
 Ken Chung, University of Sydney, Sydney, Australia
 Darren Dalcher, Hertfordshire Business School, UK
 Stephen Disney, Cardiff Business School, UK
 Bill Hefley, University of Pittsburgh, Pittsburgh, PA
 Yvan Petit, Université du Québec à Montréal, Québec, Canada
 Art Thomas, Syracuse University, Syracuse, NY
 Barbara Natalie Unger, Technische Universität Berlin, Germany

Faculty Workshop Contributors:

Muhammad Abu Baker Ilyas, Gulf University for Science and Technology, Kuwait
 Chivonne Algeo, Faculty of Design, University of Technology, Sydney, Australia
 Faisal Arain, Northern Alberta Institute of Technology, Edmonton, Alberta, Canada
 Monique Aubry, Université du Québec à Montréal, Québec, Canada
 Mario Bourgault, École Polytechnique de Montréal, Québec, Canada
 John Cable, University of Maryland, College Park, MD
 Paolo Canonico, University of Napoli, Italy
 Kevin Castle, Brigham Young University-Hawaii, Laie, HI
 Darren Dalcher, University of Hertfordshire, UK
 George DeFeis, Monroe College and Pace University, New York, NY
 Randy Delorey, St. Francis Xavier University, Antigonish, Nova Scotia, Canada
 Gene Dixon, East Carolina University, Greenville, NC
 Barbara Edington, St. Francis College, Brooklyn, NY
 Panos Fitsilis, Technological Educational Institute of Larissa, Greece
 Luis Flores García, Pontificia Universidad Católica del Perú, Lima, Peru
 Vangel Fustik, University Saints Cyril and Methodius, Skopje, Macedonia
 Carl Gavin, University of Manchester, UK

Mihály Görög, Corvinus University of Budapest, Hungary
 Mario Gstrein, IIMT, University of Fribourg, Switzerland
 Lars Hallin, IHM Business School, Sweden
 Mikael N. Hjorth, Linköping University, Sweden
 Liaquat Hossain, University of Sydney, Australia
 Marshall Issen, Clarkson University, Potsdam, NY
 Valentina Ivanova, New Bulgarian University, Bulgaria
 Davinder Kaur, Metropolitan College of New York, New York, NY
 Stephen Leybourne, Boston University, Boston, MA
 Linh Luong, City University of Seattle, Seattle, WA
 Harvey Maylor, Cranfield University, UK
 Pamela McGee, Minnesota State University, Moorhead, MN
 Jack Meredith, Wake Forest University, Winston-Salem, NC
 Yvan Petit, Université du Québec à Montréal, Québec, Canada
 Wael Ramadan, Sheridan College, ITAL, Toronto, Ontario, Canada
 Gary Richardson, University of Houston, Houston, TX
 Richard Scudder, University of Denver, Denver, CO
 Anissa Stein, Bellevue University, Bellevue, NE
 Late Hans Thamhain, Bentley University, Boston, MA (1936–2014)
 Art Thomas, Syracuse University, Syracuse, NY
 Jeff Trailer, California State University-Chico, Chico, CA
 Rodney Turner, SKEMA, Lille, France
 Barbara Unger, Technische Universität Berlin, Germany
 Nick Wake, University of Warwick, UK
 Roger Warburton, Metropolitan College, Boston University, Boston, MA
 Gabriela Ziegler, Davenport University, Grand Rapids, MI

Other Faculty Contributions

The board members of the Global Accreditation Center for Project Management Education Programs (GAC) and Academic Member Advisory Group (AMAG) provided input to this document.

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PREFACE

This document contains curriculum guidelines and resources for undergraduate programs in project management (PM). There are two volumes in this document.

Volume I: Curriculum Guidelines

Volume I covers the undergraduate project management (PM) curriculum. It describes the principles that guided the design of the curriculum and the objectives of the guidelines.

It lists a series of knowledge modules and associated learning outcomes. It also provides a list of courses and a program of study in project management with core knowledge modules for both a minor and a major in project management.

Volume II: The Foundations of Project Management Course [PM-1]

Volume II describes the content of a foundational course in project management, along with relevant resources for teaching it.

The effort was sponsored by the Project Management Institute (PMI) and represents over two years of effort working with the academic community to determine the academic preparation required of students who will grow professionally and, in due course, become project managers. It also reflects industry review by professional project management specialists and managers from several key sectors who can identify the educational requirements and coursework required of PM students.

What is the motivation for these curriculum guidelines? What is the value? Who will benefit? How will they help the project management profession?

We created the guidelines in response to academic demands and the fact that there is no comprehensive curriculum and resources framework available to guide academic institutions interested in introducing courses in project management. The primary stakeholders, academic departments in any domain, can use the framework to develop a new undergraduate PM curriculum, or to refine their existing project management curriculum.

PMI's 2013 Project Management Talent Gap Report estimates that 15.7 million new project management jobs will be added globally across seven project-intensive industries between 2010 and 2020. This implies that there will be a strong demand for educational programs providing training in project management. A well-designed common framework developed with the help of academics can address this demand and guide the nascent academic discipline of project management to new heights.

In response to requests from the academic community, we provide undergraduate PM curriculum guidelines, along with *resource materials* to help instructors introduce, or enhance, a course in project management. The website <http://www.pmiteach.org> will serve as a key resource for users of the guidelines, and it will provide ancillary material for both Volumes I and II. The website will contain updates to the guidelines as well as links to new teaching resources. Specifically, it will consist of: exemplars of course outlines, useful case studies, activities, term project assignments, and other PM teaching resources. The website will also provide faculty with an opportunity for knowledge exchange and an avenue for contribution to the project management knowledge base.

Developing the curriculum guidelines for project management is a challenge. Initially, there was the question of which faculty or school to target. Should we target business schools? Should we target technical programs and schools like

engineering, IT, or construction management? What about the emerging health sciences or health informatics sector, which can benefit from the PM guidelines? Once the curriculum guidelines development process began, all of these questions were resolved, as you will see in this document. It was a global, participatory, and consensus-driven process involving academics from many disciplines, with significant experience in several industry domains. The document evolved through several meetings, workshops, conferences, and surveys. It has undergone verification and validation from academics, and eventually, from the professionals who hire our students, as well.

The curriculum framework and resources is a living document, and it will be updated regularly with the aim of keeping the guidelines and resources relevant. We hope the readers find the curriculum guidelines and the resources relevant and useful, and anticipate your contribution as the project evolves. We need faculty experts to moderate the curriculum discussions and to aid in the development of new courses. Please provide your ideas for further development at <http://www.pmiteach.org>.

Last but not least, this first release of the curriculum guidelines would not have been possible without the participation of the sponsors at PMI, all of whom were determined to see this project launch and succeed. Specifically, the senior management at PMI who chartered the project, managers and staff in the project team who managed this project, and finally the manager of academic resources who shaped the project and navigated the faculty group brilliantly.

Dr. Vijay Kanabar, PMP

*Chair, Curriculum & Resources Faculty Advisory Group
On behalf of the Steering Group and Faculty Volunteers*

CHAPTER 1: INTRODUCTION

This document is the first in a series of curriculum guidelines for project management (PM) education. The guidelines are relevant for undergraduate programs offered in business, computer and information sciences, engineering, health sciences, and related disciplines interested in introducing or enhancing their coverage of PM topics.

The entry-level roles come in many forms for the new PM graduate. Graduating students can enter the field of project management as a project assistant, project associate, project lead, project analyst, project coordinator, project consultant, or junior project manager. The job titles and project role vary widely across industry domains. As an illustration, in the field of engineering, one could be a project engineer; in IT, a systems analyst or application programmer; in construction, a project coordinator; in healthcare, a clinical project associate; or in business, an analyst, a project accountant, or a junior project manager.

The current initiative supports undergraduate project management education by providing *Curriculum Guidelines* and *Curriculum Resources*. Let us introduce these terms and their components next.

The Curriculum Guidelines

The guidelines consist of a curriculum framework and recommended approaches to designing a project management curriculum.

The framework consists of a compendium of knowledge modules. The topics specified in the knowledge modules can be combined in different ways to create a curriculum of new courses or simply augment any existing curriculum.

Volume I introduces the rationale and principles that guided the design of the curriculum framework in Chapters 2 and 3, the knowledge modules and instances of several courses derived from the knowledge modules in Chapters 4 and 5, and various ways to leverage the guidelines in Chapter 6. This volume also provides guidance for designing a curriculum that can lead to minors or majors in PM.

The Curriculum Resources

The curriculum resources introduce detailed specifications of exemplar project management courses and pedagogically relevant teaching assets.

Volume II introduces one such exemplar foundational course in project management (PM-1). This foundational course is relevant to several academic domains including Business, IT, Health Sciences, and Engineering. Volume II also introduces the necessary resources for teaching PM-1. The teaching resources include detailed course content, course syllabi, case studies, discussion questions, assignment activities, and a term project. New academics, especially, will find the resource materials useful when introducing that first course in project management at their institutions.

Charter

A significant window of opportunity for the project management academic community is developing at the undergraduate level, and that is driving us to design the guidelines for undergraduate project management education. As employers' demand for students competent in project management continues to grow, it is important to provide guidelines and resources for faculty interested in teaching project management.

PMI's aforementioned 2013 Project Management Talent Gap Report states that 15.7 million new project management roles will be created globally across seven project-intensive industries by 2020. This suggests that there will be a strong demand for educational programs providing training in project management. Along with that job growth, there will be a significant increase in the economic footprint of the project management profession. This enormous anticipated growth provides an opportunity over the next few years for academics in all domains to strengthen their PM knowledge base and course offerings. It seems inevitable that employers will be looking for students competent in project management skills. In this context, PMI, as the world's largest association for the project management profession, has appropriately shown leadership to advocate the development of the PM curriculum guidelines.

The charter from PMI defines the scope of this project:

Develop a project management curriculum guideline along with teaching resources for the Undergraduate (UG) market. The curriculum framework should provide useful guidance to the academic community and as such, the project should seek extensive support and participation from them.

In the development of the guidelines, PMI has continuously emphasized two ideas:

1. This effort is "by academics, for academics." This includes experienced practitioners involved in teaching and research in academia either on a full-time or part-time basis.
2. This is not to be a "curriculum in a box." It is expected that the guidelines can be tailored to individual faculty needs and is therefore designed to be flexible.

The curriculum task force established the scope of the curriculum framework and guidelines to launch the effort:

1. The PM curriculum guidelines should provide the core PM skill set and competencies that a student should possess.
2. The guidelines should define the skill sets that are in concordance with the project management community.
3. The guidelines should be rich in both qualitative and quantitative skill sets.
4. The guidelines should be designed to integrate with existing academic programs.
5. The guidelines should produce proficient, entry-level graduates for the workplace in any domain.

It should be emphasized that the PM curricula will likely interface or intersect with similar curricula in other application or industry domains. However, we regard such curricula as outside the scope of this project.

The process of developing the framework followed directly from this charter. Before we begin, it is useful to document what is outside the scope of the framework:

1. It shall not focus on any curricula that are not project management.
2. It shall not focus on any one domain or discipline.
3. It shall not contradict other standards.
4. It shall not exclude theoretical or applied principles.
5. It shall not focus on pedagogical techniques or the channel of delivery.

The Users of the Guidelines

The following entities will find the project management curriculum framework useful:

- Heads of any academic departments simply interested in offering a cluster of project management courses
- Heads of any academic departments interested in offering a specialization in project management or a program with project management emphasis
- Heads of established project management programs interested in comparing or benchmarking their programs with a consensus-driven curriculum guideline
- Project management faculty interested in introducing new courses to strengthen their offerings in project management
- Other faculty interested in integrating useful project management topics into their existing courses

Additionally, college administrators or department chairs charged with expanding their program offerings might find the guidelines useful. Developing new courses can be challenging and, as indicated earlier, comprehensive teaching material to introduce that first course in project management is also being made available to all users of the guidelines.

Project Management as a Field of Study

Before we identify the key components of the PM curriculum framework, we conceptualize the educational requirements for a PM undergraduate. What are the skills that he or she must possess?

1. In general, students should be able to function in any industry domain upon graduation. Colleges and universities that host just a few PM courses should attempt to prepare students for diverse industry careers. Project management careers exist in a broad variety of industry domains, including:
 - information technology, engineering, and construction;
 - life sciences and healthcare;
 - business, government, defense, and aeronautics;
 - arts, media, sports, hospitality, and event management;
 - logistics, transportation, and supply chains;
 - international development.
2. Project management is an art, a science, and a practice. A student of project management will learn to appreciate both the beauty of analysis and the elegance of precision.
3. Project management graduates must certainly have strong technical skills, but the real world needs more than hard project management skill sets. The real world needs more than a well-crafted project plan. Projects are about people working with people. Therefore, soft skills are a key requirement to be successful in project settings. Skills like communication, working effectively in teams, interpersonal skills, time management, and organizational skills are all valued by employers hiring the young undergraduate.
4. Teaching critical-thinking skills is important for success in project management. Students should master the art of critical thinking by being encouraged to ask if everything they read, or are told, makes sense. They should look at a paragraph, plan, chart, number, or formula and ask if it makes sense. Is something else the correct answer?
5. Students should be problem solvers and must be capable of applying both traditional and new concepts and skills. Providing good analytical skills is therefore important. Students should be able to enhance organizational performance through project management.
6. Professionals in project management must master disciplined project management starting at the portfolio level, where the strategic vision drives initial investments and where value measures are established. Subsequently, they plan, organize, and deliver projects fully aligned with the strategy.

7. Professionals in project management must have a strong foundation in ethics and professional responsibility. Therefore, any curriculum framework must introduce these topics to develop respectable project managers and leaders.

Typical Expectations for PM Students

The expectations for PM students are listed as follows and form the basis of developing the foundational PM courses. Students have the capability to:

- understand business cases and project selection methods;
- understand strategic objectives in PM;
- understand the conceptual definitions of portfolios, programs, and projects;
- effectively analyze and manage stakeholder requirements;
- develop a project charter;
- define requirements and scope based on business need;
- identify and analyze detailed customer and stakeholder requirements;
- document high-level risks, assumptions, and constraints;
- create a risk-response plan and monitor and control risks;
- identify project management methods and procedures;
- identify key project processes and their importance;
- create a work breakdown structure, identify resources, and estimate effort;
- create a project schedule and understand the importance of a critical path;
- create a comprehensive project management plan;
- optimize a project schedule using various tools and techniques;
- conduct a kickoff meeting with all key stakeholders;
- execute tasks as defined in the project plan;
- control and evaluate the project;
- manage and report project progress;
- integrate change control and manage configuration;
- allocate and manage resources;
- implement a quality management plan;
- estimate costs, develop a budget, and perform cost management;
- implement approved changes according to a change-management plan;
- implement approved actions required to mitigate risks;
- demonstrate a broad range of competency in communication skills;
- demonstrate leadership skills and knowledge of leadership styles;
- demonstrate knowledge of team building and mindfulness of high-performing teams;
- demonstrate ability to work productively in a project team;
- motivate team members and manage conflict effectively;
- perform cost and schedule analysis using earned value management techniques;
- understand life cycles, including stage gates;
- ensure that deliverables conform to quality standards;
- formalize the final acceptance for a project;
- obtain financial, legal, and administrative closure;
- perform project procurement planning;
- release all project resources using appropriate organizational policies;
- communicate and present lessons learned;
- perform project information management and reporting;
- perform project handover and closeout;
- capture lessons learned and archive project records;
- measure project success or failure and customer satisfaction;

- ensure their personal integrity and enhance their professional competency at all times; and
- understand the relevance of the various standards that apply to project management.

The bulk of the above skill areas can be classified as “Technical Project Management” skills in the PMI Talent Triangle™ (see Figure 1-1).

We expect PM graduates to develop comprehensive behavioral competencies and strategic business awareness as they relate to PM. These include:

- Develop effective communications skills
- Develop leadership skills
- Develop interpersonal competencies to manage stakeholders effectively
- Develop effective oral, written, and formal presentation skills
- Conduct oneself with ethics and professionalism
- Prepare to negotiate and conduct negotiations
- Perform effective negotiation and conflict management
- Understand organizational politics and deal with them effectively
- Develop interpersonal skills and leadership
- Understand behavioral elements of team development
- Map team differences and bridge them
- Understand the organizational context
- Understand team building
- Complexity management
- Learn about emerging trends
- Develop health, safety, and legal awareness
- Understand organizational roles and context
- Understand the general business environment
- Understand business functional areas, such as finance and production
- Understand and manage supply chains
- Understand project governance and manage global projects
- Understand agile approaches to project management and their use in various contexts
- Work in large international projects
- Communicate across countries and cultures
- Lead distributed and virtual project teams
- Align projects with business goals and execute them strategically
- Develop knowledge of PM international standards

The above knowledge is mapped into the following two skill areas in the PMI Talent Triangle™—“Leadership” and “Strategic & Business Management” (see Figure 1-1).

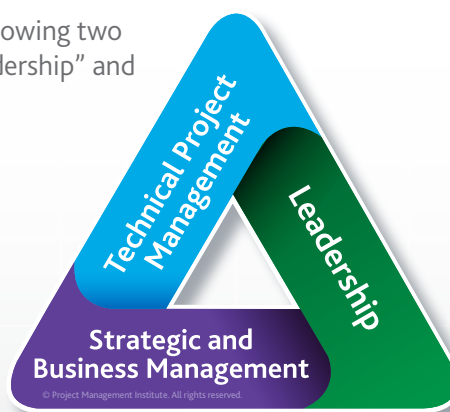


Figure 1-1: The three skill areas required of PM students

Students need a mix of skills to be successful in project management. Figure 1-2 graphically illustrates such a mix. It integrates other important dimensions of PM skills, such as ethics and professional responsibility and knowledge of emerging trends in business. Therefore, to develop well-rounded students, a curriculum plan should integrate components of the Talent Triangle with other competencies often obtained by students in non-PM courses.



Figure 1-2: Students need a mix of skills to be successful in PM.

In our curriculum guidelines, we focus on the Talent Triangle from the following knowledge dimensions: technical knowledge; behavioral skills, capabilities, and knowledge; and strategic awareness. This aspect is elaborated in Chapter 4: The Knowledge Modules.

Overview of the Curriculum Framework and the Guidelines Development Process

In this section, we describe the process used to develop the guidelines. But first we provide a brief summary about the state of the PM curriculum.

State of Project Management Curriculum

The curriculum guidelines introduce a framework of knowledge modules. The modules represent curriculum building blocks that support project management education. For instance, topics from any three relevant knowledge modules can be assembled into a sound foundational course in project management. Alternatively, depending upon the area of emphasis in an academic department, selected topics from several knowledge modules can be assembled to create a foundational course. This flexible approach permits specialization in curriculum and development of a variety of subject-oriented concentrations, such as IT Project Management, Health Informatics Project Management, Construction Project Management, and Engineering Projects Supervision.

Note that the current version of the guidelines identifies thirty knowledge modules and twelve unique course descriptions that are relevant in a primary project management career track.

Students taking twelve or more PM courses are possibly in a pure PM degree program, such as BS Project Management or BS Construction Management.

Students taking four to six PM courses can be said to be in a program with a “project management emphasis,” or taking a “minor in project management.” It is important to note that globally, different institutions use different terms to describe PM degrees, PM programs, and majors or minors in project management.

Background and Methods

The process for developing the model curriculum presented in this document is the result of the combined efforts of educators, experienced academic specialists, practitioners, and administrators.

In 2012, PMI undertook a preliminary study of 25 undergraduate business and technically oriented project management education programs. The resulting research report utilized surveys and interviews with each of the institutions in the hopes of establishing a basic understanding of the similarities and differences in history, structure, and content of their project management curriculum.

Many of the programs were quite young, indicating that their educators only recently came to the realization that PM is an important discipline. Academic units acknowledged that the primary motivation for undergraduate project management programs was the need to satisfy the employment and PM skills demands of local industry. In this context, the units also recognized the importance of PM skills for their students in understanding quantitative methods in management and to garner better job placements. The advisory and leadership boards of these institutions often encouraged the introduction of project management courses. Therefore, industry was a key influence in not only the decision to start teaching project management, but also in the design of a suitable curriculum to satisfy industry needs regarding PM knowledge and skills.

The real intent of these PM education programs was to instill PM skills and to better enable students to perform in the workplace, regardless of the base discipline of their degree. Units that offered core courses as electives in the same institution found ready acceptance of students and, often, in large numbers.

In looking at where these programs reside in institutions, we noted that an equal number of technical and business units supported project management programs.

Regardless of whether the program was a minor specialization in project management or a dedicated degree, there was a common approach to teaching PM. There was a common sequence of courses, and, as would be expected, most programs customize their integration of project management with the given discipline of the department. This key research finding led us to believe that a generic curriculum for project management is possible and will be helpful in creating a customized fit for any given discipline.

Another important finding was that most institutions in the study choose to start with a core PM course and then advance to a minor concentration. This research finding led us to believe that introducing even a single PM course could act as a nucleus for growth of a desirable project management curriculum.

The 2012 survey completed by PMI concluded that at most institutions, undergraduate PM programs were just as likely to evolve *de novo* as to be offshoots of an existing graduate program. Also, in many cases, graduate PM programs were the outgrowth of an existing undergraduate nucleus of courses.

When asked to describe the impact and importance of project management courses, respondents gave the following illustrative comments:

"Students find summer jobs."

"Numbers talk ... 950 students have completed the program since inception."

"Dramatic growth of student enrollment in the project management subject. . ."

"The program gives students an edge trying to start a career."

"Early exposure to project management prepares students for the realities of the workplace."

"The School of Business seeks regular advice from their Business Leadership Council, and they consistently heard that a project management background was highly valued."

This preliminary survey provided justification to investigate the development of the curriculum guidelines designed primarily for undergraduate programs. A series of workshops were conducted in different cities, and, subsequently, a steering committee was created.

In October 2013, a core curriculum was crafted in a three-day workshop in Boston, MA. Experienced faculty and curriculum designers, representing well-developed undergraduate project management programs from across North America, contributed to the creation of a generic curriculum for 10 courses in project management. The experience of faculty was balanced, and both the technical and behavioral dimensions of the PM curriculum were well represented.

To continue the curriculum research effort, a different group of experienced faculty met in San Diego, CA, five months later to validate the curriculum crafted in the first workshop in Boston. Upon conclusion, the steering committee felt comfortable with the baseline of the curriculum from these workshops. However, since it was the intention of PMI to get global input, a third workshop was organized in Europe consisting of well-recognized experts in project management from different European countries and some from as far away as Australia.

Validation for the courses occurred at a workshop, in Brussels, Belgium, organized by PMI to obtain a global perspective of the PM major courses earlier identified in North American workshops. Many updates to the PM course specifications took place upon integration of the European/Australian perspectives into the curriculum guidelines.

Upon conclusion of the European workshop it was clear that there were divergent models. While this workshop successfully verified and validated the curriculum developed within the North American context, it raised many questions. As a result, the curriculum grew even larger and additional topics were added to the mix. For example, one topic was added on supply chain and procurement and another on organizational behavior within the project context.

Although the field of project management has a role to play in integrating with other disciplines, it is not feasible to expand the size of the curriculum in most undergraduate programs because it is a zero-sum game. Students have to graduate within a scheduled duration. This led the steering committee to research a more flexible architecture for curriculum development.

After researching emerging trends in curriculum design we introduced *knowledge modules*, rather than courses, as the primary building blocks for the PM curriculum. Knowledge modules, which are independent curriculum building blocks, could be assembled as needed by an institution to develop courses. A subcommittee of the steering committee met in Pittsburgh, PA, in late 2013 to refine the knowledge modules and identify key lecture topics and learning outcomes for the knowledge modules.

Extensive communication among faculty experts and the steering committee occurred on a weekly basis through conference calls and live virtual meetings. Subsequently, many such meetings occurred to design an extensive survey that would seek validation from faculty all over the world for the core model of knowledge modules. The survey and selected results are described in the following section.

Validation: Input from a Global Survey

To assess the need for both the guidelines, the teaching resources, and relevance of the knowledge modules, PMI contracted with an independent agency to execute a quantitative survey in January and February 2014.

Background and Objectives

The goal of the survey was to understand the resources required by the academic community within the context of providing a foundational course in project management. PMI sent the survey to approximately 3,000 project management (and related discipline) department chairs and directors internationally.

Specific objectives of the survey included:

1. determining the needs of faculty when developing academic courses;
2. identifying what faculty currently does to develop course materials;
3. identifying tools and resources that faculty needs to develop a course or courses in project management; and
4. gauging faculty reaction to a curriculum concept proposed by PMI.

The survey automatically eliminated respondents if they did not meet some criteria. Participant responses were screened to ensure that they had at least part-time teaching responsibilities at an institution that awarded degrees at the bachelor's level or higher. Therefore, a good dataset of 284 responses was eventually available to refine and develop the current curriculum guidelines.

The survey was divided into two parts:

1. *Mandatory questions:* These covered the respondent's profile, current practices for course development, resources required to implement project management education, and reaction to the proposed curriculum guidelines.
2. *Optional questions:* These included an in-depth review of proposed knowledge modules, and willingness to contribute to a module (e.g., lecture notes, syllabus, etc.).

Results were examined by institution type, whether the respondent taught project management, the level of project management taught, and primary discipline. Two sample sources were used to recruit participants worldwide: PMI lists (n=182) and a purchased list of faculty and academic administrators (n=102).

A total of 284 respondents completed the mandatory questions; of these, 187 respondents continued to the optional questions.

Next, we provide some significant data analysis from the survey and our research interpretation and analysis.

Respondent Profile

Respondents were well distributed throughout the world, which is shown in Figure 1-3.

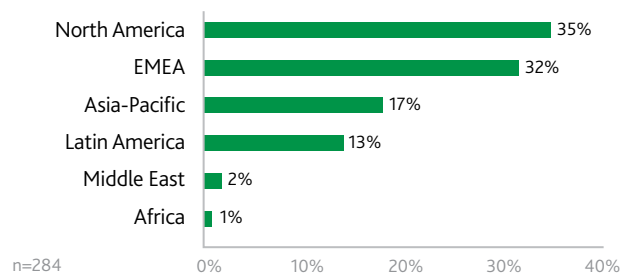


Figure 1-3: Geographical distribution of respondents

Respondents primarily came from schools that award mostly bachelor’s degrees (46%) and schools that award equal numbers of bachelor’s and graduate degrees (46%). This distribution of faculty was well balanced and assured us comments from several academic domains. More than 50% of the respondents had full-time academic appointments, and about 30% were academic program administrators with part-time or full-time teaching duties. The disciplines of the respondents are shown in Figure 1-4.

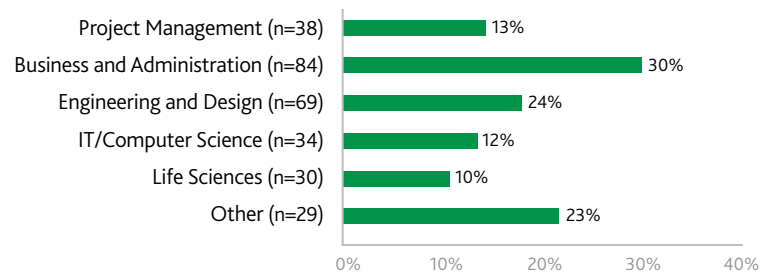


Figure 1-4: Respondents' disciplines

The respondents’ levels of teaching and types of learning environments are shown in Figure 1-5.

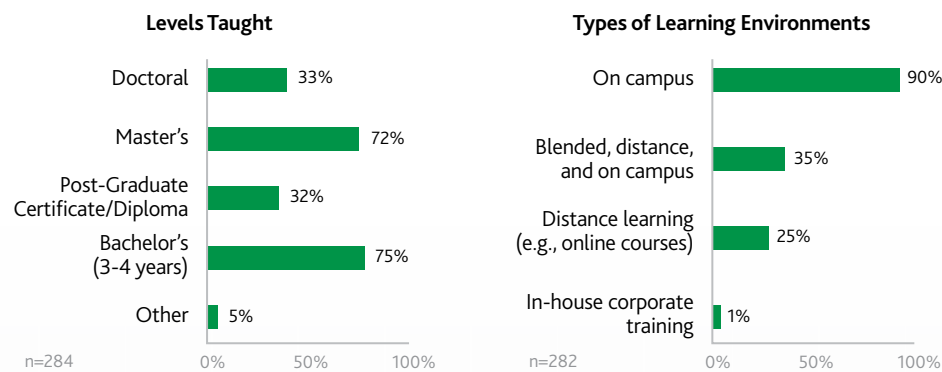


Figure 1-5: Respondents’ levels of teaching and types of learning environments

Figure 1-6 shows the distribution of the teaching of project management at the institutions.

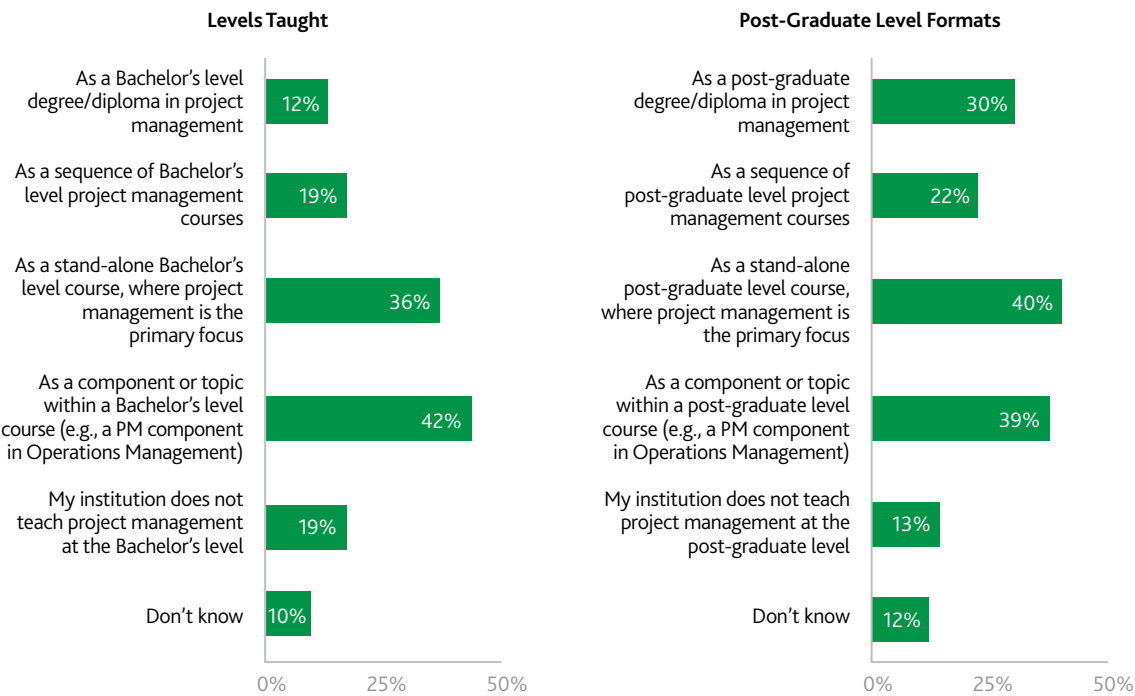


Figure 1-6: Project management at the institutions

Figure 1-7 shows the respondents' experience with teaching project management.

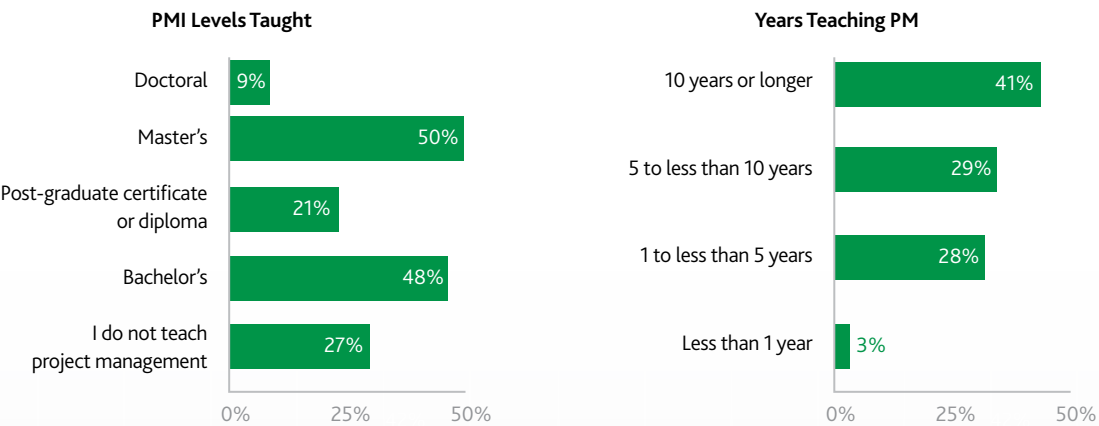


Figure 1-7: Experience teaching project management

In comparison to those who only answered the mandatory questions, optional questions were answered by:

- a greater proportion of respondents from Latin America and fewer from Asia-Pacific;
- a larger proportion of respondents whose primary discipline is project management, and fewer in life sciences;
- a larger proportion of respondents who teach project management and who have been responsible for developing a course in project management;
- fewer respondents who teach at the doctoral level; and
- a larger proportion of respondents who come from institutions with undergraduate courses and graduate course sequences in project management.

Respondents who teach project management to undergraduates considered the curriculum to be either somewhat valuable (43%) or very valuable (42%). Respondents teaching only at the graduate level considered the curriculum to be slightly less valuable (26% somewhat valuable, 44% very valuable). This also held true across disciplines. See Figure 1-8.

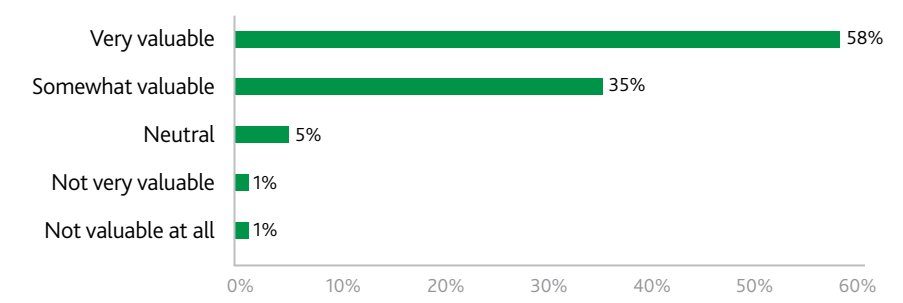


Figure 1-8: 93% of respondents suggested that the proposed resources would be valuable

Table 1-1 shows respondents believe the curricula guidelines would serve many needs.

Curriculum Uses	Overall (n=269)
To introduce new content to an existing Bachelor's level course	55%
To introduce a new Bachelor's level course in PM	42%
To introduce a new sequence of courses in PM at Bachelor's level	39%
To introduce a new Bachelor's level program of study	32%
To benchmark/enhance an existing course or course sequence in Bachelor's level PM	37%
To benchmark/enhance an existing Bachelor's level program of study	30%
To introduce new course content, courses, or a program of study at the post-graduate level	43%
To benchmark/enhance an existing post-graduate course, sequence of courses, or program of study	44%
Other	1%
Would not be used	2%

Table 1-1: The curricula guidelines would serve a variety of needs

Those who did not perceive the curriculum guidelines as useful were from institutions with an existing, deep knowledge of project management topics. Also, those at institutions that develop innovative and customized content believed that a standard guide would not add value to their approach.

The survey proposed that the following resources and support materials should be available for knowledge modules:

- A list of topics and subtopics, in the format of a table of contents
- An annotated topic outline with detailed instructional discussion points and definitions
- A bibliography, including lists of relevant texts, papers, and abstracts
- Learning outcomes: knowledge students should have acquired after completing the module
- Teaching considerations: suggestions for course format and delivery, and suggested reading lists

Most faculty thought the resources described were comprehensive. The most useful categories were PM case studies, practice materials, and assessment tools—see Figure 1-9.

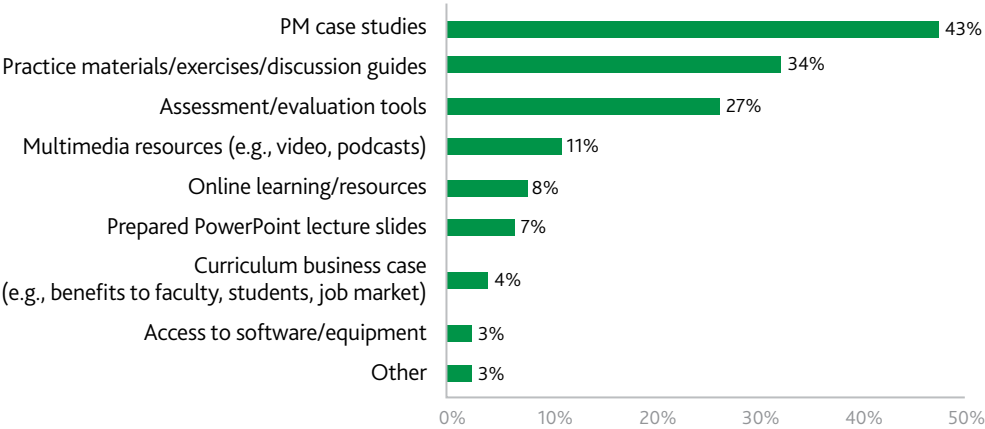


Figure 1-9: Module resources and support materials were perceived as valuable

Instructional content was considered to be more valuable to undergraduate-dominant than balanced institutions. This is shown in Figure 1-10.

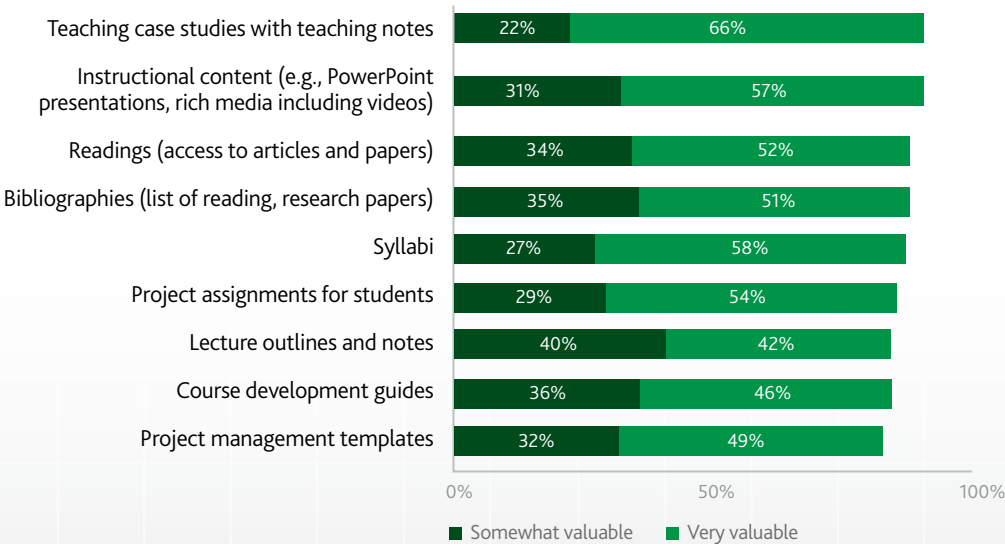


Figure 1-10: Module resources and support materials were almost universally perceived as valuable

Additional Resource Needs and Considerations

Over half (51%) of respondents think it is very important that PM faculty develop the curriculum guidelines. Another 27% think it is somewhat important.

A list of recommended texts is not considered as valuable as the proposed resources, but possibly an acceptable alternative to free texts. For most disciplines, access to a reading list is not significantly less valued than textbook access.

English-language resources are considered valuable overall, but are less strongly valued outside of North America. Nevertheless, the net value of English materials is still strong in most areas. Resources translated into a local language other than English are considered very valuable in Latin America. Also, curriculum resources developed in one’s own country are more valuable.

There was a very strong preference for online access to curriculum resources—see Figure 1-11.

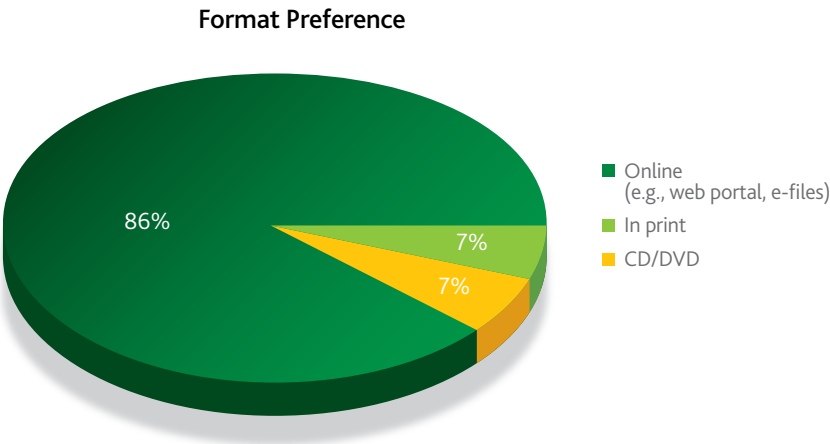


Figure 1-11: There is a very strong preference for online access to curriculum resources

Analysis and Interpretations from the Survey

Some key conclusions from the survey are presented as follows:

1. The value of providing the curriculum guidelines was tested, and 78% of the faculty agreed that development of the guidelines is valuable.
2. Many faculty members were willing to contribute to this project.
3. Respondents agreed that faculty should develop the curriculum guidelines and resources; however, practitioner input should be obtained.
4. It is unlikely that a “one-size-fits-all” approach to implement a new curriculum is possible, or acceptable to the faculty community.

- 5. The design of a PM curriculum plan requires participation from several cognate undergraduate academic units.
- 6. While respondents immersed in PM education understood the value of the curriculum guidelines, those in “other” disciplines (i.e., arts or social sciences) may not have enough awareness of PM to readily leverage the guidelines. Special effort might need to be made to reach out to those not teaching PM currently, for example, by organizing workshops.
- 7. Along with the technical project management knowledge modules, respondents suggested that socially oriented soft skills such as ethics, team building, interpersonal skills, and stakeholder engagement should be considered foundational knowledge topics.

Many of the above conclusions from the survey speak for themselves. However, a more significant impact of the survey was the emphasis on allowing significant flexibility in curriculum planning, and strengthening of the behavioral knowledge modules. As indicated earlier, several faculty felt that a standardized template of recommended courses is not desirable and is simply unacceptable. Introduction of knowledge modules in favor of a template of recommended courses mitigated that risk.

The behavioral curriculum knowledge modules were improved in several significant ways. For example, the Ethics and Professional Responsibility, Project Leadership, Identifying and Engaging Stakeholders, and Project Team Building and Motivating were strengthened in the final version of the guidelines.

Practitioner Input

One of the key recommendations from the survey was to integrate input from practitioners or part-time educators who are working full time in the industry. Such input would be valuable, as it provides the unique perspective of a hiring manager and employers working with newly recruited undergraduate students. We subsequently invested effort in interviewing several practitioners. It should be noted, however, that the development of the undergraduate curriculum guidelines was augmented by a cadre of faculty volunteers who not only teach project management full time, but also have a wealth of practice and industry experience behind them.

Among the 30 participants, there were 32 industry sectors represented with over 900 years of combined experience if education is included as an industry segment, or 683 years combined experience without the education sector. Details of the data are provided in the Table 1-2.

	Including Education Sector	Without Education Sector
Combined experience	901 years	683 years
Average years sector experience	12.2 years	11.2 years
Median years sector experience	7 years	6 years

Table 1-2: Education sectors and experience

Looking at the education sector by itself, the respondents had an average of 16.8 years of teaching experience or a median of 15 years. Accordingly, the content of the guidelines reflects real-world experience and has been developed to assure learning outcomes that will prepare students for meaningful positions in project management. Complete details of industry sector experience are provided in Appendix I-D.

In addition to the faculty input, we obtained input from full-time practitioners working in nine industry sectors. The details are provided in Appendix I-E. Contacts were asked to review the proposed exemplar foundational course (the Foundations of Project Management [PM-1] course, presented in Volume II). The respondents had previous experience in 20 industry sectors. The majority of respondents either had direct hiring responsibility or advised those who hired new project managers. Half of the respondents had previously taught project management at some level and were familiar with PM education and pedagogy. All of the respondents believed the course, as outlined, was comprehensive and adequate for preparation of entry-level project managers. The respondents noted a number of suggestions to augment the course and its learning outcomes. Many suggestions dealt with communication and soft skills, including role-playing scenarios and simulations as well as recommended involvement of students in actual (real-time) projects for both industry and practice experience. Their input was fully accommodated in the final revision of the current curriculum guidelines.

Input From Other Associations

PMI surveyed several non-PM-related associations that have developed discipline specific guidelines comparable to the current PM undertaking. It conducted several interviews with these associations and their current and former chairs to obtain information on best practices. This conversation strengthened the design and development of our PM curriculum guidelines.

Conclusions

The cornerstone of this curriculum initiative is to present a global narrative of PM knowledge modules with course topics and learning outcomes. As the refinement process continues, we plan to integrate input from all regions of the world.

The development of curriculum guidelines for PM education is challenging within the context of a typical academic organization, as they are structured around functional areas such as computer science, marketing, engineering, public health, and law, and scattered across various colleges. It is this opportunity for integration of PM with other disciplines that makes this project timely and compelling.

In response to this challenge we have to design a curriculum architecture that is modular and flexible. Academics in other domains can adapt and enhance their curriculum with PM knowledge modules to create a relevant and functional curriculum.

We expect an outcome of the PM curriculum framework and guidelines to be either the introduction of an undergraduate course in project management at schools that don't yet have one, or strengthening of PM knowledge in courses of other disciplines that could benefit from PM. The surveys and subsequent research resulted in an overarching approach for the development of PM curriculum.

Integrating input from full-time practitioners provided us with a balanced vision for our introductory curriculum in project management. The results of the practitioner survey showed that hiring professionals with well-developed behavioral skills and capabilities, is regarded very highly, and in some cases considered even more important than technical PM knowledge and skills. The reason for this bias is that well-developed teamwork, communication, and interpersonal skills allow for rapid and successful integration of entry-level employees. Even the full-time faculty who were surveyed ranked knowledge and skills in the behavioral areas highly and recommended their coverage in a comprehensive manner in the PM curriculum.

CHAPTER 2: PRINCIPLES THAT GUIDED THE DESIGN OF THE CURRICULUM

We identified a set of principles to guide the design and development of the curricula guidelines and, ultimately, their implementation. A summary of the principles that guided the design of the curriculum framework is illustrated in Figure 2-1.

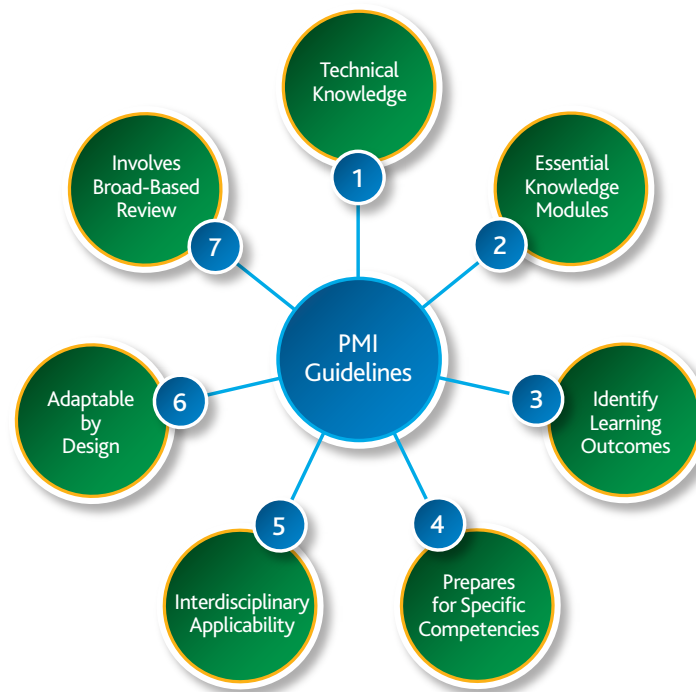


Figure 2-1: The seven principles that guided the curriculum

Based on research and the results from our surveys and subsequent conversation, we define the following seven principles:

1. *Project management curricula should be designed to be flexible and should work across many disciplines and industry domains.* Project management is not unique to any specific discipline. Therefore, PM students should acquire the flexibility to work across disciplines. Especially at the undergraduate level, it is not possible to predict the industry domain in which students will find employment. Project management curricula should be designed to prepare graduates for a variety of professions, attracting the full range of talent to the field.
2. The number of courses, or education hours, in degree programs of the hosting academic units is limited, and, therefore, **essential knowledge modules** must be identified. The number and range of relevant topics, both in PM and the hosting units, continue to expand. For instance, agile approaches to project management is a topic of importance in PM today, but for a department that plans to introduce only one course in PM, providing coverage on this topic might come at the expense of other key topics. The number of courses, or education hours, representing the size of undergraduate education is finite. Thus, the guidelines must carefully choose topics and identify a minimum set for an “essentials of PM” curriculum. To this end, the guidelines must define a core foundational course in project management.
3. *Curricula guidelines should provide guidance for both the topics and the expected **learning outcomes** for students.* It is important to recognize that these are undergraduate students taking professional courses. They are not likely to start a career as project managers making critical project decisions. More likely, they will start their PM careers as productive project team members or project associates. Therefore, we should identify the relevant topics and expected learning outcomes for undergraduates. For example, we may want the students to

demonstrate knowledge of basic topics in project planning, team communications, and conflict management, while coverage of advanced topics in program management or project governance can wait. Depending upon the course or instructor's preference, such topics can be touched upon but need not necessarily be covered in depth.

4. Project management curricula must prepare students for **specific competencies** and the professional work environment they will encounter upon graduation. As the faculty survey revealed, stakeholder engagement skills, communication skills, teamwork, and ethics are important competencies that project management students must experience and learn. Students must master personal competencies and learn to function well in diverse sociocultural project environments if they are to succeed in today's global PM environment. The curricula guidelines should identify such key topics. To successfully prepare students for the professional work environment, the instructor could target such topics so as to develop student knowledge and these fundamental skills through the use of exercises, case studies, and term projects.

5. Curricula guidelines must be realistic and adoptable to a variety of departments, units, or colleges and assure **interdisciplinary applicability** to implementers. There is a wide range of institutions and programs in the target education space for introducing PM. The variety of disciplines, such as arts and sciences, liberal arts, business, technology, medical, public health, engineering, and many more, can all be considered to be relevant audiences for the PM curricula guidelines. Therefore, providing curricula flexibility is important, since the faculty members naturally have to accommodate the primary subject matter of the academic unit.

6. The curricula guidelines should be **adaptable by design** and provide flexibility in organizing topics into relevant courses or curricula modules. The guidelines acknowledge that there may be many approaches to describing and packaging PM courses. While the guidelines can present effective ways to combine topics, when describing exemplar courses it is even more important to identify an architecture of PM knowledge modules of smaller curricula buckets that can be combined for the definition and development of a particular curriculum. Such knowledge modules could then be combined into courses through different permutations and combinations by any hosting department based on their particular departmental educational mission.

7. *The development of the curricula guidelines must involve input and **broad-based review**.* The curricula framework effort must include broad-based participation from academics in different disciplines and countries, and must include a review and input from practitioners working in different industry domains, including nonprofits and government.

Conclusion

The premises for establishing guiding principles for the project management curricula guidelines are crucial. In this section, a conceptual framework to design and implement a curriculum was outlined. Seven premises were articulated, and each premise can be explored as a principle for curriculum design.

CHAPTER 3: ESTABLISHING EDUCATIONAL OBJECTIVES

This chapter provides an introduction to establishing PM educational objectives. Identifying and assessing these objectives is a requirement for almost all accredited institutions today. Translating mandated standards into concrete educational objectives and then designing appropriate learning outcomes is a challenge for educators. This chapter provides an outline of two distinct processes for designing the educational objectives for a PM program of study.

Program Goals and Learning Outcomes

It is very likely that a PM curriculum is embedded within schools that have specific learning goals and accreditation standards that must be accommodated. In this section, we establish the educational objectives of a typical curriculum plan as they relate to PM education.

Designing educational objectives involves distinct processes:

- *Identifying program goals:* A goal is a statement of general outcome. It is a broad definition of student competence. The mission of the college, department, or program typically defines several baccalaureate goals. It answers the question, “What will the students learn from a program?” It defines educational expectations of a program. In this chapter, we provided twelve goals for programs involved in PM education. We state them in terms of what we want our students to be able to do, and have identified sustainable skills and knowledge that are valued by students and employers.
- *Identifying course objectives and learning outcomes:* An objective is a statement summarizing specific course content. It answers the question, “What will the students learn from a course?” Learning objectives should map to goals. Furthermore, a detailed description of what the student must be able to do at the completion of a course is also addressed within this context. When writing outcomes, it is useful to identify transferable skills.

In the next section, we introduce program goals and illustrate some possible learning outcomes.

Learning Goals for Project Management

The main thrust of undergraduate-level educational studies for students focused on a career in project management is twofold: acquiring competency in their chosen discipline (such as computer science, health sciences, engineering, marketing, etc.) and acquiring competency in the discipline of PM.

Preparing students for a PM career can be challenging for most academic units, as PM students must have a wide range of skills and an understanding of the discipline. In this section, we present undergraduate competency requirements for the PM dimension. Discussion of learning goals and competency requirements for a student’s non-PM undergraduate discipline is outside the scope of these curriculum guidelines.

We illustrate learning goals below with a few examples of outcomes, as they characterize the academic learning objectives for PM careers. A comprehensive list of learning outcomes is presented in the Appendix I-A: Knowledge Module Specifications.

1. Student is fully acquainted with the fundamentals of project management.

Possible Learning Outcomes:

- Describe the importance of PM in the context of various organizational cultures and strategies, and summarize the typical components of the PM system and the processes that are considered essential to any project.
- Select and describe an appropriate PM strategy for a new project that can meet stakeholder expectations in a given organizational context.

2. Student is acquainted with the full project life cycle and various project management processes.

Possible Learning Outcomes:

- List and describe the project phases that make up a typical project, and summarize PM processes that occur within each.
- Describe the typical PM process documentation and PM deliverables that are produced by project managers in each project phase.

3. Student is able to define stakeholder expectations and initiate a project successfully.

Possible Learning Outcomes:

- Given an organizational context, project objectives, and recommended strategy, develop a sequence of categorized PM processes and activities that will meet stakeholder expectations.
- Create, or identify, a project charter and its primary components, including writing a concise statement of business needs that the project will address.

4. Student is able to create a comprehensive project plan.

Possible Learning Outcomes:

- Develop a PM plan that documents the actions necessary to define, coordinate, and measure all project activities, and to ensure control and management of costs and changes to the project.
- Describe the components of the project plan and the interactions of the various processes of the project plan with other processes in the PM system.

5. Student is able to work in teams, manage team members, and interact with stakeholders.

Possible Learning Outcomes:

- Select appropriate communication tools and methods to communicate with identified stakeholders, including commonly used templates for communication activities such as status reporting, issues tracking, change control, and project reviews.
- Understand sources of conflict and, given a specific challenge, apply a problem-solving process that focuses on confronting and resolving the problem.

6. Student is able to plan and monitor project budget and schedule.**Possible Learning Outcomes:**

- Identify necessary labor and material resources, including contracted resources, and estimate how many units of each are required to meet project expectations.
- Describe the fundamental types of time- and cost-estimating approaches and how these are best related to the time line of the project, becoming more specific as more information is known about project requirements, risks, and activities.

7. Student is acquainted with the basic tools and techniques of managing project quality and risk.**Possible Learning Outcomes:**

- Given a specific project context and plan, identify potential project risks and/or opportunities, evaluate each according to criteria for impact on the project, and document them in a prioritized risk register.
- Demonstrate knowledge of the core quality processes and explain the role of each process in planning and managing projects.

8. Student is acquainted with the principles of identifying, developing, and managing resources.**Possible Learning Outcomes:**

- Demonstrate how teams are assigned and formed, and describe the stages of team development.
- Enhance team capability after assessing personal strengths and weaknesses, and develop skills to manage a team and lead others.

9. Student is competent at navigating a project experiencing scope, resource, and scheduling constraints through effective communication.**Possible Learning Outcomes:**

- Demonstrate ability to optimize the project schedule by allocating resources to the critical path.
- Demonstrate ability to optimize schedules to maximize efficiency.

10. Student is acquainted with the technical and human aspects of project control, especially change control.**Possible Learning Outcomes:**

- Demonstrate knowledge of how changes to project scope may affect the project's schedule, cost, and quality, and how to evaluate the impact and recommend a solution that produces the desired project product.
- Describe how to monitor and control variances as they pertain to project cost, schedule, scope, and quality, and how to formally communicate such variances to the stakeholder.

11. Student is acquainted with the contextual relationship between the project and the organization that hosts the project.

Possible Learning Outcomes:

- Describe how to manage a project in a matrix organizational structure, and illustrate how to successfully deliver a project when the PM might not be sufficiently empowered.
- Demonstrate knowledge of key linkages between organizational and project-level issues, including decision making, motivation, and project roles.
- Demonstrate knowledge and skills in procurement, supply-chain management, finance, cost management, and other business aspects of projects.

12. Student is acquainted with the importance of ethical considerations in every aspect of a project's operations.

Possible Learning Outcomes:

- Given a case study scenario involving ethical considerations, demonstrate how a project can be executed according to the standards of the organization hosting the project.
- Demonstrate knowledge of situations involving unethical project activities, and best practices for whistle blowing and ethical decision making.

Other Skills

There are additional skills and competencies that PM students should acquire that are not explicitly listed in the previous section. Some of the competencies listed as follows manifest in the general education component of typical Bachelor's degree programs.

Organizational Aspects

- Time management skills, including managing priorities and project organization skills
- Thinking, problem-solving, and analytical skills
- Interpersonal skills—being able to listen well and work well with team members from different cultures and of different genders
- Planning to present and making effective presentations

Informational Aspects

- Research: understand the relationship between theory and practice, conduct literature research on topics, research methodology
- Information literacy: skills needed to find, retrieve, analyze, and use information
- Effective electronic communication (especially email) and virtual communication

Business and Commercial Aspects

- Obtaining project funding, marketing the project, and managing relationship with the customer (relationship marketing)
- Project handover and successful project implementation
- Suspending a project due to financial constraints and restarting the project
- Legal and safety aspects

Some of these competencies are well known and occur in the learning mission statements of several academic programs. Many academic programs focus on developing teamwork and interpersonal skills, working with diverse cultures, problem solving, and information literacy. These competencies align well with the necessary background preparation for PM students.

It is quite possible that there could be an overlap in curriculum between the competency requirements in a student's academic major and the PM track. This redundancy occurs more commonly than one might imagine. For instance, the academic preparation for programmers/analysts in a Bachelor's degree track in information systems (IS) is quite aligned with the PM curriculum. Many IS concentrations require a PM course as a core, and the curriculum focuses on the project life cycle, communications, and managing teams.

There is always room to optimize a curriculum by selecting alternate topics from the PM curriculum to minimize redundancy. Of course, some redundancy is possibly desirable; any curriculum that focuses on ability to work in teams and to communicate information is a welcome duplication, as it enhances the student's core competency.

Broad Statements of Learning Goals

In the previous section, we defined specific educational goals that are suitable for assessment. As illustrated, they can be translated into one or more measurable learning outcomes. However, for purposes of brevity, educators might be asked to provide only broad statements of accomplishment for a PM curriculum. Below, we illustrate examples of broad statements that capture *PM learning goals*.

Upon graduation the student will

- be proficient in customizing a project management life cycle and developing a comprehensive project plan.
- have acquired proficiency in all basic PM tools and techniques with an emphasis in communications, risk analysis, cost estimation and budgeting, and quality control.
- have obtained knowledge of tools for project scheduling, templates for managing a project, and an in-depth knowledge of techniques to control cost and schedule.
- be an effective communicator, and demonstrate effective interpersonal communication skills in a team setting.

Many programs have college-wide or university-wide *general education* learning goals. Below, we illustrate examples of broad statements that illustrate several general education learning goals that are compatible with *PM learning goals*.

Upon graduation, the student will

- be an effective communicator.
- apply critical thinking and demonstrate problem-solving skills supported by relevant analytical and quantitative techniques.
- have a global perspective and understand the importance of behaving ethically.

Conclusion

We have introduced twelve program design goals and a basic approach for educators to develop meaningful and transparent educational objectives for PM programs. We have mapped such goals with a few learning outcomes for illustration purposes. Learning outcomes are statements that specify what learners will know or be able to do as a result of a learning activity.

We have also illustrated how the twelve program design goals can be condensed into broad statements of learning goals.

The educational objectives and goals introduced in this chapter constitute the basis for the discrete building blocks of our curriculum guidelines, which are introduced in the next chapter.

CHAPTER 4: THE KNOWLEDGE MODULES

Primary Objective of the Curriculum Guidelines

As noted previously, the primary objective of the guidelines is “to provide students with the knowledge and ability to effectively manage projects in varied disciplinary domains.” Earlier, we introduced educational objectives for students associated with a PM curriculum. The knowledge modules (KMs), a cluster of PM topics, are the mechanism with which we develop a PM curriculum plan. The need for KMs as a design principle has been articulated as a design principle for the guidelines in Chapter 2.

Workshops and the comprehensive surveys given to the global audience of academics (see Chapter 1) were instrumental in identifying, validating, and ranking the KM introduced in this chapter. We present some of the research analysis in this section, as well.

Knowledge Modules

A knowledge module is a module of PM educational information that covers a well-defined topic and represents a discrete component of PM knowledge. KMs implement a curriculum plan and operationalize the curriculum objectives. The integrated set of KMs spans all the major activities of project management. The principles that governed the design of KMs were identified in Chapter 2: Principles that Guided the Design of the Curriculum. Some of the primary relevant principles that played an instrumental role in the design of KMs are:

- Project management curriculum should be designed to be flexible so that KMs are easily adoptable in many disciplines and industry domains.
- The education hours in degree programs of the hosting academic units are constrained, and, therefore, smaller chunks of PM knowledge must be identified to assure flexibility for implementers when designing a PM curriculum.
- The guidelines should provide flexibility in assembling topics into courses to create a relevant curriculum in a variety of academic situations and countries.

Each KM contains a distinct set of learning outcomes that students are expected to achieve. Figure 4-1 shows the various attributes of a KM, which are:

1. Name
2. Definition
3. Learning outcomes
4. Topics

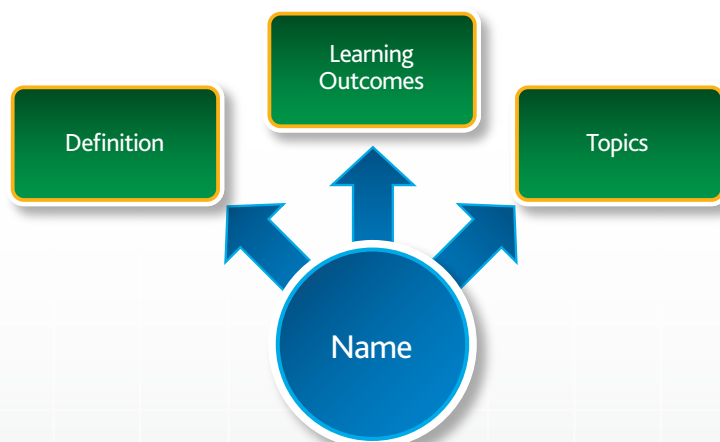


Figure 4-1: Knowledge module

A rough estimate for each KM would be about 12 to 16 hours of lecture material. This translates to one credit in the North American education system. Since the credit system is not universal, in this guideline, we make no further reference to it and simply express the size of each KM in hours.

Illustration of a Comprehensive Knowledge Module

In this section, we illustrate a comprehensive KM. (Note: Appendix I-A provides the details for all the KMs.) The learning outcomes clearly state what a student is expected to know, or be able to do, after completing the KM. Each learning outcome is skill-based or knowledge-based and is measurable. Each KM has no more than three learning outcomes. Figure 4-2 shows KM-1: Project Management Principles.

Knowledge Module 1 (KM-1): Project Management Principles

Definition

This module introduces the principles of PM applicable to all projects. It examines the core concepts and applied techniques for cost-effective management of projects. It provides an introduction to the importance of PM, organizational strategy, project selection and prioritization, as well as organizational capabilities within the context of projects, such as structure, culture and roles, project life cycle and organization, and developing project-related product or service description, and chartering a project.

Key Topics

- Core concepts: business case, project, PM, and role of project manager
- Benefits of project management
- Projects and their environment
- Organizational strategy and opportunities
- Projects, strategy, and project alignment
- Projects, organizational structure, and governance
- Project portfolios and project selection
- Competencies of project personnel
- Project constraints: types, interdependency, and balance
- Project initiation: opportunity evaluation, sponsors, stakeholders and strategy, and chartering a project

Learning Outcomes

- Analyze the importance of PM in the context of various organizational cultures and strategies, and summarize the essential components of a project and the processes that are considered essential to its successful implementation.
- Evaluate factors important to project selection and prioritization as evidenced by organizational capability and available resource capacity.
- Evaluate and recommend an appropriate project management strategy for a new project to meet stakeholder expectations in a given organizational context.

Figure 4-2: The first knowledge module: KM-1 PM Principle

We have classified the KMs into three groups for expediency. These three skill areas, which are illustrated in Figure 1-1, are as follows:

1. *Technical knowledge*: These KMs cover the basic theory and practice of PM. They provide students with a comprehensive technical understanding of the PM common themes and principles. Technical KMs explain how one can apply knowledge to meet project requirements.
2. *Behavioral skills, capabilities, and competencies*: These KMs deal with personal, behavioral, and organizational aspects of PM, and provide students with an opportunity to develop both personally and professionally. They integrate an individual's well-rounded PM knowledge with communication, management, and organizational competencies.
3. *Strategic awareness*: This group of KMs includes business, commercial, and organizational aspects. These include strategic issues, program and portfolio management, and governance. This group also includes emerging topics in PM, such as agile approaches to PM, international issues, and global projects.

Technical Knowledge Modules

1. Project Management Principles [T-PM]
2. Project Phases and Processes [T-PP]
3. Project Planning and Integration [T-PI]
4. Project Resource Management [T-PR]
5. Estimating Costs [T-EC]
6. Project Scheduling [T-PS]
7. Opportunity and Risk Management [T-OR]
8. Plan and Control Quality [T-PQ]
9. Procurement and Contract Management [T-PC]
10. Finance and Cost Budgeting [T-FC]
11. Scope Management [T-SM]
12. Project Control [T-CP]
13. Business Analysis & Requirements Management [T-BR]
14. Project Handover, Closeout, and Reviews [T-HC]
15. Project Management Information Systems and Information Management [T-IS]

The comprehensive list of topics and learning outcomes is presented in Appendix I-A. We provide numbers for convenience, but they don't communicate any ranking or sequencing order. For expediency, we provide acronyms in brackets.

Ranking Technical Modules

The research survey (discussed in Chapter 1) gave us an opportunity to list the key modules that should be covered in an introductory course. In Figure 4-3, we see the top seven KMs as ranked by the academic communities. An astounding 91% of the surveyed faculty ranked the Project Management Principles KM as the number one module of importance. Note that to ensure integrity of the results, faculty surveyed were presented KMs to rank in randomized orders.

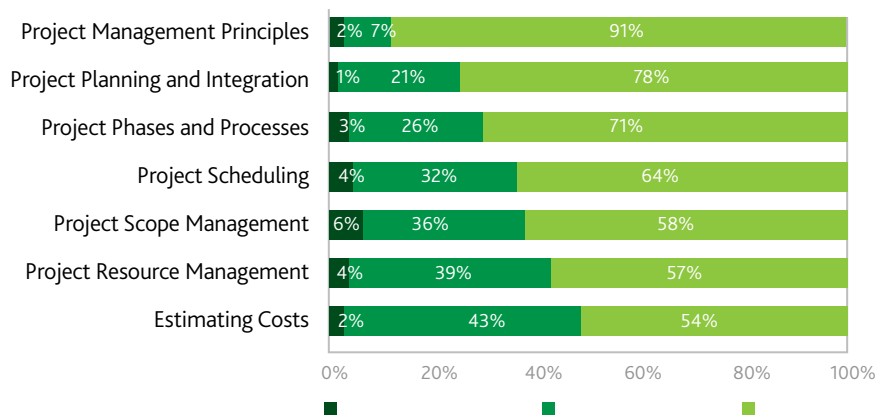


Figure 4-3: Ranking of technical KMs by order of importance

The recommendations suggest that for an introductory course, a comprehensive coverage of project planning topics and PM processes is desirable, while a reasonable coverage of project scheduling topics along with exposure to a scheduling tool is recommended. On the basis of this research and further analysis, we were able to recommend a prioritized list of specific topics for the Foundations of Project Management course, PM-1, introduced in Volume II.

Behavioral Knowledge Modules

Articulated in the mission of the curriculum design is one of its tenets: “Project management curriculum must prepare students for the professional work environment they will encounter upon graduation.” Therefore, the PM curriculum will place substantial emphasis on providing students with the ability to work in teams, communicate, and interact with stakeholders, along with exposure to ethics and professionalism.

Behavioral Knowledge Modules

- 1. Plan, Distribute, and Manage Project Communications [B-DC]
- 2. Project Team Building and Motivating [B-TB]
- 3. Project Leadership [B-PL]
- 4. Identifying and Engaging Stakeholders [B-SE]
- 5. Project Organization and Context [B-OC]
- 6. Managing Global Projects [B-GP]
- 7. Virtual Project Management [B-VP]
- 8. Ethics and Professionalism [B-EP]

Ranking Behavioral Modules

The following KMs were researched and presented to faculty experts to rank in order of importance:

1. Project Team Building and Motivating
2. Project Leadership
3. Project Organization and Context
4. Negotiating and Influencing
5. Identifying and Engaging Stakeholders
6. Ethics and Professionalism
7. Virtual Project Management

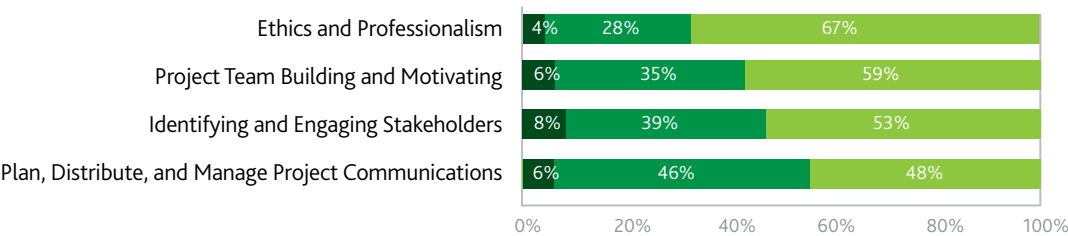


Figure 4-4: The top four behavioral KMs in order of importance, as ranked by the academic communities.

Once again, it should be noted that the choices were randomized and the faculty could select only one first choice as a KM of importance. The strong emphasis on ethics and professionalism as a foundational topic in project management is compelling and will serve the profession well. But, as determined by our task group and verified at workshops, the other key topics dealing with people skills and communication skills appear as highly rated choices of topics to be covered in a foundational course in PM.

Strategic Knowledge Modules

Strategic knowledge modules introduce a rich knowledge base of topics in PM, one that accommodates growth and changes in the field. For example, if an academic program wants to design a course or curriculum involving strategic planning of international projects and one involving project management governance of large complex projects, they select strategic KMs that deliver such learning outcomes and competencies.

Strategic Knowledge Modules

1. Strategic Project Management [S-SM]
2. Supply Chain in Projects [S-SC]
3. Legal Aspects in Project Management [S-LA]
4. Business and Commercial Aspects of Projects [S-BC]
5. Governance in Projects [S-GV]
6. Agile Approaches to Project Management [S-AM]
7. Portfolio and Program Management Principles [S-PP]

Many educational programs such as information systems project management (ITPM) often include comprehensive coverage of some elective KMs such as Agile Approaches to Project Management.

Core Knowledge Modules of a Foundational Course

Table 4-1 summarizes the core KMs that should be presented in a foundational PM course (see Volume II):

Table 4-1: Core KMs for a foundational course

Category	KM
Technical	Project Management Principles
Technical	Project Planning
Technical	Project Phases and Processes
Technical	Project Scheduling
Behavioral	Ethics and Professionalism
Behavioral	Project Team Building and Motivating
Behavioral	Identifying and Engaging Stakeholders
Behavioral	Plan, Distribute, and Manage Communications

If a curriculum accommodates the design of two courses in PM, it is natural to have two foundational courses in PM, one technical and the second focused on the behavioral aspects. This is illustrated in the next chapter. Alternatively, a balance of the coverage of technical, personal, and organizational topics in one course can be achieved, as illustrated in our exemplar course, Foundations of Project Management, or PM-1, which is described in Volume II.

Knowledge Modules Are Not Courses

Before we conclude this chapter, we need to assert that KMs are not courses. They are the building blocks of courses. To create a balanced curriculum of courses, we have to select topics from different KMs. This will be dictated by the needs of the academic unit introducing PM courses. When designing a course, we should also ensure that the learning outcomes are addressed. All of these issues are addressed in the next chapter, where we introduce exemplar courses.

A related issue to consider is redundancy of topic areas. When assembling courses from KMs, we need to watch for redundancy with existing courses in the domain. For example, two courses dealing with ethics and professional responsibility might appear in the curriculum, one in the PM track and the second in the discipline-specific bachelor’s degree in business track. The content of these courses might overlap significantly.

Description of Knowledge Modules

In Appendix I-A, we present a comprehensive description of each knowledge module. However, for purposes of reference, we list the KM titles and descriptions here.

Technical Knowledge Modules

1. Project Management Principles [T-PM]
2. Project Phases and Processes [T-PP]
3. Project Planning and Integration [T-PI]
4. Project Resource Management [T-PR]
5. Estimating Costs [T-EC]
6. Project Scheduling [T-PS]
7. Opportunity and Risk Management [T-OR]
8. Plan and Control Quality [T-PQ]
9. Procurement and Contract Management [T-PC]
10. Finance and Cost Budgeting [T-FC]
11. Project Scope Management [T-SM]
12. Project Control [T-CP]
13. Business Analysis & Requirements Management [T-BR]
14. Project Handover, Closeout, and Reviews [T-HC]
15. PM Information Systems and Information Management [T-IS]

Behavioral Knowledge Modules

1. Plan, Distribute, and Manage Project Communications [B-DC]
2. Project Team Building and Motivating [B-TB]
3. Project Leadership [B-PL]
4. Identifying and Engaging Stakeholders [B-SE]
5. Project Organization and Context [B-OC]
6. Managing Global Projects [B-GP]
7. Virtual Project Management [B-VP]
8. Ethics and Professionalism [B-EP]

Strategic Knowledge Modules

1. Strategic Project Management [S-SM]
2. Supply Chain in Projects [S-SC]
3. Legal Aspects in Project Management [S-LA]
4. Business and Commercial Aspects of Projects [S-BC]
5. Governance in Projects [S-GV]
6. Agile Approaches to Project Management [S-AM]
7. Portfolio and Program Management Principles [S-PP]

Mapping to the Knowledge Modules

Creating courses by mapping topics from different KMs provides the curriculum designer in an institution with flexibility in determining the appropriate topics for a course. Figure 4-5 illustrates how KMs map to courses.

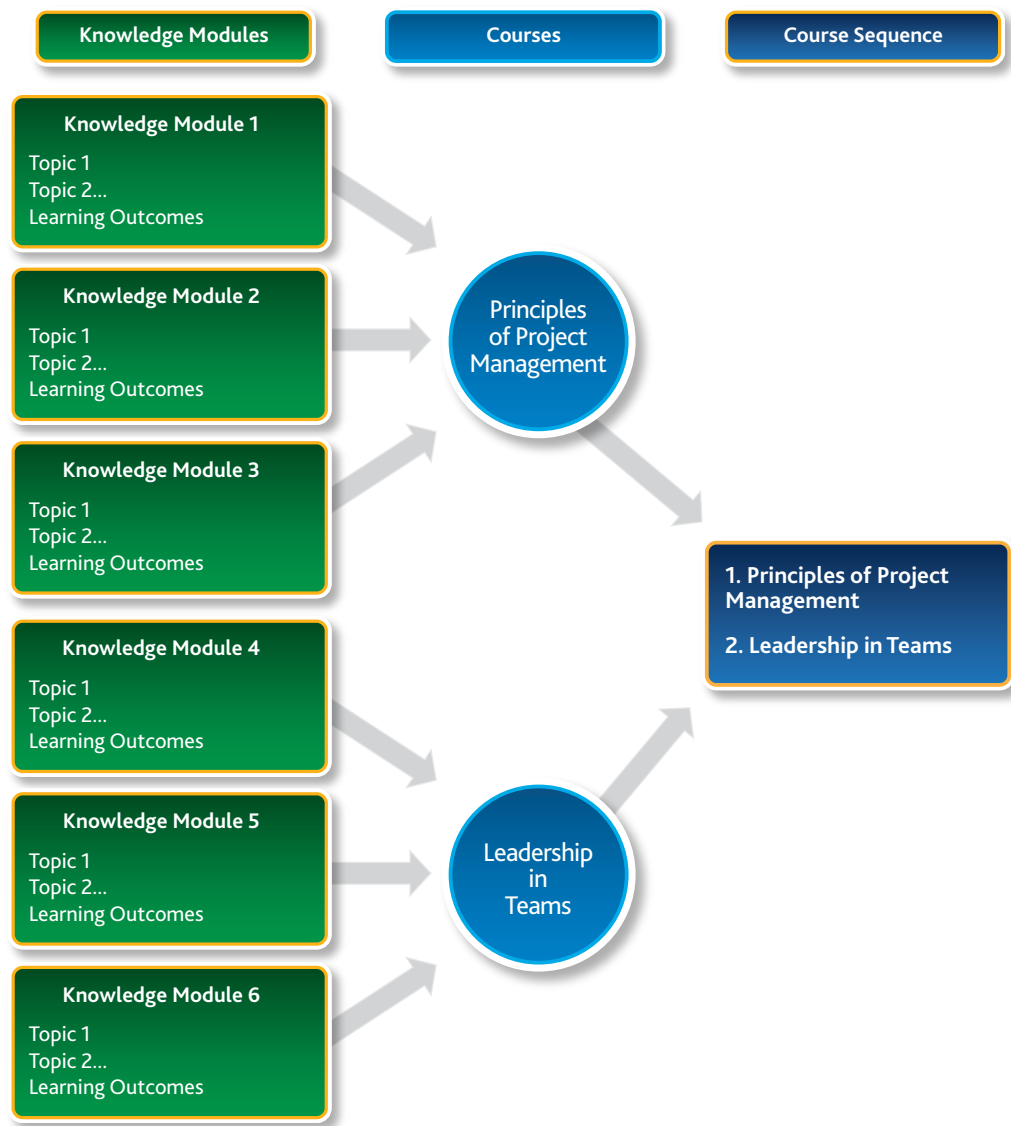


Figure 4-5: Mapping the knowledge modules to design a sequence of project management courses

On average, a course draws primarily from three KMs. For example, the PM-1 course, Foundations of Project Management, draws topics (many, but not necessarily all) from three KMs: KM-1: Project Management Principles, KM-3: Project Planning and Integration, and KM-6: Project Scheduling.

A course should, however, not be seen simply as a direct mapping of the topics in KMs. As illustrated in the composition of the PM-1 course, we integrated topics from more than the three major KMs but also drew risks from Opportunity and Risk Management, and ethics from Ethics and Professionalism. These were considered essential topics for a foundational course.

It is likely that implementers of the curriculum guidelines will need to consider other curricula issues and department needs before identifying the final list of KMs and topics to be included in a course.

Mapping courses to KMs in this manner provides flexibility in designing different types of curriculum for different types of disciplines and degree programs. It addresses our curriculum-design principle of assuring flexibility in course design and construction.

In Figure 4-6, we illustrate how a program might elect to skip Topic 2 when designing a course PM-1, but might instead select topics from KM-n.

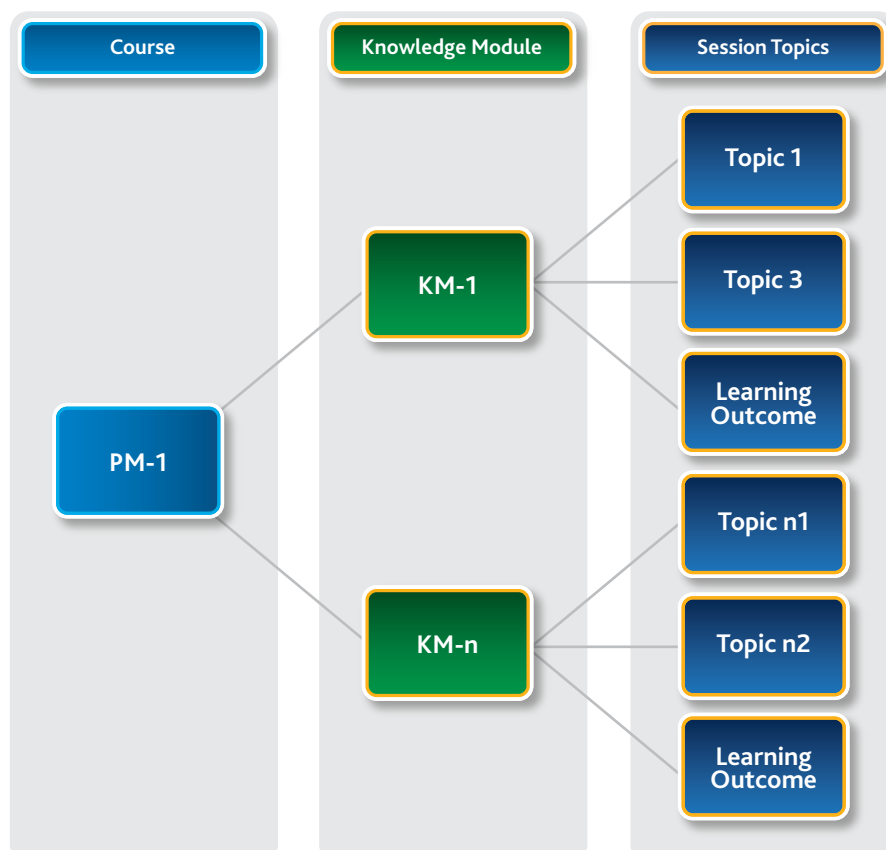


Figure 4-6: Flexibility in selecting topics from various KMs

An additional advantage of this approach is that it provides flexibility in terms of accommodating the different types of academic systems that exist globally. A case in point is the North American region of the United States and Canada. Some universities use a quarter system for scheduling courses, while others use a *semester* system. Here one can experience a range of *credit hours*—some colleges offer three credits of education in a semester, while others offer four credits.

Additionally, the definitions of credit hours, courses, modules, and terms vary widely by country and continent. For example, our unit of instruction, "courses," is referred to as "modules" in the United Kingdom. In this guide, we have generally used U.S. terminology: a course is taught over 16 weeks in a semester and the student earns three credits. Where possible, we have added examples from other international situations.

Goals, Objectives, and Learning Outcomes

Many accrediting agencies now require that faculty include clear objectives and learning outcomes in all course outlines and in their syllabi. So, to assist with that process we provide some details in Table 4-2 and summarize which sections of the guidelines should be referenced for such purposes.

Table 4-2: Learning goals, objectives, and learning outcomes

Curriculum Process	Answers the Question	Where Covered
Program Goal • Broad definition of student competence	What will students learn from a PM program?	See Chapter 3
Course Objective • Describes what is covered in the course	What does a faculty member intend to cover in a course?	See Chapter 5 & Appendix 1-B
Learning Outcome • Description of what a student must be able to do at the conclusion of a course	What will students learn from a course or a module? What are the transferable skills?	See Chapter 4 & Appendix 1-A
Assessing Outcomes • This is typically the focus of university administrators and accreditation agencies	What did they learn? What were the transferable skills?	Out of scope for our guidelines.

The systematic process for designing and assessing educational objectives was introduced in the previous chapter, where we defined student-learning goals for project management. In this chapter, we introduced learning outcomes within the context of knowledge modules (see Appendix I-A: Knowledge Module Specifications, where a comprehensive list of 90 learning outcomes is presented). This list provides an opportunity for educators to design courses with learning objectives that are relevant to their academic units. In the next section, we introduce courses that can leverage the KMs.

Conclusion

In this chapter, we introduced the notion of KMs and the role they play in curriculum design. They provide substantial flexibility to course designers when they set about creating a curriculum plan. We also grouped KMs into three areas briefly regarded as “technical knowledge”; “behavioral skills, capabilities, and competencies”; and “strategic awareness.”

Our surveys from faculty and practitioners suggest the following key points that might be relevant for curriculum design:

- An entry-level curriculum designed for entry-level professionals needs to introduce both technical and behavioral KMs. Students need to be skilled in both the art and the science of project management.
- A strong technical foundation, consisting of topics from several technical KMs that provide the required technical skills, is essential. However, a lack of even basic behavioral skills, capabilities, and competencies can have serious consequences for projects and certainly the career of the young professional.
- Depending on the organization, and the kind of projects it delivers, behavioral skills become equally as important as, if not more important than, technical skills. The good news, however, is that the project management behavioral skill set, especially leadership and interpersonal, would evolve as the young professional progresses in his or her career.

The discipline of project management cannot be taught only as chunks of knowledge modules. Courses that bring together the technical skills, behaviors, and competence of real-world project managers, and the dynamics of the organizations they work in, are needed. We introduce several such courses in the next chapter by blending in modules and their topics.

CHAPTER 5: PROJECT MANAGEMENT COURSES

The scope of this chapter is to identify a curriculum of courses for a bachelor's degree in project management, or for a project management track within a bachelor's degree in a cognate discipline such as IT, engineering, or business.

Here we identify unique PM courses based on the KMs introduced in the previous chapter. One of the most distinctive characteristics of KMs is that they allow us to design new courses from a broad range of subject topics, and these courses in turn can be sequenced into a program of study in PM.

Courses and Programs of Study in PM

A course incorporates topics from multiple KMs. Each course has the structure illustrated in Figure 5-1. It consists of the following attributes:

- Course Label: Shown as simply "course" in Figure 5-1
- Definition: A description of the course and the pedagogy
- Relevant KMs: List of relevant KMs associated with the course
- Objective and Learning Outcomes: A course objective describes the scope of the course in terms of topics. The relevant KMs allow us to derive the observable and measurable knowledge that a student should be able to demonstrate as a result of taking the course
- Topics: Lecture topics drawn from KMs
- Student Expectations: Includes topics such as any research required, laboratory work, teamwork, and preparation
- Instructional Hours: An estimate of time spent on each session topic
- Required or Optional: Status of the course in the curriculum structure
- Prerequisite: Indicates if the current course has a prerequisite

The data structure of the "course" introduced above should be familiar to most teaching faculty. A key difference is the association of "Relevant KMs" with the course. By identifying relevant KMs in a course, when designing courses, a professor has the opportunity to inherit topics and learning outcomes. It may be a stand-alone, self-contained course. It may also be tailored to a specific discipline, such as construction or information technology.

The pedagogical approach for the course includes the following considerations:

- Seminar versus lecture format
- Case-based
- Critical thinking skills required
- Teamwork

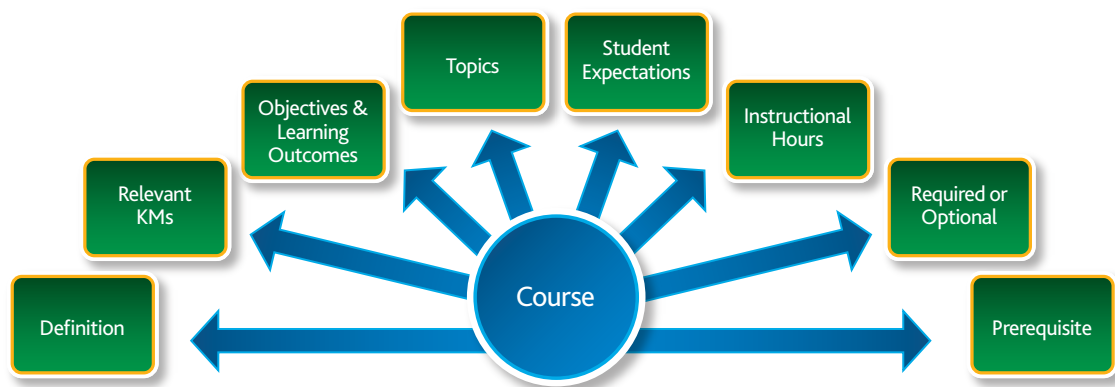


Figure 5-1: Data structure requirements of a course

Minimal Core for Project Management (PM Minor/Specialization)

In this section, we identify a minimal core for PM that can be used to create a minor subject concentration in PM. In some countries such a program of study in PM incorporated at the bachelor’s-degree level is regarded as a specialization in project management or PM specialization.

The identified courses are actual adaptations of fielded courses, and are based on the experiences of educators from a variety of disciplines, universities, and colleges worldwide. The courses and the sequence of the program of study in PM is an outcome of several workshops completed over a span of two years.

Building PM courses that target diverse disciplines is a challenge but nevertheless essential, as our goal is to make PM accessible to a wide range of programs. For such different targeted audiences with varying preparations and expectations, thematically focused adaptations of the introductory courses presented as follows are desirable. Students in a construction-management program would benefit from a course such as Introduction to Construction Project Management, as the content and case studies in the course can be specialized and made relevant for the construction-industry sector. However, with the exception of the Foundations of Project Management course, PM-1 (see Volume II), specialized discussion of courses for various disciplines is not presented in the guidelines. Curriculum designers should use the specified courses as a baseline and then adapt them as appropriate to a variety of industry domains.

An exemplar curriculum core of five PM courses is shown in Table 5-1. It balances all of the technical, behavioral, and strategic awareness KMs. These courses can be regarded as a foundational sequence of courses for the undergraduate PM curriculum.

Table 5-1: Foundational courses: A minimal core

Course	Course Title
PM-1	Foundation of Project Management
PM-2	Project Communications
PM-3	Advanced Project Management
PM-4	Leadership in Teams
PM-5	Organizational and Behavior and Projects

Students interested in this core would be pursuing a minor in PM within an academic unit where they are working toward a major in a non-PM discipline. A program of study involving several courses in PM can define a student's career path more clearly and enhance his or her employability upon graduation.

The minimal core illustrated represents a sound program of study in PM that can integrate well with undergraduate degree programs in diverse disciplines such as business, engineering, IT, or healthcare.

Curriculum for the PM Minor

Additional details about the core courses for the PM minor are provided as follows. We describe relevant principal KMs that are associated with each of the courses. These are only suggestions, and we strongly encourage you to select the most appropriate KMs relevant to your program.

PM-1 Foundations of Project Management

The objective of the course is to teach students how to approach project management and understand all the essential concepts from both a theoretical and applied perspective. It draws extensively from the following three knowledge modules:

- Project Management Principles
- Project Phases and Processes
- Project Planning and Integration

The course also draws upon lecture topics from several personal and organizational modules, such as the Ethics and Professionalism, Project Communications and Stakeholder Engagement, and Opportunity and Risk Management.

(Volume II of the curriculum guidelines illustrates this comprehensive first course in project management.)

PM-2 Project Communications

This course provides students with comprehensive project communications and stakeholder engagement knowledge and skills. They will master theoretical and applied skills drawn from the following KMs:

- Plan, Distribute, and Manage Project Communications
- Identifying and Engaging Stakeholders
- Project Organization and Context

The course might also draw topics from the Virtual Project Management and Managing Global Projects KMs.

PM-3 Advanced Project Management

This course builds on the foundation of PM-1 by introducing coverage of advanced topics in project scheduling, risk and quality management, and cost control as well as providing comprehensive knowledge of scheduling and other PM tools. This course can act as a mop-up for teaching the technical KMs not introduced in the PM-1 foundational course. It can draw extensively from the following KMs:

- Project Resource Management
- Project Scheduling
- Project Control
- Opportunity and Risk Management

The lecture topics from the following KMs are also typical of the advanced project management course: Estimating Costs, Plan and Control Quality, and PM Information Systems and Information Management. Depending upon the mission of the department it can also focus on the procurement and supply-chain KMs.

PM-4 Leadership in Teams

The objective of this course is to prepare students for the professional work environment they will encounter upon graduation, and to prepare them for careers as project leaders and managers. This course draws extensively from the following KMs:

- Project Team Building and Motivating
- Project Leadership
- Negotiating and Influencing

PM-5 Organizational Behavior and Projects

This course details the relationship between the organizations that host the projects and the projects themselves. Projects are a key vehicle for the execution of organizational strategy, and the effectiveness of that execution is determined to a large extent by the environment that the organization itself creates for those projects. This course draws from the following KMs:

- Project Organization and Context
- Strategic Project Management
- Ethics and Professionalism

A Major in Project Management (PM Major)

Global workshops resulted in a framework of ten exemplar courses that the faculty identified as relevant for students in a PM track. We approached the design of the course specifications from a deeper perspective by asking the question, “What is the landscape of PM education 10 years from now?”

The academic institutions interested in more comprehensive PM educational coverage can study the exemplar list of courses described briefly in this section and shown in full in Appendix I-B: PM Course Specifications. Developing a curriculum based on this course specification (which should be appropriately enriched with additional KMs from Appendix I-A) provides educators with an opportunity to create a comprehensive curriculum plan for a major in PM. We acknowledge that the terms minor and major are not universally familiar. A major in PM could be regarded as a primary degree or a joint degree (also known as PM specialism [UK]) in project management.

Note that this comprehensive coverage of PM in several courses also allows a program to integrate almost all the available PM curriculum KMs into a degree program.

Curriculum for the PM Major

It is difficult to recommend a model PM curriculum for a PM major due to the fact that different countries have different guidelines for offering degrees. The numbers of contact hours and courses vary significantly. Here we only attempt to identify a comprehensive PM curriculum core based around the nucleus of the five PM courses introduced in the previous section.

PM Courses

- PM-1 Foundations of Project Management
 PM-2 Project Communications
 PM-3 Advanced Project Management
 PM-4 Leadership in Teams
 PM-5 Organizational Behavior and Projects

Minimal Core

The following five courses can contribute to the curriculum plan for the major:

- PM-6 Project Governance
 PM-7 Project Procurement and Supply Chains
 PM-8 Project Stakeholder Engagement
 PM-9 Special Topics in Project Management
 PM-10 Integrative Study

Advanced Core

Additional details about the advanced core are provided next. We also describe relevant principal KMs that are associated with each of the courses.

PM-6 Project Governance

This course provides an integrated introduction to enterprise project and program management and project governance. Students learn all of the fundamental aspects of modern PM, both managerial and technical. It also focuses on change management. This course draws from the following KMs:

- Governance in Projects
- Project Scope Management
- Ethics and Professionalism

PM-7 Project Procurement and Supply Chains

In most organizations, projects are now delivered through complex supply chains and networks. They have several suppliers, contractors, and customers. There is project procurement involving detailed planning and scheduling time lines. This course begins with an exploration of core principles of project procurement and expands to a consideration of how modern organizations expand their influence beyond simple contractual relationships. This course draws from the following KMs:

- Supply Chain in Projects
- Procurement and Contract Management
- Project Handover, Closeout, and Reviews

PM-8 Project Stakeholder Engagement

The focus of this course is the application of the customer interface, leadership to ensure customer satisfaction, and sustainability. It also deals with the business and commercial aspects of PM. This course draws from the following KMs:

- Project Control
- Identifying and Engaging Stakeholders
- Managing Global Projects

PM-9 Special Topics in Project Management

This course focuses on introducing emerging trends and reviews unique methodologies and approaches to PM, such as Agile Approaches to Project Management or Virtual Project Management. Students investigate tools to conduct simulation and modeling to better understand scheduling and risk. Students are exposed to advanced research methods and often do some level of original research. This course draws from the following KMs:

- Agile Approaches to Project Management
- Portfolio and Program Management Principles
- Finance and Cost Budgeting

PM-10 Integrative Study

This could be a capstone course or a collection of multiple courses. The goal is to provide an opportunity for students to demonstrate that they have fully mastered the principles of PM. These courses can also integrate learning from the PM major with other non-PM courses. Courses may involve interdisciplinary partnerships among university departments and, even industry. This course draws from the entire set of KMs. Courses might include:

- Simulation
- Ethics and Professional Responsibility
- Advanced Cost and Schedule Estimation

Designing Additional Courses

In some universities, to meet the minimum degree requirements, an additional course or two might need to be offered. Here we illustrate how the KMs can be leveraged to identify relevant additional courses by illustrating the description of the course PM-11 Global Project Management. This course is designed by drawing from the following KMs:

- Managing Global Projects
- Portfolio and Program Management Principles
- Finance and Cost Budgeting
- Strategic Project Management
- Virtual Project Management

We present the course label and a detailed definition for a proposed new course as follows. We do not attempt to list topics, as an educator proposing such a course can derive them from the KMs. The topics can be enriched from other sources as well, including research papers (or relevant monographs such as “PM-11 International Development Projects” from PMI) and PM-12 Agile Approaches to Project Management as needed to develop a useful course.

PM-11 Global Project Management

This course provides an opportunity to acquire and integrate skills and knowledge as they pertain to international projects. Global projects demand a broad range of research, analysis, and skills in the financial planning and budgeting area. A key PM issue introduced throughout the course is managing complexity in projects, and how one can go about applying mindfulness and analysis for optimal results. Other issues introduced in this course include distributed project management, outsourcing, virtual project management, governance issues, language and cultural diversity, and management of risks. Students have an opportunity to master the topics of managing conflict in projects, change management, and portfolio and program management. This course also provides students with an opportunity to enrich leadership skills as they pertain to decision making within distributed teams, as well as change control in large, distributed projects.

PM-12 Agile Approaches to Project Management

This course provides students with the skills needed to master core concepts pertaining to agility and agile approaches to project management. Agility refers to the ability of an organization to rapidly react to unpredictable scenarios, and within the context of product development, to respond to unclear requirements. There are several industry domains where agility is being practiced, such as manufacturing, engineering, software development, and supply chain management. This course provides students with a comprehensive overview of the principles, processes, and practices of agile approaches to project management. Students learn techniques for initiating, planning, and executing projects using agile practices. Knowledge of agile development frameworks and agile tools and techniques are introduced.

PM Curriculum Plan and Structure for a PM Degree

The relationships between the various courses are illustrated graphically in Figure 5-2. It shows the relationships between the courses; arrows in the diagram indicate progression through the coursework. The first two courses (PM-1 and PM-2) are foundational courses in PM. Along with the next set of three courses, they constitute the minimal core of courses for a minor in PM.

The next group of courses (PM-6 to PM-n) can be regarded as upper-division courses. Collectively, they result in a PM sequence of courses that can span three years of undergraduate schooling.

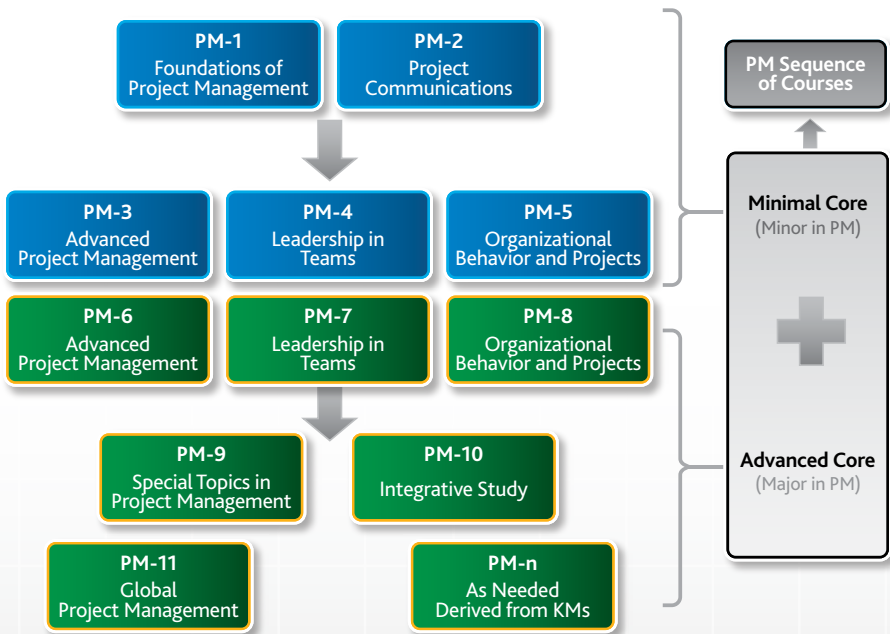


Figure 5-2: Structure of a possible PM curriculum plan

As specified earlier, we do not illustrate domain-specific courses, but the existence of a number of such courses provides us with the ability to come up with a PM bachelor's degree. For example, the bachelor's degree in construction project management would have an additional set of 10 to 12 application domain-specific courses in project management. The PM sequence of courses together with the application domain-specific courses would address the complete undergraduate schooling requirements for many typical degree structures globally to allow us to grant a full degree in project management.

We illustrate the relationships between the different educational categories in Figure 5-3. It describes one possible way in which an undergraduate academic degree in PM can be implemented, and ranges from 35 courses to 44 courses.

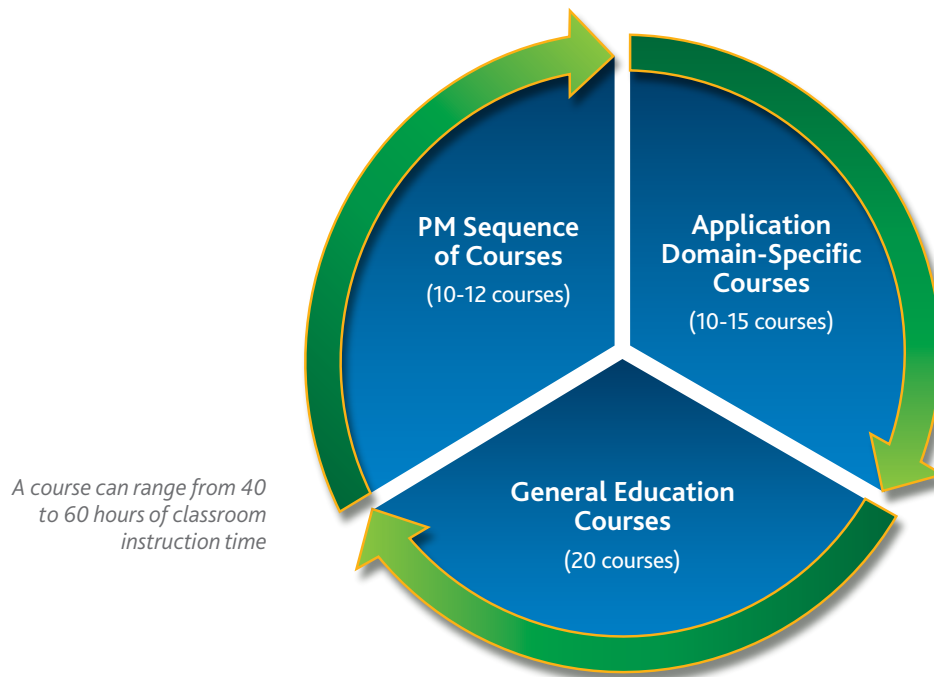


Figure 5-3: Undergraduate structure for a bachelor's degree in PM

Considerations in Designing the Curriculum

When designing a curriculum and selecting topics for either the major or minor, it is important to consider selecting highly diverse subject matter so that students get a good perspective on the breadth of the PM landscape. For instance, for students in a highly technical discipline (e.g., engineering or computer science), curriculum designers should consider integrating courses that are rich in behavioral and organizational topics. Content from KMs on project stakeholder engagement, communication, leadership, and organizational behavior can also provide a balanced education for computer science students.

We also recommend that the KMs and courses identified be customized with the student's course of study (industry domain such as health sector).

Finally, please note that we have omitted courses such as Ethics and Professional Responsibility and Risk and Quality Management. While these topics are very important, they are frequently integrated throughout the curriculum. Ethics and Professional Responsibility skills are readily found in most liberal arts and management-based curricula and are mandated as an educational program goal at many universities. So a discussion of whether or not Ethics and Professional Responsibility can be a stand-alone course can vary from discipline to discipline.

Risk and Quality Management similarly tends to be embedded within several courses, especially PM-1 and PM-3. Some technical and engineering disciplines, however, may decide to augment coverage of these topics by offering Risk and Quality Management as a stand-alone course.

Summary

With this chapter, we have completed our introduction of the organizational model of the PM curriculum framework. It consists of the following entities:

1. *Knowledge modules*: KMs constitute the basic “curriculum units” and are the repository for curriculum topics. They have been organized into three basic groups for classification purposes: technical, behavioral, and strategic.
2. *Courses*: KMs serve as the building blocks for courses. Their definition and scope vary from country to country, and even by institution within a country.
3. *A program of study in PM*: A sequence of courses within a degree can lead to a more detailed program of study in project management. In our model, we have introduced a five-course sequence for a minor in PM and suggested several additional courses for a major in PM.

CHAPTER 6: USERS OF CURRICULA GUIDELINES

In the evolving and rapidly growing field of PM, enhancing the marketability of undergraduate students depends upon the existence of quality PM courses and programs. Employers are increasingly requiring higher levels of specific competencies in new hires; the abilities employers expect of new graduates have dramatically increased. These graduates must be prepared to demonstrate higher levels of proficiencies and abilities than those who graduated as recently as five years ago. Accordingly, the primary audience for the curriculum guidelines is the committed, full-time faculty who will want to design, develop, and enhance undergraduate courses in PM, or maintain a current curriculum, and give their students an extra advantage when seeking first employment.

The curriculum guidelines will also likely be of considerable value to academic deans, directors, or chairs of departments who are interested in providing their students with new academic programs. Such programs can enhance their academic portfolios, generate newfound revenues, and help assure successful careers for their students.

For these stakeholders, we can visualize several program structures for the introduction of PM curriculum, as illustrated in Figure 6-1. It shows the relationships between a minimal foundational introduction of PM, a suggested sequence of PM emphasis (called minor in many countries), and comprehensive coverage of PM supporting a specialized degree in project management.

We can visualize progression through the three curriculum structures as a college or university introduces project management. Volume II describes the details of PM-1.

See Appendix I-C for course flow for PM emphasis (minors) and majors (specialized degree).

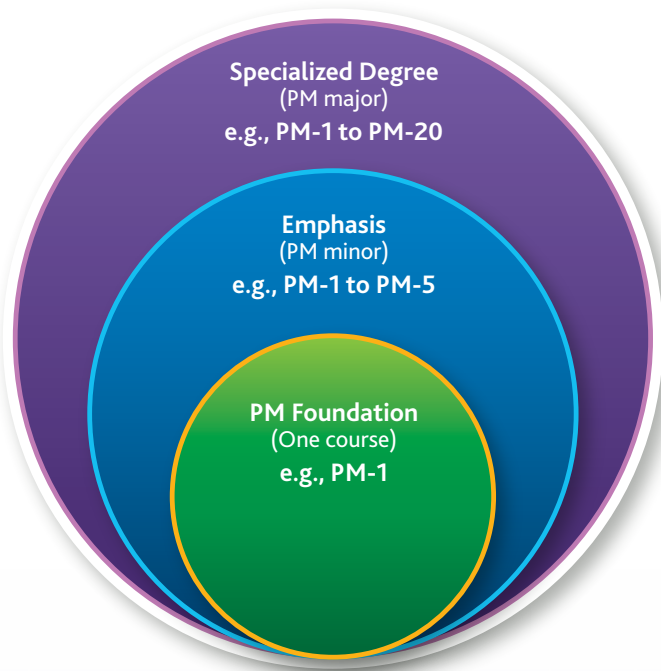


Figure 6-1: Curriculum structures: Foundational, emphasis, and specialized degree

Use Case Scenarios

We summarize the various scenarios for the use of the guidelines in Table 6-1. “Project-based” teaching, which involves learning through engagement in a project-intensive setting, is offered in many colleges and departments, both in technical academic units, such as engineering or computer science, and business units, such as innovation.

Table 6-1: Uses for the Guidelines

Use Cases	Overall (n=269)
#1 Introduce a new degree or joint degree that requires substantial depth of PM knowledge and competency.	This use case describes the scenario where a potential college is consulting the guidelines for a new undergraduate degree. Example: <i>The faculty member would review the curriculum guidelines and tailor the identified courses by studying the KMs and courses.</i>
#2 Benchmark and enhance an existing degree offering.	This use case describes the scenario where a potential college is interested in benchmarking and enhancing their existing PM curriculum. Example: <i>The user of the curriculum guidelines would leverage sample curriculum in Appendix B.</i>
#3 Introduce a new minor, joint degree, or undergraduate certificate in PM.	This use case describes the scenario where a potential college is interested in consulting the guidelines to introduce a new minor/joint degree/undergraduate certificate in PM. Example: <i>The faculty member would tailor the identified courses by reviewing the KMs in Appendix A.</i>
#4 Introduce a new course on PM.	This use case describes the scenario where a college wants to introduce their first PM course. This use case is very common, as many programs are now introducing a stand-alone course on PM. Example: <i>Users should leverage the exemplar introductory courses in Volume II of the guidelines along with its teaching resources.</i>
#5 Enhance an existing course	This case describes the scenario where a college is adapting an existing course. This course may or may not be a PM course. Example: <i>Add the PM Ethics KM into an existing Business Ethics course.</i>
#6 Using the product for project-based teaching	This case describes the scenario where a college is using modern project-based approach to teach PM. Example: <i>A college or department integrates KMs or individual curriculum topics across their primary curriculum as needed.</i>

Survey Results

Responses to the survey conducted by PMI provided insight into some of the use-case scenarios listed in Table 6-1. The responding cohort of PM teaching faculty and administrators, including deans and directors/chairs, showed primary interest in introducing new course content as a first priority. According to the research results, more than half the faculty are also interested in maintaining their existing courses. The guidelines provide value to this audience, as a review of the KMs can provide insight into additional lecture topics that could be integrated into various existing courses.

A significant number of the respondents to the survey (42%) are interested in the guidelines because they are considering adding a new course to their bachelor’s-level program. The survey results indicate that a large number of faculty members or administrators would use the guidelines to compare their program with best practices.

Table 6-2: Survey responses for use cases

Use-Cases	Overall (n=269)
To introduce <i>new content</i> to an existing bachelor’s-level course	55%
To introduce a new bachelor’s-level <i>course</i> in PM	42%
To introduce new <i>sequence of courses</i> in PM at the Bachelor’s level	39%
To introduce new bachelor’s-level <i>program of study</i>	32%
To benchmark/enhance an existing <i>course or course sequence</i> in bachelor’s-level PM	37%
To benchmark/enhance an existing bachelor’s-level <i>program of study</i>	30%
To introduce new course content, courses, or a program of study at the post-graduate level	43%
To benchmark/enhance an existing post-graduate course, sequence of courses, or program of study	44%

Conclusion

In conclusion, the primary audience for the curriculum guidelines is faculty who are responsible for designing, developing, and updating courses. There is clear evidence from the survey that a significant number of the faculty would be committed to reading the guidelines for benchmarking purposes as well. This is a “by academics for academics” curriculum-guideline project, and there is a high probability that the faculty members interested in leveraging the guidelines would also want to contribute to keeping it updated.

CHAPTER 7: IMPLEMENTING THE CURRICULUM

In this chapter, we describe issues ranging from introducing the curriculum to institutional challenges within the context of implementing the curriculum guidelines.

Introducing the Curricula Guidelines

A survey of PM curriculum courses and programs at several colleges and universities will reveal that the courses are being offered slowly when compared to market demands, and in a haphazard manner, with a lot of missing content or redundancies in content in different courses. This is possibly due to the fact that at many colleges globally, PM faculty are not assigned specifically to dedicated departments. Therefore, it is timely to provide curriculum guidelines to facilitate the smooth introduction of PM competencies at these institutions.

Deploying the PM curriculum guide at any individual institution requires consideration of, and adaptation to, local needs. The institution must think about innovative ways in which the KMs may be best integrated into a new set of courses or inserted into existing courses to make them PM-centric. Consideration of the department's mission, faculty strength, industry demands, and student needs will help to ensure successful introduction of the guidelines.

Challenges with Managing the Size of the Curriculum

Although the field of PM has a key role to play in other disciplines, it is not feasible to significantly expand the size of the PM curriculum in other undergraduate programs. Using smaller knowledge modules, which can be integrated into existing courses, is a good approach to overcome this challenge. Institutions don't have to adopt entire courses from the guidelines; they can take smaller chunks of knowledge modules and integrate them into existing disciplines.

The Research Dimension

By introducing guidelines for PM, the academic community is taking yet another step toward establishing project management as a formal academic discipline. Since many educators are also researchers, the majority are inclined to see a sound research dimension introduced in all aspects of PM educational curriculum. In the resources provided with the curriculum guidelines, we are offering an activity assignment that develops scholarly practices in the art and science of writing research papers.

Because PM is a component of a wide array of academic disciplines, PM literature tends to be scattered throughout multiple college libraries in most large universities. Therefore, it is helpful to create a centralized project management literature research web page for students to support the research dimension of PM education. The reference librarian at most universities will be supportive of requests to create a customized PM research page detailing available PM resources.

Balancing the Knowledge Modules

The curriculum guidelines have a large number of technical modules, which are appealing and relevant. Engineering and technical disciplines, such as computer science, risk selection of more technical KMs at the expense of behavioral and strategic-awareness KMs. However, there needs to be equal emphasis on soft skills such as those emphasized in the personal and organizational modules. These modules focus on communication at multiple levels and strategic decision making, and support an understanding of the project within the context of organizational or management behavior. If it is not possible to dedicate entirely new courses to such topics, one may want to insert content from the personal and organizational KMs into

the technical courses. Indeed, industry feedback reveals that we have to provide a strong focus on the human, organization, leadership, and management skills that are so necessary today within the context of implementing projects.

Project management should not be perceived only as an implementation function without any connection to organization strategy or leadership. A well-designed curriculum should incorporate additional dimensions of PM, such as learning around teamwork, decision making, organization behavior, systems engineering, change management, project knowledge, and effective communications. Even the foundational course in PM should challenge undergraduates to consider the broader role of PM in leading a change and guiding people involved in the change.

Finally, the importance of experiential education within the context of balancing the curriculum cannot be emphasized enough; interviewed practitioners indicate that while a prospective student's assertion, "I took coursework in project management," may be good, it is not sufficient. The industry will continue to prefer experience over formal education. A curriculum leveraging experiential learning and case studies must fully immerse students in the real world of organizational politics and conflicts, and negotiation around resources, schedule, and cost. Students need exposure to working on projects within severely resource-constrained environments, and working in non-matrixed or projectized organizations. All of this will require creative implementation of courses and useful resources such as case studies, simulations, and more.

Differences Between Undergraduate and Graduate Curricula

At first glance, the KMs would appear similar to those in a graduate curriculum, and indeed, there is a substantial overlap in the knowledge base; however, there are some principal differences between the undergraduate and graduate curriculum.

The topics and the rigor with which the topics are covered are different at the undergraduate level. Research and the depth of PM investigation and analysis are more significant at the graduate level.

Selection of KMs for teaching also might vary when compared with the graduate curriculum. Some of the KMs in the *strategic awareness* group are of more significant importance for coverage at the graduate level. For example, Portfolio and Program Management Principles, and Agile Approach to Project Management, are relevant topics for introduction at the undergraduate level, but their coverage in the graduate PM curriculum is more comprehensive.

Actively Promoting and Marketing PM Education

Project management is a new academic discipline, and awareness of this discipline is still a challenge in academia. Students are often not aware of career opportunities associated with taking even a single PM course. Promoting possibilities of introducing courses in PM to students and faculty is therefore very important.

Once introduced, success requires maintaining a commitment to actively scheduling PM courses. Initial enrollments can sometimes be low until awareness of PM courses spreads throughout the institution and the local region.

A good opportunity for recruiting potential PM students is identifying and recruiting *non-traditional* students. These could be working students interested in a career change, the accidental project manager (someone thrust into the role of being a project manager who does not possess the PM basics), or the mature, working student who did not complete a bachelor's degree due to career constraints. All of them might possess rich working experience that translates well to a career in project management.

Project work, and the role of a project manager, is fast becoming popular in the administrative units of academia. There is an opportunity to build on this momentum and communicate the essential role project management plays in successful implementation of academic and administrative projects. This can serve to establish PM as a valuable discipline within academia.

PM Learning Outcomes Align With the Institution's Academic Mission

A case can be made to encourage courses in PM by demonstrating that the learning outcomes for PM courses align well with the educational objectives and mission of the college. Program goals such as “student will be able to work in diverse cultural environments” and “student will demonstrate effective communication skills and ability to work well in teams” align well with the mission of typical PM curriculum. Within this context, stakeholders such as deans, provosts, and chairs need to be made aware of the importance of the undergraduate course in PM. Just as courses in mathematics, physics, and chemistry are considered valuable for general education, an argument can be made that an introductory PM course could fulfill the requirements for general education. A modest start would be to collaborate with departments willing to introduce the course PM-1 Foundations of Project Management as an elective.

Conclusion

In this volume, we have introduced a framework of knowledge modules. The modules represent curriculum building blocks that support project management education in a flexible manner. For instance, topics from any three relevant knowledge modules can be assembled into a sound foundational course in project management. Alternatively, depending upon the area of emphasis in an academic department, selected topics from several knowledge modules can be assembled to create a foundational course. This flexible approach permits specialization in curriculum and development of a variety of subject-oriented concentrations, such as IT Project Management, Health Informatics Project Management, Construction Project Management, and Engineering Projects Supervision.

Note that the current version of the guidelines identifies thirty knowledge modules and twelve unique course descriptions that are relevant in a primary project management career track. These are introduced in the appendix in the next section.

Students taking twelve or more PM courses are possibly in a pure PM degree program such as BS Project Management, BS Construction Project Management, or BS Engineering Management. Students taking four to six PM courses can be said to be in a program with a “project management emphasis” or taking a “minor in project management.” It is important to note that globally different institutions use different terms to describe PM degrees, PM programs, and majors or minors in project management. The pmiteach.org website describes equivalent terminology.

While students out of college would be hired first and foremost for their technical ability in their profession, the traits that employers would immediately seek out would be effective behavioral skills and competencies. Strong teamwork, interpersonal and communication skills will be expected from the new hires. In some competitive environments employers will soon be expecting students to display leadership abilities and take over projects that implement significant change!

Crafting an ideal PM curriculum framework is a challenge. A candid comment from a hiring manager in the industry who reviewed the *PM-1 Foundational Course in Project Management* captures this challenge: “A student needs to know more than just the fundamentals, having been through years of organizational politics, team dysfunctions, and project failures...a newly minted graduate without additional PM background would not be successful where I currently work.” In the curriculum guidelines, we have specified several knowledge modules that address the behavioral and leadership competencies that are expected in the professional workplace. The instructor should target such topics so as to develop student knowledge and fundamental skills through the use of exercises, case studies, and term projects. Our exemplar courses provide examples of such activities and assignments. There is encouragement and optimism from many reviewers of the guidelines—the following comment about the PM-1 foundations course hits the mark: “If new employees came to us with this kind of education and awareness, it would be much easier for us to raise their level of maturity and have them fully functional in the workplace faster!”

In conclusion, with the introduction of the guidelines, we have simply presented a baseline for a dialogue with the academic community, and through continued feedback and collaboration, we hope to develop a comprehensive and useful PM curriculum. When all is said and done, the success of PM graduates in the workplace will serve as a testament to the value of the curriculum guidelines.

APPENDIX I-A: KNOWLEDGE MODULE SPECIFICATIONS

Summary List of the Thirty KMs

Technical Knowledge Modules

1. Project Management Principles [T-PM]
2. Project Phases and Processes [T-PP]
3. Project Planning and Integration [T-PI]
4. Project Resource Management [T-PR]
5. Estimating Costs [T-EC]
6. Project Scheduling [T-PS]
7. Opportunity and Risk Management [T-OR]
8. Plan and Control Quality [T-PQ]
9. Procurement and Contract Management [T-PC]
10. Finance and Cost Budgeting [T-FC]
11. Project Scope Management [T-SM]
12. Project Control [T-CP]
13. Business Analysis & Requirements Management [T-BR]
14. Project Handover, Closeout, and Reviews [T-HC]
15. PM Information Systems and Information Management [T-IS]

Behavioral Knowledge Modules

1. Plan, Distribute, and Manage Project Communications [B-DC]
2. Project Team Building and Motivating [B-TB]
3. Project Leadership [B-PL]
4. Identifying and Engaging Stakeholders [B-SE]
5. Project Organization and Context [B-OC]
6. Managing Global Projects [B-GP]
7. Virtual Project Management [B-VP]
8. Ethics and Professionalism [B-EP]

Strategic Knowledge Modules

1. Strategic Project Management [S-SM]
2. Supply Chain in Projects [S-SC]
3. Legal Aspects in Project Management [S-LA]
4. Business and Commercial Aspects of Projects [S-BC]
5. Governance in Projects [S-GV]
6. Agile Approaches to Project Management [S-AM]
7. Portfolio and Program Management Principles [S-PP]

The Technical Knowledge Modules

1. Project Management Principles (T-PM)

This module introduces the principles of PM applicable to all projects. It examines the core concepts and applied techniques for cost-effective management of projects. It provides an introduction to the importance of PM, organizational strategy, project selection and prioritization, as well as organizational capability within the context of projects. This can include structure, culture and roles, project life cycle and organization, and developing project-related product or service description and chartering a project.

Key Topics:

- Core concepts: prerequisites for a project (business case) and projects, PM, and the role of the project manager
- Benefits of PM
- Projects and their environment
- Organizational strategy and opportunities
- Projects, business strategy, and project alignment
- Projects, organizational structure, and governance
- Project portfolios and project selection
- Competencies of project personnel
- Project constraints: types, interdependency, and balance
- Project initiation: opportunity evaluation, sponsors, stakeholders and strategy, and chartering a project

Learning Outcomes:

- Analyze the importance of PM in the context of various organizational cultures and strategies, and summarize the essential components of a project and the processes that are considered essential to its successful implementation.
- Evaluate factors important to project selection and prioritization as evidenced by organizational capability and available resource capacity.
- Evaluate and recommend an appropriate project management strategy for a new project to meet stakeholder expectations in a given organizational context.

2. Project Phases and Processes (T-PP)

This module provides in-depth coverage of the project life cycle and PM processes. Traditional and agile life cycles are illustrated and contrasted. This module covers recommended process groups and processes that a project manager can tailor for a specific phase or an entire project. Key PM processes are identified in international standards. Process groups include initiating, planning, executing, monitoring and control, and closing. Processes, which are associated with a process group, have inputs, tools and techniques, and outputs.

Key Topics:

- Project life cycles: traditional, predictive, and agile
- Process groups, processes, and knowledge (subject) areas
- PM processes and international standards
- Initiating, planning, implementing, controlling, and closing process groups
- Overview of all key process groups and knowledge areas
- Primary inputs and outputs associated with processes
- Map process groups with subject areas
- Relationships and interactions between processes, process groups, and subject areas
- Contrast project life cycles with process groups

Learning Outcomes:

- List and describe the project phases that make up a typical project, and summarize the PM processes that occur within each. Explain the relationships between subject areas, process groups, and processes.
- Describe the typical PM process, its documentation, and deliverables that are produced in each project phase.
- Given an organizational context, project objectives, and business strategy, generate a sequence of PM processes and activities that will meet stakeholder expectations, and, for a specific industry, construct and assess an appropriate life cycle.

3. Project Planning and Integration (T-PI)

Using the project charter and pre-project data, students learn to develop a project plan. They learn how to identify and categorize requirements, define the project scope, create a work breakdown structure (WBS), sequence activities, create a schedule, and identify the critical path. Students also learn to estimate costs, assess risks and quality, and produce subsidiary plans for managing stakeholders, human resources, communications, and procurement. Students learn the broader definition and role of the project plan and all of its components. The topic of project integration is introduced, establishing the important role of the project manager as the person who not only leads the effort to create a comprehensive project plan but also executes the processes that result in successful implementation of the project plan.

Key Topics:

- Identifying requirements and producing the scope and specification
- Creating a WBS
- Estimating activity duration
- Constructing a network of project activities and identifying the critical path
- Identifying and scheduling resources
- Optimizing the allocation of resources: smoothing and leveling
- Developing a project schedule and optimizing it to accommodate project constraints
- Creating a project plan and bringing together all subsidiary planning documents
- Understanding the role of project manager as an integrator
- Integration of processes and their role in defining, planning, executing, controlling, and closing a project

Learning Outcomes:

- Given an organizational context and project objectives, create a charter and a preliminary scope that document high-level project strategy, milestones, deliverables, and estimates for stakeholder, customer, and sponsor approval.
- Construct a project management plan that documents the actions necessary to define and coordinate activities; assesses project deliverables; and ensures the control and management of cost, schedule, and changes to the project.
- Assess the interaction between the various components of a project, and evaluate and critique how changes in one component can impact how project managers should adjust activities, coordinate responses, and communicate the results to stakeholders.

4. Project Resource Management (T-PR)

This KM deals with acquiring and assigning resourcing to projects, and the management of those resources. It addresses establishing and coordinating a project team; estimating and quantifying the required resources; and building, developing, and managing the team. It covers resource planning: identifying resources, including subcontracted resources, and querying historical information regarding various types of resources. Finally, organizational policies and procedures are reviewed and the plan is made consistent with them.

Key Topics:

- Resource planning: estimating and balancing
- Identifying and acquiring the required human resources, including supplier resources
- Documenting team roles and responsibilities
- Identifying and acquiring the required equipment, materials, and resources
- Managing resources, including equipment, materials, and the project team

Key Topics (*continued*):

- Decision-making tradeoff when experiencing resource and schedule constraints
- Tools and techniques for resource management, including organizational breakdown structures and responsibility assignment matrices
- Staffing, training, and development of resources
- Global teams and networks

Learning Outcomes:

- Identify necessary labor and material resources, including contracted resources, and estimate the units of each that are required to meet stakeholder expectations.
- Apply appropriate resource management tools and methods in a given project context, including organizational breakdown structures, responsibility assignment matrices, and other means, to document and communicate project roles and responsibilities.
- Evaluate and select commonly accepted methods for project managers to acquire, develop, and manage human resources that are appropriate in a specific project context and consistent with established policies.

5. Estimating Costs (T-EC)

This module provides comprehensive exposure to cost estimation in the project domain. Students will develop reliable estimates at an appropriate level of detail. Various estimating methods are covered, including analogous, parametric, and bottom-up. Cost estimation methods are supported by specialized, computer-based tools.

Key Topics:

- Principles and concepts in estimating cost
- The life-cycle stages of project estimating
- Estimating approaches and models
- Managing estimates: continuously refining and improving estimates
- Improving the estimation process
- Understanding project costs: direct and indirect costs, overhead, and other expenses
- Estimating contingency costs and management reserves
- Estimating the impact of cost-estimation changes on project duration and staffing
- Managing changes to time and cost

Learning Outcomes:

- Analyze the project's goals and select an appropriate cost-estimation approach.
- Prepare a cost estimate and analyze staff resources, cost drivers, contingency costs, and management reserves.
- Evaluate types of resource costs necessary to draw up a complete cost estimate, and determine the accounting category of each, such as direct, indirect, capital, and operating.

6. Project Scheduling (T-PS)

This KM introduces advanced techniques for planning, managing, and controlling the schedule. The student will learn to create, analyze, and manage the critical path. The student will study resource leveling and scheduling within constraints (limited resources, time, cost, quality, risk, and communication). The student will learn how to use scheduling software at an advanced level. The student will study advanced formal scheduling techniques, such as earned schedule and program evaluation and review technique (PERT).

Key Topics:

- Creating networks, estimating durations, and analyzing the critical path
- Estimating, analyzing, and managing the schedule, using the critical path method (CPM), critical chain, and PERT
- Optimizing the schedule and assessing the impact on resources and costs—crashing and fast-tracking
- Managing schedule variance using earned-value analyses, and optimizing schedule performance using corrective options and actions
- Estimating schedule contingencies, schedule buffers, and management reserves, and managing risk
- Understanding schedule-management approaches and tactics to keep projects on schedule
- Schedule and cost integration

Learning Outcomes:

- Categorize and distinguish between commonly used approaches for the analysis and management of project schedules, including CPM, critical chain, and PERT.
- Given a project plan and proposed schedule, apply one or more specific techniques to analyze the schedule, and identify and classify issues and risks that could impact the schedule.
- Demonstrate the use of tools and techniques, such as CPM, fast-tracking, crashing, and resource leveling in typical PM software.

7. Opportunity and Risk Management (T-OR)

This module covers project risk management, including project risk planning, roles and responsibilities, risk definitions and categories, opportunity and risk identification, risk analysis, risk response or risk treatment, and risk monitoring and control. The module covers tools and techniques for qualitative and quantitative risk analysis.

Key Topics:

- Identifying risks and opportunities
- Identifying sources of risk
- Performing qualitative and quantitative risk analyses
- Creating a risk-management plan
- Executing simulation tools to quantify risks
- Understanding the roles and responsibilities in risk management, including the role of the project manager
- Understanding the organizational structure for risk management
- Establishing a risk-response plan
- Managing the treatment of risks, including addressing secondary or residual risks

Learning Outcomes:

- Construct a qualitative risk assessment using tools such as a risk-assessment matrix and a quantitative risk assessment using tools such as expected monetary value and decision trees.
- Evaluate the nature of risk and opportunity, and construct a prioritized risk register.
- Given a specific project context and plan, classify the project risks and construct a prioritized risk register with a risk-response plan.

8. Plan and Control Quality (T-PQ)

This KM focuses on all aspects of quality management of the project and includes understanding and evaluating the organization's quality policies and processes, developing an appropriate quality policy and plan, using quality tools and techniques, and understanding the key processes for measuring and documenting the project's quality. The module also covers tools and techniques for assuring quality during the project-execution phase, as well as controlling project and product quality.

Key Topics:

- Definitions of quality, foundations, and paradigms
- Quality approaches: defect identification, prevention, avoidance, and correction
- Components of quality management in projects
- Developing a quality-management plan
- Project requirements and identification of metrics to manage quality
- Integrating quality-management activities within the project
- Tools for managing project quality, including Ishikawa diagrams, control charts, and audits
- Continuous improvement and related quality processes
- Inspection and quality assurance
- Quality-control techniques
- Managing changes and quality issues with stakeholders

Learning Outcomes:

- Evaluate the core quality processes and explain the role of each process in planning and managing projects.
- Given a project scenario with a well-defined goal and scope, construct a comprehensive quality plan that addresses the stakeholders' needs.
- Apply appropriate quality-control tools and techniques to a given scenario where improvement is warranted as a result of the project's quality-control data.

9. Procurement and Contract Management (T-PC)

This module includes identifying project needs by using techniques such as a make-or-buy analysis, solicitation planning, and determining vendors through the bidding process. The module also covers contract types, their risks, and their advantages and disadvantages for the project manager and the vendors. The module covers tools and techniques for evaluating contract incentives, the method of contracting with the appropriate vendor, and the processes for monitoring and managing them.

Key Topics:

- The processes for planning procurements
- Identifying project needs, including make-or-buy analysis
- Identifying potential deliverables for contracting and their delivery milestones
- Determining a vendor and the bidding process
- Determining contract types, risks, and incentives
- Solicitation planning
- Awarding the contract
- Monitoring and managing the vendor

Learning Outcomes:

- Construct a procurement management plan that reflects the project's procurement needs.
- Analyze different types of contracts and the risks associated with each type of contract and determine contract incentives.
- Evaluate and recommend best practices for vendor management and contract-procurement monitoring.

10. Finance and Cost Budgeting (T-FC)

This advanced cost-management module describes the processes that follow project cost estimation and pricing. Students master how to construct a project budget and how to monitor and control it. Fundamentals of accounting and finance are reviewed.

Key Topics:

- Project-budget process
- Cost centers, cost metrics, and cost history
- Cost-control tools
- Strategies to address cost escalation
- Financial decision making
- Capital and operational expenditure categories

Learning Outcomes:

- Critique the concepts of responsibility-center accounting and budgeting.
- Given a specific project context, which includes a plan, cost, schedule, and deliverable metrics, analyze the project data, classify various project expenditures as capital or operational, and recommend approaches for funding the project.
- Apply best practices for project cost control to case problems, and recommend specific approaches that can be taken by the project manager to ensure that the project meets its financial expectations.

11. Project Scope Management (T-SM)

This KM covers advanced topics in managing scope within projects and their context. It covers scope verification and validation. Finally, change control and configuration management is explained in detail, as it is a necessary mechanism to ensure that such changes are handled in a managed and controlled way in order to keep the project on track.

Key Topics:

- Project scope versus product specifications
- Processes associated with project-scope management
- Collecting and defining requirements
- Scope management plan
- Change-control and configuration management
- Scope verification and validation
- Best practices to plan and manage scope changes
- Monitor progress and manage issues by ranking them and escalating them

Learning Outcomes:

- Evaluate how changes to project scope may impact the project's schedule, cost, and quality, and create a scope document that will produce the desired project outcomes.
- Prepare a scope management plan that ensures the identified project work is completed after verification and validation.
- Given a project context involving scope changes, recommend appropriate change-management activities.

12. Project Control (T-CP)

The module introduces advanced topics related to project execution. The important topic of managing project changes is addressed. This includes activities such as comparing actual performance with planned performance, and analyzing variances as they pertain to project scope, quality, schedule, and cost. This module also describes how to take corrective actions when needed, and how to formally communicate project status to stakeholders. Earned value management (EVM) for controlling project cost and schedule is covered here.

Key Topics:

- Project progress and performance
- Identifying changes to the project baseline
- Project tracking and monitoring: planned versus actuals, deliverable status list
- Determining the impact and following procedures as defined in the change-control plan
- Communicating project issues, their impact, variance, changes, and proposed solutions to stakeholders
- Change-control and configuration management.
- Earned value management to monitor and control cost and schedule
- Earned value approach to forecast revised project estimates

Learning Outcomes:

- Apply EVM techniques to assess the project cost and schedule.
- Evaluate variances as they pertain to project scope, cost, and schedule, and demonstrate how to formally communicate such variances to the stakeholders.
- Estimate revised costs and schedule forecasts using EVM and report the new estimates to the stakeholders.

13. Business Analysis & Requirements Management (T-BR)

This module covers the essential concepts in the domains of business analysis and requirements management. The focus is on business analysis, requirements elicitation, requirements prioritization, and facilitating and tracing implementation of requirements. This module also focuses on integrated change control, and covers related topics that ensures stakeholder satisfaction within the context of project changes.

Key Topics:

- Business analysis and its application in project and program management
- Evaluate business needs, elicit requirements from stakeholders, and recommend a viable solution
- Tools and elicitation techniques for capturing requirements
- Specify and document functional and non-functional requirements using techniques such as user stories or use cases.
- Create a requirements document and document acceptance criteria
- Create a requirements traceability matrix to monitor and control a project
- Tools and techniques to support requirements management
- Controlling and communicating requirement changes
- Change management and integrated change control processes
- The purpose and major tasks and activities of configuration management

Learning Outcomes:

- Construct a plan for best practices in business analysis, requirements elicitation, and requirements management that can be applied to a given project.
- Evaluate the relevance of identified tools and techniques to elicit and document requirements.
- Implement a plan to manage project changes and communicate changes to stakeholders.

14. Project Handover, Closeout, and Reviews (T-HC)

This KM introduces the key concepts pertaining to project closeout and completion of projects, including the project audit process. This includes administrative closure, lessons learned, and contract closures and payments. Finally, the important topic of post-completion reviews is covered here.

Key Topics:

- Activities necessary to formally close a project
- Special cases where projects have been suspended or abruptly ended for business or other reasons
- Obtaining final acceptance
- Formal project audits
- Transfer of deliverables to stakeholders
- Contract closure and payments
- Other administrative closure activities
- Executing processes for releasing project resources
- Lessons-learned activities and reporting
- Post-completion project reviews
- Communicating project and team-member performance to the organization

Learning Outcomes:

- Evaluate the best practices of project closeout and show how they must be adapted, depending upon how the project context varies in formality, scale, and complexity.
- Interpret the signs of a troubled project and assess whether the project manager should either continue operation or execute an early termination, and recommend what specific activities might be incorporated in the project to achieve each outcome.
- Incorporate into a PM plan appropriate approaches and methods for project audits, reviews, and performance reporting.

15. PM Information Systems, and Information Management (T-IS)

The focus of this module is on PM Information Systems (PMIS) and their use. In this module, students learn to leverage various information management tools in depth. Students learn how IT systems can help with managing various aspects of project documentation and communications.

Key Topics:

- Overview of software systems from spreadsheets to full-blown enterprise solutions; applications include document management, accounting, scheduling, estimating, word processing, and electronic data interchange (EDI)
- Characteristics of project management information system (PMIS) and their benefits
- Information and data required by both the organization and the project to manage and execute projects successfully
- PMIS integration into, and support of, functional units (finance, HR, production)
- PMIS software to manage documentation, resource pools, and project costs and schedules
- PMIS software for supporting stakeholder communications

Learning Outcomes:

- Appraise the features, advantages, and disadvantages of typical PMIS, from simple spreadsheets to enterprise systems, and demonstrate which project contexts may be best suited for certain types of PMIS and why.
- Given a complex project context and its plan, use one or more PMISs to recommend a suite of tools, and demonstrate how the PMISs will be used to monitor and control project deliverables.
- Demonstrate how collaboration and communication tools that are provided in a PMIS can be used in various types of projects, and defend the best practices in the use of these tools.

The Behavioral Knowledge Modules**16. Plan, Distribute, and Manage Project Communications (B-DC)**

The role of communications in planning and managing projects is covered in this KM, which covers communications planning, developing and distributing information, and reporting to relevant parties. This module uses communication analysis, design, and delivery techniques to familiarize students with concepts, tools, and skills that effectively influence stakeholders. This module covers the formal theory behind effective listening and two-way communications.

Key Topics:

- Communication models, communication process
- Communication barriers, communication tools and techniques
- Types of communication and information distribution
- Communication planning
- Relationship between project complexity and communication
- Planning and executing effective project communications, such as formal and informal, face-to-face, virtual meetings, performance reporting, and briefings
- Personal communication, managing meetings and presentations
- Writing performance reports

Learning Outcomes:

- Distinguish between formal and informal communications methods and defend when each is applicable on a project.
- Evaluate and select appropriate communication tools and methods to communicate with identified stakeholders, including commonly used templates for communication activities such as status reporting, issues tracking, change control, and project reviews.
- Given an organizational context and project objectives, construct a communication-management plan that defines the participants, communication processes, tools, and methods required for appropriate project communication.

17. Project Team Building and Motivating (B-TB)

Building high-performance teams and motivating them is the topic of this module. Successful projects depend on both the effectiveness of the project team and the leadership and management of that team. This module focuses on team formation and development, and managing and motivating team members. Topics include assessing the abilities and effectiveness of team members, team building, leadership, motivation, and conflict resolution. Stages and effective actions for developing and utilizing teams and team members are also covered.

Key Topics:

- Describing high-performance teams
- Team-building processes and challenges
- Launching a team, including goal setting, process definition, and kickoff meetings
- Barriers to successful teams, such as trust, and skills deficiencies
- Team decision-making processes
- Increasing project-team performance, addressing performance issues, and appraising processes and incentives
- Principles of motivation, motivational theories, and leadership styles
- Team-building challenges in the PM context
- The role of the project manager in team formation, development, and closeout

Learning Outcomes:

- Demonstrate how teams are assigned and formed and describe the stages of team development.
- Plan and conduct a successful project kickoff meeting and reflect upon the formation and dynamics of teamwork and how to motivate teams.
- Analyze sources of conflict and, given a specific challenge, apply a problem-solving process that focuses on confronting and resolving the conflict.

18. Project Leadership (B-PL)

Project management occurs in a team setting. Therefore, a key skill set that a project leader must master is the understanding and application of a flexible management style that is reflective of the multidisciplinary and multicultural milieu of PM practice. The focus of this KM is on the key topics required to be an effective project manager, manage stakeholders, and build trust.

Key Topics:

- Recognizing the roles of a manager and a leader in projects
- Understanding external and internal role requirements
- Leadership styles and self-assessment
- Understanding the different types of power
- Analysis of collaborative (informal) and authoritative (formal) powers
- Managing up: managing the project within the organizational context
- Developing trust
- Managing and negotiating conflicts
- Managing stakeholders
- Managing team dynamics
- Leading in an intercultural environment
- Recognizing the roles of business and personal ethics in PM leadership
- Best practices in project leadership—techniques to win over team members and stakeholders

Learning Outcomes:

- Describe the fundamental aspects of team structure, interpersonal dynamics, and the role of the project manager.
- Given a project situation that may involve multicultural, intergenerational, hierarchical, and virtual teams, apply leadership techniques and defend the use of appropriate practices for motivating teams and developing leadership abilities.
- Reflect upon personal strengths and weaknesses and develop a plan for continuous improvement with respect to team-management skills.

19. Identifying and Engaging Stakeholders (B-SE)

This module covers the key steps in identifying stakeholders and prioritizing them by power, influence, and interest in the project outcome; then, a strategy is planned and executed to engage stakeholders. The scope of stakeholder-engagement activities extends from the initiation phase through to project completion.

Key Topics:

- Understanding stakeholder engagement, the types of stakeholders, and their roles, influence, and power
- Developing a stakeholder-engagement plan
- Identifying, categorizing, and prioritizing stakeholders
- Gathering information about stakeholders
- Assessing stakeholders' strengths and weaknesses

Learning Outcomes:

- Analyze the nature of stakeholder groups and summarize their impact on project performance.
- Choose from among a suite of appropriate strategies for stakeholder management, and recommend an approach based upon stakeholder strengths and weaknesses, their impact on the project, and other categories of stakeholder characteristics, such as priority and authority.
- Given a specific project context, create a stakeholder engagement plan that includes approaches to issues such as communication, ethics, and leadership.

20. Project Organization and Context (B-OC)

This KM details the relationships between the organizations that host projects and the projects themselves. In many companies, projects are a key vehicle for the execution of organizational strategy, and the effectiveness of that execution is determined to a large extent by the environment that the organization itself creates for those projects. A key focus of this module is organizational behavior.

Key Topics:

- Organizational behavior and projects
- Organizational structure and design within the project context
- Organization of the project team and other human resources
- Managing strategic and organizational changes
- Project organization: structure and teams
- Organizational structure, organizational roles, and power relationships
- Organizational behavior and management roles—decision making and techniques to improve performance
- Risk tolerance—balancing radical and incremental innovation
- Organizational changes and managing the impact of change due to projects
- Change management—understanding the human side of change
- Knowledge management—learning from experience: knowledge as a resource in projects

Learning Outcomes:

- Evaluate the different types of project organizational structures and debate the advantages and disadvantages of each structure.
- Critique a project management approach in a matrix organizational structure, and recommend methods that will successfully deliver a project considering the inherited power relationships.
- Based on the inherited linkages between the organization and the project, assess and recommend the best approaches to project-execution methods, roles, and responsibilities.

21. Managing Global Projects (B-GP)

Global projects are inherently complex by nature; language, culture, and logistics are key issues. Global and megaprojects succeed if they are guided by leaders who can give the project team a clear vision, keep various stakeholders engaged, and communicate well with the entire global-project team. Global PM leadership requires adapting the organization and projects to work effectively in a multicultural environment. Managing interorganizational relationships, managing highly complex projects, program management, and related topics are covered here.

Key Topics:

- Leading and managing global projects
- Characteristics of large global projects
- Identifying complexity factors and issues
- Logistics, distance, time zone, and jurisdiction challenges
- Challenges associated with language and culture
- Working effectively in a multicultural environment
- Logistics and governance challenges
- Managing interorganizational relationships
- Designing a project management solution: methods and tools for global projects
- Managing megaprojects
- Managing international development (ID) projects

Learning Outcomes:

- Evaluate the impact of contextual factors such as a client's organizational culture, needs, risk tolerance, and project size on tools and methods of PM.
- For projects with multiple cultures and languages in large-scale, global environments across time zones, recommend appropriate approaches for managing communications, teams and their motivation, meetings, cross-functional teams, matrix management, and virtual team environments.
- Given project objectives for certain projects of varying scale, geographic dispersion, and complexity, construct a PM plan that can achieve these objectives while mitigating the potential risks inherent in large, complex, widespread, and intercultural projects.

22. Virtual Project Management (B-VP)

This KM deals with the topics of project communication when the project team is geographically dispersed, whether distributed across a single facility or across the globe. Managing virtual project teams is covered in detail. International projects (global PM) is covered, emphasizing topics such as environmental factors and cross-cultural considerations.

Key Topics:

- PM methods to support geographically dispersed, distributed, or remote teams
- Traditional PM versus virtual project management
- Types of virtual teams and their advantages, disadvantages, and challenges
- Leading and managing virtual teams
- Navigating obstacles, building trust, and related issues
- Communication and coordinating work in virtual teams
- Work-environment tools and techniques to support virtual teams, including technology solutions to support communications
- Cross-cultural considerations for virtual teams
- Building trust and communication between distant sites
- Best practices for organizing and managing virtual project teams, including managing cross-border teams

Learning Outcomes:

- Compare the communication and management tools, methods, and approaches that could be used in projects in which team members are co-located versus those in which they are not.
- Interpret the advantages, disadvantages, and issues that are typical of virtual project teams, and recommend whether or not to use either virtual or co-located teams.
- Given a specific project context and plan that specifies a virtual team in a cross-cultural project environment, formulate plans for communication and project integration that will define how the project manager and others will employ tools, methods, and approaches to best deal with the issues of managing the project with a virtual project team.

23. Ethics and Professionalism (B-EP)

The module covers the importance of ethical considerations in every aspect of a project's operations and emphasizes how ethics are critical to the successful completion of most projects. Ethics is important to the well-being of the many stakeholders that encompass the project, including the performing organization itself, the project managers, employees, customers, suppliers, sponsors, and members of society impacted by the project's operations.

Key Topics:

- The competent project manager
- Ethical issues and considerations in project management
- Ethics models and examples of ethics issues
- How to navigate political and social ethical issues inside and outside the organizations
- Tactfully communicating values and standards to stakeholders
- Ethical issues involving compensation, conflicts of interest, and procurement
- Exploring ethical situations, including whistle blowing
- Competing with integrity in global projects
- Sustainability: the new professional responsibility
- Green PM issues and embracing greater accountability
- Professional growth of the project manager and project team

Learning Outcomes:

- Evaluate and assess the importance of ethics and professionalism in every aspect of the project's operation, and examine the factors that influence moral conduct.
- Given a case-study scenario involving ethical considerations, determine how a project can be executed according to the standards of the organization performing the project.
- Analyze ethical situations and recommend best practices for ethical decision making.

Strategic Awareness Knowledge Modules

24. Strategic Project Management (S-SM)

This KM teaches students the importance of aligning projects with the business strategy. Strategic alignment is a two-way process. Overall business strategy guides project planning, and, in turn, project success drives enterprise strategy. Students understand the bigger-picture goals of PM, how to accomplish strategic goals, how to identify what is being accomplished and why, and how to achieve goals. Other topics include measuring project success and portfolio and program management.

Key Topics:

- Understanding business strategy and its relation to projects
- Mission, goals, objectives, and processes to bring an organization's intended strategy to reality
- Strategic choices and strategic management practices
- Methods of aligning projects with strategy
- Strategic evaluation and selection of projects to create a well-balanced portfolio
- Critical success factors, financial evaluation criteria, and measuring project success
- Strategic portfolio and program management
- Case study of an organization with strong strategic PM focus

Learning Outcomes:

- Analyze the company's mission, goals, and objectives, and develop a plan to ensure that project outcomes reflect an appropriate strategy.
- Evaluate critical success factors, use the principles of project portfolio management (PPM) to evaluate potential projects, and justify the selection of an appropriate portfolio that reflects company goals and objectives.
- Demonstrate how project success can be quantified and measured, and construct a plan to allocate appropriate resources to the portfolio.

25. Supply Chain in Projects (S-SC)

Even the simplest projects in most organizations involve complex supply chains and networks. We begin with an exploration of core principles of project procurement and expand to a consideration of how modern organizations expand their influence beyond simple contractual relationships. This module also focuses on managing connected supply chains.

Key Topics:

- Foundational knowledge of procurement
- Understanding the role of supply chains in PM
- Project supply-chain building blocks
- The project-planning chain and project-delivery chain
- Life cycle and processes and supply-chain integration
- Plan, execute, and control of supply-chain projects
- Managing connected supply chains
- Dealing with direct suppliers and suppliers far removed from the immediate chain

Learning Outcomes:

- Evaluate the role of supply-chain management in PM, and identify the impact of tangible and intangible components of supply chains on the project's management and processes.
- Given a specific project context and plan, construct a procurement management plan to ensure the effective integration of supply-chain components throughout the project life cycle.
- Critique the issues associated with a given project supply chain, and recommend appropriate adjustments to the project to account for these issues.

26. Legal Aspects in Project Management (S-LA)

This KM focuses on contracts and procurement. Additional topics, such as labor law, could be covered in lesser detail. Depending upon the industry, various issues such as health, safety, and legal implications are covered. Also covered are employment law, data protection, data privacy, and information assurance.

Key Topics:

- Legal issues as they pertain to project procurement
- Contracts and procurement
- Labor law within the project context
- Health, safety, and legal implications
- Employment laws
- Complying with standards and regulations, both local and global
- Data protection, data privacy

Learning Outcomes:

- Given a selection of project-procurement contract examples, analyze the contracts, assess the way each deals with various procurement issues, and recommend how the contract can be an instrument through which the project manager can better coordinate and manage project resources.
- Evaluate common labor issues that can impact projects through the regulatory environment, and recommend how project managers can use various tools, methods, and approaches to accommodate these constraints positively throughout the project.
- Given a specific project context and plan, analyze the points where information and information systems may be vulnerable to certain threats, or where stakeholders' privacy may be impacted through the handling of information, and recommend best practices for maintaining protection of data integrity, access, and privacy throughout the project.

27. Business and Commercial Aspects of Projects (S-BC)

This KM covers assorted topics ranging from innovation, strategic alignment, obtaining funding, finance and cost management, and return on investment (ROI) (i.e., making money from projects). This module also covers killing a project when it is not profitable, or no longer relevant to the company strategy.

Key Topics:

- The strategic relation between projects and companies
- Marketing goods and services in the PM environment
- Obtaining funding and financing
- Making good decisions

Key Topics (*continued*):

- Relationship marketing: focusing on client commitment, service, and retention
- Delivering benefits—Project ROI: successfully making a profit and deriving benefits from projects
- Interpreting the ROI metric for nonprofit organizations and from government and public services projects
- Benefit forecasting—cognitive biases, organizational and cultural factors
- Stopping a project that will provide no benefits

Learning Outcomes:

- Using the language of business modeling, organizational behavior, financial analysis, and market analysis, present a justification for how a given project can achieve various business strategies in dimensions such as funding, revenue, profit, market share, and sustainability.
- Analyze various models for project, program, and portfolio analysis to determine the viability of projects in the context of the organization, and, on the basis of this analysis, recommend the appropriate points throughout the project life cycle where there should be a decision to proceed.
- Given a specific project context and plan, apply the principles of client-and-customer relationship management to recommend appropriate methods and activities to demonstrate client commitment, service, and long-term retention strategies.

28. Governance in Projects (S-GV)

This module introduces the principles of project governance. Sound governance establishes a good project structure, harmonizes processes and resources, and provides a smooth path to achieve project goals. It removes costly inefficiencies that negatively impact smooth running, and reduces the risk of conflict. Topics such as governance methods and procedures, project structure, and organizational roles are covered. This module also provides an opportunity to discuss enterprise projects and other megaprojects.

Key Topics:

- Definition of governance
- Types of governance structures
- Creating governance structures
- Creating a transparent and accountable organization with well-defined roles and that is based on transparency and accountability
- Understanding project ownership versus asset ownership
- Understanding project governance structures in large projects, programs, or portfolios
- Understanding the roles of governance in decision making, risk management, including opportunity management and threat management, and resource allocation and decision making
- Enterprise PM

Learning Outcomes:

- Categorize the core issues of project governance within the context of projects and programs.
- Evaluate and critique the strengths and challenges of various governance structures.
- Given a large enterprise project, recommend methods and procedures that ensure the project is governed according to best practices.

29. Agile Approaches to Project Management (S-AM)

This module covers agile approaches, processes, and roles in project management. The module also covers when to use agile, the advantages and disadvantages, and the challenges of the agile approach when compared with traditional methods.

Key Topics:

- History, principles, and values of agile approaches and the Agile Manifesto
- Understanding agile approaches: general practices
- How agile is similar and how it is different from traditional PM life cycles
- Strengths and weaknesses of the agile approach
- Agile frameworks
- Working with a framework such as Scrum
- Managing agile projects
- Hybrid life cycles: designing and customizing agile and traditional life cycles
- Key metrics and resources for agile

Learning Outcomes:

- Distinguish the approaches, advantages, and disadvantages of both classic and agile project approaches, assess the deliverables and contexts best suited to each approach, and apply these principles to the development of an appropriate PM strategy.
- Develop a workable PM approach that includes the typical steps, activities, and participant roles for an agile project, and evaluate how and when these agile characteristics can be integrated with steps from a traditional PM life cycle to achieve an effective hybrid approach.
- Use appropriate tools and resources for agile projects, including specific or adapted metrics that can assist the project manager in defining, executing, and controlling projects that follow an agile, or hybrid, life cycle.

30. Portfolio and Program Management Principles (S-PP)

This module addresses the fundamental principles of managing portfolios and programs. Portfolios translate an organization's business strategy into a collection of activities that can be managed with desired benefits and results. Program management deals with managing several related projects in a cohesive, multiproject environment, and provides benefits that one might not get from managing the projects individually. Both portfolio and program management align projects with business objectives.

Key Topics

- Identifying strategic opportunities and benefits that achieve the organization's strategic objectives through program implementation
- Program management life-cycle activities
- Understanding what happens in the initiating, planning, executing, controlling, and closing stages of a program
- Understanding the critical success factors for portfolios and portfolio management, and the key metrics to value the performance of a portfolio
- Overview of domains and tasks of portfolio management
- Strategic alignment of portfolios, programs, and projects

Key Topics *(continued)*:

- Program maturity and governance issues
- Measuring portfolio performance
- Understanding issues specific to portfolio management: risks, communications, knowledge, and skills

Learning Outcomes:

- Evaluate critical success factors for projects and programs, use these factors to create project portfolios that align with strategic goals of the organization, and describe best practices for managing such a portfolio.
- Construct a program management plan that describes best practices for the creation and management of programs and how to coordinate activities such as finance, procurement, and risk across programs.
- Given a case consisting of a specific set of project contexts and plans within a project portfolio, recommend approaches for managing and balancing resource demands, allocations, and stakeholder expectations across the projects, programs, and the portfolio.

APPENDIX I-B: PM COURSE SPECIFICATIONS

In this appendix, we list several suggested descriptions and specifications for courses. We use an informal approach to specify courses, as it is not our goal to be prescriptive about the structure and content of courses. Moreover, depending upon the college and industry, the course specification might take on a completely different look.

The PM course specifications follow a simple pattern. It consists of the label, title, description, learning objectives, and topics.

Each course maps to a few relevant KMs. Course topics are derived from such KMs; however, additional topics (not listed in KMs in the Appendix 1-A) are also listed in the course specifications. These additional topics were recommended by faculty to make a course cohesive. In the future, such topics will be embedded with the most appropriate KMs.

The learning goals for each course are listed as “objectives.” They are broader than learning outcomes. By associating a KM with a course, a detailed learning outcome can be derived from the KMs introduced in Appendix 1-A.

Finally, Volume II of the curriculum guidelines illustrates a comprehensive specification for the first course in project management along with some resources. We recommend that you consider the outlines presented in Volume II for PM-1 Foundations of Project Management course, as it is a considerably more comprehensive specification.

PM-1 Foundations of Project Management

The objective of the course is to teach students how to approach project management and understand all the essential concepts from both a theoretical and applied perspective.

It draws topics extensively from the following three knowledge modules:

- Project Management Principles [T-PM]
- Project Phases and Processes [T-PP]
- Project Planning and Integration [T-PI]

The course also draws upon lecture topics from several personal and organizational modules, such as Ethics and Professionalism, Project Communications and Stakeholder Engagement, and Opportunity and Risk Management.

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Identify the elements of the PM life cycle, including plan, control, and organize and allocate resources.
2. Understand PM processes.
3. Comprehend and become familiar with the use of basic tools and techniques to plan, organize, and manage a project.
4. Optimize results while managing the triple constraints.
5. Manage stakeholder communications.
6. Demonstrate the principles and practice of team leadership.
7. Describe the career paths in the PM profession.

Topics

- PM foundations: Define project, PM, and the role of the project manager
- Program management and portfolio management
- Project sponsorship, project office (PMO)
- Project organizational structures
- Understanding the PM context
- Project life cycle: sample life cycles, including traditional versus agile
- PM processes
- Project initiation: creating a charter and identifying stakeholders
- Project planning: creating a scope statement, building a WBS, identifying resources, building a project budget, and basic overview of scheduling networks
- Creating a PM plan along with some key subsidiary plans
- Project execution: directing and managing work
- Project monitoring and controlling: problem solving and decision making, managing changes to scope and schedule, understanding team dynamics, and managing resources effectively
- Project closing: gaining customer acceptance and documenting lessons learned
- Global issues in PM
- Introduction to the importance of people-oriented skills, such as communications management, HR, and leadership
- Product-based planning: documents and deliverables that need to be produced at each stage in the process (i.e., the artifacts of project control)

Volume II of the curriculum guidelines illustrates a comprehensive specification for the PM-1 Foundations of Project Management course.

It also illustrates how learning outcomes are identified and satisfied in a given course.

PM-2 Project Communications

This course provides students with comprehensive project-communications and stakeholder-engagement knowledge and skills. They will master theoretical and applied skills drawn extensively from the Plan, Distribute, and Manage Project Communications [B-DC] KM.

Topics associated with the following KMs are also drawn upon:

- Identifying and Engaging Stakeholders [B-SE]
- Project Organization and Context [B-OC]
- Virtual Project Management [B-VP]

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Fundamentals of communications theory and practice
2. Effectively analyze audience and construct appropriate communication for that audience.
3. Use effective listening and two-way communications to express ideas.

Objectives (continued)

4. Plan and execute effective project communications, such as face-to-face, virtual meetings, performance reporting, and briefing.
5. Develop methods for conducting negotiations and resolving conflicts.
6. Identify appropriate communication methods for different audiences.
7. Develop written and verbal communication management plan.
8. Effective communications within a project team

Topics

- Communication: behavioral characteristics, and mechanics and styles
- Communication models and processes
- Identifying communication requirements
- Building an effective project communication plan
- Selecting suitable tools and techniques to communicate with identified stakeholders
- Effective listening and open team communications
- Two-way communication, reflective communication
- Influential communication—communicating to persuade
- Cross-cultural awareness and sensitivity
- Role of communication in transforming projects
- Communication methods for stakeholders
- Type of communication and information distribution
- Relationship between project complexity and communication
- Running briefings and meetings
- Personal communication, managing meetings and presentations
- Virtual project teams and communicating in a distributed environment
- Competency and assessing personal strengths and weaknesses
- Performance reporting and giving constructive feedback
- Managing conflict through effective communication
- Understanding stakeholder engagement, the types of stakeholders, and their roles, influence, and power
- Organizational behavior and projects
- Project organization: structure and teams
- Organizational structure, organizational roles, and power relationships

Note: It is our intention to develop a Volume III of the curriculum guidelines and resources next for PM-2 Project Communications. The pmiteach.org website will provide the details once it is available.

PM-3 Advanced Project Management

This course builds on the foundation of PM-1 by introducing coverage of advanced topics in project scheduling, risk and quality management, and cost control as well as providing comprehensive knowledge of scheduling and other PM tools. It also introduces the topic of delivering complex projects. It draws topics from the following KMs:

- Project Resource Management [T-PR]
- Project Scheduling [T-PS]
- Project Control [T-CP]
- Opportunity and Risk Management [T-OR]

This course can also draw lecture topics from the following KMs: PM Information Systems and Information Management [T-IS], Estimating Costs [T-EC], Plan and Control Quality [T-PQ], and Project Control [T-CP]. Depending upon the mission of the program it can also consider topics from: Procurement and Contract Management [T-PC], and Supply Chains in Projects [S-SC] KMs.

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Construct project selection matrix: Evaluate different approaches to selecting a project.
2. Create a business-case cost-benefit analysis. Consider external issues such as environment.
3. Estimate and analyze schedule, tools, and techniques.
4. Managing project uncertainty, strategic risk appraisal
5. Opportunities and threats: risk identification, quantification, response and control
6. Cost management: cost estimating, budgeting, and cost control
7. Project progress and performance and managing changes to the project baseline
8. Determining the impact and following procedures as defined in the change-control plan
9. Communicating project issues, their impact, variance, changes, and proposed solutions to stakeholders
10. Earned value management to monitor and control cost and schedule
11. Quality management: plan, analyze, and control quality
12. Role of projects in delivering strategic change, starting with need for performance improvement, identifying change, project objectives, and scope of the project
13. Managing and executing the project plan, change control (includes configuration management)
14. Successfully delivering complex projects

Topics

- Project-selection methods
- Creating a business-case cost-benefit analysis
- Advanced time, cost, risk, and quality estimating and planning
- Cost budgeting and cost control using EVM, estimate at completion
- Cost and schedule performance indices, schedule variance, cost variance, optimize for the second phase, corrective options and actions
- Schedule estimation and management, earned schedule
- Risk management: identifying and quantifying risks, creating a risk-response plan, monitoring and controlling risks, simulation tools to quantify risks (Monte Carlo, decision trees, expected monetary value)
- Quality management: plan and control quality, quality analysis tools (control charts, Ishikawa diagram, audits)
- Dealing with unstructured project data and knowledge repository across the organization, data analytics, system dynamics, and incorporating learning theory
- Resource planning: estimating, balancing
- Resource tools and techniques: organizational breakdown structures, and responsibility assignment matrix
- Change management
- Delivering complex projects and programs

PM-4 Leadership in Teams

The use of teams has increased in organizations, but in project management they are an important component. The project leader has to forge a team and ensure that it functions as a cohesive unit to achieve goals and objectives under preset project constraints. The objective of this course is to prepare students for the professional work environment they will encounter upon graduation. It will prepare them for PM careers as productive project team members and eventually skilled project leaders and managers. This course draws extensively from the following KMs:

- Project Team Building and Motivating [B-TB]
- Project Leadership [B-PL]

Additionally this course may also draw topics from: Plan, Distribute, and Manage Project Communications [B-DC], Identifying and Engaging Stakeholders [B-SE], Virtual Project Management [B-VP], Project Organization and Context [B-OC], and Leadership in projects.

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Understand the fundamental aspects of team structure, interpersonal dynamics, and role of the project manager.
2. Time-management techniques and strategies for individuals and team activities.
3. Apply emotional intelligence to project team operation.
4. Review your personal team-management skills, and understand your strengths and weaknesses.
5. Understand your emotional intelligence and utilize it to manage others.
6. Learn facilitation techniques for effective conflict resolution.
7. Demonstrate appropriate practices for motivating teams.
8. Acquire effective intercultural communication. Demonstrate communication competencies in multicultural, intergenerational, hierarchical, and virtual teams.

Topics

- Leadership competence in project management
- Leadership-development models
- Leadership styles and self-assessment
- Building the project team and team-building challenges in the PM context
- Team-building processes and building high-performance teams
- Launching a team, including goal setting, process definition, and kickoff meetings
- Principles of motivation, motivational theories, and leadership styles
- Barriers to leading project teams successfully, such as trust, and skills deficiencies
- Managing the team dynamics
- Understanding decision making within teams
- Conflict management theory and practice
- Addressing performance issues and increasing project-team performance
- Understanding the role of the project manager in team formation, development, and closeout
- Managing stakeholder expectations, and engaging stakeholders
- Negotiation and leadership
- Unique challenges of cross-functional teams
- Leading in an intercultural environment; Gender issues in leadership; Emotional intelligence
- Team communication and socialization

Topics (continued)

- Managing changes due to project impact
- Best practices in project leadership—techniques to win over team members and stakeholders
- Role of the human resource function within the context of team selection, planning, development, managing, appraisals, incentives, release, and retention

PM-5 Organizational Behavior and Projects

This course details the relationships between the organizations that host projects and the projects themselves. Projects are a key vehicle for the execution of organizational strategy, and the effectiveness of that execution is determined to a large extent by the environment that the organization itself creates for those projects.

This course draws extensively from the following KMs:

- Project Organization and Context [B-OC]
- Strategic Project Management [S-SM]
- Governance in Projects [S-GV]

Additionally this course may also draw topics from: Ethics and Professionalism [B-EP], Plan, Distribute, and Manage Project Communications [B-DC], Identifying and Engaging Stakeholders [B-SE], Virtual Project Management [B-VP], Project Leadership [B-PL].

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Highly identifiable and explicit aspect of strategy and structure as they pertain to projects
2. Key linkages between organizational and project-level issues, including decision making, motivation, behavior, and ethics
3. Project structure and roles
4. Consider the subject from a strategic perspective, covering both the role of projects in the execution of organizational strategy and the application of strategic principles in projects.
5. Cover a wide range of project settings, from the traditional large-scale industrial projects through to small-scale personal projects, in both service and manufacturing settings.
6. Role of projects and PM as a core business activity for most organizations.
7. The use of structures to help explain what is going on at different points in the life cycle of a project (stage gates).

Topics:

- Organizational behavior and projects
- Organizational structure and design within the project context
- Managing strategic and organizational changes
- Project organization: structure and teams
- Organizational structure, organizational roles, and power relationships
- Organizational behavior and decision making
- Organizational risk tolerance

- Project organization: structure and teams: organizational structure, roles, power, relationships, strategic PM
- Organizational behavior: decision making, management roles, organizational risk tolerance, balancing radical and incremental innovation, and motivational techniques to improve performance
- Understanding business strategy and its relation to projects
- Mission, goals, objectives, and processes to bring an organization's intended strategy to reality
- Strategic portfolio and program management
- Strategic evaluation and selection of projects to create a well-balanced portfolio
- Critical success factors, financial evaluation criteria, and measuring project success
- Types of governance structures for projects within an organization
- Understanding governance and decision making within the context of opportunity and risk management, resource allocation, and project schedules.
- Professionalism and ethics:
 - Understand global codes of ethics and conduct.
 - Be aware of ethical issues.
 - Recognize cultural influence on ethics.
 - Analyze and remediate ethical situations.
 - Sustainability: the new professional responsibility
 - Learning from experience: knowledge as a resource in projects (managing knowledge—its generation and use), acquiring knowledge ahead of time, creating knowledge as you go (organizationally and at the project level)
 - Organizational changes and managing the impact of change due to projects. Tracking and administering project changes in a sustainable manner.
 - Competing with integrity in global projects

PM-6 Project Governance

This course provides an integrated introduction to enterprise project and program management and project governance. It also focuses on change management. Students learn the fundamental aspects of modern project management, both managerial and technical from the lens of governance. The key topics associated with this course are: organizational governance of projects, governance in projects, governance of the project, and change management:

This course draws extensively from the following KMs:

- Governance in Projects [S-GV]
- Project Scope Management [T-SM]
- Ethics and Professionalism [B-EP]
- Project Handover, Closeout, Reviews [T-HC]

Additionally this course may also draw topics from: Identifying and Engaging Stakeholders [B-SE], Virtual Project Management [B-VP], and Project Leadership [B-PL].

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Facing uncertainty: project governance and control
2. Project governance paradigms
3. Project governance models
4. Organizational governance of projects
5. Monitoring and controlling projects

6. Applying scope-management and change-control principles to a project
7. Management of monitoring and controlling of risk, scheduling, resources, and quality
8. Governance of the project, starting and stopping projects, and project closeout
9. Measure project sponsor or customer satisfaction—validation of results with sponsors

Topics:

- Project-governance framework for sound decision making and managerial action
- Creating a transparent and accountable organization with well-defined roles that is based on transparency and accountability
- Governance of project and program-based organization—structure, methods, procedures, and people
- Understanding project governance, processes, and structures (e.g., sponsors, steering groups, organizational structure, large projects, portfolio management, sponsors and steering groups, PMOs, and program management)
- Elements of good project governance and role of top management in project sponsorship and championing projects
- Ensuring effective communication; ensuring sound project decision making
- Project structure and organizational roles in projects; making sure that there is single point of accountability
- Professionalism and ethics
- Providing training, supporting audits and reviews
- Enterprise-wide projects and management of megaprojects.
- Risk-opportunity management, and synergy
- Awareness of legal issues
- Formalization (single-project versus multiproject level)
- Strategy—translating organizational strategy into portfolios; governance strategy for large complex projects
- Resource allocation and decision making
- Understanding the multiple environments in which projects function (e.g., internal versus external)
- Understanding the roles and responsibilities
- Ability to match decision-making approach to the situation (e.g., consultative, authoritative)
- Ability to match governance processes to the appropriate project-specific situation (e.g., management review boards, PMO, single decision maker, change management boards)
- Approaches to management of closeout processes, including termination, documentation, contracts, resources, and lessons learned
- Measure project sponsor or customer satisfaction by validating results

PM-7 Project Procurement and Supply Chains

In most organizations, projects are now delivered through complex supply chains and networks. They have several suppliers, contractors, and customers. There is a substantial amount of project procurement involving these entities and a substantial amount of detailed planning and scheduling occurs. This course begins with an exploration of core principles of project procurement and expands to a consideration of how modern organizations expand their influence beyond simple contractual relationships by considering supply chains.

This course draws extensively from the following KMs:

- Supply Chain in Projects [S-SC]
- Procurement and Contract Management [T-PC]
- Project Handover, Closeout, and Reviews [T-HC]

Additionally, this course may also draw topics from: Business and Commercial Aspects of Projects [S-BC], Ethics and Professionalism [B-EP], Virtual Project Management [B-VP], and Portfolio and Program Management Principles [S-PP].

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

- Foundational knowledge of procurement
- Understanding the role of supply chains in PM
- Developing a procurement strategy
- Project planning and delivery chain
- Life cycle and processes and supply-chain integration
- Legal issues as they pertain to project procurement
- Plan, execute, and control supply-chain projects.
- Project and contract closeouts (includes project review)
- Focus on suppliers beyond the scope of the immediate contract.

Topics:

- The processes for planning procurements
- Foundational knowledge of supply chains and developing a strategy
- Project planning and delivery-chain management
- Identifying project procurement needs, including make-or-buy analysis
- Identifying potential deliverables for contracting and their delivery milestones
- Determining a vendor and the bidding process
- Negotiating and ensuring due diligence and an equitable process when contracting
- Determining contract types, risks, and incentives
- Awarding the contract
- Monitoring and managing the vendor
- Supply-chain management processes and life cycle
- Managing vendor performance and relationships, amending contracts and managing change, the dispute process
- Closing contracts: auditing, settling contracts, early termination
- Project management issues pertaining to supply chains
- Risk management—especially when the supplier is far removed from the chain
- Supply-chain integration: quality and performance management
- Trust and legal aspects: contracts claims, litigation, intellectual property
- International aspects and managing global projects
- Management of ethical issues in global projects
- Implementing collaborative relationships

PM-8 Project Stakeholder Engagement

This course focuses on the understanding and the application of the stakeholder interface with special emphasis on leadership to ensure customer satisfaction, and sustainability. This course can draw from the following KMs:

- Identifying and Engaging Stakeholders [B-SE]
- Managing Global Projects [B-GP]
- Project Leadership [B-PL]

Additionally, this course may also draw topics from: Plan, Distribute, and Manage Project Communications [B-DC], Virtual Project Management [B-VP], Project Organization and Context [B-OC]

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Defining customer success factors
2. Understanding proper stakeholder engagement
3. Understanding and identifying stakeholders and categorizing them
4. Defining strategy with stakeholders to meet customer expectations
5. Ability to gather customer requirements

Topics:

- Understanding stakeholder engagement, the types of stakeholders, and their roles, influence, and power
- Developing a stakeholder-engagement plan
- Gathering information about stakeholders
- Identifying, categorizing, and prioritizing stakeholders
- Assessing stakeholders' strengths and weaknesses
- Measuring stakeholder attitude and monitoring the relationship
- Managing stakeholder expectations for key project deliverables
- Strategic leadership and best practices in the stakeholder management
- Concepts of customer consultation, customer renewal, and sustainability
- Stakeholder orientation in agile projects

PM-9 Special Topics in Project Management

This course focuses on emerging trends and reviews unique methodologies and approaches to project management. This course also provides an opportunity to teach and develop PM simulation and modeling tools. Students are exposed to advanced research methods and contribute to original research in the emerging PM areas.

This course draws extensively from the strategic awareness KMs, but there is ample opportunity to identify topics from all the KMs.

Objectives

The following represent high-level objectives for the course. Detailed learning outcomes can be derived from the selected KMs. Appendix I-A has the learning outcomes for all KMs that can be considered in identifying learning outcomes.

1. Introduce emerging trends.
2. Cover PM in practice trends, globally.
3. Review other unique methodologies and approaches to PM.
4. Learn some key topics in-depth.
5. Get exposed to other learn-by-doing tools and techniques.
6. Conduct simulation and modeling to learn from mistakes.
7. Learn useful PMIS and information management software including simulation software.

Topics:

The following is a brief list of suggested topics that can be leveraged to identify a topics course. The pmiteach.org site will describe current special topics.

- Agile Approaches to PM
- Sustainability and green PM
- Scrum, LEAN, Capability Maturity Model Integration (CMMI), and Six Sigma
- 24/7 business cycle and PM
- Outsourcing, offshoring, and in-shoring
- Trends in information technology tools: collaborative and social media tools
- Crisis-management leadership and stakeholder engagement
- Project management software
- Ethics and professionalism: ethical decision making
- Dealing with various interfaces and stakeholders
- Universal application of ethics (internal versus external)
- Global projects and leading virtual project teams
- Decision making within distributed teams
- Mastering the leadership role in project management
- Business analysis
- Change management
- Requirements management
- Advanced cost estimating
- Risk analysis and management of healthcare projects
- Simulation, modeling, and testing
- Project management and entrepreneurship
- Project management and organizational change
- Strategic-oriented implementation of projects
- Transitioning from project management to program management
- IT project management for mobile application development
- Distributed software development

Other Courses

For the remaining courses, PM-10 to PM-12, we only provide a course label, description, and learning objective. We do not provide a list of topics, and customization would depend upon the organization.

PM-10 Integrative Study

This is an example of a capstone course that provides an opportunity to demonstrate that students have fully mastered the principles of project management. The course integrates learning from the courses in the PM major with other academic courses taken, and may involve interdisciplinary partnerships among university departments and/or industry. Experiential learning, that is, reflection, is a key focus and occurs throughout this course. Substantial learning can take place here, especially if implementation of a real-world project will strengthen chances for entry-level employment at an organization that values PM.

Objectives

The following represent high-level objectives for the course. Specific learning outcomes can be identified by consulting the KMs in Appendix I-A. However, due to the nature of the course, a customized learning outcome might need to be designed.

1. Integrate skills and knowledge across curriculum.
2. Demonstrate proficiency in PM skills.
3. Assess the capability and performance as a team member.
4. Demonstrate ethical and communication skills.
5. Provide an opportunity to start gaining some work experience.

PM-11 Global Project Management

This course provides an opportunity to acquire and integrate skills and knowledge as they pertain to international projects. Global projects demand a broad range of research, analysis, and skills in the financial planning and budgeting area. A key PM issue introduced throughout the course is managing complexity in projects, and how one can go about applying mindfulness and analysis for optimal results. Other issues introduced in this course include distributed project management, outsourcing, virtual project management, governance issues, language and cultural diversity, and management of risks. Students have an opportunity to master the topics of managing conflict in projects, change management, and portfolio and program management. This course also provides students with an opportunity to enrich leadership skills as they pertain to decision making within distributed teams, as well as change-control in large, distributed projects.

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

1. Managing global projects and virtual project management
2. Tackling project complexity
3. Portfolio and program management in distributed projects
4. Finance and cost budgeting
5. Decision making within distributed teams
6. Interpersonal skills for managing global projects
7. Managing global teams and networks
8. Managing change in global organizations

PM-12 Agile Approaches to Project Management

Agility refers to the ability of an organization to rapidly react to unpredictable scenarios, and within the context of product development, responding to unclear requirements. There are several industry domains where agility is being practiced, such as manufacturing, engineering, software development, and Supply-chain management. This course provides students with a comprehensive overview of the principles, processes, and practices of agile approaches to project management. Students learn techniques for initiating, planning, and executing projects using agile approaches. Knowledge of agile development frameworks and agile tools and techniques are introduced.

Objectives

The following represent high-level learning objectives for the course. Detailed learning outcomes can be derived from the mapped KMs. Appendix I-A has the learning outcomes for all KMs.

Objectives

1. Multidisciplinary review of agile literature
2. Agile project management principles
3. Comparison of agile and traditional PM models
4. New roles and responsibilities in agile projects
5. Best practices and techniques to introduce agile

APPENDIX I-C: COURSE FLOWS FOR PM MAJOR AND MINOR

Course Flow for PM Emphasis (Minor)

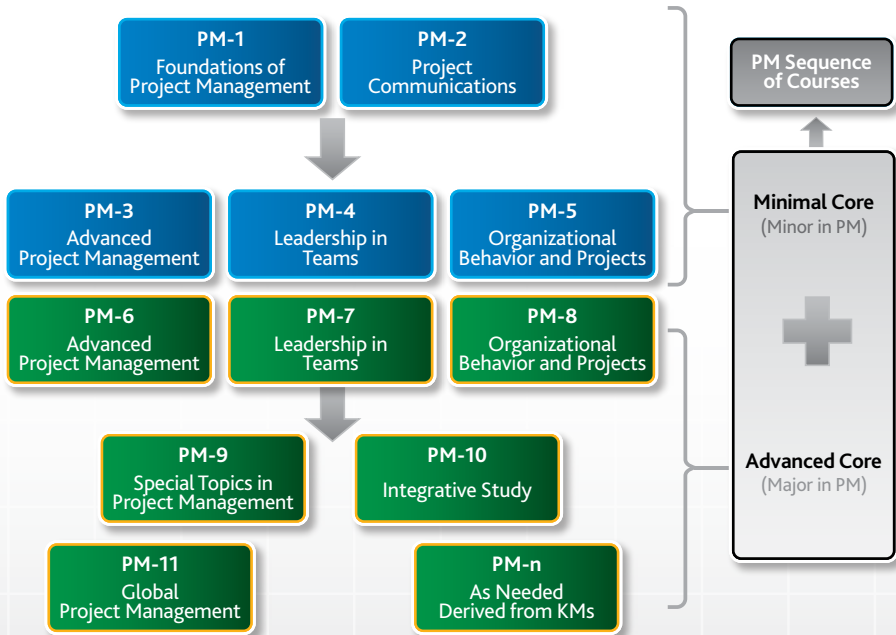
Course	Course Title
PM-1	Foundations of Project Management *
PM-2	Project Communications
PM-3	Advanced Project Management
PM-4	Leadership in Teams
PM-5	Organizational Behavior and Projects

Course Flow for PM Emphasis (Major)

Course	Course Title
PM-1	Foundations of Project Management*
PM-2	Project Communications
PM-3	Advanced Project Management
PM-4	Leadership in Teams
PM-5	Organizational Behavior and Projects
PM-6	Project Governance
PM-7	Project Procurement and Supply Chains
PM-8	Project Stakeholder Engagement
PM-9	Special Topics in Project Management
PM-10	Integrative Study
PM-11	Global Project Management
PM-12	Agile Project Management

* Volume II Provides details for PM-1.

The diagram below suggests the PM sequence and course dependencies.



APPENDIX I-D: INDUSTRY BACKGROUND AND TEACHING EXPERIENCE OF FACULTY

A questionnaire was prepared and sent to the 45 volunteers participating in the five undergraduate PM curriculum workshops sponsored by PMI from 2012 to 2014. Thirty respondents (68.2%) were used for analysis. The 30 participants represented all of the PMI global regions and had combined industry-sector experiences of over 900 years in the 32 sectors cited. The average industry experience was 12.5 years (median 7 years). The respondents cited teach in 53 countries spread across all PMI global regions. A total of 107 teaching experiences were cited across the 53 countries identified. The average teaching experience for respondents was 16.8 years (median 15 years). The majority (24) of respondents had past or active affiliations with PMI as chapter members, officers, or volunteers, or related affiliations. Input by these educators introduces real-world relevance and adequately prepares students for entry-level positions in PM.

Industries

Advertising and marketing	Hospitality
Aerospace	Human resources
Architecture	Information systems/IT
Banking	Insurance
Biotechnology	International consulting
Conformity assessment	Liquid petroleum/gas
Chemical industry	Manufacturing
Construction	Nonprofit (charities)
Department of Defense/defense-related	Oil industry
Education	Product development
Electronics/electrical engineering	Retail
Executive management	Soft-skills facilitation
Financial services	Software development
Food manufacturing	Telecommunications
Government (national and local)	Training and development
Healthcare	Utilities

Countries Where Respondents Taught PM

Australia	France	Norway	Spain
Austria	Germany	Pakistan	Sultanate of Oman
Bahrain	Greece	Palestine	Thailand
Belgium	Hungary	Panama	Turkey
Brazil	India	Peru	UAE
Bulgaria	Iran	Philippines	UK
Canada	Jordan	Poland	USA
Chile	Kuwait	Qatar	Vietnam
China	Lebanon	Romania	
Columbia	Lithuania	Russia	
Costa Rica	Macedonia	Rwanda	
Czech Republic	Malaysia	Saudi Arabia	
Denmark	Malta	Singapore	
Egypt	Mexico	Slovenia	
Finland	Netherlands	South Africa	

Countries Where PMI Global Region Taught PM

North America

USA
Canada
Mexico

EMEA

Austria	Kuwait	South Africa
Bahrain	Lebanon	Spain
Belgium	Lithuania	Sultanate of Oman
Bulgaria	Macedonia	Turkey
Czech Republic	Malta	UAE
Denmark	Netherlands	UK
Egypt	Norway	
Finland	Palestine	
France	Poland	
Germany	Qatar	
Greece	Romania	
Hungary	Russia	
Iran	Rwanda	
Jordan	Saudi Arabia	
	Slovenia	

Central and Latin America

Brazil
Chile
Columbia
Costa Rica
Mexico
Panama
Peru

Asia Pacific

Australia	Malaysia
China	Pakistan
India	Philippines
Russia	Singapore
Japan	Thailand
South Korea	Vietnam

APPENDIX I-E: INDUSTRY INPUT FROM PRACTITIONERS

Nine industry-sector contacts were asked to review the PM-I course section of the undergraduate curriculum guidelines document (Volume II). In addition to their current industry sectors, the respondents had previous experience in 20 industry sectors. The majority of respondents either had direct hiring responsibility or advised those who hired new project managers. Half of the respondents had previously taught project management at some level and were familiar with course outlines and expected learning outcomes. All of the respondents believed the course, as outlined, was comprehensive and adequate for preparation of entry-level project managers. The respondents also noted a number of suggestions to augment the course and its learning outcomes. Many suggestions dealt with communication and soft skills, including role playing scenarios and simulations, as well as recommended involvement of students in actual (real-time) projects for both industry and practice experience. Respondents clearly demonstrated their preference for entry-level personnel skilled in communication, working in teams, problem solving, and critical thinking. However, practitioner surveys also show that technical skills are very important for entry-level professionals.

Industry sectors represented:

- Digital media: entertainment TV (non-news)/mobile apps/console apps/software development
- Engineering/technology
- Healthcare medical devices
- IT and IT services
- Nuclear power
- Software and hardware
- Government: construction
- Government: aerospace
- Government: IT

Range of position titles and industries surveyed:

A diversified portfolio of practitioners from different industry sectors, who play a key role in hiring undergraduates were surveyed. The key organizations surveyed are: Oracle America; HP; Google, Inc.; Philips Healthcare; Exelon Generation; Disney/ABC TV Group; NASA Headquarters; City of Winnipeg; and City of Boston. The job titles of the surveyed practitioners who employed undergraduates were: Chief of Staff; Program Manager; Director; Project Management Practice Leader, Healthcare Sector Head; PPM Academy Manager; Implementation & Support Manager; Software Development Chief Knowledge Officer; Superintendent of Property Management; and PMO Director.

The following represents a consistent theme of response from the practitioners:

“If new employees came to us with this kind of education and awareness (as illustrated in the KMs and the PM-1 course), it would be much easier for us to raise their level of maturity and have them fully functional in the workplace faster!”

“We need students with more education and capabilities in the domain of behavioral skills and capabilities.”

“Students should be able to take on a leadership role in a project and be quick to react to changes.”

GUIDELINES FOR UNDERGRADUATE PROJECT MANAGEMENT CURRICULA AND RESOURCES

15 January 2015

Volume II: The Foundations of Project Management Course PM-1



Studying Volume II or implementing a course based on the curricula content and guidelines here does not assure that the student can or will pass the CAPM® or PMP® exam or other related exams. Implementing these curricula guidelines does not assure that an institution will be accredited by Global Accreditation Center.

RATIONALE

The goal of Volume II is not to be prescriptive. It is not intended to be a “curriculum in a box.” Rather, this volume is designed to provide resources, illustrative examples, and options to faculty wishing to develop PM courses.

The foundational course, PM-1, can provide valuable guidance for an academic unit planning to introduce a project management course into its curriculum for the first time. This volume addresses the following questions that such an academic program might be asking:

- What PM content should be covered in a foundational course?
- How might that content be organized?
- What instructional guidelines, syllabi, and resources are available to teach such a course?

If a PM curriculum already exists in an academic program, the Foundations of Project Management course (PM-1) can lend to the discussion on viability. The document reflects input from a diverse faculty many of whom have worked in key industry domains and have taught PM in more than fifty different countries.

CHAPTER II-1: COURSE OVERVIEW

Background

In this chapter, we describe the content for, and philosophy behind, an undergraduate foundational course in project management, PM-1: Foundations of Project Management.

Our goal is to provide curriculum resources for the creation of a first undergraduate course in PM. Therefore, as well as the course content, we describe the instructional resources, including syllabi, proposed curricula, suggested lectures, and activities (homework assignments, discussion topics, class work, etc.).

This course contributes to the establishment of PM as an academic and research discipline. PM educators consider research to be a key aspect of the student's educational experience, and it has been strongly recommended that a significant number of assignments integrate scholarly literature review, critical reflection, and informed consideration of PM topics.

The rationale for PM-1 includes the idea that developing a research culture requires planning and preparation and cannot be left to the last module in a sequence of PM courses. Acquiring research and critical-reflection skills is a formative process, which implies continuous development and nurturing. Therefore, it is advised that PM-1 assignments provide students with an opportunity to begin to master these skills as well as feedback to improve and grow as researchers. While this may not be an explicit part of the grading scheme, it is a formative component of developing the skills.

The details we provide for a one-semester course are intended, it is intended as a baseline or template for other types of implementations as well—we do not present a single, uniform approach. Rather, we establish a baseline in Chapters 2 through 4. We then present variations, such as different approaches to the final project and suggestive localizations, by which we mean adaptations for different industries (healthcare, construction, information technology, etc.) and variations in approaches necessitated by teaching PM-1 in different countries.

The content is designed to serve as an undergraduate course for students who are majoring in PM, for students who might wish to consider a minor in PM, as well as for students taking a PM course outside of their major as a separate offering. This could include students enrolled in business, engineering, and liberal arts programs. The content can also be tailored to fit different teaching modes (classroom, online, blended), as well as the needs of different countries and time frames.

The curriculum is designed to be applicable to projects in all disciplines and industries, including construction, technical, research, defense, healthcare, information technology, and pharmaceuticals, as well as nonprofit and arts organizations.

There are no prerequisites for the course, so it can be taught in a stand-alone fashion.

The course is intended to cover most of the fundamental aspects of modern PM, both managerial and technical, as well as to give the students direct experience in implementing appropriate tools and techniques. By the end of this course, students should have a mastery of the basic theory and practice of PM, as described by the core knowledge modules (KMs). Since this is a foundational course in project management, students should also have a mastery of the behavioral and sociocultural themes in PM, including communication, interpersonal, critical-thinking, and problem-solving skills in a variety of contexts.

There are important PM skills and topics that are not part of PM-1. The major omissions in this regard are communications and people skills. These were deemed so important that they required their own course. The issues can be emphasized and discussed in PM-1, but the fundamental concepts and techniques have been assigned to PM-2. That is, we believe the second course in the sequence should immediately address the “soft skills” of PM.

PM-1 includes significant case work to embed the concepts in real-world situations and to show students how to apply the skills and techniques required when working on a project. Ethics and professional responsibility aspects of PM are introduced. The course structure for PM-1, which was defined in Volume I, Chapter 5, is shown below:

Course Structure

Course Label: PM-1: Foundations of Project Management

Definition:

The objective of the course is to teach students how to approach project management and understand all the essential concepts from both a theoretical and applied perspective.

The following are the high-level learning objectives:

1. Identify the elements of the PM life cycle, including plan, control, and organize and allocate resources.
2. Understand PM processes.
3. Comprehend and become familiar with the use of basic tools and techniques to plan, organize, and manage a project.
4. Optimize results while managing the triple constraints.
5. Manage stakeholder communications.
6. Demonstrate the principles and practice of team leadership.
7. Describe the career paths in the PM profession.

The course also includes an introduction to the importance of people-oriented skills, such as communications management, HR, and leadership.

Relevant KMs:

PM-1 draws topics extensively from the following three knowledge modules:

- Project Management Principles [T-PM]
- Project Phases and Processes [T-PP]
- Project Planning and Integration [T-PI]

The course also draws upon lecture topics from several personal and organizational modules, such as the Ethics and Professionalism, Project Communications and Stakeholder Engagement, and Opportunity and Risk Management.

Objective and LOs:

See Chapter II.

Topics:

See Chapter II.

Student Expectations:

See Chapter II.

Laboratory work, teamwork, and preparation:

PM-1 includes significant case work to embed the concepts in real-world situations and to show students how to apply the skills and techniques required when working on a project.

Instructional Hours:

40 hours

Required or Optional:

The content is designed to serve as an undergraduate course for students majoring in PM, students who might wish to consider a minor in PM, as well as students taking a PM course outside of their major as a separate offering.

Prerequisite:

None. This course is explicitly designed to be taught without prerequisites.

Seminar versus lecture format:

Lecture with moderate teamwork

Case-based:

Extensive use of cases is included

Critical thinking skills required:

Extensive critical thinking skills are built in. Acquiring research and critical-reflection skills is a formative process, which implies continuous development and nurturing. Assignments provide students with an opportunity to begin to master these research skills.

Teamwork:

Many assignments are designed to be performed in teams.

PM-1: Learning Outcomes and Content***Learning Outcomes***

- Identify the elements of the PM life cycle, including plan, control, and organize and allocate resources.
- Understand PM processes.
- Comprehend and become familiar with the use of basic tools and techniques to plan, organize, and manage a project.
- Optimize results while managing the triple constraints.
- Manage stakeholder communications.
- Demonstrate the principles and practice of team leadership.
- Describe the career paths in the PM profession.

Content:

- PM Foundations: Define a project, project management, and the role of the project manager.
- Program management and portfolio management
- Project sponsorship and the project office
- Project organizational structures

- Understanding the PM context
- Project life cycle: sample life cycles, along with traditional versus agile
- Project management processes
- Project initiation: creating a charter and identifying stakeholders
- Project planning: creating a scope statement; building a WBS; identifying resources, and building a project budget; basic scheduling, networks, and critical path; and creating a PM plan along with key subsidiary plans
- Project execution: problem solving and decision making
- Project monitoring and controlling: managing changes to scope, cost, and schedule; understanding team dynamics; and managing resources effectively
- Project closing: gaining customer acceptance and documenting lessons learned
- Global issues in PM
- Introduction to the importance of people-oriented skills, such as communications management, human resources, and leadership
- Product-based planning: PM documents that need to be produced at each stage in the process (artifacts of project control)

By the end of this course, students should be able to:

- Describe the importance of PM in the context of various organizational cultures and strategies, and summarize the typical components of the PM system and the processes that are considered essential to any project.
- Evaluate factors important to project selection and prioritization as evidenced by organizational capability and available resource capacity.
- Select and describe an appropriate project management strategy for a new project that can meet stakeholder expectations in a given organizational context.
- List and describe the project phases that make up a typical project, and summarize the PM processes that occur within each. Explain the relationships between subject areas, process groups, and processes.
- Describe the typical PM process documentation and the PM deliverables that are produced by project managers in each project phase.
- Develop a sequence of categorized PM processes and activities that will meet stakeholder expectations.
- Compose a life cycle for a specific project in a specific industry.
- Develop a project charter and a preliminary scope that document high-level project strategy, milestones, deliverables, and estimates for stakeholder, customer, and sponsor approval.
- Develop a PM plan that documents the actions necessary to define and coordinate activities, assess project deliverables, and ensure control and management of costs, schedule, and changes to the project.
- Describe the interaction of the various components of the PM system, and give examples of how changes impact projects and how project managers adjust activities, coordinate responses, and communicate the results to stakeholders.

In addition, we expect students to develop the relevant sociocultural competencies and behavioral skills as they relate to project management. In this course, these are:

- Communication
- Ethics and professionalism
- Negotiation
- Organizational roles and context

To demonstrate competency (within the context of assignments, projects, or examinations), students should be able to:

- Create a business case and explain the purpose and primary components of the project charter.
- Define the role and responsibilities of a project manager.
- Perform a high-level assessment of the current environment and be able to identify organizational resources for the project.
- Describe project alignment with strategic company objectives.
- Utilize project selection methods/decision models, including benefit-measurement methods; implement a scoring matrix to select a project.
- Create a project schedule using any automated tool.
- Identify suitable project templates to create a comprehensive project plan.

Pedagogical Approach

Soon after graduation, many students find themselves on a project without any knowledge about, or formal training in, PM. One of the major goals of the PM-1 course is to address this deficiency by giving the student competency in the most important concepts in PM. PM-1 is also designed to provide a foundation for all future courses, for either a minor or major in PM. Therefore, in the course we emphasize fundamental principles, along with the essentials required to both work on and manage projects. Specifically, the course covers the accepted methodology for implementing a project, the essential project components, techniques for designing and implementing those components, tools for generating specific project data, techniques for analyzing data to report project status, and case studies of real-world projects that illustrate both the project components and the processes used to build them.

The course is designed to teach the skills and background that students need to work on existing projects and to plan and design new ones. The materials are based on established, research-supported project approaches.

The curriculum is not specific to any one industry or project type. It is designed to be applicable across all industries, such as construction, transportation, defense, healthcare, new product development, information technology, pharmaceutical, theater, the arts, museums, and nonprofit organizations. The curriculum is also designed to be flexible enough to allow interesting and novel ways to combine topics.

Since this is an introductory course, it emphasizes the following topic areas:

- Carefully defining the terminology associated with projects, PM, and the role of the project manager
- Understanding the project environment, including project goals versus company goals, the project's reason for existence, and ways that companies organize projects
- Defining the PM processes, including initiation, planning, execution, monitoring and controlling, and closing
- Creating the charter, scope statement, and a project plan
- Identifying resources, estimating and sequencing activities, and building the budget
- Creating the project network, the schedule, and the critical path
- Creating subsidiary plans, including risks, quality, human resources, and procurement
- Analyzing global issues in PM, including ethics and professional responsibility and cultural diversity
- Practicing people-oriented skills, such as communications management, human-resources management, leadership, conflict management, and ethics
- Understanding the roles and careers in the profession of PM

The inclusion of these topics is based on the following philosophy:

Understanding the Vocabulary

To work on a project, students must be able to understand typical PM terminology. Therefore, this course exposes the students to a wide variety of topics. Not all PM topics can be covered in detail, but the vocabulary should be emphasized. We cover the components that make up a project, as well as the processes with which they are developed. Finally, the course covers the essential tools and techniques with which the student should be familiar.

Analysis:

Effective PM depends on the ability to understand and reason about the deliverables from both the process and the product points of view. Process deliverables include such items as the PM plan, WBS, cost, and schedule. Product deliverables include items such as the specification, design, and product itself. Along the way, there are many tools and techniques that help analyze these products, particularly risk and quality analyses.

Tools:

When teaching tools, the emphasis is on accomplishing an analysis of the state of the project, not on the tools themselves.

Many project tools have an established, formal basis underlying their use, which is emphasized. Examples of tools with a formal basis include the critical path method (CPM), earned value management (EVM), risk analysis, and quality analysis. While facility with such tools is a necessary and valuable skill for students, emphasis is on when the tools apply and how to use them effectively. Many existing software tools provide excellent illustrations of the kinds of automated support that exists (e.g., network diagram tools).

Cases:

Real-world cases improve a student's understanding of the project terminology as well as the appropriateness of tools and techniques. The course includes a number of cases that illustrate how to exploit knowledge from specific project examples.

We rely heavily on case studies in all topic areas and across many industries. Cases are used to distill the importance of considering different approaches, to illustrate what can be accomplished on projects, and to give students models for creating their own projects.

Implementation of a Final Project

It is a recurring theme among faculty across different disciplines and cultures that the PM-1 course should build to a final project. While there are many different approaches to the final project, students are expected to work through all of the elements of a project by using either an assigned case or one of their own choosing. By doing so, students can practice applying project techniques and analysis.

The final project is typically implemented gradually throughout the course as topics are covered. Weekly deliverables accumulate and form the basis for the final project. Some faculty members require students to pick their own project early on and others assign a single project for all students work on. Chapters 4 through 6 explore different approaches to this problem. In all cases, students work on their project throughout the course. Rarely is the final project assigned as a stand-alone assignment at the end of the course.

Communications and Soft Skills

After much discussion and debate, it was decided that it would be impossible to do justice to the teaching of soft skills in PM-1. The major omissions from PM-1 in this regard are communications, leadership, and human resources. While the issues can be emphasized and discussed in PM-1, the fundamental concepts and techniques have been assigned to PM-2. That is, we believe the second course in the sequence should immediately address the “soft skills” of PM.

Mapping to Knowledge Modules

Appendix II-B provides the detailed mapping between the topics included in PM-1 and the KMs. Metrics for the KMs are provided to explain the degree to which topics are covered. The coverage metrics are defined as follows:

- I: Introduction:** Terms are defined and some coverage of the concepts and terminology is provided.
- F: Fraction:** A fraction of the KM concepts are covered in enough detail so that it prepares the student for advanced courses.
- C: Complete:** The concept is covered in enough detail with cases and homework assignments so that the LOs for this KM are completely satisfied.
- X: Not Covered:** The topic is not covered in the course.

Tables II-1-1 to II-1-3 present the mapping between the technical, behavioral, and strategic KMs to PM-1:

The Technical Knowledge Modules	Coverage
Project Management Principles [T-PM]	C
Project Phases and Processes [T-PP]	I
Project Planning and Integration [T-PI]	C
Project Resource Management [T-PR]	F
Estimating Costs [T-EC]	F
Project Scheduling [T-PS]	F
Opportunity and Risk Management [T-OR]	F
Plan and Control Quality [T-PQ]	F
Procurement and Contract Management [T-PC]	I
Finance and Cost Budgeting [T-FC]	X
Project Scope Management [T-SM]	C
Project Control [T-CP]	F
Business Analysis & Requirements Management [T-BR]	I
Project Handover, Closeout, and Reviews [T-HC]	X
PM Information Systems and Information Management [T-IS]	X

Table II-1-2: The relation between the behavioral KMs and the topics in PM

The Behavioral Knowledge Modules	Coverage
Plan, Distribute, and Manage Project Communications [B-DC]	I
Project Team Building and Motivating [B-TB]	X
Project Leadership [B-PL]	I
Identifying and Engaging Stakeholders [B-SE]	I
Project Organization and Context [B-OC]	F
Managing Global Projects [B-GP]	X
Virtual Project Management [B-VP]	X
Ethics and Professionalism [B-EP]	I

Table II-1-3: The relation between the strategic KMs and the topics in PM

The Strategic Knowledge Modules	Coverage
Strategic Project Management [S-SM]	I
Supply Chain in Projects [S-SC]	X
Legal Aspects in Project Management [S-LA]	X
Business and Commercial Aspects of Projects [S-BC]	I
Governance in Projects [S-GV]	X
Agile Approaches to Project Management [S-AM]	X
Portfolio and Program Management Principles [S-PP]	I
Strategic Project Management [S-SM]	I

Assessment

In Volume I, Chapter 3, we presented educational goals for the academic preparation for PM careers.

Table II-1-4 shows the satisfaction of the goals that are completely covered (C) or fractionally covered (F) in the PM-1 course. The terminology for the coverage of LOs is as follows:

- F: Fraction:** A fraction of the LOs are satisfied, but the LOs that are satisfied are satisfied completely.
- A: Advanced:** The LOs are demonstrated in a comprehensive manner with cases, homework, and the final project.
- C: Complete:** The LOs are completely satisfied with cases and homework assignments.
- X: Not Covered:** The LO is not satisfied in the course.

Table II-1-4: The satisfaction of the high-level undergraduate program goals by PM-1

Learning Goal		Degree Satisfied in PM	Session	Assessed by Assignment
1	Student is fully acquainted with the fundamentals of project management.	A	1-4	1-3
2	Student is acquainted with the full project life cycle and various project management processes.	A	1	2
3	Student is able to define stakeholder expectations and initiate a project successfully.	C	7	9-10
4	Student is able to create a comprehensive project plan.	A	3	6-21
5	Student is able to work in teams, manage team members, and interact with stakeholders.	C	7	9-10
6	Student is able to plan and monitor project budget and schedule.	F	8-10	11-15
7	Student is acquainted with the basic tools and techniques of managing project quality and risk.	F	12	16-19
8	Student is acquainted with the principles of identifying, developing, and managing resources.	X		
9	Student is competent at navigating a project experiencing scope, resource, and scheduling constraints through effective communication.	X		
10	Student is acquainted with the technical and human aspects of project control, especially change control.	X		
11	Student is acquainted with the contextual relationship between the project and the organization that hosts the project	F	1, 6	9-10
12	Student is acquainted with the importance of ethical considerations in every aspect of a project's operations.	F	7	10

Note: Depending upon the expectations of the university administration and accreditation bodies, both the satisfaction of the high-level undergraduate program goals, and demonstration of achieving learning outcomes might be required.

The detailed learning outcomes for PM-1 were listed in Volume I, Appendix I-A. Table II-1-5 shows an illustration of how these learning outcomes are also satisfied by the activities and assignments in the PM-1 course.

Table II-1-5: The satisfaction of LOs specific to PM-1

Learning Outcome (as derived from KM-1)	Satisfied in PM-1	Session	Assessed by Assignment
Analyze the importance of PM in the context of various organizational cultures and strategies, and summarize the essential components of a project and the processes that are considered essential to its successful implementation.	C	1	2, 3
Evaluate factors important to project selection and prioritization as evidenced by organizational capability and available resource capacity.	C	1	3
Given an organizational context and project objectives, create a charter and a preliminary scope that document high-level project strategy, milestones, deliverables, and estimates for stakeholder, customer, and sponsor approval.	C	1-3	2, 5, 6
Describe the typical PM process, its documentation, and deliverables that are produced in each project phase.	C	1 Details in 2-13	2 Details in 5-21
List and describe the project phases that make up a typical project, and summarize the PM processes that occur within each. Explain the relationships between subject areas, process groups, and processes.	C	1 Details in 2-13	2 Details in 5-21
Comprehend and become familiar with the use of basic tools and techniques to plan, organize, and manage a project.	C	8-10	11-14
Construct a project management plan that documents the actions necessary to define and coordinate activities, assesses project deliverables, and ensures the control and management of cost, schedule, and changes to the project.	C	4, 11	6, 12-16
Assess the interaction between the various components of a project, and evaluate and critique how changes in one component can impact how project managers should adjust activities, coordinate responses, and communicate the results to stakeholders.	C	7	9, 10

CHAPTER II-2: COURSE CONTENT

COURSE DESCRIPTION

In this section, we provide the list of topics to be covered in the course. Table II-1 lists the topics, the associated subtopics, and homework assignments. Topics are referred to as “session topics,” as they could be covered in a single or multiple lectures and in more or less detail.

The goal is not to be prescriptive but to provide topics that can be assembled in different ways to meet diverse needs. This is not designed to be a “curriculum in a box.” Each row of the table contains the session topics and subtopics, and typical assessment topics are also listed. These can be implemented as in-class discussions, homework assignments, or teamwork.

However, it is not assumed that all topics will be separately assigned and completed as individual assignments. They are divided up and numbered here to ensure that they can be mapped to the LOs. For example, the three assessment topics (12: Implement a project in an automated software tool; 13: Create Gantt chart; and 14: Manage resources) could easily be combined into a single homework assignment.

Table II-2-1: Session-topics outline for a typical course

Session Topic		Subtopics	Typical Assessments and Activities
1	Project manager and project environment	Definitions The project manager's role Internal and external environment Project structures Project and product life cycles PM processes The project management office Rationale and business case Mission, goals, and strategy Portfolio management Financial analysis	1. Identify projects in the student's experience. 2. Define project processes and product and project life cycles. 3. Give examples of mismatches between projects and company missions. 4. Perform a net present value (NPV) analysis for a project.
2	Charter	The PM plan The charter The triple constraints	5. Write a charter.
3	Scope	Project justification The specification Constraints, limits, assumptions, and technical requirements Statement of work (SOW) Priority matrix	6. Write a scope.
4	The WBS	WBS structure WBS dictionary Graphical vs. outline format Work packages Control accounts	7. Write a WBS.
5	Cost estimation	Top-down and bottom-up Types of estimates and accuracies Parametric estimates Budget, contingencies, and reserves	8. Write a cost estimate.
6	Stakeholder engagement and communications	Identify stakeholders Manage stakeholder expectations Communications tools	9. Create the stakeholder register and document their influence in a project. 10. Create a communication matrix.
7	The network and the critical path	Forward and backward passes Slack and critical path Assigning resources Milestones Lags, leads, and loops	11. Analyze sample network diagrams.

Session Topic		Subtopics	Typical Assessments and Activities
8	Automation tools for network and critical path analysis	Tutorial for automation tool	12. Implement a project using an automated software tool. 13. Create Gantt chart. 14. Manage resources.
9	Earned value management	Planned value, earned value, and actual cost Cost and schedule performance indices Cost and schedule analyses	15. Carry out an earned value analysis using real-world data.
10	Risk analysis	Positive and negative risks Risk strategies Qualitative risk analyses Program evaluation and review technique Cost contingencies and reserves Schedule buffers	16. Perform a qualitative risk analysis for a project.
11	Quality	Quality standards Cause-and-effect diagrams Audits	17. Create a quality plan. 18. Identify quality metrics to control quality. 19. Construct a cause-and-effect diagram.
12	Procurement	Contract types and risks Incentive and award fees	20. Recommend contract types to specific situations. 21. Calculate the incentive fee for a contract.
13	Ethics	Ethics and professional responsibility Ethical case studies	22. Give example of personal ethical issues that could apply to projects.
14	Presentation of students' final projects	Presentation of lessons learned	23. Final projects 24. Lessons learned
15	Final Examination		

Practical Observations

1) The Order

While the topic order generally follows the project life cycle, it need not be followed strictly. In reality, there will be the usual calendar breaks: midterms, holidays (bank holidays, Thanksgiving, Spring break, etc.).

It is recommended that the network analysis be covered as soon as is practical after the WBS (which is required before the network can be developed). That way, students get more time to work with the software automation tool, which usually takes some time to work through a tutorial to gain familiarity.

We also suggest that the technical aspects of the network diagram analysis be covered in detail before the demonstration of a software tool is used to implement it. Experience shows that considerable time is required to get the students comfortable with a software tool.

It is also recommended that the earned value topic be moved as soon as is practical after the network. That way, students have more time to understand and develop an analysis of their projects. Students often struggle with earned value and need additional time to absorb the underlying concepts.

Cost estimation, risk, and quality are typically fairly stand-alone topics and can be moved around to allow schedule flexibility.

2) Continuous Topics

Several topics are more suitably covered continually throughout the course, rather than in a single specific lecture. These topics include:

Communications

Different aspects of communications could be emphasized in each lecture (e.g., stakeholder communications in the lecture on the charter).

Analysis

Analysis should be emphasized as a way to obtain the true project status; it is not an end in itself.

3) Missing Topics

This is an introductory course, so several important PM topics are not covered. The topics and the rationale for leaving them out are listed below:

Communications

As explained in the rationale, the formal aspects of communications (e.g., communications models) are typically covered in a later course, although some aspects can be woven throughout the current course. Also, topics such as team leadership and stakeholder engagement are typically covered in the advanced course.

Human Resources Management

This is typically covered in detail in the later course on communications.

Quantitative Analysis

It is unlikely that there will be time to cover detailed quantitative tools, such as quality analysis (i.e., expected monetary value and decision trees, and control charts).

4) Accumulating Deliverables

The topics generally follow the life cycle and so, as students complete assignments and class discussions, they accumulate all of the deliverables for a project: charter, scope, WBS, cost and schedule estimate, and network diagram. For example, up to this point, the student has accumulated most of the elements of the PM plan.

If the student's project, or the project assigned by the faculty member, has real- world data, then the student can analyze the accumulated execution data and proceed to an earned value analysis. The student can then be challenged to develop new cost and schedule estimates, along with a series of recommendations for the future of the project. Managing changes is an important aspect of PM and can be addressed at this point.

5) Practical Implementation

The assignments generally focus on a practical objective (e.g., Write a scope). This reflects the idea that students should be able to implement the components of a project, and not just be able to describe them in a superficial way.

6) Case Studies

Research suggests that students tend to ignore the lessons from sensational and famous examples. It is better to focus on smaller, specific examples relevant to the students' experiences.

7) Ethics and Professionalism

There is debate as to whether this topic should be taught as a stand-alone course or scattered throughout courses. This is an issue that is not decided in the literature. There are also differences of opinion by region. For example, the U.S. opinion tends to favor a stand-alone approach, while European opinion tends to favor the integrated approach. Some countries, such as Germany, de-emphasize the entire topic.

8) Student Experience

Many faculty members who reviewed earlier versions of this document noted an incorrect assumption commonly made by students. In particular, mature students, many of whom are working on projects, assume they have knowledge of project management concepts. When students express these views, inexperienced faculty members are often tempted to gloss over the fundamental PM concepts, only to find that the students do not, in fact, understand the foundational concepts. It is generally accepted that time spent on the foundations in the early part of the course is well spent.

Detailed Course Description

In this section, the topics in the course are elaborated in more detail.

Projects and the Project Manager

- Definitions of project, project manager, and PM
- The importance of the project manager's role
- The project's internal and external environment
- Project structures (functional, matrix, and projectized)
- Project and product life cycles, with examples from different industries (e.g., construction, pharmaceutical, defense, non profits, arts organizations)
- An introduction to PM processes

Project Environment

- The project management office
- Rationale and business case for the project
- Mission, goals, objectives, and strategy as they relate the project
- The role of portfolio management in selecting projects
- Financial analysis to determine the return on investment (e.g., payback, NPV)

Project Initiation, the PM Plan, and the Charter

- The PM plan
- Charter, definition, and examples
- Managing for stakeholders
- The importance of change control
- The triple constraints

Scope

- Project justification
- The specification
- Constraints, limits, assumptions, and technical requirements
- Statement of work (SOW)
- Priority matrix

The WBS

- Design and decomposition
- WBS structure
- WBS dictionary
- Graphical versus outline format
- Work packages
- Control accounts

Cost

- Cost elements: labor, travel, resources, etc.
- Top-down and bottom-up
- Types of estimates and their accuracies
- Parametric estimates
- Budget, contingencies, and reserves
- Negotiation with stakeholders

Stakeholder Engagement

- Identify stakeholders
- Define stakeholder engagement strategies
- Manage stakeholder expectations
- Management of stakeholders and for stakeholders

Communications

- Communications tools
- Leadership
- Teams

The Network and the Critical Path

- Integration of the WBS into the network
- Forward and backward passes
- Slack and critical paths
- Assigning resources
- Scheduling
- Deliverables and milestones
- Lags, leads, and loops

Automation Tools for Network and Critical Path Analysis

- Tutorial for automation tool
- Implementation of project in software tool

Earned Value Management

- Planned value, earned value, and actual cost
- Cost and schedule performance indices
- Cost and schedule analyses
- Estimates at completion

Risk Analysis

- Positive and negative risks
- Risk strategies
- Qualitative risk analyses
- Program evaluation and review technique
- Cost contingencies and reserves

Quality

- Create a quality plan and identify metrics to control quality
- Quality standards
- Cause-and-effect diagrams
- Audits

Procurement

- Overview of contract types and associated risks
- Nonfinancial issues: brand, reputation, etc.
- Incentives, award fees, and damages
- Legal issues

Ethics and Professionalism

- The role of ethics and professional responsibility in project management
- Ethics terminology: deontology, teleology, Kant, utilitarianism
- Ethics case studies: personal, organizational, industrial, and corporate

CHAPTER II-3: TEACHING RESOURCES

Syllabus

A detailed syllabus is presented in Appendix II-A. Many sections of a syllabus contain data that are specific to a particular course (the professor, the schedule, etc.) and a university (classroom, dates, etc.).

A syllabus also typically contains specific college and school data, such as the textbook and where to buy it, and important policies and procedures, such as attendance rules, grading standards, plagiarism policies, sickness make-up rules, and so forth.

A syllabus has been provided with placeholders for specific course information. Therefore, a faculty member should be able to easily create their own syllabus by adding the course and university data, which are usually readily available.

Faculty members will also expect to be able to adapt the schedule for the course to take account of calendar variations and, more importantly, to tailor the topics to their specific needs. The course topics presented in this syllabus should be considered a baseline that can be adapted to specific faculty member's needs. In Chapter 7, we present many different "localizations," which are examples of adaptation of the topics and assignments. Rather than considering these as specific examples (e.g., teaching construction in the U.S.) faculty members should consider that they represent different creative approaches that they might adapt to their own environment.

Assignments

The purpose of the assignments is to help students master the material. Equally important, the students' mastery of the material establishes a basis for evaluation of the LOs.

The foundational assumption is that the students in PM-1 are unfamiliar with PM concepts and the profession. This also supports the idea that there are no prerequisites for the course. Therefore, we concentrated on providing a fundamental basis that provides students with a working knowledge of the field of PM.

Practical observations as well as the use of formal methods are considered to be essential. Therefore, the assignments tend to be somewhat detailed, but the goal is for the students to determine and understand the underlying concepts. An equally important goal is for the students to be able to apply the principles of PM to practical cases.

Choosing relevant, but not too complex, practical cases is a challenging but important aspect of developing a PM course. Faculty members need to have access to problems that are doable yet complex enough to be challenging. There is also a limit to the quantity of project data that students can handle, especially in the short time available.

One approach to this problem is to assign each student a single project that they can work on throughout the course. This reduces the time a student would otherwise consume to become familiar with multiple cases. Assigning a single case to the entire class also addresses this problem as class discussions of the case can aid slower students in reaching the desired standard.

Two approaches to this have been discussed in some detail. One is to have the students select their own project, which is illustrated in the syllabus section. In this case, the faculty member must spend some time helping the students find a suitable project. While time consuming, the eventual project can be rewarding to the students.

On the other hand, a faculty member can select one or more projects. This has the advantage that the faculty member can more definitively define the outcomes and grading rubrics. On the other hand, the faculty member must find suitable cases. PMI plans for suitable cases to be available on the curricula website. An example in which a single case is assigned to all students in the class is given in Chapter 5.

Even if a single project is assigned, students should be exposed throughout the course to diverse project cases that illustrate and clarify PM concepts. Students should then be encouraged to apply the lessons from the cases to homework assignments.

Finally, students should perform an analysis of their assignments and the assignments are designed to help the students through these activities.

The course is organized around lectures that provide interpretation, explanation, and additional elaboration of PM concepts. Guidance is provided on the important concepts to help students focus on the most significant issues. Case work requires students to apply the lecture materials as aids in evaluating their own project assignments. The assessment may consist of homework, discussions, a final project, and a final exam, which could be weighted as follows:

Weekly homework:	40%
Discussion topics:	10%
Final project:	30%
Final examination:	20%

The weights reflect the importance assigned to the evaluation of real-world cases. However, the weights could be adjusted to meet the needs of different courses, faculty expectations, and institutional standards.

Sample homework assignments and project descriptions are provided in Tables II-2 and II-4-1.

Teams

The issue of grouping students in teams is complex. If the course is a prerequisite, then all students should be encouraged to become familiar with all concepts before taking additional courses. This would argue against assigning, say, critical path analysis, as a team assignment because some students may not complete this key topic of the course.

On the other hand, projects are inherently team-oriented and so exposure to teamwork is a necessary part of educating students in project techniques. Therefore, it is recommended that there be a balance between teamwork and individual work.

Formal Analysis Techniques

To develop skills in understanding and manipulating formal models, we provide several analytical assignments in the areas of risk analysis and earned value management in Appendix II-D.

Resources

There are several excellent textbooks suitable for this particular undergraduate course. The textbooks, with an evaluation as to their suitability for use in this undergraduate course, are to be provided as part of the online materials.

Rationale for Teaching PM

The rationale for teaching this course was discussed in Volume I, Chapter 1. Here we present some additional thoughts that are specific to the implementation of the PM-1 course:

There are established principles of PM that are effective.

- Students are capable of rapidly developing an appreciation of PM. They can identify projects in their own experience, and quickly identify flawed approaches and examples of poorly performed projects.
- Students are quite capable of dealing with the open-ended nature of PM. They are at ease with the idea of defending their positions clearly and rationally. They are also comfortable with the idea that there is not a single “right” approach; different students will promote different approaches to the same problem.
- There is a wealth of material about PM available to students. Students can get significant help in their approach to a problem and in resolving differences. Instructors should make every effort to present techniques for selecting among PM alternatives, including even simple rules of thumb, such as “The scope is the most important document—do not rush into it.”
- There is more than enough substantive material to fill the first course. The selection we made was based on the opinions of a group of experts who have taught undergraduates in several formats and countries. We have slightly overdesigned the course with the idea that a particular faculty member will emphasize, and take more time with, certain topics and leave out others.
- There are many excellent textbooks that cover the materials, so we have not recommended a specific text, although sample references are provided in the resources section of this document and on the website.
- We have concentrated on a very practical approach to PM, with an emphasis on real-world applications and cases. This reflects the current state of the art of PM, which has a very practical focus. Every formal or abstract topic is supported by a real example so that the student learns not only the correct formal theory but also the characteristics of a concrete instance of that theoretical aspect of a project.
- Practice in using cases is important. Analyzing existing projects allows the student to recognize the strengths and weaknesses of individual approaches and the characteristics of different industries (e.g., pharmaceutical, defense, healthcare, construction, information technology). It is not sufficient for students to be able to recognize a specific industry; they must also be able to decide which processes to apply to a particular project.

Discussion Topics

To encourage every student to complete readings before the corresponding class lecture, a short homework assignment (perhaps a discussion topic) can be set for each class. This can be enhanced with questions about the readings.

Also, projects are widely featured in the news, so it is relatively easy to add current readings.

Assigning questions to be answered in class is a good idea. It serves both to focus students’ attention and to encourage them to do the reading in advance.

PMI Resources Goal

PMI plans to support an ongoing review of the course resources. This includes the identification of homework assignments, cases, and templates that professors can use to develop their own versions of the course. Resources will also be made available to students.

PMI has scheduled the development of an open-source website “by academics for academics” that will provide all necessary resources and guidance for the course. Potential resources include:

1. An instructor’s guide to the course, including items such as:

- Guidance on the instructional setting, management of the learning process, and perspectives on the learning material
- Reference articles for faculty on the course topics
- Articles on related pedagogy from a curriculum perspective
- Lists of available textbooks
- Detailed topical outlines and notes
- Lesson plans

2. Instructional content, such as:

- Lecture source materials and associated notes
- Lecture slides
- Other instructional resources, such as:
 - Reference articles for assigned readings
 - Topic videos and rich media
 - Lecture video content that could be used in a “flipped classroom” approach
 - Homework questions, problem sets, and assignments
 - Case problems to solve
 - Simulations and games
 - Case studies and vignettes
 - Discussion questions
 - Internet research questions and links to key sites
 - Running cases that extend across multiple concepts or modules
 - Examination questions
 - Illustrative figures and diagrams
 - Blank templates for students to use
 - Completed template examples

CHAPTER II-4: FINAL PROJECT ASSIGNMENT

Objectives of the Final Project

Faculty across different disciplines and cultures are all quite emphatic in that PM courses should build to a final project. While there are many different approaches to the final project, students are expected to work through all of the elements of a project by using either an assigned case or one of their own choosing. By doing so, students practice applying project techniques and analysis.

The final project is typically implemented gradually throughout the course as topics are covered. Weekly deliverables accumulate and form the basis for the final project. Some faculty members require students to pick their own project early on and others assign a single project for all students to work on. In this chapter, students pick their own project.

Letting students select their own case to work on throughout the semester works well when students have had contact with managing real projects in their work environment. These students are normally a minority in the undergraduate population. The alternative is to use a common case for all students. Chapter 6 describes a term project that is focused on research.

The assignment is to complete, at the end of the course, a project that covers all, or at least most, of the concepts covered in the course.¹ In addition to a formal written analysis, students are expected to present their lessons learned to the class. Several lectures were allotted to cover this. The grade on the project can be weighted between the written analysis and the class presentation.

The objectives for the final project are for the student to be able to:

- discuss and explain all of the core concepts introduced in the course;
- write effectively about the project;
- analyze project data and back up conclusions with analysis;
- select a project and acquire the appropriate and relevant data;
- apply the tools and techniques of the course to a realistic project;
- learn enough from an analysis to be able to make useful recommendations about the project; and
- acquire and present the lessons learned.

Students should analyze the project and discuss the important issues about its status, such as critical path and earned value analyses. Finally, students provide recommendations about the project.

Content and Format

The analysis in the paper should not be too long (we suggest around 10 pages), allowing students to focus on clear communication and emphasize the presentation of an analysis of the project and its status, which are important skills for a project manager.

Detailed documents, such as scope and WBS, etc., may be included as appendices. Students are encouraged to provide references.

Software analysis tools should be required in the project analysis (e.g., critical path analysis, cost and schedule estimates).

¹ Some universities refer to this as a “capstone” assignment. In this document, the word “capstone” is reserved for a course at the end of a program—see course PM-10.

Each student's project is unique, and so each will have different sections. However, the aim is to include as many of the topics from the course topic list as possible (e.g., charter, scope statement, WBS, project network, risks, etc.). Therefore, a checklist of topics to be covered in the final project should include: project charter and scope, WBS, schedule and key milestones, cost estimate, project network diagram with critical path, earned value analysis, risk analysis, and recommendations.

One way to think about the recommendations section is to imagine that the student has been asked to brief a company manager on the status of the project (which may or may not have started, depending on which project the student picks). The student first analyzes the project and then presents his or her findings and recommendations.

Students may modify the outline to suit their projects. Different projects have different objectives, and the weight given to each section will vary. The key is clear communication.

References are very important. They show that students are aware of the PM literature (and that they are not reinventing the wheel).

Selecting a Project

Students are encouraged to pick any project to analyze. However, it is strongly recommended that they pick an organization or company they are familiar with and analyze a project in that organization. By picking a familiar project, they can ask for, and usually obtain, realistic data.

In an introductory course, it is better to encourage students to pick small, rather than large, projects. On large projects, it is difficult for faculty to assess what role the student played and to what extent the student actually produced the assigned homework content.

Using an organization known to the student also shortens the learning curve. Students should resist the temptation to select large, famous projects because they can be overwhelming. Also, it is difficult to say something new about a project that has been extensively analyzed and discussed by others.

Students may pick a project that has not started (new), one that is ongoing (active), or one that has been completed (historical). The requirements and outline will vary somewhat depending on what type of project they choose.

Students should be encouraged to concentrate on their own analyses of their projects.

General Guidelines

During the course, the faculty member should regularly discuss the students' projects and not leave it until the final few weeks. The goal should be to provide constructive feedback throughout, and answer ongoing questions as they arise. Students should be advised as to whether they appear to be proceeding in the right direction and, especially, whether their projects are feasible. A significant portion of the project should consist of research and analysis.

Grading

Projects could be evaluated in the following categories.

Communication (20%)

Communication is a key aspect of PM. The project should clearly communicate the fundamental concepts, conclusions from the data, and lessons learned. The references should be appropriate and students should use PM terminology correctly throughout.

Project Tools (30%)

Students should correctly use the tools and technology of the course. They should also use a diverse collection of tools and use them in appropriate ways.

Project Analysis (30%)

The project data should be analyzed in depth and the true project status reported.

Recommendations (20%)

The recommendations should be clearly derived from the data and analysis.

Sample Assignments

Table II-4-1: Sample assignments for PM-1 by topic

Session Topic	Subtopics	Sample Assessment and Activities
Projects, project management, and the project manager	Definitions Importance of project management The project manager's role Project context: internal and external environment Project structures: functional, matrix, projectized Project-delivery system: design, build, construct Project and product life cycles PM processes Knowledge and subject areas	Identify projects in the students' experience Define project processes and product and project life cycles In-class exercise: Pull up movie posters and get students to identify "the" project; what's the difference between projects and operations? Flipped classroom: Watch movie at home; explain in class the project in the movie. Strength and weakness interview: On topic project manager—presented as large group discussion Storytelling: Tell about a project you did. Put in perspective. Does it satisfy the definition of a project? Give examples of mismatches between projects and company missions.
Project environment	Project governance: the project management office, sponsorship Project selection Rationale and business case Mission, goals, and strategy: organization and projects Program and portfolio management	Give examples of mismatches between projects and company missions. Perform an NPV analysis for a project. Perform an NPV analysis of the student's degree. Source students' projects, which they pursue for the whole course, applying different perspectives: (1) hired work, (2) select own project, (3) university project, (4) self-forming groups. Single assignments vs. assigned groups

Session Topic	Sub-Topics	Sample Assessment and Activities
Project initiation and the charter	The charter Major assumptions and constraints Project management plan Influential stakeholders	Write a charter. Write a charter based on theory input in class (unifying project across the whole semester).
Scope	Project goals and objectives Definition of project scope (i.e., what needs to be done?) Academic domain-specific outcomes (i.e., product, process, length of code) Requirements elicitation and acceptance Definition of project scope Goals, assumptions, constraints, priorities, requirements, limits, and technical requirements In-scope versus out-of-scope Validation and verification Specification and design Statement of work (SOW) Change management Change control process Scope creep and gold plating Change control boards (CCB) Scope creep Project deliverables	Write a scope. Write a scope based on theory input in class (unifying project across the whole semester).
Work breakdown structure (WBS)	Decomposition of scope Benefits of using WBS WBS structure and dictionary WBS formats: chart, tabular, and free formats (mind map); graphical vs. outline format Work packages Design of WBS Relationship to other processes * Control accounts	Write a WBS.
Scheduling	Creating a network from a WBS Dependencies (mandatory, discretionary) Forward and backward pass Slack and critical path Assigning resources Lags, leads, and loops Creating a schedule Optimizing a schedule Milestones and deliverables	Analyze sample network diagrams. Create a critical-path network without software; focus on theory.
Cost	Cost elements (labor, material, variable cost) Types of cost (direct, indirect, fixed, variable) Estimating: top-down, bottom-up Types of estimates, accuracies Estimating techniques (analogous, parametric, three-point method) Contingencies and management reserves Budget (creation): time-phased budget Negotiating and communicating: risks, budget, changes	Develop a cost estimate without software, only Excel, focus on theory Graduation cost exercise (a) teach using software – MS-Project; (b) teach cost theory
Stakeholder engagement	Identify stakeholders Classification Analysis: interest, influence, and impact Stakeholder buy-in and engagement strategy Manage stakeholder expectations Customer value proposition as a stakeholder	Create the stakeholder list and document their influence in a project. Create a communication matrix. Rehearsal role-play: provider: rehearsal, which goes through loops of work, lectured feedback, peer feedback, work, etc. Identify stakeholder and do a stakeholder-communication plan (on term project). Stakeholder mapping (power-interest matrix) (on term project)
Communication	Communication model Communication skills Communication plan Communications tools Matrix, RAM Types of reports Meetings (kickoff, team, milestone, gate, status-update, virtual)	Write a communication plan (on term project): (a) Classroom: difficult meeting activity: set up mock meeting, assign different roles to different people, meeting falls apart. Apply methods to save meeting. (b) Online class: virtual meeting management

Session Topic	Subtopics	Sample Assessment and Activities
Project scheduling	Forward and backward passes Slack and critical path Assigning resources, milestones Lags, leads, and loops	Develop a schedule without software (only Excel); focus on theory. Use Microsoft Project to develop schedule.
Software tools for scheduling and cost	What's available Advantages, intelligent use Limitations of the software tool Scheduling tools Cost-estimation and budgeting tools Tutorial for a cost/schedule tool	Implement a project cost and schedule using an automated software tool. Create Gantt chart. Manage resources. Implement final project in software tool.
Earned value	Establishing the measurement of planned vs. actual S-curves and cumulative values Planned value, earned value, and actual cost Cost and schedule performance indices Variances and their interpretation Estimates at completion Cost and schedule analyses	Carry out an earned value analysis using real-world data.
Risk and opportunity	Uncertainty Positive risks (beneficial) and negative (threats or detrimental) Risk-management strategies Risk analyses Analytical techniques Project contingencies and reserves and schedule buffers	Perform a qualitative risk analysis for a project. Create a risk register (list, probability, impact); prioritize risks.
Quality	Quality planning Metrics for quality Quality-planning and control tools Continuous improvement * Quality standards	Create a quality plan. Identify quality metrics to control quality. Construct a cause-and-effect diagram. Create a quality plan (for final project).
Procurement	Types of procurement (make or buy) Liability Definition of a contract and legal responsibilities; contract types and associated risks: FFP, CPFF, CPIF, T&M, BPO, BOT Authorized representatives Overview of procurement types Public vs. private tenders Partnerships and collaborations Offshore Incentive and award fees and damages Contract management Alternate dispute resolution (ADR) Negotiation, mitigation, arbitration, litigation Legal, exit clauses, etc. Non-financial risks (brand, reputation) Dispute resolution	Recommend contract types to specific situations. Calculate the incentive fee for a contract.
Ethics	Definitions, concepts, and theories Ethics and cultural issues Personal, professional, corporate, societal Differences between approaches Team members' views, cultural issues Influences: colleagues, family, society Influence on decision making Ethics and professional responsibility Code of ethics (PMI, professional codes of ethics, etc.) Legal aspects	Give example of personal ethical issues that could apply to projects. Group grading among team members/influences grade: 100 pts/U.S. dollar to spend on single team member (to include team dynamics and individual member engagement) Scenarios of ethical problem solving (ethical considerations for project managers and participants) Ethics case studies
Final Projects	Presentation of project plans/deliverables/lessons learned	Final projects and assessments. Lessons learned.
Final Examination	Examination of key deliverables and/or examination.	Final Exam

CHAPTER II-5: FINAL PROJECT CASE ALTERNATIVE

In this chapter, we provide an alternative means for assignments throughout course PM-1 using the concept of a “running problem case.” This involves the use of a single problem scenario that provides an opportunity for students to create multiple deliverables throughout the course that apply to this scenario as they learn various topics within the subject of project management (PM). The case develops as the students learn the fundamentals in class, and the deliverables match the course content. Sections 5.14, 5.18, and 5.22 of this chapter provide the detailed description of the case that would be provided respectively for PM classes in IT, Management, and Engineering domains but, for context, we provide a brief summary below:

PROBLEM CASE SUMMARY

Wilmont's is a top-ranked U.S. retail pharmacy with more than 8,000 stores nationwide. The company is secretly considering delivering prescriptions by flying drone. DroneTech, a small firm in San Francisco, CA announced the approach in March, and Wilmont's has made an agreement with DroneTech to prototype this project in the San Francisco area. DroneTech will provide the drone technology as well as the drone piloting and delivery systems, but will customize its systems and business process to conform to Wilmont's requirements.

You are the project manager assigned to lead this project. (Depending upon the course domain, the case positions the student as the project manager in either Wilmont's IT, Wilmont's Pharmacy Operations, or DroneTech Engineering.)

- Wilmont's has limited the project expenditures to a maximum of US\$1,750,000 for this prototype project and will implement it first in only four stores.
- The project begins next January 5 and the first customer delivery flight should take place no later than November 30 to avoid harsh weather in the San Francisco area.
- You will need to plan tasks and assign team members to them from a list of people involved in the project. Regular meetings need to be held with the team and stakeholders as well as other forms of communication.
- Approval points are needed through the project sequence.
- Risks, testing, quality control, and provision issues may develop.
- Issues in security, reliability, integrity, interfaces between the systems of the two organizations, and customer interaction are all considerations that must be made as you plan the project.
- User training and other preparations will be required for system implementation. The Wilmont's change management team will assist you in this effort.

Final schedules need to show a certain level of completion based upon a given date.

Rationale for Use of a Common Case for All Students:

This chapter involves the teaching approach of assigning all students in the course the same case problem from which they develop their PM deliverables throughout the progression of the course. This differs from the alternative common practice of allowing students to choose their own individual case problem for their assignments. There are some advantages and disadvantages to the common case approach:

Advantages:

- All students in the class are required to analyze a relatively sophisticated project scenario that has been designed to incorporate typical issues in real-world project management. Sometimes, when students are allowed to choose their own project scenario, the less ambitious students will likely choose scenarios having fewer complications. The common case brings all students into contact with a certain scale of problem size and complexity, requiring a certain level of critical thinking on their part.
- Students learn from each other as the course progresses, and their own expectations increase as they see the quality of work produced by their peers.
- Instructors can develop a common and clear set of standards for grading, discussions, and other measures of learning.
- Instructors can be more prescriptive and better defined in expectations, an important criterion particularly for undergraduates in such issues as late work and resubmission procedures.
- Depending upon the instructor's preference, individuals or groups can be assigned certain roles within the common scenario, creating an even more challenging environment as the overall project is planned and managed.
- Instructors should use the specific case domain version (IT, Management, or Engineering) that most closely represents their own domain of expertise and that of the majority of the students. Neither instructors nor students need to be experts in IT or the technology of the drones, because the point of the case is to apply PM best practices to it, and relevant details of the technology are provided in the case problem text. In addition, the domain versions remain focused on the particular aspects of that given domain within this case. There is no requirement for IT people to know the technology of the drones, for example, because the emphasis of that case version is on the information systems that are involved. The Engineering version focuses not on developing the specific drone technology, but rather on typical issues in the preparation of any newly developed technology for the purpose of commercial retail use. The Management version focuses on internal business processes, contractor relationships, market acceptance issues, and regulatory concerns that would accompany any such innovative use of subcontracted technology.
- The case has two views: The first is an initial view, but the second iteration of the case introduces very detailed information about the project for later use in the course, and requires the student to simulate a certain level of completion as well. This provides a limited, but effective, opportunity for instructors to challenge students with measuring completion, EVM approaches, and tracking techniques.

Disadvantages:

- The more that students have had contact with managing real projects in a work environment, the more they may prefer to use their own projects for their assignments. These students are normally a minority in the university undergraduate (and possibly even graduate) environment, although certain domains such as construction and engineering, where students may be more familiar with projects, may fall into this category. Instructors should feel free to allow such experienced individual students to use their own case if it is approved to be of sufficient scale and complexity to compare to the common case, as there may be only from one to three such students in a given introductory PM course such as PM-1.
- Common case scenarios need to be changed somewhat as the course is repeated in order to keep each class dealing with unique situations, and preventing the use of previous course solutions that may be available to students in digital format. Many instructors develop a "pool" of scenarios that can be rotated through time, or the specific constraints, dates, people's names, costs, and types of resources can be varied with each implementation of the case. Electronically posting "best" solutions is discouraged since this is the first step in subsequent students using this solution for their own assignment work.

Chapter Sections:

The remaining sections of this chapter will define specific types of related assignments based on a case problem, including instructor guidance for each. Finally, a specific sample problem case scenario will be given in three separate versions for the Information Technology, Management, and Engineering domain areas, along with instructor administration guidance. The nature of the scenario content has to do with some actual experimentation with technology dimensions in healthcare product retail. These combinations and alternatives will give instructors a modular set of materials that can be interchanged according to the intended domain of the course.

5.1 The Nature of a “Running Problem Case”

The classic “case study” is normally a structured account of a past actual occurrence that gives students an opportunity to analyze the situation according to methods taught, and then to provide some form of written deliverable that describes this analysis and makes certain recommendations or poses certain outcomes. The students discuss the case further in class and then learn about the actual outcome of the scenario so that they can determine how completely their own analysis reflected the actual situation and outcome.

However, another type of case used in teaching features a scenario that is highly adapted to the course content, but incorporates sufficient realistic content that it can stimulate some amount of experiential learning. Such scenarios need to be based on concepts that either are, or might actually be, taking place in the field of application, and they can contain either real or contrived information, which will sufficiently enable the student to develop the necessary deliverables that reflect professional project documents. This approach serves to aid significantly in the transfer of the student’s learning from the course environment to future project scenarios that the student encounters in practice. These types of cases pose problems for the student, who then must provide appropriate deliverables that address these problems, so the concept is not necessarily to understand what happened in a real past situation, but rather to engineer an appropriate set of project plans and other documents that would be sufficient to carry out the project in the future. Therefore, it is not critical that the case be historically accurate, but it must be practical and realistic in order to preserve the learning that comes from this type of situational simulation.

This chapter provides materials that are in this latter category. The problem case scenario is based upon certain events that are taking place in practice today, but it uses organization and personnel names and other data that are not necessarily real. The information is structured to allow the student to develop different and increasingly complex deliverables in pace with the course topics learned throughout the full course delivery period. Information is provided in such a way to illustrate various issues or complex concepts, with students seeing different modules of the content revealed to them by the instructor as the course progresses. This creates opportunities for students to learn new information and to respond to newly occurring issues along the way that simulate much of what the practicing project manager might experience in the field during the full term of a project. Such a single case scenario that develops more detail over time and involves the student’s completion of multiple deliverables as the course progresses is known as a “running problem case.”

5.2 Syllabus Information for the Running Problem Case

Instructors may wish to include a section in the course syllabus that describes the nature of how the case is used in various assignments. The following is an example of such a statement:

Project Assignments:

Assignments will demonstrate the student's understanding of the course concepts learned and the student's ability to construct the typical work products expected of real-world project managers. There will be multiple assignments submitted during the semester, each consisting of individual parts that are related to a single case problem that develops throughout the course. Assignments are submitted by students individually to ensure that students acquire the skills needed to perform individually as a competent project manager.

Case scenarios used for the assignments will provide students opportunities to respond to the complexities of real-world issues in project time, cost, scope, and resource management. The focus of grading the deliverables created will be on how well the student organizes the information about the case problem and creates the typical project management documents that explain to stakeholders how the project will be designed and executed.

Assignments in the earlier portion of the course will reflect fundamental information typically understood by a project manager at that point in the project time line, and which takes the form of the initial set of planning deliverables that might be submitted to management and/or stakeholders for approval as the project is designed. Assignments in the latter portion of the course will reflect increasingly complex information that often develops as projects are refined and more detailed requirements are understood, while still remaining within the overall project objectives that were first defined in the earlier assignment submissions.

5.3 Student Deliverables Based Upon the Problem Case

The following are the types of deliverables recommended for submission by students for the running problem case:

- Project charter and initial scope document (25 points), including summary sections for:
 - Name, Background, and Context of the Project
 - Business Case
 - Process and Product Deliverables
 - Initial Project Constraints and Assumptions
 - Project Team Management, Members, and Reporting Structure
 - Project Integration Plan and Management Strategy
 - Initial description of Risks and Mitigation Summary
 - Quality Management
 - Project Milestones
 - Document Approval by Key Stakeholders
- Initial WBS (16 points)
- Sample WBS dictionary (9 points)
- Project Risk Management Plan (30 points), including Risk Register
- Project Communications Management Plan (30 points), including stakeholder analysis and communications planning matrix
- Final WBS (60 points), including resource assignments, task sequencing, and costs of work and materials

Deliverable Scheduling:

Scheduling of the assignment deliverables can take many forms, but it is common to group certain deliverables together, or at least close to one another in time for submission. For example, the instructor can require students to submit the project charter/scope first, followed closely by the WBS and WBS dictionary. Later in the course, the students can submit the risk

management and/or communications management plans at the time that these are covered in class. Lastly, the Final WBS is submitted near the end of the course because it incorporates numerous high-level concepts of scheduling, resource assignment, procurement, budgeting, and project strategy that come together as a terminal assignment.

5.4 General Assignment Grading

The point values above suggest relative weights of the deliverables so that the instructor can see how their impacts will vary on the student’s final course grade. Actual point values may be different as the instructor desires, but at least the above points give a starting value to illustrate relative effort involved. The following are examples of how to describe the evaluation of the student submissions, and it is recommended that a section like this be included in the course syllabus to inform students well in advance about how the Running Problem Case assignments will be evaluated generally:

Time Management

Deduction as per situation based on the following table:

- 0 No deduction–assignment on time or late with permission.
- 1 Assignment up to 1 day late
- 2 Assignment 1–2 days late
- 3 Assignment submitted 2–3 days late
- 4 Assignment submitted 3–4 days late
- 5 Assignment submitted more than 4 days late.

*Note: Points deducted for late submission will remain on resubmission of the same assignment.
Late resubmissions may be subject to additional deductions.*

Assignment Overall Quality

Points earned based on the following:

- 1 Appropriate analysis effort and correct file naming and submitted file format.
- 0 Appropriate analysis effort, but file submission format or naming does not follow requested criteria as specified.
- 1 Assignment does not clarify enough detail to serve as a client-ready document for this case.
- 2 Use of templates or generic sections that are not adjusted enough to this case problem.
- 3 Assignment does not reflect appropriate analysis or understanding of the case problem.
- 4 Assignment is incomplete with several missing segments that decrease its overall value.

Concept/Skill Mastery	Most Mastered	Criteria Achieved	Could be greatly improved
(See below for list of skills)	(3 points)	(2 points)	(1 point)

Bonus points may be earned with exceptional work on any given skill category.

Project Charter/Scope, WBS, and WBS Dictionary Evaluated Skill Categories:

- Has the student summarized the basic problem of the case study in sufficient detail, including what is to be done and who is to do it?
- Are the roles and responsibilities of the stakeholders and team members in the case study correctly identified?
- Are all major deliverables listed and defined correctly so that they are easily understood?

4. *Does the scope document contain the needed content sections as defined in class and explain the project as far as possible with the initial case information given?*
5. *Is there an appropriate section where it is described how the project will be structured in terms of relationships of team members and management?*
6. *Is the project defined generally in terms of milestones and description of the general order of activities to accomplish all deliverables successfully?*
7. *Are there sections that describe the approach to be taken to ensure quality of deliverables, project integration strategy, and the monitoring/control activities that will be used?*
8. *Is there a formal place for a few key stakeholders, the sponsor, and the project manager to sign and date?*
9. *Is the WBS logical and numbered properly, does it follow the case problem, show proper action words, and is it appropriate to the scale of this case problem (not just from a general template)?*
10. *Is the WBS dictionary formatted properly, does it contain several entries, and does it describe work, not include just definitions of terms?*

Risk and Communications Management Plan Evaluated Skill Categories:

1. *Does the risk management and/or communications management plan follow the general content as specified in class? Is the content reasonable and customized to be specific and sufficiently detailed for this project?*
2. *Is a detailed risk register included in the risk management plan that specifies the nature and priorities of each identified risk according to the approach covered in class?*
3. *Is a detailed communications analysis matrix included in the communications management plan that specifies the nature, interval, originator, recipient, and technologies for each identified communication event?*

Project Final WBS Evaluated Skill Categories:

1. *Is the Gantt chart properly formatted with necessary data columns? Top-level task? Auto scheduled?*
2. *Does the WBS contain details for the assignment as specified in the case problem? Logic allows for time to receive procured equipment before installation? Looks reasonable for this project? Predecessors logical?*
3. *Are the costs reasonable for equipment and labor? Do all tasks have appropriate costs?*
4. *Do all tasks have resources assigned? Reasonable hours for tasks and no tasks with zero hours?*
5. *Does the project resource sheet contain resources specified in the assignment? Are the rates and costs correct?*
6. *Does the budget total seem reasonable for this project? Is the project time and cost consistent with the case problem and at the correct scale?*

5.5 Assignment Resubmissions

It is recommended that instructors consider allowing students to resubmit assignments a second time based upon initial instructor feedback on the first submission. While this involves additional instructor grading of the second submission, it promotes learning from mistakes while minimizing the fear of not submitting a perfect deliverable the first time. However, to encourage students to submit their best efforts the first time, it is recommended that a policy be developed that reduces the final grade points of the second submission based upon the quality of the first submission. An example policy that can be placed into the course syllabus might be as follows:

Policy of Mastery Achievement through Assignment

Resubmission:

This course is designed to allow students to take advantage of feedback from the instructor on their knowledge and skills in order to master the subject matter. Students may revise an assignment one time and resubmit it to show that the quality has improved based on the feedback received originally.

The grade entered for the resubmitted assignment will be that earned from the revised submission, but with the following point deductions that depend upon the value of the original grade as follows:

- If the original grade was 1 - 4 points lower than the maximum grade, then the resubmission may earn up to 1 point less than the maximum grade.
- If the original grade was 5 - 7 points lower than the maximum grade, then the resubmission may earn up to 2 points less than the maximum grade.
- If the original grade was 8 - 10 points lower than the maximum grade, then the resubmission may earn up to 3 points less than the maximum grade.
- If the original grade was 11 - 15 points lower than the maximum grade, then the resubmission may earn up to 4 points less than the maximum grade.
- If the original grade was more than 15 points below the maximum grade, then the resubmission may earn up to 5 points less than the maximum grade.

Original point deductions for late assignment submissions will carry through to the resubmission as well, which means that these late penalty points cannot be made up through resubmission. Assignment revisions must be resubmitted on the due date specified in the class schedule.

5.6 The Role of the Problem Case in the Context of the Course

From a pedagogical standpoint, the role of the problem case is not comprehensive in evaluating student acquisition of knowledge, skills, or attitudes for PM-1. The total course grade should include evaluation of attendance and participation, discussions, examination(s), and reading as appropriate. The most appropriate role of the problem case is to provide an evaluation of the student's ability to take what has been learned through class activities and apply their new knowledge and skills to a specific scenario through transfer of learning.

The problem case is not a good tool to measure acquisition of terms and their definitions—examinations or quizzes are better suited for this. It is also not a good tool for measuring attitudinal skills or the relationship skills used in interacting with, and/or managing stakeholder, management, and/or team members associated with the project. These can best be measured through written or presented reflections or by actual project management experience in an experiential learning environment.

Therefore, the problem case is specifically designed to evaluate the student's ability to create the most common deliverables that project managers typically use, given a specific project scenario. This means that the instructor should not use this approach exclusively to calculate a total course grade, but should use it as an important part of a suite of student performance evaluation tools that, together, will measure the student's achievement of all course learning objectives as well as they can be measured in a typical college course.

5.7 Student Assignments

5.7.1 Charter and Initial Scope Document Assignment

Assignment Requirements:

- Due on #####
- Format: PDF file, formatted in standard U.S. letter size.
- Tools: Standard word-processing software; Adobe Acrobat or compatible print-image software
- File-Naming Requirements:
- Note: You may not be familiar with all of the technical aspects of the project, but this project requires that you know something about the typical life cycle of projects and the processes that occur within them, which you have learned in class. Therefore, do not concentrate on the technology or process solutions—focus instead on the management of this project as stated in the case, using the best practices that you have learned.

Assignment Deliverable Content:

Project charter/scope document, containing:

- Project identification: name/number
- Background—the organizational context
- Business objectives and business case (benefits)
- Detailed and measurable deliverables to be produced
- Detailed constraints (time, cost, scope) and scope/out-of-scope boundaries
- Project organizational structure
- List of high-level milestones, no dates or budget unless specifically mentioned in the case
- Project strategy, including project integration and quality management approach
- Initial summary of risks and mitigation approaches
- Signature lines/dates for evidence of approval by sponsor, PM, and key stakeholders only

You may include some text from the assignment case problem in certain categories of your charter/scope document as appropriate.

General Assignment Guidelines For Students:

While you can use help gained from researching templates found online, your documents must reflect the content and scale of this project case only! Most templates found online contain too many steps that are not appropriate for project cases we will use in class. Please focus on this problem only and do your best to produce proper documentation on your own that you would actually submit on the job. You will be graded as though this were a professional assignment, so be sure you think through what would be needed as though you were producing this for your boss! Note: ***Do not attempt to produce a project schedule in MS-Project or assign resources for this assignment.*** You do not have the necessary detail to produce a schedule, estimate times for tasks, or assign resources to specific tasks at this time and you will lose points if you do.

Don't get distracted with the technology solution—think instead about what you, as a project manager, and your team should do, even if you don't know how the technology components or project steps will all be at this point. Try to imagine as much detail as you can. If you aren't familiar with the technology concepts, technical terms or approaches, please ask for help.

There is no single, correct “answer” to this assignment. Rather than make you guess a predetermined solution, you need to think out the problem on your own and develop documentation that you consider best. Grades will depend upon what you have included, how you have structured the documentation; the way you have expressed expectations, constraints, deliverables, or other concerns; and the approach you have suggested for organizing and executing the work.

(Instructor should attach the appropriate Part 1 Case Problem here—see 5.14, 5.18, or 5.22.)

5.7.2 Student Initial WBS Assignment

Assignment Requirements:

- Due on #####
- Format: PDF file, formatted in standard U.S. letter size. The appropriate print-image can be created as a PDF file within the MS-Project software by using the “save as PDF” command in the File tab.
- File-Naming requirements:
- Tools: MS-Project software
- Note: You may not be familiar with all of the technical aspects of the project, but this project requires that you know something about the typical life cycle of projects and the processes that occur within them, which you have learned in class. Therefore, do not concentrate on the technology or process solutions—focus instead on the management of this project as stated in the case, using the best practices that you have learned.

Assignment Deliverable Content:

Preliminary Work Breakdown Structure (WBS) using MS-Project software that illustrates the possible structure of the project work from general concepts to detailed work packages that you would recommend at this stage as a project manager. Remember that you do not have all details of the project at this point, so do not attempt to infer what the details are—use only the information you have to develop a preliminary list of activities in the form of a WBS.

- THE FILE NAME OF THE SUBMITTED ASSIGNMENT must appear at the top task (PROJECT LEVEL) OF YOUR WBS. If you name the project file with the proper name following the instructions for formatting as stated in the assignment submission instructions above, and if you check on the “Project Summary Task”, this will appear automatically.
- Show at least three task detail levels in MOST of the areas of your WBS (major task level and two additional subtask levels).
- Include appropriate project management tasks, like team meetings, training, and testing tasks in all appropriate areas of the WBS for this particular case study.
- Include all of the features you have learned about in your WBS, including code numbering.
- Show very manageable tasks at the work package level. Enter the WBS into MS-Project
- Save the WBS directly from the software into a PDF format document according to the directions given in lab/class. (Screen shots of the WBS are not acceptable.)

General Assignment Guidelines For Students:

While you can use help gained from researching templates found online, your WBS must reflect the content and scale of this project case only! Most templates found online contain too many steps that are not appropriate for project cases we will use in class. Please focus on this problem only and do your best to produce proper documentation on your own that you would actually submit on the job. You will be graded as though this were a professional assignment, so be sure you think through what would be needed as though you were producing this for your boss!

Note: *Do not attempt to produce a project schedule in MS-Project or assign resources for this assignment.* You do not have the necessary detail to produce a schedule, estimate times for tasks, or assign resources to specific tasks at this time, and you will lose points if you do.

Don't get distracted with the technology solution—think instead about what you, as a project manager, and your team should do, even if you don't know how the technology components or project steps will all be at this point. Try to imagine as much detail as you can. If you aren't familiar with the technology concepts, technical terms, or approaches, please ask for help.

There is no single, correct “answer” to this assignment. Rather than make you guess a predetermined solution, you need to think out the problem on your own and develop documentation that you consider best. Grades will depend upon what you have included; how you have structured the documentation; the way you have expressed expectations, constraints, deliverables, or other concerns; and the approach you have suggested for organizing and executing the work.

(Instructor should attach the appropriate Part 1 Case Problem here—see sections 5.14, 5.18, or 5.22.)

5.7.3 Student Sample WBS Dictionary Assignment

Assignment Requirements:

- Due on #####
- Format: PDF file, formatted in standard U.S. letter size.
- Tools: Standard word-processing software; Adobe Acrobat or compatible print-image software
- Note: You may not be familiar with all of the technical aspects of the project, but this project requires that you know something about the typical life cycle of projects and the processes that occur within them, which you have learned in class. Therefore, do not concentrate on the technology or process solutions—focus instead on the management of this project as stated in the case, using the best practices that you have learned.

Assignment Deliverable Content:

WBS Dictionary formatted as described in class and in the textbook using standard word-processing software. The WBS Dictionary is a special type of project management document, and is not a glossary of terms. Those submitting a glossary of terms will not get credit for this part of the assignment. THERE SHOULD BE AT LEAST 15 TASKS IN YOUR WBS DICTIONARY selected from various parts of your project to show that you know how to do this. You should use only the SIMPLE format WBS Dictionary consisting of:

WBS code (1.2.3.4)
Task description
Detailed description of the work being performed
Example:

5.2.4 Product Testing
Products will be scheduled for testing in six stages, as defined within the corporate quality assurance manual. The product quality assurance team will be the lead for this set of tasks.

(Instructor should attach the appropriate Part 1 Case Problem here—see sections 5.14, 5.18, or 5.22.)

5.7.4 Student Project Risk Management Plan Assignment

Assignment Requirements:

- Due on #####
- Format: PDF file, formatted in standard U.S. letter size.
- Tools: Standard word-processing software; Adobe Acrobat or compatible print-image software
- Note: You may not be familiar with all of the technical aspects of the project, but this project requires that you know something about the typical life cycle of projects and the processes that occur within them, which you have learned in class. Therefore, do not concentrate on the technology or process solutions—focus instead on the management of this project as stated in the case, using the best practices that you have learned.

Assignment Deliverable Content:

You defined initial risks in your charter/scope document, and then identified some of the risk management activities in your initial WBS. This assignment extends these previous assignments by providing you an opportunity to create a specific “subsidiary plan” that concentrates on risk and opportunity management. You may include other risks besides those you had in your charter/scope document. You are now much further in the course, and you are more aware of the types of things that can present risk or opportunity to a project of this particular subject, scale, and complexity. This assignment is your opportunity to define these positive and negative risks in a professional document that demonstrates your understanding of what risk management includes, and how you envision that it applies to this specific project.

A project risk management plan describes in detail the types of risk management that will take place in the project, and the list of risks/opportunities that will be the focus of these activities. Package this document into a presentable format that could be issued to all team members, stakeholders, and the sponsor once approved.

Risk management plan contents must include the following items only (do not submit a risk planning template gathered from outside the course, as this will not satisfy this particular assignment requirement):

1. Title Page (with your name)
2. Description of Risk Management Activities—In this section of the plan, you should imagine what you would do as a project manager to conduct what sort of meetings or other activities you would need in order to define in detail what risks and opportunities might be present in this project, and also what specific sequence of actions you would need to have in the WBS to assess, document, prepare practical contingency actions for, and monitor the risks or opportunities that could affect THIS CASE PROBLEM.

Be sure to keep your activities appropriate to the scale of the project and the content of this case problem. You should apply your learned knowledge of what risk management activities there could be to this situation and describe the various activities that should take place in the sequential order that you think is best. For each of the risk management meeting, planning, documentation, or monitoring activities you think you should list, you should describe the risk management activity and identify who will participate in it, what role they have in the risk management process and what risk management deliverable will be the outcome of that activity. Think of risk and opportunity management as something that is a subproject throughout this client project. Remember that we have a number of specific deliverables that have been requested by the client, so your risk management activities should be designed to assess, document, track, and report on all the different types of risks or opportunities that these particular deliverables will involve.

3. Risk register table with the following contents for each risk:
 - a. Risk/opportunity ID (a sequential number that you give each risk in the table)
 - b. Risk/opportunity description—short description of the risk.
 - c. Impact probability (IP); (scale 1-5)

- (1) No Impact
- (2) Impact is Not Likely
- (3) Impact is Unknown
- (4) Impact is Likely
- (5) Impact is Definite
- d. Impact severity (IS); (scale 1-5)
 - (1) No Effect on the Project
 - (2) Effect is Not Significant
 - (3) Effect is Unknown
 - (4) Effect is Significant
 - (5) Effect is Severe
- e. Likelihood of advance discovery (AD); (scale 1-5)
 - (1) Definite
 - (2) Probable
 - (3) Unknown
 - (4) Not Likely
 - (5) Not Possible
- f. Risk/opportunity priority number (RPN) calculated according to only the following formula as discussed in class: $RPN = P \times IS \times AD$
- g. Potential responses to each risk/opportunity based on priority and the standard choices for risk/opportunity responses we discussed in class. You will need to be specific on each according to how you feel a particular response is recommended and the practical rationale for your recommendation.
- h. Risk/opportunity owner (accountable person who is assigned to monitor the risk, track it, and report on it)—You must appoint a risk owner for each risk in your table.

4. Place for signatures/dates for key stakeholders to indicate approval (like you did for the charter/scope document). The highest scores on this assignment will be for a practical risk management plan containing information specific to this project's requirements and deliverables, which name specific people and roles, address the practical concerns or opportunities that exist only in this project, and will help the client to feel like you have the project under control, demonstrating that you can produce a professional document. Assignments should not contain generic material imported from somewhere else, as this will not be appropriate for this situation and will lose points.

(Instructor should attach the appropriate Part 1 Case Problem here—see sections 5.14, 5.18, or 5.22.)

5.7.5 Student Project Communications Management Plan Assignment

Assignment Requirements:

- Due on #####
- Format: PDF file, formatted in standard U.S. letter size.
- Tools: Standard word-processing software; Adobe Acrobat or compatible print-image software
- Note: You may not be familiar with all of the technical aspects of the project, but this project requires that you know something about the typical life cycle of projects and the processes that occur within them, which you have learned in class. Therefore, do not concentrate on the technology or process solutions—focus instead on the management of this project as stated in the case, using the best practices that you have learned.

Assignment Deliverable Content:

A project communications management plan describes in detail the types of communications that will take place in the project, and specifies forms to use for certain types of key project information that must be transferred among team members and to others involved in the project. The communications management plan should be written for the case problem. As the project manager, you will need to develop the policies and procedures for all means of communication across the project, taking into account the requirements for communicating with the sponsor, stakeholders, vendors, and project team. Package this document into a presentable format that could be issued to all team members, stakeholders, and the sponsor once approved.

The communications management plan should include:

1. Title Page (with your name)
2. Table of Contents
3. Description of “Who needs what communication, and by when or how often”
4. Description of “Who will produce this information for each of the above”
5. Determine the various technologies you will use to communicate for each of these, including:
 - a. Format of the information—communication systems or software to be used
 - b. Where forms or templates can be found by team members
 - c. Where copies of the official project records will be stored; who can access them
6. List communication constraints:
 - a. Your policy for confidential or restricted information
 - b. How do you define these and how should the team members handle such situations?
7. Your policy for communication outside the project team, stakeholders, and sponsor group
8. Include sample form templates as well as the instructions for using them for the following standard project management tools:
 - a. Status reporting
 - b. Change control
 - c. Issues management

The highest scores on this assignment will be for a practical project communications management plan containing information specific to this project’s requirements and deliverables, which name specific people and roles and address the practical communication requirements that exist for this project, demonstrating that you can produce a professional document. Assignments should not contain generic material imported from somewhere else, as this will not be appropriate for this situation and will lose points.

(Instructor should attach the appropriate Part 1 Case Problem here—see sections 5.14, 5.18, or 5.22.)

5.7.6 Student Final WBS Assignment**Assignment Requirements:**

- Due on #####
- Format: MS-Project File (.mpp)
- File-Naming Requirements:
- Tools: MS-Project software
- Note: You may not be familiar with all of the technical aspects of the project, but this project requires that you know something about the typical life cycle of projects and the processes that occur within them, which you have learned in class. Therefore, do not concentrate on the technology or process solutions—focus instead on the management of this project as stated in the case, using the best practices that you have learned.

Assignment Deliverable Content:

MS-Project Schedule with Resource Assignments and Costs:

- a. Develop the original Case Problem Part 1 and the new Part 2 details into a formal project schedule. *You will need to modify and finalize your WBS from the new case problem information* in order to develop the complete list of tasks that must be entered into the software for the schedule. This will mean that you may need to either take out information, or add new information, to modify your previous WBS from Assignment 1 now that you have the details.
- b. All tasks in the WBS must be set to Auto Schedule task mode. While an occasional constraint is sometimes appropriate, points will be lost if you force the schedule using manual constraints on your tasks to get the dates to work.
- c. Be sure to add project management and quality management tasks on your own in order to show how you would accomplish the project management and ensure that stakeholder satisfaction is achieved with the quality of the deliverables and communications.
- d. Set up the project software according to the instructions you receive in class (and the lab sessions) to add columns for Work and Cost and to set the necessary parameters, including work hours per day and work hours per week.
- e. *Your Gantt chart schedule should also show total work hours, cost, duration, average percentage complete, and start/finish dates for the entire project through the use of a project summary task in the WBS as discussed in class. This summary task should show your project submitted file name as the project name using the file name format specified above.*

Other Tips and Requirements for a Successful Assignment:

MS-Project Resource Sheet:

1. Resource sheet should show all resources as mentioned in the case, types, availability, and costs.
2. Your name should clearly be one of the resources assigned to appropriate project management tasks and should appear in the resource sheet.
3. Names of individual team members, vendors, and other stakeholders should clearly be shown in the resource listing; you may list three-character initials for these people as specified in the case, but you may not group these into general teams.
4. If any material resources are mentioned in this case problem, these also should be visible in the resource sheet with correct costs specified *on a unit basis only*. *Combined costs for material resources will not be acceptable. Material resources should be included ONLY if they are mentioned in the case!*

WBS Work Packages:

1. No work packages at the lowest level of your WBS should have zero resources assigned, or zero hours (0h) in the work column. The only work packages that may have no cost in the cost column are special cases where fixed fees for this work are factored in from outside the scope of this project, or where executives or other staff of the client organization are doing certain work at no cost to the specific project team you manage. If these scenarios are appropriate for this case, it will be clearly mentioned, and you should follow those guidelines.
2. Grade will depend on how appropriate your effort estimates are—be careful to give a realistic estimate for project management and quality tasks. For example, writing a report or revising a schedule in 30 minutes or one hour may not be realistic! Think carefully about each task and review your work. If you see a resource allocation of 0.13 FTE for a single resource on a task, for example, this means that the person will spend about eight minutes on the task at a time, and this is not at all something that can be managed. In this situation, it is likely that the software adjusted things due to schedule constraints that you have put manually on tasks, and that you did not go back and reset these allocations to a more realistic level.
3. *Costs must be automatically calculated through resource assignment onto work packages only, not entered directly into any task or summary task cost fields.*

4. *Budget total must reflect the appropriate scale and complexity of this case problem, and must comply with any constraints and restrictions indicated previously in the case. Do not add costs to try to get to the top-level constraint mentioned in this case problem. If you work carefully on the appropriate tasks for the case, you will be able to justify a cost total, even if it is under the constraints. Just be sure that all resource costs are included.*

Some additional considerations:

1. You need to modify your original WBS to produce a *final* WBS from the additional information in this part of the case study. *Be sure you give each of the WBS entries the proper numerical code and indents to show the structure of the project WBS.*
2. Resources and costs have been identified for you. The final budget total will be calculated using the MS-Project software but should adhere to the constraints in the case. Points will be deducted if your budget exceeds the constraints of the case.
3. You must think about how to sequence the tasks logically and efficiently. Some task dependency may be mentioned in the assignment, but is ultimately up to you, as there are several correct possibilities. Do your best to identify the logical progression of tasks that makes sense and determine which can be done in parallel.

There is no single, correct “answer” to this assignment. Rather than make you guess a correct approach, you need to think out the problem on your own and develop a deliverable that you consider best. You will be evaluated on what you have included, how you have structured the project, how you have assigned resources, the way you have forecasted costs, and the approach you have suggested for organizing and sequencing the work.

(Instructor should attach the appropriate Part 2 Case Problem here—see sections 5.15, 5.19, or 5.23.)

5.8 Instructor Guide for Overall Assignment Management

Instructor Notes for Student Project Charter/Initial Scope Assignment (5.7.1)

This assignment is designed for the early stages of the course after the concepts of project structure, methodology, integration, scope, and stakeholders are covered.

The case problem used for this segment (Part 1) has various bits of critical information scattered through the text. This is purposeful, because it is meant to simulate the situation where information comes to the project manager in several clues, contexts, and forms. Part of the skill of developing the documents that describe the project at the early stages of the project is making certain that everything is gathered together and organized in those documents. This activity is critical to helping students realize that very important pieces of information about the project may appear very inconsequential at first, only to become a major constraint or critical risk factor.

One of the most common issues that occurs in this assignment is the use of generic templates that students can find on the internet and even on some textbook publisher sites. Instructors should be firm with students that submission of these generic templates are not acceptable. Grading should focus on the details of the case problem, and whether the student has made the effort to properly analyze the case.

There can be confusion about how some sections seem to duplicate information found in others. Students are sometimes uneasy about this, and they think that each section should contain mutually exclusive information with regard to all other sections. Instructors need to point out that this is project documentation, and that the point of a structured document is to allow the reader to find the information needed in the appropriate labeled sections. Some readers will only review certain sections, so it is acceptable to repeat some information in multiple sections if it makes sense if recipients of the document are reading only that section.

Students often ask for sample documents. This is symptomatic of a student who is uneasy about where to begin because they have had little experience in originating a structured document. The instructor should be cautious about providing a sample that is very similar to the case, because students will focus on that sample as the assumed required format and content. If a sample is provided, it should show the appropriate format and section headers that the instructor requires, but the content should be very different from the case problem. It is also appropriate to review the process of creating the document in class. Students can be instructed to start first with a document formatted with each section title, then review the case problem and insert points as phrases into the appropriate sections of the document, and then the student works to make these sections readable with all complete information.

It is important that the instructor recognize that this assignment incorporates only Part 1 information for the case problem. This means that the document will necessarily be more high-level, but it should still reflect the nuances of the specific case situation.

Instructor Notes for Student Initial WBS Assignment (5.7.2)

The WBS assignment is designed to be due at the point when students have first learned about developing a WBS.

Like assignment section 5.7 above, the most common issue that occurs in this assignment is the use of generic WBS templates that students can find on the internet and are even provided by MS-Project with the software. Instructors should be firm with students that submission of these generic templates is not acceptable. Grading should focus on the details of the case problem, and whether the student has made the effort to properly analyze the case and build WBS steps that are specific to the project.

It is important that the instructor recognize that this assignment incorporates only Part 1 information for the case problem. The purpose of this assignment is not to develop a full project schedule, but to gain practice with the MS-Project software earlier in the course rather than waiting until the final assignment. In practice, this has reduced final assignment errors and student anxiety significantly because students have at least had some contact with the software in order to do this earlier assignment.

Therefore, only a properly formatted WBS is needed—no resources, Gantt chart, or costs are required, and that is why the Part 1 Case Problem does not contain this information. This simulates the very initial information that project managers often get when they must come up with an early idea of the tasks that may be involved in the project. If students receive only this rather light form of the information, they become more aware that project managers have to begin developing documents without complete project information at the early stages of the project time line. If students are given complete information at the beginning, they will expect it on the job later, and this can lead to frustration when it is not available, compromising the learning effectiveness.

Instructors should look for project administration, quality, and communication tasks in the WBS. These are purposefully left out of the case problem in order to give students the experience of needing to think about these tasks and add them. Often, students look only at the given information of the case for their WBS, and it is a major learning experience when they realize that there is more to a project than just the specific deliverables that are named in the initial requirements.

Instructor Notes for Student Sample WBS Dictionary Assignment (5.7.3)

The WBS dictionary assignment is designed to be due at the same time as the WBS assignment (5.7.2).

The most common error made with this assignment is the use of the WBS dictionary document to simply define terms or abbreviations. Students have a difficult time understanding that the term “dictionary” in this context is not meant literally. Instructors are encouraged to reinforce the fact that the WBS dictionary is for the purpose of further defining the work that would be involved in a given task of the WBS. Examples help significantly with this, but the examples given should be different in content from any part of the case problem.

Another issue with this assignment is whether the student is using a format of the WBS dictionary that requires detailed task information to be included. The student does not have this information at this stage of the course, so that is why the WBS dictionary format should be simplified. If instructors want students to submit the full, complex WBS dictionary format with all task, cost, and schedule information, then this assignment should be given along with the final project schedule assignment (5.12) that includes more detailed case information from Part 2.

Instructor Notes for Student Project Risk Management Plan Assignment (5.7.4)

This assignment can be due at any point in the course after the topic of risk management is covered, but it should proceed the Final WBS assignment (5.7.6) because that assignment should include the incorporation of detailed tasks for the team's risk planning and the development of the plan document that was done here. When students do this assignment before that final plan, they have a more realistic sense of what it takes to do risk assessment and mitigation planning.

Students normally need only a week or so to complete this assignment.

The most common issues that come up with this type of assignment appear in the nature of the risks that are assessed by the student. Instructors should be firm about distinguishing generic risks (e.g., "A critical team member may fall ill and not be able to perform their duties sufficiently.") from more specific risks to this case problem (e.g., "Regulatory agencies in California may issue restrictions for the use of drones to deliver pharmacy products.") when coaching students. While the former are appropriate to include, the risk management plan should not consist of these exclusively. The majority of the risks should be specific to the case problem, discouraging students from merely copying generic plan templates that can be derived from internet sources.

Risk management planning activities is an area that can confuse students. The instructor needs to coach students to think about this particular case problem, and to determine what activities should be done in order to properly assess potential risks and to develop this plan. This differs from risk mitigation activities, of course, but some students will focus on what one does once a risk has been identified or occurs, and not on the nature of assessment and planning for risks.

Another issue that occurs is the common misunderstanding of the nature of the "risk owner" in the risk register. Some students may assign the whole team to this role in the belief that all people have some responsibility for every risk. Other students may assign only themselves as project manager to be the owner of all risks in the belief that the PM has the ultimate accountability if a risk threatens the project plan. However, instructors need to focus the student on the role of risk owner as the one who is specialized in this particular area, can monitor the project context for the occurrence of the risk, determine to what extent it is taking place, and at least alert the PM to the fact that actions need to be engaged to take account of it.

Sometimes the student's calculations of the risk priority number (RPN) are in error, so it is important that the instructor not only check these, but assess the relative priority being calculated for a given risk to ensure that it makes logical sense based upon the case scenario.

Instructor Notes for Student Project Communications Management Plan Assignment (5.7.5)

This assignment can be due at any point in the course after the topic of project communication is covered, but it should precede the Final WBS assignment (5.7.6) because that assignment should include the incorporation of detailed tasks for the team's communication planning and the development of the plan document that was done here. When students do this assignment before that final plan, they have a more realistic sense of what it takes to do assessment of total project communications activity and the assignment of roles and responsibilities associated with these items..

Students normally need only a week or so to complete this assignment.

The most common issues that come up with this type of assignment appear in the nature of the communications that are included. Instructors should be firm about distinguishing generic communications (e.g., "Hold regular status meetings between the project team and the client.") from more specific risks to this case problem (e.g., "Hold weekly status meetings between

key team representatives from Wilmont's and DroneTech project teams.") when coaching students. While the former are appropriate to include, the communication management plan should not consist of these exclusively. The majority of the communication activities and deliverables should be specific to the case problem, discouraging students from merely copying generic plan templates that can be derived from internet sources.

Another area that can be of concern in this assignment is in students understanding the difference between a stakeholder communications analysis and a common RACI or RAM assignment matrix for general project tasks. Again, the instructor may need to coach students on the nature of how project communications activities like meetings, reports, and other communication information needs to be planned with regard to the originator, the receiver, and the properties of that communication. The difference between communication activities and other project activities is critical in this assignment. There also needs to be consistency between the areas of the plan that list certain communication activities and deliverables and then the corresponding areas of the stakeholder communications analysis where these deliverables and activities should all be further defined. Students often leave things out of the communication analysis table, even though they have mentioned that a meeting, report, or communication is necessary in the communications activity management area of the plan.

Instructor Notes for Student Final WBS Assignment (5.7.6)

This assignment is designed to be the final assignment for the course because it involves multiple skills and concepts delivered throughout the course. Students should have about three weeks to complete this assignment, so instructors should distribute it along with the Case Problem Part 2 about four to five weeks before the final class, with the due date about one to two weeks prior to that class to allow for grading and feedback. If the course schedule permits students to turn in a resubmission one week after the last class meeting time, this will be sufficient, but if not, the assignment schedule will need to be moved up one week to be distributed about five to six weeks before the last class.

This is an intense assignment, and students should be provided with guidance, in a lab setting if possible, for the use of the software tools that are involved in creating the schedule from the WBS. A lab or course assistant will help if there is a large quantity of students enrolled in the course, but this assistant needs to be coached by the instructor not to divulge information about how to analyze the case or sequence the tasks. The assistant's role is in helping students to understand the use of the software tools to enable them to create their schedule deliverable. Lab settings can be used to discuss techniques for how to schedule recurring meetings, develop resource lists, create lag and lead times for tasks, and assign resources to tasks. Demonstrations are an important part of this assignment, so the instructor needs to be familiar with the software tools.

The assignment is submitted in the preferred scheduling software file format, allowing the instructor to examine how the student has formulated all aspects of the schedule, including cost, time, and scope. The native software tools will also be at the instructor's disposal to enable investigation of issues that might be present in a student's submission, helping in the delivery of constructive feedback to the student for potential resubmission as appropriate.

Special Notes Regarding Evaluation of Student Submissions for the Assignment:

As described in the Instructor Guide for Part 1 of the Case Problem (See sections 5.20, 5.22, and 5.24), one of the features of this case problem is that the constraints defined in the problem text are maximum. There is a budget figure mentioned, and there is a requirement for the date of the first prototype flight/delivery. However, these constraints of time and cost are greatly in excess of those required for the range of appropriate project plans. In essence, this case problem is a "trick question," and the specifications of the project contained in it could lead some students to assume that the final project schedule and budget should be at the constraint levels that were mentioned in the case.

Of course, best practice would suggest that projects should be planned with schedule and budget constraints in mind, but not so that all time or cost resources are consumed. Therefore, the parameters of this situation must be carefully analyzed by students to fully understand that the stakeholders in the case problem are not requiring the project to reach these constraints, but are simply stating that these are the ultimate constraints. Case problems with this type of twist will challenge students to think critically, and it is obvious when looking at their final schedules that some have greatly exaggerated estimates of time and cost in order to stretch the project to reach the maximum constraints. Other students get the concept that the

responsible project manager estimates tasks realistically, and then uses the constraints to adjust the plan if needed to remain within them—not the other way around!

Therefore, the instructor should examine the student's submitted WBS to determine to what extent the student has followed estimation, scheduling, and resource allocation best practices. There are specific features of this case problem that make such an examination straightforward, including the relative proportion of development versus testing, cost of project administration tasks versus design/execution, contract payments to the vendor, and so forth.

If using MS-Project, the resource sheet should list all resources mentioned in the case problem, and the resource utilization/usage view will identify to which tasks resources have been assigned, giving a clear picture of how the student has allocated resources throughout the project.

Project meetings and other administrative tasks should be reasonable for the project's scale and complexity. Project template files are readily available, and the instructor should become familiar with these options that students sometimes will attempt to submit. Look for very generic tasks in the WBS, or tasks that are well beyond the scale and complexity of the project situation. Generally, the instructor can assume that if the WBS clearly shows the specific details of the case problem, then that indicates that the student had to have developed it carefully in order to incorporate all of those unique details. If the WBS looks like it could be for any general project, then likely the student used a general template without much customization for this problem situation. Many available project software template files already have resources and costs assigned to these general tasks, but the lack of tasks and resources that are unique to the case problem situation would be the first indicator of a substandard effort by the student.

Of particular interest should be the sequencing of procurement and execution tasks. If parts or equipment are required, then they cannot be used until they have been purchased and received. If contract payments are made upon completion of certain deliverables, then these deliverables should be appropriately scheduled within the overall project plan, and the payments would be sequenced at the points where they reflect the completion of those stages.

Another issue that can develop is in the area of recurring task scheduling, such as weekly meetings. Students can independently program such a recurring schedule of repetitive meetings to start and end at specific dates, and some students do so without thinking about the total range of time they have specified. This can be confusing, since the meetings may continue for several weeks beyond the final stages of the project execution, extending the project finish date simply because of the meeting tasks. In some cases, students may do this deliberately as a technique to make the project extend to a certain length that they feel is appropriate given the constraints as mentioned above. Therefore, instructors should carefully check the meeting schedules to ensure that they correspond to the project execution dates and remain within the appropriate time frame for the other project tasks.

Predecessors should be checked to ensure that weekly status meetings are not used as predecessor tasks for project execution, as this is another technique that can be used by students to make a project "fit" into a specific fixed time frame without having to actually specify start dates for certain tasks. In addition, predecessors should be examined to ensure that these are logical and do not create excessive constraints on the scheduling algorithms. If many tasks do not have predecessors, this can be an indicator that the student has taken shortcuts in developing the schedule rather than sequencing carefully at the detailed work package level.

The nature of the assignment specifies that all tasks must be auto-scheduled, allowing the project scheduling software to take all the parameters specified by the student in calculating the final schedule. The instructor should examine the schedule information column (MS-Project) for indicators that specific tasks have been constrained by dates, or the tasks are manually scheduled. In either case, the learning is compromised, because the student forces the schedule to take a certain time line.

Another item to examine is the nature of the cost roll-up. Sometimes, when students place costs directly on tasks, the total costs of the project are compounded and greatly expanded. Students should place costs on resources in the resource database only (MS-Project resource sheet) from which costs enter the budget when those resources are assigned to a task in the

schedule. This particular condition is difficult to determine without careful comparison of task costs to assigned resource costs, but the typical indicator that something is wrong will be most likely that costs on subtasks do not add up properly, or that they do not correspond to the individual costs of the resources assigned to those tasks.

The case problem states that students need to indicate a degree of completion of various tasks that are scheduled up to a given date. This section of the assignment can be managed according to the priority of the instructor, who may wish to include EVM and other measures of progress in addition to those specifically mentioned in this document. Instructors should remember that a running problem case is a form of simulation, but it is not reality. The classroom can only simulate the progress of projects just so much, and it may not adequately prepare students to make judgments in the way that they may have to in real project situations. Still, it is useful for students to get a sense of what might be involved in tracking progress using the tools of PM and scheduling—in other words, to reflect a given decision or status of progress in the form of defined deliverables rather than in the nature of actually making the decision itself.

Finally, instructors need to take note of the fact that the case problem does not specify project administration, requirements gathering, deliverable design, project integration, risk and quality management, stakeholder interaction, or communication tasks. This requires the student to take what has been learned in the course and make their own judgments about what these tasks and effort estimates might need to be. If students have learned sufficiently, their schedules will be complete and practical with all of these considerations in place, demonstrating that they can approach the problem as a project manager, and not as a domain specialist who considers only project execution as the most important priority.

5.9 Problem Case: Information Technology Student Information

5.9.1 Part 1

Case Problem – Part 1:

Wilmont's is a top-ranked U.S. retail pharmacy company based in St. Louis, MO with more than 8,000 stores nationwide and in all 50 states, and employing more than 244,000 people overall.

The company has engaged in a number of innovative business practices, and now they are once again secretly considering breaking ground with an even newer concept—delivering prescriptions and drugstore items by flying drone.

The concept isn't new—a small firm named DroneTech in San Francisco, CA announced the approach in March, and they are looking to develop a relationship with drugstores nationwide to launch the concept for real. Wilmont's may be the big break they are looking for!

The Operations Vice President (George Cranston) of Wilmont's has asked the CIO to develop a pilot project to get something moving and see how this works. George will provide the funds and will oversee all aspects of this initiative. Mary Pearson is the project lead on the business operations side who will manage the project generally for Mr. Cranston. Mr. Cranston has made an agreement with DroneTech CEO and founder Jordan Kempler to prototype this project in the San Francisco area, which is the home location of the DroneTech organization where it developed the system. DroneTech will customize its systems, interfaces, and business processes to conform to project requirements from Wilmont's.

You are a project manager for Wilmont's internal IT department, and you have been assigned by your CIO, James Connor, to lead this project in terms of the information systems that will be needed to support the initiative. Phillip Greenberg is the project manager at DroneTech who will work with you. Generally, from the IT perspective, the project will likely need to accomplish the following:

- Develop a Wilmont's online order entry system modification that will allow customers in the San Francisco area to register their willingness to have a drone deliver their orders by means of online entry or smartphone entry. There will be significant restrictions on the approval of customers for this service, so there will need to be a segment of the system to allow Wilmont's management to approve the customer, send a confirmation to the customer, and so on.
- Create reports for Wilmont's management to provide information on sales, customer reactions, and key performance indicators that senior management will define for you.
- Create communications for customers electronically through email, online and through mobile alerts as the customer requests.
- Interface to the DroneTech Corporation for its order entry, delivery confirmation, and mobile application software. Eileen Seymour is the point of contact on the information systems side with DroneTech and will be overseeing the team on their side. A price for this system customization is not yet determined and the development of this proposal will be a part of your project plan.
- Develop security options for all systems that will safeguard the data as it is stored within your company, and also as it is exchanged with DroneTech. You will work with Wilmont's information security management team to accomplish this, and William Scott is the project lead on that team for this project.
- You will need to identify basic requirements and then determine your team members from the list of people given in this document as you move toward final project planning.
- It has been determined that only four (4) of Wilmont's pharmacies will participate in the prototype delivery system. These are in a close geographic area to one another, and they are in a non-city environment consisting mainly of suburban homes and small businesses. Customers in apartment buildings will not be permitted in the prototype due to delivery issues.

No hardware, servers, workstations, or other network infrastructure will be required for this project, as all of that is only on the DroneTech side, and they will be including it in their proposal and a separate project plan that they will give to you as a part of their contract. Wilmont's can accommodate this prototype system within their existing infrastructure that handles customer orders. Ongoing system maintenance scheduling or planning after the prototype is implemented will not be a part of the project schedule or plans—you will be developing that plan separately once the systems design is known.

Wilmont's has allocated a maximum of US\$1,750,000 for this prototype project. You have been asked by your CIO to ensure that your project does not go over this figure, and, if possible, that the total project cost is under that amount.. The two companies agreed that they would like to begin the project on next January 5, and that their first customer delivery flight should take place no later than November 30 to avoid harsh weather in the San Francisco area.

Of course, you also need to include specific steps and processes for:

- Regular meetings with the team, stakeholders, and cross-impacted areas of the company.
- Approval points as needed through the project sequence.
- Points at which you will refine cost and staffing requirements (you do not need to calculate costs or total staffing at this point).
- Points at which you will produce the various project plan documentation deliverables discussed in class.
- Testing, quality control, and provision for issues that may develop.
- User training and other preparations for system implementation. The Wilmont's change management team, headed by Shirley Johnson, will assist you in this effort.

Summary of Personnel Involved in the Project (name initials are in brackets):

DroneTech Corporation Staff:

- Jordan Kempler (JXK), CEO and Founder
- Phillip Greenberg (PAG), Project Manager – main point of contact
- Stephanie Williams (SMW), Senior Business Analyst
- Gerald Hasper (GPH), Senior Systems Engineer
- Eileen Seymour (ERS), Project Lead, IT Systems

Wilmont's Staff:

- George Cranston (GWC), Operations VP
- James Connor (JFC), CIO
- Mary Pearson (MJP), Project Lead, Business Operations Team
- William Scott (WKS), Project Lead, Security Team
- Julie Green (JRG), Pharmacy Manager Store #35864
- Steve Haskell (SLH), Pharmacy Manager Store #32185
- James O'Donnell (JLO), Pharmacy Manager Store #38734
- Wilma Marcy (WPM), Pharmacy Manager Store #33001
- You as Project Manager (Come up with your own initials)
- Mary Kerstner (MJK), Business Systems Analyst
- Jonathan Perry (JSP), Programmer
- William Postner (WKP), Senior Programmer
- Sherry Loganthorpe (SPL), Database Administrator
- Linda Thornton (LET), Reports Systems Programmer/Analyst
- Gerald Peritoni (GEP), Testing Specialist
- Elizabeth Walton (EMW), Senior Testing Specialist
- Shirley Johnson (SPJ), Change Management Coordinator

End of Case Problem

5.9.2 Part 2

Case Problem – Additional Information for Part 2:

Please review the Part 1 Case Problem information, as it contains the general background and requirements of the case. This information should be added to the following clarifications regarding the project schedule:

1. Total project cost must not exceed project constraints. Project schedule should begin January 5, and should meet the schedule constraints as per the case for completion. You may assume 100% (1.0 FTE) allocation to this project for each resource in the list below. Load leveling is NOT required for this assignment, and over-allocation warnings on your WBS will not be counted as a problem as long as the resource effort allocation is reasonable.
2. It is critical that your assignment WBS is specific to this case problem in detail. You must ensure that all required deliverables appear in your WBS specifically, and that each includes design, development, testing, and implementation as appropriate. Your WBS must include project management steps for the charter/scope, risk management plan, WBS, schedule, training, and the required meetings to conduct and manage the project. Do not include things like "procurement management plan" or "staffing plan" or "quality management plan", as these are not a part of this case problem. A generic WBS is not acceptable for this assignment. This is practice for you to see how you might deliver such a detailed schedule for this case problem to your boss, and it will be evaluated that way.

3. It is up to you to add the project management, communication, testing, and training tasks as needed to make the project successful. Use the information in the case and the other assignments, along with your own ideas about how much effort is involved to ensure a quality implementation overall throughout the project. Be sure that you do not exceed the project constraints.
4. Remember that this project will be tight in terms of time and cost, so do not include steps that are not really necessary for this particular project. You should schedule the project from the beginning, including charter/scope, planning meetings, risk management and communications management plan development, and WBS and schedule development—these items need to appear in this schedule along with resource assignments and the appropriate costs that go along with them.
5. Finally, you are required to indicate an appropriate quantity of tasks that have likely been already in progress or completed. Assume that we are looking at your schedule on June 27. Show which work packages would probably be at what stage of completion by this specific time in the schedule. Use your own judgment based on the work package finish dates, but be reasonable!
6. The personnel involved in the DroneTech Corporation do not have billing rates per hour because their cost is being absorbed by the fixed fee specified in their proposal below. These people should be listed in your resource sheet, but with US\$0.00 standard rate, and they should be assigned to the appropriate tasks for the project.
 - Jordan Kempler (JXK), CEO and Founder
 - Phillip Greenberg (PAG), Project Manager and main point of contact
 - Stephanie Williams (SMW), Senior Business Analyst
 - Gerald Hasper (GPH), Senior Systems Engineer
 - Eileen Seymour (ERS), Project Lead, IT Systems

They should be assigned to project tasks as appropriate using the information in the case and the details below.

7. DroneTech Corporation Contract Fees and Dates:
 Wilmont's has signed a contract with DroneTech specifying the following phased payment plan that is linked to specific dates or deliverables. You are responsible for ensuring that the payments occur on time, but are only made if the appropriate conditions have been met. Be sure to include the necessary tasks in your WBS to accommodate evaluating, and paying for, these contract activities:
 - Total DroneTech fee for customizing order entry, delivery confirmation, and mobile application software to Wilmont's specifications: US\$423,592.00 with payments to be received as follows:
 - February 2—initial payment due: US\$42,000
 - After Wilmont's approval of DroneTech Customization Design Phase: payment of US\$45,000
 - After successful demonstration of order entry module: payment of US\$35,000
 - After successful demonstration of delivery confirmation module: payment of US\$55,000
 - After successful demonstration of mobile application module: payment of US\$25,000
 - After production system test approval by Wilmont's: payment of US\$85,000
 - After successful implementation sign off by Wilmont's: final payment of US\$136,592
8. Wilmont's staff, internal effective hourly rates, and official abbreviated names (initials):
 - George Cranston (GWC), Operations VP (US\$200/hr)
 - James Connor (JFC), CIO (US\$150/hr)
 - Mary Pearson (MJP), Project Lead, Business Operations Team (US\$50/hr)
 - William Scott (WKS), Project Lead, Security Team (US\$50/hr)
 - Julie Green (JRG) Pharmacy Manager Store #35864 (US\$60/hr)
 - Steve Haskell (SLH) Pharmacy Manager Store #32185 (US\$60/hr)
 - James O'Donnell (JLO) Pharmacy Manager Store #38734 (US\$60/hr)
 - Wilma Marcy (WPM) Pharmacy Manager Store #33001 (US\$60/hr)
 - You as Project Manager (Add your own initials): (US\$55/hr)
 - Mary Kerstner (MJK), Business Systems Analyst (US\$45/hr)
 - Jonathan Perry (JSP), Programmer (US\$40/hr)

- William Postner (WKP), Senior Programmer (US\$52/hr)
 - Sherry Loganthorpe (SPL), Database Administrator (US\$55/hr)
 - Linda Thornton (LET), Reports Systems Programmer/Analyst (US\$38/hr)
 - Gerald Peritoni (GEP), Testing Specialist (US\$38/hr)
 - Elizabeth Walton (EMW), Senior Testing Specialist (US\$49/hr)
 - Shirley Johnson (SPJ), Change Management Coordinator (US\$38/hr)
9. The following is the estimated total EFFORT HOURS for only the software programming and reporting to the customer and Wilmont's management for the prototype systems. (These do not include design requirements, project management activities, testing, training, final implementation, or meetings—you will need to add those additional steps and estimates for each.):
1. Wilmont's Inventory Management System Modifications (180 hours)
 2. Wilmont's Pharmacy Customer Database System Modifications (180 hours)
 3. DroneTech General Interface—Wilmont's Side System (150 hours)
 4. Website Content Update—Wilmont's Side (175 hours)
 5. Customer/Management Reporting (135 hours)
 6. Store Management Reporting (135 hours)
 7. Credit Card Processing (75 hours)
 8. Wilmont's Sales Management Reporting (150 hours)

You need to determine who on Wilmont's and DroneTech's staff should be involved in the various deliverables based upon your best judgment, and how their positions and skills relate to the tasks.

End of Case Problem

5.10 Information Technology Instructor Guide for Part 1

This part of the problem case sets the stage as a situation involving the student as a project manager in Wilmont's IT group. This case focuses on the modification of Wilmont's systems to enable the DroneTech control systems to interface with them.

The DroneTech system customizations are characterized in this case as a "black box" type of software development project scenario—where the vendor has an independent project plan that is largely unknown to the client organization, but where deliverables are created for that organization in return for payments matched to those deliverables. Therefore, the case stages a typical vendor/client relationship, but it does not complicate the project by making the student consider project details for both vendor and client. In a more advanced course, such complexity could be more appropriate than in a fundamental PM course.

Students might wish to use agile approaches in developing the project strategy, so the instructor needs to be clear about whether this is permissible. If agile approaches are permitted, then the instructor needs to be clear about how the documents will be judged for best reflection of agile best practices.

One distraction that often comes up is the focus of some students on just the software development aspects of the project. This is an excellent opportunity for students to learn how much is involved in a software development or modification project other than software! In addition, each subgroup of the project has its own project manager, so the IT PM is the only one and the students must design the project to take account of the other PMs as key stakeholders. The instructor should help to focus the students on PM without letting them get lost in the details of a particular system or technical solution.

In Part 1, the focus is on designing the project overall, so students should not get distracted with scheduling things at this point, nor should they attempt to develop details that are not given in the case. Certain key points are mentioned, including start date, first flight date, and ultimate budget constraints. Student deliverables should remain consistent with these, and they should not read into the case things that are not mentioned. Costs for certain milestones are not known, so until the final

assignment, these should not be mentioned in the charter/scope document. Instead, students need to imagine themselves dealing with all the information systems that would be necessary to properly take the customer's original order for a product and carry that through to the point where it is reflected in the drone control systems at DroneTech and the management reporting systems at Wilmont's. There are numerous systems that are involved, so student plans should reflect these individual deliverables and the surrounding effort that is needed in order to build quality, reliable software to manage this approach.

Instructors should help the IT students envision the scale and complexity of the information systems that would be involved in such a project for such a large organization—even though the actual project is involving only four pharmacies at the prototype stage. This is a typical IT scenario—the systems need to be modified or built completely even for a limited prototype. If one can develop the systems for drone delivery of one customer's product, then theoretically it will work when scaled up to hundreds of thousands.

However, in this case problem, the limit of four pharmacies in the prototype keeps the project complexity at a certain level while students focus on the PM tools and approaches in this fundamental PM course. The purpose of Part 1 is to help the students gain a sense of what would be involved and what is the appropriate scale, while helping them to be clear about deliverables, constraints, multiple teams, contract relationships, and end-user acceptance of both the drones and the information systems that must be used along with them.

5.10.1 Problem Case: Information Technology Instructor Guide for Part 2

Since the second part of the case builds upon the first part with additional information, specific resource costs and estimates for certain portions of the project effort, students may need the original case text as well as the text for Part 2. Instructors should provide the original text in a place where students can get to it while working on Part 2, or combine the case texts into one set that is distributed together for the final assignment.

The second part of the case details the effort, people, and costs involved in the systems and more fully expands the nature of the contract with DroneTech. Key to this part of the case is that the information given is limited to just the costs and effort of software development. This gives students an opportunity to estimate other parts of the project effort based upon the known software development parts. Algorithms are not given in the case for these—instructors should either provide these algorithms or have students do their own research on ways to estimate the unknown surrounding tasks of requirements gathering, design, testing, and implementation of software when the programming effort is known. Final solutions will vary, but instructors should view acceptable results as a range of possible solutions rather than a right or wrong answer. Making a first pass through the assignments to gauge the overall extent of the range of project time and cost values will help the instructor to determine what the acceptable values are. Then students who submitted solutions that are outside of the acceptable range should be given feedback about what might have gone wrong.

Students will often ask how to use the given effort estimates to arrive at an appropriate schedule: Should they split hours among the assigned resources? Should they include certain detailed steps to be involved in system development? Should they consider documentation and requirements gathering as one step or two? These questions are typical of students with less experience in project planning, and it may also reflect students who have had some detailed experience with software development that was planned in a specific way in one organization. The instructor should be prepared for these questions and have answers ready. Remember that the focus of the assignment is on the project management process, so it is up to the instructor to use their own domain knowledge in order to best respond to student inquiries. None of these issues will greatly affect the nature of the way this case is intended to be used as a learning tool. So, a variety of possible student approaches are completely workable, and the instructor should feel free to direct students to approach these queries in the ways that seem most appropriate.

Instructors should also feel free to adjust various parameters of this part of the case to conform to a particular approach that makes sense for the course and for the domain area of focus. The intent of the case is to lift the student from the details of the technology or business process and focus them on what is needed to get the project done successfully within the constraints of PM best practices. Above all, the case is intended to assist students in understanding where tools and templates

for project management can be used, and what it might be like to adapt and apply them to a given scenario. Therefore, the values of effort, cost per hour, total budget, dates, and other constraints and values can be flexible without compromising the nature of what the case can do for the learning process. The important thing is to provide students a scenario that appears somewhat realistic, while recognizing that it is impossible to make it actually real within the context of a college course learning experience. In its present form, the case is only partially able to be a simulation, so the instructor should keep the focus on giving students the opportunity to rehearse under controlled circumstances while recognizing that the ultimate performance will be up to the students when they must apply their skills to a real situation at a later time.

5.11 Problem Case: Management

5.11.1 Problem Case: Management Student Information Part 1

CASE PROBLEM – Part 1:

Wilmont's is a top-ranked U.S. retail pharmacy company based in St. Louis, MO with more than 8,000 stores nationwide and in all 50 states, and employing more than 244,000 people overall.

The company has engaged in a number of innovative business practices, and now they are once again secretly considering breaking ground with an even newer concept—delivering prescriptions and drugstore items by flying drone.

The concept isn't new—a small firm named DroneTech in San Francisco announced the approach in March, and they are looking to develop a relationship with drugstores nationwide to launch the concept for real. Wilmont's may be the big break they are looking for!

The Operations Vice President (George Cranston) of Wilmont's wants to develop a pilot project to get something moving and see how this works. George will provide the funds and will oversee all aspects of this initiative. You are the project manager on Wilmont's business operations side who will manage the project generally for Mr. Cranston. Mr. Cranston has made an agreement with DroneTech CEO and founder Jordan Kempler to prototype this project in the San Francisco area, which is the home location of the DroneTech organization where it developed the system. DroneTech will customize its systems, interfaces and business process to conform to project requirements from Wilmont's.

Mary Pearson is the project manager for Wilmont's internal IT department, and she has been assigned by CIO James Connor to lead the information systems development that will be needed to support the initiative. Phillip Greenberg is the project manager at DroneTech who will work with you. Generally, from the operations perspective, the project will likely need to accomplish the following:

- Develop a Wilmont's online order entry process that will allow customers in the San Francisco area to register their willingness to have a drone deliver their orders by means of online entry or smartphone entry. There will be significant restrictions on the approval of customers for this service, so there will need to be a segment of the process to allow Wilmont's management to approve the customer, send a confirmation to the customer, and so forth.
- Create reports for Wilmont's management to provide information on sales, customer reactions, and key performance indicators that senior management will define for you.
- Create communications for customers electronically through email, online, and through mobile alerts as the customer requests.
- DroneTech will handle piloting the drones and delivery of the products. They already have processes that handle order entry, delivery confirmation, and a mobile app, but they need to be customized for Wilmont's so that customers don't see these as two separate companies. Eileen Seymour is the point of contact on the information systems side with DroneTech and will be overseeing the team on their side. A price for this system customization is not yet determined and the development of this proposal will be a part of your project plan. You will need to build in the contract negotiations between Wilmont's and DroneTech as you develop the project plan as well. Members of the legal teams of both organizations will assist you with this.

- Ensure that the relationship between DroneTech and Wilmont's does not compromise the security of Wilmont's business information, the customer's privacy, and the proprietary information about how Wilmont's will use the drones for delivery. You will work with Wilmont's information security management team to accomplish this, and William Scott is the project lead on that team for this project.
- You will need to identify basic business process requirements and then determine your team members from the list of people given in this document as you move toward final project planning.
- It has been determined that only four (4) Wilmont's pharmacies will participate in the prototype delivery system. These are in a close geographic area to one another, and they are in a non-city environment consisting mainly of suburban homes and small businesses. Customers in apartment buildings will not be permitted in the prototype due to delivery issues. You will need to ensure that the four participating pharmacies are fully ready to engage in this prototype by the time for first flight, and the drone deliveries need to be seamless enhancements to Wilmont's already top-quality delivery processes for customers.
 - The IT folks have determined that no additional IT infrastructure will be required for this project from Wilmont's, as all of that specialized technology is only on the DroneTech side, and they will be including it in their proposal and a separate project plan that they will give to you as a part of their contract. Wilmont's can accommodate operating this prototype system within their existing infrastructure that handles customer orders, but those processes need to be enhanced in order to provide this delivery option and all the management processes that must accompany them.
 - Wilmont's has allocated a maximum of US\$1,750,000 for this prototype project, although this is only an ultimate constraint—you will eventually need to tell Mr. Cranston what your project estimate will be, but you don't have enough information about the project design yet to be able to give such a budget figure. You have been asked by Mr. Cranston to ensure that your project not only does not go over this figure, but that it is under that total if possible. The two companies agreed that they would like to begin the project on next January 5, and that their first customer delivery flight should take place no later than November 30 to avoid harsh weather in the San Francisco area.

Of course, you also need to include specific steps and processes for:

- Regular meetings with the team, stakeholders, and cross-impacted areas of the company.
- Approval points as needed through the project sequence.
- Points at which you will refine cost and staffing requirements (you do not need to calculate costs or total staffing at this point)
- Points at which you will produce the various project plan documentation deliverables discussed in class.
- Testing, quality control, and provision for issues that may develop.
- User training and other preparations for system implementation. The Wilmont's change management team, headed by Shirley Johnson, will assist you in this effort.

Summary of Personnel Involved in the Project (name initials are in brackets):

DroneTech Corporation Staff:

- Jordan Kempler (JXK), CEO and Founder
- Phillip Greenberg (PAG), Project Manager—main point of contact
- Stephanie Williams (SMW), Senior Business Analyst
- Gerald Hasper (GPH), Flight Operations Manager
- Eileen Seymour (ERS), Project Lead, IT Systems
- Katie O'Ryan (KRO), Corporate Attorney—DroneTech

Wilmont's Staff:

- George Cranston (GWC), Operations VP
- James Connor (JFC), CIO
- Mary Pearson (MJP), Project Lead, IT Systems Team

- William Scott (WKS), Project Lead, Security Team
- Julie Green (JRG), Pharmacy Manager Store #35864
- Steve Haskell (SLH), Pharmacy Manager Store #32185
- James O'Donnell (JLO), Pharmacy Manager Store #38734
- Wilma Marcy (WPM), Pharmacy Manager Store #33001
- You as Project Manager on the Business Operations side (Come up with your own initials)
- Mary Kerstner (MJK), Business Systems Analyst
- Jonathan Perry (JSP), Retail Operations Assistant
- William Postner (WKP), Marketing Analyst
- Sherry Loganthorpe (SPL), Social Media Specialist
- Linda Thornton (LET), Online Customer Process Analyst
- Gerald Peritoni (GEP), Testing Specialist
- Elizabeth Walton (EMW), Senior Testing Specialist
- Shirley Johnson (SPJ), Change Management Coordinator
- Alan Swanson (AES), Attorney—Legal Department
- Denise Delgado (DLD), Financial Operations Analyst

End of Case Problem

5.11.2 Problem Case: Management Student Information Part 2

CASE PROBLEM – Additional Information for Part 2:

Please review the Part 1 Case Problem information, as it contains the general background and requirements of the case. This information should be added to the following clarifications regarding the project schedule:

1. Total project cost must not exceed project constraints. Project schedule should begin January 5, and should meet the schedule constraints as per the case for completion. You may assume 100% (1.0 FTE) allocation to this project for each resource in the list below. Load leveling is NOT required for this assignment, and over-allocation warnings on your WBS will not be counted as a problem as long as the resource effort allocation is reasonable.
2. It is critical that your assignment WBS is specific to this case problem in detail. You must ensure that all required deliverables appear in your WBS specifically, and that each includes design, development, testing and implementation as appropriate. Your WBS must include project management steps for the charter/scope, risk management plan, WBS, schedule, training and the required meetings to conduct and manage the project. Do not include things like "procurement management plan" or "staffing plan" or "quality management plan" as these are not a part of this case problem. A generic WBS is not acceptable for this assignment. This is practice for you to see how you might deliver such a detailed schedule for this case problem to your boss, and it will be evaluated that way.
3. It is up to you to add the project management, communication, testing and training tasks as needed to make the project successful. Use the information in the case and the other assignments, along with your own ideas about how much effort is involved to ensure a quality implementation overall throughout the project. Be sure that you do not exceed the project constraints.
4. Remember that this project will be tight in terms of time and cost, so do not include steps that are not really necessary for this particular project. You should schedule the project from the beginning, including charter/scope, planning meetings, Risk Management and Communication Plan development, WBS and schedule development – these items need to appear in this schedule along with resource assignments and the appropriate costs that go along with them.
5. Finally, you are required to indicate an appropriate quantity of tasks that have likely been already in progress or completed. Assume that we are looking at your schedule on June 27. Show which work packages would

probably be at what stage of completion by this specific time in the schedule. Use your own judgment based on the work package finish dates, but be reasonable!

6. The personnel involved in the DroneTech Corporation do not have billing rates per hour because their cost is being absorbed by the fixed fee specified in their proposal below. These people should be listed in your resource sheet, but with US\$0.00 standard rate, and they should be assigned to the appropriate tasks for the project.

- Jordan Kempler (JXK), CEO and Founder
- Phillip Greenberg (PAG), Project Manager—main point of contact
- Stephanie Williams (SMW), Senior Business Analyst
- Gerald Hasper (GPH), Flight Operations Manager
- Eileen Seymour (ERS), Project Lead, IT Systems
- Katie O’Ryan (KRO), Corporate Attorney—DroneTech

They should be assigned to project tasks as appropriate using the information in the case and the details below.

7. DroneTech Corporation contract fees and dates:

After a complicated negotiation, Wilmont’s has signed a contract with DroneTech specifying the following phased payment plan that is linked to specific dates or deliverables. You are responsible for ensuring that the payments occur on time, but are only made if the appropriate conditions have been met. Be sure to include the necessary tasks in your WBS to accommodate evaluating, and paying for, these contract activities:

- Total DroneTech fee for customizing order entry, delivery confirmation, and mobile application software to Wilmont’s specifications: US\$423,592.00 with payments to be received as follows:
- February 2—Initial payment due: US\$42,000
- After Wilmont’s approval of DroneTech customization design phase: Payment of US\$45,000
- After successful demonstration of order entry module: Payment of US\$35,000
- After successful demonstration of delivery confirmation module: Payment of US\$55,000
- After successful demonstration of mobile application module: Payment of US\$25,000
- After production system test approval by Wilmont’s: Payment of US\$85,000
- After successful implementation signoff by Wilmont’s: Final payment of US\$136,592

8. Wilmont’s staff, internal effective hourly rates and official abbreviated names (initials):

- George Cranston (GWC), Operations VP (US\$200/hr)
- James Connor (JFC), CIO (US\$150/hr)
- Mary Pearson (MJP), Project Lead, IT Systems Team (US\$55/hr)
- William Scott (WKS), Project Lead, Security Team (US\$50/hr)
- Julie Green (JRG) Pharmacy Manager Store #35864 (US\$60/hr)
- Steve Haskell (SLH) Pharmacy Manager Store #32185 (US\$60/hr)
- James O’Donnell (JLO) Pharmacy Manager Store #38734 (US\$60/hr)
- Wilma Marcy (WPM) Pharmacy Manager Store #33001 (US\$60/hr)
- You as Project Manager on the Business Operations side (Come up with your own initials) (US\$55/hr)
- Mary Kerstner (MJK), Business Systems Analyst (US\$45/hr)
- Jonathan Perry (JSP), Retail Operations Assistant (US\$40/hr)
- William Postner (WKP), Marketing Analyst (US\$52/hr)
- Sherry Loganorpe (SPL), Social Media Specialist (US\$45/hr)
- Linda Thornton (LET), Online Customer Process Analyst (US\$40/hr)
- Gerald Peritoni (GEP), Testing Specialist (US\$38/hr)
- Elizabeth Walton (EMW), Senior Testing Specialist (US\$49/hr)
- Shirley Johnson (SPJ), Change Management Coordinator (US\$40/hr)
- Alan Swanson (AES), Attorney Legal Department (US\$60/hr)
- Denise Delgado (DLD), Financial Operations Analyst (US\$40/hr)

9. The following is the estimated total EFFORT HOURS for only the business process enhancements and reporting to the customer and Wilmont's management for the prototype systems. (These do not include the time for process design requirements, project management activities, testing, training, final implementation, or meetings—you will need to add those additional steps and estimates for each).
1. Wilmont's/DroneTech Legal Contract Negotiations (250 hours)
 2. Wilmont's Inventory Management Process Modifications (180 hours)
 3. Wilmont's Pharmacy Customer Information Modifications (180 hours)
 4. DroneTech Reporting Interface—Wilmont's Side System (150 hours)
 5. Website/Mobile App Content Update—Wilmont's Side (175 hours)
 6. Social Media Strategy and Implementation Plan—(75 hours)
 7. Customer/Management Reporting (135 hours)
 8. Store Management Reporting (135 hours)
 9. Credit Card Processing (75 hours)
 10. Wilmont's Sales Management Reporting (150 hours)

You need to determine who on Wilmont's and DroneTech's staff should be involved in the various deliverables based upon what you think best, and how their positions and skills relate to the tasks.

End of Case Problem

5.11.3 Problem Case: Management Instructor Guide for Part 1

This part of the problem case sets the stage as a situation involving the student as a project manager in Wilmont's Pharmacy Operations group. This case focuses on the modification of Wilmont's business procedures and systems to enable seamless use of DroneTech for the purpose of product delivery to Wilmont's customers.

DroneTech will be handling the technology and the details of the flight operations, but there is a need to customize their operations in order to appear as one organization to the customer. This subcontractor relationship is characterized in this case as a "black box" type of vendor scenario – where the vendor has an independent project plan that is largely unknown to the client organization, but where deliverables are created for that organization in return for payments matched to those deliverables. Therefore, the case stages a typical vendor/client relationship, but it does not complicate the project by making the student consider project details for both vendor and client. In a more advanced course, such complexity could be more appropriate than in a fundamental PM course.

Students might wish to use agile approaches in developing the project strategy, so the Instructor needs to be clear about whether this is permissible. If Agile approaches are permitted, then the Instructor needs to be clear about how they will judge the documents for best reflection of Agile best practices.

One distraction that often comes up is the focus of some students on specific business procedures or solutions and less on project management. The case mentions that each subgroup of the project has its own project manager, so the operations PM is only one of these and they must design the project to take account of the other PMs as key stakeholders. The Instructor should help to focus the students on PM without letting them get lost in the details of a particular procedure, system, or solution.

In Part 1, the focus is on designing the project overall, so students should not get distracted with scheduling things at this point, nor should they attempt to develop details that are not given in the case. Certain key points are mentioned, including start date, first flight date, and ultimate budget constraints. Student deliverables should remain consistent with these, and they should not read into the case things that are not mentioned. Costs for certain milestones are not known, so until the final assignment, these should not be mentioned in the charter/scope document. Instead, students need to imagine themselves

dealing with all the business procedures and systems that would be necessary to properly take the customer's original order for a product and carry that through to the point where DroneTech can seamlessly execute each delivery according to plan. There are numerous additional aspects of this plan that must be involved, such as contract negotiations, marketing, social media, management reporting, and information systems. Student plans should reflect these individual aspects, the appropriate deliverables that are part of these, and the surrounding effort that is needed in order to implement an initial prototype.

Instructors should help the management students envision the scale and complexity of the tasks that would be involved in such a project for such a large organization—even though the actual project is involving only four pharmacies at the prototype stage. This is a typical business process change scenario—the approaches need to be modified or built completely even for a limited prototype, while keeping in mind that the ultimate goal will be to scale up. If one can successfully design the business approaches to deliver one customer's product by drone, the next step is to adjust these approaches to work even when scaled up to hundreds of thousands.

However, in this case problem, the limit of four pharmacies in the prototype keeps the project complexity at a certain level while students focus on the PM tools and approaches in this fundamental PM course. The purpose of Part 1 is to help the students gain that sense of what would be involved and what is the appropriate scale, while helping them to be clear about deliverables, constraints, multiple teams, contract relationships, and end-user acceptance of both the drones and the new business processes that must be used along with them.

5.11.4 Problem Case: Management Instructor Guide for Part 2

Since the second part of the case builds upon the first part with additional information, specific resource costs, and estimates for certain portions of the project effort, students may need the original case text as well as the text for this Part 2. Instructors should provide the original text in a place where students can get to it while working on Part 2, or combine the case texts into one set that is distributed together for the final assignment.

The second part of the case details the effort, people, and costs involved in the project by both companies and more fully expands the nature of the contract with DroneTech. Key to this part of the case is the limit of the information given to just the costs and effort for business process enhancements and reporting to the customer and Wilmont's management for the prototype systems. This gives students an opportunity to estimate other parts of the project effort based upon the known parts. Instructors should have students do their own research on ways to estimate the unknown surrounding tasks of requirements gathering, testing, and implementation when the core effort for process design is known. Final solutions will vary, but instructors should view acceptable results as a range of possible solutions rather than a right or wrong answer. Making a first pass through the assignments to gauge the overall extent of the range of project time and cost values will help the instructor determine what the acceptable values are. Then students who submitted solutions that are outside of the acceptable range should be given feedback about what might have gone wrong.

Students will often ask how to use the given effort estimates to arrive at an appropriate schedule: Should they split hours among the assigned resources? Should they include certain detailed steps to be involved in marketing analysis? Should they consider definition of business processes and the information systems that support them as one project activity or two? These questions are typical of students with less experience in project planning, and it may also reflect students who have had some detailed experience with business procedures or operations that might have been planned in a specific way in one organization. The instructor should be prepared for these questions and have answers ready. Remember that the focus of the assignment is on the project management process, so it is up to the instructor to use their own domain knowledge in order to best respond to student inquiries. None of these issues will greatly affect the nature of the way this case is intended to be used as a learning tool. So, a variety of possible student approaches are completely workable, and the instructor should feel free to direct students to approach these queries in the ways that seem most appropriate.

Instructors should also feel free to adjust various parameters of this part of the case to conform to a particular approach that makes sense for the course and for the domain area of focus. The intent of the case is to lift the student from the details of the technology or business process and focus them on what is needed to get the project done successfully within the

constraints of PM best practices. Above all, the case is intended to assist students in understanding where tools and templates for project management can be used, and what it might be like to adapt and apply them to a given scenario. Therefore, the values of effort, cost per hour, total budget, dates, and other constraints and values can be flexible without compromising the nature of what the case can do for the learning process. The important thing is to provide students a scenario that appears somewhat realistic, while recognizing that it is impossible to make it actually real within the context of a college course learning experience. In its present form, the case is only partially able to be a simulation, so the instructor should keep the focus on giving students the opportunity to rehearse under controlled circumstances while recognizing that the ultimate performance will be up to the students when they must apply their skills to a real situation at a later time.

5.12 Problem Case: Engineering

In this section, we provide the problem case and instructor guide.

5.12.1 Problem Case: Engineering Student Information Part 1

CASE PROBLEM – Part 1:

Wilmont's is a top-ranked U.S. retail pharmacy company based in St. Louis, MO with more than 8,000 stores nationwide and in all 50 states, and employing more than 244,000 people overall. The company has engaged in a number of innovative business practices, and now they are once again secretly considering breaking ground with an even newer concept—delivering prescriptions and drugstore items by flying drone.

The concept isn't new—your company is a small firm named DroneTech in San Francisco, CA and your firm announced the approach in March, and is looking to develop a relationship with drugstores nationwide to launch the concept for real. Wilmont's may be the big break your firm is looking for!

The Operations Vice President (George Cranston) of Wilmont's wants to develop a pilot project to get something moving and see how this works. He will provide the funds and will oversee all aspects of this initiative. Mr. Cranston has made an agreement with DroneTech CEO and founder Jordan Kempler to prototype this project in the San Francisco area, which is the home location of the DroneTech organization where it developed the system. DroneTech will customize its systems, interfaces, and business process to conform to project requirements from Wilmont's. You are the project manager for DroneTech who will manage the DroneTech customization project generally and serve as DroneTech's point of contact for Wilmont's. You report directly to Jordan Kempler, as this is a visible project that could mean the future for DroneTech. While your company's drones will fly with Wilmont's markings, a successful long-term relationship with a large-scale company like Wilmont's will make DroneTech a stable company in any measure.

As far as DroneTech's interface to Wilmont's is concerned, the project will likely need to accomplish the following in order to appear seamless to Wilmont's pharmacy customers:

- DroneTech will handle piloting the drones and delivery of the products. You already have processes that handle order entry, delivery confirmation, and a mobile app on the DroneTech side, but these need to be customized for Wilmont's so that customers don't see these as two separate companies. Eileen Seymour is your firm's IT point of contact on the DroneTech information systems side and will be overseeing the data interface team with her counterparts at Wilmont's. Mary Pearson is the project manager for Wilmont's internal IT department, and she has been assigned by CIO James Connor to lead the information systems development for Wilmont's that will be needed to support the initiative. Phillip Greenberg is the project manager on Wilmont's business operations side who will work with you to organize the Wilmont's resources in order to interface with DroneTech's flight operations and other management systems that control and manage the drone delivery system.

- Interface to Wilmont's enhanced online order entry process that will allow customers in the San Francisco area to register their willingness to have a drone deliver their orders by means of online entry or smartphone entry. There will be significant restrictions on the approval of customers for this service, so there will need to be a segment of the process to allow Wilmont's management to approve the customer, send a confirmation to the customer, and so forth. While DroneTech systems already do this, you need to interface your systems to Wilmont's so that customers are not going directly to DroneTech's normal customer websites or mobile applications.
- Interface communications about deliveries for Wilmont's customers electronically through email, online, and through mobile alerts as the customer requests.
 - Your firm has not yet established a signed contract with Wilmont's, and there is not yet an agreement on all aspects of either the services to be provided, or the cost of those services. DroneTech needs to modify several systems and interfaces for the drone flight operations in order to customize things for Wilmont's, but the nature of this is not yet determined. The development of this proposed contract and payment plan will be a part of your project plan. You will need to build in a period of time for contract negotiations between Wilmont's and DroneTech as you develop the project plan as well. Members of the legal teams of both organizations will assist you with the negotiations, so your role in this will be to ensure that the right people from DroneTech Engineering and Flight Operations are involved in the development of the legal requirements for the relationship.
- Ensure that the relationship between DroneTech and Wilmont's does not compromise the security of Wilmont's business information, the customer's privacy, and the proprietary information about how Wilmont's will use the drones for delivery. You will work with Wilmont's information security management team to accomplish this, and William Scott is the project lead on that team for this project.
- You will need to identify what modifications to the drone flight operations will be necessary and then determine your team members from the list of people given in this document as you move toward final project planning.
 - Your Flight Operations Manager, Gerald Hasper, has let you know that Wilmont's already wants one such modification: They want to adapt a temperature-controlled product bagging system along with a bubble-type cushioning system for the customer delivery packaging in order to ensure that certain temperature-sensitive or breakable items are not affected by the delivery process. While you've got the ability to adapt the drone package clamps to this sort of packaging, it will require a measure of testing to make sure that issues are resolved and that the new package release systems will work reliably. You'll need to be sure that your project plan has this engineering subproject defined.
- It has been determined that only four (4) of Wilmont's pharmacies will participate in the prototype delivery system. These are in a close geographic area to one another, and they are in a non-city environment consisting mainly of suburban homes and small businesses. Customers in apartment buildings will not be permitted in the prototype due to delivery issues. You will need to provide the four participating pharmacies with all the information needed on the drone delivery technology, making sure they are fully comfortable loading products into the drone package carrier and engaging in this prototype by the time for first flight. As mentioned earlier, the drone deliveries need to be seamless enhancements to Wilmont's already top-quality delivery processes for customers, and Jordan Kempler has promised Mr. Cranston that this will be the case.
 - DroneTech will need to allocate a total of four new drones for this prototype project, and these will need to be painted in the Wilmont's corporate colors and logo.
 - Wilmont's can accommodate operating this prototype system within their existing infrastructure that handles customer orders, but those processes need to be enhanced by Wilmont's project teams in order to provide this delivery option and all the management processes that must accompany them. The customized special technology needed for delivery and drone control is on your side, and you will be including it in your proposal and budget. A project plan with detailed costs will be given to Wilmont's as a part of your final contract.

- Jordan Kempler is unsure of the cost of the customized enhancements of the flight operations systems for this prototype project because the project is just being defined right now. However, based on some customized work that was done before with another customer for small package delivery, Kempler determined that the project should likely come well under a total of US\$750,000, so he gave that initial figure to Wilmont's last week. That puts you in the position of needing to treat this figure as the maximum that the project could cost. This is only an ultimate constraint—you will eventually need to tell Mr. Kempler what your project estimate will be, but you don't have enough information about the project design yet to be able to give such an accurate budget estimate. You have been asked by Mr. Kempler to ensure that your project not only does not go higher than this, but that it should be less than that total, if possible.
- The two companies agreed that they would like to begin the project on next January 5, and that their first customer delivery flight should take place no later than November 30 to avoid harsh weather in the San Francisco area.

Of course, you also need to include specific steps and processes for:

- Regular meetings with the team, stakeholders, and cross-impacted areas of the company.
- Approval points as needed through the project sequence.
- Points at which you will refine cost and staffing requirements (you do not need to calculate costs or total staffing at this point).
- Points at which you will produce the various project plan documentation deliverables discussed in class.
- Testing, quality control, and provision for issues that may develop.
- User training and other preparations for system implementation. The Wilmont's change management team, headed by Shirley Johnson, will assist you in this effort.

Summary of Personnel Involved in the Project (name initials are in brackets):

DroneTech Corporation Staff:

- Jordan Kempler (JXK), CEO and Founder
- You as Project Manager overall for DroneTech (Add your own initials)
- Stephanie Williams (SMW), Senior Business Analyst
- Gerald Hasper (GPH), Flight Operations Manager
- Eileen Seymour (ERS), Project Lead, IT Systems
- Katie O'Ryan (KRO), Corporate Attorney for DroneTech
- Rohan Shah (RXS), Programmer
- Shravani Sinha (SXS), Senior Programmer
- William Holt (WKH), Drone Systems Engineer (US\$45/hr)
- Ashish Nehra (AXN), Drone Systems Technician (US\$35/hr)

Key members of Wilmont's Staff for this project:

- George Cranston (GWC), Operations VP
- James Connor (JFC), CIO
- Mary Pearson (MJP), Project Lead, IT Systems Team
- William Scott (WKS), Project Lead, Security Team
- Julie Green (JRG), Pharmacy Manager Store #35864
- Steve Haskell (SLH), Pharmacy Manager Store #32185
- James O'Donnell (JLO), Pharmacy Manager Store #38734
- Wilma Marcy (WPM), Pharmacy Manager Store #33001
- Phillip Greenberg (PAG), Project Manager, Business Operations side
- Jonathan Perry (JSP), Retail Operations Assistant
- Linda Thornton (LET), Online Customer Process Analyst
- Gerald Peritoni (GEP), Testing Specialist

- Elizabeth Walton (EMW), Senior Testing Specialist
- Shirley Johnson (SPJ), Change Management Coordinator
- Alan Swanson (AES), Attorney—Legal Department

End of Case Problem

5.12.2 Problem Case: Engineering Student Information Part 2

CASE PROBLEM – Additional Information for Part 2:

Please review the Part 1 Case Problem information, as it contains the general background and requirements of the case. This information should be added to the following clarifications regarding the project schedule:

1. Total project cost must not exceed project constraints. Project schedule should begin January 5, and should meet the schedule constraints as per the case for completion. You may assume 100% (1.0 FTE) allocation to this project for each resource in the list below. Load leveling is NOT required for this assignment, and over-allocation warnings on your WBS will not be counted as a problem as long as the resource effort allocation is reasonable.
2. It is critical that your assignment WBS is specific to this case problem in detail. You must ensure that all required deliverables appear in your WBS specifically, and that each includes design, development, testing, and implementation as appropriate. Your WBS must include project management steps for the charter/scope, risk management plan, WBS, schedule, and training, and the required meetings to conduct and manage the project. Do not include things like procurement management plan or staffing plan or quality management plan, as these are not a part of this case problem. A generic WBS is not acceptable for this assignment. This is practice for you to see how you might deliver such a detailed schedule for this case problem to your boss, and it will be evaluated that way.
3. It is up to you to add the project management, communication, testing, and training tasks as needed to make the project successful. Use the information in the case and the other assignments, along with your own ideas about how much effort is involved to ensure a quality implementation overall throughout the project. Be sure that you do not exceed the project constraints.
4. Remember that this project will be tight in terms of time and cost, so do not include steps that are not really necessary for this particular project. You should schedule the project from the beginning, including charter/scope, planning meetings, risk management and communications management plan development, WBS, and schedule development—these items need to appear in this schedule along with resource assignments and the appropriate costs that go along with them.
5. Finally, you are required to indicate an appropriate quantity of tasks that have likely been already in progress or completed. Assume that we are looking at your schedule on June 27. Show which work packages would probably be at what stage of completion by this specific time in the schedule. Use your own judgment based on the work package finish dates, but be reasonable!
6. The personnel involved in Wilmont's do not have billing rates per hour because their cost is being separately budgeted internally for Wilmont's. These people should be listed in your resource sheet, but with US\$0.00 standard rate, and they should be assigned to the appropriate tasks for the project.
 - George Cranston (GWC), Operations VP
 - James Connor (JFC), CIO
 - Mary Pearson (MJP), Project Lead, IT Systems Team
 - William Scott (WKS), Project Lead, Security Team
 - Julie Green (JRG), Pharmacy Manager Store #35864
 - Steve Haskell (SLH), Pharmacy Manager Store #32185

- James O'Donnell (JLO), Pharmacy Manager Store #38734
- Wilma Marcy (WPM), Pharmacy Manager Store #33001
- Phillip Greenberg (PAG), Project Manager on the Business Operations side
- Jonathan Perry (JSP), Retail Operations Assistant
- Linda Thornton (LET), Online Customer Process Analyst
- Gerald Peritoni (GEP), Testing Specialist
- Elizabeth Walton (EMW), Senior Testing Specialist
- Shirley Johnson (SPJ), Change Management Coordinator
- Alan Swanson (AES), Attorney—Legal Department

These people should be assigned to project tasks as appropriate using the information in the case and the other details below, but they will not affect the DroneTech portion of the project budget.

7. Special equipment needed:

- DroneTech Corporation New Drone Procurement: Each new delivery drone will cost US\$18,034.00. DroneTech will supply four of these to Wilmont's for the purpose of the prototype project. The cost of the drones will be incorporated into the budget of your project.
- Drone Maintenance/Repair Parts: You should allow US\$20,000 worth of spare drone parts and batteries to be on hand for this project.

8. DroneTech's staff, effective hourly rates, and official abbreviated names (initials):

- Jordan Kempler (JXK), CEO and Founder (US\$200/hr)
- You as Project Manager overall for DroneTech (Add your own initials) (US\$55/hr)
- Stephanie Williams (SMW), Senior Business Analyst (US\$50/hr)
- Gerald Hasper (GPH), Flight Operations Manager (US\$65/hr)
- Eileen Seymour (ERS), Project Lead, IT Systems (US\$60/hr)
- Katie O'Ryan (KRO), Corporate Attorney – DroneTech (US\$65/hr)
- Rohan Shah (RXS), Programmer (US\$45/hr)
- Shravani Sinha (SXS), Senior Programmer (US\$50/hr)
- William Holt (WKH), Drone Systems Engineer (US\$45/hr)
- Ashish Nehra (AXN), Drone Systems Technician (US\$35/hr)

9. The following is the estimated total EFFORT HOURS for DroneTech engineering, flight operations enhancements, and customized interfaces to the pharmacy customer and Wilmont's management for the prototype project. (These do not include the time for procurement, process, or engineering design requirements, project management activities, testing, training, or final implementation or meetings—you will need to add those additional steps and estimates for each.):

1. Wilmont's/DroneTech Legal Contract Negotiations (160 hours)
2. Specialized Customer Order/Information Interface (150 hours)
3. Custom Management Reporting Interface (135 hours)
4. Customization of Flight/Delivery Processing (75 hours)
5. Custom Drone Construction (40 hours each for four drones—160 hours total)
6. Custom Temperature/Shock Protection Product Carrier (160 hours)

7. Flight path engineering (120 hours)
8. Pharmacy manager drone delivery operations procedures (80 hours)
9. Drone maintenance/repair procedures and parts (80 hours)

You need to determine who on Wilmont's and DroneTech's staff should be involved in the various deliverables based upon your best judgment, and how their positions and skills relate to the tasks.

End of Case Problem

5.12.3 Problem Case: Engineering Instructor Guide for Part 1

This part of the problem case sets the stage as a situation involving the student as a project manager in DroneTech's Engineering group. This case focuses on the modification of DroneTech's drones, procedures, and systems to enable seamless use of DroneTech for the purpose of product delivery to Wilmont's customers.

DroneTech will be handling the technology and the details of the flight operations, but there is a need to customize their operations in order to appear as one organization to the customer. This sub contractor relationship is characterized in this case by deliverables that are created for that organization in return for payments matched to those deliverables. Therefore, the case stages a typical vendor/client relationship, but it does not complicate the project by making the student consider project details for both the vendor and client—only the vendor in this case. In a more advanced course, such complexity would be more appropriate than in a fundamental PM course.

Students might wish to use agile approaches in developing the project strategy, so the instructor needs to be clear about whether this is permissible. If agile approaches are permitted, then the instructor needs to be clear about how the documents will be judged for best reflection of agile best practices.

One distraction that often comes up is the focus of some students on specific engineering solutions and less on project management. The case mentions that each subgroup of the project has its own project manager, so the DroneTech Engineering PM is only one of these and the students must design the project to take account of the other PMs as key stakeholders. The instructor should help to focus the students on PM without letting them get lost in the details of a particular procedure, system, or solution.

In Part 1, the focus is on designing the project overall, so students should not get distracted with scheduling things at this point, nor should they attempt to develop details that are not given in the case. Certain key points are mentioned, including start date, first flight date, ultimate budget constraints, and certain key engineering modifications. Student deliverables should remain consistent with these, and they should not read into the case those things that are not mentioned. Costs for certain milestones are not known, so until the final assignment, these should not be mentioned in the charter/scope document. Instead, students need to imagine themselves dealing with all the procedures and systems that would be necessary to properly take the customer's original order for a product through Wilmont's and then carry that through to the point where DroneTech can seamlessly execute each delivery according to plan. There are numerous additional aspects of this plan that must be involved, such as contract negotiations, engineering of specialized devices, management reporting, and information systems. Student plans should reflect these individual aspects, the appropriate deliverables that are part of these, and the surrounding effort that is needed in order to implement an initial prototype.

Instructors should help the engineering students envision the scale and complexity of the tasks that would be involved in such a project for such a large organization even though the actual project involves only four pharmacies at the prototype stage. This is a typical technology scenario—the approaches need to be modified or built completely even for a limited prototype, while keeping in mind that the ultimate goal will be to scale up. If one can successfully design the technology and supporting systems to deliver one customer's product by drone, the next step is to adjust these concepts to work even when scaled up to hundreds of thousands.

However, in this case problem, the limit of four pharmacies in the prototype keeps the project complexity at a certain level while students focus on the PM tools and approaches in this fundamental PM course. The purpose of Part 1 is to help the students to gain a sense of what would be involved and what is the appropriate scale, while helping them to be clear about deliverables, constraints, multiple teams, contract relationships, and end-user acceptance of both the drones and the new business processes that must be used along with them.

5.12.4 Problem Case: Engineering Instructor Guide for Part 2

Since the second part of the case builds upon the first part with additional information, specific resource costs, and estimates for certain portions of the project effort, students may need the original case text as well as the text for Part 2. Instructors should provide the original text in a place where students can get to it while working on Part 2, or combine the case texts into one set that is distributed together for the final assignment.

The second part of the case details the effort, people, and costs involved in the project by both companies and more fully expands the nature of the contract between DroneTech and Wilmont's. Key to this part of the case is the limit of the information given to just the costs and effort for DroneTech engineering, flight operations enhancements, and customized interfaces to the pharmacy customer and Wilmont's management for the prototype project. This gives students an opportunity to estimate other parts of the project effort based upon the known parts. Instructors should have students do their own research on ways to estimate the unknown surrounding tasks of requirements gathering, testing, and implementation when the core effort for the engineering of the products, processes, and systems is known. Final solutions will vary, but instructors should view acceptable results as a range of possible solutions rather than a right or wrong answer. Making a first pass through the assignments to gauge the overall extent of the range of project time and cost values will help the instructor to determine what the acceptable values are. Then students who submitted solutions that are outside of the acceptable range should be given feedback about what might have gone wrong.

Students will often ask how to use the given effort estimates to arrive at an appropriate schedule: Should they split hours among the assigned resources? Should they include certain detailed steps to be involved in custom drone modification? Should they consider technology engineering and the information systems that support the drones as one project activity or two? These questions are typical of students with less experience in project planning, and it may also reflect students who have had some detailed experience with the engineering of products or technology operations that might have been planned in a specific way in one organization. The instructor should be prepared for these questions and have answers ready. Remember that the focus of the assignment is on the project management process, so it is up to the instructor to use their own domain knowledge in order to best respond to student inquiries. None of these issues will greatly affect the nature of the way this case is intended to be used as a learning tool. So, a variety of possible student approaches are completely workable, and the instructor should feel free to direct students to approach these queries in the ways that seem most appropriate.

Instructors should also feel free to adjust various parameters of this part of the case to conform to a particular approach that makes sense for the course and for the domain area of focus. The intent of the case is to lift the student from the details of the technology or engineering process and focus them on what is needed to get the project done successfully within the constraints of PM best practices. Above all, the case is intended to assist students in understanding where tools and templates for project management can be used, and what it might be like to adapt and apply them to a given scenario. Therefore, the values of effort, cost per hour, total budget, dates, and other constraints and values can be flexible without compromising the nature of what the case can do for the learning process. The important thing is to provide students a scenario that appears somewhat realistic, while recognizing that it is impossible to make it actually real within the context of a college course learning experience. In its present form, the case is only partially able to be a simulation, so the instructor should keep the focus on giving students the opportunity to rehearse under controlled circumstances while recognizing that the ultimate performance will be up to the students when they must apply their skills to a real situation at a later time.

CHAPTER II-6: A RESEARCH-ORIENTED TERM PAPER

In this chapter, we focus on a research-oriented final paper. To distinguish this from the previous chapters and to clarify the differences, we refer to this version of the final paper as a “term paper.” We document one specimen research term paper assignment on a project management topic, including the required learning outcomes, sample project idea, research methods details, and possible grading rubrics, alongside general guidance regarding research projects and dissertations.

Objectives and Organization of the Term Paper

Objectives

The research term paper builds on the foundations of research and enables students to develop to completion an agreed individual research investigation. The topic of investigation can be negotiated at the outset with the instructor or can be given to students, but it is important to ensure that the scope of the investigation is feasible within the time available. The assignment will give students a chance to consolidate the knowledge and skills acquired, including research-related aspects, while enabling them to explore a specific area and bring a substantial and demanding piece of work to a successful completion. Guidance on marking criteria will be provided at the end of this chapter.

The overall objectives are:

- To gain an understanding of the research process and methods,
- To obtain a deeper engagement and familiarity with the specific topic under investigation.

The detailed learning outcomes can be split into two groupings to cover the above objectives:

Research-Related Learning Outcomes:

The student should be able to:

1. Understand the different research approaches—quantitative, qualitative, and mixed methods.
2. Describe the different research methods, including experiment, survey, case study, action research, narrative, grounded theory, and ethnography.
3. Understand the different data collection methods, including sampling, secondary data (documentation, survey, and multiple sources), observation, questionnaire, and interview.
4. Select appropriate research methods for a given project.
5. Reflect on and evaluate the processes and resources used to carry out the investigation, giving clear evidence of independent thought.
6. Structure a report in a scientific manner.
7. Present data and findings in a clear manner, and cite and list references appropriately.
8. Work (individually/in a group) to complete an investigation.

Topic-Related Learning Outcomes

These are typically evidenced through showing that the research is applied in context. The student should be able to:

1. Learn more about the specific topic under investigation (e.g., Agile Project Failures).
2. Consolidate knowledge relevant to your research paper.
3. Articulate and apply relevant concepts showing insights and awareness of complexities in the problem domain.

4. Explicitly analyze a problem or concern.
5. Properly use evidence, such as journal papers, to support argument and use up-to-date information and relevant sources.
6. Show that research undertaken is relevant and properly sourced.
7. Evaluate available information within your context.
8. Summarize key issues and outcomes.

What is a Term Paper?

A research-oriented term paper is a substantial piece of independent study leading to a formal written report. It presents students with an opportunity to specialize in a particular context or domain, to research a specific problem or question, and to provide a platform for integrating many aspects of PM that are covered in different parts of the course. It is also an important mechanism that allows the students to practice and develop key skills as both a learner and a researcher, thereby allowing students to demonstrate their graduatedness capacity, as well as their abilities in analysis, synthesis, evaluation, communication, problem solving, and creativity.

Term papers enable student to work either individually or in small groups to explore the boundaries of a topic and to evidence their ability to manage time and carry out research. Given that the research paper involves a significant task, it is not uncommon for this to be exploitable by students in job interviews and requests for references. Performance in research tasks often provides a reliable guide to the potential of students to complete tasks and assignments, to communicate, and to solve problems.

Content, Structure, and Format

The length of the document should be appropriate (we suggest around 12-15 pages, plus appendices for data). This allows students to focus on clear communication of the relevant details and emphasizes the presentation of the relevant aspects, which are crucial skills for project managers.

The primary purpose of the term paper is to report and inform regarding relevant research, and its primary audience is other project management students and examiners. In consequence, the design goals to aim for are: continuity—that the material is ordered both to demonstrate the development of the student's work and to develop the reader's understanding, and completeness—that the student is able to give as full account of their work as is necessary, and, especially, that nothing of significance is left out. Put simply, the report must tell a story—a full story and an interesting one.

Unlike an essay, a report contains headings and subheadings that support the storyline. Each subheading may be further divided into subsections or subdivisions. Each section and subsection is numbered and relates to the design of the story.

To develop and improve the continuity of the report, it will be necessary for students to pay attention to the fine structure of the document, that is, to how the individual chapters within the main body of the report are designed. If these are thought out beforehand, in outline or even just as sub-headings, then at least the students will know where they are going as they write. For each subsection in the outline plan, students should try to begin with general idea (or broad picture) and then develop their argument (or focus) toward the more detailed points or areas they want to consider. This follows the maxim: "Move from the general to the particular," which is also useful when the student finally comes to write the paragraphs.

The Main Sections

The physical layout and formatting of the report is important and, yet, very often neglected. A tidy, well laid out, and consistently formatted document makes for easier reading and is suggestive of a careful and professional attitude toward its preparation. Each research project and the resulting report is unique; however, they share a particular structure and sequence and should attempt to include as many of the following aspects as possible, see Table II-6-1.

Table II-6-1: Sample topics to be included in the term paper

Suggested Final Projects Topics
Title
Front Page
Abstract
Key Words
Acknowledgements
Table of Contents
(List of Figures—optional)
(List of Tables—optional)
(List of Abbreviations—optional)
Content
• Introduction
• Literature review
• Research design/Methodology
• Results/Findings
• Evaluation
• Summary and Conclusions
References
(Bibliography—optional)
(Appendices—if needed)
Declaration of Authenticity, or Institutional Plagiarism Rubric

The story that the student is developing should be divided into sections, which support the general flow of the story. It should be emphasized that this is not an exhaustive list or a specific outline but a checklist. Each research project will require a specific structure that includes the relevant items that support the story. The topics in Table II-6-1 are elaborated below:

Title: A concise description capturing the essence of the investigation. Example: Agile Project Failures.

Front Page: This gives the title, the student’s full name, the qualification for which the work is being submitted, the university name, and the date of submission.

Abstract: This is a synopsis of the work and should provide a flavor of the research. More importantly, it should encourage busy researchers to read on. A brief informative summary of about 250 words is normally written as the last item in the project, when everything else is completed, and so it can encapsulate what is actually known and what has been discovered. The abstract summarizes the content of the report, the way it is organized, the scope of the work, the research methodology used, and the main findings and conclusions.

Key Words: This is a list of key terms that define and classify the research. Examples for the Agile Project Failures report might include: agile development, project management, project failures, agile project failures, agile approaches.

Acknowledgments: This is an optional section that acknowledges the help of supervisors, other members of the staff, colleagues, and any other relevant people. Where access to companies, facilities, resources, or individuals was provided, these must be mentioned and the relevant providers thanked. Students should not forget to give credit to any individuals who may have commented on early drafts of the work as well as helpful librarians and technicians.

Table of Contents: This table gives the full headings of all chapters (and the sections within them) with the appropriate page numbers. It should also list the appendices in similar fashion. Page numbers should be right-margin aligned.

List of Figures: If any figures appear in the text, this list will provide the number and name of each together with the relevant page number. Note that sometimes this may be split into a List of Figures and a List of Tables (if the report contains many tables in addition to diagrams and charts). The figures must be numbered consistently using either sequential numbering (e.g., Figure 1, Figure 2, Figure 3) or numbering within the chapters (e.g., Figure 1.1, Figure 1.2, Figure 2.1, Figure 2.2, Figure 2.3, Figure 3.1). Both lists are optional and should only be used for a long report.

List of Abbreviations: If the student has used any sets of abbreviations many times within the text (of components, methodologies, phase names, or different sections within an organization), they should be listed in this section for easy reference. This section typically comes just before the main report.

Introduction: The introduction contains a brief outline of the topic as a whole. The aims and objectives of the report are then stated. Questions to be answered include: What is the purpose of the report, and what did it set out to investigate? There should be no indication of the author's own personal stance on the topic. The introduction is probably the first section that the student will write, as it sets out the work and the approach. It probably is also the last section that will be rewritten to reflect the changes that have taken place.

Context: This section examines the organizational context of the project/ investigation/ topic of report. For example, was the investigation carried out by a well-financed, well-resourced multinational organization, or was it carried out by a local group concerned about the environment? These factors may affect the information gathered and the approach taken. For example, the groups concerned may have talked to other businesses but found local residences uncooperative. Therefore, they were unable to give a clear idea of local feelings toward the proposed road or the new initiative. The lack of money may affect the report of the small local group who might not be able to carry out large-scale surveys. They may rely on the generosity of others to gather scientific information and ecological studies.

Literature Review: The student must review previous research, highlighting useful and relevant work on which the student can build. Even a project focusing on a particular organization will benefit from a literature review!

Research Design (also known as Research Methods or Methodology): This section should include general research approaches, the information or data needed, methods for obtaining the data, sample sizes, and techniques for collecting and analyzing the data. The student should relate the choice of method to the objectives and be discriminating in their choice.

Results: This includes the data and findings.

Evaluation: This is a discussion and analysis of the results with the aim of either validating or refuting the results. Here, the collected information is evaluated to determine what conjectures can be deduced from it. All information is brought together and analyzed and an evaluation is made.

Summary and Conclusion: The final chapter summarizes the research project as a whole, outlines the main findings, and lists the recommendations. The summary should include: What the student set out to achieve, how they went about it, and what they ended up doing. The conclusion section is also likely to include any limitations on the interpretation and recommendations for future work to be carried out in this area. The project planning should also be described and critically evaluated in light of actual events. If certain aspects were compromised as a result, the student should explain why the decision was made and what impact it had on the project. Any omissions or scope reductions will contribute to additional, further work, which can be recommended. The student should comment and retrospectively evaluate both the **product** and the **process** used. Note this chapter may be split into subsections, depending on the number and type of comments that have to be made.

References: This is a complete list of all the works referred to in the text, and possibly in the appendices. Full bibliographical details are needed for each entry following the notation indicated by the relevant faculty members. If the student feels that there is a need for a brief bibliography that lists key books, papers, and articles **not already referenced**, they may also add a Bibliography.

Appendices: Any additional material that did not make it into the main sections, but which is relevant to the report, should appear as separate appendices. Such material should be self-explanatory or can be referred to from within the report itself. The appendices can also include material that was too lengthy for the main report, big data sets that have been collected, or text and questions used in surveys and questionnaires.

Index: This is not normally required for undergraduate research projects.

Declaration of Authenticity: This is often required as part of the submission process in many universities.

Starting a Research Project

Selecting a Project

It is often left up to the student to determine which research methods are best suited to their project's context. It is important to note, however, that the choice of research method is not a simple decision, but a series of deliberations and questions that refine and address the required aspects of the research.

The steps required for setting up an adequate research design process can be formulated as follows:

1. Identify the research area
2. Define the problem and its boundaries
3. Consider and select an appropriate research philosophy
4. Establish the research strategy that will fulfill the main objectives (in terms of the research approach, specific research methods, and appropriate data collection techniques)
5. Produce the research design
6. Conduct the research
7. Gather the data
8. Analyze the data
9. Evaluate the findings
10. Write up the results.

The choice of research area may be made by students or be allocated to them. Undergraduate students typically have limited experience of project work, so the selection of suitable topics must be carefully considered by instructors. Some institutions prefer to allow students to select an individual topic. Others may offer a list of relevant topics or assign an entire cohort, or a group, to a particular topic of investigation.

Once the student has selected, or been given a topic (e.g., Agile Project Failures), it is important for them to read the available literature in order to form a basic understanding of the topic and its boundaries. It is particularly important to pay attention to controversies in the discipline, as they tend to point to the disputed aspects and may offer a fertile ground for further exploration. The selection of a descriptive title for the project is an excellent start, as it begins to define the context, the scope, and the boundaries. Once the student has a working title, it is useful to pause and reflect on what the title conveys. It is particularly useful to consider each word in the title and how they relate together. Students should ask themselves if it is

possible to interpret the title and its individual words in a different way from the original intention. For example, “Agile Project Failures” suggests at least three areas of investigation: failures in agile approaches, failures in agile projects, and a combination that suggests failures that occur when agile approaches are applied to projects.

The working title, and the student’s growing understanding of the scope of the area, can help them to form a research question that they would like to investigate further. For example, the student may ask if agile project failures are different from more traditional failures. That question implies that the student should investigate the existence of something called “agile project failures” and determine if it occurs, if the instances are frequent, and what are the implications.

Research questions are a concise way of defining what the student is going to research in an objective way, free of assumptions and biases. Defining a good question is an art that will take time to master. However, the following questions provide a good starting point:

- Is the question testable?
- Is it ambiguous?
- Does it cover more than one particular possibility?
- Are all terms clearly defined? And agreed upon?
- Would everyone agree with the definition?
- Is it clear what needs to be tested or discovered?

Selecting a Research Approach

Research approaches are broad strategies for conducting research and there are many alternative strategies for conducting the research. Each strategy makes certain assumptions about the research environment and the type of question to be addressed. Each one also has certain benefits and drawbacks. The student’s choice of a basic approach needs to be made explicit.

It is also possible that the project’s objectives can be achieved by using different approaches.

One common way of looking at approaches is by distinguishing quantitative and qualitative features. Quantitative approaches focus on measurements expressed as numbers, while qualitative approaches emphasize words and include richer descriptions that explain feelings, moods, and contexts.

Quantitative approaches: These primarily use experiments and surveys to collect numerical data. Theories are found in the literature, or proposed through data and observations, and experiments can then be decided upon to test their applicability. Quantitative research can take established aspects to new domains or contexts to measure applicability. The researcher’s job is to identify causes, typically from the observed effects. These are often defined as specific hypotheses that examine relationships and impacts in detail. Research problems are reduced to questions about variables and impacts, which are tested to determine if the relationships are verified or falsified.

Qualitative approaches: These place a greater importance on the context and its impact. Theories are therefore built inductively from the data and insights that have been collected. Researchers collect much richer data that is analyzed in reference to social and cultural phenomena. The interpretation of knowledge by participants plays a key part in forming particular views and understanding of observed phenomena, as explanations play a part in constructing a new understanding of events in the context of participants’ comments. Qualitative methods rely on words to convey feelings and perceptions rather than on numbers. Meaning therefore requires interpretation and sense-making in context.

Mixed methods approaches: Rather than treat the two extremes as totally distinct, it is possible to collect both qualitative and quantitative data from cases and use the two sets to provide a richer, yet a better supported perspective. Hybrid, or mixed

methods, are increasingly popular. The clear benefit is the ability to save time on the intensive and often laborious collection of qualitative data, while utilizing more efficient and early results from the quantitative study to direct the qualitative process. Mixed approaches can be applied in parallel or build on the results of one another to devise a more challenging and better informed set of questions and emerging understanding as research progresses.

One of the student's key objectives is to have a strong research underpinning for their approach. The following questions might be useful as part of the reflection:

- Is the approach appropriate to my research question?
- Will the approach enable me to arrive at the required type of result?
- What kind of result will it support?
- Have I the experience (or the skills) required to use this approach?
- Have I the time to apply it correctly and effectively?
- What are the limitations associated with this approach?
- Can I use it exclusively, or do I need to supplement it?
- Is this approach better than other approaches?

Selecting a Research Method

A rich variety of research methods can be applied to research projects. The following sections will explore surveys, experiments, case studies, action research, and systematic reviews.

Surveys: Surveys attempt to elicit information about a defined group of people at a certain point in time. Students may be familiar with surveys, as they often get stopped by people asking them to complete survey questions. Surveys entail the selection of a sample group that represents the wider population. They are used to describe, highlight, or measure certain generalized features or trends.

Examples of surveys include:

- Opinion polls prior to an election
- Student preferences for academic courses
- Examining the usage of sporting facilities on your campus
- Satisfaction surveys in the student cafeteria
- A national census that goes to all heads of households in a country

Note that not all surveys are conducted face-to-face, as telephone interviews and various electronic media make new forms of questioning and interaction possible. One notable feature of surveys is that all subjects will be asked the same set of questions. As you can see from the examples above, some surveys may entail contacting every member of the population (or every household in a country, in the case of the census), while other involve a smaller sample group. Selecting the sample size is an important part of adopting the survey approach, as it can have a significant bearing on the results. Generally, sampling techniques will be used to create a reasonable subset of the population that will be contacted for the purposes of the research. Sampling assumes that the trends and patterns observed in the sample population will apply to the population as a whole (assuming that adequate care was taken in selecting the sample population and that enough responses that are representative of the group have been returned). Note that one of the easiest methods of sampling is by creating a random sample through the random selection of subjects out of a larger population.

The size of the population (and the number of subjects who return the forms or who are interviewed) is also crucial: the smaller the size of this group, the less reliable and less representative the results, due to the uncertainty about scaling them up for the entire population. The survey approach relies primarily on questionnaires and interviews (see Information Gathering

Methods). Tests and observations may also be used to supplement other sources of information (but this is not standard practice). Note that surveys can allow some control over the uncertainties, thereby enabling estimation of the significance of the findings.

Students are encouraged to pick any project to analyze. However, it is strongly recommended that they pick an organization or company they are familiar with and analyze a project in that organization. By picking a familiar project, they can ask for and, usually obtain, realistic data.

Experiments: Experiments entail making changes to the value of a given variable (the independent variable) and observing the effect of the change on another variable (the dependent variable). They may also require the neutralization of other variables (the controlled variables) in order to eliminate their effects.

The setting of experiments can be crucial and requires attention to the setting of apparatus to collect and record the data. In the laboratory, experiments take place within carefully devised mechanisms so that the researcher has full control over the variables and the conditions. The researcher is thus able to manipulate the independent variables and measure the results in terms of the dependent variables.

Once the experiment moves outside the confines of the laboratory, the researcher has to relinquish some of the control. This may result in unpredictable results and interactions, making the field experiment more realistic, yet far more challenging for the researcher (in terms of control, setting up, and drawing conclusions). Note that by moving away from the laboratory, the researcher can no longer be said to be in control of the independent variable, as it becomes dependent on other actors and relationships. Generalizing from the results of laboratory experiments can be problematic, as students must show that their results will hold even when the variables are no longer under the sole control of the researcher.

If the student is planning to use human subjects, it is also very important to consider the choice of subjects and their skills, and to assess if they are suited for the experiment. Many universities have strict policies with detailed approvals that must be completed before any experiments can be conducted.

Case Studies: Case study research is particularly common in social sciences and medical studies, but is also gaining in popularity in other disciplines, including business and management. The term “case study” is an umbrella term used in different contexts to mean different things that include a wide range of evidence capture and analysis procedures.

Case study research is an in-depth analysis of a single instance in its natural context, which allows the researcher to focus on the phenomena of interest in great detail. A case study can be viewed as a way of establishing valid and reliable evidence for the research process as well as presenting findings that result from research.

Case studies can be viewed as a comprehensive research strategy, rather than as an information collection tool or a research design method. Information collection methods for case studies often use observation, document, reading, and interviews, but other methods can be selected to suit the particular requirements of a case and the general strategy. Case study work needs to be self-contained, but researchers have the luxury of being able to expand the boundaries to incorporate emerging patterns and perceptions. The data, and indeed, the analysis, are grounded in reality.

Case studies are ideal for exploring interactions between people and their understanding of a situation. The richness of the data obtained by multiple means from multiple perspectives provides a real insight into the main issues at play. Case studies are useful in exploring novel situations in a real life setting and in covering different perspectives of the same problem. Case studies present difficulties in controlling variables, locating causes, and introducing potential biases. Preparing case study documentation can be time consuming. It is also tricky to try to generalize from the findings, especially when they only relate to a single case study, leading to doubts about the reliability and generality of any potential conclusions.

If the student chooses case studies as their research approach, they will be expected to clearly explain their choice of case or cases. In order to relate it to the discipline and overcome the concern about the applicability of findings from a single case to the entire domain, the student will also be expected to explain why the case is relevant to the discipline and in what ways it is representative.

Action Research: Action research entails a practical project attempting to change the environment by solving a real-world problem. Action research is conducted within the actual problem setting. The researchers become active participants and take an active role as members of the team. This implies having access to the team and the willingness to let the researcher join the organization and act as an integral part. Researchers thus play a part in developing the new reality and, through reflection, can revise existing theories on the basis of their individual experiences. In order to belong to the team, the researcher needs to have the skills that are required for completing the tasks allocated to the team.

Action research starts with a problem in need of resolving and attempts to engender the change needed in resolving the problem. Participation in the activity brings the researcher much closer to the action, but also means that she or he plays a part in shaping and directing it. Intimate interaction with the problem may mean sacrificing some of the more general perspective through focusing on smaller and more localized detail.

Note that unless the student is already working on a project and considered as part of the team, it is unlikely that action research can be implemented in any effective way over the course of a single semester project.

Systematic Reviews: The literature survey, as well as additional documents that may be available, can provide a valuable source of information that is needed for providing a foundation for research and for supporting further work. Systematic literature reviews of primary or secondary sources are an evidence-based approach that can provide background, historical, and supporting information and be useful in identifying trends and particular solutions or approaches that may be helpful in practice. Such reviews need to be carried out with a clear purpose related to the problem the student is trying to solve.

Alternative research approaches may involve narrative inquiry, ethnographic studies, phenomenology, or grounded theory. It is unlikely that any of these forms will be used in an undergraduate student report unless the student is already familiar with the method.

Selecting a Data-Gathering Method

There are a number of trusted and well-used techniques for collecting data. Many of these techniques are used by systems analysts and business analysts. Typical methods for gathering information (sometimes encompassing both facts and feelings) include:

- Questionnaires
- Interviews
- Observation
- Documents

Note that perhaps not surprisingly, data-gathering methods rely on the use of different senses. The key skills that are required to use them effectively are listening (during interviews), seeing (observation and once again observing reactions during interviews), and reading (documents and questionnaires). It also helps if the student can read between the lines and identify trends and hidden meanings.

Generally, the student will find that certain research strategies tend to be associated with specific methods for data collection. Questionnaires and interviews, for example, are often associated with the survey approach; while observation will typically be connected to experiments. However, it is still up to the student, as the researcher, to select the most suitable method within

their research strategy and to make choices about how to implement items such as the size of the sample, the number of documents, the time per interview, and so on. The student's choices will reflect the priorities and constraints of the project. It is hoped that students will also show a clear understanding of the principles of research and the relative merits of their decisions.

The four main data-gathering methods are detailed below.

Questionnaires: A questionnaire can produce useful data for a project, provided the necessary detailed work is done in advance. Note that questionnaires have been described as the most difficult method of information gathering to use successfully. Typically questionnaires are employed in measuring political opinions, consumer preferences, usage patterns and scope, functionality, and perceived cause-effect studies.

Advantages of Questionnaires:

- They achieve **wide coverage**
- They are **fast** in terms of reaching a large or geographically dispersed group
- They are relatively **inexpensive** to produce and administer to a large group
- They are **standardized**, ensuring identical questions are asked of all subjects
- They can be **anonymous**, if that is desired, but can also allow full and honest answers
- They are suitable for **extending** data collection beyond the interview

Disadvantages of Questionnaires

- They need to be **carefully designed**, requiring specialist skills
- Their design can be **time-consuming**
- They are normally subject to **poor response** rates (a typical return rate in the region of 10%)
- One **cannot check** or validate the results unless the respondents are named
- One is only analyzing the results of those who bothered to return the forms, so there might be a **bias**

Interviews: Interviews are used in many student projects. They are a type of meeting used to collect information verbally. The purpose of conducting an interview is for one party, or both, to gain information as well as elicit mutual confidence and trust. In many situations, the first step in dealing with a problem is to interview someone carefully about it. All interviews need to be documented and the interview reports, or transcripts with their subsequent analysis, will form part of the project report.

Interviews come in varying sizes ranging from one-on-one (with one interviewer and one interviewee), via group interviews where four to six people meet together with the interviewer to talk about certain topics, to focus groups where a small group is brought together to explore attitudes and perceptions.

Interviews are particularly useful in their openness to the investigation of new directions and topics as they emerge, in the flexibility that they encourage, in fostering a positive relationship between interviewer and interviewee, and in having a live guide who can direct the process.

Interviews tend to fail for two reasons:

- Inability or unwillingness to listen
- Inability or unwillingness to establish an open relationship

Remember, an interview is a form of conversation between two parties. Many people who cannot express themselves well in writing may be able to discuss their feelings during a conversation. Listening is an important part of any dialogue. After every interview, the student should try to evaluate their own performance. When they discover problems, they should develop techniques to correct or avoid the triggering situation in the future.

Observation: This involves the scrutiny and recording of actions in natural settings. Detailed observation is, in general, not a very effective way of obtaining the kind of information required for answering management questions. Major drawbacks are the ease with which people can be antagonized if they are being watched (or even if they think they are), and the fact that behavior changes when people are being observed, and not always for the better. There is also the need to negotiate agreement from the organization for the student to be present for prolonged periods to observe their operating procedures.

Observation is also very expensive in terms of time. Furthermore, it does not reveal emotions or feelings, or provide any rationale for particular behavior patterns.

However, when a special event or a critical time is anticipated, it may be worthwhile to observe a special occurrence to see if it is approached differently and what kind of special behavior patterns it stimulates. Observation is direct and focused and can concentrate on a specific aspect, as required, and uncover unexpected relationships.

If the student intends to use observation as a technique, care must be taken to document the activities thoroughly. The student needs to decide in advance: the plan for observation, what is to be observed, the method of recording observations, and how the observations are to be analyzed.

Informal observation, simply being present and being observant, can be very valuable in getting the feel of a particular organization and the way it is managed. Look for piles of papers, closeness of supervision, frequent interruptions, bad time keeping as well as the positive signs of a productive and efficient workplace. This can be done during a visit or on your way to an interview. However, remember to be careful of such subjective information, which can be embarrassing, misleading, and out of context.

Documentation: Documentation can include both written and nonwritten documents. Document scrutinizing and record searching are often useful in establishing quantitative information about data and procedures. For example, a simple record search can reveal the number of customers or the number of fields per record. It can further highlight the typical number of transactions per record or the forms and data that needs to be filled for a particular task.

Document searching is useful because it relies on documents that are already in existence thereby providing a good introduction to the work, the participants, or the departments and organizations involved. Operating procedures, organization charts, forms, publicity booklets, job descriptions, statements of company policies and manuals can be useful in detailing how work processes are supposed to be followed according to organizational guidelines and, in providing a background to the organizational setting. It can also be very instructive to compare filled-in documents and forms, with organizational procedures dictating how they should be completed. Sampling a set of documents can also be useful for identifying typical mistakes, shortcuts and revised procedures.

Document searching can also be useful in confirming points that have come up during interviews. However, documentation is not always kept up to date. Furthermore, in most situations there is either insufficient documentation or an overabundance, making it impossible to trace the relevant sections.

It is important for students to look again at their objectives and the choice of their research approach to ensure that their data collection method is consistent with the overall philosophy of the project. Useful questions to ask include the following:

- It is possible that more than one technique is suitable?
- Is my technique appropriate for my problem?
- Is my technique suitable in terms of the research approach?
- Are there any alternative techniques that I could use?
- What are the main benefits from using the technique I selected?
- What are the drawbacks?
- Would any of the other alternatives offer a better balance between benefits or drawbacks?
- Is there any point in combining techniques? Have I time to do that?
- Do I know how to use this technique?

- Do I need any special skills?
- What do I need to learn?
- Do I have enough time to apply the technique?
- When can I start?

Student Guidelines

The Issue of Plagiarism

Plagiarism is using words and ideas from another text without acknowledgment and without referencing correctly where the information came from. It can occur through negligence, foolishness, or deliberate intent. Often, plagiarized sections in reports stand out because they are written in a different style from the rest of the report. Faculty members, or persons marking the report, will often be familiar with the main texts on the subject the student is writing about. They will also be aware of the main arguments and theories, so trying to pass something off as the student's own work is not that easy. Copying another student's work is also plagiarism.

Plagiarism is dealt with severely in universities and can result in dismissal. Students should be aware of the plagiarism policy in their university.

How to Avoid Plagiarism

If a student uses quotes or text from another author, they should make sure that they reference that work correctly. Ideas can also be plagiarized so these need to be referenced as well. The reference should include the author's name, the year of publication, and the page number. The references at the back of the project should give the name of the author, the chapter name, the name of the book, the page number, the year of publication, and the publisher. Each discipline within a university has its own format for referencing material.

When summarizing ideas from books or journal articles, make sure that they are written in your own words if you are going to use them in your essay. Read over your summary and check that the phrases and sentences are structured differently from the original text. Use your own examples. Some information that is well known and agreed upon does not need to be referenced, for example, "London is the capital of England," or "smoking is bad for your health."

Make sure words and ideas taken from other works are referenced correctly. When summarizing, ensure your own words and phrases are used. The penalty for plagiarism can be very severe so if in doubt, add a reference. If you are unsure about a different type of reference, ask for help.

Major Pitfalls

Some of the most useful things to know about individual research projects are the common pitfalls. This list can be used as a partial checklist or an informal risk assessment exercise. Here are some of the common causes of failure:

- A large number of small, annoying errors, which could have easily been corrected through proofreading and careful use of a spell-checker.
- Choosing/Starting the project too late. Submit your project proposal on time and start the project as soon as you can. The longer you leave it the harder it is to get motivated, especially when all your friends seem to be flying ahead.
- Failing to meet your supervisor regularly. If you arrange a meeting with your supervisor, turn up at the agreed time. If you are stuck for any reason and you have no meeting arranged, contact him or her immediately. You

gain no sympathy from anyone if you lose contact with your supervisor and produce a poor project as a result. Your supervisor will be happy to help you, but they can do nothing if they are unaware that you are having trouble.

- An inadequate literature review.
- Allowing too little time for writing the report. You should try to produce as much of your report as you can as you go along. The last two weeks of the project should be dedicated to pulling together the material you have accumulated and producing a polished final product.
- Over/Under ambition. Try to be realistic about what you can achieve in the time available. A good project requires a lot of input from you and should prove to be technically challenging throughout. At the same time, however, it is better to do a small job well than it is to fail to do a big job at all. Your supervisor will advise you on his or her expectations of the project and this will help you to set your sights accordingly.
- Blind Assertions of fact. Avoid the assertion of facts, often as a list (e.g., the critical success factors are... OR it is known that...). Everything in your report has either an external source or is a result of your work. Either way, make the source clear. It should be clear whether the assertion was derived through logical argument, practical evidence and results, or evidence from the literature. Only repeat an external source list if you intend to discuss every point.
- Lack of clear explanation of your reasons for making decisions, in particular, decisions involving selection of methods and choices need to be justified.
- Unsourced complex diagrams. A diagram is supplied without a source. Give the source. If you have adapted several sources, make clear the contribution of each.
- Lack of definitions of terms or acronyms, which spoils readability.
- Perfectionism. Try to avoid the tendency to perfect every task. A "good enough" project finished on time is better than the promise of unfinished "perfection" (see over ambition above).

Tutor and Facilitator Guidelines

General Guidelines

During the course, the faculty member should regularly discuss the students' projects and not leave it until the final few weeks. The goal should be to provide constructive feedback throughout, and answer ongoing questions as they arise. Students should be advised early on whether they appear to be proceeding in the right direction and, especially, to ensure that their project is feasible.

An important aspect of the project is that there should be a significant contribution in terms of the research methods and approaches. Selecting a feasible combination of methods and approaches is essential and requires the faculty member to be vigilant to ensure the students do not proceed in the wrong direction.

Group or Solo Projects?

Research projects can be done individually or in small groups, enabling the group to scrutinize a greater range of sources and marshal a larger body of evidence. It also relies on having the time to coordinate and liaise and may require greater attention to the functioning of individual members. The choice relates to the size of the group and the preferences of the instructor.

Submitting Project Proposals?

Given the importance of research projects, there is a clear need to involve faculty in approving the titles and approaches selected by students. One solution is to get students to submit a formal proposal for the project. Another approach is to allocate agreed upon topics or to negotiate the topics up front during the initial weeks. Ultimately, the choice also depends on the length of the module/course, and the time available for working on the assignment.

The Need for Presentations?

Individual or group presentations can be used as part of the assessment and development work for the research paper. The advantage in preparing a presentation is that students get to engage with the material at a more intensive level, as the preparation of the presentation forces the presenter to master the topic. The other key advantage is the ability of other students to engage in the topic (assuming that each group or individual is working on a separate topic) and provide additional feedback, which makes for more relevant learning. Presentations require time to prepare and will use up class sessions and, hence, require careful consideration and planning. It is typical to allocate 25–30% of the marks to presentations. Response to feedback, or at least consideration of given feedback, could also be added to the rubric following presentations.

Grading Research Term papers

A detailed marking criteria is provided in Table II-6-2. The detailed scheme covers 18 key aspects and can be tailored to the specific requirements of a faculty member by removing some of the aspects. Instructors can also decide if some of the aspects count for more.

The criteria can also be utilized as a marking rubric, see Table II-6-3, where checks (or ticks) are applied against each item. Rubrics provide a simple communication tool, and have proved to be a useful tool for students to rank their own work in advance of submission so they can gauge and frame their expectations.

Table II-6-2: Project-marking grid

	FAIL	POOR	AVERAGE	GOOD	EXCELLENT
Abstract	Abstract missing.	A poorly structured paragraph.	Insufficient definition and clarity. Very basic coverage of aims, approach, and conclusions.	Defines subject but summary of aims, approach, and conclusions incomplete.	Clearly defines subject. Includes aims, approach, and conclusions.
Introduction	Introduction missing or irrelevant. Aim and objectives not clear. Topic not introduced.	Reasonable attempt to introduce topic and aim of project.	Aims and objectives of project made clear.	Clear and concise indication of aims and objectives clarifying the background. Particular areas of research topic of work identified.	Precise description and explanation of all objectives. Concise, clear, sets scene, and presents summary for rest of document.
Problem definition	No attempt to define scope of topic or a totally misunderstood or irrelevant scope. Major areas left unexplored.	Scope definition contains many omissions and misunderstandings. The problem definition and its context is included but raises as many problems as answers.	Attempt to cover scope contains some omissions/ misunderstandings/ irrelevant material. The problem definition and its context is well presented but the supporting arguments lack depth.	Good attempt to reflect scope. The problem definition and its context is generally well presented. Most key points covered.	Excellent interpretation and conceptual grasp. The problem definition and its context is fully presented to a knowledgeable reader. Scope appropriate. Almost all significant points covered.

	FAIL	POOR	AVERAGE	GOOD	EXCELLENT
Concepts (understanding and application)	Concepts are not explained or are incorrectly applied. Very little or no understanding of the issues raised by the topic (or serious misunderstanding of the topic). Content largely irrelevant.	A few underpinning concepts are presented with only a minority well understood or applied. Understanding appears superficial and/or confused. Contains irrelevant material.	Some underpinning concepts are presented with some well applied. Basic awareness of the issues, but at a general level or awareness of only some of the issues.	Most underpinning concepts are presented with all well applied. Clear awareness and exposition of relevant issues. Some awareness of nuances and complexities.	The relevant concepts are understood and are explicitly articulated within the report and well applied. Excellent exposition of relevant issues. Good awareness of nuances and complexities. Insightful and well informed.
Use of literature	No references to literature or even to class notes in relevant topic. Inadequate or inaccurate information.	Little evidence to support arguments and inadequate coverage of basic sources. Few citations in writing. Only a minority are academically respectable references.	Weak, inconsistent use of evidence to support arguments. Insufficient evidence of research in terms of identification of relevant source material. Most references are academically respectable (with low proportion of newspapers and web addresses).	Good use of evidence to support arguments. Relevant published material utilized to support critical evaluation. Evidence of a comprehensive coverage. Good use of citations, avoids unnecessary description of other's work. Cross-section of classical and up-to-date references, including specialized journals and conferences.	Excellent use of evidence to support arguments/ points. Substantial evidence of good use of a wide range of sources. Use of up-to-date information and relevant sources. Material used includes different types of evidence, including contradictions and challenging information. Excellent balance between classical and recent academic references.
Relevance of research	No research is included, or all research presented is irrelevant.	Some research is presented; but the majority is disjointed from the work presented.	There is some research presented, but it does not fully underpin the project.	The research is sound but lacks aspects of coherence to the project.	The research undertaken is relevant, sourced, and critically reviewed in a synoptic fashion.
Method selection	No attempt has been made to discuss the approach, or a totally inadequate choice. No understanding of merits or concerns associated with the selected method/s.	An acceptable approach is discernible but not well explained. Some evidence of little regard to appropriateness of the method.	An appropriate approach has been adopted with some unexplained deviations.	A sound approach has been used throughout, but the argument omits some of the justification steps. The method itself is clearly set out and explained. Variations used are fully justified.	A reasoned selection of the available options and approach. Disciplined, well-planned choice, may also include adjustments to approach. Similar justification of the choice (and range) of methods and tools.
Analysis/Design	Little attempt at analysis, synthesis, and design. Wrong problem addressed.	Major gaps in the analysis and/or design with respect to the original problem.	Evidence of analysis and design which appears incomplete in comparison with original problems. Some missing aspects.	Evidence of analysis and design in respect to the original problem.	Analysis and design is explicit. All problems addressed.
Overall approach	No understanding of conceptual framework. Report appears overly descriptive and includes many errors and omissions.	Weak understanding of conceptual frameworks. Over reliance on undigested sources or a superficial perspective. Too descriptive.	Little questioning of sources, but evidence of a critical approach applied in places.	Some evidence of a questioning approach. Good standard of critical analysis.	Questioning, unbiased approach. Clear evidence of independent thought. Excellent standard of critical approach.

	FAIL	POOR	AVERAGE	GOOD	EXCELLENT
Results	No significant results. No attempt at discussion or justification.	Similar findings are widely available. Distinctive aspects of the problem not covered.	Weaknesses detract seriously but are acknowledged.	High standard reached. Findings fit the problem studied and alternatives are compared. Clear indication of assumptions and crucial trade-off decisions.	Results offer a notable original feature, quality or purpose. Pathway indicated for further development. Findings are original and could be applied in other projects and appear superior to the usual alternatives. Deep understanding of assumptions and trade offs.
Evaluation (of both product and process)	No attempt at evaluation. No recommendations stated. No clear idea of how, or if, the recommendations could be implemented.	Lacks objectivity. Only minor relevant evaluation of the work is presented. Limited evaluation without clear links to the objectives.	Some evaluation with some links to work undertaken. Many key issues identified.	Significant evaluation of the outcome (or product) with little emphasis on the process and methods. Clearly stated evaluation firmly based on evidence provided. Feasible set of recommendations linked with project objectives.	Reflective and insightful evaluation. Assessment of both process and outcome. Choices of approaches and methods re-visited in light of outcomes. Objectives fully reviewed. Clear understanding of potential and limitations. Appropriate and realistic recommendations consistent with results.
Conclusion (section)	No recognizable conclusion.	Conclusion perfunctory. Descriptive summary of projects contents.	Conclusion does not do justice to the report. Inadequate summary of key points/ issues/ outcomes. Conclusions drawn but insubstantial or unproven.	Good. Summarizes key points/issues and outcomes. Conclusions drawn, supported by body of writing.	Excellent. Accurately identifies and summarizes key points/issues/outcomes with reference to the original problem. Critical, reflective conclusions. Propose new work in light of findings. A convincing argument shows that the recommendation is superior to the usual alternatives. Discussion of limits and reservations (and alternatives obvious in retrospect).
Logical flow of ideas	No logical structure and no evident story line.	Arguments confused or not fully developed.	Arguments not developed. Arguments not always clear.	Arguments clearly structured and logically developed. Evidence of a story line developing. Uses headings, introductory statements, and summary to provide narrative links.	Convincing case made. A clear story line forming a coherent argument. Aims, arguments, and conclusions fully compatible. Chapters well organized and fit together.
Structure of report	No evidence of any attempt to plan and construct the report. A loose collection of ideas or irrelevant information. No sequence and links within chapters.	Little if any of the report is well constructed. Collection of self-contained sections.	The report lacks coherence or addresses only significant issues. Structure flawed but sections reflect project aims.	Most of the report is well constructed with the correct use of language and addresses many of the issues noted above.	The report is well constructed with the correct use of language and addresses all the issues noted above.

	FAIL	POOR	AVERAGE	GOOD	EXCELLENT
Spelling, grammar, and syntax	Frequent errors in punctuation, misuse of words, spelling, and sentence construction make the work largely incomprehensible.	Many errors in punctuation, misuse of words, spelling, and sentence construction occasionally make meaning unclear.	Occasional errors in punctuation, misuse of words, spelling, and sentence construction.	Acceptable standard. Few errors, typos.	Very high standard. Negligible errors.
Clarity and style	Style makes work largely incomprehensible. A self-centered ramble evoking emotive terms.	Style too colloquial or makes work difficult to understand. Lacks objectivity.	Style acceptable. Coherent sentence content and correct choice of words. Little use of first person.	Effective use of language. Clear and easy to read. Content free from generalizations and unsupported statements and opinions.	Very effective use of language. Clear, concise, and easy to read. Impartial academic style.
Data and references	No use of relevant data, tables, figures, diagrams, etc. No referencing and/or bibliography. No apparent understanding of system of reference.	Poor use of relevant tables, examples, figures, and data to break up text. Some errors in citation, including missing or incorrect citations.	Some good use of relevant tables, examples, figures, and data to break up text. References accurately cited and listed most of the time.	Good use of relevant tables, examples, figures, and data to break up text. References accurately cited and listed.	Excellent use of relevant tables, examples, figures, and data to break up text. References accurately cited and listed.
Overall presentation	Unacceptable presentation. Pagination, title, margins, and paragraphs need serious attention. Repetitive content.	Unacceptable presentation. Pagination, title, margins, or paragraphs need some attention.	Presentation generally satisfactory. Acceptable appearance. Correct use of paragraphs, headings, subheadings, numbering, and sections.	Carefully organized. A good standard of appearance, neatness and legibility.	Excellent presentation. Carefully organized and well presented Interesting to read and visually appealing.

Table II-6-3

	FAIL	POOR	AVERAGE	GOOD	EXCELLENT
Abstract introduction					
Problem definition					
Concepts					
Use of literature					
Relevance of research					
Method selection					
Analysis and design					
Overall approach					
Results					
Evaluation conclusion					
Logical flow structure					
Spelling					
Clarity and style					
Data & references					
Overall presentation					

CHAPTER II-7: LOCALIZATIONS OF PM-1 FOR DIFFERENT COUNTRIES AND INDUSTRIAL DOMAINS

In this chapter, we discuss the issues surrounding the localization and modification of the PM-1 course to fit different academic needs. There are two degrees of localization: the domain or industry (e.g., construction, information technology, pharmaceutical, etc.), and the country in which the course is to be taught.

In workshops, it emerged that there is very little standardization across, or even within, domains and industries. While there is a good deal of commonality in the pedagogical goals, learning objectives, assignments, and topics, faculty consistently expressed the desire to localize PM-1 to their own specific situation. For example, we observed that even construction PM is taught differently in different countries.

In this chapter, we provide the background for a variety of localizations. However, the goal is not just to meet a specific need (e.g., PM for IT in France) but to provide ideas and suggestions for a wide selection of approaches to PM-1. The goal is to provide a diversity of approaches that will suggest ideas to faculty, so they can tailor the content to meet their own specific needs.

The localization details are given in Appendix II-D: Localizations of PM-1.

Domain Localizations

Health/Healthcare/Medical Projects

This is a person-centric sector and, therefore, the social aspect is a priority and the order of topics can be changed dependent on the faculty focus.

The context will vary based on whether the course addresses a patient-care situation, and whether the situation is delivering, managing, or procuring for the patient care. Variations will also occur, depending on the environment: station nurses, emergency room, laboratory, or pharmacy. Beyond patient care, the issue of research will reorder priorities and depend on whether the research is medical, animal, or phase 1, 2, 3, or 4 drug development. The following curriculum was developed to emphasize face-to-face patient care.

There will be differences between PM in clinical research, which will be patient-centered, and PM in new drug development, which may be approached as a standard project to deliver hypotheses. Standard research could also fit under new product development, but will depend on the nature of the research (e.g., drug related). Social science research is another healthcare context, but with a slightly different emphasis. Educational healthcare will be different, as it will focus on students.

Construction Management

Construction management undergraduate degree programs cover numerous project topics that directly relate to the construction environment. There are several differences from a more traditional, stand-alone PM curriculum. While construction courses often include topics that are considered here as aspects of the KMs, they are often covered in more depth than in more traditional PM courses. Examples of courses that include in-depth coverage of project management topics include:

- Construction Contracts, Specifications, and Law
- Construction Cost Estimating
- Construction Planning and Scheduling
- Construction Project Administration

- Construction Cost Management
- Project Risk Analysis
- Project Control Systems
- Cost Analysis for Project Management

An introductory course in project management could provide an overall understanding of PM concepts and vocabulary that spans the construction topics. By providing a better understanding of the project life cycle and the importance of each phase, construction management students could be better prepared to address in-depth construction project topics. An introductory course might also advance the behavioral skills that are emphasized in the traditional project environment.

Information technology projects

Information technology (IT) undergraduate degree programs cover numerous PM topics as part of the software development environment. Several of the more technical PM topics might be covered in-depth in the IT curriculum. When compared with the PM-1 course, the following changes are frequently noticed:

- Cost estimation topics are covered in detail and in a manner specific to IT. In addition to the basic cost estimation techniques covered in PM-1, students might need to understand complex parametric models for software estimation.
- Project risk analysis focuses more specifically on software risks. Students must have a sound understanding of factors that cause software project failure.
- Project quality management should focus on software quality planning and quality assurance. Additional quality control techniques, such as black-box testing and white-box testing, might need to be introduced here.
- Agile software development is quickly becoming the IT industry's norm over plan-based approaches. The PM-1 course might be modified to introduce agile approaches to project management early on, even though it might be regarded as an elective for other disciplines.

Localization by Country

Germany

Industry Domain/Academic Domain

Engineering (Mechanical, Construction, IT)/Mathematics, Business

Type of Undergraduate Student

In Germany, undergraduate students are about 17 to 19 years old and will have no or very limited (i.e., summer internship) work experience. The academic year at most German universities consists of two semesters: winter (October to March) and summer (April to September). There are two types of universities: traditional hard-core academic universities and universities of applied sciences. Students of the latter institutions spend about half their university education (i.e., 1.5 years out of a three-year course) working at a (sponsoring) company.

Students' backgrounds upon attending a PM-1 course will include some fundamental courses in their major subjects (e.g., engineering, mathematics, business). They would probably take a PM-1 course at the end of their first year or during their second year. All of the students will be resident and full time.

Most of the students will go on to do a master's degree immediately after their bachelor's degree, so a certain percentage of any PM-1 audience will be master's students in their fourth or fifth year. Therefore, the audience for PM-1 may be quite heterogeneous due to a diversity of course backgrounds and a variety of year groups. Courses are typically in class with only marginal aspects of homework and group work delivered via digital learning platforms.

The typical class size is not limited and so can be anywhere from 80 to 240 students.

Australia

Industry Domain/Academic Domain

Financial Services, Marketing, Design, Health

Type of Undergraduate Student

Approximately 90% of students begin as full-time, but by the fourth year, around 50% are part time, as they are working full time in the construction industry. Around 5% are full time international students for the duration of the degree.

Roles in the construction industry vary from on-site builders and carpenters to other students taking subjects as an elective in a property degree.

The typical size of class is 100 to 120 each semester (twice a year).

Arabian Gulf Region

Industry Domain/Academic Domain

Publicly Funded Projects, Other Projects

Type of Undergraduate Student

A typical class would have mix of students, with the majority being undergraduates.

There may be up to 180 students enrolled in a class, but they are divided into sections with no more than 40 in a single section.

Canada

Industry Domain/Academic Domain

Construction

Type of Undergraduate Student

A typical class would include a blend of working professionals, high-school graduates, and full-time, part-time, and international students. Typically, 60% are mature working professionals, and 40% are high-school graduates (local and international). The typical class size is 32 students.

United States

Industry Domain/Academic Domain

The course can include a mix of students from engineering and management program, business majors (supply chain, logistics, entrepreneur, and innovation), construction management programs, (civil engineering) and other engineering majors, IT, graphic/visual arts, and mathematics majors.

Type of Undergraduate Student

Students include typical undergraduates and nontraditional undergraduates (i.e., returning veterans and others not starting college right after high school). The typical class size is 35 to 45 students per section, with two to four sections depending on the semester and teaching loads.

APPENDIX II-A: SYLLABUS

PM-1: Foundations of Project Management

We begin with the example of a typical one-semester course. The content may also be implemented in other formats. Therefore, we have added sections in this appendix to illustrate how the content may be approached in different situations. These additions focus on the course schedule, as most of the other sections are assumed to be common to any version of a syllabus.

Many sections of a syllabus contain data that are specific to the course (professor, schedule, etc.) and the university (classroom, dates, etc.). Therefore, this syllabus will have to be modified to match the appropriate setting.

Information that provides rationale or is explanatory is placed in italics (like this paragraph) to distinguish it from the syllabus content. The course structure presented as follows is the baseline for the localizations in Appendix II-D.

Example: A Typical One-Semester Course

Professor Jones
Project Management Department Some College
Another University

1. Course Description

Project management (PM) is increasingly important in today’s world. This course covers the fundamental concepts and applied techniques for cost-effective management of both long-term development programs and short-term projects. The content deals with planning, scheduling, organizing, and controlling projects. The course uses cases from a wide variety of industries, including construction, information systems, nonprofit organizations, the government, and the military.

Project management principles and methodology are provided with special focus on planning, controlling, and managing projects to successful completion. The topics are divided into two categories: the behavioral aspects of a project and the technical components that make up the project. Behavioral issues include management and leadership, cultural differences, organizational structures, and conflict and negotiation. The technical issues include the relation between the performing organization and the project; determining strategy and project selection; developing the project plan; estimating costs, schedules, and the critical path; methods for determining project status; and risks, quality, and procurement.

Computer tools will be introduced to provide hands-on practical skills with the above topics. Mastery of the concepts introduced in this course should give students a significant competitive advantage in the marketplace.

Prerequisites: None

2. Basic Information

Classroom:	TBD
Dates and Times:	TBD
Instructor:	Professor Jones Associate Professor, My Department My University

Contact: jones@myuniversity.edu
Office: Room 123, Main Street
Office Hours: Tuesdays 4:00–5:00 pm
Wednesdays 2:00–4:00 pm
and by appointment

3. Text and Materials

Required Text:

See online resources.

4. Course Overview

4.1 Course Goals and Objectives

This course provides an integrated introduction to PM. In this case, “integrated” means that the student will learn all of the fundamental aspects of modern PM, both managerial and technical. Students will also become familiar with PM software tools. Finally, in discussions and cases students will learn how to apply the skills required of a project manager.

This course will:

- Provide experience in using the concepts, techniques, and tools available to project managers for organizing, planning, and controlling projects.
- Help you develop an appreciation for the managerial, cultural, and social aspects of PM.
- Raise awareness of the importance of the organization’s strategy during project selection.
- Provide an understanding of the critical role of work breakdown structures and networks in planning, scheduling, and estimating the status of projects.
- Create an awareness of potential conflicts and scheduling problems that occur on projects.
- Demonstrate how to reliably estimate the status of projects.
- Expose you to MS Project and demonstrate its usefulness for planning and scheduling projects.

In pursuing these objectives, the course will:

- Use the textbook and cases.
- Combine theory and practice.
- Combine the strategic with the tactical.
- Use relevant concepts to analyze and assess complex project management situations.

4.2 Course Learning Outcomes

After successfully completing this course, the student will be able to:

- Identify the elements of the PM life cycle, including plan, control, and organize and allocate resources.
- Understand PM processes.
- Comprehend basic tools and techniques to plan, organize, and manage a project.
- Optimize results while managing the triple constraints.
- Manage stakeholder communications.
- Demonstrate the principles and practice of team leadership.
- Describe the career paths in the PM profession.

5. Class and Homework Schedule

The class structure is presented here in terms of a typical 16-week (one semester) course, with three lectures per week. However, the content can also accommodate other formats, such as one three-hour lecture per week. The content could even be presented in a seven-week online course, in which case one would cover two topics per week.

(This assumes that the online course carries the same credits and contact hours as a standard, one-semester course.) The homework assignments identified here are designed to meet the learning objectives established for the course. They combine the detailed breakdown in Table II-A-1 and present it as a more typical course format.

Table II-A-1: Class and homework schedule for PM-1 implemented as a one-semester course

Week	Lecture	Class Topic	Sub-Topics	Homework Assignments
1	1–3	Projects and the project manager	Definitions The project manager's role Internal and external environment Project structures Project and product life cycles PM processes	Identify projects in the student's experience.
2	4–6	Project environment	The project management office Rationale and business case Mission, goals, and strategy Portfolio management Financial analysis	Give examples of mismatches between projects and company missions. Perform an NPV analysis for a project.
3	7–9	Charter	The PM plan The charter The triple constraints	Write a charter.
4	10–12	Scope	Project justification The specification Constraints, limits, assumptions, and technical requirements Statement of work (SOW) Priority matrix	Write a scope.
5	13–15	The WBS	WBS structure WBS dictionary Graphical vs. outline format Work packages Control accounts	Write a WBS.
6	16–18	Cost estimation	Top-down and bottom-up Types of estimates and accuracies Parametric estimates Budget and contingencies	Develop a cost estimate.
7	19–21	Stakeholder engagement and communications	Identify stakeholders Manage stakeholder expectations Communications tools	Create the stakeholder list and document their influence for a project.
8	22–24	The network and the critical path	Forward and backward passes Slack and critical path Assigning resources Milestones Lags, leads, and loops	Analyze sample network diagrams.
9	25–27	Automation tools for network and critical path analysis	Tutorial for automation tool	Implement a project in an automated software tool.

Week	Lecture	Class Topic	Sub-Topics	Homework Assignments
10	28–30	Earned value management	Planned value, earned value, and actual cost Cost and schedule Performance indices Cost and schedule analyses	Carry out an earned value analysis using real-world data.
11	31–33	Risk analysis	Positive and negative risks Risk strategies Qualitative risk analyses Program evaluation and review technique Contingencies and reserves Quality standards	Perform a qualitative risk analysis for a project.
12	34–36	Quality	Quality standards Cause-and-effect diagrams Audits	Create a quality plan. Identify quality metrics to control quality. Construct a cause-and-effect diagram.
13	37–39	Procurement	Contract types and risks Incentive and award fees	Calculate the incentive fee for a contract.
14	40–42	Ethics	Ethics and professional responsibility Ethical case studies	Give example of personal ethical issues that could apply to projects.
15	43–44	Presentation of students' final projects Presentation of lessons learned		Final projects Lessons learned
16	45	Final examination		

6. Requirements, Policies, and Standards

6.1 Attendance

Attendance at all classes is mandatory. Attendance will be taken in accordance with department policy.

6.2 Course Structure

The course will be conducted by means of a sequence of lectures. There will be one lecture each week.

Homework will be in the form of essay questions and exercises (calculations). Each week students will be assigned a discussion topic, which will be the focus of an in-class discussion. Every student will be expected to contribute every week.

There is a major final project due at the end of the course that will require the use of software tools. Students will be required to demonstrate their understanding of the key features of PM, as well as the practical application of the tools.

6.3 Grading Policy

All students will be expected to demonstrate knowledge of the role of the project manager and the techniques, tools, and behavioral aspects of PM.

6.4 Assignments, Exams, and Discussions

There will be weekly homework assignments. In addition, there will be weekly discussion topics that students are required to participate in.

The final examination will be scheduled by (My College).

6.5
 Grading Standards

Student participation is defined as contributing to the discussion in each class. The course will consist of homework, a mid-term, a final project, and a final examination, weighted as follows:

Homework:	35%
<i>Assignments</i>	25%
<i>Discussion Topics</i>	10%
Midterm:	20%

The objective of the midterm examination is to establish that all students have learned the terminology and the fundamental technical aspects of PM. The midterm examination will contain a combination of essay questions and calculations.

Project:	25%
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The project will be an individual (not a team) assignment.

Final Examination:	20%
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The final examination will consist of essay questions and calculations.

6.6
 Expectations

Homework will be assigned each week and collected the following week. Assignments will be graded. Proper attribution is required for sources.

6.7
 Paper Formatting Requirements

Students are to complete the final paper using the departments or instructors style for citations and references. Work from other authors must be correctly cited and referenced.

6.8
 Timely Presentation of Materials Due

All assignments (papers, homework, etc.) have due dates. Insert policy on the right to refuse, or downgrade, any materials presented after due dates.

6.9
 Academic Conduct Policy

The academic-conduct policy for plagiarism is published in the university’s website.

APPENDIX II-B: DETAILED MAPPING OF KNOWLEDGE MODULES AND LEARNING OUTCOMES TO PM-1

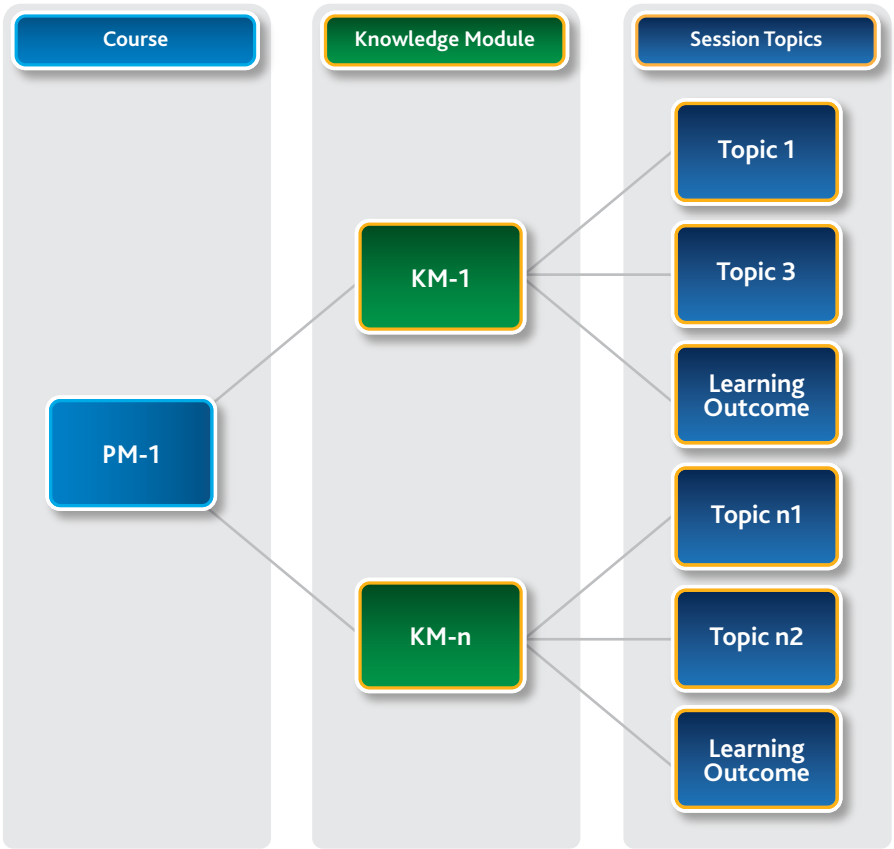


Figure II-B-1: Mapping course to knowledge modules

B-1 Coverage Metrics

The knowledge modules (KMs) were detailed in Appendix I-A of Volume I. The coverage metrics for the KMs are defined as follows:

I: Introduction

Concepts are defined, and an introduction to the concepts is provided.

Example in PM-1:

Project phases and processes are defined and the implications discussed in comprehensive detail in PM-1. In a future course, not much further definition than a refresher of the concepts should be required. For example, future courses can assume that the student is thoroughly familiar with all aspects of the definition of a “process.”

However, this does not imply coverage of the details of subtopics, such as all inputs and outputs associated with a particular process.

As a second example, agile approaches to project management might be discussed, but only to clarify the distinction between traditional and agile approaches. Specifically, the topics included in KM-28, Agile Approaches to Project Management, would not be covered (e.g., agile frameworks, hybrid life cycles, and metrics for agile approaches to project management).

F: Fraction

A fraction of the KM concepts are covered in detail with cases and homework assignments. For the topics that are covered, the coverage is in enough detail that it prepares the student for the advanced level.

The LOs for this KM are completely satisfied for the topics covered.

Example in PM-1:

PM-1 covers almost half of the subtopics in KM-7, Opportunity and Risk Management. The following topics are covered in detail with the LOs being satisfied:

- Creating risk management plan
- Identifying risks and opportunities
- Sources of risk
- Qualitative risk analysis

However, it is not expected that the following topics from KM-7 be covered in

PM-1:

- Simulation tools to quantify risks
- Roles and responsibilities in risk management, including the role of the project manager
- Organizational structure for risk management
- Establishing a risk-response plan
- Managing treatment of risks, including addressing secondary or residual risks

C: Complete

The concept is covered in detail with cases and homework assignments. The coverage is in enough detail that it prepares the student for advanced-level courses.

The LOs for this KM are completely satisfied.

The topic is completely covered, and no further courses need elaborate on the topic.

The LOs for this KM are completely satisfied.

Example in PM-1:

The network diagram is covered leading to the critical path, which is analyzed in detail with examples, cases, class discussions, and homework assignments. The concept of the critical path is covered in enough detail that future courses could cover topics such as advanced earned value analysis.

A: Advanced

The topic is covered to a degree that approaches state-of-the-art research on the subject.
 The LOs for this KM are completely satisfied.

Example in PM-1:

No topics in PM-1 are covered to this level of detail.

X: Not Covered

The topic is not covered in the course.

Example in PM-1:

Legal issues are not covered in PM-1.

B-2 Detailed Mapping of Knowledge Modules for PM-1

In Table II-B-1, the KMs are cross-referenced to the course PM-1: Foundations of Project Management. The table lists all of the KMs and shows which are included in PM-1, and to what level of detail. The coverage metrics defined in the previous section are listed in the second column.

Since not all subtopics in a KM are covered in PM-1, the coverage metric applies to the majority of the KM. Therefore, the third column notes if a significant portion of a topic of the KM is not intended to be covered in the course.

Discussion

KM-2, Project Phases and Processes, includes considerable detail, such as key process groups and knowledge areas, international standards, primary inputs and outputs associated with processes, and mapping of process groups to subject areas. These are unlikely to be covered in detail in the foundational course. Therefore, this KM is indicated as “I,” which means that the topics would be introduced, defined, and explained.

On the other hand, most of the topics in KM-6, Project Scheduling, can be expected to be covered in detail. Students should emerge from a foundational course with a practical knowledge of creating a network, identifying the critical path, and analyzing and optimizing the schedule. The details of earned value would be assigned to a future course, PM-2: Project Communications.

Table II-B-1: The relation between all of the KMs and the topics in PM-1

Knowledge Module	Coverage	Sub-Topic Exceptions
Technical Knowledge Modules		
1. Project Management Principles [T-PM]	C	
2. Project Phases and Processes [T-PP]	I	
3. Project Planning and Integration [T-PI]	C	
4. Project Resource Management [T-PR]	X	
5. Estimating Costs [T-EC]	F	Improve estimating process. Project costs: direct and indirect. Costs and other expenses. Contingency planning for time and cost estimates. Estimating project duration and staffing. Managing changes to time and cost.
6. Project Scheduling [T-PS]	F	Advanced scheduling topics, such as earned schedule, schedule buffers, cost, and schedule contingencies, are not included.
7. Opportunity and Risk Management [T-OR]	F	Simulation tools to quantify risks Roles and responsibilities in risk management, including the role of the project manager. Organizational structure for risk management. Establishing a risk-response plan. Managing treatment of risks, including addressing secondary or residual risks.
8. Plan and Control Quality [T-PQ]	I	
9. Procurement and Contract Management [T-PC]	I	
10. Finance and Cost Budgeting [T-FC]	X	
11. Project Scope Management [T-SM]	I	
12. Project Control [T-CP]	I	
13. Business Analysis & Requirements Management [T-BR]	I	
14. Project Handover, Closeout, and Reviews [T-HC]	I	
15. PM Information Systems and Information Management [T-IS]	I	
Behavioral Knowledge Modules		
1. Plan, Distribute, and Manage Project Communications [B-DC]	F	This KM focuses on communications models, tools, and techniques. The only aspect of communications in PM-1 is stakeholder communication.
2. Project Team Building and Motivating [B-TB]	X	
3. Project Leadership [B-PL]	X	
4. Identifying and Engaging Stakeholders [B-SE]	I	
5. Project Organization and Context [B-OC]	X	
6. Managing Global Projects [B-GP]	X	
7. Virtual Project Management [B-VP]	I	
8. Ethics and Professionalism [B-EP]	F	Ethical issues involving compensation, conflicts of interest, procurement. Exploring ethical situations including whistle-blowing. Green project management issues including sustainability. Professional growth of the project manager and project team.
Strategic Knowledge Modules		
1. Strategic Project Management [S-SM]	I	
2. Supply Chain in Projects [S-SC]	X	
3. Legal Aspects in Project Management [S-LA]	X	
4. Business and Commercial Aspects of Projects [S-BC]	X	
5. Governance in Projects [S-GV]	X	
6. Agile Approaches to Project Management [S-AM]	I	
7. Portfolio and Program Management Principles [S-PP]	X	

For those KMs that have significant coverage included in PM-1 [KM-1 (C), KM-3 (C), and KM-6 (F)], Table II-B-2 provides a detailed breakdown of their coverage.

Table II-B-2: The relation between the KMs that are covered in PM-1 and coverage of its subtopics

Knowledge Module	Coverage	Topics	Week
1. Project Management Principles	C	1.1. Core concepts: prerequisites for a project (business case) and projects, PM, and the role of the project manager	1, 2
		1.2. Benefits of PM	1
		1.3. Projects and their environment	2
		1.4. Organizational strategy and opportunities	1
		1.5. Projects, strategy, and project alignment	1
		1.6. Project organizational structures and governance	1
		1.7. Project portfolios and project selection	2
		1.8. Competencies of project personnel	
		1.9. Project constraints: types, interdependency, and balance	3, 4
		1.10. Project initiation: opportunity evaluation, sponsors, stakeholders and strategy, and chartering a project	3
3. Project Planning and Integration	C	3.1 Identifying requirements and producing the scope and specification	4
		3.2 Creating a WBS	5
		3.3 Estimating activity duration	6
		3.4 Constructing a network of project activities and identifying the critical path	8, 9
		3.5 Identifying and scheduling resources	9
		3.6 Optimizing the allocation of resources: smoothing and leveling	9
		3.7 Developing a project schedule and optimizing it to accommodate project constraints	9
		3.8 Creating a project plan and bringing together all subsidiary planning documents	3
		3.9 Understanding the role of project manager as an integrator	1
		3.10 Integration of processes and their role in defining, planning, executing, controlling, and closing a project	1
6. Project Scheduling	F	6.1 Creating networks, estimating durations, and analyzing the critical path	8
		6.2 Estimating, analyzing, and managing the schedule, using the critical path method (CPM), critical chain, and PERT.	8
		6.3 Optimizing the schedule and assessing the impact on resources and costs—crashing and fast-tracking	8
		6.4 Managing schedule variance using earned value analyses, and optimizing schedule performance using corrective options and actions	X
		6.5 Estimating schedule contingencies, schedule buffers, and management reserves	X
		6.6 Understanding schedule management approaches and tactics to keep projects on schedule	X
		6.7 Schedule and cost integration	X

The mapping of the LOs associated with the KMs to be covered in PM-1 is shown in Table II-B-3. For those KMs that have significant coverage included in PM-1 [(KM-1 (C), KM-3 (C), and KM-6 (F))], Table II-B-2 provides a detailed breakdown of the LOs that apply.

Table II-B-3: The learning outcomes associated with the KMs that are covered in PM-1 and the sessions in which they are covered

Knowledge Module	Coverage	Learning Outcome	Session
1. Project Management Principles	C	1.1. Describe the importance of PM in the context of various organizational cultures and strategies, and summarize the typical components of the PM system and the processes that are considered essential to any project.	1, 2
		1.2. Evaluate factors important to project selection and prioritization as evidenced by organizational capability and available resource capacity.	1, 2
		1.3. Select and describe an appropriate project management strategy for a new project that can meet stakeholder expectations in a given organizational context.	2

Knowledge Module	Coverage	Learning Outcome	Session
3. Project Planning and Integration	C	3.1 Given an organizational context and project objectives, develop a project charter and a preliminary scope that document high-level project strategy, milestones, deliverables, and estimates for stakeholder, customer, and sponsor approval.	8
		3.2 Develop a PM plan that documents the actions necessary to define and coordinate activities, assess project deliverables, and ensure control and management of costs, schedule, and changes to the project.	3, 8
		3.3 Describe the interaction of the various components of the PM system, and give examples of how changes in one component can impact how project managers adjust activities, coordinate responses, and communicate the results to stakeholders.	9
6. Project Scheduling	F	6.1 Define commonly used approaches for the analysis and management of project schedules, including CPM, critical chain, and PERT.	8
		6.2 Given a project plan and a schedule, apply one or more specific techniques to analyze the schedule, and identify and describe issues and risks that could impact the schedule.	11
		6.3 Use tools and techniques, such as fast-tracking, crashing, and resource leveling implemented in typical PM software, to determine if a project is on schedule.	8
		6.4 Demonstrate how to optimize a project schedule using one or more approaches.	8

APPENDIX II-C: LOCALIZATION OF PM-1

1. A 20-Week, UK-Based Course

It is worth noting that a U.K. module may extend over 20 weeks or, more likely, 24 weeks. Such a module will be the equivalent of a quarter, or even a third, of the credits for a full-time year. This would make the module equivalent to about 8 to 10 credits in the U.S. system, or about three one-semester courses. Some of the terminology and approaches have been tailored to suit local needs and tastes.

Table II-C-1: Session topics outline for a typical UK-oriented course

Session Topic	Subtopics	Typical Assessment and Activities
Projects and the project manager	Definitions and characteristics of projects Types of projects The project manager's role Internal and external environment Project structures History of project management	Identify projects in the student's experience. Review case study of historical project.
Project life cycle	Project and product life cycles PM processes	Define project processes and product and project life cycles. Select appropriate life cycle for a given scenario.
Project environment	The Project Management Office Rationale and business case Mission, goals and strategy Portfolio management Financial analysis	Give examples of mismatches between projects and company missions. Perform an NPV analysis for a project.
Project selection	Project selection models Payback periods Return on investment (ROI) Net present value (NPV)	Select and justify an appropriate model. Make simple investment calculation. Make simple return calculation.
Project initiation	Project definition Project initiation document (PID) The PM plan The triple constraints	Write a project initiation document.

Session Topic	Sub-Topics	Typical Assessment and Activities
Scope	Scope definition Project justification The specification Constraints, limits, assumptions, and technical requirements Statement of work (SOW) Priority matrix Scope change control	Write a scope definition.
The WBS	WBS structure PBS, OBS, CBS WBS dictionary Graphical vs. outline format Work packages Control accounts	Write a WBS.
Cost estimation	To-down and bottom-up Types of estimates and accuracies Parametric estimates Budget, contingencies, and reserves	Write a cost estimate.
Stakeholder engagement and communications	Identify stakeholders Stakeholder expectations Stakeholder maps Communications tools	Create the stakeholder list and document their influence for a project. Create a communication matrix.
The network and the critical path	Forward and backward passes Dependencies Slack and critical path Assigning resources Milestones Lags, leads, and loops	Analyze sample network diagrams.
Resource allocation	Managing resources Resource loading Resource smoothing Time-limited scheduling Resource-limited scheduling Reducing project resources	Create resource histogram. Conduct resource-level smoothing. Determine resource requirements for a project.
Earned value Management	Planned value, earned value, and actual cost Cost and schedule performance indices Cost and schedule analyses	Carry out an earned-value analysis using real-world data.
Risk analysis	Positive and negative risks Opportunities Risk strategies Qualitative risk analyses Program evaluation and review Technique Cost contingencies and reserves Schedule buffers	Perform a qualitative risk analysis for a project.
Quality	Quality standards Quality plans Cause-and-effect diagrams Audits Continuous improvement	Create a quality plan. Identify quality metrics to control quality. Construct a cause-and- effect diagram.
Procurement	Contract types and risks Incentive and award fees Procurement models	Recommend contract types to specific situations. Calculate the incentive fee for a contract.
Ethics	Ethics and professional responsibility Ethical case studies	Give example of personal ethical issues that could apply to projects.
Working in teams	Project teams Benefits of working in teams Team charter Team building	Develop a team charter. Identify benefits of working in teams.

Session Topic	Subtopics	Typical Assessment and Activities
Project closure	Handover Project termination Project closeout Lessons learned	Write a lessons-learned report.
Project success and failure	Project success Project failure Improving project performance Project maturity models	Identify the performance of a project. Devise a maturity reading.
Change management	Dealing with change Change and projects Overcoming resistance	Write a change management plan.
Presentation of students' final projects	Potential for student presentations reflecting lessons learned or research topic.	Final projects Lessons learned Research project
Final examination	If terms allow, additional weeks could incorporate a revision session prior to the examination.	

2. Arabian Gulf Region

Industry and Academic Domain

Most of the students hope to work on publicly funded, large government funded projects. These project managers will have to deal with very specific issues, such as:

- The projects are large and diverse, covering construction, infrastructure, and manufacturing plants.
- The workforce is diverse, coming from many countries, with elaborate labor-related issues. Therefore, the course puts considerable emphasis on management of stakeholders, communications, and human resources.
- These project managers will most likely have a support staff that will perform the detailed cost and scheduling. The PMs will concentrate on higher level issues, and, as a result, the course places considerable emphasis on programs and governance.
- The projects will be executed by external entities, so there is a strong focus on contractual issues as well as measuring and assuring quality.

If suitable examples are used, the proposed outline with some adjustments can also suit students from non-engineering disciplines.

Profile of Typical Students

A typical class may have mix of students from different disciplines, but the majority are likely to be engineering undergraduates. Items with (*) may be skipped for a non-engineering undergraduate class or substituted with other topics.

Table II-C-2: PM-1 localized for implementation in the Arabian Gulf Region

Session Topic	Subtopics	Typical Assessment and Activities
Projects, project management, and the project manager	Importance of project management The project manager's role Project context: internal and external environment Project structures: functional, matrix, projectized Project-delivery systems: BOT, EPC, etc. Project and product life cycles PM processes Knowledge and subject areas	Identify projects in the student's experience. Define project processes and product and project life cycles.
Project environment	Project governance: the project management office, sponsorship Project selection Rationale and business case Mission, goals, and strategy: organization and projects Program and portfolio management	Give examples of mismatches between projects and organizational strategies. Perform an NPV analysis for a project.
Project initiation and the charter	The charter: major assumptions and constraints Project management plan Influential stakeholders	Write a charter.
Scope	Project goals and objectives Definition of project scope (i.e., what needs to be done?) Requirements elicitation and acceptance Definition of project scope: goals, assumptions, constraints, priorities, requirements, in-scope vs. out-of-scope Scope validation and verification Specification and design Constraints, limits, assumptions, and technical requirements Statement of work (SOW) Change management, change control, and change control boards (CCB) Scope creep and gold plating Project deliverables	Write a scope.
Work breakdown structure (WBS)	Decomposition of scope Benefits of using WBS WBS structure, dictionary, formats (chart, tabular, and free formats (mind-map); graphical vs. outline) Work packages Design of WBS Relationship of WBS to other processes Control accounts*	Develop a WBS.
Scheduling	Creating a network from a WBS Dependencies (mandatory, discretionary) Forward and backward pass Slack and critical path Assigning resources Lags, leads, and loops Creating a schedule Optimizing a schedule Milestones and deliverables Monitoring and tracking the schedule	Analyze sample network diagrams. Possible theme (non-engineering): Plan a vacation to a country you have not visited before during the summer/winter. List and label the activities and make a network diagram. Prepare different scenarios around the constraints and identify the total duration of your trip for each scenario. You should plan to visit as many places as possible, spend no more than US\$3,000 per person, and be back a week before the fall/spring semester.
Cost	Cost elements (labor, material, variable cost) Types of cost (such as direct, indirect, fixed, variable) Estimating: top-down and bottom-up Types of estimates and accuracies Estimating techniques (analogous, parametric, three-point method) Contingencies and management reserves Budget (creation): time-phased budget Negotiating and communicating: risks, budget, changes Monitoring and tracking the cost	Write cost estimates for a sample project.

Session Topic	Subtopics	Typical Assessment and Activities
Stakeholder engagement	Identify stakeholders Classification and analysis: interest, influence, and impact Stakeholder buy-in and engagement strategy Manage stakeholder expectations Customer value proposition as a stakeholder	Create the stakeholder list and document their influence in a project.
Communication	Communication models Communication plan Communication skills and tools, RAM Types of reports Meetings (kickoff, team, milestone, gate, status-update, virtual)	Create a communication matrix.
Human resources	Organizational structures Geographical structure, by product, etc. Basics of team organization Select team, build and manage, feedback, coaching Leadership, decision making, and motivation Resolving conflicts Labor regulations*	
Software tools for scheduling and cost	What's available Advantages and intelligent use Limitations of the software tool Scheduling tools Cost-estimation and budgeting tools Tutorial for a cost/schedule tool	Implementation of capstone project in a software tool Create Gantt chart. Manage resources. Possible theme (non-engineering): Create a project plan of your travel project using MS Project. The plan should show all the activities on your planned dates, the individuals responsible for carrying them out, and the costs involved. Include all possible scenarios and display a dashboard report to show project overview.
Earned value	Establishing the measurement of planned vs. actual S-curves and cumulative values Planned value, earned value, and actual cost Cost and schedule performance indices Variances, interpretation, estimates at completion, cost, and schedule analyses	Carry out an earned-value analysis using real-world data.
Risk and opportunity	Uncertainty Positive risks (beneficial) and negative (threats or detrimental) Risk management strategies and analyses Analytical techniques Project contingencies and reserves Schedule buffers	Perform a qualitative risk analysis for a project.
Quality	Quality planning Metrics for quality Quality planning and control tools Continuous improvement Quality standards	Create a quality plan. Identify quality metrics to control quality. Construct a cause-and-effect diagram.
Procurement	Types of procurement (make or buy) and associated risks, liability Definition of a contract and legal responsibilities Authorized representatives, public vs. private tenders, partnerships and collaborations Overview of contract types: incentive and award fees (and damages), FFP, CPFF, CPIF, T&M, BPO, BOT, and associated risks Contract management* Alternate dispute resolution (ADR): negotiation, mitigation, arbitration, and litigation Nonfinancial issues and risks (brand, reputation, etc.)	Recommend contract types to specific situations. Calculate the incentive fee for a contract. Possible theme (non-engineering): Plan an online side business selling a product like flowers, t-shirts, or toys. Investigate the entire supply chain and list sources, types of contracts, and associated costs and risks.

Session Topic	Subtopics	Typical Assessment and Activities
Ethics	Definitions, concepts, and theories Ethics and cultural issues Personal, professional, corporate, and societal ethics and differences Team members' views and cultural issues Ethical influences: colleagues, family, society, influence on decision making Scenarios of ethical problem solving (project managers and participants) Ethics and professional responsibility Code of ethics (PMI, professional, etc.) Legal aspects Ethics case studies	Give example of personal ethical issues that could apply to projects.
Final projects	Presentation of project plans: deliverables, lessons learned Examination of key deliverables	Final projects and assessments Lessons learned
Final examination		

Customer-Centric Project Management

Purpose

There are several topics that are emerging from both research and industry practice that changes the focus of the way a project might be developed. Once such topic is a customer-centric approach in which the emphasis is on the customer as the focal point. Therefore, the instructor creates a sense of urgency in project teams to focus on the customer. There are a number of impacts that such an approach might have:

- Create learning outcomes in the knowledge modules that emphasize the customer interactions.
- Define and utilize the term “customer” as it specifically applies in different industries (e.g., the patient is the customer in healthcare, the student is the customer in education, etc.).
- Recognize that there are both internal and external customers on the project.

Customer-Centric Topics

The following are recommended for the development of a customer-centric PM-1 course.

- Adapt the KM learning outcomes to emphasize a customer-centric approach.
- Include aspects of the Project Stakeholder Engagement knowledge module that emphasize customer engagement.
- Focus on customer analysis, including the categorization and stratification of key customers based on their impact and influence, and engage key customers in the feedback loop.
- Establish a customer value proposition that defines key customer benefits resulting from the project.
- Identify issues from a customer perspective (e.g., risks, quality, cost, and schedule).
- Create a customer communication plan, including project team expectations.

Table II-C-3: PM-1 localized for customer-centric PM

Session Topic	Subtopics	Typical Assessment and Activities
Projects, project management, and the project manager	Definitions Importance of project management The project manager's role Importance of the customer <i>De-emphasize:</i> <i>Project context, project structures (functional, matrix, projectized)</i> <i>Project-delivery system: design, build, BOT, etc., project and product life cycles, PM processes, knowledge and subject areas</i>	1. Identify projects in the student's experience. 2. Define project processes and product and project life cycles.
Project environment	Project governance: the project Mission, goals, and strategy: organization and projects <i>De-emphasize:</i> <i>Program and portfolio management</i> <i>Management office, sponsorship</i> <i>Project selection</i> <i>Rationale and business case</i>	3. Give examples of mismatches between projects and company missions. 4. Perform an NPV analysis for a project.
Project initiation and the charter	The charter, major assumptions, and constraints Project management plan Influential stakeholders Customers as stakeholders	5. Write a charter.
Scope	Project goals and objectives Project scope Requirements elicitation and acceptance, customers Statement of work (SOW) Change management and scope creep Project deliverables	6. Write a scope.
Work breakdown structure (WBS)	Decomposition of scope WBS and its benefits	7. Write a WBS.
Scheduling	Creating a network from a WBS Forward and backward pass Slack and critical path Optimizing a schedule Milestones and deliverables	8. Analyze sample network diagrams.
Cost	Estimating: top-down and bottom-up - Types of estimates and accuracies - Estimating techniques (analogous, parametric, three-point method) Contingencies and management reserves Budget (creation): time-phased budget Negotiating & Communicating: risks, budget, changes	9. Write a cost estimate.
Stakeholder engagement	Identify stakeholders Classification Analysis: interest, influence, and impact Stakeholder buy-in and engagement strategy Manage stakeholder expectations Customer value proposition as a stakeholder <i>This may be moved earlier to emphasize the role of the customer.</i>	10. Create the stakeholder list and document their influence in a project. 11. Create a communication matrix.

Session Topic	Subtopics	Typical Assessment and Activities
Communication	Communication model and skills Communication plan Communications tools - Matrix, RAM - Types of reports Meetings (kickoff, team, milestone, gate, status-update, virtual)	
Human resources	Organizational structures • By geography, by product, etc. • Basics of team organization • Select, build, manage team • Feedback, coaching, etc. • Making decisions • Leadership and motivation • Resolving conflicts * Labor regulations	
Software tools for scheduling and cost	What's available Advantages, intelligent use, and limitations Scheduling tools Cost-estimation and budgeting tools Tutorial for a cost/schedule tool Implementation of final project using software tool	12. Implement a project using an automated software tool. 13. Create Gantt chart. 14. Manage resources.
Earned value	Establishing the measurement of planned vs. actual Planned value, earned value, and actual cost Cost and schedule performance indices Variances and interpretation Estimates at completion Cost and schedule analyses	15. Carry out an earned value analysis using real-world data.
Risk and opportunity	Positive risks (beneficial) and negative (threats or detrimental) Risk management strategies Risk analyses Analytical techniques Project contingencies and reserves Schedule buffers	16. Perform a qualitative risk analysis for a project.
Quality	Quality planning Customer metrics for quality Quality planning and control tools Continuous improvement	17. Create a quality plan. 18. Identify quality metrics to control quality. 19. Construct a cause-and-effect diagram.
Procurement	Types of procurement (make or buy) Liability, contract, and legal responsibilities Authorized representatives Overview of procurement types and associated risks • Incentive and award fees • FFP, CPFF, CPIF, T&M, BPO, BOT, and associated risks Contract management • Alternate dispute resolution (ADR) • Negotiation, mitigation, arbitration, litigation, exit clauses • Nonfinancial risks (brand, reputation)	20. Recommend contract types to specific situations. 21. Calculate the incentive fee for a contract.
Ethics	Definitions, concepts, and theories Ethics and cultural issues Personal ethics, professional ethics, corporate ethics, societal ethics Scenarios of ethical problem solving (ethical considerations for project managers and participants) Ethics and professional responsibility • Codes of ethics (PMI, professional, etc.) Legal aspects Ethics case studies	22. Give an example of personal ethical issues that could apply to projects.

Session Topic	Subtopics	Typical Assessment and Activities
Presentation of students' final projects	Potential for student presentations reflecting lessons learned or research topic	Final projects Lessons learned Research project
Final examination	If terms allow, additional weeks could incorporate a revision session prior to the examination.	

Localization: Germany

Industry and Academic Domain

The students typically come from a wide variety of disciplines, such as engineering (mechanical, construction, IT), mathematics, and business.

Type of Undergraduate Student

In Germany, undergraduate students are about 17 to 19 years old and will have no or very limited (e.g., summer internship) work experience. The academic year at most German universities consists of two semesters: winter (October to March) and summer (April to September).

There are two types of universities: traditional academic universities and universities of applied sciences. Students in the latter institutions spend about half their university education (i.e., 1.5 years out of a three-year course) working at a company that sponsors their education.

The backgrounds of the students attending a PM-1 course will include some fundamental courses in their major subjects (e.g., engineering, mathematics, business). They would probably take a PM-1 course at the end of their first year or during their second year. All of the students will be resident and full time.

Most of the students will go on to do a master's degree immediately after their bachelor's degree, so a certain percentage of the PM-1 audience will be master's students in their fourth or fifth year. Therefore, the audience for PM-1 may be quite heterogeneous, with a diversity of course backgrounds and year groups. Courses are typically held in classrooms with only marginal aspects of homework and group work delivered via digital learning platforms.

The typical class size is not limited and so can be anywhere from 80 to 240 students. An individual exam counts for 100% of the grade. Topics from PM-1 that would typically not be covered in Germany include: ethics, charter, and procurement.

Table II-C-4: PM-1 localization for Germany for bachelor of science students in years 1, 2, 3, and 4

Week	Lecture (1.5 hr.)	Tutorial (1.5 hr.)
1	Projects and the project manager	Exercise
2	Project environment	
3	Stakeholders	
4	Project selection	Case
5	Project organization and plan	
6	Cost	
7	Resources	Paper
8	Time	
9	Execution and performance control	
10	Risk	
11	Quality	
12	Change control	
13	Closing and termination	
14	Knowledge management	
15	Revision and practice for exam	

Localization: Canada

Industry and Academic Domain: Construction

Students are a blend of working professionals, high-school graduates, and full-time, part-time, and international students. Typically, 60% are mature working professionals, and 40% are high school graduates, both local and international.

Students demonstrate competencies in the entire project management domain, both soft skills and technical skills. This is a formative assessment based on numerous mini field case studies throughout the term. The rationale for this approach is that students get the opportunity to learn from hands-on (applied) approaches, which is our institutional focus (training career-ready graduates). These assessments directly address program-level outcomes and competencies: communications, critical thinking, teamwork, leadership, project management, and research. Students also get an opportunity to connect with and learn from industry professionals.

In Table II-D-5, all of the mini case studies will form parts of a major final project.

Type of Undergraduate Student

Students in construction typically have good mathematics skills, and the topics of NPV, scheduling, earned value, and so forth can be taught in detail. The typical class size is 32 students.

Table II-C-5: Localization of PM-1 for Canada and with a construction focus

Topic	Subtopics	Typical Assessment and Activities
WEEK 1: Projects, project management, and the project manager	Definitions and importance of PM The project manager's role Project context: internal and external environment Project structures: functional, matrix, projectized PM processes Knowledge and subject areas <i>Overview only: Project-delivery systems: design and build, BOT, project and product life cycles</i>	Identify projects and project types. Provide a brief overview of project management and examples of the best-managed projects in the local area. Define project processes and product and project life cycles. Mini case study: Select a project and identify who the stakeholders are/were and how the project team was developed.
WEEK 2: Project environment	Project governance: the project management office, sponsorship Project selection Rationale and business case Mission, goals, and strategy: organization and projects Program and portfolio management	Give examples of mismatches between projects and company missions. Perform an NPV analysis for a project. Distinguish between program and portfolio management by providing local industry examples. Select two projects (one small scale and one large scale) and discuss the criteria for project selection. Mini case study
WEEK 3: Project initiation and the charter	The charter Major assumptions and constraints Project management plan Influential stakeholders	Write a project charter Mini case study
WEEK 4: Scope	Project goals and objectives Definition of project scope Academic domain-specific outcomes Requirements elicitation and acceptance Definition of project scope, goals Assumptions, constraints, priorities, requirements, in-scope vs. out-of-scope, validation, and verification Specification and design Constraints, limits, assumptions, and technical requirements Statement of work (SOW) <i>A brief overview of change management to set the foundation for a full-fledged course to follow later</i>	What is the significance of a comprehensive project scope in the context of effective project and cost management? Identify the project phase when a change management system should be implemented, and explain why. Mini case study

Topic	Sub-Topics	Typical Assessment and Activities
WEEK 5: Work breakdown structure (WBS) <i>Brief overview; this topic to be covered in detail in subsequent courses</i>	Decomposition of scope Benefits of using WBS WBS structure WBS dictionary WBS formats: chart, tabular, and free formats (mind map); graphical vs. outline Work packages Design of WBS Relationship of WBS to other processes * Control accounts	Write a WBS. Select a project WBS from local industry projects and explain the WBS to peers in a classroom arrangement.
WEEK 6: 1) Scheduling 2) Software tools for scheduling <i>Brief overview; this topic to be covered in detail in subsequent courses</i>	Creating a network from a WBS Dependencies (mandatory, discretionary) Forward and backward pass Slack and critical path Assigning resources Lags, leads, and loops Creating a schedule Optimizing a schedule Milestones and deliverables What's available: advantages, intelligent use; limitations of the software tool Scheduling tools Cost-estimation and budgeting tools Tutorial for a cost/schedule tool Implementation of capstone project in software tool	Analyze sample network diagrams. Present a local industry project schedule as planned and as completed. Identify the most commonly used software tools in the local industry, and their major differences/benefits. <i>Also consider here or in a future course:</i> Implement a project using an automated software tool. Create Gantt chart. Manage resources.
WEEK 7: Cost estimation <i>This will be the focus of an entire cost-estimation course.</i>	Cost elements (labor, material, variable cost) Types of cost (such as direct, indirect, fixed, variable) Estimating: top-down and bottom-up Types of estimates and accuracies Estimating techniques (analogous, parametric, three-point method) Contingencies and management reserves Budget (creation): time-phased budget Negotiating and communicating: risks, budget, changes	Identify different types of project costs, and correlate the types with project phases. Mini case study
WEEK 8: Stakeholder engagement	Identify stakeholders Classification Analysis: interest, influence, and impact Stakeholder buy-in and engagement strategy Manage stakeholder expectations Customer value proposition as a stakeholder	Create the stakeholder list and document their influence in the project. Create a communication matrix. Mini case study
WEEK 9: Communication	Communication models and skills Communication plan Communications tools: matrix, RAM Types of reports Meetings (kickoff, team, milestone, gate, status-update, virtual)	Develop a communication plan for a small project team, and identify how it would differ from a communication plan for a medium/large project team environment (including teams stationed globally). Mini case study
WEEK 10: Human resources	Organizational structures Geographical structure, by product, etc. Basics of team organization Select team, build team, manage team Feedback, coaching, etc. Making decisions and leadership Motivation Resolving conflicts * Labor regulations	Identify different leadership styles and explain which ones are more relevant to construction industry projects. Discuss the issues of motivation in project teams in a multicultural global project environment. Mini case study
WEEK 11: Earned value	Establishing the measurement of planned vs. actual S-curves and cumulative values Planned value, earned value, and actual cost Cost and schedule performance indices Variances Interpretation Estimates at completion Cost and schedule analyses	Carry out an earned-value analysis using real-world data.

Topic	Subtopics	Typical Assessment and Activities
WEEK 12: Risk and opportunity <i>Overview, because this will be the focus of an entire risk course</i>	Uncertainty Positive risks (beneficial) and negative (threats or detrimental) Risk management strategies Risk analyses Analytical techniques Project contingencies and reserves Schedule buffers	Identify major strategies for risk management in the construction industry. <i>A qualitative risk analysis will be done in the risk course.</i>
Week 13: Quality <i>Overview, because this will be the focus of an entire quality course</i>	Quality planning Metrics for quality Quality planning and control tools Continuous improvement * Quality standards	<i>Create a project quality plan.</i> Identify quality metrics to control project quality. Construct a cause-and-effect diagram for a project.
WEEK 14 Procurement <i>Overview, because this will be the focus of an entire contracts and procurement course</i>	Overview of contract types and associated risks; incentive and award fees Public vs. private tenders, partnerships and collaborations, offshore FFP, CPFF, CPIF, T&M, BPO, BOT Contract management, liability and legal responsibilities, exit clauses Alternate dispute resolution (ADR) Negotiation, mitigation, arbitration, litigation Nonfinancial risks (brand, reputation)	Identify different contract types and recommend contract types to specific situations.
WEEK 15: Ethics <i>Brief overview: sets the foundation for a full course called Ethics and Professionalism.</i>	Definitions, concepts, and theories Ethics and cultural issues Personal ethics, professional ethics, corporate ethics, societal ethics The difference between approaches Team members' different views Cultural issues and ethical influences: colleagues, family, society Influence on decision making Scenarios of ethical problem solving Ethics and professional responsibility, code of ethics (PMI, professional codes of ethics, etc.) Legal aspects Ethics case studies	Give an example of personal ethical issues that could apply to projects. Select an international or global project (could be any published case study) and discuss ethics and professionalism expectations.
WEEK 16: Presentation of students' final projects	Potential for student presentations reflecting lessons learned or research topic	Final projects Lessons learned Research project
Final examination	If terms allow, additional weeks could incorporate a revision session prior to the examination.	

Localization: Healthcare

This is a person-centric sector and, therefore, the social aspect is a priority and the order of topics can be changed dependent on the faculty focus.

The context will vary based on whether the course addresses a patient-care situation, and whether the situation is delivering, managing, or procuring for the patient care. Variations will also occur, depending on the environment: station nurses, emergency room, laboratory, or pharmacy. Beyond patient care, the issue of research will reorder priorities and depend on whether the research is medical, animal, or phase 1, 2, 3, or 4 drug development. The following curriculum was developed to emphasize face-to-face patient care.

There will be differences between PM in clinical research, which will be patient-centered, and PM in new drug development, which may be approached as a standard project to deliver hypotheses. Standard research could also fit under new product development but will depend on the nature of the research (e.g., drug related). Social science research is another healthcare context, but with a slightly different emphasis. Educational healthcare will be different, as it will focus on students.

Table II-C-7: PM-1 localization for healthcare

Lecture Hrs.	Session Topic	Subtopics	Typical Assessment and Activities
2	Projects, project management, and the project manager	Definitions Importance of project management The project manager's role Project context: internal and external environment Project structures: functional, matrix, projectized Delivery systems: design, build, BOT Project and product life cycles PM processes Knowledge and subject areas	1. Identify projects in the student's experience. 2. Define project processes and product and project life cycles.
3	Project environment	Project governance and the project management office, sponsorship Project selection Rationale and business case Mission, goals, and strategy: organization and projects Program and portfolio management	3. Give examples of mismatches between projects and company missions. 4. Perform an NPV analysis for a project.
3	Project initiation and the charter	The charter Major assumptions and constraints Project management plan Influential stakeholders	5. Write a charter.
2	Scope	Project goals and objectives Definition of project scope: academic domain-specific outcomes (i.e., product, process, length of code) Requirements elicitation and acceptance Goals, assumptions, constraints, priorities, requirements, in-scope vs. out-of-scope, validation and verification Specification and design Statement of work (SOW) Change management, change control, and change control boards (CCB) Scope creep and gold plating Project deliverables	6. Write a scope.
3	Ethics	Definitions, concepts, and theories Ethics and cultural issues Personal, professional, corporate, and societal ethics Difference between approaches, team members, and cultural issues Ethical influences: colleagues, family, society, and influence on decision making Scenarios of ethical problem solving (ethical considerations for project managers and participants) Ethics and professional responsibility Code of ethics (PMI, professional codes of ethics, etc.) Legal aspects Ethics case studies	22. Give an example of personal ethical issues that could apply to projects.

Lecture Hrs.	Session Topic	Subtopics	Typical Assessment and Activities
3	Stakeholder engagement	Identify stakeholders Classification and analysis: interest, influence, and impact; buy-in and engagement strategy Manage stakeholder expectations Customer value proposition as a stakeholder	10. Create the stakeholder list and document their influence in a project. 11. Create a communication matrix.
3	Communication	Communication models and skills Communication plan Communications tools: matrix, RAM Types of reports Meetings (kickoff, team, milestone, gate, status-update, virtual)	
3	Risk and opportunity	Uncertainty Positive risks (beneficial) and negative (threats or detrimental) Risk management strategies Risk analyses and analytical techniques Project contingencies and reserves Schedule buffers	16. Perform a qualitative risk analysis for a project.
3	Quality	Quality planning Metrics for quality Quality planning and control tools Continuous improvement * Quality standards	17. Create a quality plan. 18. Identify quality metrics to control quality. 19. Construct a cause- and-effect diagram.
1	Work breakdown structure (WBS)	Decomposition of scope Benefits of using WBS WBS structure, dictionary, formats chart, tabular, and free formats like mind map and graphical vs. outline format Work packages Design of WBS Relationship of WBS to other processes * Control accounts	7. Write a WBS.
2	Scheduling	Creating a network from a WBS Dependencies (mandatory, discretionary) Forward and backward pass Slack and critical path Assigning resources Lags, leads, and loops Creating a schedule Optimizing a schedule Milestones and deliverables	8. Analyze sample network diagrams.
2	Procurement	Types of procurement (make or buy) Definition of a contract and legal responsibilities Authorized representatives Overview of procurement types Public vs. private tenders Partnerships and collaborations Offshore Overview of contract types and associated risks and liability, legal, and exit clauses Incentive and award fees, FFP, CPFF, CPIF, T&M, BPO, BOT, and associated risks Contract management Alternate dispute resolution (ADR) Negotiation, mitigation, arbitration, litigation Nonfinancial risks (brand, reputation)	20. Recommend contract types to specific situations. 21. Calculate the incentive fee for a contract.
1	Cost	Cost elements (labor, material, variable cost), types of cost (direct, indirect, fixed, variable) Estimating: top-down and bottom-up Types of estimates and accuracies Estimating techniques (analogous, parametric, three-point method) Contingencies and management reserves Budget (creation): time-phased budget Negotiating and communicating: risks, budget, changes	9. Write a cost estimate.

Lecture Hrs.	Session Topic	Subtopics	Typical Assessment and Activities
2	Human resources	Organizational structures Geographical structure, by product, etc. Basics of team organization Select team, build team, manage team Feedback, coaching, etc. Making decisions, leadership, and motivation Resolving conflicts * Labor regulations	
2	Software tools for scheduling and cost	What's available Advantages, intelligent use Limitations of the software tool Scheduling tools Cost-estimation and budgeting tools Tutorial for a cost/schedule tool Implementation of final project in software tool	12. Implement a project using an automated software tool. 13. Create Gantt chart. 14. Manage resources.
1	Earned value	Establishing the measurement of planned vs. actual S-curves and cumulative values Planned value, earned value, and actual cost Cost and schedule performance indices Variances and interpretation Estimates at completion Cost and schedule analyses	15. Carry out an earned value analysis using real-world data.
Presentation of students' final projects	Potential for student presentations reflecting lessons learned or research topic	Final projects Lessons learned Research project	Presentation of students' final projects
Final examination	If terms allow, additional weeks could incorporate a revision session prior to the examination		Final examination

Appendix II-D: Sample Analysis Problems

Risk Analysis

Students often select a new website as a project because they think they understand websites. While they may understand websites, they usually do not have any idea about the complexities associated with a project to build them. In that case, a risk analysis is a good way to demonstrate the complexities of a project.

This section is based on the excellent article by Versa Studio called "Website Planning."² Websites are inherently flexible, so one must reconcile the need for a clear and detailed specification (the scope) with the changeable nature of the web. The key is to define a clear process, part of which is to spend time on the creation of a clear design specification. The emphasis on clarifying what is required (the content) greatly reduces the potential for mid-project crises. It is also important to take the time to create a well designed product (the design process) that will support the goals of the company, both now and in the future. The scope defines both the specification and the process and is the most important document in most projects.

Since websites change, it is essential to define a process that allows the website to grow with time. In fact, for most websites, it is clear that one needs to plan for expansion, allowing, for example, sections for news, social networking, and users' comments. This will require procedures to manage the content with the ability to swap out photos and documents; change web pages, titles, and content; and maintain growing databases. All these changes call for well-defined policies for who can make the changes.

Students frequently underestimate the importance of the specifications, and a risk analysis can clarify the issues. Common issues that need to be addressed in a good scope are:

- Discovering the true needs of the client halfway through the project results in backtracking, rewriting, extended schedules, cost overruns, and missed deadlines.
- The developer is forced to make assumptions about what the client wants, which may or may not be correct.
- Unclear specifications result in much more back-and-forth communication about trivial matters.
- When the developer makes an incorrect assumption about the content, backtracking occurs, which causes delays and missed deadlines.
- Forgotten requirements and even unclear specifications result in work outside the original scope, creating cost increases.
- A website rarely stands alone; it interacts with many other departments, such as marketing, customer management, and IT. Their needs must be included or the website will need to be redesigned to meet their requirements.
- Failing to identify important stakeholders results in an incomplete requirements specification.
- Different stakeholders have different priorities, which must be accounted for in the specification.
- Underestimating the complexity of the content results in costly delays and a poor website, which reflects poorly on the organization. Photography, audio, video, YouTube, Flash, Flickr, and RSS all need to be addressed.
- Poor writing reflects badly on the organization. What do the customers care about? How will the site avoid business-speak, confusing acronyms, and dry details? Which technical aspects will be assigned to multipage PDFs available for download?
- Reading on a screen is tiring, so the design might specify short blocks of copy and bulleted or numbered lists.
- Use a uniform style that can be applied to the entire site.
- Content in one part of the site is related to content in another. Avoiding duplication helps reduce errors, but repeating information makes the scope easier to understand.
- Collecting data (e.g., web visitor data) is a good idea, but it will need to be analyzable later. For example, collecting customer names and addresses is obvious, but the ability later on to sort by last name or zip code may require some database design work early on.

² "Web Site Project Planning, Versa Studio, [versastudio.com](http://versastudio.com/download/guide/wufoo/12669), available at: <http://versastudio.com/download/guide/wufoo/12669>.

- Should the site plan to optimize for search engine optimization (SEO)?
- Avoid committee design. While a review process is essential, allowing a committee to degrade the design will ruin the entire project. Address stakeholder comments and criticisms, but do not allow them to specify solutions—that is the designer’s job.
- Think about expansion. What happens when there are 10,000 user comments?
- Is the website to be interactive, using such things as JavaScript, jQuery, Flash? Does the organization have the technical capabilities to support these?
- Is there a defined testing process?
- Is there a process for the early users to give feedback?
- Does the site require regular backups?
- Is the website secure from hackers?

These requirements may be elicited in a class discussion. The next step is to turn these general issues into a risk assessment.

Risk Identification:

Each of the above issues can result in a risk, so we might classify them into categories of risks, as follows:

- **Failing to develop all the requirements:** Discovering the true needs late in the project; the developer makes assumptions about what the client wants; unclear specifications results in extra communication; forgotten requirements; including the needs of marketing, customer management, and IT.
- **Failing to manage stakeholders:** Failing to identify important stakeholders; not interacting with marketing, customer management, and IT; different stakeholders have different priorities.
- **Underestimating the complexity of the content:** Web objects, such as photography, audio, video, YouTube, Flash, Flickr, and RSS; assigning technical aspects to multipage PDFs; collecting analyzable data; optimize for SEO; interactive site; backups.
- **Poor Writing:** Understanding the customers’ impressions; avoiding business-speak, confusing acronyms, and dry details.
- **Poor Design:** Avoid committee design; hard-to-read small print; not using a uniform style; code is vulnerable to security attacks.
- **Poor Scope:** Content in multiple places.
- **Failing to allow for future maintenance:** Ability to sort and analyze data; massive increase in data.
- **Inadequate validation and verification:** Not obtaining early user feedback about functionality, design, and website usability.

The next step is to classify the risks, which is typically done by individually assessing the impact and likelihood of each one. To do this, the likelihood is typically defined with values between 1 and 5, where “1” might represent that the risk is “Rare, it occurs in exceptional circumstances,” “2” represents “Unlikely,” “3” represents “Possible,” “4” represents “Likely—it will probably occur in the project,” and “5” represents “Very Likely—it is expected to occur in the project.”

The impact is similarly defined with values between 1 and 5, where “1” represents “Insignificant cost/schedule impact,” “2” represents “Minor damage or loss and/or minor cost/schedule impact,” “3” represents “Moderate damage and/or significant cost/schedule impact,” “4” represents “Major damage or loss and/or extensive cost/schedule impact,” and “5” represents “Catastrophic Damage to reputation and huge financial loss with unrecoverable cost and/or schedule impact.”

Values are assigned to each of the risks in Table II-D-1.

Table II-D-1: Impact and likelihood of risks

Risk ID	Risk	Impact	Likelihood	Mitigation
1	Failing to uncover requirements	4	4	Conduct user and stakeholder workshops
2	Failing to manage stakeholders	3	4	Develop stakeholder management plan
3	Underestimating the complexity of content	3	5	Hire technical specialist to review requirements
4	Poor writing	2	4	Hire writer
5	Poor design	4	5	Contract with experienced web designer
6	Poor scope	4	3	Seek experienced PM for guidance on scope
7	No maintenance plan	3	2	Add maintenance requirements section to scope and PM plan
8	Inadequate validation, verification, and testing	2	3	Develop test criteria in scope Consider agile approach Do usability testing early

The final step is to create the risk assessment matrix, an example of which is shown in Figure II-D-1. Risks with high values of likelihood and high values of impact should be designated for further investigation.

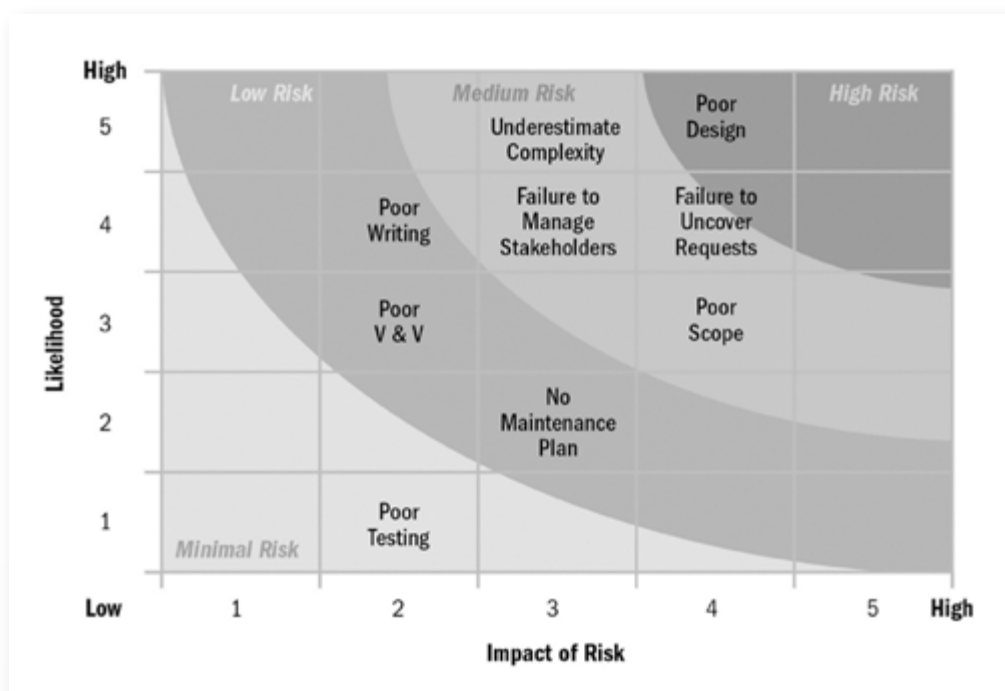


Figure II-D-1: Risk assessment matrix

Students should also consider “good risks,” which provide an opportunity to reduce costs and optimize the schedule. For example, one could research the availability of new tools or methods that could help with building the website. Tools may also provide automatic generation of quality code, which reduces errors. One could also consider subcontracting some work to a high-quality vendor to exploit their knowledge in reducing risks and improving the design.

Earned Value Road Problem

The following problem is designed to test the understanding of the students' appreciation of earned value (EV) concepts.

Problem Statement for Students

Route I93 is planned to be repaved. The entire route from the I90-I93 interchange to the Route 128/I93 interchange is 7.7 miles. The plan is for 0.77 miles to be complete each month for 10 months. The estimated cost of the entire project is US \$1,470,000.

Table II-D-2 represents the status of the project at the end of month 4:

*Table II-D-2: Sample earned value analysis problem
Currency values are in US dollars*

Month	Miles Completed		Cost		
	Planned	Earned	Planned	Actual	Earned
1	0.77	0.77	\$147,000	\$173,531	\$147,000
2	0.77	0.62	\$147,000	\$161,711	\$118,364
3	0.77	0.64	\$147,000	\$154,089	\$122,182
4	0.77	0.72	\$147,000	\$199,213	\$137,455
5	0.77				
6	0.77				
7	0.77				
8	0.77				
9	0.77				
10	0.77				

1. Calculate the cumulative planned and earned value as well as the cumulative actual costs. Calculate the CPI and SPI.
2. Plot the quantities.
3. Estimate the final cost.
4. Write a letter to the mayor, explaining the status of the project.

Rationale and Explanation of the Assignment

This is a relatively simple earned value problem, but it features many of the essential features that the students should understand.

This assignment is an excellent example of the goal of encouraging, not just analysis skills (calculation of the overrun), but of also showing students why analysis skills are important. The assignment also shows the importance of communication skills. Further, both analysis and communications are complementary and important to a PM.

Route I93 goes right through the middle of Boston, so, everyone knows the route. It is immediately and practically relevant. Faculty members can easily substitute their local highway for I93.

The "Miles Completed" data can actually be seen and measured as you drive down the highway. That is, as the improvements proceed, it is quite possible for a driver to measure the progress with little effort. Actually, it is not even necessary to get out of the car to track miles completed over time. This reinforces the idea that earned value is a measurable quantity.

The “Actual Cost” data is made up to make an interesting case.

The key assignment is “Write a letter to the mayor.” This emphasizes that the problem is not about the earned value analysis, but the communications skills. The topics to be discussed upon completion of this assignment are discussed in some detail.

Standard Answer

1. Calculate the cumulative planned and earned value, as well as the cumulative actual costs. Calculate the CPI and SPI.

The first thing the student is expected to do is to complete a table with the cumulative values for planned value (PV), earned value (EV), and actual cost (AC). A sample is given in Table II-D-3. It is important to emphasize that EV calculations are all performed using on cumulative data.

These calculations are best performed in a spreadsheet.

Table II-D-3: Cumulative values for PV, EV, and AC
Currency values are in US dollars

Month	Planned	Actual	Monthly			Cumulative		
	Miles	Miles	Planned	Earned	Actual	Planned	Earned	Actual
1	0.77	0.77	\$147,000	\$147,000	\$173,531	\$147,000	\$147,000	\$173,351
2	0.77	0.62	\$147,000	\$118,364	\$161,711	\$294,000	\$265,364	\$335,242
3	0.77	0.64	\$147,000	\$122,182	\$154,089	\$441,000	\$387,545	\$489,331
4	0.77	0.72	\$147,000	\$137,455	\$199,213	\$588,000	\$525,000	\$688,544

We use capital letters for the cumulative values and lower case for the monthly values. The cumulative PV is computed as follows:

$$PV(1) = pv(1) = 147,000$$

$$PV(2) = PV(1) + pv(2) = 147,000 + 147,000 = 294,000$$

$$PV(3) = PV(2) + pv(3) = 294,000 + 147,000 = 441,000, \text{ and so on.}$$

The next thing the student is expected to do is to compute the EV, which is the percentage of planned value that has been completed. In month #1, 0.77 miles were complete, which is 100% of the plan that was assigned to month #1. Therefore, the earned value is 100% of the plan = 147,000.

In month #2, they only completed 0.62 miles, which is $0.62/0.77 = 0.805$ of the work. Therefore, they only earn 80.5% of the planned value, which is $0.805 \times \text{US\$}147,000 = \$118,364$.

The cumulative EV is then computed in the same way as the cumulative PV:

$$EV(1) = ev(1) = 147,000$$

$$EV(2) = EV(1) + ev(2) = 147,000 + 118,364 = 265,364$$

$$EV(3) = EV(2) + ev(3) = 265,364 + 122,182 = 387,546 \text{ and so on. The cumulative AC is calculated in the same way.}$$

The next thing the student is expected to do is to compute the cost and schedule performance indices (CPI and SPI). The formulas are:

$$CPI = EV/AC \quad SPI = EV/PV$$

For example:

$$CPI(2) = 265,364/335,242 = 0.79$$

$$SPI(2) = 265,364/294,000 = 0.90$$

These calculations are completed in Table II-D-4.

Table II-D-4: CPI and SPI.
 currency values are in US dollars.

Month	Planned	Actual	Monthly			Cost			CPI	SPI
	Miles	Miles	Planned	Earned	Actual	Planned	Earned	Actual		
1	0.77	0.77	\$147,000	\$147,000	\$173,531	\$147,000	\$147,000	\$173,351	0.85	1.00
2	0.77	0.62	\$147,000	\$118,364	\$161,711	\$294,000	\$265,364	\$335,242	0.79	0.90
3	0.77	0.64	\$147,000	\$122,182	\$154,089	\$441,000	\$387,545	\$489,331	0.79	0.88
4	0.77	0.72	\$147,000	\$137,455	\$199,213	\$588,000	\$525,000	\$688,544	0.79	0.88

Students should not provide more decimal places than necessary. Two places for CPI and SPI are sufficient.

This completes the calculation portion of this assignment, which is #1.

2. Plot the quantities

The next part of the assignment is to plot the quantities. The students should be encouraged to plot as many quantities as they can. Plotting the data shows the status much better than just viewing the data in a table. The following plots can be drawn (again, most easily in a spreadsheet).

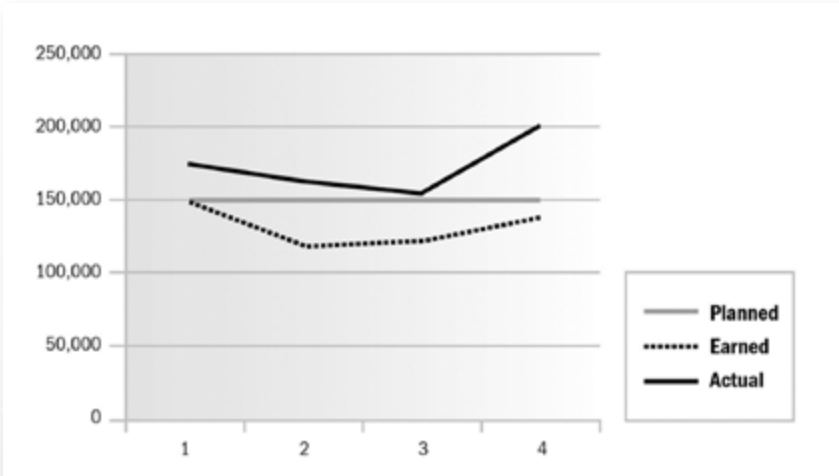


Figure II-D-2: Monthly data.

Monthly data gives a good view of what is happening—see Fig. II-D-2. The planned number of miles to be completed is constant. The earned value is the percentage of the planned value that was actually completed and in month #1 is equal to the planned value. However, in month #2, the earned value is less, which is shown in the figure by the EV falling below the PV.

The EV rises a little in months 3 and 4 showing that the monthly work is completed is increasing.

The AC is above the plan, showing that the project is over budget. Also, the monthly costs seem to be increasing and could be a sign of trouble.

Next, the student should plot the cumulative data, which is shown in Fig. II-D-3.

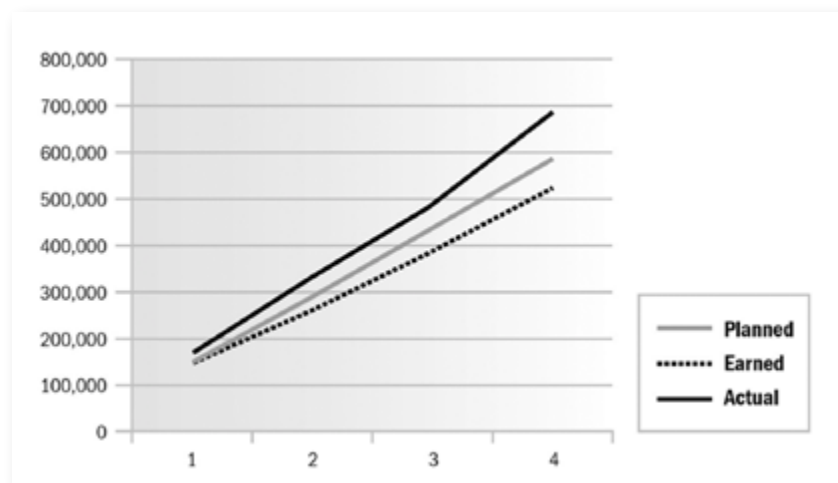


Figure II-D-3: Cumulative monthly data.

The cumulative data is much less informative as to what is happening on the project. A student might observe a slight increase in the cost trend, but the cumulative figure is not as informative as the monthly figure.

It is clear, however, that the EV is below the PV and that the AC is above the PV. Next, the student should plot the CPI and SPI, which are shown in Fig. II-D-4.

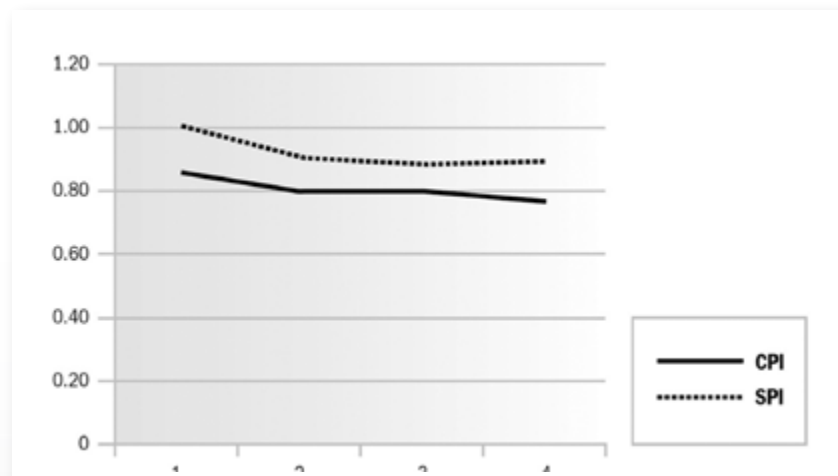


Figure II-D-4: CPI and SPI

The CPI seems to be hovering around 0.8 and is declining. The SPI may have leveled off. Therefore, the schedule performance of the project is much better than the cost performance.

3. Estimate the final cost

To determine the seriousness of the cost overrun, one computes the estimate at completion, EAC, which is the budget divided by the average CPI:

$$EAC = \text{Budget} / \langle \text{CPI} \rangle$$

For example, for month #2:

$$EAC(2) = 1,470,000 / \text{CPI}(2) = 1,470,000 / 0.79 = 1,860,759.$$

The final budget is predicted to be US \$1,860,759, which is US \$390,759 over budget. This is 26.5% overrun.

Note that from standard EV theory, one cannot use the SPI to compute the final schedule; one has to use a concept called “Earned Schedule.” This presents a challenge to the students who might be tempted to compute the new final duration as:

$$\text{Schedule at Completion, SAC}(2) = \text{Planned Schedule} / \text{SPI} = 10 / 0.9 = 11.1 \text{ months.}$$

It must be emphasized that this calculation is not valid. While the SPI *indicates* that the project is behind schedule, it cannot be used to compute the final duration.

Finally, the student should plot the monthly value of the computed EAC, which is shown in Fig. II-D-5.

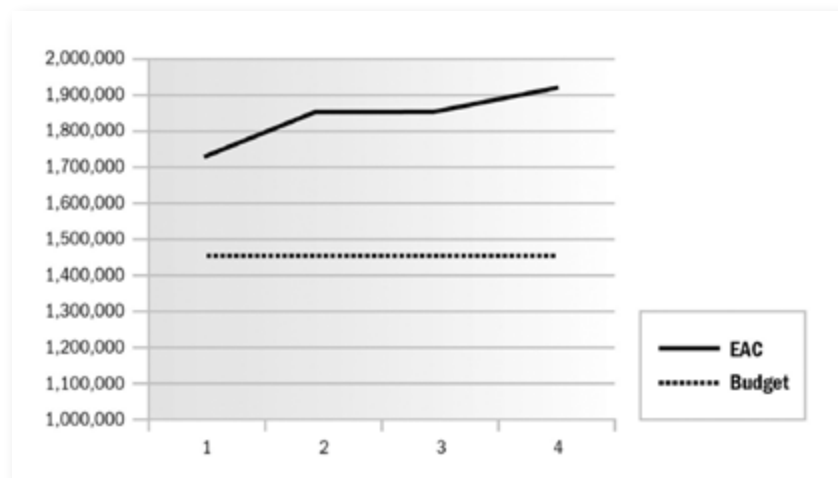


Figure II-D-5: The value of the estimate at completion, EAC

Figure II-D-5 shows that the EAC is rising. This means that the current value of the EAC should probably be considered an optimistic value and that the project is likely to cost more than the current EAC is predicting.

4. Write a letter to the mayor, explaining the status of the project

Figure II-D-6 is an example of an excellent letter to the mayor, in this case, the recently deceased mayor of Boston, Mayor Menino. This letter highlights many of the sorts of issues that students should be encouraged to explore:

- What is the best way to present detailed technical data, such as CPI and SPI?
- Are charts or data better for CPI and SPI?
- Does the letter to the mayor need to include this technical data? Is it enough to say the project is over budget? An interesting class discussion can be encouraged on whether the inclusion of CPI and SPI provides credibility to the PM and therefore enhances the impact of the budget overrun.

- Should charts go in the letter? The class will often split on this issue. Adding charts as appendices is a reasonable compromise.
- The reasons for the overrun can be hinted at in the case so that students have something on which to hang their explanation of the problem. Typical extra information that can be added include information about weather condition, contract negotiation problems and so forth.

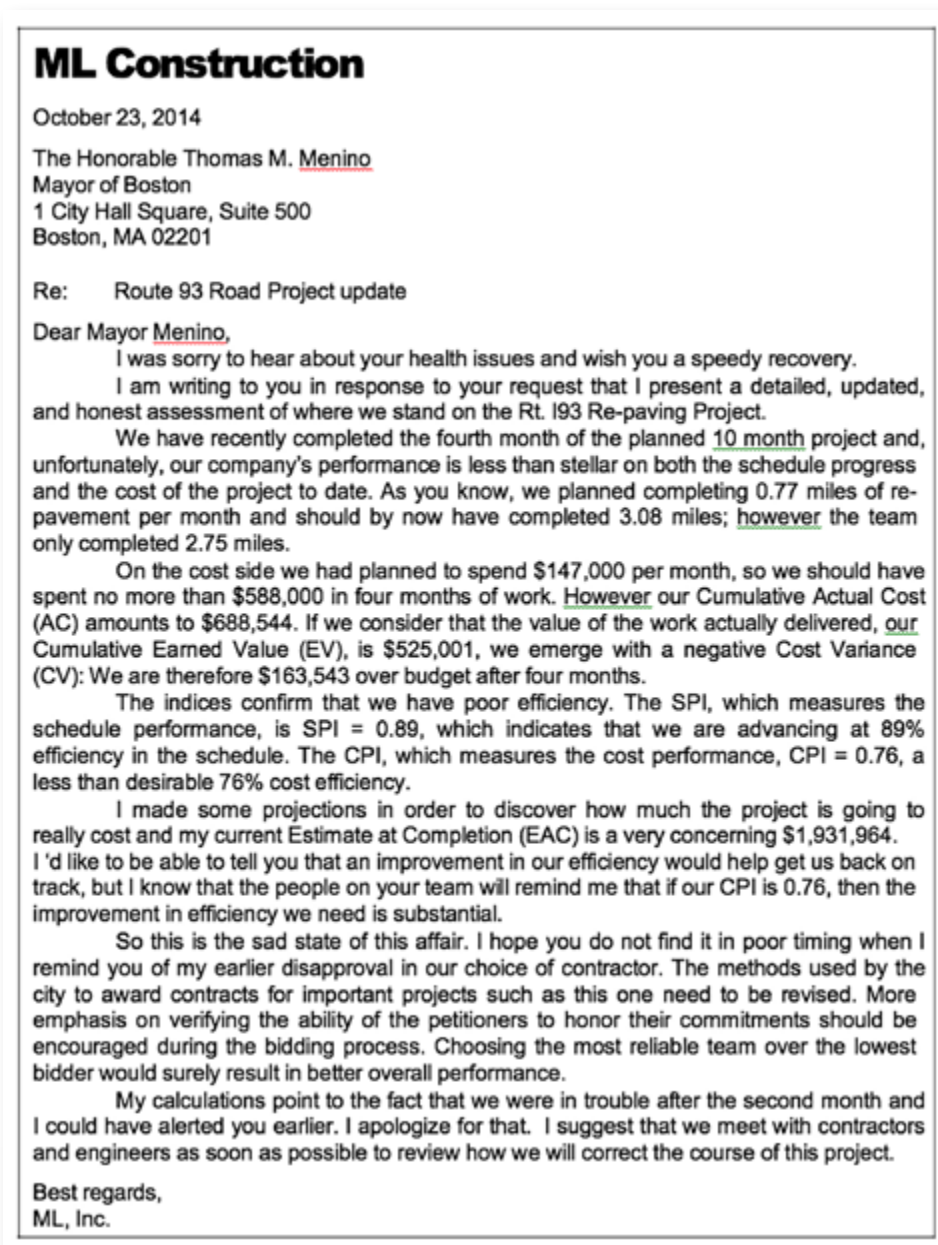


Figure II-D-6: Sample student letter to the mayor

Figure II-D-6 is an excellent example of the required combination of analysis skills (calculation of the EAC) and communication skills. Both types of skills are important to a PM, as the PM must both determine the true project status and also effectively communicate that status to stakeholders.



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Project Management Institute
Global Operations Center
14 Campus Blvd
Newtown Square, PA 19073-3299 USA
Tel: +1 610 356 4600 | Fax: +1 610 356 4647
Email: customercare@pmi.org