香港開放教科書
Open Textbooks for Hong Kong

Free to use. 自由編輯運用
Free to change. 共享優質課本
Free to share.

Project Management

香港公開大學
THE OPEN UNIVERSITY OF HONG KONG

Original source: The Saylor Foundation
http://open.bccampus.ca/find-open-textbooks/?uuid=8678fbae-6724-454c-a796-3c6667d826be&contributor=&keyword=&subject=

Contents

Introduction

People have been undertaking projects since the earliest days of organized human activity. The hunting parties of our prehistoric ancestors were projects. Large complex projects such as the pyramids and the Great Wall of China were also projects. Even something as simple as creating a dinner is considered a project. We use the term “project” frequently in our daily conversations. This book covers the basics of project management. This includes the process of initiation, planning, execution, control, and closeout that all projects share.

Preface

The primary purpose of this text is to provide an open source textbook that covers most project management courses. The material in the textbook was obtained from a variety of sources. All the sources are found in the reference section at the end of each chapter. I expect, with time, the book will grow with more information and more examples.

I welcome any feedback that would improve the book. If you would like to add a section to the book, please let me know.

About the Book

Project Management is a remix and adaptation. The adaptation is a part of the BCcampus Open Textbook project .

The B.C. Open Textbook Project began in 2012 with the goal of making post-secondary education in British Columbia more accessible by reducing student cost through the use of openly licensed textbooks. The BC Open Textbook Project is administered by BCcampus and funded by the British Columbia Ministry of Advanced Education.

Open textbooks are open educational resources (OER); they are instructional resources created and shared in ways so that more people have access to them. This is a different model than traditionally copyrighted materials. OER are defined as teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others (Hewlett Foundation). Our open textbooks are openly licensed using a Creative Commons license, and are offered in various e-book formats free of charge, or as printed books that are available at cost. For more information about this project, please contact opentext@bccampus.ca. If you are an instructor who is using this book for a course, please let us know.

Project Management by Adrienne Watt is a remix of the following works:

100 Percent Rule by Pabipedia licensed under Creative Commons Attribution-ShareAlike 3.0 License

Communication Plans by Inte6160 Wiki licensed under Creative Commons Attribution 3.0 Unported.

Decision Matrix Method and Project Charter by Wikipedia the Free Encyclopedia licensed under Creative Commons Alike Attribution 3.0 Unported.

Gantt chart by Wikipedia licensed under Creative Commons Attribution-ShareAlike 3.0 Unported

How to Build Relationships with Stakeholders By Erin Palmer licensed under Creative Commons Attribution 3.0 Unported

Planning a Project by OpenLearn Labspace under Creative Commons Attribution 3.0 Unported.

Project Decelerators – Lack of Stakeholder Support By Jose Solera licensed under Creative Commons Attribution

3.0 Unported Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported

Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project

Management for Instructional Designers. Retrieved from http://pm4id.org/ under Creative Commons Attribution 3.0 Unported.

Project Management for Skills for All Careers by Project Management Open Resources and TAP-a-PM licensed under Creative Commons Attribution 3.0 Unported.

Project Management from Simple to Complex by Russel Darnall, John Preston, Eastern Michigan University licensed under Creative Commons Attribution 3.0 Unported.

Project Management/PMBOK/Human Resources Management and Development Cooperation Handbook/How do we manage the human resources of programmes and projects?/Manage the Project Team by Wikibooks licensed under Creative Commons Attribution-Share Alike 3.0,

Project Management/PMBOK/Scope Management and Development Cooperation Handbook/Designing and Executing Projects/Detailed Planning or design stage by Wikibooks licensed under Creative Commons Attribution 3.0 Unported.

Resource Management and Resource Leveling by Wikipedia licensed under Creative Commons Attribution-Share Alike 3.0 License. Work Breakdown Structure by Wikipedia licensed under Creative Commons Attribution-ShareAlike 3.0 License

Chapter 1 Project Management: Past and Present

Adrienne Watt

1.1 Careers Using Project Management Skills

Skills learned by your exposure to studying project management can be used in most careers as well as in your daily life. Strong planning skills, good communication, ability to implement a project to deliver the product or service while also monitoring for risks and managing the resources will provide an edge toward your success. Project managers can be seen in many industry sectors including agriculture and natural resources; arts, media, and entertainment; building trades and construction; energy and utilities; engineering and design; fashion and interiors; finance and business; health and human services; hospitality, tourism, and recreation; manufacturing and product development; public and private education services; public services; retail and wholesale trade; transportation; and information technology.

Below we explore various careers and some of the ways in which project management knowledge can be leveraged.

1.2 Business Owners

Business owners definitely need to have some project management skills. With all successful businesses, the product or service being delivered to the customer meets their needs in many ways. The product or service is of the quality desired, the costs are aligned with what the consumer expected, and the timeliness of the product or service meets the deadline for the buyer of that item.

The pillars of project management are delivering a product/service within schedule, cost, scope, and quality requirements. Business owners need planning, organizing, and scoping skills and the ability to analyze, communicate, budget, staff, equip, implement, and deliver.

Understanding the finances, operations, and expenses of the business are among the skills that project managers learn and practice. Some businesses may focus more on accounting, providing financial advice, sales, training, public relations, and actuary or logistician roles. Business owners may own a travel agency or provide hospitality.

Business owners could be managing a storefront or a location in their town's marketplace.

Example: Restaurant Owner/Manager

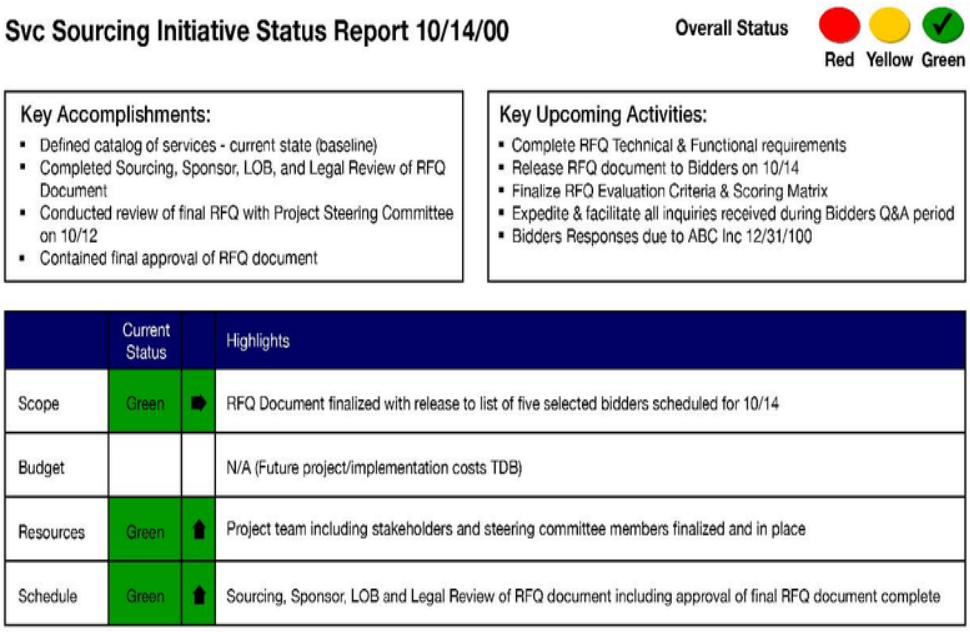
Restaurant managers are responsible for the daily operations of a restaurant that prepares and serves meals and beverages to customers. Strong planning skills, especially coordinating with the various departments (kitchen, dining room, banquet operations, food service managers, vendors providing the supplies) ensure that customers are satisfied with their dining experience. Managers' abilities to recruit and retain employees, and monitor employee performance and training ensure quality with cost containment. Scheduling in many aspects, not only the staff but also the timing of the food service deliveries, is critical in meeting customer expectations.

Risk management is essential to ensure food safety and quality. Managers monitor orders in the kitchen to determine where delays may occur, and they work with the chef to prevent these delays. Legal compliance is essential in order for the restaurant to stay open, so restaurant managers direct the cleaning of the dining areas and the washing of tableware, kitchen utensils, and equipment. They ensure the safety standards and legality, especially in serving alcohol. Sensitivity and strong communication skills are needed when customers have complaints or employees feel pressured because more customers arrive than predicted.

Financial knowledge is needed for the soundness of running the restaurant, especially tracking special projects, events, and costs for the various menu selections. Catering events smoothly can be an outcome of using project plans and the philosophy of project management. The restaurant manager or the executive chef analyzes the recipes to determine food, labor, and overhead costs; determines the portion size and nutritional content of each serving; and assigns prices to various menu items, so that supplies can be ordered and received in time.

Planning is the key for successful implementation. Managers or executive chefs need to estimate food needs, place orders with distributors, and schedule the delivery of fresh food and supplies. They also plan for routine services (equipment maintenance, pest control, waste removal) and deliveries, including linen services or the heavy cleaning of dining rooms or kitchen equipment, to occur during slow times or when the dining room is closed. A successful restaurant relies on many skills that the project management profession emphasizes.

1.2.1 Outsourcing Services



Svc Sourcing Initiative Status Report 10/14/00

Overall Status: Red Yellow Green

Key Accomplishments:

- Defined catalog of services - current state (baseline)
- Completed Sourcing, Sponsor, LOB, and Legal Review of RFQ Document
- Conducted review of final RFQ with Project Steering Committee on 10/12
- Contained final approval of RFQ document

Key Upcoming Activities:

- Complete RFQ Technical & Functional requirements
- Release RFQ document to Bidders on 10/14
- Finalize RFQ Evaluation Criteria & Scoring Matrix
- Expedite & facilitate all inquiries received during Bidders Q&A period
- Bidders Responses due to ABC Inc 12/31/100

	Current Status		Highlights
Scope	Green	➡	RFQ Document finalized with release to list of five selected bidders scheduled for 10/14
Budget			N/A (Future project/implementation costs TDB)
Resources	Green	⬆	Project team including stakeholders and steering committee members finalized and in place
Schedule	Green	⬆	Sourcing, Sponsor, LOB and Legal Review of RFQ document including approval of final RFQ document complete

Figure 1.1 Sample status chart, which is typical with the use of a red-yellow-green, by Maura Irene Jones in Project Management Skills for All Careers

Sample status chart, which is typical with the use of a red-yellow-green, by Maura Irene Jones in Project Management Skills for All Careers (http://textbookequity.org/ oct/Textbooks/ProjectManagementforAllCareersEdition2.pdf, https://creativecommons.org/licenses/by/3.0/) .

Many businesses explore outsourcing for certain services. Below is a sample status and project plan that reflects the various tasks needed for a project. A review of finances, the importance of communicating to stakeholders, and the importance of time, cost, schedule, scope, and quality are reflected. Many companies may use these steps in their business. These plans show the need for the entire team to review the various proposals to choose the best plan. Figure 1.1 Sample status chart, which is typical with the use of a red-yellow-green, by Maura Irene Jones in Project Management Skills for All Careers represents a sample project status report.

Example: Construction Managers

Construction managers plan, direct, coordinate, and budget a wide variety of residential, commercial, and industrial construction projects including homes, stores, offices, roads, bridges, wastewater treatment plants, schools, and hospitals. Strong scheduling skills are essential for this role. Communication skills are often used in coordinating design and construction processes, teams executing the work, and governance of special trades (carpentry, plumbing, electrical wiring) as well as government representatives for the permit processes. A construction manager may be called a project manager or project engineer. The construction manager ensures that the project is completed on time and within budget while meeting quality specifications and codes and maintaining a safe work environment. These managers create project plans in which they divide all required construction site activi-ties into logical steps, estimating and budgeting the time required to meet established deadlines, usually utilizing sophisticated scheduling and cost-estimating software. Many use software packages such as Microsoft Project® or Procure® or online tools like BaseCamp®. Most construction projects rely on spreadsheets for project management. Procurement skills used in this field include acquiring the bills for material, lumber for the house being built, and more. Construction managers also coordinate labor, determining the needs and overseeing their performance, ensuring that all work is completed on schedule.

Values including sustainability, reuse, LEED-certified building, use of green energy, and various energy efficiencies are being incorporated into today's projects with an eye to the future. Jennifer Russell, spoke about project management and global sustainability" at the 2011 Silicon Valley Project Management Institute (PMI) conference. She informed the attendees of the financial, environmental, and social areas in expanding the vision of project management with the slide in Figure 1.2 Project Management by Jennifer Russell . These values are part of the PMI's code of ethics and professionalism. By adhering to this code, project managers include in their decisions the best interests of society, the safety of the public, and enhancement of the environment.

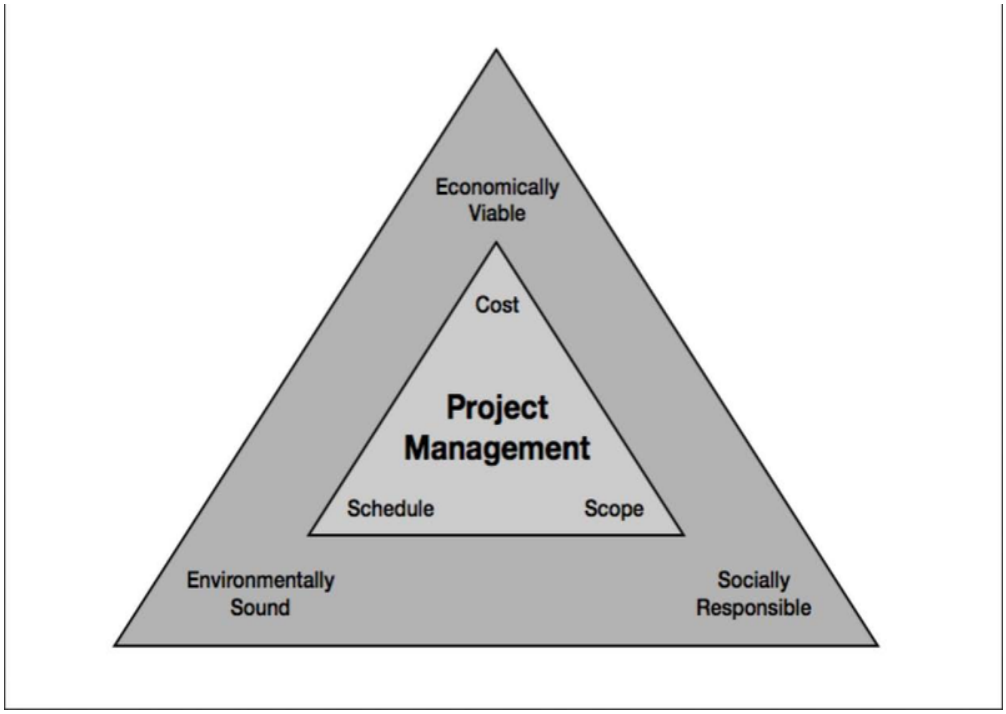


Figure 1.2 Project Management by Jennifer Russell

1.3 Creative Services

Creative service careers include graphic artists, curators, video editors, gaming managers, multimedia artists, media producers, technical writers, interpreters, and translators. These positions use project management skills, especially in handling the delivery channel and meeting clients' requirements.

Let us look at one example, graphic artists, to understand and identify some of the project management skills that aid in this career.

Example: Graphic Artists

Graphic artists plan, analyze, and create visual solutions to communication problems. They use many skills found in project management, especially communications. They work to achieve the most effective way to get messages across in print and electronic media. They emphasize their messages using color, type, illustration, photography, animation, and various print and layout techniques. Results can be seen in magazines, newspapers, journals, corporate reports, and other publications. Other deliverables from graphic artists using project management skills include promotional displays, packaging, and marketing brochures supporting products and services, logos, and signage. In addition to print media, graphic artists create materials for the web, TV, movies, and mobile device apps.

Initiation in project management can be seen in developing a new design: determining the needs of the client, the message the design should portray, and its appeal to customers or users. Graphic designers consider cognitive, cultural, physical, and social factors in planning and executing designs for the target audience, very similar to some of the dynamics a project manager considers in communicating with various project stakeholders. Designers may gather relevant information by meeting with clients, creative staff, or art directors; brainstorming with others within their firm or professional association; and performing their own research to ensure that their results have high quality and they can manage risks.

Graphic designers may supervise assistants who follow instructions to complete parts of the design process. Therefore scheduling, resource planning, and cost monitoring are pillars of project management seen in this industry. These artists use computer and communications equipment to meet their clients' needs and business requirements in a timely and cost-efficient manner.

1.4 Educators

"Educator" is a broad term that can describe a career in teaching, maybe being a lecturer, a professor, a tutor, or a homeschooler. Other educators include gurus, mullahs, pastors, rabbis, and priests. Instructors also provide vocational training or teach skills like learning how to drive a car or use a computer. Educators provide motivation to learn a new language or showcase new products and services. Educators use project management skills including planning and communication.

Let us look at teachers, since we all have had teachers, and see if we can recognize the project management skills that are demonstrated in this profession.

Example: Teachers

Some teachers foster the intellectual and social development of children during their formative years; other teachers provide knowledge, career skill sets, and guidance to adults. Project management skills that teachers exhibit include acting as facilitators or coaches and communicating in the classroom and in individual instruction. Project managers plan and evaluate various aspects of a project; teachers plan, evaluate, and assign lessons; implement these plans; and monitor each student's progress similar to the way a project manager monitors and delivers goods or services. Teachers use their people skills to manage students, parents, and administrators. The soft skills that project managers exercise can be seen in teachers who encourage collaboration in solving problems by having students work in groups to discuss and solve problems as a team.

Project managers may work in a variety of fields with a broad assortment of people, similar to teachers who work with students from varied ethnic, racial, and religious backgrounds. These teachers must have awareness and understanding of different cultures.

Teachers in some schools may be involved in making decisions regarding the budget, personnel, textbooks, curriculum design, and teaching methods, demonstrating skills that a project manager would possess such as financial management and decision making.

1.5 Engineers

Engineers apply the principles of science and mathematics to develop economical solutions to technical problems. As a project cycles from an idea in the project charter to the implementation and delivery of a product or service, engineers link scientific discoveries to commercial applications that meet societal and consumer needs.

Engineers use many project management skills, especially when they must specify functional requirements. They demonstrate attention to quality as they evaluate a design's overall effectiveness, cost, reliability, and safety similar to the project manager reviewing the criteria for the customer's acceptance of delivery of the product or service.

Estimation skills in project management are used in engineering. Engineers are asked many times to provide an estimate of time and cost required to complete projects.

1.6 Health Care

There are many jobs and careers in health care that use project management skills. Occupations in the field of health care vary widely, such as athletic trainer, dental hygienist, massage therapist, occupational therapist, optometrist, nurse, physician, physician assistant, and X-ray technician. These individuals actively apply risk management in providing health care delivery of service to their clients, ensuring that they do not injure the person they are caring for. *Note: There is a section on nursing later in this chapter.*

Many of you may have had a fall while you were growing up, and needed an X-ray to determine if you had a fracture or merely a sprain. Let us look at this career as an example of a health care professional using project management skills.

Example: Radiology Technologists

Radiology technologists and technicians perform diagnostic imaging examinations like X-rays, computed tomography (CT), magnetic resonance imaging (MRI), and mammography. They could also be called radiographers, because they produce X-ray films (radiographs) of parts of the human body for use in diagnosing medical problems.

Project management skills, especially people skills and strong communication, are demonstrated when they prepare patients for radiologic examinations by explaining the procedure and what position the patient needs to be in, so that the parts of the body can be appropriately radio graphed. Risk management is demonstrated when these professionals work to prevent unnecessary exposure to radiation by surrounding the exposed area with radiation protection devices, such as lead shields, or limiting the size of the X-ray beam. To ensure quality results, the health technician monitors the radiograph and sets controls on the X-ray machine to produce radiographs of the appropriate density, detail, and contrast.

Safety and regulations concerning the use of radiation to protect themselves, their patients, and their coworkers from unnecessary exposure is tracked in an efficient manner and reported as a control to ensure compliance. Project management skills are also used in preparing work schedules, evaluating equipment for purchase, or managing a radiology department.

Some radiological technologists specialize in CT scans; as CT technologists they too use project management skills. CT uses ionizing radiation to produce a substantial number of cross-sectional X-rays of an area of the body. Therefore, it requires the same precautionary measures that are used with X-rays, hence the need for risk management and monitoring for exposure.

Teamwork, not only with the patient that the radiological technologist supports and the doctor who ordered the request, but also with other health care providers, relies on strong communication, quality, work done in a timely manner, and wise use of hospital resources. This all boils down to ensuring that the three elements of the project management triangle of cost, schedule, and scope with quality delivered remain the essentials that provide a cornerstone to project management and the skills needed to obtain the objective.

Example: Nurses

Nurses treat and educate patients and their families and the public about various medical conditions and provide advice and emotional support. Nurses establish a care plan for their patients that include activities like scheduling the administration and discontinuation of medications (e.g., intravenous (IV) lines for fluid, medication, blood, and blood products) and application of therapies and treatments. Communication with the patient, their family, physicians and other health care clinicians may be done in person or via technology. Telehealth allows nurses to provide care and advice through electronic communications media including videoconferencing, the Internet, or telephone.

Risk management is very important for a nurse, with some cases having a life or death consequence. Nurses monitor pain management and vital signs and provide status reports to physicians to help in responding to the health care needs of the patient.

The nursing field varies. Some nurses work in infection control. They identify, track, and control infectious outbreaks in health care facilities and create programs for outbreak prevention and response to biological terrorism. Others are educators who plan, develop, execute, and evaluate educational programs and curricula for the professional development of students and graduate nurses. Nurses may use project management skills while conducting health care consultations, advising on public policy, researching in the field, or providing sales support of a product or service.

1.7 Paralegal

Attorneys assume the ultimate responsibility for legal work but they often obtain assistance. Paralegals assume this role in law firms and perform many tasks to aid the legal profession. However, they are explicitly prohibited from carrying out duties considered to be the practice of law (e.g., giving legal advice, setting legal fees, presenting court cases).

Project management skills such as planning are used in helping lawyers prepare for closings, hearings, trials, and corporate meetings. Communication skills are used in preparing written reports that help attorneys determine how cases should be handled or drafts for actions such as pleading, filing motions, and obtaining affidavits.

Monitoring skills aid paralegals who may track files of important case documents, working on risk containment related to filing dates and responses to the court. Procurement skills, which a project manager uses, can also be seen from a paralegal

perspective in negotiating terms of hiring expert witnesses as well as other services such as acquiring services from process servers.

Financial skills may be used as well, such as assisting in preparing tax returns, establishing trust funds, and planning estates or maintaining financial office records at the law firm.

Government, litigation, personal injury, corporate law, criminal law, employee benefits, intellectual property, labor law, bankruptcy, immigration, family law, and real estate are some of the many different law practices where a paralegal professional may use project management skills.

1.8 Software developer

Computer software developers and computer programmers design and develop software. They apply the principles of computer science and mathematics to create, test, and evaluate software applications and systems that make computers come alive. Software is developed in many kinds of projects: computer games, business applications, operating systems, network control systems, and more. Software developers us project management skills to develop the requirements for the software, identify and track the product development tasks, communicate within the development team and with clients, test cases, and manage quality, the schedule, and resources (staff, equipment, labs, and more).

1.9 Science Technicians

Science technicians use principles and theories of science and mathematics to assist in research and development and help invent and improve products and processes. In their jobs, they are more practically oriented than scientists. Planning skills project managers use can be seen as science technicians set up, operate, and maintain laboratory instruments; monitor experiments; and observe, calculate, and record results. Quality is a factor here as it is in project management; science technicians must ensure that processes are performed correctly, with proper proportions of ingredients, for purity or for strength and durability.

There are different fields in which science technicians can apply project management skills. Agricultural and food science technicians test food and other agricultural products and are involved in food, fiber, and animal research, production, and processing. Control and risk management are important here in executing the tests and experiments, for example, to improve the yield and quality of crops, or the resistance of plants and animals to disease, insects, or other hazards. Quality factors are paramount when food science technicians conduct tests on food additives and preservatives to ensure compliance with government regulations regarding color, texture, and nutrients.

Biological technicians work with biologists studying living organisms. Many assist scientists who conduct medical research or who work in pharmaceutical companies to help develop and manufacture medicines. Skills in scheduling, especially in incubation periods for the study of the impact on cells, could impact projects, such as exploring and isolating variables for research in living organisms and infectious agents. Biotechnology technicians apply knowledge and execution skills and techniques gained from basic research, including gene splicing and recombinant DNA, to product development. Project management skills are used in collaboration and communication among team members to record and understand the results and progress toward a cure or product.

Other kinds of technicians are chemical technicians who may work in laboratories or factories, using monitoring and control skills in the way they collect and analyze samples. Again, quality assurance is an important factor for most process technicians' work in manufacturing, testing packaging for design, ensuring integrity of materials, and verifying environmental acceptability.

Technicians use a project management skill set to assist in their initiation, planning, and executing tasks, while managing risks with some measure of reporting to determine if their objectives satisfy the constraints of cost, schedule, resource, and quality standards set.

1.10 History

Could the Great Wall of China, the pyramids, or Stonehenge have been built without project management? It is possible to say that the concept of project management has been around since the beginning of history. It has enabled leaders to plan bold and massive projects and manage funding, materials, and labor within a designated time frame.

In late 19th century, in the United States, large-scale government projects were the impetus for making important decisions that became the basis for project management methodology such as the transcontinental railroad, which began construction in the 1860s. Suddenly, business leaders found themselves faced with the daunting task of organizing the manual labor of thousands of workers and the processing and assembly of unprecedented quantities of raw material.

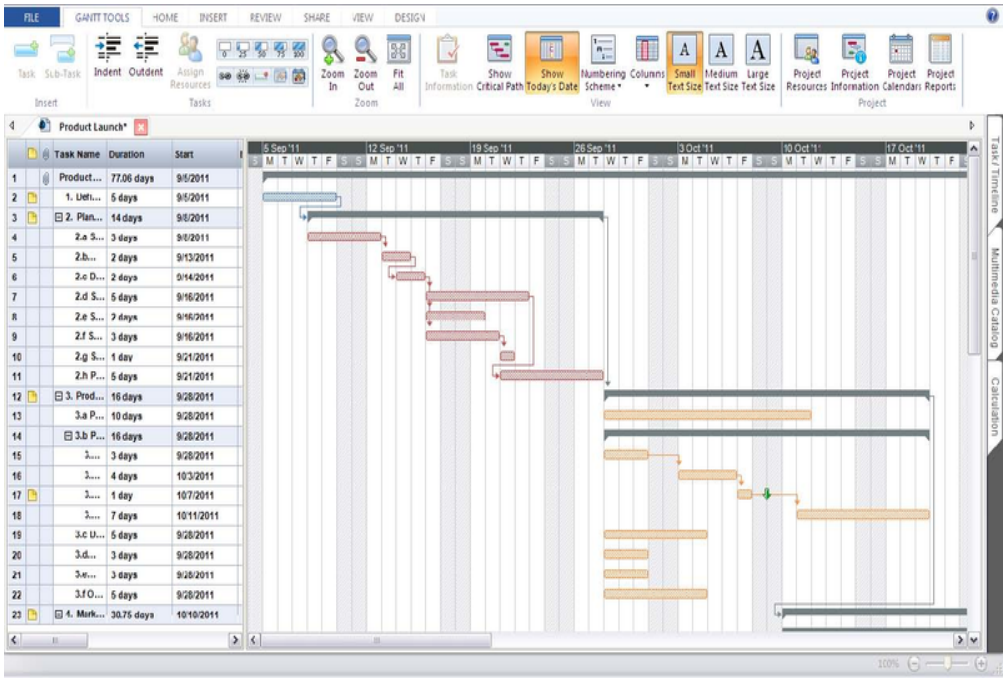


Figure 1.3 MindView Gantt Chart, by Matchware Inc (MindView)

MindView Gantt Chart, by Matchware Inc (MindView) (http://commons.wikimedia.org/wiki/File%3AMindView-Gantt_Chart.png, https://creativecommons.org/licenses/by-sa/3.0/) .

Henry Gantt, studied in great detail the order of operations in work and is most famous for developing the Gantt chart in the 1910s. A Gantt chart (Figure 1.3 MindView Gantt Chart, by Matchware Inc (MindView)) is a popular type of bar chart that illustrates a project schedule and has become a common technique for representing the phases and activities of a project so they can be understood by a wide audience.

Although now a common charting technique, Gantt charts were considered revolutionary at the time they were introduced. Gantt charts were employed on major infrastructure projects in the United States including the Hoover Dam and the interstate highway system and are still accepted today as important tools in project management.

By the mid-20th century, projects were managed on an ad hoc basis using mostly Gantt charts and informal techniques and tools. During that time, the Manhattan Project was initiated and its complexity was only possible because of project management methods. The Manhattan Project was the code name given to the Allied effort to develop the first nuclear weapons during World War II. It involved over 30 different project sites in the United States and Canada, and thousands of personnel from the United States, Canada, and the U.K. Born out of a small research program that began in 1939, the Manhattan Project would eventually employ 130,000 people, cost a total of nearly US$2 billion, and result in the creation of multiple production and research sites operated in secret. The project succeeded in developing and detonating three nuclear weapons in 1945.

The 1950s marked the beginning of the modern project management era. Two mathematical project-scheduling models were developed.

The program evaluation and review technique (PERT) was developed by Booz-Allen and Hamilton as part of the United States Navy's Polaris missile submarine program. PERT is basically a method for analyzing the tasks involved in completing a project, especially the time needed to complete each task, the dependencies among tasks, and the minimum time needed to complete the total project (Figure 1.4 Pert Chart by Jeremykemp derivative work: Hazmat2 from Wikimedia Commons).

The critical path method (CPM) was developed in a joint venture by DuPont Corporation and Remington Rand Corporation for managing plant maintenance projects. The critical path determines the float, or schedule flexibility, for each activity by calculating the earliest start date, earliest finish date, latest start date, and latest finish date for each activity. The critical path is generally the longest full path on the project. Any activity with a float time that equals zero is considered a critical path task. CPM can help you figure out how long your complex project will take to complete and which activities are critical, meaning they have to be done on time or else the whole project will take longer. These mathematical techniques quickly spread into many private enterprises.

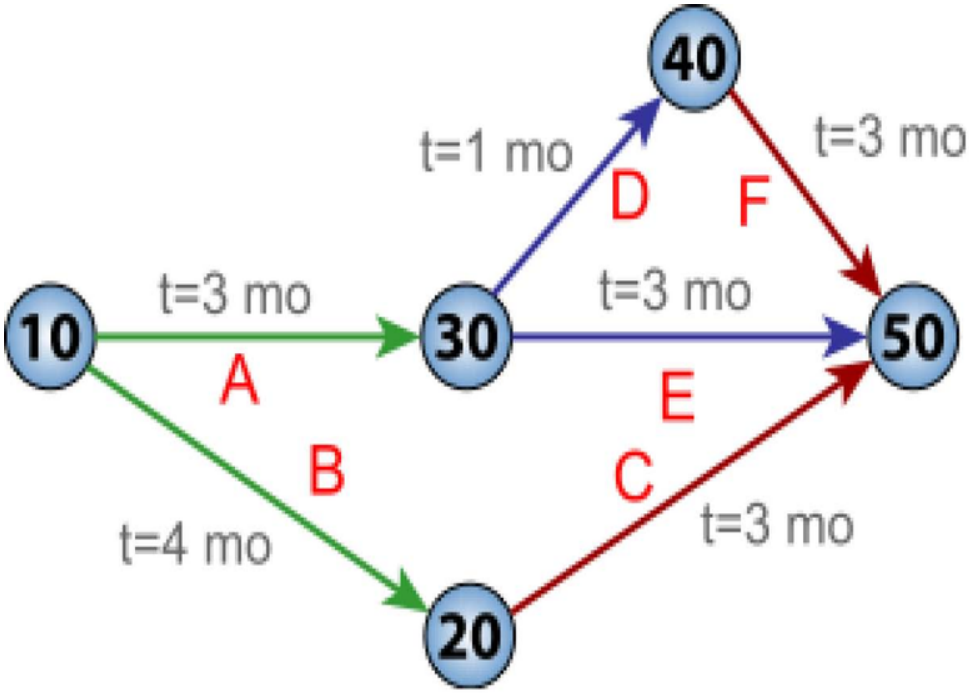


Figure 1.4 Pert Chart by Jeremykemp derivative work: Hazmat2 from Wikimedia Commons

Pert Chart by Jeremykemp derivative work: Hazmat2 from Wikimedia Commons (http://commons.wikimedia.org/wiki/File:Pert_chart_colored.svg, http://en.wikipedia.org/wiki/Public_domain) .

Project management in its present form began to take root a few decades ago. In the early 1960s, industrial and business organizations began to understand the benefits of organizing work around projects. They understood the critical need to communicate and integrate work across multiple departments and professions.

1.11 Attribution

Chapter 2 Project Management Overview

Adrienne Watt

The starting point in discussing how projects should be properly managed is to first understand what a project is and, just as importantly, what it is not.

People have been undertaking projects since the earliest days of organized human activity. The hunting parties of our prehistoric ancestors were projects, for example; they were temporary undertakings directed at the goal of obtaining meat for the community. Large complex projects have also been with us for a long time. The pyramids and the Great Wall of China were in their day of roughly the same dimensions as the Apollo project to send men to the moon. We use the term “project” frequently in our daily conversations. A husband, for example may tell his wife, “My main project for this weekend is to straighten out the garage.” Going hunting, building pyramids, and fixing faucets all share certain fea tures that make them projects.

2.1 Project Attributes

A project has distinctive attributes that distinguish it from ongoing work or business operations. Projects are temporary in nature. They are not an everyday business process and have definitive start dates and end dates. This characteristic is important because a large part of the project effort is dedicated to ensuring that the project is completed at the appointed time. To do this, schedules are created showing when tasks should begin and end. Projects can last minutes, hours, days, weeks, months, or years.

Projects exist to bring about a product or service that hasn’t existed before. In this sense, a project is unique. Unique means that this is new; this has never been done before. Maybe it’s been done in a very similar fashion before but never exactly in this way. For example, Ford Motor Company is in the business of designing and assembling cars. Each model that Ford designs and produces can be considered a project. The models differ from each other in their features and are marketed to people with various needs. An SUV serves a different purpose and clientele than a luxury car. The design and marketing of these two models are unique projects. However, the actual assembly of the cars is considered an operation (i.e., a repetitive process that is followed for most makes and models).

In contrast with projects, operations are ongoing and repetitive. They involve work that is continuous without an ending date and with the same processes repeated to produce the same results. The purpose of operations is to keep the organization

functioning while the purpose of a project is to meet its goals and conclude. Therefore, operations are ongoing while projects are unique and temporary.

A project is completed when its goals and objectives are accomplished. It is these goals that drive the project, and all the planning and implementation efforts undertaken to achieve them. Sometimes projects end when it is determined that the goals and objectives cannot be accomplished or when the product or service of the project is no longer needed and the project is cancelled.

2.2 Definition of a Project

There are many written definitions of a project. All of them contain the key elements described above. For those looking for a formal definition of a project, the Project Management Institute (PMI) defines a project as a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists.

2.3 Project Characteristics

When considering whether or not you have a project on your hands, there are some things to keep in mind. First, is it a project or an ongoing operation? Second, if it is a project, who are the stakeholders? And third, what characteristics distinguish this endeavor as a project?

Projects have several characteristics:

- Projects are unique.
- Projects are temporary in nature and have a definite beginning and ending date.
- Projects are completed when the project goals are achieved or it's determined the project is no longer viable.

A successful project is one that meets or exceeds the expectations of the stakeholders.

Consider the following scenario: The vice-president (VP) of marketing approaches you with a fabulous idea. (Obviously it must be "fabulous" because he thought of it.) He wants to set up kiosks in local grocery stores as mini-offices. These offices will offer customers the ability to sign up for car and home insurance services as well as make their bill payments. He believes that the exposure in grocery stores will increase awareness of the company's offerings. He told you that senior management has already cleared the project, and he'll dedicate as many resources to this as he can. He wants the new kiosks in place in 12 selected stores in a major city by the end of the year. Finally, he has assigned you to head up this project.

Your first question should be, “Is it a project?” This may seem elementary, but confusing projects with ongoing operations happens often. Projects are temporary in nature, have definite start and end dates, result in the creation of a unique product or service, and are completed when their goals and objectives have been met and signed off by the stakeholders.

Using these criteria, let’s examine the assignment from the VP of marketing to determine if it is a project:

- Is it unique? Yes, because the kiosks don’t exist in the local grocery stores. This is a new way of offering the company’s services to its customer base. While the service the company is offering isn’t new, the way it is presenting its services is.
- Does the product have a limited timeframe? Yes, the start date of this project is today, and the end date is the end of next year. It is a temporary endeavor.
- Is there a way to determine when the project is completed? Yes, the kiosks will be installed and the services will be offered from them. Once all the kiosks are installed and operating, the project will come to a close.
- Is there a way to determine stakeholder satisfaction? Yes, the expectations of the stakeholders will be documented in the form of requirements during the planning processes. These requirements will be compared to the finished product to determine if it meets the expectations of the stakeholder.

If the answer is yes to all these questions, then we have a project.

2.4 The Process of Project Management

You’ve determined that you have a project. What now? The notes you scribbled down on the back of the napkin at lunch are a start, but not exactly good project management practice. Too often, organizations follow Nike’s advice when it comes to managing projects when they “just do it.” An assignment is made, and the project team members jump directly into the development of the product or service requested. In the end, the delivered product doesn’t meet the expectations of the customer. Unfortunately, many projects follow this poorly constructed path, and that is a primary contributor to a large percentage of projects not meeting their original objectives, as defined by performance, schedule, and budget.

In the United States, more than $250 billion is spent each year on information technology (IT) application development in approximately 175,000 projects. The Standish Group (a Boston-based leader in project and value performance research) released the summary version of their 2009 CHAOS Report that tracks project failure rates across a broad range of companies and industries (Figure 2.1 Summary of 2009 Standish Group CHAOS report. Chaosreport2009 by Merrie Barron & Andrew R. Barron).

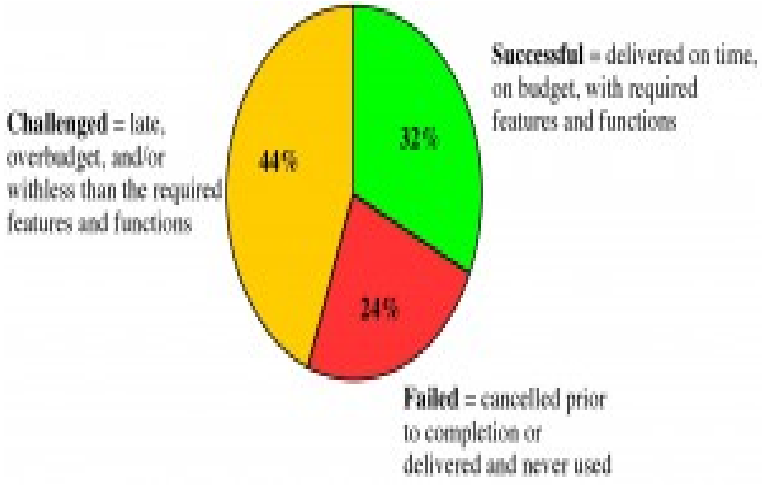


Figure 2.1 Summary of 2009 Standish Group CHAOS report. Chaosreport2009 by Merrie Barron & Andrew R. Barron

(http://commons.wikimedia.org/wiki/File:Chaosreport2009.jpg, https://creativecommons.org/licenses/by/3.0/) .

Jim Johnson, chairman of the Standish Group, has stated that "this year's results show a marked decrease in project success rates, with 32% of all projects succeeding which are delivered on time, on budget, with required features and functions, 44% were challenged-which are late, over budget, and/or with less than the required features and functions and 24% failed which are cancelled prior to completion or delivered and never used."

When are companies going to stop wasting billions of dollars on failed projects? The vast majority of this waste is completely avoidable: simply get the right business needs (requirements) understood early in the process and ensure that project management techniques are applied and followed, and the project activities are monitored.

Applying good project management discipline is the way to help reduce the risks. Having good project management skills does not completely eliminate problems, risks, or surprises. The value of good project management is that you have standard processes in place to deal with all contingencies.

Project management is the application of knowledge, skills, tools, and techniques applied to project activities in order to meet the project requirements. Project management is a process that includes planning, putting the project plan into action, and measuring progress and performance.

Managing a project includes identifying your project's requirements and writing down what everyone needs from the project. What are the objectives for your project? When everyone understands the goal, it's much easier to keep them all on the right path. Make sure you set goals that everyone agrees on to avoid team conflicts later on. Understanding and addressing the needs of everyone affected by the project means the end result of your project is far more likely to satisfy your stakeholders. Last but not least, as project manager, you will also be balancing the many competing project constraints.

On any project, you will have a number of project constraints that are competing for your attention. They are cost, scope, quality, risk, resources, and time.

- Cost is the budget approved for the project including all necessary expenses needed to deliver the project. Within organizations, project managers have to balance between not running out of money and not under spending because many projects receive funds or grants that have contract clauses with a “use it or lose it” approach to project funds. Poorly executed budget plans can result in a last-minute rush to spend the allocated funds. For virtually all projects, cost is ultimately a limiting constraint; few projects can go over budget without eventually requiring a corrective action.
- Scope is what the project is trying to achieve. It entails all the work involved in delivering the project outcomes and the processes used to produce them. It is the reason and the purpose of the project.
- Quality is a combination of the standards and criteria to which the project’s products must be delivered for them to perform effectively. The product must perform to provide the functionality expected, solve the identified problem, and deliver the benefit and value expected. It must also meet other performance requirements, or service levels, such as availability, reliability, and maintainability, and have acceptable finish and polish. Quality on a project is controlled through quality assurance (QA), which is the process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.
- Risk is defined by potential external events that will have a negative impact on your project if they occur. Risk refers to the combination of the probability the event will occur and the impact on the project if the event occurs. If the combination of the probability of the occurrence and the impact on the project is too high, you should identify the potential event as a risk and put a proactive plan in place to manage the risk.
- Resources are required to carry out the project tasks. They can be people, equipment, facilities, funding, or anything else capable of definition (usually other than labor) required for the completion of a project activity.
- Time is defined as the time to complete the project. Time is often the most frequent project oversight in developing projects. This is reflected in missed deadlines and incomplete deliverables. Proper control of the schedule requires the careful identification of tasks to be performed and accurate estimations of their durations, the sequence in which they are going to be done, and how people and other resources are to be allocated. Any schedule should take into account vacations and holidays.

You may have heard of the term “triple constraint,” which traditionally consisted of only time, cost, and scope. These are the primary competing project constraints that you have to be most aware of. The triple constraint is illustrated in the form of a triangle to visualize the project work and see the relationship between the scope/quality, schedule/time, and cost/resource (Figure 2.2 A schematic of the triple constraint triangle. The triad constraints by John M. Kennedy T.).

Your project may have additional constraints that you must face, and as the project manager, you have to balance the needs of these constraints against the needs of the stakeholders and your project goals. For instance, if your sponsor wants to add functionality to the original scope, you will very likely need more money to finish the

project, or if they cut the budget, you will have to reduce the quality of your scope, and if you don't get the appropriate resources to work on your project tasks, you will have to extend your schedule because the resources you have take much longer to finish the work.

You get the idea; the constraints are all dependent on each other. Think of all of these constraints as the classic carnival game of Whac-a-mole (Figure 2.3 Whac-a-mole.). Each time you try to push one mole back in the hole, another one pops out. The best advice is to rely on your project team to keep these moles in place.

Here is an example of a project that cut quality because the project costs were fixed. The P-36 oil platform (Figure 2.4 The Petrobras P-36 oil platform. P36 No 010 by Richard Collinson) was the largest footing production platform in the world capable of processing 180,000 barrels of oil per day and 5.2 million cubic meters of gas per day. Located in the Roncador Field, Campos Basin, Brazil, the P-36 was operated by Petrobras.

In March 2001, the P-36 was producing around 84,000 barrels of oil and 1.3 million cubic meters of gas per day when it became destabilized by two explosions and subsequently sank in 3,900 feet of water with 1,650 short tons of crude oil remaining on board, killing 11 people. The sinking is attributed to a complete failure in quality assurance, and pressure for increased production led to corners being cut on safety procedures. It is listed as one of the most expensive accidents with a price tag of $515,000,000.

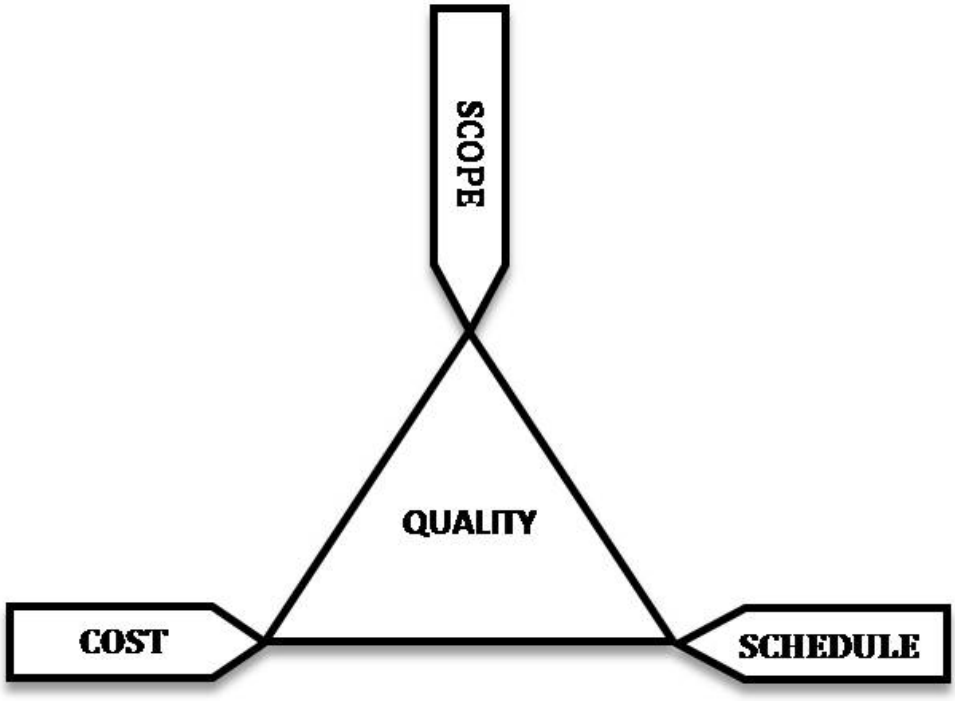


Figure 2.2 A schematic of the triple constraint triangle. The triad constraints by John M. Kennedy T. IIn this triangle, each side represents one of the constraints (or related constraints) wherein any changes to any one side cause a change in the other sides. The best projects have a perfectly balanced triangle. Maintaining this balance is difficult because projects are prone to change. For example, if scope increases, cost and time may increase disproportionately. Alternatively, if the amount of money you have for your project decreases, you may be able to do as much, but your time may increase.

(http://commons.wikimedia.org/wiki/ File:The_triad_constraints.jpg, https://creativecommons.org/ licenses/by-sa/3.0/) .

Figure 2.3 Whac-a-mole. Go to www.dorneypark.com/public/online fun/mole.cfm to play Whac-a-mole.

whack-a-mole by sakura

(https://www.flickr.com/photos/sa_ku_ra/18984918/sizes/o/, https://creativecommons.org/licenses/by-sa/2.0/) .

Figure 2.4 The Petrobras P-36 oil platform. P36 No 010 by Richard Collinson

(https://www.flickr.com/photos/richard_collinson/ 2083526793/sizes/o/, https://creativecommons.org/licenses/ by-nd/2.0/) .

The following quotes are from a Petrobras executive, citing the benefits of cutting quality assurance and inspection costs on the project, while the accompanying pictures are the result of this proud achievement in project management by Petrobras. The quotation is provided one sentence at a time and compared with pictures of the actual outcome.

“Petrobras has established new global benchmarks for the generation of exceptional shareholder wealth through an aggressive and innovative program of cost cutting on its P36 production facility.” “Conventional constraints have been successfully challenged and replaced with new paradigms appro priate to the globalized corporate market place.”

“Elimination of these unnecessary straitjackets has empowered the project’s suppliers and contractors to propose highly economical solutions, with the win-win bonus of enhanced profitability margins for themselves.”

“The P36 platform shows the shape of things to come in the unregulated global market economy of the 21st century.”

The dynamic trade-offs between the project constraint values have been humorously and accurately described in Figure 2.5 A sign seen at an automotive repair shop. .

2.5 Project Management Expertise

In order for you, as the project manager, to manage the competing project constraints and the project as a whole, there are some areas of expertise you should bring to the project team (Figure 2.6 Areas of expertise that a project manager should bring to the project team.). They are knowledge of the application area and the standards and regulations in your industry, understanding of the project environment, general management knowledge and skills, and interpersonal skills. It should be noted that industry expertise is not in a certain field but the expertise to run the project. So while knowledge of the type of industry is important, you will have a project team supporting you in this endeavor. For example, if you are managing a project that is building an oil platform, you would not be expected to have a detailed understanding of the engineering since your team will have mechanical and civil engineers who will provide the appropriate expertise; however, it would definitely help if you understood this type of work.

Let's take a look at each of these areas in more detail.

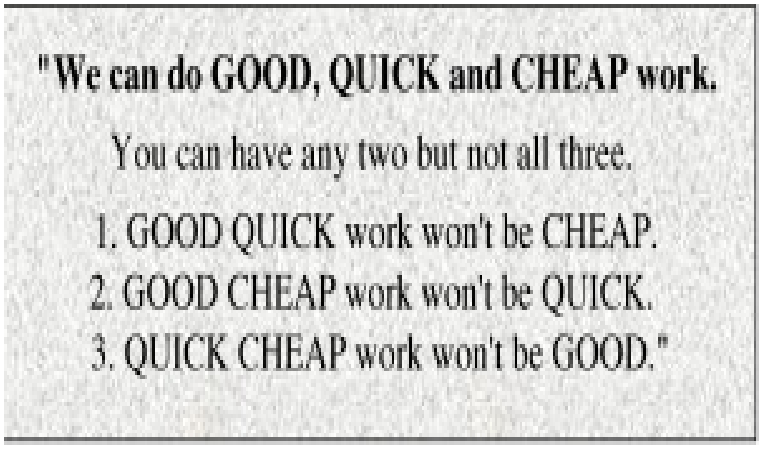


Figure 2.5 A sign seen at an automotive repair shop. Illustration from Barron & Barron Project Management for Scientists and Engineers.

(http://cnx.org/content/m31508/latest/?collection=col11120/1.4) .

2.6 Application knowledge

By standards, we mean guidelines or preferred approaches that are not necessarily mandatory. In contrast, when referring to regulations we mean mandatory rules that must be followed, such as government-imposed requirements through laws. It should go without saying that as a professional, you're required to follow all applicable laws and rules that apply to your industry, organization, or project. Every industry has standards and regulations. Knowing which ones affect your project before you begin

work will not only help the project to unfold smoothly, but will also allow for effective risk analysis.

Figure 2.6 Areas of expertise that a project manager should bring to the project team. Table from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Some projects require specific skills in certain application areas. Application areas are made up of categories of projects that have common elements. They can be defined by industry group (pharmaceutical, financial, etc.), department (accounting, marketing, legal, etc.), technology (software development, engineering, etc), or management specialties (procurement, research and development, etc.). These application areas are usually concerned with disciplines, regulations, and the specific needs of the project, the customer, or the industry. For example, most government agencies have specific procurement rules that apply to their projects that wouldn't be applicable in the construction industry. The pharmaceutical industry is interested in regulations set forth by government regulators, whereas the automotive industry has little or no concern for either of these types of regulations. You need to stay up-to-date regarding your industry so that you can apply your knowledge effectively. Today's fast-paced advances can leave you behind fairly quickly if you don't stay abreast of current trends.

Having some level of experience in the application area you're working in will give you an advantage when it comes to project management. While you can call in experts who have the application area knowledge, it doesn't hurt for you to understand the specific aspects of the application areas of your project.

2.7 Understanding the Project Environment

There are many factors that need to be understood within your project environment (Figure 2.7 The important factors to consider within the project environment.). At one level, you need to think in terms of the cultural and social environments (i.e., people, demographics, and education). The international and political environment is where you need to understand about different countries' cultural influences. Then we move

to the physical environment; here we think about time zones. Think about different countries and how differently your project will be executed whether it is just in your country or if it involves an international project team that is distributed throughout the world in five different countries.

Project Environment	
Cultural	Social
International	Political
Physical	

Figure 2.7 The important factors to consider within the project environment. Table from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Of all the factors, the physical ones are the easiest to understand, and it is the cultural and international factors that are often misunderstood or ignored. How we deal with clients, customers, or project members from other countries can be critical to the success of the project. For example, the culture of the United States values accomplishments and individualism. Americans tend to be informal and call each other by first names, even if having just met. Europeans tend to be more formal, using surnames instead of first names in a business setting, even if they know each other well. In addition, their communication style is more formal than in the United States, and while they tend to value individualism, they also value history, hierarchy, and loyalty. The Japanese, on the other hand, tend to communicate indirectly and consider themselves part of a group, not as individuals. The Japanese value hard work and success, as most of us do.

How a product is received can be very dependent on the international cultural differences. For example, in the 1990s, when many large American and European telecommunications companies were cultivating new markets in Asia, their customer's cultural differences often produced unexpected situations. Western companies planned their telephone systems to work the same way in Asia as they did in Europe and the United States. But the protocol of conversation was different. Call-waiting, a popular feature in the West, is considered impolite in some parts of Asia. This cultural blunder could have been avoided had the team captured the project environment requirements and involved the customer.

It is often the simplest things that can cause trouble since, unsurprisingly, in different countries, people do things differently. One of the most notorious examples of this is also one of the most simple: date formats. What day and month is 2/8/2009? Of course it depends where you come from; in North America it is February 8th while in Europe (and much of the rest of the world) it is 2nd August. Clearly, when schedules and deadlines are being defined it is important that everyone is clear on the format used.

The diversity of practices and cultures and its impact on products in general and on software in particular goes well beyond the date issue. You may be managing a project to create a new website for a company that sells products worldwide. There are language and presentation style issues to take into consideration; converting the site into different languages isn't enough. It is obvious that you need to ensure the translation is correct; however, the presentation layer will have its own set of requirements for different cultures. The left side of a website may be the first focus of attention for a Canadian; the right side would be the initial focus for anyone from the Middle East, as both Arabic and Hebrew are written from right to left. Colors also have different meanings in different cultures. White, which is a sign of purity in North America (e.g., a bride's wedding dress), and thus would be a favored background color in North America, signifies death in Japan (e.g., a burial shroud). Figure 2.8 The meaning of colors in various cultures. summarizes different meanings of common colors.

Color	United States	China	Japan	Egypt	France
Red	Danger, stop	Happiness	Anger, danger	Death	Aristocracy
Blue	Sadness, melancholy	Heavens, clouds	Villainy	Virtue, faith, truth	Freedom, peace
Green	Novice, apprentice	Ming dynasty, heavens	Future, youth, energy	Fertility, strength	Criminality
Yellow	Cowardice	Birth, wealth	Grace, nobility	Happiness, prosperity	Temporary
White	Purity	Death, purity	Death	Joy	Naturality

Figure 2.8 The meaning of colors in various cultures. Adapted from P. Russo and S. Boor, How Fluent is Your Interface? Designing for International Users, Proceedings of the INTERACT'93 and CHI'93, Association for Computing Machinery, Inc. (1993). Table from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Project managers in multicultural projects must appreciate the culture dimensions and try to learn relevant customs, courtesies, and business protocols before taking responsibility for managing an international project. A project manager must take into consideration these various cultural influences and how they may affect the project's completion, schedule, scope, and cost.

2.8 Management Knowledge and Skills

As the project manager, you have to rely on your project management knowledge and your general management skills. Here, we are thinking of items like your ability to plan the project, execute it properly, and of course control it and bring it to a successful

conclusion, along with your ability to guide the project team to achieve project objectives and balance project constraints.

There is more to project management than just getting the work done. Inherent in the process of project management are the general management skills that allow the project manager to complete the project with some level of efficiency and control. In some respects, managing a project is similar to running a business: there are risk and rewards, finance and accounting activities, human resource issues, time management, stress management, and a purpose for the project to exist. General management skills are needed in every project.

2.9 Interpersonal Skills

Last but not least you also have to bring the ability into the project to manage personal relationships and deal with personnel issues as they arise. Here were talking about your interpersonal skills as shown in Figure 2.9 Interpersonal skills required of a project manager. .

2.9.1 Communication

Project managers spend 90% of their time communicating. Therefore they must be good communicators, promoting clear, unambiguous exchange of information. As a project manager, it is your job to keep a number of people well informed. It is essential that your project staff know what is expected of them: what they have to do, when they have to do it, and what budget and time constraints and quality specifications they are working toward. If project staff members do not know what their tasks are, or how to accomplish them, then the entire project will grind to a halt. If you do not know what the project staff is (or often is not) doing, then you will be unable to monitor project progress. Finally, if you are uncertain of what the customer expects of you, then the project will not even get off the ground. Project communication can thus be summed up as knowing “who needs what information and when” and making sure they have it.

Interpersonal Skills	
Communication	Influence
Leadership	Motivation
Negotiation	Problem solving

Figure 2.9 Interpersonal skills required of a project manager. Table from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

All projects require sound communication plans, but not all projects will have the same types of communication or the same methods for distributing the information. For example, will information be distributed via mail or email, is there a shared website, or are face-to-face meetings required? The communication management plan documents how the communication needs of the stakeholders will be met, including the types of information that will be communicated, who will communicate them, and who will receive them; the methods used to communicate; the timing and frequency of communication; the method for updating the plan as the project progresses, including the escalation process; and a glossary of common terms.

2.9.2 Influence

Project management is about getting things done. Every organization is different in its policies, modes of operations, and underlying culture. There are political alliances, differing motivations, conflicting interests, and power struggles. A project manager must understand all of the unspoken influences at work within an organization.

2.9.3 Leadership

Leadership is the ability to motivate and inspire individuals to work toward expected results. Leaders inspire vision and rally people around common goals. A good project manager can motivate and inspire the project team to see the vision and value of the project. The project manager as a leader can inspire the project team to find a solution to overcome perceived obstacles to get the work done.

2.9.4 Motivation

Motivation helps people work more efficiently and produce better results. Motivation is a constant process that the project manager must guide to help the team move toward completion with passion and a profound reason to complete the work. Motivating the team is accomplished by using a variety of team-building techniques and exercises. Team building is simply getting a diverse group of people to work together in the most efficient and effective manner possible. This may involve management events as well as individual actions designed to improve team performance.

Recognition and rewards are an important part of team motivations. They are formal ways of recognizing and promoting desirable behavior and are most effective when carried out by the management team and the project manager. Consider individual preferences and cultural differences when using rewards and recognition. Some people don't like to be recognized in front of a group; others thrive on it.

2.9.5 Negotiation

Project managers must negotiate for the good of the project. In any project, the project manager, the project sponsor, and the project team will have to negotiate with stakeholders, vendors, and customers to reach a level of agreement acceptable to all parties involved in the negotiation process.

2.9.6 Problem Solving

Problem solving is the ability to understand the heart of a problem, look for a viable solution, and then make a decision to implement that solution. The starting point for problem solving is problem definition. Problem definition is the ability to understand the cause and effect of the problem; this centers on root-cause analysis. If a project manager treats only the symptoms of a problem rather than its cause, the symptoms will perpetuate and continue through the project life. Even worse, treating a symptom may result in a greater problem. For example, increasing the ampere rating of a fuse in your car because the old one keeps blowing does not solve the problem of an electrical short that could result in a fire. Root-cause analysis looks beyond the immediate symptoms to the cause of the symptoms, which then affords opportunities for solutions. Once the root of a problem has been identified, a decision must be made to effectively address the problem.

Solutions can be presented from vendors, the project team, the project manager, or various stakeholders. A viable solution focuses on more than just the problem; it looks at the cause and effect of the solution itself. In addition, a timely decision is needed or the window of opportunity may pass and then a new decision will be needed to address the problem. As in most cases, the worst thing you can do is nothing.

All of these interpersonal skills will be used in all areas of project management. Start practicing now because it's guaranteed that you'll need these skills on your next project.

2.10 Attribution

Chapter 3 The Project Life Cycle (Phases)

Adrienne Watt

The project manager and project team have one shared goal: to carry out the work of the project for the purpose of meeting the project's objectives. Every project has a beginning, a middle period during which activities move the project toward completion, and an ending (either successful or unsuccessful). A standard project typically has the following four major phases (each with its own agenda of tasks and issues): initiation, planning, implementation, and closure. Taken together, these phases represent the path a project takes from the beginning to its end and are generally referred to as the project "life cycle."

3.1 Initiation Phase

During the first of these phases, the initiation phase, the project objective or need is identified; this can be a business problem or opportunity. An appropriate response to the need is documented in a business case with recommended solution options. A feasibility study is conducted to investigate whether each option addresses the project objective and a final recommended solution is determined. Issues of feasibility ("can we do the project?") and justification ("should we do the project?") are addressed.

Once the recommended solution is approved, a project is initiated to deliver the approved solution and a project manager is appointed. The major deliverables and the participating work groups are identified, and the project team begins to take shape. Approval is then sought by the project manager to move onto the detailed planning phase.

3.2 Planning Phase

The next phase, the planning phase, is where the project solution is further developed in as much detail as possible and the steps necessary to meet the project's objective are planned. In this step, the team identifies all of the work to be done. The project's tasks and resource requirements are identified, along with the strategy for producing them. This is also referred to as "scope management." A project plan is created outlining the activities, tasks, dependencies, and time-frames. The project manager coordinates the preparation of a project budget by providing cost estimates for the

labor, equipment, and materials costs. The budget is used to monitor and control cost expenditures during project implementation.

Once the project team has identified the work, prepared the schedule, and estimated the costs, the three fundamental components of the planning process are complete. This is an excellent time to identify and try to deal with anything that might pose a threat to the successful completion of the project. This is called risk management. In risk management, “high-threat” potential problems are identified along with the action that is to be taken on each high-threat potential problem, either to reduce the probability that the problem will occur or to reduce the impact on the project if it does occur. This is also a good time to identify all project stakeholders and establish a communication plan describing the information needed and the delivery method to be used to keep the stakeholders informed.

Finally, you will want to document a quality plan, providing quality targets, assurance, and control measures, along with an acceptance plan, listing the criteria to be met to gain customer acceptance. At this point, the project would have been planned in detail and is ready to be executed.

3.3 Implementation (Execution) Phase

During the third phase, the implementation phase, the project plan is put into motion and the work of the project is performed. It is important to maintain control and communicate as needed during implementation. Progress is continuously monitored and appropriate adjustments are made and recorded as variances from the original plan. In any project, a project manager spends most of the time in this step. During project implementation, people are carrying out the tasks, and progress information is being reported through regular team meetings. The project manager uses this information to maintain control over the direction of the project by comparing the progress reports with the project plan to measure the performance of the project activities and take corrective action as needed. The first course of action should always be to bring the project back on course (i.e., to return it to the original plan). If that cannot happen, the team should record variations from the original plan and record and publish modifications to the plan. Throughout this step, project sponsors and other key stakeholders should be kept informed of the project’s status according to the agreed-on frequency and format of communication. The plan should be updated and published on a regular basis.

Status reports should always emphasize the anticipated end point in terms of cost, schedule, and quality of deliverables. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria. Once all of the deliverables have been produced and the customer has accepted the final solution, the project is ready for closure.

3.4 Closing Phase

During the final closure, or completion phase, the emphasis is on releasing the final deliverables to the customer, handing over project documentation to the business, terminating supplier contracts, releasing project resources, and communicating the closure of the project to all stakeholders. The last remaining step is to conduct lessons-learned studies to examine what went well and what didn't. Through this type of analysis, the wisdom of experience is transferred back to the project organization, which will help future project teams.

Example: Project Phases on a Large Multinational Project

A U.S. construction company won a contract to design and build the first copper mine in northern Argentina. There was no existing infrastructure for either the mining industry or large construction projects in this part of South America. During the initiation phase of the project, the project manager focused on defining and finding a project leadership team with the knowledge, skills, and experience to manage a large complex project in a remote area of the globe. The project team set up three offices. One was in Chile, where large mining construction project infrastructure existed. The other two were in Argentina. One was in Buenos Aries to establish relationships and Argentinian expertise, and the second was in Catamarca—the largest town close to the mine site. With offices in place, the project start-up team began devel oping procedures for getting work done, acquiring the appropriate permits, and developing relationships with Chilean and Argentine partners.

During the planning phase, the project team developed an integrated project schedule that coordinated the activities of the design, procurement, and construction teams. The project controls team also developed a detailed budget that enabled the project team to track project expenditures against the expected expenses. The project design team built on the conceptual design and developed detailed drawings for use by the procurement team. The procurement team used the drawings to begin ordering equipment and materials for the construction team; develop labor projections; refine the construction schedule; and set up the construction site. Although planning is a never-ending process on a project, the planning phase focused on developing sufficient details to allow various parts of the project team to coordinate their work and allow the project management team to make priority decisions.

The implementation phase represents the work done to meet the requirements of the scope of work and fulfill the charter. During the implementation phase, the project team accomplished the work defined in the plan and made adjustments when the project factors changed. Equipment and materials were delivered to the work site, labor was hired and trained, a construction site was built, and all the construction activities, from the arrival of the first dozer to the installation of the final light switch, were accomplished.

The closeout phase included turning over the newly constructed plant to the operations team of the client. A punch list of a few remaining construction items was developed and those items completed. The office in Catamarca was closed, the office in Buenos Aries archived all the project documents, and the Chilean office was already working on

the next project. The accounting books were reconciled and closed, final reports written and distributed, and the project manager started on a new project.

3.5 Attribution

Chapter 4 Framework for Project Management

Adrienne Watt

Many different professions contribute to the theory and practice of project management. Engineers and architects have been managing major projects since pre-history. Since approximately the 1960s, there have been efforts to professionalize the practice of project management as a specialization of its own. There are many active debates around this: Should project management be a profession in the same way as engineering, accounting, and medicine? These have professional associations that certify who is legally allowed to use the job title, and who can legally practice the profession. They also provide a level of assurance of quality and discipline members who behave inappropriately. Another ongoing debate is: How much industry knowledge is required of a seasoned project manager? How easily can a project manager from one industry, say, IT, transition to another industry such as hospitality?

There are two major organizations with worldwide impact on the practice of project management: the Project Management Institute (PMI), with world headquarters in the United States, and the International Project Management Association (IPMA), with world headquarters in Switzerland. This textbook takes an approach that is closer to the PMI approach (http://www.pmi.org). More details are included in this chapter, along with a section on the project management office.

4.1 Project Management Institute Overview

Five volunteers founded the Project Management Institute (PMI) in 1969. Their initial goal was to establish an organization where members could share their experiences in project management and discuss issues. Today, PMI is a non-profit project management professional association and the most widely recognized organization in terms of promoting project management best practices. PMI was formed to serve the interests of the project management industry. The premise of PMI is that the tools and techniques of project management are common even among the widespread application of projects from the software to the construction industry. PMI first began offering the Project Management Professional (PMP) certification exam in 1984. Although it took a while for people to take notice, now more than 590,000 individuals around the world hold the PMP designation.

To help keep project management terms and concepts clear and consistent, PMI introduced the book *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* in 1987. It was updated it in 1996, 2000, 2004, 2009, and most recently in 2013

as the fifth edition. At present, there are more than one million copies of the *PMBOK Guide* in circulation. The highly regarded Institute of Electrical and Electronics Engineers (IEEE) has adopted it as their project management standard. In 1999 PMI was accredited as an American National Standards Institute (ANSI) standards developer and also has the distinction of being the first organization to have its certification program attain International Organization for Standardization (ISO) 9001 recognition. In 2008, the organization reported more than 260,000 members in over 171 countries. PMI has its headquarters in Pennsylvania, United States, and also has offices in Washington, DC, and in Canada, Mexico, and China, as well as having regional service centers in Singapore, Brussels (Belgium), and New Delhi (India). Recently, an office was opened in Mumbai (India).

Because of the importance of projects, the discipline of project management has evolved into a working body of knowledge known as PMBOK – Project Management Body of Knowledge. The PMI is responsible for developing and promoting PMBOK. PMI also administers a professional certification program for project managers, the PMP. So if you want to get grounded in project management, PMBOK is the place to start, and if you want to make project management your profession, then you should consider becoming a PMP.

4.2 So what is PMBOK?

PMBOK is the fundamental knowledge you need for managing a project, categorized into 10 knowledge areas:

1. Managing integration: Projects have all types of activities going on and there is a need to keep the “whole” thing moving collectively – integrating all of the dynamics that take place. Managing integration is about developing the project charter, scope statement, and plan to direct, manage, monitor, and control project change.
2. Managing scope: Projects need to have a defined parameter or scope, and this must be broken down and managed through a work breakdown structure or WBS. Managing scope is about planning, definition, WBS creation, verification, and control.
3. Managing time/schedule: Projects have a definite beginning and a definite ending date. Therefore, there is a need to manage the budgeted time according to a project schedule. Managing time/schedule is about definition, sequencing, resource and duration estimating, schedule development, and schedule control.
4. Managing costs: Projects consume resources, and therefore, there is a need to manage the investment with the realization of creating value (i.e., the benefits derived exceed the amount spent). Managing costs is about resource planning, cost estimating, budgeting, and control.
5. Managing quality: Projects involve specific deliverables or work products. These deliverables need to meet project objectives and performance standards. Managing quality is about quality planning, quality assurance, and quality control.

6. Managing human resources: Projects consist of teams and you need to manage project team(s) during the life cycle of the project. Finding the right people, managing their outputs, and keeping them on schedule is a big part of managing a project. Managing human resources is about human resources planning, hiring, and developing and managing a project team.
7. Managing communication: Projects invariably touch lots of people, not just the end users (customers) who benefit directly from the project outcomes. This can include project participants, managers who oversee the project, and external stakeholders who have an interest in the success of the project. Managing communication is about communications planning, information distribution, performance reporting, and stakeholder management.
8. Managing risk: Projects are a discovery-driven process, often uncovering new customer needs and identifying critical issues not previously disclosed. Projects also encounter unexpected events, such as project team members resigning, budgeted resources suddenly changing, the organization becoming unstable, and newer technologies being introduced. There is a real need to properly identify various risks and manage these risks. Managing risk is about risk planning and identification, risk analysis (qualitative and quantitative), risk response (action) planning, and risk monitoring and control.
9. Managing procurement: Projects procure the services of outside vendors and contractors, including the purchase of equipment. There is a need to manage how vendors are selected and managed within the project life cycle. Managing procurement is about acquisition and contracting plans, sellers' responses and selections, contract administration, and contract closure.
10. Managing stakeholders: Every project impacts people and organizations and is impacted by people and organizations. Identifying these stakeholders early, and as they arise and change throughout the project, is a key success factor. Managing stakeholders is about identifying stakeholders, their interest level, and their potential to influence the project; and managing and controlling the relationships and communications between stakeholders and the project.

This is the big framework for managing projects and if you want to be effective in managing projects, then you need to be effective in managing each of the 10 knowledge areas that make up PMBOK (see Figure 4.1 PM Star Model suggested by GeekDisplaced)

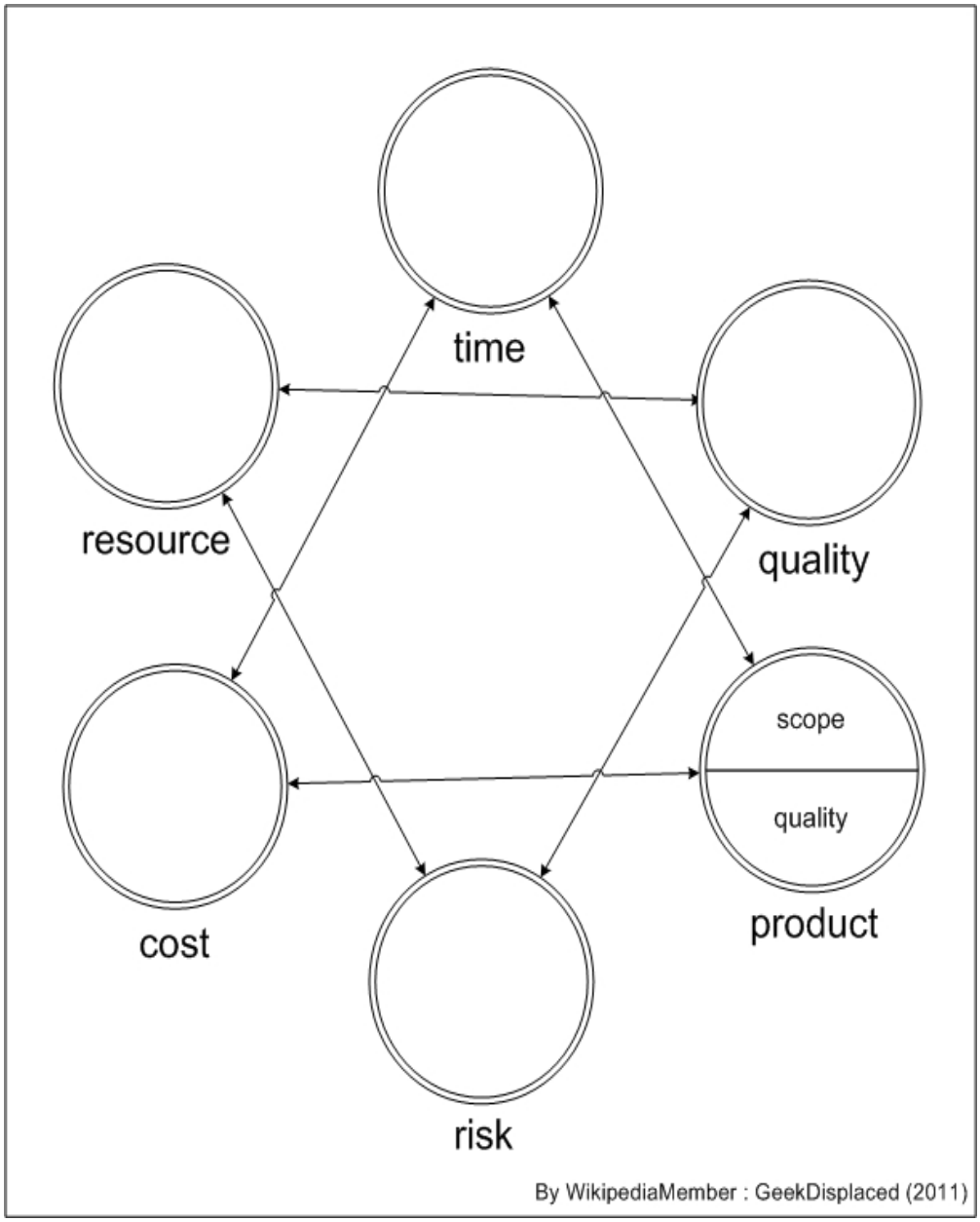


Figure 4.1 PM Star Model suggested by GeekDisplaced

Certification in project management is available from the PMI, PRINCE2, ITIL, Critical Chain, and others. Agile project management methodologies (Scrum, extreme programming, Lean Six Sigma, others) also have certifications.

4.3 Introduction to the Project Management Knowledge Areas

As discussed above, projects are divided into components, and a project manager must be knowledgeable in each area. Each of these areas of knowledge will be

explored in more depth in subsequent chapters. For now, let's look at them in a little more detail to prepare you for the chapters that follow.

4.3.1 Project Start-Up and Integration

The start-up of a project is similar to the start-up of a new organization. The project leader develops the project infrastructure used to design and execute the project. The project management team must develop alignment among the major stakeholders—those who have a share or interest—on the project during the early phases or definition phases of the project. The project manager will conduct one or more kickoff meetings or alignment sessions to bring the various parties of the project together and begin the project team building required to operate efficiently during the project.

During project start-up, the project management team refines the scope of work and develops a preliminary schedule and conceptual budget. The project team builds a plan for executing the project based on the project profile. The plan for developing and tracking the detailed schedule, the procurement plan, and the plan for building the budget and estimating and tracking costs are developed during the start-up. The plans for information technology, communication, and tracking client satisfaction are also all developed during the start-up phase of the project.

Flowcharts, diagrams, and responsibility matrices are tools to capture the work processes associated with executing the project plan. The first draft of the project procedures manual captures the historic and intuitional knowledge that team members bring to the project. The development and review of these procedures and work processes contribute to the development of the organizational structure of the project.

This is typically an exciting time on a project where all things are possible. The project management team is working many hours developing the initial plan, staffing the project, and building relationships with the client. The project manager sets the tone of the project and sets expectations for each of the project team members. The project start-up phase on complex projects can be chaotic, and until plans are developed, the project manager becomes the source of information and direction. The project manager creates an environment that encourages team members to fully engage in the project and encourages innovative approaches to developing the project plan.

4.3.2 Project Scope

The project scope is a document that defines the parameters—factors that define a system and determine its behavior—of the project, what work is done within the boundaries of the project, and the work that is outside the project boundaries. The

scope of work (SOW) is typically a written document that defines what work will be accomplished by the end of the project—the deliverables of the project. The project scope defines what will be done, and the project execution plan defines how the work will be accomplished.

No template works for all projects. Some projects have a very detailed scope of work, and some have a short summary document. The quality of the scope is measured by the ability of the project manager and project stakeholders to develop and maintain a common understanding of what products or services the project will deliver. The size and detail of the project scope is related to the complexity profile of the project. A more complex project often requires a more detailed and comprehensive scope document.

According to the PMI, the scope statement should include the following:

- Description of the scope
- Product acceptance criteria
- Project deliverables
- Project exclusions
- Project constraints
- Project assumptions

The scope document is the basis for agreement by all parties. A clear project scope document is also critical to managing change on a project. Since the project scope reflects what work will be accomplished on the project, any change in expectations that is not captured and documented creates the opportunity for confusion. One of the most common trends on projects is the incremental expansion in the project scope. This trend is labeled “scope creep.” Scope creep threatens the success of a project because the small increases in scope require additional resources that were not in the plan. Increasing the scope of the project is a common occurrence, and adjustments are made to the project budget and schedule to account for these changes. Scope *creep* occurs when these changes are not recognized or not managed. The ability of a project manager to identify potential changes is often related to the quality of the scope documents.

Events do occur that require the scope of the project to change. Changes in the marketplace may require change in a product design or the timing of the product delivery. Changes in the client’s management team or the financial health of the client may also result in changes in the project scope. Changes in the project schedule, budget, or product quality will have an effect on the project plan. Generally, the later in the project the change occurs, the greater the increase to the project costs. Establishing a change management system for the project that captures changes to the project scope and assures that these changes are authorized by the appropriate level of management in the client’s organization is the responsibility of the project manager. The project manager also analyzes the cost and schedule impact of these changes and adjusts the project plan to reflect the changes authorized by the client. Changes to the scope can cause costs to increase or decrease.

4.3.3 Project Schedule and Time Management

The definition of project success often includes completing the project on time. The development and management of a project schedule that will complete the project on time is a primary responsibility of the project manager, and completing the project on time requires the development of a realistic plan and the effective management of the plan. On smaller projects, project managers may lead the development of the project plan and build a schedule to meet that plan. On larger and more complex projects, a project controls team that focuses on both costs and schedule planning and controlling functions will assist the project management team in developing the plan and tracking progress against the plan.

To develop the project schedule, the project team does an analysis of the project scope, contract, and other information that helps the team define the project deliverables. Based on this information, the project team develops a milestone schedule. The milestone schedule establishes key dates throughout the life of a project that must be met for the project to finish on time. The key dates are often established to meet contractual obligations or established intervals that will reflect appropriate progress for the project. For less complex projects, a milestone schedule may be sufficient for tracking the progress of the project. For more complex projects, a more detailed schedule is required.

To develop a more detailed schedule, the project team first develops a work breakdown structure (WBS)—a description of tasks arranged in layers of detail. Although the project scope is the primary document for developing the WBS, the WBS incorporates all project deliverables and reflects any documents or information that clarifies the project deliverables. From the WBS, a project plan is developed. The project plan lists the activities that are needed to accomplish the work identified in the WBS. The more detailed the WBS, the more activities that are identified to accomplish the work.

After the project team identifies the activities, the team sequences the activities according to the order in which the activities are to be accomplished. An outcome from the work process is the project logic diagram. The logic diagram represents the logical sequence of the activities needed to complete the project. The next step in the planning process is to develop an estimation of the time it will take to accomplish each activity or the activity duration. Some activities must be done sequentially, and some activities can be done concurrently. The planning process creates a project schedule by scheduling activities in a way that effectively and efficiently uses project resources and completes the project in the shortest time.

On larger projects, several paths are created that represent a sequence of activities from the beginning to the end of the project. The longest path to the completion of the project is the critical path. If the critical path takes less time than is allowed by the client to complete the project, the project has a positive total float or project slack. If the client's project completion date precedes the calculated critical path end date, the

project has a negative float. Understanding and managing activities on the critical path is an important project management skill.

To successfully manage a project, the project manager must also know how to accelerate a schedule to compensate for unanticipated events that delay critical activities. Compressing—crashing—the schedule is a term used to describe the techniques used to shorten the project schedule. During the life of the project, scheduling conflicts often occur, and the project manager is responsible for reducing these conflicts while maintaining project quality and meeting cost goals.

4.3.4 Project Costs

The definition of project success often includes completing the project within budget. Developing and controlling a project budget that will accomplish the project objectives is a critical project management skill. Although clients expect the project to be executed efficiently, cost pressures vary on projects. On some projects, the project completion or end date is the largest contributor to the project complexity. The development of a new drug to address a critical health issue, the production of a new product that will generate critical cash flow for a company and the competitive advantage for a company to be first in the marketplace with a new technology are examples of projects with schedule pressures that override project costs.

The accuracy of the project budget is related to the amount of information known by the project team. In the early stages of the project, the amount of information needed to develop a detailed budget is often missing. To address the lack of information, the project team develops different levels of project budget estimates. The conceptual estimate (or “ballpark estimate”) is developed with the least amount of knowledge. The major input into the conceptual estimate is expert knowledge or past experience. A project manager who has executed a similar project in the past can use those costs to estimate the costs of the current project.

When more information is known, the project team can develop a rough order of magnitude (ROM) estimate. Additional information such as the approximate square feet of a building, the production capacity of a plant, and the approximate number of hours needed to develop a software program can provide a basis for providing a ROM estimate. After a project design is more complete, a project detailed estimate can be developed. For example, when the project team knows the number of rooms, the type of materials, and the building location of a home, they can provide a detailed estimate. A detailed estimate is not a bid.

The cost of the project is tracked relative to the progress of the work and the estimate for accomplishing that work. Based on the cost estimate, the cost of the work performed is compared against the cost budgeted for that work. If the cost is significantly higher or lower, the project team explores reasons for the difference between expected costs and actual costs.

Project costs may deviate from the budget because the prices in the marketplace were different from what was expected. For example, the estimated costs for lumber on a

housing project may be higher than budgeted or the hourly cost for labor may be lower than budgeted. Project costs may also deviate based on project performance. For example, a project team estimated that the steel design for a bridge over a river would take 800 labor hours, but 846 hours were actually expended. The project team captures the deviation between costs budgeted for work and the actual cost for work, revises the estimate as needed, and takes corrective action if the deviation appears to reflect a trend.

The project manager is responsible for assuring that the project team develops cost estimates based on the best information available and revises those estimates as new or better information becomes available. The project manager is also responsible for tracking costs against the budget and conducting an analysis when project costs deviate significantly from the project estimate. The project manager then takes appropriate corrective action to ensure that project performance matches the revised project plan.

4.3.5 Project Quality

Project quality focuses on the end product or service deliverables that reflect the purpose of the project. The project manager is responsible for developing a project execution approach that provides for a clear understanding of the expected project deliverables and the quality specifications. The project manager of a housing construction project not only needs to understand which rooms in the house will be carpeted but also what grade of carpet is needed. A room with a high volume of traffic will need a high-grade carpet.

The project manager is responsible for developing a project quality plan that defines the quality expectations and ensures that the specifications and expectations are met. Developing a good understanding of the project deliverables through documenting specifications and expectations is critical to a good quality plan. The processes for ensuring that the specifications and expectations are met are integrated into the project execution plan. Just as the project budget and completion dates may change over the life of a project, the project specifications may also change. Changes in quality specifications are typically managed in the same process as cost or schedule changes. The impact of the changes is analyzed for impact on cost and schedule, and with appropriate approvals, changes are made to the project execution plan.

The PMI's *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* has an extensive chapter on project quality management. The material found in this chapter would be similar to material found in a good operational management text.

Although any of the quality management techniques designed to make incremental improvement to work processes can be applied to a project work process, the character of a project (unique and relatively short in duration) makes small improvements less attractive on projects. Rework on projects, as with manufacturing operations, increases the cost of the product or service and often increases the time needed to complete the reworked activities. Because of the duration constraints of a

project, the development of the appropriate skills, materials, and work processes early in the project is critical to project success. On more complex projects, time is allocated to developing a plan to understand and develop the appropriate levels of skills and work processes.

Project management organizations that execute several similar types of projects may find process improvement tools useful in identifying and improving the baseline processes used on their projects. Process improvement tools may also be helpful in identifying cost and schedule improvement opportunities. Opportunities for improvement must be found quickly to influence project performance. The investment in time and resources to find improvements is greatest during the early stages of the project, when the project is in the planning stages. During later project stages, as pressures to meet project schedule goals increase, the culture of the project is less conducive to making changes in work processes.

Another opportunity for applying process improvement tools is on projects that have repetitive processes. A housing contractor that is building several identical houses may benefit from evaluating work processes in the first few houses to explore the opportunities available to improve the work processes. The investment of $1,000 in a work process that saves $200 per house is a good investment as long as the contractor is building more than five houses.

4.3.6 Project Team: Human Resources and Communications

Staffing the project with the right skills, at the right place, and at the right time is an important responsibility of the project management team. The project usually has two types of team members: functional managers and process managers. The functional managers and team focus on the technology of the project. On a construction project, the functional managers would include the engineering manager and construction superintendents. On a training project, the functional manager would include the professional trainers; on an information technology project, the software development managers would be functional managers. The project management team also includes project process managers. The project controls team would include process managers who have expertise in estimating, cost tracking, planning, and scheduling. The project manager needs functional and process expertise to plan and execute a successful project.

Because projects are temporary, the staffing plan for a project typically reflects both the long-term goals of skilled team members needed for the project and short-term commitment that reflects the nature of the project. Exact start and end dates for team members are often negotiated to best meet the needs of individuals and the project. The staffing plan is also determined by the different phases of the project. Team members needed in the early or conceptual phases of the project are often not needed during the later phases or project closeout phases. Team members needed during the implementation phase are often not needed during the conceptual or closeout phases. Each phase has staffing requirements, and the staffing of a complex

project requires detailed planning to have the right skills, at the right place, at the right time.

Typically a core project management team is dedicated to the project from start-up to closeout. This core team would include members of the project management team: project manager, project controls, project procurement, and key members of the function management or experts in the technology of the project. Although longer projects may experience more team turnover than shorter projects, it is important on all projects to have team members who can provide continuity through the project phases.

For example, on a large commercial building project, the civil engineering team that designs the site work where the building will be constructed would make their largest contribution during the early phases of the design. The civil engineering lead would bring on different civil engineering specialties as they were needed. As the civil engineering work is completed and the structural engineering is well underway, a large portion of the civil engineers would be released from the project. The functional managers, the engineering manager, and civil engineering lead would provide expertise during the entire length of the project, addressing technical questions that may arise and addressing change requests.

Project team members can be assigned to the project from a number of different sources. The organization that charters the project can assign talented managers and staff from functional units within the organization, contract with individuals or agencies to staff positions on the project, temporarily hire staff for the project, or use any combination of these staffing options. This staffing approach allows the project manager to create the project organizational culture. Some project cultures are more structured and detail oriented, and some are less structured with less formal roles and communication requirements. The type of culture the project manager creates depends greatly on the type of project.

4.3.7 Communications

Completing a complex project successfully requires teamwork, and teamwork requires good communication among team members. If those team members work in the same building, they can arrange regular meetings, simply stop by each other's office space to get a quick answer, or even discuss a project informally at other office functions. Many complex projects in today's global economy involve team members from widely separated locations, and the types of meetings that work within the same building are not possible. Teams that use electronic methods of communicating without face-to-face meetings are called virtual teams.

Communicating can be divided into two categories: synchronous and asynchronous. If all the parties to the communication are taking part in the exchange at the same time, the communication is synchronous. A telephone conference call is an example of synchronous communication. When the participants are not interacting at the same time, the communication is asynchronous. (The letter *a* at the beginning of the word

means *not*.) Communications technologies require a variety of compatible devices, software, and service providers, and communication with a global virtual team can involve many different time zones. Establishing effective communications requires a communications plan.

4.3.8 Project Risk

Risk exists on all projects. The role of the project management team is to understand the kinds and levels of risks on the project and then to develop and implement plans to mitigate these risks. Risk represents the likelihood that an event will happen during the life of the project that will negatively affect the achievement of project goals. The type and amount of risk varies by industry type, complexity, and phase of the project. The project risk plan will also reflect the risk profile of the project manager and key stakeholders. People have different comfort levels with risk, and some members of the project team will be more risk averse than others.

The first step in developing a risk management plan involves identifying potential project risks. Some risks are easy to identify, such as the potential for a damaging storm in the Caribbean, and some are less obvious. Many industries or companies have risk checklists developed from past experience. The Construction Industry Institute published a 100-item risk checklist that provides examples and areas of project risks. No risk checklist will include all potential risks. The value of a checklist is the stimulation of discussion and thought about the potential risks on a project.

The project team analyzes the identified risks and estimates the likelihood of the risks occurring. The team then estimates the potential impact on project goals if the event does occur. The outcome from this process is a prioritized list of estimated project risks with a value that represents the likelihood of occurrence and the potential impact on the project.

The project team then develops a risk mitigation plan that reduces the likelihood of an event occurring or reduces the impact on the project if the event does occur. The risk management plan is integrated into the project execution plan, and mitigation activities are assigned to the appropriate project team member. The likelihood that all the potential events identified in the risk analysis would occur is extremely rare. The likelihood that one or more events will happen is high.

The project risk plan reflects the risk profile of the project and balances the investment of the mitigation against the benefit for the project. One of the more common risk mitigation approaches is the use of contingency. Contingency is funds set aside by the project team to address unforeseen events. Projects with a high-risk profile will typically have a large contingency budget. If the team knows which activities have the highest risk, contingency can be allocated to activities with the highest risk. When risks are less identifiable to specific activities, contingency is identified in a separate line item. The plan includes periodic risk-plan reviews during the life of the project. The risk review evaluates the effectiveness of the current plan and explores possible risks not identified in earlier sessions.

4.3.9 Project Procurement

The procurement effort on projects varies widely and depends on the type of project. Often the client organization will provide procurement services on less complex projects. In this case, the project team identifies the materials, equipment, and supplies needed by the project and provides product specifications and a detailed delivery schedule. When the procurement department of the parent organization provides procurement services, a liaison from the project can help the procurement team better understand the unique requirements of the project and the time-sensitive or critical items of the project schedule.

On larger, more complex projects, personnel are dedicated to procuring and managing the equipment, supplies, and materials needed by the project. Because of the temporary nature of projects, equipment, supplies, and materials are procured as part of the product of the project or for the execution of the project. For example, the bricks procured for a construction project would be procured for the product of the project, and the mortar mixer would be equipment procured for the execution of the project work. At the end of the project, equipment bought or rented for the execution of the work of the project are sold, returned to rental organizations, or disposed of some other way.

More complex projects will typically procure through different procurement and management methods. Commodities are common products that are purchased based on the lowest bid. Commodities include items like concrete for building projects, office supplies, or even lab equipment for a research project. The second type of procurement includes products that are specified for the project. Vendors who can produce these products bid for a contract. The awarding of a contract can include price, ability to meet the project schedule, the fit for purpose of the product, and other considerations important to the project. Manufacturing a furnace for a new steel mill would be provided by a project vendor. Equipment especially designed and built for a research project is another example. These vendors' performances become important parts of the project, and the project manager assigns resources to coordinate the work and schedule of the vendor. The third procurement approach is the development of one or more partners. A design firm that is awarded the design contract for a major part of the steel mill and a research firm that is conducting critical subparts of the research are examples of potential project partners. A partner contributes to and is integrated into the execution plan. Partners perform best when they share the project vision of success and are emotionally invested in the project. The project management team builds and implements a project procurement plan that recognizes the most efficient and effective procurement approach to support the project schedule and goals.

4.3.10 Project Stakeholder Management

People and organizations can have many different relationships to the project. Most commonly, these relationships can be grouped into those who will be impacted by the project and those who can impact the project.

A successful project manager will identify stakeholders early in the project. For each stakeholder, it is important to identify what they want or need and what influence or power they have over the project. Based on this information, the need to communicate with the stakeholder or stakeholder group can be identified, followed by the creation of a stakeholder management plan. A stakeholder register is used to identify and track the interactions between the project and each stakeholder. This register must be updated on a regular basis, as new stakeholders can arise at any time, and the needs and interest levels of a particular stakeholder may change through the course of the project.

Knowledge Area	Initiating	Planning	Executing	Monitoring and Controlling	Closing
Project Integration Management	• Develop Project Charter	• Develop Project Management Plan		• Monitor and Control Project Work • Perform Integrated Change Control	• Close Project or Phase
Project Scope Management		• Plan Scope Management • Collect Requirements • Define Scope • Create WBS		• Validate Scope • Control Scope	
Project Time Management		• Plan Schedule Management • Define Activities • Sequence Activities • Estimate Activity Resources • Estimate Activity Durations • Develop Schedule		• Control Schedule	
Project Cost Management		• Plan Cost Management • Estimate Costs • Determine Budget		• Control Costs	
Project Quality Management		• Plan Quality Management	• Perform Quality Assurance	• Control Quality	

Figure 4.2 Stakeholder Register

. Source: A. Watt.

4.3.11 Scrum Development Overview

“Scrum” is another formal project management/product development methodology and part of agile project management. Scrum is a term from rugby (scrimmage) that

means a way of restarting a game. It's like restarting the project efforts every X weeks. It's based on the idea that you do not really know how to plan the whole project up front, so you start and build empirical data, and then re-plan and iterate from there.

Scrum uses sequential sprints for development. Sprints are like small project phases (ideally two to four weeks). The idea is to take one day to plan for what can be done now, then develop what was planned for, and demonstrate it at the end of the sprint. Scrum uses a short daily meeting of the development team to check what was done yesterday, what is planned for the next day, and what if anything is impeding the team members from accomplishing what they have committed to. At the end of the sprint, what has been demonstrated can then be tested, and the next sprint cycle starts.

Scrum methodology defines several major roles. They are:

- Product owners: essentially the business owner of the project who knows the industry, the market, the customers, and the business goals of the project. The product owner **must** be intimately involved with the Scrum process, especially the planning and the demonstration parts of the sprint.
- Scrum Master: somewhat like a project manager, but not exactly. The Scrum Master's duties are essentially to remove barriers that impede the progress of the development team, teach the product owner how to maximize return on investment (ROI) in terms of development effort, facilitate creativity and empowerment of the team, improve the productivity of the team, improve engineering practices and tools, run daily standup meetings, track progress, and ensure the health of the team.
- Development team: self-organizing (light-touch leadership), empowered group; they participate in planning and estimating for each sprint, do the development, and demonstrate the results at the end of the sprint. It has been shown that the ideal size for a development team is 7 +/- 2. The development team can be broken into "teamlets" that "swarm" on user stories, which are created in the sprint planning session.

Typically, the way a product is developed is that there is a "front burner" (which has stories/tasks for the current sprint), a "back burner" (which has stories for the next sprint), and a "fridge" (which has stories for later, as well as process changes). One can look at a product as having been broken down like this: product -> features -> stories -> tasks.

Often effort estimations are done using "story points" (tiny = 1 SP, small = 2 SP, medium = 4 SP, large = 8 SP, big = 16+ SP, unknown = ? SP) Stories can be of various types. User stories are very common and are descriptions of what the user can do and what happens as a result of different actions from a given starting point. Other types of stories are from these areas: analysis, development, QA, documentation, installation, localization, and training.

Planning meetings for each sprint require participation by the product owner, the Scrum Master, and the development team. In the planning meeting, they set the goals for the upcoming sprint and select a subset of the product backlog (proposed stories) to work on. The development team decomposes stories to tasks and estimates them.

The development team and product owner do final negotiations to determine the backlog for the following sprint.

The Scrum methodology uses metrics to help with future planning and tracking of progress; for example, “burn down” – the number of hours remaining in the sprint versus the time in days; “velocity” – essentially, the amount of effort the team expends. (After approximately three sprints with the same team, one can get a feel for what the team can do going forward.)

Some caveats about using Scrum methodology: 1) You need committed, mature developers; 2) You still need to do major requirements definition, some analysis, architecture definition, and definition of roles and terms up front or early; 3) You need commitment from the company and the product owner; and 4) It is best for products that require frequent new releases or updates, and less effective for large, totally new products that will not allow for frequent upgrades once they are released.

4.3.12 The Project Management Office

Many large and even medium-sized organizations have created a department to oversee and support projects throughout the organization. This is an attempt to reduce the high numbers of failed projects (see the Project Management Overview chapter.) These offices are usually called the project management office or PMO.

The PMO may be the home of all the project managers in an organization, or it may simply be a resource for all project managers, who report to their line areas.

Typical objectives of a PMO are:

- Help ensure that projects are aligned with organizational objectives
- Provide templates and procedures for use by project managers
- Provide training and mentorship
- Provide facilitation
- Stay abreast of the latest trends in project management
- Serve as a repository for project reports and lessons learned

The existence and role of PMOs tends to be somewhat fluid. If a PMO is created, and greater success is not experienced in organizational projects, the PMO is at risk of being disbanded as a cost-saving measure. If an organization in which you are a project manager or a project team member has a PMO, try to make good use of the resources available. If you are employed as a resource person in a PMO, remember that your role is not to get in the way and create red tape, but to enable and enhance the success of project managers and projects within the organization.

4.4 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported and Project Management From Simple to Complex by Russel Darnall, John Preston, Eastern Michigan University licensed under Creative Commons Attribution 3.0 Unported.

Chapter 5 Stakeholder Management

Adrienne Watt

A project is successful when it achieves its objectives and meets or exceeds the expectations of the stakeholders. But who are the stakeholders? Stakeholders are individuals who either care about or have a vested interest in your project. They are the people who are actively involved with the work of the project or have something to either gain or lose as a result of the project. When you manage a project to add lanes to a highway, motorists are stakeholders who are positively affected. However, you negatively affect residents who live near the highway during your project (with construction noise) and after your project with far-reaching implications (increased traffic noise and pollution).

The project sponsor, generally an executive in the organization with the authority to assign resources and enforce decisions regarding the project, is a stakeholder. The customer, subcontractors, suppliers, and sometimes even the government are stakeholders. The project manager, project team members, and the managers from other departments in the organization are stakeholders as well. It's important to identify all the stakeholders in your project upfront. Leaving out important stakeholders or their department's function and not discovering the error until well into the project could be a project killer.

Figure 5.1 Project stakeholders. Illustration from Barron & Barron Project Management for Scientists and Engineers shows a sample of the project environment featuring the different kinds of stakeholders involved on a typical project. A study of this diagram confronts us with a couple of interesting facts.

First, the number of stakeholders that project managers must deal with ensures that they will have a complex job guiding their project through the lifecycle. Problems with any of these members can derail the project.

Second, the diagram shows that project managers have to deal with people external to the organization as well as the internal environment, certainly more complex than what a manager in an internal environment faces. For example, suppliers who are late in delivering crucial parts may blow the project schedule. To compound the problem, project managers generally have little or no direct control over any of these individuals.

NOTE: Key stakeholders can make or break success of a project. Even if all the deliverables are met and the objectives are satisfied, if your key stake-holders aren't happy, nobody's happy.

Let's take a look at these stakeholders and their relationships to the project manager.

5.1 Project Stakeholders

5.1.1 Top Management

Top management may include the president of the company, vice-presidents, directors, division managers, the corporate operating committee, and others. These people direct the strategy and development of the organization.

On the plus side, you are likely to have top management support, which means it will be easier to recruit the best staff to carry out the project, and acquire needed material and resources; also visibility can enhance a project manager's professional standing in the company.

On the minus side, failure can be quite dramatic and visible to all, and if the project is large and expensive (most are), the cost of failure will be more substantial than for a smaller, less visible project.

Some suggestions in dealing with top management are:

,

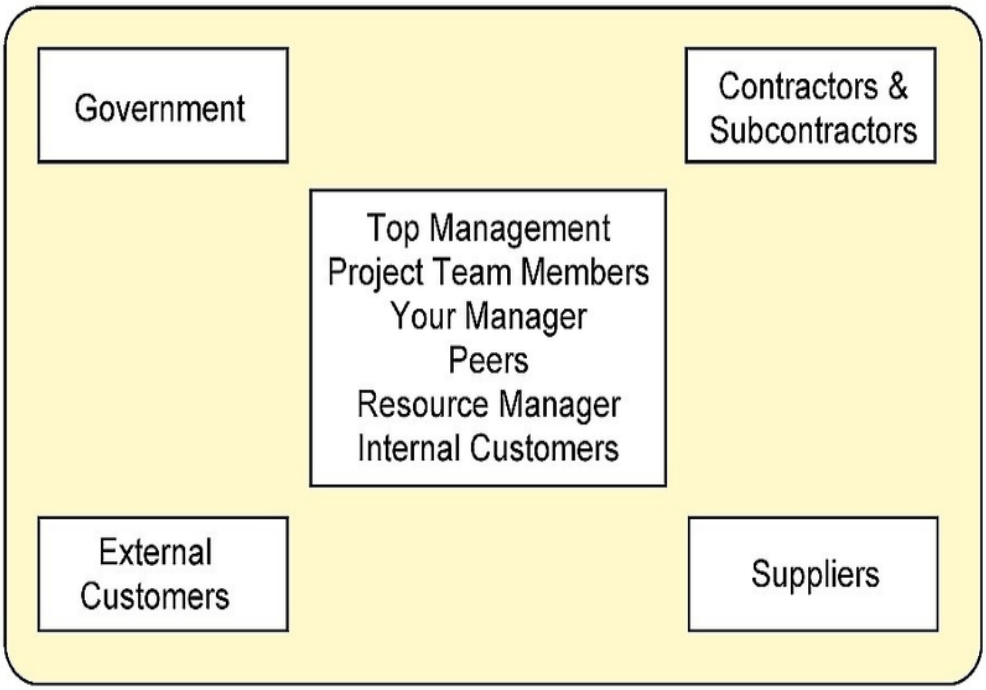


Figure 5.1 Project stakeholders. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

- Develop in-depth plans and major milestones that must be approved by top management during the planning and design phases of the project.
- Ask top management associated with your project for their information reporting needs and frequency.
- Develop a status reporting methodology to be distributed on a scheduled basis.

- Keep them informed of project risks and potential impacts at all times.

5.1.2 The Project Team

The project team is made up of those people dedicated to the project or borrowed on a part-time basis. As project manager, you need to provide leadership, direction, and above all, the support to team members as they go about accomplishing their tasks. Working closely with the team to solve problems can help you learn from the team and build rapport. Showing your support for the project team and for each member will help you get their support and cooperation.

Here are some difficulties you may encounter in dealing with project team members:

- Because project team members are borrowed and they don't report to you, their priorities may be elsewhere.
- They may be juggling many projects as well as their full-time job and have difficulty meeting deadlines.
- Personality conflicts may arise. These may be caused by differences in social style or values or they may be the result of some bad experience when people worked together in the past.
- You may find out about missed deadlines when it is too late to recover.

Managing project team members requires interpersonal skills. Here are some suggestions that can help:

- Involve team members in project planning.
- Arrange to meet privately and informally with each team member at several points in the project, perhaps for lunch or coffee.
- Be available to hear team members' concerns at any time.
- Encourage team members to pitch in and help others when needed.
- Complete a project performance review for team members.

5.1.3 Your Manager

Typically the boss decides what the assignment is and who can work with the project manager on projects. Keeping your manager informed will help ensure that you get the necessary resources to complete your project.

If things go wrong on a project, it is nice to have an understanding and supportive boss to go to bat for you if necessary. By supporting your manager, you will find your manager will support you more often.

- Find out exactly how your performance will be measured.
- When unclear about directions, ask for clarification.
- Develop a reporting schedule that is acceptable to your boss.
- Communicate frequently.

5.1.4 Peers

Peers are people who are at the same level in the organization as you and may or may not be on the project team. These people will also have a vested interest in the product. However, they will have neither the leadership responsibilities nor the accountability for the success or failure of the project that you have.

Your relationship with peers can be impeded by:

- Inadequate control over peers
- Political maneuvering or sabotage
- Personality conflicts or technical conflicts
- Envy because your peer may have wanted to lead the project
- Conflicting instructions from your manager and your peer's manager

Peer support is essential. Because most of us serve our self-interest first, use some investigating, selling, influencing, and politicking skills here. To ensure you have cooperation and support from your peers:

Get the support of your project sponsor or top management to empower you as the project manager with as much authority as possible. It's important that the sponsor makes it clear to the other team members that their cooperation on project activities is expected.

Confront your peer if you notice a behavior that seems dysfunctional, such as bad-mouthing the project.

Be explicit in asking for full support from your peers. Arrange for frequent review meetings.

Establish goals and standards of performance for all team members.

5.1.5 Resource Managers

Because project managers are in the position of borrowing resources, other managers control their resources. So their relationships with people are especially important. If their relationship is good, they may be able to consistently acquire the best staff and the best equipment for their projects. If relationships aren't good, they may find themselves not able to get good people or equipment needed on the project.

5.1.6 Internal Customers

Internal customers are individuals within the organization who are customers for projects that meet the needs of internal demands. The customer holds the power to accept or reject your work. Early in the relationship, the project manager will need to negotiate, clarify, and document project specifications and deliverables. After the project begins, the project manager must stay tuned in to the customer's concerns and issues and keep the customer informed.

Common stumbling blocks when dealing with internal customers include:

- A lack of clarity about precisely what the customer wants
- A lack of documentation for what is wanted
- A lack of knowledge of the customer's organization and operating characteristics
- Unrealistic deadlines, budgets, or specifications requested by the customer
- Hesitancy of the customer to sign off on the project or accept responsibility for decisions
- Changes in project scope

To meet the needs of the customer, client, or owner, be sure to do the following:

- Learn the client organization's buzzwords, culture, and business.
- Clarify all project requirements and specifications in a written agreement.
- Specify a change procedure.
- Establish the project manager as the focal point of communications in the project organization.

5.1.7 External customer

External customers are the customers when projects could be marketed to outside customers. In the case of Ford Motor Company, for example, the external customers would be the buyers of the automobiles. Also if you are managing a project at your company for Ford Motor Company, they will be your external customer.

5.1.8 Government

Project managers working in certain heavily regulated environments (e.g., pharmaceutical, banking, or military industries) will have to deal with government regulators and departments. These can include all or some levels of government from municipal, provincial, federal, to international.

5.1.9 Contractors, subcontractors, and suppliers

There are times when organizations don't have the expertise or resources available in-house, and work is farmed out to contractors or subcontractors. This can be a construction management foreman, network consultant, electrician, carpenter, architect, or anyone who is not an employee. Managing contractors or suppliers requires many of the skills needed to manage full-time project team members.

Any number of problems can arise with contractors or subcontractors:

- Quality of the work
- Cost overruns
- Schedule slippage

Many projects depend on goods provided by outside suppliers. This is true for example of construction projects where lumber, nails, bricks, and mortar come from outside suppliers. If the supplied goods are delivered late or are in short supply or of poor quality or if the price is greater than originally quoted, the project may suffer.

Depending on the project, managing contractor and supplier relationships can consume more than half of the project manager's time. It is not purely intuitive; it involves a sophisticated skill set that includes managing conflicts, negotiating, and other interpersonal skills.

5.2 Politics of Projects

Many times, project stakeholders have conflicting interests. It's the project manager's responsibility to understand these conflicts and try to resolve them. It's also the project manger's responsibility to manage stakeholder expectations. Be certain to identify and meet with all key stakeholders early in the project to understand all their needs and constraints.

Project managers are somewhat like politicians. Typically, they are not inherently powerful or capable of imposing their will directly on coworkers, subcontractors, and suppliers. Like politicians, if they are to get their way, they have to exercise influence effectively over others. On projects, project managers have direct control over very few things; therefore their ability to influence others – to be a good politician – may be very important

Here are a few steps a good project politician should follow. However, a good rule is that when in doubt, stakeholder conflicts should always be resolved in favor of the customer.

5.3 Assess the environment

Identify all the relevant stakeholders. Because any of these stakeholders could derail the project, you need to consider their particular interest in the project.

- Once all relevant stakeholders are identified, try to determine where the power lies.
- In the vast cast of characters, who counts most?
- Whose actions will have the greatest impact?

5.3.1 Identify goals

After determining who the stakeholders are, identify their goals.

- What is it that drives them?
- What is each after?
- Are there any hidden agendas or goals that are not openly articulated?
- What are the goals of the stakeholders who hold the power? These deserve special attention.

5.3.2 Define the problem

- The facts that constitute the problem should be isolated and closely examined.
- The question “What is the real situation?” should be raised over and over.

5.3.3 Culture of Stakeholders

When project stakeholders do not share a common culture, project management must adapt its organizations and work processes to cope with cultural differences. The following are three major aspects of cultural difference that can affect a project:

1. Communications
2. Negotiations
3. Decision making

Communication is perhaps the most visible manifestation of culture. Project managers encounter cultural differences in communication in language, context, and candor.

Language is clearly the greatest barrier to communication. When project stakeholders do not share the same language, communication slows down and is often filtered to share only information that is deemed critical.

The barrier to communication can influence project execution where quick and accurate exchange of ideas and information is critical.

The interpretation of information reflects the extent that context and candor influence cultural expressions of ideas and understanding of information. In some cultures, an affirmative answer to a question does not always mean yes. The cultural influence can create confusion on a project where project stakeholders represent more than one culture.

Example: Culture Affects Communication in Mumbai

A project management consultant from the United States was asked to evaluate the effectiveness of a U.S. project management team executing a project in Mumbai, India. The project team reported that the project was on schedule and within budget. After a project review meeting where each of the engineering leads reported that the design of the project was on schedule, the consultant began informal discussions with individual engineers and began to discover that several critical aspects of the project were behind schedule. Without a mitigating strategy, the project would miss a critical window in the weather between monsoon seasons. The information on the project flowed through a cultural expectation to provide positive information. The project was eventually canceled by the U.S. corporation when the market and politi cal risks increased.

Not all cultural differences are related to international projects. Corporate cultures and even regional differences can create cultural confusion on a project.

Example: Cultural Differences between American Regions

On a major project in South America that included project team leaders from seven different countries, the greatest cultural difference that affected the project communication was between two project leaders from the United States. Two team members, one from New Orleans and one from Brooklyn, had more difficulty communicating than team members from Lebanon and Australia.

5.3.4 Managing Stakeholders

Often there is more than one major stakeholder in the project. An increase in the number of stakeholders adds stress to the project and influences the project's complexity level. The business or emotional investment of the stakeholder in the

project and the ability of the stakeholder to influence the project outcomes or execution approach will also influence the stakeholder complexity of the project. In addition to the number of stakeholders and their level of investment, the degree to which the project stakeholders agree or disagree influences the project's complexity.

A small commercial construction project will typically have several stakeholders. All the building permitting agencies, environmental agencies, and labor and safety agencies have an interest in the project and can influence the execution plan of the project. The neighbors will have an interest in the architectural appeal, the noise, and the purpose of the building.

Example: Tire Plant in India

A U.S. chemical company chartered a project team to design and build a plant to produce the raw materials for building truck tires designed for unpaved roads. The plant was to be built in India a few years after an accident that killed several Indians and involved a different U.S. chemical company. When the company announced the new project and began to break ground, the community backlash was so strong that the project was shut down. A highly involved stakeholder can significantly influence your project.

A small college in South Carolina won a competitive grant to erect and operate a wind turbine on campus. The engineering department submitted the grant as a demonstration project for engineering students to expose students to wind technology. The campus facilities department found only one location for the wind turbine that would not disrupt the flow of traffic on campus. The engineering department found that location unacceptable for students who had to maintain the wind turbine. The county construction permitting department had no policies for permitting a wind turbine and would not provide a building permit. The college had to go to the county council and get an exception to county rules. The marketing department wanted the wind turbine placed in a highly visible location to promote the innovative approach of the college.

Each of the college's stakeholders had a legitimate interest in the location of the wind turbine. The number of stakeholders on the project, multiplied by their passion for the subject and the lack of agreement on the location, increased the complexity of the project. Significant time and resources of a project will be dedicated to identifying, understanding, and managing client expectations.

Example: Stakeholders and a Bridge Project

The Department of Highways chartered a project to upgrade a number of bridges that crossed the interstate in one of the larger cities in South Carolina. The closing of these bridges severely impacted traffic congestion, including a large shopping mall. The contract included provisions for minimizing the impact on the traffic and communities near the construction areas. This provision allowed businesses or interested parties to review the project schedule and make suggestions that would lessen the impact of the construction. The project leadership invested significant time and resources in developing alignment among the various political stakeholders on the project approach and schedule.

5.4 Relationship Building Tips

Take the time to identify all stakeholders before starting a new project. Include those who are impacted by the project, as well as groups with the ability to impact the project. Then, begin the process of building strong relationships with each one using the following method.

- **Analyze stakeholders:** Conduct a stakeholder analysis, or an assessment of a project's key participants, and how the project will affect their problems and needs. Identify their individual characteristics and interests. Find out what motivates them, as well as what provokes them. Define roles and level of participation, and determine if there are conflicts of interest among groups of stakeholders.
- **Assess influence**: Measure the degree to which stakeholders can influence the project. The more influential a stakeholder is, the more a project manager will need their support. Think about the question, "What's in it for them?" when considering stakeholders. Knowing what each stakeholder needs or wants from the project will enable the project manager to gauge his or her level of support. And remember to balance support against influence. Is it more important to have strong support from a stakeholder with little influence, or lukewarm support from one with a high level of influence?
- **Understand their expectations**: Nail down stakeholders' specific expectations. Ask for clarification when needed to be sure they are completely understood.
- **Define "success"**: Every stakeholder may have a different idea of what project success looks like. Discovering this at the end of the project is a formula for failure. Gather definitions up front and include them in the objectives to help ensure that all stakeholders will be supportive of the final outcomes.
- **Keep stakeholders involved**: Don't just report to stakeholders. Ask for their input. Get to know them better by scheduling time for coffee, lunch, or quick

meetings. Measure each stakeholder's capacity to participate and honor time constraints.
- **Keep stakeholders informed**: Send regular status updates. Daily may be too much; monthly is not enough. One update per week is usually about right. Hold project meetings as required, but don't let too much time pass between meetings. Be sure to answer stakeholders' questions and emails promptly. Regular communication is always appreciated – and may even soften the blow when you have bad news to share.

These are the basics of building strong stakeholder relationships. But as in any relationship, there are subtleties that every successful project manager understands – such as learning the differences between and relating well to different types stakeholders.

5.5 How to Relate to Different Types of Stakeholders

By conducting a stakeholder analysis, project managers can gather enough information on which to build strong relationships – regardless of the differences between them. For example, the needs and wants of a director of marketing will be different from those of a chief information officer. Therefore, the project manager's engagement with each will need to be different as well.

Stakeholders with financial concerns will need to know the potential return of the project's outcomes. Others will support projects if there is sound evidence of their value to improving operations, boosting market share, increasing production, or meeting other company objectives.

Keep each stakeholder's expectations and needs in mind throughout each conversation, report or email, no matter how casual or formal the communication may be. Remember that the company's interests are more important than any individual's – yours or a stakeholder's. When forced to choose between them, put the company's needs first.

No matter what their needs or wants, all stakeholders will respect the project manager who:

- Is always honest, even when telling them something they don't want to hear
- Takes ownership of the project
- Is predictable and reliable
- Stands by his or her decisions
- Takes accountability for mistakes

5.6 Supportive Stakeholders are Essential to Project Success

Achieving a project's objectives takes a focused, well-organized project manager who can engage with a committed team and gain the support of all stakeholders. Building strong, trusting relationships with interested parties from the start can make the difference between project success and failure.

5.7 Tools to Help Stakeholder Management

There are many project decelerators, among them lack of stakeholder support. Whether the stakeholders support your project or not, if they are important to your project, you must secure their support. How do you do that?

First, you must identify who your stakeholders are. Just because they are important in the organization does not necessarily mean they are important to your project. Just because they think they are important does not mean they are. Just because they don't think they need to be involved does not mean they do not have to be. The typical suspects: your manager, your manager's manager, your client, your client's manager, any SME (subject matter expert) whose involvement you need, and the board reviewing and approving your project. Note that in some situations there are people who think they are stakeholders. From your perspective they may not be, but be careful how you handle them. They could be influential with those who have the power to impact your project. Do not dismiss them out of hand.

Second, you need to determine what power they have and what their intentions toward your project are. Do they have the power to have an impact on your project? Do they support or oppose you? What strategies do you follow with them?

Third, what's the relationship among stakeholders? Can you improve your project's chances by working with those who support you to improve the views of those who oppose you? Figure 5.2 Stakeholder Analysis summarizes the options based on an assessment of your stakeholders' potential for cooperation and potential for threat.

Figure 5.2 Stakeholder Analysis

(http://svprojectmanagement.com/project-decelerators-%E2%80%93-lack-ofstakeholder-support) .

Now that you have this information, you can complete a stakeholder analysis template (Table 5.1) that will help you define your strategies to improve their support:Table 5.1 Stakeholder Analysis Template

Stakeholder Names and Roles	How important? (Low-Med-High)	Current level of support? (Low-Med-High)	What do you want from stakeholders?	What is important to stakeholders?	How could stakeholde block your efforts?

Table 5.1 Stakeholder Analysis Template

(http://svprojectmanagement.com/project-decelerators-%E2%80%93-lack-of-stakeholder-support) .

Finally, a key piece of your stakeholder management efforts is constant communication to your stakeholders. Using the information developed above, you should develop a communications plan that secures your stakeholders' support. The template in Table 5.2 Stakeholder Analysis Template can be used.

- Project Scope:
- Key Message:
- Communication Goals:

- Communication Team:
- Project Team:
- Other stakeholders:

Communication Date	Deliverable	Audience	Message	Action Item or FYI(Info?)	Plans	Sta

Table 5.2 Stakeholder Analysis Template

5.8 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported And Project Decelerators – Lack of Stakeholder Support By Jose Solera licensed under Creative Commons Attribution 3.0 Unported And How to Build Relationships with Stakeholders By Erin Palmer licensed under Creative Commons Attribution 3.0 Unported And Project Management From Simple to Complex by Russel Darnall, John Preston, Eastern Michigan University licensed under Creative Commons Attribution 3.0 Unported

Chapter 6 Culture and Project Management

Adrienne Watt

6.1 What Is Organizational Culture?

When working with internal and external customers on a project, it is essential to pay close attention to relationships, context, history, and the corporate culture. Corporate culture refers to the beliefs, attitudes, and values that the organization's members share and the behaviors consistent with them (which they give rise to). Corporate culture sets one organization apart from another, and dictates how members of the organization will see you, interact with you, and sometimes judge you. Often, projects too have a specific culture, work norms, and social conventions.

Some aspects of corporate culture are easily observed; others are more difficult to discern. You can easily observe the office environment and how people dress and speak. In one company, individuals work separately in closed offices; in another, teams may work in a shared environment. The more subtle components of corporate culture, such as the values and overarching business philosophy, may not be readily apparent, but they are reflected in member behaviors, symbols, and conventions used.

6.2 Project Manager's Checklist

Once the corporate culture has been identified, members should try to adapt to the frequency, formality, and type of communication customary in that culture. This adaptation will strongly affect project members' productivity and satisfaction internally, as well as with the client organization.

- Which stakeholders will make the decision in this organization on this issue? Will your project decisions and documentation have to go up through several layers to get approval? If so, what are the criteria and values that may affect acceptance there? For example, is being on schedule the most important consideration? Cost? Quality?
- What type of communication among and between stakeholders is preferred? Do they want lengthy documents? Is "short and sweet" the typical standard?

- What medium of communication is preferred? What kind of medium is usually chosen for this type of situation? Check the files to see what others have done. Ask others in the organization.
- What vocabulary and format are used? What colors and designs are used (e.g., at Hewlett-Packard, all rectangles have curved corners)?

6.3 Project Team Challenges

Today's globally distributed organizations (and projects) consist of people who have differing "worldviews." *Worldview* is a looking glass through which people see the world as Bob Shebib describes: "[It is] a belief system about the nature of the universe, its perceived effect on human behavior, and one's place in the universe. Worldview is a fundamental core set of assumptions explaining cultural forces, the nature of humankind, the nature of good and evil, luck, fate, spirits, the power of significant others, the role of time, and the nature of our physical and natural resources" (Shebib, 2003, p. 296).

If, for example, a Canadian manager is sent to India to manage an R&D team or a joint venture, they are likely to have to "[cope] with eco-shock or the physiological, psychological, and social reaction to a new assignment ecology." Hanging a shingle in a fluid and culturally diverse organization, project team, and work culture, a project manager may find new working relationships and hidden challenges have significant implications for performance and knowledge exchange – for the manager and colleagues at home and in the host country.

In most situations, there is simply **no** substitute for having a well-placed person from the host culture to guide the new person through the cultural nuances of getting things done. In fact, if this "intervention" isn't present, it is likely to affect the person's motivation or desire to continue trying to break through the cultural (and other) barriers. Indeed, optimal effectiveness in such situations requires learning of cultures in developing countries or international micro-cultures and sharing perceptions among the culturally diverse task participants on how to get things done. Project leaders require sensitivity and awareness of multicultural preferences. The following broad areas should be considered:

- Individual identity and role within the project versus family of origin and community
- Verbal and emotional expressiveness
- Relationship expectations
- Style of communication
- Language
- Personal priorities, values, and beliefs
- Time orientation

There are many interpersonal dynamics and intra-project challenges faced by a globally distributed team. Individual members and the team itself requires important social supports to mitigate uncertainty, conflict, motivational challenges, culture shock,

and the more-encompassing eco-shock that comes from facing head-on the unfamiliar and diverse situations consistent with a different cultural and geographically distributed context.

Diverse and globally distributed project teams (i.e., different ethnic cultures, genders, ages, and functional capabilities), often working on complex projects spanning multiple time zones, geography, and history, and operating with tight deadlines in cost-conscious organizations, need to make time and resources available to physically meet each other, and connect (at the very least) at a formal "kick-off" meeting. Especially when working with team members from high-context cultures, it is essential to meet face-to-face, discover member's individual identities and cultural preferences, share professional knowledge and personal stories, and observe critical verbal and non-verbal cues (that may not easily be observed online, or on the telephone). This is key to establishing a safer climate and building trust for stronger relation ships among both team members and management.

6.4 Dealing with Conflict

The question isn't whether, when, or with what frequency conflict will occur among intercultural team members — or what will create the conflict. If a team wants to overcome (or harness) conflict for effectiveness and productivity, the question is how to navigate and resolve the conflicts. Conflict that springs from diversity can actually assist the team in completing complex problem solving. However, if not navigated successfully, it can create relationship strain and derail achievement due to increased difficulties in communication and coordination.

As the global marketplace continues its rapid expansion, researchers are increasingly turning their attention to the issue of conflict management. Differing social and cultural values don't necessarily increase the number of conflicts a team will experience, but they can have an impact on how conflicts are managed and resolved. Cultural awareness is needed for understanding and appreciating others' values and behavioral norms. Without that, foreign assignments will become an overwhelming challenge. Self-awareness and skill development can aid in resolving the problematic conflict arising from cultural differences to help a team maintain good relations and remain productive.

6.5 References

Shebib, B. (2003). Choices: Interviewing and Counselling Skills for Canadians, 2nd edition, Pearson Education Canada Inc.

6.6 Attribution

This chapter of *Project Management* is a derivative copy of Project Management for Skills for All Careers by Project Management Open Resources and TAP-a-PM licensed under Creative Commons Attribution 3.0 Unported.

Chapter 7 Project Initiation

Adrienne Watt

The project initiation phase is the first phase within the project management life cycle, as it involves starting up a new project. Within the initiation phase, the business problem or opportunity is identified, a solution is defined, a project is formed, and a project team is appointed to build and deliver the solution to the customer. A business case is created to define the problem or opportunity in detail and identify a preferred solution for implementation. The business case includes:

- A detailed description of the problem or opportunity with headings such as Introduction, Business Objectives, Problem/Opportunity Statement, Assumptions, and Constraints
- A list of the alternative solutions available
- An analysis of the business benefits, costs, risks, and issues
- A description of the preferred solution
- Main project requirements
- A summarized plan for implementation that includes a schedule and financial analysis

The project sponsor then approves the business case, and the required funding is allocated to proceed with a feasibility study. It is up to the project sponsor to determine if the project is worth undertaking and whether the project will be profitable to the organization. The completion and approval of the feasibility study triggers the beginning of the planning phase. The feasibility study may also show that the project is not worth pursuing and the project is terminated; thus the next phase never begins.

All projects are created for a reason. Someone identifies a need or an opportunity and devises a project to address that need. How well the project ultimately addresses that need defines the project's success or failure.

The success of your project depends on the clarity and accuracy of your business case and whether people believe they can achieve it. Whenever you consider past experience, your business case is more realistic; and whenever you involve other people in the business case's development, you encourage their commitment to achieving it.

Often the pressure to get results encourages people to go right into identifying possible solutions without fully understanding the need or what the project is trying to accomplish. This strategy can create a lot of immediate activity, but it also creates significant chances for waste and mistakes if the wrong need is addressed. One of the best ways to gain approval for a project is to clearly identify the project's objectives and describe the need or opportunity for which the project will provide a solution. For most of us, being misunderstood is a common occurrence, something that happens on a daily basis. At the restaurant, the waiter brings us our dinner and we note that

the baked potato is filled with sour cream, even though we expressly requested “no sour cream.” Projects are filled with misunderstandings between customers and project staff. What the customer ordered (or more accurately what they think they ordered) is often not what they get. The cliché is “I know that’s what I said, but it’s not what I meant.” Figure 7.1 Project Management by Andreas Cappell demonstrates the importance of establishing clear objectives.

The need for establishing clear project objectives cannot be overstated. An objective or goal lacks clarity if, when shown to five people, it is interpreted in multiple ways. Ideally, if an objective is clear, you can show it to five people who, after reviewing it, hold a single view about its meaning. The best way to make an objective clear is to state it in such a way that it can be verified. Building in ways to measure achievement can do this. It is important to provide quantifiable definitions to qualitative terms.

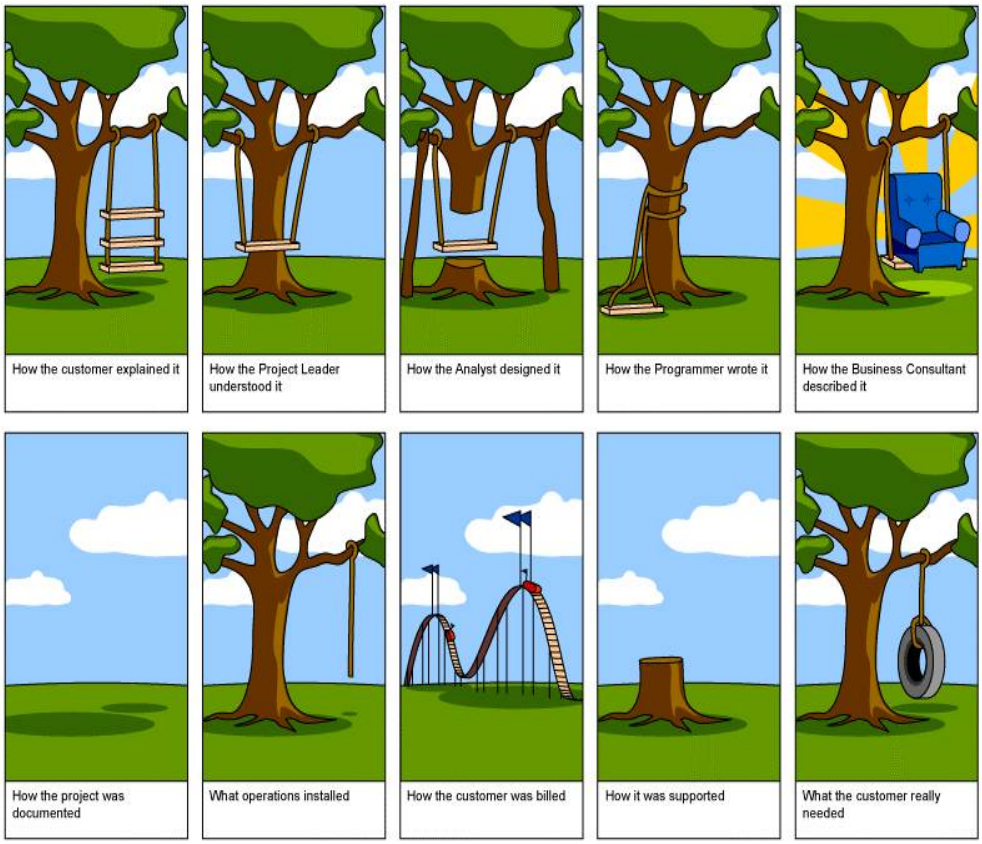


Figure 7.1 Project Management by Andreas Cappell

(https://www.flickr.com/photos/cappellmeister/5921913/, https://creativecommons.org/licenses/bync-sa/2.0/) .

For example, an objective of the team principle (project manager) of a Formula 1 racing team may be that their star driver, “finish the lap as fast as possible.” That objective is filled with ambiguity.

How fast is “fast as possible?” Does that mean the fastest lap time (the time to complete one lap) or does it mean the fastest speed as the car crosses the start/finish line (that is at the finish of the lap)?

By when should the driver be able to achieve the objective? It is no use having the fastest lap after the race has finished, and equally the fastest lap does not count for qualifying and therefore starting position, if it is performed during a practice session.

The ambiguity of this objective can be seen from the following example. Ferrari's Michael Schumacher achieved the race lap record at the Circuit de Monaco of 1 min 14.439 sec in 2004 (Figure 7.2 Despite achieving the project goal of the "finish the lap as fast as possible," Ferrari's Michael Schumacher crashed 21 laps later and did not finish the race (top); Renault's Jarno Trulli celebrating his win at the 2004 Monaco Grand Prix (middle); Jenson Button took his Brawn GP car to pole position at the Monaco Grand Prix with a lap time of 1 min 14.902 sec. He also went on to win the race, even though he did not achieve that lap time during the race (bottom).). However, he achieved this on lap 23 of the race, but crashed on lap 44 of a 77-lap race. So while he achieved a fastest lap and therefore met the specific project goal of "finish the lap as fast as possible," it did not result in winning the race, clearly a different project goal. In contrast, the fastest qualifying time at the same event was by Renault's Jarno Trulli (1 min 13.985 sec), which gained him pole position for the race, which he went on to win (Figure 7.2 Despite achieving the project goal of the "finish the lap as fast as possible," Ferrari's Michael Schumacher crashed 21 laps later and did not finish the race (top); Renault's Jarno Trulli celebrating his win at the 2004 Monaco Grand Prix (middle); Jenson Button took his Brawn GP car to pole position at the Monaco Grand Prix with a lap time of 1 min 14.902 sec. He also went on to win the race, even though he did not achieve that lap time during the race (bottom).). In his case, he achieved the specific project goal of "finish the lap as fast as possible," but also the larger goal of winning the race.

The objective can be strengthened considerably if it is stated as follows: "To be able to finish the 3.340 km lap at the Circuit de Monaco at the Monaco Grand Prix in 1 min 14.902 sec or less, during qualifying on May 23, 2009." This was the project objective achieved by Brawn GP's Jenson Button (Figure 7.2 Despite achieving the project goal of the "finish the lap as fast as possible," Ferrari's Michael Schumacher crashed 21 laps later and did not finish the race (top); Renault's Jarno Trulli celebrating his win at the 2004 Monaco Grand Prix (middle); Jenson Button took his Brawn GP car to pole position at the Monaco Grand Prix with a lap time of 1 min 14.902 sec. He also went on to win the race, even though he did not achieve that lap time during the race (bottom).).

There is still some ambiguity in this objective; for example, it assumes the star driver will be driving the team's race car and not a rental car from Hertz. However, it clarifies the team principal's intent quite nicely. It should be noted that a clear goal is not enough. It must also be achievable. The team principal's goal becomes unachievable, for example, if he changes it to require his star driver to finish the 3.340 km lap in 30 sec or less.

Figure 7.2 Despite achieving the project goal of the "finish the lap as fast as possible," Ferrari's Michael Schumacher crashed 21 laps later and did not finish the race (top); Renault's Jarno Trulli celebrating his win at the 2004 Monaco Grand Prix (middle); Jenson Button took his Brawn GP car to pole position at the Monaco Grand Prix with a lap time of 1 min 14.902 sec. He also went on to win the race, even though he did not achieve that lap time during the race (bottom).

. Monaco 2004 by Cord Rodefeld (https://www.flickr.com/photos/rodefeld/386917280/) used under CC-BY license (https://creativecommons.org/licenses/by/2.0/) (top); Jarno Trulli by ph-stop (https://www.flickr.com/photos/ph-stop/4698634584/) used under CC-BY-SA license (https://creativecommons.org/licenses/by-sa/2.0/) (middle); Jenson Button by Evoflash (https://www.flickr.com/photos/evoflash/7614681230/) used under CC-BY license (https://creativecommons.org/licenses/by/2.0/) (bottom).

To ensure the project's objectives are achievable and realistic, they must be determined jointly by managers and those who perform the work. Realism is introduced because the people who will do the work have a good sense of what it takes to accomplish a particular task. In addition, this process assures some level of commitment on all sides: management expresses its commitment to support the work effort and workers demonstrate their willingness to do the work.

Imagine an office manager has contracted a painter to paint his office. His goal or objective is to have the office painted a pleasing blue color. Consider the conversation that occurs in Figure 7.3 The consequence of not making your objective clear. after the job was finished.

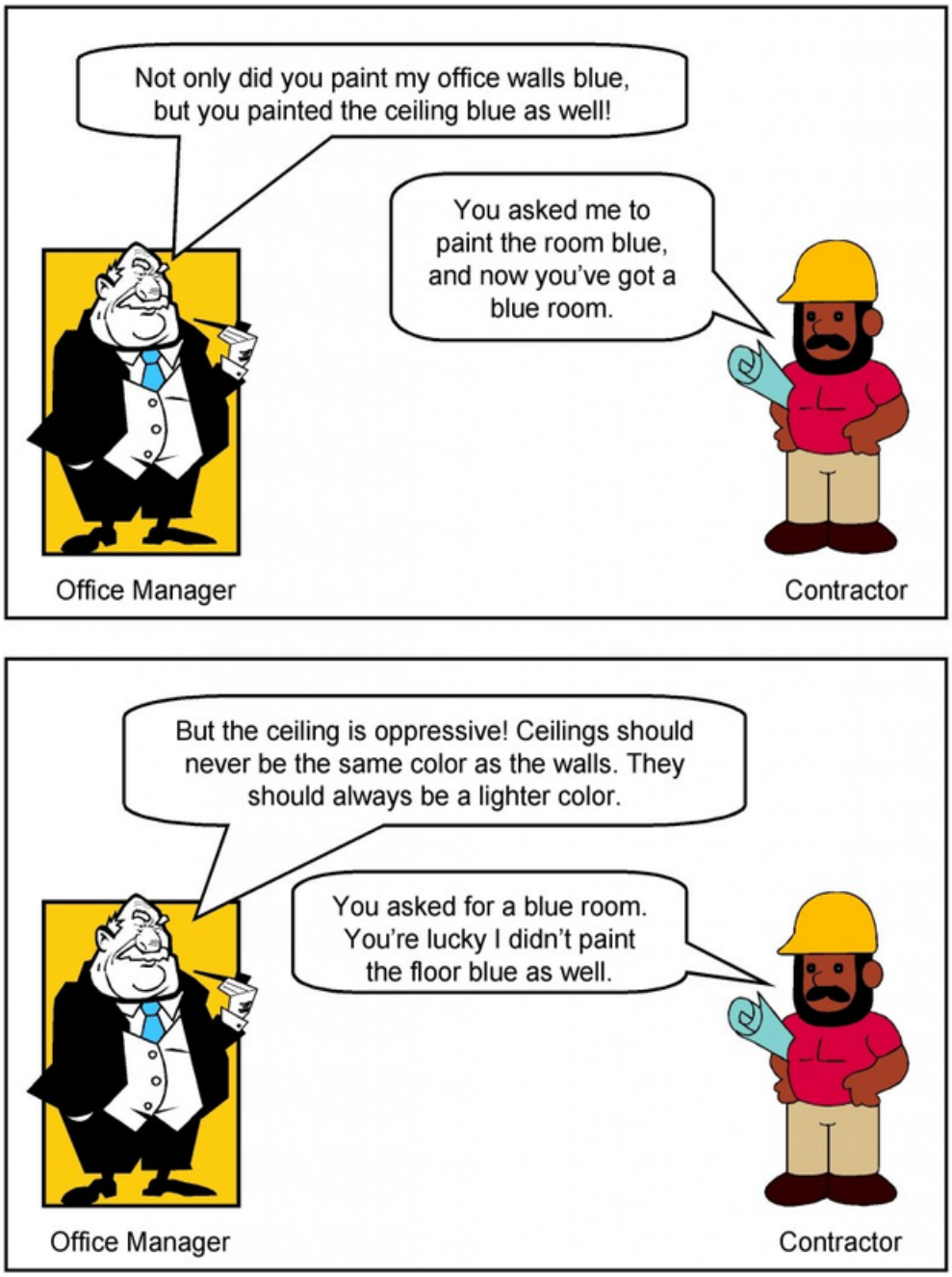


Figure 7.3 The consequence of not making your objective clear. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

This conversation captures in a nutshell the essence of a major source of misunderstandings on projects: the importance of setting clear objectives. The office manager's description of how he wanted the room painted meant one thing to him and another to the painter. As a consequence, the room was not painted to the office manager's satisfaction. Had his objective been more clearly defined, he probably would have had what he wanted.

7.1 Comparing Options Using a Weighted Decision Matrix

Sometimes we have multiple options to choose from when determining requirements and deciding which project to work on. To select the best option, we can use tools such as a weighted decision matrix.

A basic decision matrix consists of establishing a set of criteria for options that are scored and summed to gain a total score that can then be ranked. Importantly, it is not weighted to allow a quick selection process.

A weighted decision matrix operates in the same way as the basic decision matrix but introduces the concept of weighting the criteria in order of importance. The resultant scores better reflect the importance to the decision maker of the criteria involved. The more important a criterion, the higher the weighting it should be given. Each of the potential options is scored and then multiplied by the weighting given to each of the criteria to produce a result.

The advantage of the weighted decision matrix is that subjective opinions about one alternative versus another can be made more objective. Another advantage of this method is that sensitivity studies can be performed. An example of this might be to see how much your opinion would have to change in order for a lower-ranked alternative to outrank a competing alternative.

A **weighted decision matrix** therefore allows decision makers to structure and solve their problem by:

1. **Specifying** and **prioritizing** their needs with a list a criteria; then
2. **Evaluating**, **rating**, and **comparing** the different solutions; and
3. **Selecting** the best matching solution.

A weighted decision matrix is a decision tool used by decision makers.

A *decision matrix* is basically an array presenting on one axis a list of **alternatives**, also called *options* or *solutions*, that are evaluated regarding, on the other axis, a list of **criteria**, which are *weighted* depending on their respective importance in the final decision to be taken.

7.2 Weighted Decision Matrix Sample

The example in Figure 7.4 Weighted Decision Matrix for Game Delivery Project shows a weighted decision matrix that compared three options for a web development project (SJS Enterprises). This method is especially useful when choosing purchase alternatives and comparing them against specific desirable system requirements.

7.3 Financial Considerations

In many new project endeavors, we need to find out if our project is financially feasible. We do that by using net present value (NPV), rate of return (ROI), and payback analysis.

Weighted Decision Matrix for Game Delivery Project

	Criteria	Weight	SJS Enterprises	Game Access	DVDLink
A	Educational	15%	90	0	0
B	Sports- related	15%	90	90	90
C	Secure payment area with the ability to use Paypal, bank payments, cheque, school payment systems as a payment source	10%	90	50	50
D	Live Support	15%	90	0	0
E	Search Option	5%	50	50	30
F	Games available for all platforms currently on the market including school learning systems	10%	60	30	30
G	Longer Rental Periods (1 to 2 weeks)	5%	40	20	40
H	Sidebar with categories such as most popular, multiplayer and just released	5%	50	50	20
I	Registered customers must be able to order the videos, track delivery, return of videos and be able to provide reviews of videos	10%	50	30	30
J	Age/grade appropriate section (can isolate certain games to certain ages or grade levels)	10%	70	5	0
	Weighted Project Scores	**100%**	**56**	**14.5**	**12.5**

Figure 7.4 Weighted Decision Matrix for Game Delivery Project

. Source: A. Watt.

7.4 NPV

A dollar earned today is worth more than a dollar earned one or more years from now. The NPV of a time series of cash flows, both incoming and outgoing, is defined as the sum of the present values (PVs) of the individual cash flows of the same entity.

In the case when all future cash flows are incoming and the only outflow of cash is the purchase price, the NPV is simply the PV of future cash flows minus the purchase price (which is its own PV). NPV is a standard method for using the time value of money to appraise long-term projects. Used for capital budgeting and widely used throughout economics, finance, and accounting, it measures the excess or shortfall of cash flows, in present value terms, once financing charges are met.

NPV can be described as the “difference amount” between the sums of discounted cash inflows and cash outflows. It compares the present value of money today to the present value of money in the future, taking inflation and returns into account.

The NPV of a sequence of cash flows takes as input the cash flows and a discount rate or discount curve and outputs a price.

Each cash inflow/outflow is discounted back to its present value (PV). Then they are summed. Therefore NPV is the sum of all terms.

$$\frac{R_t}{(1+i)^t}$$

Figure 7.5

where

*t*is the time of the cash flow

*i*is the discount rate (the rate of return that could be earned on an investment in the financial markets with similar risk; the opportunity cost of capital)

*Rt*is the net cash flow (i.e., cash inflow – cash outflow, at time *t*).

NPV is an indicator of how much value an investment or project adds to the firm. With a particular project, if NPV is a positive value, the project is in the status of positive cash inflow in the time *t*. If NPV is a negative value, the project is in the status of discounted cash outflow in the time *t*. Sometimes risky projects with a positive NPV could be accepted. This does not necessarily mean that they should be undertaken since NPV at the cost of capital may not account for opportunity cost (i.e., comparison with other available investments). In financial theory, if there is a choice between two mutually exclusive alternatives, the one yielding the higher NPV should be selected.

If...	It means...	Then...
NPV>0	The investment would add value to the firm	The project may be accepted
NPV<0	The investment would subtract value from the firm	The project should be rejected
NPV=0	The investment would neither gain nor lose value for the firm	We should be indifferent in the decision whether to accept or reject the project. This project adds no monetary value. Decision should be based on other criteria (e.g, strategic positioning or other factors not explicitly included in the calculation).

Table 7.1 Net Present Value

(http://en.wikipedia.org/wiki/Net_present_value) .

Present Value Table

Periods	6%	8%	10%	12%	14%
1	0.943	0.926	0.909	0.893	0.877
2	0.890	0.857	0.826	0.797	0.769
3	0.840	0.794	0.751	0.712	0.675
4	0.792	0.735	0.683	0.636	0.592
5	0.747	0.681	0.621	0.567	0.519
6	0.705	0.630	0.564	0.507	0.456
7	0.665	0.583	0.513	0.452	0.400
8	0.627	0.540	0.467	0.404	0.351
9	0.592	0.500	0.424	0.361	0.308
10	0.558	0.436	0.386	0.322	0.270

Table 7.2 Take note of the decreasing value of money as the period increases from 1 to 10 years.

. Source: A. Watt.

7.5 NPV Example

The following example is calculating the NPV of a project at a discount rate of 12%. The project takes five years to complete with given benefits and costs for each year. In Year 0, there is no benefit to the organization, just an initial cost of $75,000 with no discount rate. In Year 1, the discount rate is 89%. This means that at 12% assumed interest, the time value of money says that the $1 today is worth $0.89 in one year, $0.80 in two years, etc. By calculating the NPV for the benefits and the costs, you subtract the NPV of all costs from the NPV of all benefits. The final result is a positive value of $105,175.

7.6 ROI

Return on investment (ROI) is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. It is one way of considering profits in relation to capital invested.

This is calculated by subtracting the project's costs from the benefits and then dividing by the costs. For example, if you invest $100 and your investment is worth $110 next year, the ROI is (110-100)/100 = 0.1 or a 10% return.

In our example: (306,425-201,175)/ 306,425 = .52 = 52% return. That's considered a nice return on investment.

7.7 Payback Period

Payback analysis is important in determining the amount of time it will take for a project to recoup its investments. This is the point at which the benefits start to outweigh the costs. The best way to see that is by charting the cumulative benefits and costs. As you can see in the example in Figure 7.7 Payback Analysis Chart. , the cumulative benefits outweigh the cumulative costs in the second year.

	A	B	C	D	E	F	G	H
1	NPV		Discount Factors (12%) (used Row 10)					
2			0.893	0.797	0.712	0.636	0.567	
3	EXAMPLE							
4								
5	Interest rate	12%						
6								
7	Year	0	1	2	3	4	5	
8								
9	Benefits		85,000	85,000	85,000	85,000	85,000	
10	PV factor	100%	89%	80%	71%	64%	57%	
11	PV of Benefits	-	75,905	67,745	60,520	54,060	48,195	
12	Cumulative Benefits PV	-	75,905	143,650	204,170	258,230	306,425	
13	Net Present Value	306,425						
14								
15								
16								
17								
18	Year	0	1	2	3	4	5	
19								
20	Costs	75,000	35,000	35,000	35,000	35,000	35,000	
21	PV factor	100%	89%	80%	71%	64%	57%	
22	PV of Costs	75,000	31,255	27,895	24,920	22,260	19,845	
23	Cumulative Costs PV	75,000	106,255	134,150	159,070	181,330	201,175	
24	Net Present Value	201,175						
25								
26	Overall NPV	105,250		NPV of Benefits - NPV of Costs				
27								
28	ROI	0.523		benefits-costs/ costs				
29								
30	Payback	(75,000)	(30,350)	9,500	45,100	76,900	105,250	
31								
32								

Figure 7.6 Table of NPV of costs and benefits.

. Source: A. Watt.

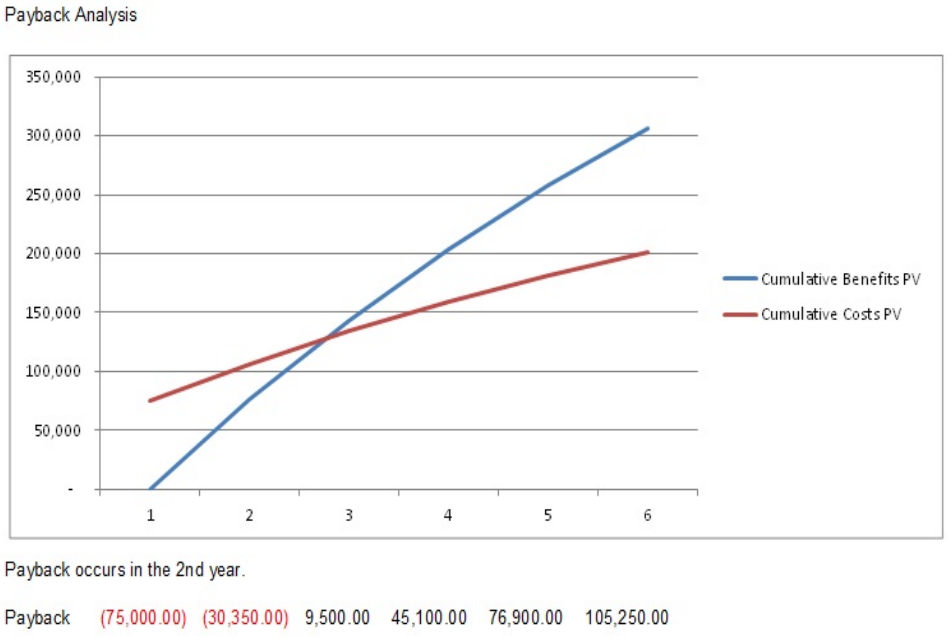


Figure 7.7 Payback Analysis Chart.

. Source: A. Watt.

7.8 Project Charter

A project charter, project definition, or project statement is a statement of the scope, objectives, and participants in a project. It provides a preliminary delineation of roles and responsibilities, outlines the project objectives, identifies the main stakeholders, and defines the authority of the project manager. It serves as a reference of authority for the future of the project.

7.8.1 Purpose of the Project Charter

The purpose of a project charter is to:

- Provide an understanding of the project, the reason it is being conducted, and its justification
- Establish early on in the project the general scope
- Establish the project manager and his or her authority level. A note of who will review and approve the project charter must be included.

7.8.2 Simple example of project charter

7.8.2.1 Identification Section

Identification Section

List the project name, the date of the current version of the project charter, the sponsor's name and authority, and the project manager's name.

Example:

Project Name: Rice University Computer Store Creation

Project Sponsor: Jane Ungam, Facilities Manager

Date: Jan 12, 2010

Revision: 1

Project Manager: Fred Rubens

7.8.2.2 Overview of the Project

Provide a simple but precise statement of the project.

Example

Rice University is planning to create a store to sell computer supplies.

7.8.2.3 Objective

State the objectives of the project clearly and ensure they contain a measure of how to assess whether they have been achieved. The statement should be realistic and should follow the **SMART** protocol:

- **Specific** (get into the details)
- **Measurable** (use quantitative language so that you know when you are finished)
- **Acceptable** (to stakeholders)
- **Realistic** (given project constraints)
- **Time based** (deadlines, not durations)

Example

The objective of this project is to implement a campus store that is ready to sell computer supplies such as memory sticks, mouse pads, and cables, when class starts in August 2010, with enough inventory to last through the first two weeks of classes.

7.8.2.4 Scope

Specify the scope of the project by identifying the domain or range of requirements.

Example

The scope of the Rice's school supplies store project includes the activities listed below:

- Determine what supplies will be sold in the store.
- Establish competitive prices for the computer supplies.
- Source and secure supply vendors.
- Establish marketing, procurement, operations, and any other necessary departments, schools, centers, and institutes.

It is equally important to include in the scope what is not included in the project.

Example

The scope of the project does not include:

- Development of any other school store departments
- Store design or construction

7.8.2.5 Major Milestones

List all major milestones needed to ensure project completion successfully.

Example

- All vendors selected
- Contracts or orders completed with all vendors
- Supplies delivered to the store
- Pricing determined

7.8.2.6 Major Deliverables

List and describe the major deliverables that will result from the project.

Example

- Supplies procured
- Operations, procurement, marketing, and other teams established
- Store supplies stocked and displayed
- Store staffing completed, including work schedules
- Store operations policies, including hours of operation, established

7.8.2.7 Assumptions

Outline the assumptions made in creating the project. An assumption is a fact you are unsure of but can either confirm at a later time or are simply stating so that the project can proceed as if the statement were true.

Example

- Only computer supplies will be sold in the store.
- Customers will be the Rice University student body and faculty.
- Rice University students will manage the project and be responsible for ongoing operations.
- A store sponsor from the university faculty or staff will be assigned to mentor students and provide oversight.
- Store hours of operation will be approved by the Rice University students or store sponsor.
- Supplier deliveries will be arranged or the store sponsor will pick them up with students.
- Students will be empowered to contact vendors for order placement and inquiries via telephone.

7.8.2.8 Constraints

Define any and all constraints on the project or those working on the project. This is an important part of the project charter. A constraint is anything that limits the range of solutions or approaches.

Example:

- Student availability to meet for project planning is limited to school hours.
- Software is not available for project planning and control.

7.8.2.9 Business Need or Opportunity (Benefits)

Provide a concise statement of the business need or opportunity that led to the creation of the project. Why was it created? What are the benefits? How does the project contribute to organizational objectives?

Example:

The goal of this project is to provide income for the Rice Student Center while supplying necessary items to students and faculty at competitive prices. The school store will be a convenience to students since necessary supplies will be available on campus. This will help students learn to manage their personal supplies.

7.8.2.10 Preliminary Cost for the Project

Provide a statement indicating how the cost of the project will be defined and controlled.

Example:

The procurement team will assemble a proposal based on expected costs for review by the Dean of Undergraduate Studies.

7.8.2.11 Project Risks

A risk is anything uncertain that may occur that will reduce or decrease the chances of project success.

Example:

1. There is a state election coming and the new government may change the taxation rules for private university retail outlets.
2. The cloud is changing student demand for media such as flash drives in somewhat unpredictable ways. If this happens faster than we forecast, we may be building a store that students don't need.
3. Deliveries of store shelves, etc. will be delayed if a major hurricane occurs.

7.8.2.12 Project Charter Acceptance

Provide the names, titles, and signature lines of the individuals who will sign off on the project charter.

7.8.2.13 Project Stakeholders

Provide the key stakeholders and team members by function, name , and role.

Function	Name	Role
Project Manager	Monica Styles	Leads the project
Sponsor	Adrienne Watt	Project sponsor
Etc.		

7.9 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under and Creative Commons Attribution 3.0 Unported and Decision Matrix Method and Project Charter by Wikipedia the Free Encyclopedia licensed under Creative Commons Share Alike Attribution 3.0 Unported.

Chapter 8 Overview of Project Planning

Adrienne Watt

After the project has been defined and the project team has been appointed, you are ready to enter the second phase in the project management life cycle: the detailed project planning phase.

Project planning is at the heart of the project life cycle, and tells everyone involved where you're going and how you're going to get there. The planning phase is when the project plans are documented, the project deliverables and requirements are defined, and the project schedule is created. It involves creating a set of plans to help guide your team through the implementation and closure phases of the project. The plans created during this phase will help you manage time, cost, quality, changes, risk, and related issues. They will also help you control staff and external suppliers to ensure that you deliver the project on time, within budget, and within schedule.

The project planning phase is often the most challenging phase for a project manager, as you need to make an educated guess about the staff, resources, and equipment needed to complete your project. You may also need to plan your communications and procurement activities, as well as contract any third-party suppliers.

The purpose of the project planning phase is to:

- Establish business requirements
- Establish cost, schedule, list of deliverables, and delivery dates
- Establish resources plans
- Obtain management approval and proceed to the next phase

The basic processes of project planning are:

- Scope planning – specifying the in-scope requirements for the project to facilitate creating the work breakdown structure
- Preparation of the work breakdown structure – spelling out the breakdown of the project into tasks and sub-tasks
- Project schedule development – listing the entire schedule of the activities and detailing their sequence of implementation
- Resource planning – indicating who will do what work, at which time, and if any special skills are needed to accomplish the project tasks
- Budget planning – specifying the budgeted cost to be incurred at the completion of the project
- Procurement planning – focusing on vendors outside your company and subcontracting
- Risk management – planning for possible risks and considering optional contingency plans and mitigation strategies

- Quality planning – assessing quality criteria to be used for the project
- Communication planning – designing the communication strategy with all project stakeholders

The planning phase refines the project's objectives, which were gathered during the initiation phase. It includes planning the steps necessary to meet those objectives by further identifying the specific activities and resources required to complete the project. Now that these objectives have been recognized, they must be clearly articulated, detailing an in-depth scrutiny of each recognized objective. With such scrutiny, our understanding of the objective may change. Often the very act of trying to describe something precisely gives us a better understanding of what we are looking at. This articulation serves as the basis for the development of requirements. What this means is that after an objective has been clearly articulated, we can describe it in concrete (measurable) terms and identify what we have to do to achieve it. Obviously, if we do a poor job of articulating the objective, our requirements will be misdirected and the resulting project will not represent the true need.

Users will often begin describing their objectives in qualitative language. The project manager must work with the user to provide quantifiable definitions to those qualitative terms. These quantifiable criteria include schedule, cost, and quality measures. In the case of project objectives, these elements are used as measurements to determine project satisfaction and successful completion. Subjective evaluations are replaced by actual numeric attributes.

Example 1

A web user may ask for a fast system. The quantitative requirement should be all screens must load in under three seconds. Describing the time limit during which the screen must load is specific and tangible. For that reason, you'll know that the requirement has been successfully completed when the objective has been met.

Example 2

Let's say that your company is going to produce a holiday batch of eggnog. Your objective statement might be stated this way: Christmas Cheer, Inc. will produce two million cases of holiday eggnog, to be shipped to our distributors by October 30, at a total cost of $1.5 million or less. The objective criteria in this statement are clearly stated and successful fulfillment can easily be measured. Stakeholders will know that the objectives are met when the two million cases are produced and shipped by the due date within the budget stated.

When articulating the project objectives you should follow the SMART rule:

- Specific – get into the details. Objectives should be specific and written in clear, concise, and understandable terms.

- Measurable – use quantitative language. You need to know when you have successfully completed the task.
- Acceptable – agreed with the stakeholders.
- Realistic – in terms of achievement. Objectives that are impossible to accomplish are not realistic and not attainable. Objectives must be centered in reality.
- Time based – deadlines not durations. Objectives should have a time frame with an end date assigned to them.

If you follow these principles, you'll be certain that your objectives meet the quantifiable criteria needed to measure success.

8.1 Attribution

Chapter 9 Scope Planning

Adrienne Watt

You always want to know exactly what work has to be done **before** you start it. You have a collection of team members, and you need to know exactly what they're going to do to meet the project's objectives. The scope planning process is the very first thing you do to manage your scope. Project scope planning is concerned with the definition of all the work needed to successfully meet the project objectives. The whole idea here is that when you start the project, you need to have a clear picture of all the work that needs to happen on your project, and as the project progresses, you need to keep that scope up to date and written down in the project's scope management plan.

9.1 Defining the Scope

You already have a head start on refining the project's objectives in quantifiable terms, but now you need to plan further and write down all the intermediate and final deliverables that you and your team will produce over the course of the project. Deliverables include everything that you and your team produce for the project (i.e., anything that your project will deliver). The deliverables for your project include all of the products or services that you and your team are performing for the client, customer, or sponsor. They include every intermediate document, plan, schedule, budget, blueprint, and anything else that will be made along the way, including all of the project management documents you put together. Project deliverables are tangible outcomes, measurable results, or specific items that must be produced to consider either the project or the project phase completed. Intermediate deliverables, like the objectives, must be specific and verifiable.

All deliverables must be described in a sufficient level of detail so that they can be differentiated from related deliverables. For example:

- A twin engine plane versus a single engine plane
- A red marker versus a green marker
- A daily report versus a weekly report
- A departmental solution versus an enterprise solution

One of the project manager's primary functions is to accurately document the deliverables of the project and then manage the project so that they are produced according to the agreed-on criteria. Deliverables are the output of each development phase, described in a quantifiable way.

9.2 Project Requirements

After all the deliverables are identified, the project manager needs to document all the requirements of the project. Requirements describe the characteristics of the final deliverable, whether it is a product or a service. They describe the required functionality that the final deliverable must have or specific conditions the final deliverable must meet in order to satisfy the objectives of the project. A requirement is an objective that must be met. The project's requirements, defined in the scope plan, describe what a project is supposed to accomplish and how the project is supposed to be created and implemented. Requirements answer the following questions regarding the **as-is** and **to-be** states of the business: who, what, where, when, how much, and how does a business process work?

Requirements may include attributes like dimensions, ease of use, color, specific ingredients, and so on. If we go back to the example of the company producing holiday eggnog, one of the major deliverables is the cartons that hold the eggnog. The requirements for that deliverable may include carton design, photographs that will appear on the carton, color choices, etc.

Requirements specify what the final project deliverable should look like and what it should do. Requirements must be measurable, testable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design. They can be divided into six basic categories: functional, non-functional, technical, business, user, and regulatory requirements.

9.3 Functional Requirements

Functional requirements describe the characteristics of the final deliverable in ordinary non-technical language. They should be understandable to the customers, and the customers should play a direct role in their development. Functional requirements are what you want the deliverable to do.

Vehicle Example

If you were buying vehicles for a business, your functional requirement might be: "The vehicles should be able to take up to a one ton load from a warehouse to a shop."

Computer System Example

For a computer system you may define what the system is to do: "The system should store all details of a customer's order."

The important point to note is that **what** is wanted is specified and **not how** it will be delivered.

9.4 Non-Functional Requirements

Non-functional requirements specify criteria that can be used to judge the final product or service that your project delivers. They are restrictions or constraints to be placed on the deliverable and how to build it. Their purpose is to restrict the number of solutions that will meet a set of requirements. Using the vehicle example, the functional requirement is for a vehicle to take a load from a warehouse to a shop. Without any constraints, the solutions being offered might result in anything from a small to a large truck. Non-functional requirements can be split into two types: performance and development.

To restrict the types of solutions, you might include these performance constraints:

- The purchased trucks should be American-made trucks due to government incentives.
- The load area must be covered.
- The load area must have a height of at least 10 feet.

Similarly, for the computer system example, you might specify values for the generic types of performance constraints:

- The response time for information is displayed on the screen for the user.
- The number of hours a system should be available.
- The number of records a system should be able to hold.
- The capacity for growth of the system should be built in.
- The length of time a record should be held for auditing purposes.

For the customer records example, the constraints might be:

- The system should be available from 9 a.m. to 5 p.m.Monday to Friday.
- The system should be able to hold 100,000 customer records initially.
- The system should be able to add 10,000 records a year for 10 years.
- A record should be fully available on the system for at least seven years.

One important point with these examples is that they restrict the number of solution options that are offered to you by the developer. In addition to the performance constraints, you may include some development constraints.

There are three general types of non-functional development constraints:

- **Time**: When a deliverable should be delivered

- **Resource**: How much money is available to develop the deliverable
- **Quality**: Any standards that are used to develop the deliverable, development methods, etc.

9.5 Technical Requirements

Technical requirements emerge from the functional requirements to answer the questions: how will the problem be solved this time and will it be solved technologically and/or procedurally? They specify how the system needs to be designed and implemented to provide required functionality and fulfill required operational characteristics.

For example, in a software project, the functional requirements may stipulate that a database system will be developed to allow access to financial data through a remote terminal. The corresponding technical requirements would spell out the required data elements, the language in which the database management system will be written (due to existing knowledge in-house), the hardware on which the system will run (due to existing infrastructure), telecommunication protocols that should be used, and so forth.

9.6 Business Requirements

Business requirements are the needs of the sponsoring organization, always from a management perspective. Business requirements are statements of the business rationale for the project. They are usually expressed in broad outcomes, satisfying the business needs, rather than specific functions the system must perform. These requirements grow out of the vision for the product that, in turn, is driven by mission (or business) goals and objectives.

9.7 User Requirements

User requirements describe what the users need to do with the system or product. The focus is on the user experience with the system under all scenarios. These requirements are the input for the next development phases: user-interface design and system test cases design.

9.8 Regulatory requirements

Regulatory requirements can be internal or external and are usually **non-negotiable**. They are the restrictions, licenses, and laws applicable to a product or business that are imposed by the government.

9.9 An Example of Requirements

Automated teller machines (ATMs) can be used to illustrate a wide range of requirements (Figure 9.1 Automated Teller Machine. ATM). What are some of the physical features of these machines, and what kinds of functions do they perform for the bank's customers? Why did banks put these systems in place? What are the high-level business requirements?

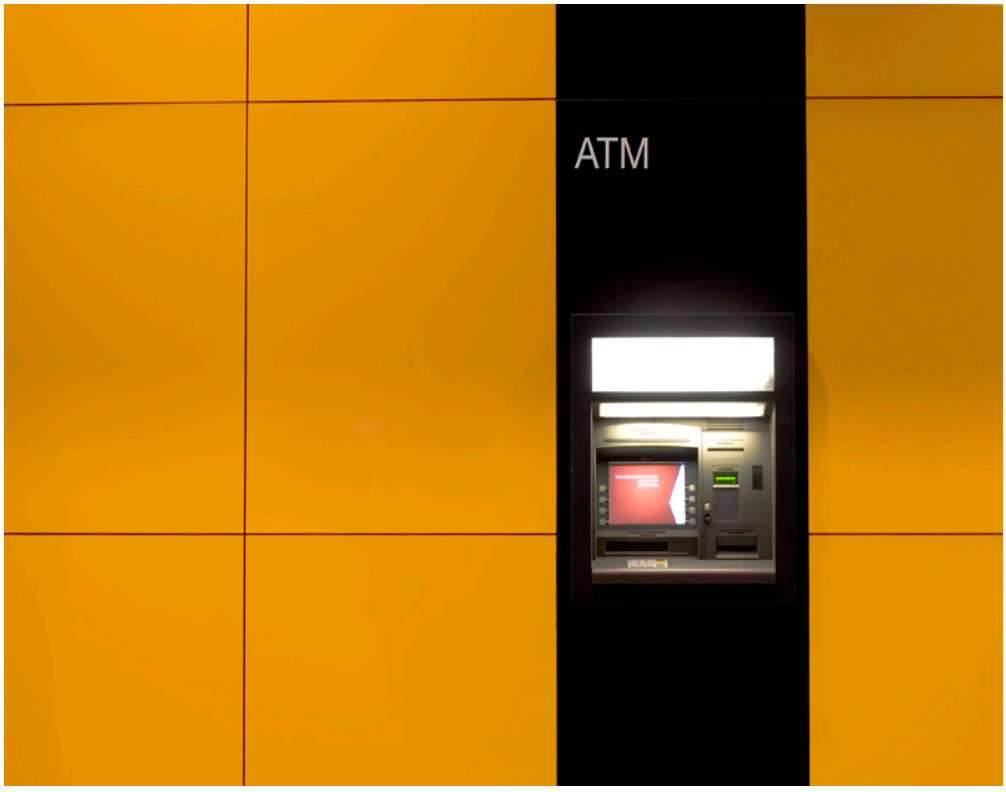


Figure 9.1 Automated Teller Machine. ATM

(https://flic.kr/p/6bHE21) by megawatts86 (https://www.flickr.com/photos/32317927@N07/, https://creativecommons.org/licenses/by-sa/2.0/) .

The following represents one possible example of each type of requirement as they would be applied to a bank's external ATM.

- ATM functional requirement: The system will enable the user to select whether or not to produce a hardcopy transaction receipt before completing a transaction.

- ATM non-functional requirement: All displays will be in white, 14-point Arial text on black background.
- ATM technical requirement: The ATM system will connect seamlessly to the existing customer's database.
- ATM user requirement: The system will complete a standard withdrawal from a personal account, from login to cash, in less than two minutes.
- ATM business requirement: By providing superior service to our retail customers, Monumental Bank's ATM network will allow us to increase associated service fee revenue by 10% annually on an ongoing basis.
- ATM regulatory requirement: All ATMs will connect to standard utility power sources within their civic jurisdiction, and be supplied with an uninterrupted power source approved by the company.

The effective specification of requirements is one of the most challenging undertakings project managers face. Inadequately specified requirements will guarantee poor project results.

Documenting requirements is much more than just the process of writing down the requirements as the user sees them; it should cover not only what decisions have been made, but why they have been made, as well. Understanding the reasoning that was used to arrive at a decision is critical in avoiding repetition. For example, the fact that a particular feature has been excluded, because it is simply not feasible, needs to be recorded. If it is not, then the project risks wasted work and repetition, when a stakeholder requests the feature be reinstated during development or testing.

Once the requirements are documented, have the stakeholders sign off on their requirements as a confirmation of what they desire. While the project manager is responsible for making certain the requirements are documented, it does not mean that the project manager performs this task. The project manager enlists the help of all the stakeholders (business analysts, requirement analysts, business process owners, customers and other team members) to conduct the discussions, brain-storming, and interviews, and to document and sign off the requirements. The project manager is responsible only for enabling the process and facilitating it. If the project manager feels that the quality of the document is questionable, his or her duty is to stop the development process.

The project manager reviews the requirements, incorporates them into the project documentation library, and uses them as an input for the project plan.

9.10 Software Requirements Fundamentals

This section refers to requirements of "software" because it is concerned with problems to be addressed by software. A software requirement is a property that must be exhibited by software developed or adapted to solve a particular problem. The problem may be to automate part of a task of someone who will use the software, to support the business processes of the organization that has commissioned the software, to correct shortcomings of existing software, to control a device, etc. The

functioning of users, business processes, and devices is typically complex. Therefore, the requirements on particular software are typically a complex combination of requirements from different people at different levels of an organization and from the environment in which the software will operate.

An essential property of all software requirements is that they be verifiable. It may be difficult or costly to verify certain software requirements. For example, verification of the throughput requirement on a call center may necessitate the development of simulation software. Both the software requirements and software quality personnel must ensure that the requirements can be verified within the available resource constraints.

Requirements have other attributes in addition to the behavioral properties that they express. Common examples include a priority rating to enable trade-offs in the face of finite resources and a status value to enable project progress to be monitored. Typically, software requirements are uniquely identified so that they can be monitored over the entire software life cycle.

9.11 Measuring Requirements

As a practical matter, it is typically useful to have some concept of the volume of the requirements for a particular software product. This number is useful in evaluating the size of a change in requirements, in estimating the cost of a development or maintenance task, or simply in using it as the denominator in other measurements (see Table 9.1 Table of Measuring Requirements).

Property	Measure
Speed	Processed transactions/ second User/ Event response time Screen refresh time
Size	K Bytes Number of RAM chips
Ease of use	Training time Number of help frames
Reliability	Mean time to failure Probability of unavailability Rate of failure occurrence Availability
Robustness	Time to restart after failure Percentage of events causing failure Probability of data corruption on failure
Portability	Percentage of target dependent statements Number of target systems

Table 9.1 Table of Measuring Requirements

. A Watt.

9.12 Scope Inputs

The project manager gathers initial project facts from the project charter. In addition, background information on the stakeholder's workplace, existing business model and rules, etc. assist in creating the vision of the final product/service, and consequently, the project scope (see Figure 9.2 Scope input-output by Flaming Sevens).

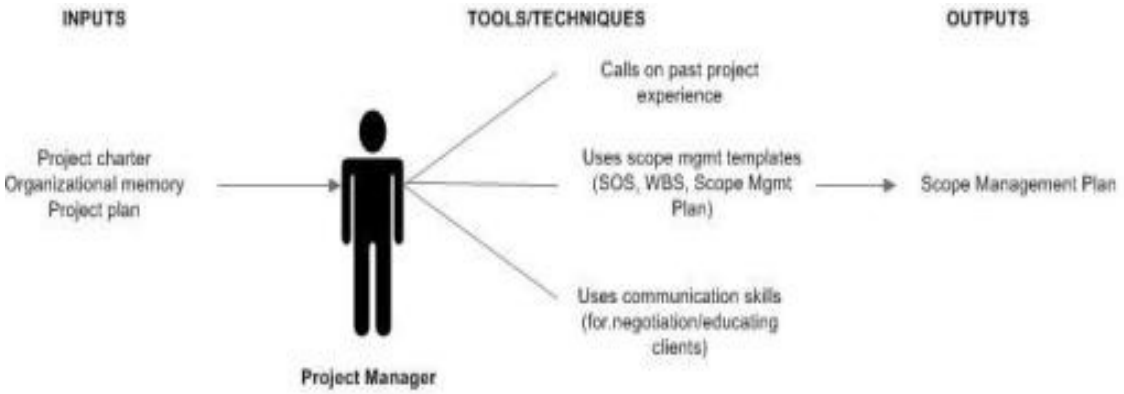


Figure 9.2 Scope input-output by Flaming Sevens

((http://en.wikibooks.org/wiki/File:ScopeIO.JPG) in the Public Domain (http://en.wikipedia.org/wiki/Public_domain).) .

9.13 Techniques

Certainly being a seasoned project manager broadens the repertoire of one's scope planning techniques. An experienced project manager can draw on past experiences with like projects to determine the work that is realistically doable, given time and cost constraints, for a current project. Communication and negotiation skills are a "must-have" as well. Project managers need to educate stakeholders about the project impacts of some requirements. Adding complexity to a project may require more staff, time, and/or money. It may also have an impact on project quality. Some aspects of the project may be unfeasible – stakeholders need to know this so they can adjust their vision or prepare for future challenges.

Gathering requirements is part of scope definition, and it can be done using one or more of following techniques:

- Interviews
- Focus groups
- Facilitated groups such as JAD (joint application development)
- Group creativity techniques: brainstorming, nominal groups, delphi, mind map, affinity diagnostics
- Prototyping
- Observation
- Questions and surveys
- Group decision-making techniques: unanimity, majority, plurality, dictatorship

9.14 Requirements Traceability Matrix

The requirements traceability matrix is a table that links requirements to their origin and traces them throughout the project life cycle. The implementation of a

requirements traceability matrix helps ensure that each requirement adds business value by linking it to the business and project objectives. It provides a means to track requirements throughout the project life cycle, helping to ensure that requirements approved in the requirements documentation are delivered at the end of the project. Finally, it provides a structure for managing changes to the product scope. This process includes, but is not limited to, tracking:

- Requirements to business needs, opportunities, goals, and objectives
- Requirements to project objectives
- Requirements to project scope/work breakdown structure deliverables
- Requirements to product design
- Requirements to product development
- Requirements to test strategy and test scenarios
- High-level requirements to more detailed requirements

Attributes associated with each requirement can be recorded in the requirements traceability matrix. These attributes help to define key information about the requirement. Typical attributes used in the requirements traceability matrix may include a unique identifier, a textual description of the requirement, the rationale for inclusion, owner, source, priority, version, current status (such as active, cancelled, deferred, added, approved), and date completed. Additional attributes to ensure that the requirement has met stakeholders' satisfaction may include stability, complexity, and acceptance criteria.

9.15 Matrix Fields

These are suggestions only and will vary based on organizational and project requirements.

- A unique identification number containing the general category of the requirement (e.g., SYSADM) and a number assigned in ascending order (e.g., 1.0, 1.1, 1.2)
- Requirement statement
- Requirement source (conference, configuration control board, task assignment, etc.)
- Software requirements specification/functional requirements document paragraph number containing the requirement
- Design specification paragraph number containing the requirement
- Program module containing the requirement
- Test specification containing the requirement test
- Test case number(s) where requirement is to be tested (optional)
- Verification of successful testing of requirements
- Modification field (If a requirement was changed, eliminated, or replaced, indicate disposition and authority for modification.)
- Remarks

Requirements Traceability Matrix by DHWiki licensed under Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 United States License.

9.16 Work Breakdown Structure

Now that we have the deliverables and requirements well defined, the process of breaking down the work of the project via a work breakdown structure (WBS) begins. The WBS defines the scope of the project and breaks the work down into components that can be scheduled, estimated, and easily monitored and controlled. The idea behind the WBS is simple: you subdivide a complicated task into smaller tasks, until you reach a level that cannot be further subdivided. Anyone familiar with the arrangements of folders and files in a computer memory or who has researched their ancestral family tree should be familiar with this idea. You stop breaking down the work when you reach a low enough level to perform an estimate of the desired accuracy. At that point, it is usually easier to estimate how long the small task will take and how much it will cost to perform than it would have been to estimate these factors at the higher levels. Each descending level of the WBS represents an increased level of detailed definition of the project work.

WBS describes the products or services to be delivered by the project and how they are decomposed and related. It is a deliverable-oriented decomposition of a project into smaller components. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.

A WBS also provides the necessary framework for detailed cost estimating and control, along with providing guidance for schedule development and control.

9.17 Overview

WBS is a hierarchical decomposition of the project into phases, deliverables, and work packages. It is a tree structure, which shows a subdivision of effort required to achieve an objective (e.g., a program, project, and contract). In a project or contract, the WBS is developed by starting with the end objective and successively subdividing it into manageable components in terms of size, duration, and responsibility (e.g., systems, subsystems, components, tasks, subtasks, and work packages), which include all steps necessary to achieve the objective.

The WBS creation involves:

- Listing all the project outputs (deliverables and other direct results)
- Identifying all the activities required to deliver the outputs
- Subdividing these activities into sub activities and tasks
- Identifying the deliverable and milestone(s) of each task

- Identifying the time usage of all the resources (personnel and material) required to complete each task

The purpose of developing a WBS is to:

- Allow easier management of each component
- Allow accurate estimation of time, cost, and resource requirements
- Allow easier assignment of human resources
- Allow easier assignment of responsibility for activities

9.18 Example of a WBS

If I want to clean a room, I might begin by picking up clothes, toys, and other things that have been dropped on the floor. I could use a vacuum cleaner to get dirt out of the carpet. I might take down the curtains and take them to the cleaners, and then dust the furniture. All of these tasks are subtasks performed to clean the room. As for vacuuming the room, I might have to get the vacuum cleaner out of the closet, connect the hose, empty the bag, and put the machine back in the closet. These are smaller tasks to be performed in accomplishing the subtask called vacuuming. Figure 9.3 A WBS for cleaning a room shows how this might be portrayed in WBS format.

It is very important to note that we do not worry about the sequence in which the work is performed or any dependencies between the tasks when we do a WBS. That will be worked out when we develop the schedule. For example, under

3.0 Vacuum, it would be obvious that 3.3 Vacuum carpet would be performed after 3.4 Connect hose and plug! However, you will probably find yourself thinking sequentially, as it seems to be human nature to do so. The main idea of creating a WBS is to capture all of the tasks, irrespective of their order. So if you find yourself and other members of your team thinking sequentially, don't be too concerned, but don't get hung up on trying to diagram the sequence or you will slow down the process of task identification. A WBS can be structured any way it makes sense to you and your project. In practice, the chart structure is used quite often but it can be composed in outline form as well (Figure 9.5 Clean Room in an outline view.).

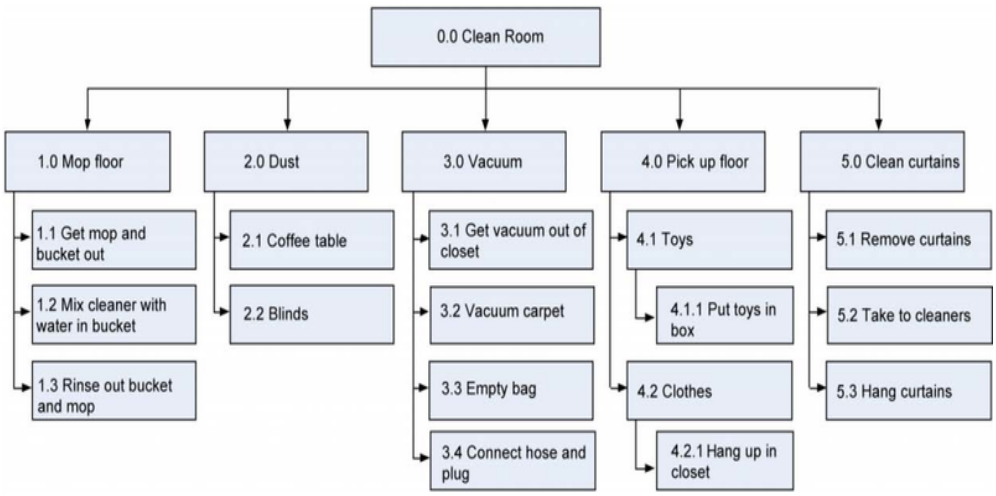


Figure 9.3 A WBS for cleaning a room

. Source: Project Management Skills for All Careers.

You'll notice that each element at each level of the WBS in both figures is assigned a unique identifier. This unique identifier is typically a number, and it's used to sum and track costs, schedules, and resources associated with WBS elements. These numbers are usually associated with the corporation's chart of accounts, which is used to track costs by category. Collectively, these numeric identifiers are known as the code of accounts.

There are also many ways you can organize the WBS. For example, it can be organized by either deliverable or phase. The major deliverables of the project are used as the first level in the WBS. For example, if you are doing a multimedia project the deliverables might include producing a book, CD, and a DVD (Figure 9.4 A WBS for a multimedia project).

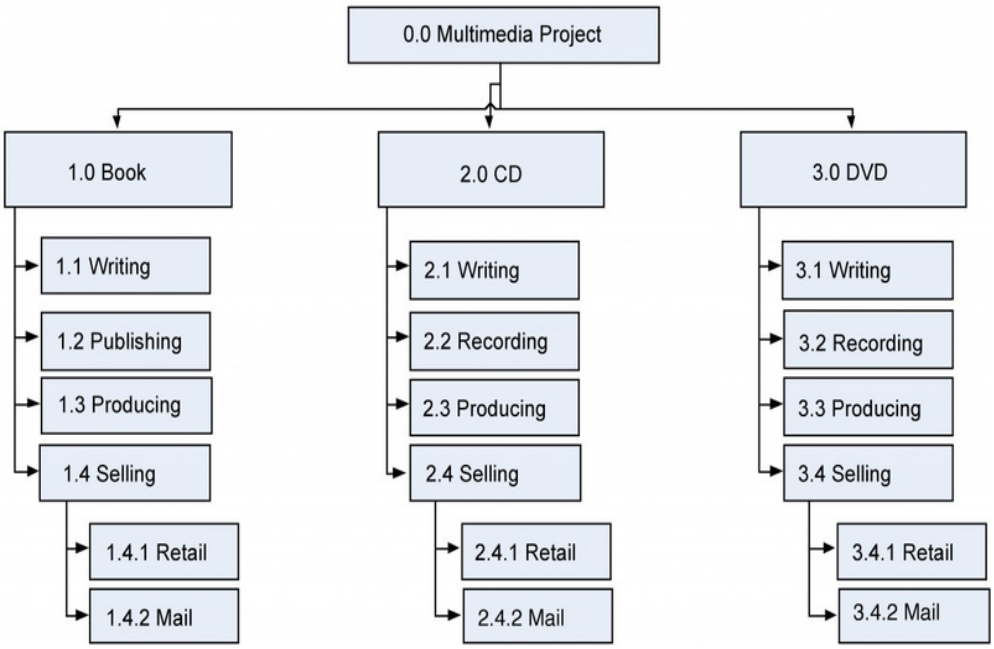


Figure 9.4 A WBS for a multimedia project

. Source: Project Management Skills for All Careers.

Many projects are structured or organized by project phases (Figure 9.6 WBS Project Phases). Each phase would represent the first level of the WBS and their deliverables would be the next level and so on.

The project manager is free to determine the number of levels in the WBS based on the complexity of the project. You need to include enough levels to accurately estimate project time and costs but not so many levels that are difficult to distinguish between components. Regardless of the number of levels in a WBS, the lowest level is called a work package.

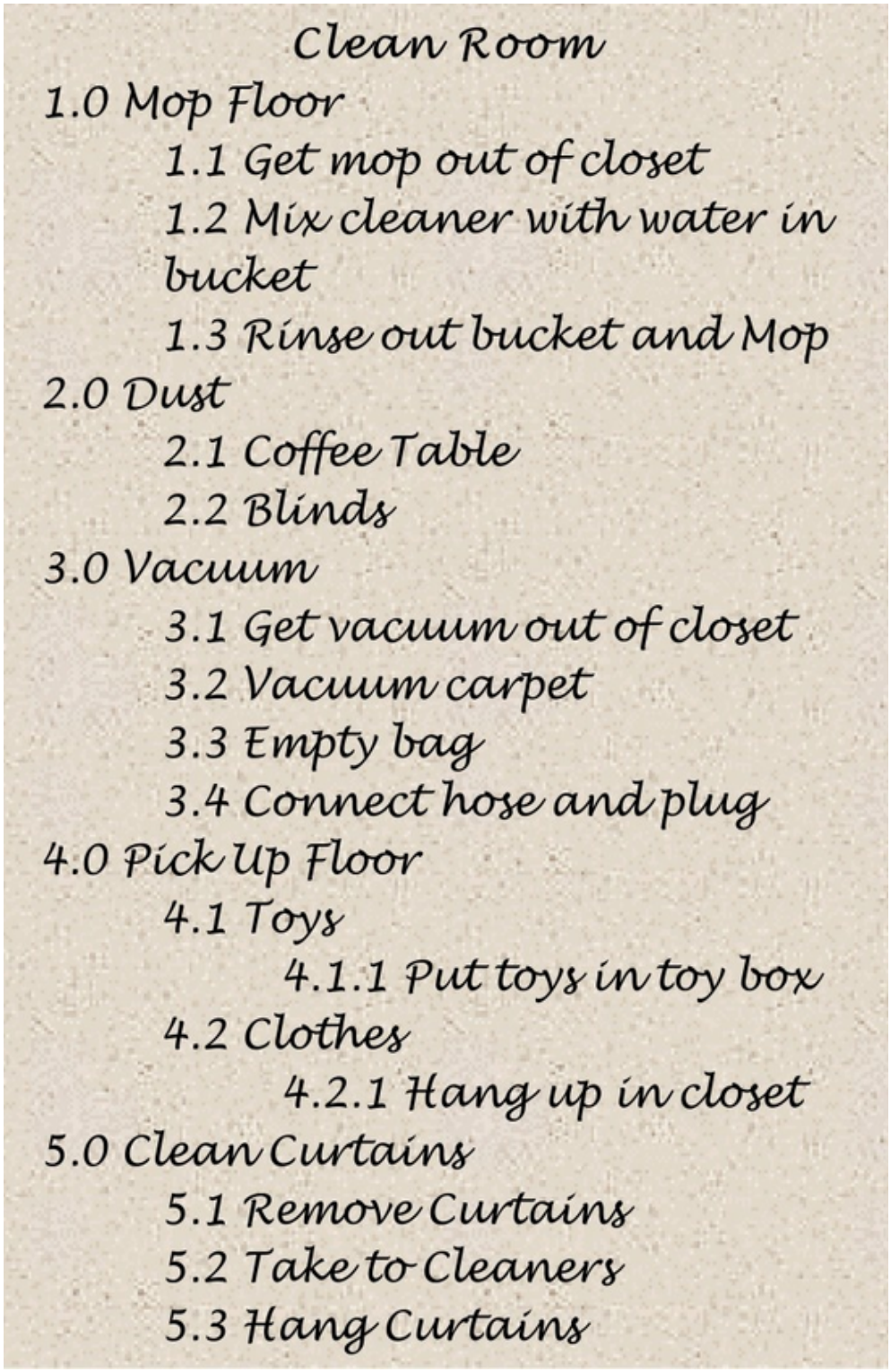


Figure 9.5 Clean Room in an outline view.

. Source: Project Management Skills for All Careers.

Work packages are the components that can be easily assigned to one person or a team of people, with clear accountability and responsibility for completing the assignment. The work-package level is where time estimates, cost estimates, and resource estimates are determined.

100 Percent Rule The 100 percent rule is the most important criterion in developing and evaluating the WBS. The rule states that each decomposed level (child) must represent 100 percent of the work applicable to the next higher (parent) element. In

other words, if each level of the WBS follows the 100 percent rule down to the activities, then we are confident that 100 per-cent of the activities will have been identified when we develop the project schedule. When we create the budget for our project, 100 percent of the costs or resources required will be identified.

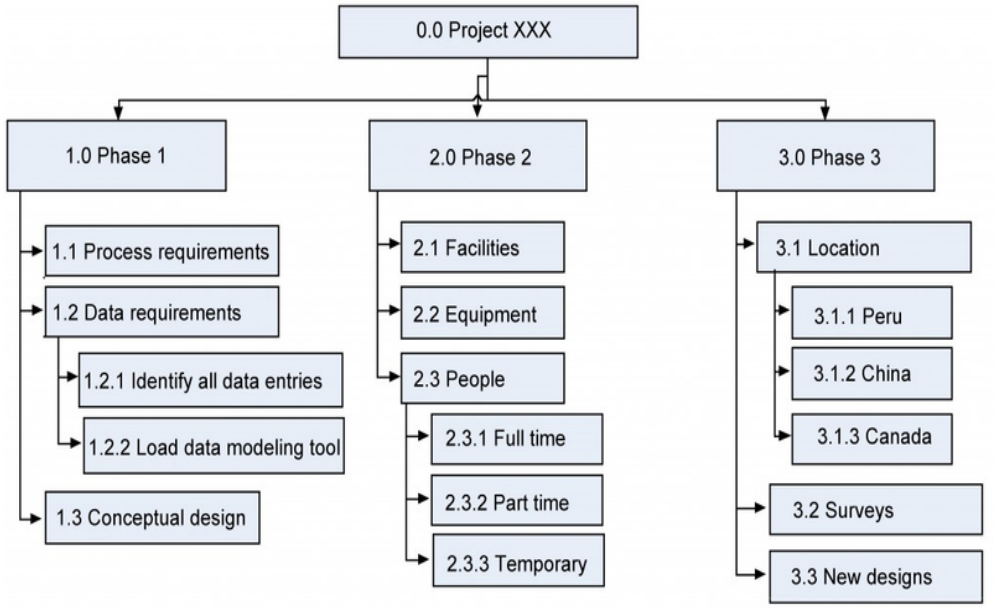


Figure 9.6 WBS Project Phases

. Source: Project Management Skills for All Careers.

9.19 Scope Statement

Scope statements may take many forms depending on the type of project being implemented and the nature of the organization. The scope statement details the project deliverables and describes the major objectives. The objectives should include measurable success criteria for the project.

A scope statement captures, in very broad terms, the product of the project: for example, “development of a software-based system to capture and track orders for software.” A scope statement should also include the list of users using the product, as well as the features in the resulting product.

As a baseline scope statements should contain:

- The project name
- The project charter
- The project owner, sponsors, and stakeholders
- The problem statement
- The project goals and objectives
- The project requirements
- The project deliverables
- The project non-goals (what is out of scope)
- Milestones
- Cost estimates

In more project-oriented organizations, the scope statement may also contain these and other sections:

- Project scope management plan
- Approved change requests
- Project assumptions and risks
- Project acceptance criteria

9.20 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported, Project Management/PMBOK/Scope Management and Development Cooperation Handbook/Designing and Executing Projects/Detailed Planning or design stage by Wikibooks licensed under Creative Commons Attribution-ShareAlike 3.0 License, Work Breakdown Structure by Wikipedia licensed under Creative Commons Attribution-ShareAlike 3.0 License., and 100 Percent Rule by Pabipedia licensed under Creative Commons Attribution-ShareAlike 3.0 License.

Chapter 10 Project Schedule Planning

Adrienne Watt

In order to develop our schedule, we first need to define the activities, sequence them in the right order, estimate the resources needed, and estimate the time it will take to complete the tasks.

10.1 Defining Activities

The activity definition process is a further breakdown of the work package elements of the WBS. It documents the specific activities needed to fulfill the deliverables detailed in the WBS. These activities are not the deliverables themselves but the individual units of work that must be completed to fulfill the deliverables. Activity definition uses everything we already know about the project to divide the work into activities that can be estimated. You might want to look at all the lessons learned from similar projects your company has done to get a good idea of what you need to do on the current one.

Expert judgment in the form of project team members with prior experience developing project scope statements and WBS can help you define activities. If you are asked to manage a project in a new domain, you might also use experts in that particular field to help define tasks so you can understand what activities are going to be involved. You may want to create an activity list and then have the expert review it and suggest changes. Alternatively, you could involve the expert from the very beginning and ask to have an activity definition conversation with him or her before even making your first draft of the list.

Sometimes you start a project without knowing a lot about the work that you'll be doing later. Rolling-wave planning lets you plan and schedule only the portion that you know enough about to plan well. When you don't know enough about a project, you can use placeholders for the unknown portions until you know more. These are extra items that are put at high levels in the WBS to allow you to plan for the unknown.

10.2 A Case Study

Susan and Steve have decided to tie the knot, but they don't have much time to plan their wedding. They want the big day to be unforgettable. They want to invite many people and provide a great time. They've always dreamed of a June wedding, but it's already January. Just thinking about all of the details involved is overwhelming. Susan

has been dreaming of the big day since she was 12, but it seems that there's so little time for all the tasks to be completed. When they were choosing the paper for the invitations, the couple realized that they needed help.

Susan	Steve, we need some help.
Steve	Don't worry. My sister's wedding planner was great. Let me give her a call. [Steve calls the wedding planner Sally.
Wedding Planner	Hello Susan and Steve.
Steve	We want everything to be perfect.
Susan	There is so much to do! Invitations, food, guests, and music.
Steve	Oh no, we haven't even booked a place!
Susan	And it has to be done right. We can't print the invitations until we have the menu planned. We can't do the seating arrangements until we have the RSVPs. We aren't sure what kind of band to get for the reception, or should it be a DJ? We're just overwhelmed.
Steve	My sister said toy really saved her wedding. I know she gave you over a year to plan.
Steve	But I've always dreamed of a June wedding, and I'm not willing to give that up. I know it's late, but Sally can you help us?
Wedding Planner	Take it easy, guys. I've got it under control. We've a lot of people and activities to get under control. You guys really should have called six months ago, but we'll still make this wedding happen on time.

Much work has to be done before June. First, Sally figures out what work needs to be done. She starts to put together a to-do list:

- Invitations

- Flowers
- Wedding cake
- Dinner menu
- Band

Since many different people are involved in the making of the wedding, it takes much planning to coordinate all the work in the right order by the right people at the right time. Initially, Sally was worried that she didn't have enough time to make sure that everything would be done properly. However, she knew that she had some powerful time management tools on her side when she took the job, and these tools would help her to synchronize all the required tasks. To get started, Sally arranged all the activities in a work breakdown structure. The next exercise presents part of the WBS Sally made for the wedding.

10.2.1 WBS Exercise (Solution follows)

Arrange the following activities into the WBS (Figure 10.1 Work breakdown structure (WBS) based on project phase.) to show how the work items decompose into activities.

- Shop for shoes
- Create guest list
- Have the tailoring and fitting done
- Shop for dress
- Find caterer
- Cater the wedding
- Wait for RSVPs
- Mail the invitations
- Finalize the menu
- Print the invitations
- Choose the bouquet

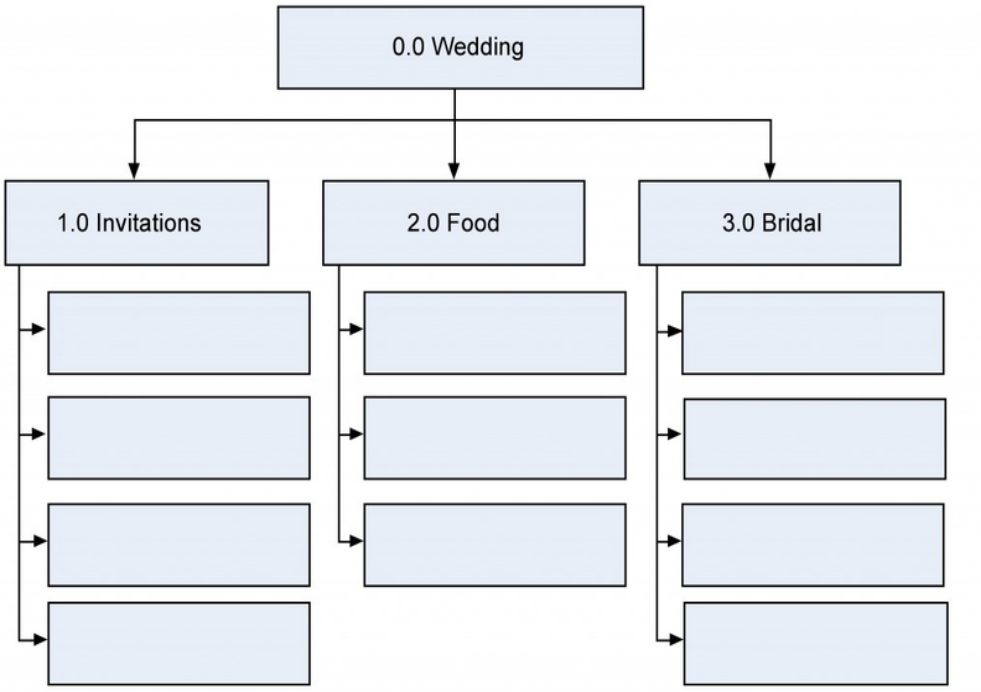


Figure 10.1 Work breakdown structure (WBS) based on project phase. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Solution to Exercise: Figure 10.2 Work breakdown structure (WBS) based on project phase – solution

10.2.2 Activity List

Now that the activity definitions for the work packages have been completed, the next task is to complete the activity list. The project activity list is a list of everything that needs to be done to complete your project, including all the activities that must be accomplished to deliver each work package. Next you want to define the activity attributes. Here's where the description of each activity is kept. It includes all the information you need to figure out plus the order of the work. Any predecessor activities, successor activities, or constraints should be listed in the attributes along with descriptions and any other information about resources or time that you need for planning. The three main kinds of predecessors are finish-to-start (FS), start-to-start (SS), and finish-to-finish (FF). The most common kind of predecessor is the finish-to-start. It means that one task needs to be completed before another one can start. When you think of predecessors, this is what you usually think of; one thing needs to end before the next can begin. It's called finish-to-start because the first activity's finish leads into the second activity's start (Figure 10.3 An example of a finish-to-start (FS) predecessor.).

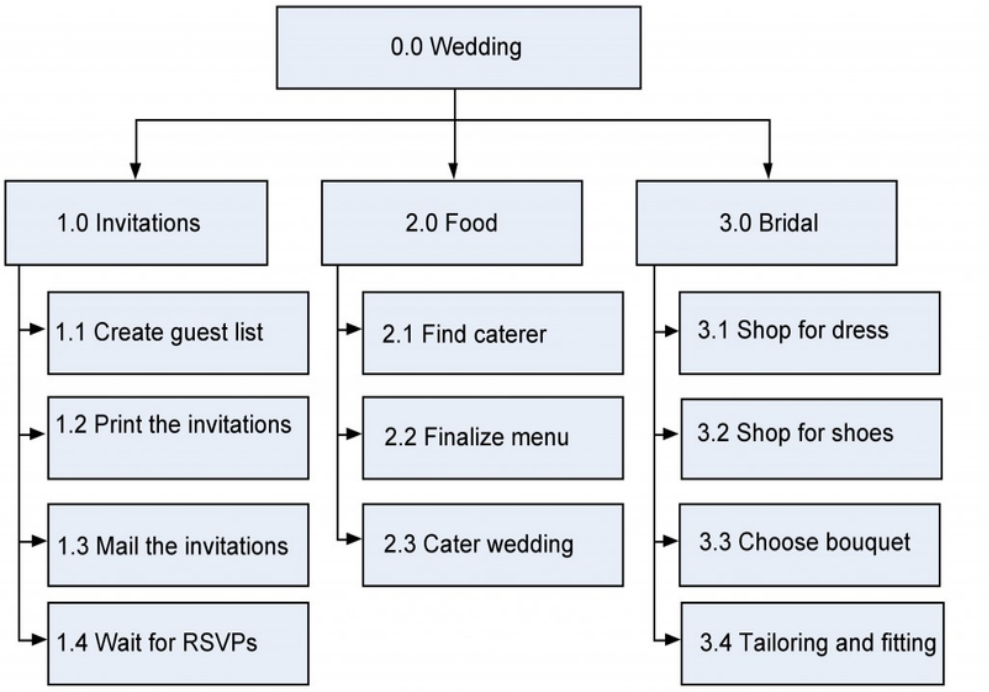


Figure 10.2 Work breakdown structure (WBS) based on project phase – solution . Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Figure 10.3 An example of a finish-to-start (FS) predecessor. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

The start-to-start predecessor is a little less common, but sometimes you need to coordinate activities so they begin at the same time (Figure 10.4 An example of a start-to-start (SS) predecessor.).

The finish-to-finish predecessor shows activities that finish at the same time (Figure 10.5 An example of a finish-to-finish (FF) predecessor.).

It is possible to have start-to-finish (SF) predecessors. This happens when activities require that another task be started before the successor task can finish. An example might be that the musicians cannot finish playing until the guests have started leaving the ceremony. In addition, there are some particular types of predecessors that must be considered.

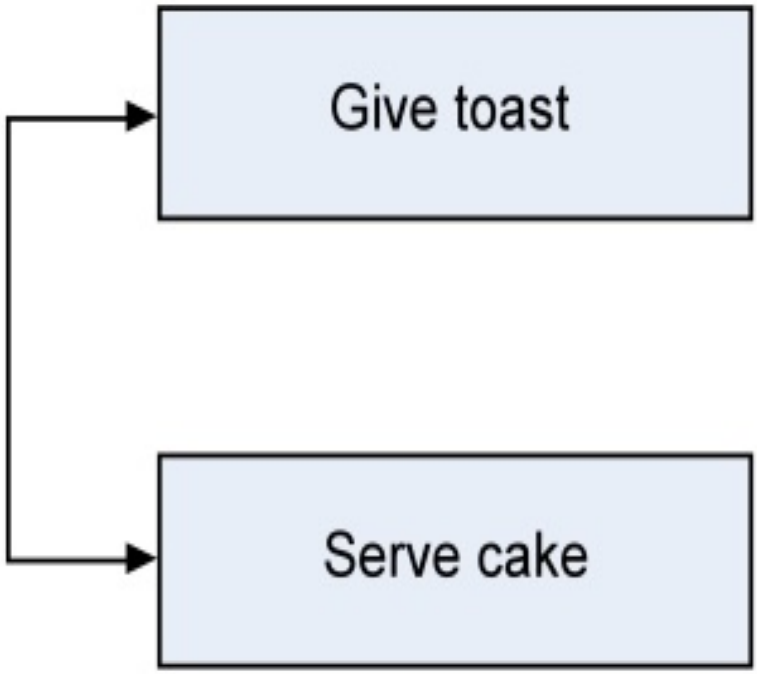


Figure 10.4 An example of a start-to-start (SS) predecessor. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

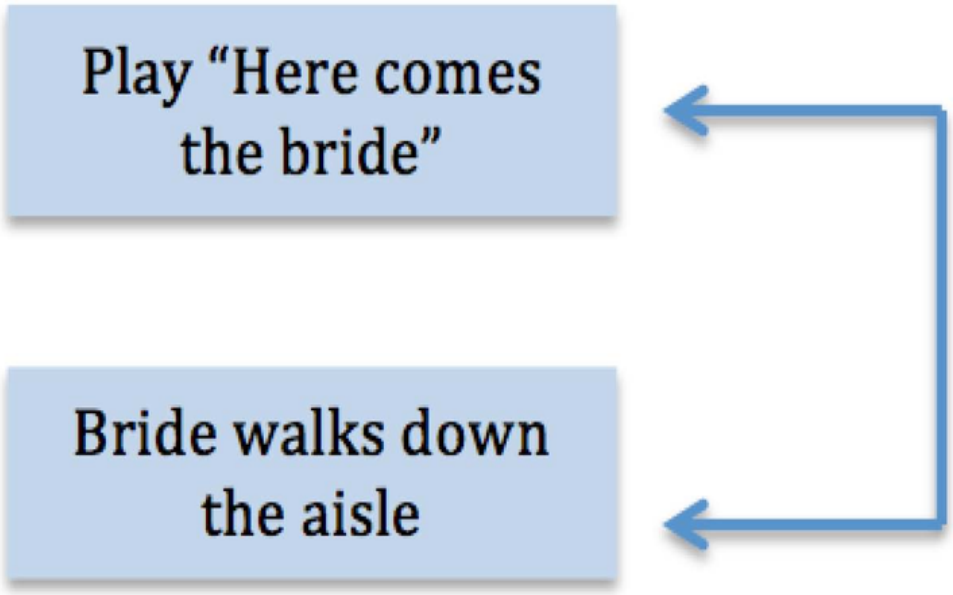


Figure 10.5 An example of a finish-to-finish (FF) predecessor. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

10.2.3 External Predecessors

Sometimes your project will depend on things outside the work you're doing. For the wedding, we are depending on the wedding party before us to be out of the reception hall in time for us to decorate. The decoration of the reception hall then depends on that as an external predecessor.

10.2.4 Discretionary Predecessors

These are usually process-or procedure-driven or best-practice techniques based on past experience. In the wedding example, Steve and Susan want the bridesmaids to arrive at the reception before the couple arrives. There's no necessity; it is just a matter of preference.

10.2.5 Mandatory Predecessors

You can't address an invitation that hasn't been printed yet. So printing invitations is a mandatory predecessor for addressing them. Mandatory predecessors are the kinds that have to exist just because of the nature of the work.

10.2.6 Leads and Lags

Sometimes you need to give some extra time between activities. Lag time is when you purposefully put a delay between the predecessor task and the successor. For example, when the bride and her father dance, the others wait awhile before they join them (Figure 10.6 A lag means making sure that one task waits a while before it gets started.).

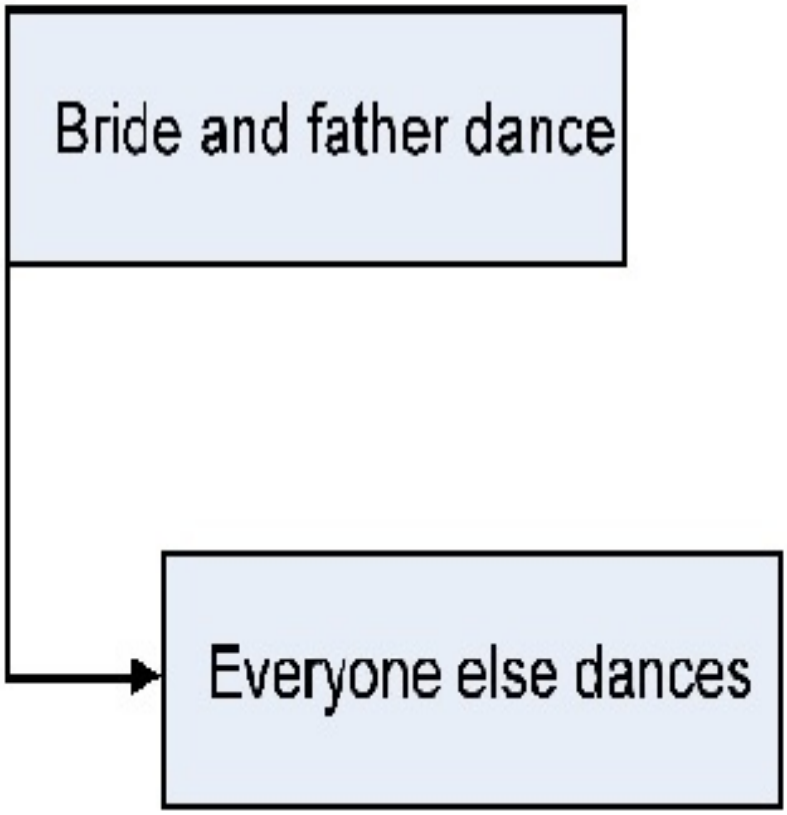


Figure 10.6 A lag means making sure that one task waits a while before it gets started. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Lead time is when you give a successor task some time to get started before the predecessor finishes (Figure 10.7 A lead is when you let a task get started before its predecessor is done.). So you might want the caterer preparing dessert an hour before everybody is eating dinner.

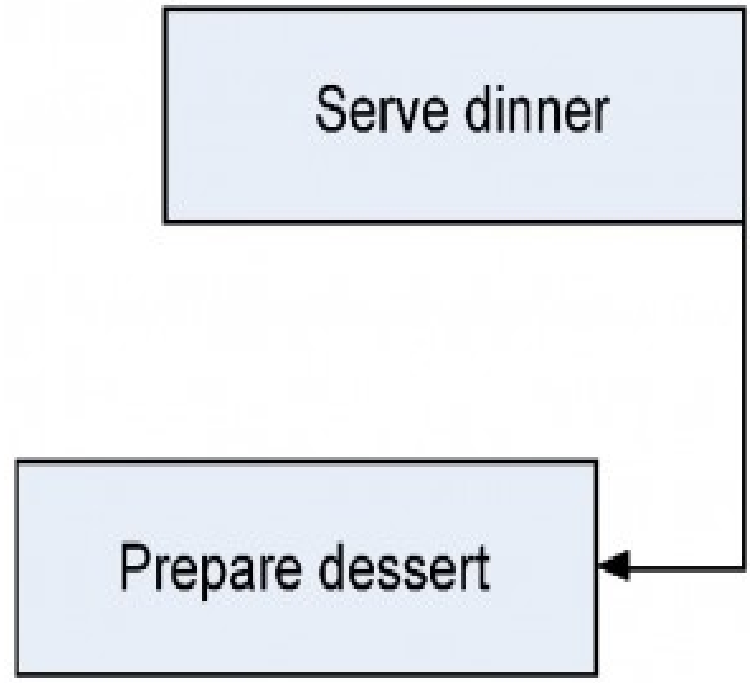


Figure 10.7 A lead is when you let a task get started before its predecessor is done. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

10.2.7 Milestones

All of the important checkpoints of your project are tracked as milestones. Some of them could be listed in your contract as requirements of successful completion; some could just be significant points in the project that you want to keep track of. The milestone list needs to let everyone know which milestones are required and which are not.

Some milestones for Susan and Steve's wedding might be:

- Invitations sent
- Menu finalized
- Location booked
- Bridesmaids' dresses fitted

As you figure out which activities will need to be done, you may realize that the scope needs to change. When that happens, you need to create a change request and send it through the change control system.

Some things that could go wrong:

Wedding Planner	We just got the programs back from the printer and they're all wrong.
Steve	The quartet cancelled. They had another wedding that day.
Susan	Aunt Jane is supposed to sing at the service, but after what happened at her uncle's funeral, I think I want someone else to do it.
Steve	Should we really have a pan flute player? I'm beginning to think it might be overkill.
Susan	Apparently! Maybe we should hold off on printing the invitations until these things are worked out.
Wedding Planner	OK, let's think about exactly how we want to do this. I think we need to be sure about how we want the service to go before we do any more printing.

10.2.8 The Activity Sequencing Process

Now that we know what we have to do to make the wedding a success, we need to focus on the order of the work. Sally sat down with all of the activities she had defined for the wedding and decided to figure out exactly how they needed to happen. That's where she used the activity sequencing process.

The activity attribute list Sally created had most of the predecessors and successors necessary written in it. This is where she thought of what comes first, second, third, etc. Sally's milestone list had major pieces of work written down, and there were a couple of changes to the scope she had discovered along the way that were approved and ready to go.

Example milestone list: Steve and Susan had asked that the invitations be printed at least three months in advance to be sure that everyone had time to RSVP. That's a milestone on Sally's list.

Example change request: When Sally realized that Steve and Susan were going to need another limo to take the bridesmaids to reception hall, she put that change through change control, including running everything by Susan's mother, and it was approved.

10.3 Creating the Gantt Chart

A Gantt chart is a type of bar chart, developed by Henry Gantt, that illustrates a project schedule. Gantt charts are easy to read and are commonly used to display schedule activities. These charts display the start and finish dates of the terminal elements and summary elements of a project. Terminal elements and summary elements comprise the work breakdown structure of the project. Some Gantt charts also show the dependency relationships (i.e., precedence network) between activities.

Gantt charts show all the key stages of a project and their duration as a bar chart, with the time scale across the top. The key stages are placed on the bar chart in sequence, starting in the top left corner and ending in the bottom right corner (Figure 10.8 Gantt chart for directory production). A Gantt chart can be drawn quickly and easily and is often the first tool a project manager uses to provide a rough estimate of the time that it will take to complete the key tasks. Sometimes it is useful to start with the target deadline for completion of the whole project, because it is soon apparent if the time scale is too short or unnecessarily long. The detailed Gantt chart is usually constructed after the main objectives have been determined.

In this example inFigure 10.8 Gantt chart for directory production , key stage K (Organize distribution) starts at week 23 so that its end point coincides with key stage L (Distribute directory). However, K could begin as early as week 17, as soon as key stage J is completed. Key stage K is therefore said to have "slack." Key stage H (Agree print contract) has been placed to end at week 12. However, it could end as late as week 22, because key stage I (Print directory) does not begin until week 23. Key stage H is therefore said to have "float." Float time can be indicated on the chart by adding a line ahead of the bar to the latest possible end point. Slack and float show you where there is flexibility in the schedule, and this can be useful when you need to gain time once the project is up and running.

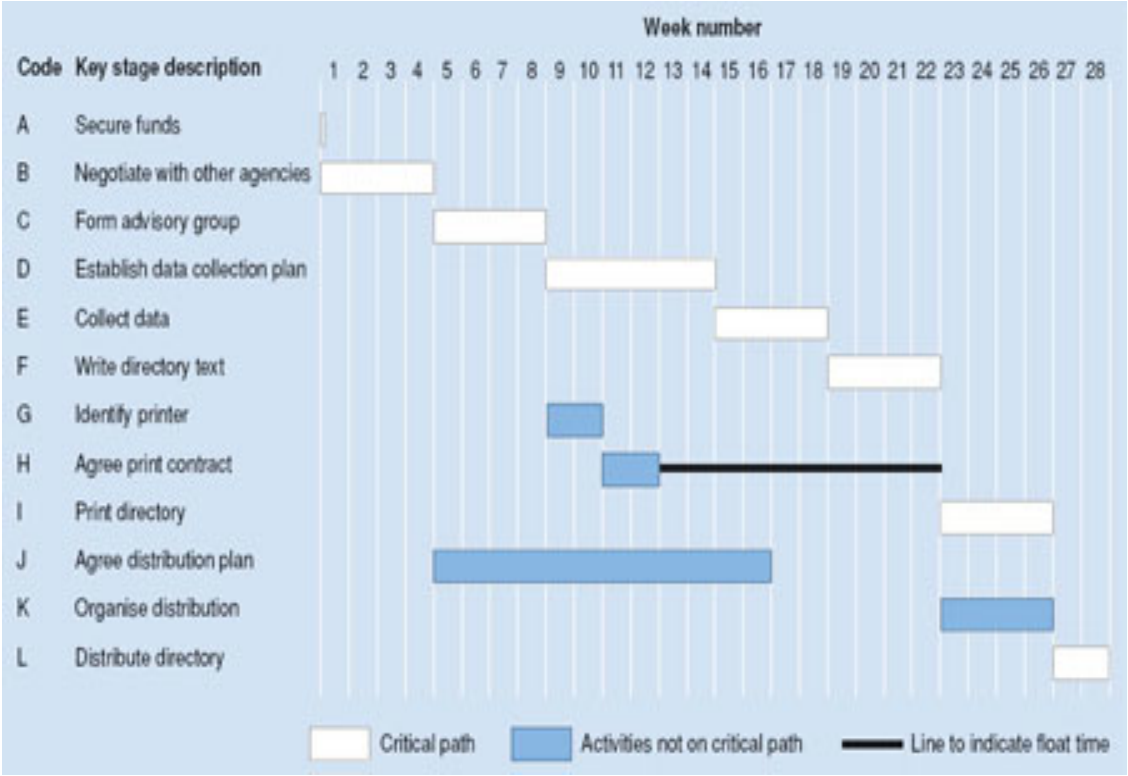


Figure 10.8 Gantt chart for directory production

(http://labspace.open.ac.uk/mod/resource/ view.php?id=451673) .

You can add other information to a Gantt chart, for example:

- Milestones could be indicated by using a symbol such as a diamond or triangle.
- Project meetings could be indicated by another symbol such as a circle.
- Reviews of progress could be indicated by a square.

For a complex project, you may decide to produce a separate Gantt chart for each of the key stages. If you do this shortly before each key stage begins, you will be able to take any last-minute eventualities into account. These charts provide a useful tool for monitoring and control as the project progresses.

Gantt charts are relatively easy to draw by hand, but this doesn't offer the same level of flexibility during monitoring that you would get from a software package. Various programs are available to assist project managers in scheduling and control. Once the data have been entered, a program helps you to work on "what if" scenarios, showing what might happen if a key stage is delayed or speeded up. This is more difficult if you are working manually.

10.4 Creating the Network Diagram

Many project managers use network diagrams when scheduling a project. The network diagram is a way to visualize the interrelationships of project activities. Network diagrams provide a graphical view of the tasks and how they relate to one

another. The tasks in the network are the work packages of the WBS. All of the WBS tasks must be included in the network because they have to be accounted for in the schedule. Leaving even one task out of the network could change the overall schedule duration, estimated costs, and resource allocation commitments.

The first step is to arrange the tasks from your WBS into a sequence. Some tasks can be accomplished at any time throughout the project where other tasks depend on input from another task or are constrained by time or resources.

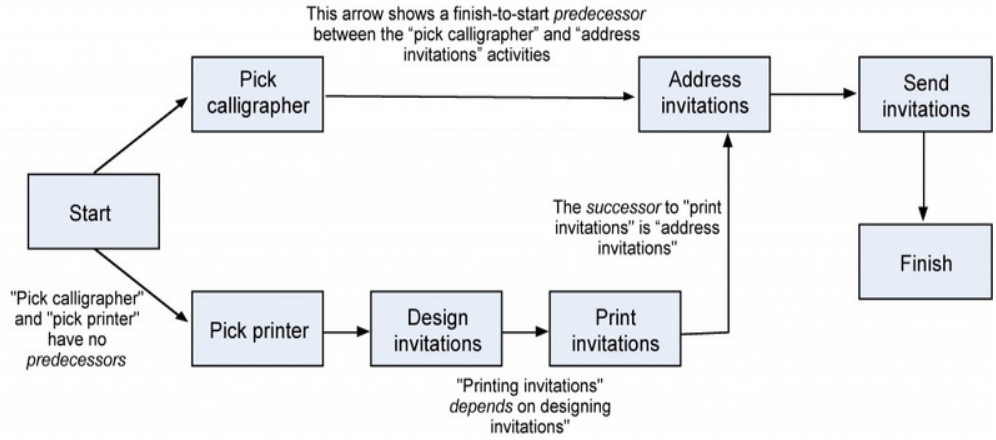


Figure 10.9 The relationship between the work breakdown structure (WBS) and the network diagram. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

The WBS is *not* a schedule, but it is the basis for it. The network diagram *is* a schedule but is used primarily to identify key scheduling information that ultimately goes into user-friendly schedule formats, such as milestone and Gantt charts.

The network diagram provides important information to the project team. It provides information about how the tasks are related (Figure 10.9 The relationship between the work breakdown structure (WBS) and the network diagram.), where the risk points are in the schedule, how long it will take as currently planned to finish the project, and when each task needs to begin and end.

In our wedding planner example, Sally would look for relationships between tasks and determine what can be done in parallel and what activities need to wait for others to complete. As an example, Figure 10.10 An example of an activity on node (AON) diagram. shows how the activities involved in producing the invitations depend on one another. Showing the activities in rectangles and their relationships as arrows is called a precedence diagramming method (PDM). This kind of diagram is also called an activity-on-node (AON) diagram.

Another way to show how tasks relate is with the activity-on-arrow (AOA) diagram. Although AON is more commonly used and is supported by all project management programs, PERT is the best-known AOA-type diagram and is the historical basis of all network diagramming. The main difference is the AOA diagram is traditionally drawn using circles as the nodes, with nodes representing the beginning and ending points of the arrows or tasks. In the AOA network, the arrows represent the activities or tasks (Figure 10.11 An example of an activity arrow (AOA) network diagram.).

All network diagrams have the advantages of showing task interdependencies, start and end times, and the critical path (the longest path through the network) but the AOA network diagram has some disadvantages that limit the use of the method.

The three major disadvantages of the AOA method are:

- The AOA network can only show finish-to-start relationships. It is not possible to show lead and lag except by adding or subtracting time, which makes project tracking difficult.
- There are instances when dummy activities can occur in an AOA network. Dummy activities are activities that show the dependency of one task on other tasks but for other than technical reasons. For example, one task may depend on another because it would be more cost effective to use the same resources for the two; otherwise the two tasks could be accomplished in parallel. Dummy activities do not have durations associated with them. They simply show that a task has some kind of dependence on another task.

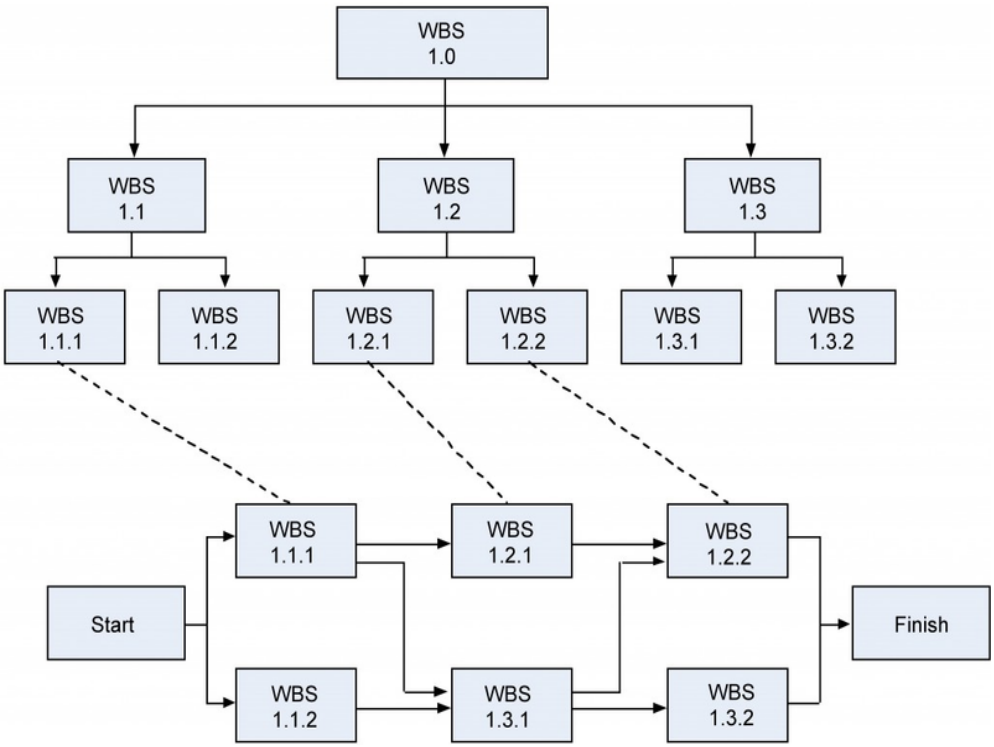


Figure 10.10 An example of an activity on node (AON) diagram. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

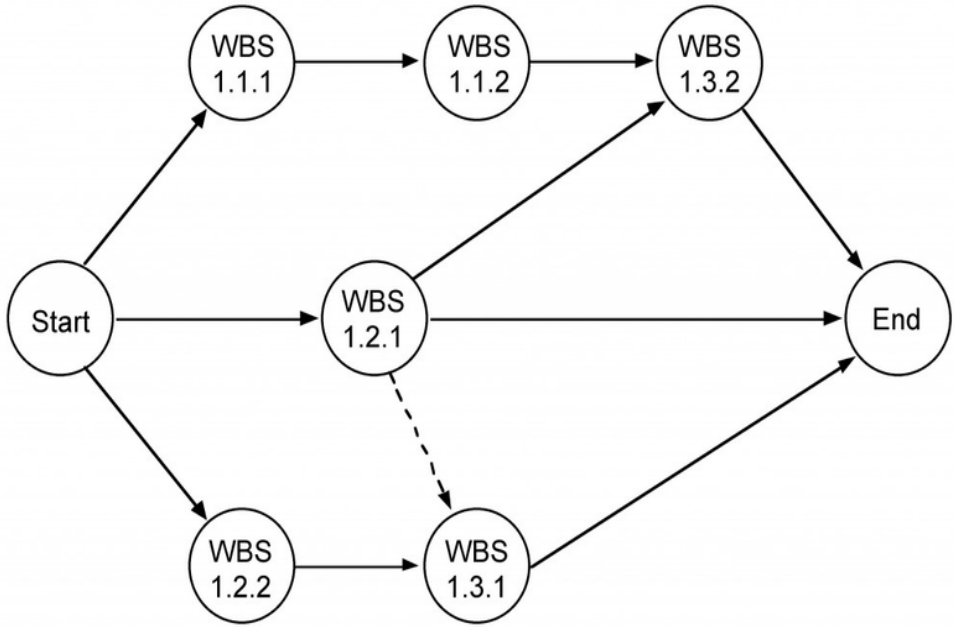


Figure 10.11 An example of an activity arrow (AOA) network diagram. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

- AOA diagrams are not as widely used as AON diagrams simply because the latter are somewhat simpler to use, and all project management software programs can accommodate AON networks, whereas not all can accommodate AOA networks.

10.5 The Critical Path

The critical path describes the sequence of tasks that would enable the project to be completed in the shortest possible time. It is based on the idea that some tasks must be completed before others can begin. A critical path diagram is a useful tool for scheduling dependencies and controlling a project. In order to identify the critical path, the length of time that each task will take must be calculated.

Let's take a look at an example. The length of time in weeks for each key stage is estimated:

	Key stage	Estimated time in weeks
A	Secure funds	0
B	Negotiate with other agencies	4
C	Form advisory group	4
D	Establish data collection plan	6
E	Collect data	4
F	Write directory text	4
G	Identify printer	2
H	Agree print contract	2
I	Print directory	4
J	Agree distribution plan	12
K	Organize distribution	4
L	Distribute directory	2

Table 10.1 Stages of Critical Path

(http://labspace.open.ac.uk/mod/resource/view.php?id=451674) .

We have given the key stage “Secure funds” an estimated time of zero weeks because the project cannot start without the availability of some funding, although estimates would provide detail at a later stage. The stages can now be lined up to produce a network diagram that shows that there are three paths from start to finish and that the lines making up each path have a minimum duration (Figure 10.12 Critical Path Diagram).

If we now trace each of the possible paths to “Distribute directory” (the finishing point), taking dependencies into account, the route that has the longest duration is known as the critical path. This is the minimum time in which it will be possible to complete the project.

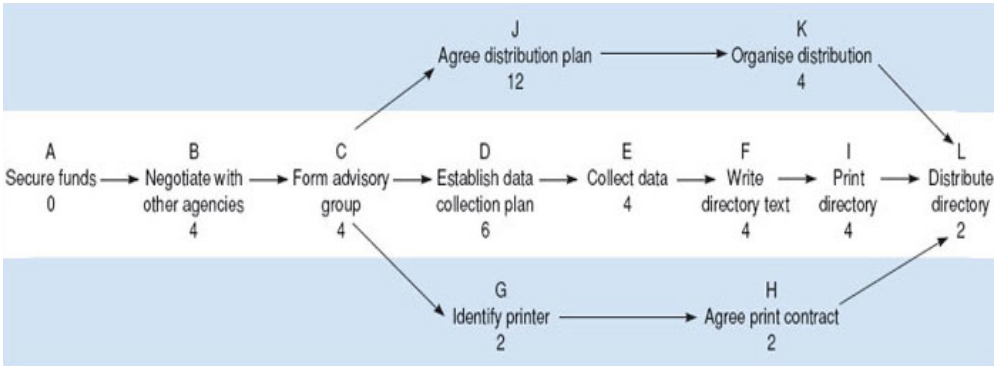


Figure 10.12 Critical Path Diagram

In this example, the critical path is A–B–C–D–E–F–I–L, and the earliest completion date for the project is the sum of the estimated times for all the stages on the critical path – 28 weeks – from the point of securing the funding. All the key stages on the critical path must be completed on time if the project is to be finished on schedule.

If the projected total time is much longer than the project sponsor's expectations, you will need to renegotiate the time scale. Mapping the critical path helps to identify the activities that need to be monitored most closely.

10.6 Attribution

Chapter 11 Resource Planning

Adrienne Watt

In the previous wedding case study, it is clear that Steve and Susan have resource problems. Getting a handle on all of the tasks that have to be done is a great start, but it's not enough to know the tasks and the order they come in. Before you can put the final schedule together, you need to know who is going to do each job, and the things they need so they can do it.

"We've got so much to do! Invitations, catering, music... and I've got no idea who's going to do it all. I'm totally overwhelmed." From this statement it is clear that Susan is worried about human resources. In comparison, Steve realizes that not all resources are people: "And it's not just people. We need food, flowers, a cake, a sound system, and a venue. How do we get a handle on this?"

Resources are people, equipment, place, money, or anything else that you need in order to do all of the activities that you planned for. Every activity in your activity list needs to have resources assigned to it. Before you can assign resources to your project, you need to know their availability. Resource availability includes information about what resources you can use on your project, when they're available to you, and the conditions of their availability. Don't forget that some resources, like consultants or training rooms, have to be scheduled in advance, and they might only be available at certain times. You'll need to know this before you can finish planning your project. If you are starting to plan in January, a June wedding is harder to plan than one in December, because the wedding halls are all booked up in advance. That is clearly a resource constraint. You'll also need the activity list that you created earlier, and you'll need to know how your organization typically handles resources. Once you've got a handle on these things, you're set for resource estimation.

11.1 Estimating the Resources

The goal of activity resource estimating is to assign resources to each activity in the activity list. There are five tools and techniques for estimating activity resources.

Expert judgment means bringing in experts who have done this sort of work before and getting their opinions on what resources are needed.

Alternative analysis means considering several different options for how you assign resources. This includes varying the number of resources as well as the kind of resources you use. Many times, there's more than one way to accomplish an activity and alternative analysis helps decide among the possibilities.

Published estimating data is something that project managers in a lot of industries use to help them figure out how many resources they need. They rely on articles, books, journals, and periodicals that collect, analyze, and publish data from other people's projects.

Project management software such as Microsoft Project will often have features designed to help project managers estimate resource needs and constraints and find the best combination of assignments for the project.

Bottom-up estimating means breaking down complex activities into pieces and working out the resource assignments for each piece. It is a process of estimating individual activity resource need or cost and then adding these up together to come up with a total estimate. Bottom-up estimating is a very accurate means of estimating, provided the estimates at the schedule activity level are accurate. However, it takes a considerable amount of time to perform bottom-up estimating because every activity must be assessed and estimated accurately to be included in the bottom-up calcu lation. The smaller and more detailed the activity, the greater the accuracy and cost of this technique.

11.2 Estimating Activity Durations

Once you're done with activity resource estimating, you've got everything you need to figure out how long each activity will take. That's done in a process called activity duration estimating. This is where you look at each activity in the activity list, consider its scope and resources, and estimate how long it will take to perform.

Estimating the duration of an activity means starting with the information you have about that activity and the resources that are assigned to it, and then working with the project team to come up with an estimate. Most of the time you'll start with a rough estimate and then refine it to make it more accurate. You'll use these five tools and techniques to create the most accurate estimates:

Expert judgment will come from your project team members who are familiar with the work that has to be done. If you don't get their opinion, there's a huge risk that your estimates will be wrong.

Analogous estimating is when you look at similar activities from previous projects and how long they took. This only works if the activities and resources are similar.

Parametric estimating means plugging data about your project into a formula, spreadsheet, database, or computer program that comes up with an estimate. The software or formula that you use for parametric estimating is based on a database of actual durations from past projects.

Three-point estimating is when you come up with three numbers: a realistic estimate that's most likely to occur, an optimistic one that represents the best-case scenario, and a pessimistic one that represents the worst-case scenario. The final estimate is the weighted average of the three.

Reserve analysis means adding extra time to the schedule (called a *contingency reserve* or a *buffer*) to account for extra risk.

In each of the following scenarios of planning Steve and Susan's wedding, determine which of the five activity resource estimation tools and techniques is being used. (Solutions follow.)

Exercises

Exercise 11.1 Sally has to figure out what to do for the music at Steve and Susan's wedding. She considers using a DJ, a rock band, or a string quartet.

Exercise 11.2 The latest issue of *Wedding Planner's Journal* has an article on working with caterers. It includes a table that shows how many waiters work with various guest-list sizes.

Exercise 11.3 There's a national wedding consultant who specializes in Caribbean-themed weddings. Sally gets in touch with her to ask about menu options.

Exercise 11.4 Sally downloads and fills out a specialized spreadsheet that a project manager developed to help with wedding planning.

Exercise 11.5 There's so much work that has to be done to set up the reception hall that Sally has to break it down into five different activities in order to assign jobs.

Exercise 11.6 Sally asks Steve and Susan to visit several different caterers and sample various potential items for the menu.

Exercise 11.7 Sally calls up her friend who knows specifics of the various venues in their area for advice on which one would work best.

Exercise 11.8 There are two different catering companies at the wedding. Sally asks the head chef at each of them to give her an estimate of how long it will take each of them to do the job.

Exercise 11.9 There's a spreadsheet Sally always uses to figure out how long it takes guest to RSVP. She enters the number of guests and their zip codes, and it calculates estimates for her.

Figure 11.1

Exercise 11.10 Sally's done four weddings that are very similar to Steve and Susan's, and in all four of them, it took exactly the same amount of time for the caterers to set up the reception hall.

Solutions

Solution to Exercise 11.1
Alternative analysis
Solution to Exercise 11.2
Published estimating data
Solution to Exercise 11.3
Expert judgment
Solution to Exercise 11.4
Project management software
Solution to Exercise 11.5
Bottom-up estimating
Solution to Exercise 11.6
Alternative analysis
Solution to Exercise 11.7
Expert judgment
Solution to Exercise 11.8
Expert judgment
Solution to Exercise 11.9
Parametric estimating
Solution to Exercise 11.10
Analogous estimating

Figure 11.2

The activity duration estimates are an estimate of how long each activity in the activity list will take. This is a quantitative measure usually expressed in hours, weeks, days, or months. Any work period is fine, and you'll use different work periods for different jobs. A small job (like booking a DJ) may take just a few hours; a bigger job (like catering, including deciding on a menu, ordering ingredients, cooking food, and serving guests on the big day) could take days.

Another thing to keep in mind when estimating the duration of activities is determining the effort involved. Duration is the amount of the time that an activity takes, while effort is the total number of person-hours that are expended. If it takes two people six hours to carve the ice sculpture for the centerpiece of a wedding, the duration is six hours. But if two people worked on it for the whole time, it took 12 person-hours of effort to create.

You'll also learn more about the specific activities while you're estimating them. That's something that always happens. You have to really think through all of the aspects of a task in order to estimate it. As you learn more about the specific activities remember to update the activity attributes.

If we go back to our case study of the wedding, we can see that while Sally has a handle on how long things are going to take, she still has some work to do before she has the whole project under control. Steve and Susan know where they want to get married, and they have the place booked now. But, what about the caterer? They have no idea who's going to be providing food. And what about the band they want? Will the timing with their schedule work out? "If the caterers come too early, the food will sit around under heat lamps. But if they come too late, the band won't have time to play. I just don't see how we'll ever work this out."

It's not easy to plan for a lot of resources when they have tight time restrictions and overlapping constraints. How do you figure out a schedule that makes everything fit together? You're never going to have the complete resource picture until you have finished building the schedule. And the same goes for your activity list and duration estimates! It's only when you lay out the schedule that you'll figure out that some of your activities and durations didn't quite work.

11.3 Project Schedule and Critical Path

The project schedule should be approved and signed off by stakeholders and functional managers. This ensures they have read the schedule, understand the dates and resource commitments, and will cooperate. You'll also need to obtain confirmation that resources will be available as outlined in the schedule. The schedule cannot be finalized until you receive approval and commitment for the resource assignments outlined in it. Once the schedule is approved, it will become your baseline for the remainder of the project. Project progress and task completion will be monitored and tracked against the project schedule to determine if the project is on course as planned.

The schedule can be displayed in a variety of ways, some of which are variations of what you have already seen. Project schedule network diagrams will work as schedule diagrams when you add the start and finish dates to each activity. These diagrams usually show the activity dependencies and critical path.

The critical path method is an important tool for keeping your projects on track. Every network diagram has something that is called the critical path. It's the string of

activities that, if you add up all of the durations, is longer than any other path through the network. It usually starts with the first activity in the network and usually ends with the last one.

Steve

Aunt Jane is a vegetarian. That won't be a problem, right?

Susan

Well, let's see. What menu did we give the caterers?

Steve

We didn't give it to them yet; because we won't have the final menu until everyone RSVPs and lets we know which entrée they want.

Susan

But they can't RSVP because we haven't sent out the invitations! What's holding that up?

Steve

We're still waiting to get them back from the printer. We can't send them out if we don't have them yet!

Susan

Oh no! I still have to tell the printer what to print on the invitations and what paper to use.

Steve

But you were waiting on that until we finished the guest list.

Susan

What a mess!

Steve thought Aunt Jane being a vegetarian was just a little problem. But it turns out to be a lot bigger than either Steve or Susan realized at first. How did a question about one guest's meal lead to such a huge mess? The reason that the critical path is critical is that every single activity on the path must finish on time in order for the project to come in on time. A delay in any one of the critical path activities will cause the entire project to be delayed (Figure 11.3 An example of problems that can be caused within t he critical path.).

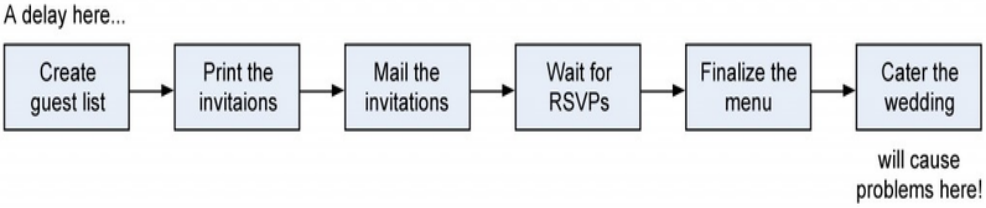


Figure 11.3 An example of problems that can be caused within the critical path. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Knowing where your critical path is can give you a lot of freedom. If you know an activity is not on the critical path, then you know a delay in that activity may not necessarily delay the project. This can really help you handle emergency situations. Even better, it means that if you need to bring your project in earlier than was originally planned, you know that adding resources to the critical path will be much more effective than adding them elsewhere.

It's easy to find the critical path in any project. Of course, on a large project with dozens or hundreds of tasks, you'll probably use software like Microsoft Project to find the critical path for you. But when it does, it's following the same exact steps that are followed here (Figure 11.4 Step 1 Network Diagram).

Step 1. Start with a network diagram.

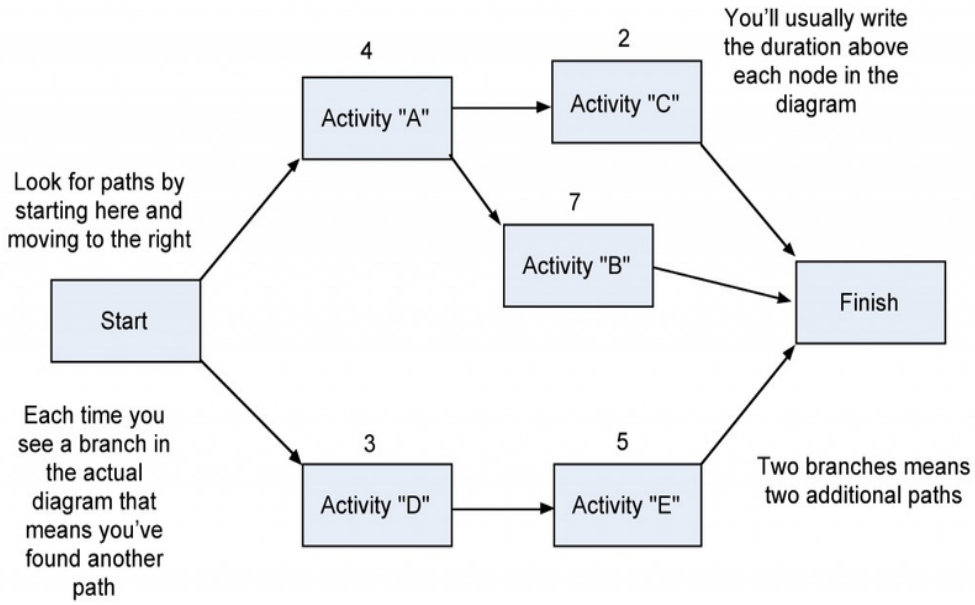


Figure 11.4 Step 1 Network Diagram Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Step 2. Find all the paths in the diagram. A path is any string of activities that goes from the start of the project to the end.

Start → Activity "A" → Activity "B" → Finish

Start → Activity "A" → Activity "C" → Finish

Start → Activity "D" → Activity "E" → Finish

Figure 11.5

Step 3. Find the duration of each path by adding up the durations of each of the activities on the path.

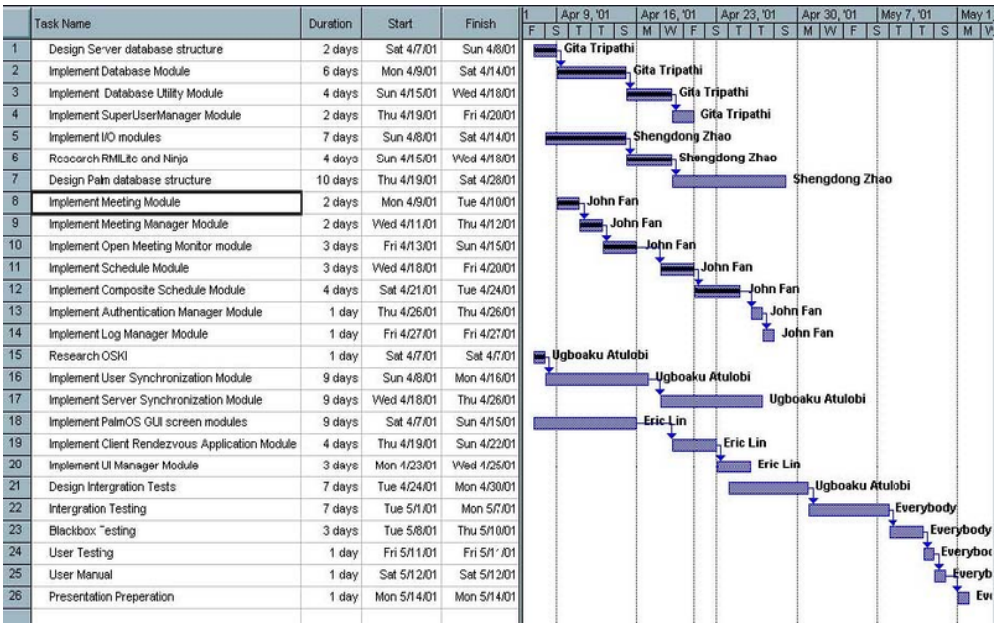
Start → Activity “A” → Activity “B” → Finish = 4 + 7 = 11

Start → Activity “A” → Activity “C” → Finish = 4 + 2 = 6

Start → Activity “D” → Activity “E” → Finish = 3 + 5 = 8

Figure 11.6

Step 4. The first path has a duration of 11, which is longer than the other paths, so it’s the critical path. The schedule can also be displayed using a Gantt chart (Figure 11.7 A n example of a Gantt chart.).



	Task Name	Duration	Start	Finish
1	Design Server database structure	2 days	Sat 4/7/01	Sun 4/8/01
2	Implement Database Module	6 days	Mon 4/9/01	Sat 4/14/01
3	Implement Database Utility Module	4 days	Sun 4/15/01	Wed 4/18/01
4	Implement SuperUserManager Module	2 days	Thu 4/19/01	Fri 4/20/01
5	Implement I/O modules	7 days	Sun 4/8/01	Sat 4/14/01
6	Research RMILite and Ninja	4 days	Sun 4/15/01	Wed 4/18/01
7	Design Palm database structure	10 days	Thu 4/19/01	Sat 4/28/01
8	Implement Meeting Module	2 days	Mon 4/9/01	Tue 4/10/01
9	Implement Meeting Manager Module	2 days	Wed 4/11/01	Thu 4/12/01
10	Implement Open Meeting Monitor module	3 days	Fri 4/13/01	Sun 4/15/01
11	Implement Schedule Module	3 days	Wed 4/18/01	Fri 4/20/01
12	Implement Composite Schedule Module	4 days	Sat 4/21/01	Tue 4/24/01
13	Implement Authentication Manager Module	1 day	Thu 4/26/01	Thu 4/26/01
14	Implement Log Manager Module	1 day	Fri 4/27/01	Fri 4/27/01
15	Research OSKI	1 day	Sat 4/7/01	Sat 4/7/01
16	Implement User Synchronization Module	9 days	Sun 4/8/01	Mon 4/16/01
17	Implement Server Synchronization Module	9 days	Wed 4/18/01	Thu 4/26/01
18	Implement PalmOS GUI screen modules	9 days	Sat 4/7/01	Sun 4/15/01
19	Implement Client Rendezvous Application Module	4 days	Thu 4/19/01	Sun 4/22/01
20	Implement UI Manager Module	3 days	Mon 4/23/01	Wed 4/25/01
21	Design Intergration Tests	7 days	Tue 4/24/01	Mon 4/30/01
22	Intergration Testing	7 days	Tue 5/1/01	Mon 5/7/01
23	Blackbox Testing	3 days	Tue 5/8/01	Thu 5/10/01
24	User Testing	1 day	Fri 5/11/01	Fri 5/11/01
25	User Manual	1 day	Sat 5/12/01	Sat 5/12/01
26	Presentation Preperation	1 day	Mon 5/14/01	Mon 5/14/01

Figure 11.7 An example of a Gantt chart. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

11.4 Resource Management

Resource management is the efficient and effective deployment of an organization’s resources when they are needed. Such resources may include financial resources, inventory, human skills, production resources, or information technology (IT). In the realm of project management, processes, techniques, and philosophies for the best approach for allocating resources have been developed. These include discussions on functional versus cross-functional resource allocation as well as processes espoused by organizations like the Project Management Institute (PMI) through the methodology of project management outlined in their publication *A Guide to the Project Management Body of Knowledge (PMBOK)*. Resource management is a key element to activity resource estimating and project human resource management. As is the case with the larger discipline of project management, there are resource management software tools available that automate and assist the process of resource allocation to projects.

11.5 HR Planning

The most important resource to a project is its people—the project team. Projects require specific expertise at specific moments in the schedule, depending on the milestones being delivered or the given phase of the project. An organization can host several strategic projects concurrently over the course of a budget year, which means that its employees can be working on more than one project at a time. Alternatively, an employee may be seconded away from his or her role within an organization to become part of a project team because of a particular expertise. Moreover, projects often require talent and resources that can only be acquired via contract work and third party vendors. Procuring and coordinating these human resources, in tandem with managing the time aspect of the project, is critical to overall success.

11.6 Managing the Team

In order to successfully meet the needs of a project, it is important to have a high-performing project team made up of individuals who are both technically skilled and motivated to contribute to the project's outcome. One of the many responsibilities of a project manager is to enhance the ability of each project team member to contribute to the project, while also fostering individual growth and accomplishment. At the same time, each individual must be encouraged to share ideas and work with others toward a common goal.

Through performance evaluation, the manager will get the information needed to ensure that the team has adequate knowledge, to establish a positive team environment and a healthy communication climate, to work properly, and to ensure accountability.

Managing the project team includes appraisal of employee performance and project performance. The performance reports provide the basis for managerial decisions on how to manage the project team.

Employee performance includes the employee's work results such as:

- Quality and quantity of outputs
- Work behavior (such as punctuality)
- Job-related attributes (such as cooperation and initiative)

After conducting employee performance reviews, project managers should:

- Provide feedback to employees about how well they have performed on established goals
- Provide feedback to employees about areas in which they are weak or could do better

- Take corrective action to address problems with employees performing at or below minimum expectations
- Reward superior performers to encourage their continued excellence

11.7 Techniques for Managing Resources

One resource management technique is resource leveling. It aims at smoothing the stock of resources on hand, reducing both excess inventories and shortages.

The required data are the demands for various resources, forecast by time period into the future as far as is reasonable; the resources' configurations required in those demands; and the supply of the resources, again forecast by time period into the future as far as is reasonable.

The goal is to achieve 100% utilization. However that is very unlikely, when weighted by important metrics and subject to constraints; for example: meeting a minimum quality level, but otherwise minimizing cost.

11.8 Resource Leveling

Resource leveling is used to examine unbalanced use of resources (usually people or equipment) over time and for resolving over-allocations or conflicts.

When performing project planning activities, the manager will attempt to schedule certain tasks simultaneously. When more resources such as machines or people are needed than are available, or perhaps a specific person is needed in both tasks, the tasks will have to be rescheduled sequentially to manage the constraint. Resource leveling during project planning is the process of resolving these conflicts. It can also be used to balance the workload of primary resources over the course of the project, usually at the expense of one of the traditional triple constraints (time, cost, scope).

When using specially designed project software, leveling typically means resolving conflicts or over-allocations in the project plan by allowing the software to calculate delays and update tasks automatically. Project management software leveling requires delaying tasks until resources are available. In more complex environments, resources could be allocated across multiple, concurrent projects thus requiring the process of resource leveling to be performed at company level.

In either definition, leveling could result in a later project finish date if the tasks affected are in the critical path.

11.9 Working with Individuals

Working with other people involves dealing with them both logically and emotionally. A successful working relationship between individuals begins with appreciating the importance of emotions and how they relate to personality types, leadership styles, negotiations, and setting goals.

11.10 Emotional Intelligence

Emotions are both a mental and physiological response to environmental and internal stimuli. Leaders need to understand and value their emotions to appropriately respond to the client, project team, and project environment.

Emotional intelligence includes the following:

- Self-awareness
- Self-regulation
- Empathy
- Relationship management

Emotions are important to generating energy around a concept, building commitment to goals, and developing high-performing teams. Emotional intelligence is an important part of the project manager's ability to build trust among the team members and with the client. It is an important factor in establishing credibility and an open dialogue with project stakeholders. Emotional intelligence is critical for project managers, and the more complex the project profile, the more important the project manager's emotional intelligence becomes to project success.

11.11 Personality Types

Personality types refer to the differences among people in such matters as what motivates them, how they process information, how they handle conflict, etc. Understanding people's personality types is acknowledged as an asset in interacting and communicating with them more effectively. Understanding your personality type as a project manager will assist you in evaluating your tendencies and strengths in different situations. Understanding others' personality types can also help you coordinate the skills of your individual team members and address the various needs of your client.

The Myers-Briggs Type Indicator (MBTI) is one of most widely used tools for exploring personal preference, with more than two million people taking the MBTI each year.

The MBTI is often referred to as simply the Myers-Briggs. It is a tool that can be used in project management training to develop awareness of preferences for processing information and relationships with other people.

Based on the theories of psychologist Carl Jung, the Myers-Briggs uses a questionnaire to gather information on the ways individuals prefer to use their perception and judgment. Perception represents the way people become aware of people and their environment. Judgment represents the evaluation of what is perceived. People perceive things differently and reach different conclusions based on the same environmental input. Understanding and accounting for these differences is critical to successful project leadership.

The Myers-Briggs identifies 16 personality types based on four preferences derived from the questionnaire. The preferences are between pairs of opposite characteristics and include the following:

Extroversion (E)-Introversion (I) Sensing (S)-Intuition (N) Thinking (T)-Feeling (F) Judging (J)-Perceiving (P)

Sixteen Myers-Briggs types can be derived from the four dichotomies. Each of the 16 types describes a preference: for focusing on the inner or outer world (E-I), for approaching and internalizing information (S-I), for making decisions

(T-F), and for planning (J-P). For example, an ISTJ is a Myers-Briggs type who prefers to focus on the inner world and basic information, prefers logic, and likes to decide quickly.

It is important to note that there is no best type and that effective interpretation of the Myers-Briggs requires training. The purpose of the Myers-Briggs is to understand and appreciate the differences among people. This understanding can be helpful in building the project team, developing common goals, and communicating with project stakeholders. For example, different people process information differently. Extroverts prefer face-to-face meetings as the primary means of communicating, while introverts prefer written communication. Sensing types focus on facts, and intuitive types want the big picture.

On larger, more complex projects, some project managers will use the Myers-Briggs as a team-building tool during project start-up. This is typically a facilitated work session where team members take the Myers-Briggs and share with the team how they process information, what communication approaches they prefer, and what decision-making preferences they have. This allows the team to identify potential areas of conflict, develop communication strategies, and build an appreciation for the diversity of the team.

Another theory of personality typing is the DISC method, which rates people's personalities by testing a person's preferences in word associations in the following four areas:

Dominance/Drive—relates to control, power, and assertiveness **Inducement/ Influence**—relates to social situations and communication **Submission/ Steadiness**—relates to patience, persistence, and thoughtfulness **Compliance/ Conscientiousness**—relates to structure and organization

Understanding the differences among people is a critical leadership skill. This includes understanding how people process information, how different experiences influence the way people perceive the environment, and how people develop filters that allow certain information to be incorporated while other information is excluded. The more complex the project, the more important the understanding of how people process information, make decisions, and deal with conflict. There are many personality-type tests that have been developed and explore different aspects of people's personalities. It might be prudent to explore the different tests available and utilize those that are most beneficial for your team.

11.12 Leadership Styles

Leadership style is a function of both the personal characteristics of the leader and the environment in which the leadership must occur, and a topic that several researchers have attempted to understand. Robert Tannenbaum and Warren Schmidt described leaders as either autocratic or democratic (1958). Harold Leavitt described leaders as pathfinders (visionaries), problem solvers (analytical), or implementers (team oriented) (1986). James MacGregor Burns conceived leaders as either transactional (focused on actions and decisions) or transformational (focused on the long-term needs of the group and organization) (1978).

Fred Fiedler introduced his contingency theory, which is the ability of leaders to adapt their leadership approach to the environment (1971). Most leaders have a dominant leadership style that is most comfortable for them. For example, most engineers spend years training in analytical problem solving and often develop an analytical approach to leadership.

A leadership style reflects personal characteristics and life experiences. Although a project manager's leadership style may be predominantly a pathfinder (using Leavitt's taxonomy), most project managers become problem solvers or implementers when they perceive the need for these leadership approaches. The leadership approach incorporates the dominant leadership style and Fiedler's contingency focus on adapting to the project environment.

No particular leadership approach is specifically appropriate for managing a project. Due to the unique circumstances inherent in each project, the leadership approach and the management skills required to be successful vary depending on the complexity profile of the project. However, the Project Management Institute published Shi and Chen's research that studied project management leadership traits and concluded that good communication skills and the ability to build harmonious relationships and motivate others are essential (2006). Beyond this broad set of leadership skills, the successful leadership approach will depend on the profile of the project. For example, a transactional project manager with a strong command-and-control leadership approach may be very successful on a small software development project or a construction project, where tasks are clear, roles are well understood, and the project environment is cohesive. This same project manager is less likely to be

successful on a larger, more complex project with a diverse project team and complicated work processes.

Matching the appropriate leadership style and approach to the complexity profile of the project is a critical element of project success. Even experienced project managers are less likely to be successful if their leadership approach does not match the complexity profile of the project.

Each project phase may also require a different leadership approach. During the start-up phase of a project, when new team members are first assigned to the project, the project may require a command-and-control leadership approach. Later, as the project moves into the conceptual phase, creativity becomes important, and the project management takes on a more transformational leadership approach. Most experienced project managers are able to adjust their leadership approach to the needs of the project phase. Occasionally, on very large and complex projects, some companies will bring in different project managers for various phases of a project. Changing project managers may bring the right level of experience and the appropriate leadership approach, but is also disruptive to a project. Senior management must balance the benefit of matching the right leadership approach with the cost of disrupting established relationships.

Example: Multinational Textbook Publishing Project

On a project to publish a new textbook at a major publisher, a project manager led a team that included members from partners that were included in a joint venture. The editorial manager was Greek, the business manager was German, and other members of the team were from various locations in the United States and Europe. In addition to the traditional potential for conflict that arises from team members from different cultures, the editorial manager and business manager were responsible for protecting the interest of their company in the joint venture.

The project manager held two alignment or team-building meetings. The first was a two-day meeting held at a local resort and included only the members of the project leadership team. An outside facilitator was hired to facilitate discussion, and the topic of cultural conflict and organizational goal conflict quickly emerged. The team discussed several methods for developing understanding and addressing conflicts that would increase the likelihood of finding mutual agreement.

The second team-building session was a one-day meeting that included the executive sponsors from the various partners in the joint venture. With the project team aligned, the project manager was able to develop support for the publication project's strategy and commitment from the executives of the joint venture. In addition to building processes that would enable the team to address difficult cultural differences, the project manager focused on building trust with each of the team members. The project manager knew that building trust with the team was as critical to the success of the project as the technical project management skills and devoted significant management time to building and maintaining this trust.

11.13 Leadership Skills

The project manager must be perceived to be credible by the project team and key stakeholders. A successful project manager can solve problems and has a high degree of tolerance for ambiguity. On projects, the environment changes frequently, and the project manager must apply the appropriate leadership approach for each situation.

The successful project manager must have good communication skills. All project problems are connected to skills needed by the project manager:

- Breakdown in communication represents the lack of communication skills
- Uncommitted team members represents the lack of team-building skills

- Role confusion represents the lack of organizational skill

Project managers need a large numbers of skills. These skills include administrative skills, organizational skills, and technical skills associated with the technology of the project. The types of skills and the depth of the skills needed are closely connected to the complexity profile of the project. Typically on smaller, less complex projects, project managers need a greater degree of technical skill. On larger, more complex projects, project managers need more organizational skills to deal with the complexity. On smaller projects, the project manager is intimately involved in developing the project schedule, cost estimates, and quality standards. On larger projects, functional managers are typically responsible for managing these aspects of the project, and the project manager provides the organizational framework for the work to be successful.

11.14 Listening

One of the most important communication skills of the project manager is the ability to actively listen. Active listening is placing oneself in the speaker's position as much as possible, understanding the communication from the point of view of the speaker, listening to the body language and other environmental cues, and striving not just to hear, but to understand. Active listening takes focus and practice to become effective. It enables a project manager to go beyond the basic information that is being shared and to develop a more complete understanding of the information.

Example: Client's Body Language

A client just returned from a trip to Australia where he reviewed the progress of the project with his company's board of directors. The project manager listened and took notes on the five concerns expressed by the board of directors to the client.

The project manager observed that the client's body language showed more tension than usual. This was a cue to listen very carefully. The project manager nodded occasionally and clearly demonstrated he was listening through his posture, small agreeable sounds, and body language. The project manager then began to provide feedback on what was said using phrases like "What I hear you say is…" or "It sounds like.…" The project manager was clarifying the message that was communicated by the client.

The project manager then asked more probing questions and reflected on what was said. "It sounds as if it was a very tough board meeting." "Is there something going on beyond the events of the project?" From these observations and questions, the project manager discovered that the board of directors meeting did not go well. The company had experienced losses on other projects, and budget cuts meant fewer resources for the project and an expectation that the project would finish earlier than planned. The project manager also discovered that the client's future with the company would depend on the success of the project. The project manager asked, "Do you think we will need to do things differently?" They began to develop a plan to address the board of directors' concerns.

Through active listening, the project manager was able to develop an understanding of the issues that emerged from the board meeting and participate in developing solutions. Active listening and the trusting environment established by the project manager enabled the client to safely share information he had not planned on sharing and to participate in creating a workable plan that resulted in a successful project.

In the example above, the project manager used the following techniques:

- Listening intently to the words of the client and observing the client's body language
- Nodding and expressing interest in the client without forming rebuttals
- Providing feedback and asking for clarity while repeating a summary of the information back to the client
- Expressing understanding and empathy for the client
- fddfasd

Active listening was important in establishing a common understanding from which an effective project plan could be developed.

11.15 Negotiation

When multiple people are involved in an endeavor, differences in opinions and desired outcomes naturally occur. Negotiation is a process for developing a mutually acceptable outcome when the desired outcome for each party conflicts. A project manager will often negotiate with a client, team members, vendors, and other project stakeholders. Negotiation is an important skill in developing support for the project and preventing frustration among all parties involved, which could delay or cause project failure.

Negotiations involve four principles:

1. Separate people from the problem. Framing the discussions in terms of desired outcomes enables the negotiations to focus on finding new outcomes.
2. Focus on common interests. By avoiding the focus on differences, both parties are more open to finding solutions that are acceptable.
3. Generate options that advance shared interests. Once the common interests are understood, solutions that do not match with either party's interests can be discarded, and solutions that may serve both parties' interests can be more deeply explored.
4. Develop results based on standard criteria. The standard criterion is the success of the project. This implies that the parties develop a common definition of project success.

For the project manager to successfully negotiate issues on the project, he or she should first seek to understand the position of the other party. If negotiating with a client, what is the concern or desired outcome of the client? What are the business drivers and personal drivers that are important to the client? Without this understanding, it is difficult to find a solution that will satisfy the client. The project manager should also seek to understand what outcomes are desirable to the project. Typically, more than one outcome is acceptable. Without knowing what outcomes are acceptable, it is difficult to find a solution that will produce that outcome.

One of the most common issues in formal negotiations is finding a mutually acceptable price for a service or product. Understanding the market value for a product or service will provide a range for developing a negotiating strategy. The price paid on the last project or similar projects provides information on the market value. Seeking expert opinions from sources who would know the market is another source of information. Based on this information, the project manager can then develop an expected range within the current market from the lowest price to the highest price.

Additional factors will also affect the negotiated price. The project manager may be willing to pay a higher price to assure an expedited delivery or a lower price if delivery can be made at the convenience of the supplier or if payment is made before the product is delivered. Developing as many options as possible provides a broader range of choices and increases the possibility of developing a mutually beneficial outcome.

The goal of negotiations is not to achieve the lowest costs, although that is a major consideration, but to achieve the greatest value for the project. If the supplier believes that the negotiations process is fair and the price is fair, the project is more likely to receive higher value from the supplier. The relationship with the supplier can be greatly influenced by the negotiation process and a project manager who attempts to drive the price unreasonably low or below the market value will create an element of distrust in the relationship that may have negative consequences for the project. A positive negotiation experience may create a positive relationship that may be beneficial, especially if the project begins to fall behind schedule and the supplier is in a position to help keep the project on schedule.

11.16 Conflict Resolution

Conflict on a project is to be expected because of the level of stress, lack of information during early phases of the project, personal differences, role conflicts, and limited resources. Although good planning, communication, and team building can reduce the amount of conflict, conflict will still emerge. How the project manager deals with the conflict results in the conflict being destructive or an opportunity to build energy, creativity, and innovation.

David Whetton and Kim Cameron developed a response-to-conflict model that reflected the importance of the issue balanced against the importance of the relationship (2005). The model presented five responses to conflict:

- Avoiding
- Forcing
- Collaborating
- Compromising
- Accommodating

Each of these approaches can be effective and useful depending on the situation. Project managers will use each of these conflict resolution approaches depending on the project manager's personal approach and an assessment of the situation.

Most project managers have a default approach that has emerged over time and is comfortable. For example, some project managers find the use of the project manager's power the easiest and quickest way to resolve problems. "Do it because I said to" is the mantra for project managers who use forcing as the default approach to resolve conflict. Some project managers find accommodating with the client the most effective approach to dealing with client conflict.

The effectiveness of a conflict resolution approach will depend on the situation. The forcing approach often succeeds in a situation where a quick resolution is needed, and the investment in the decision by the parties involved is low.

Example: Resolving an Office Space Conflict

Two senior managers both want the office with the window. The project manager intercedes with little discussion and assigns the window office to the manager with the most seniority. The situation was a low-level conflict with no long-range consequences for the project and a solution all parties could accept.

Sometimes office size and location is culturally important, and this situation would take more investment to resolve.

Example: Conflict Over a Change Order

In another example, the client rejected a request for a change order because she thought the change should have been foreseen by the project team and incorporated into the original scope of work. The project controls manager believed the client was using her power to avoid an expensive change order and suggested the project team refuse to do the work without a change order from the client.

This is a more complex situation, with personal commitments to each side of the conflict and consequences for the project. The project manager needs a conflict resolution approach that increases the likelihood of a mutually acceptable solution for the project. One conflict resolution approach involves evaluating the situation, developing a common understanding of the problem, developing alternative solutions, and mutually selecting a solution. Evaluating the situation typically includes gathering data. In our example of a change order conflict, gathering data would include a review of the original scope of work and possibly of people's understandings, which might go beyond the written scope. The second step in developing a resolution to the conflict is to restate, paraphrase, and reframe the problem behind the conflict to develop a common understanding of the problem. In our example, the common understanding may explore the change management process and determine that the current change management process may not achieve the client's goal of minimizing project changes. This phase is often the most difficult and may take an investment of time and energy to develop a common understanding of the problem.

After the problem has been restated and agreed on, alternative approaches are developed. This is a creative process that often means developing a new approach or changing the project plan. The result is a resolution to the conflict that is mutually agreeable to all team members. If all team members believe every effort was made to find a solution that achieved the project charter and met as many of the team member's goals as possible, there will be a greater commitment to the agreed-on solution.

11.17 Delegation

Delegating responsibility and work to others is a critical project management skill. The responsibility for executing the project belongs to the project manager. Often other team members on the project will have a functional responsibility on the project and report to a functional manager in the parent organization. For example, the procurement leader for a major project may also report to the organization's vice-

president for procurement. Although the procurement plan for the project must meet the organization's procurement policies, the procurement leader on the project will take day-to-day direction from the project manager. The amount of direction given to the procurement leader, or others on the project, is the decision of the project manager.

If the project manager delegates too little authority to others to make decisions and take action, the lack of a timely decision or lack of action will cause delays on the project. Delegating too much authority to others who do not have the knowledge, skills, or information will typically cause problems that result in delay or increased cost to the project. Finding the right balance of delegation is a critical project management skill.

When developing the project team, the project manager selects team members with the knowledge, skills, and abilities to accomplish the work required for the project to be successful. Typically, the more knowledge, skills, abilities, and experience a project team member brings to the project, the more that team member will be paid. To keep the project personnel costs lower, the project manager will develop a project team with the level of experience and the knowledge, skills, and abilities to accomplish the work.

On smaller, less complex projects, the project manager can provide daily guidance to project team members and be consulted on all major decisions. On larger, more complex projects, there are too many important decisions made every day for the project manager to be involved at the same level, and project team leaders are delegated decision-making authority. Larger projects, with a more complex profile will typically pay more because of the need for the knowledge and experience. On larger, more complex projects, the project manager will develop a more experienced and knowledgeable team that will enable the project manager to delegate more responsibility to these team members.

Example: Learning Project in Peru

An instructional design project in Peru was falling behind schedule, and a new manager was assigned to the design team, which was the one most behind schedule. He was an experienced project manager from the United States with a reputation for meeting aggressive schedules. However, he failed to see that as a culture, Peruvians do a great deal more socializing than teams in the U.S. The project manager's communication with the team was then limited because he did not go out and spend time with them, and his team did not develop trust or respect for him. Due to these cultural differences, the project fell further behind, and another personnel change had to be made at a significant cost of time, trust, and money.

The project manager must have the skills to evaluate the knowledge, skills, and abilities of project team members and evaluate the complexity and difficulty of the project assignment. Often project managers want project team members they have worked with in the past. Because the project manager knows the skill level of the team member, project assignments can be made quickly with less supervision than with a new team member with whom the project manager has little or no experience.

Delegation is the art of creating a project organizational structure with the work organized into units that can be managed. Delegation is the process of understanding the knowledge, skills, and abilities needed to manage that work and then matching the team members with the right skills to do that work. Good project managers are good delegators.

11.18 Adjusting Leadership Styles

Remember that personality traits reflect an individual's preferences, not their limitations. It is important to understand that individuals can still function in situations for which they are not best suited. It is also important to realize that you can change your leadership style according to the needs of your team and the particular project's attributes and scope.

For example, a project leader who is more thinking (T) than feeling (F) (according to the Myers-Briggs model) would need to work harder to be considerate of how team members who are more feeling (F) might react if they were singled out in a meeting because they were behind schedule. If individuals know their own preferences and which personality types are most successful in each type of project or project phase, they can set goals for improvement in their ability to perform in those areas that are not their natural preference.

Another individual goal is to examine which conflict resolution styles you are least comfortable and work to improve those styles so that they can be used when they are more appropriate than your default style.

11.19 Working with Groups and Teams

A team is a collaboration of people with different personalities that is led by a person with a favored leadership style. Managing the interactions of these personalities and styles as a group is an important aspect of project management.

11.19.1 Trust

Trust is the foundation for all relationships within a project. Without a minimum level of trust, communication breaks down, and eventually the project suffers in the form of costs increasing and schedules slipping. Often, when reviewing a project where the performance problems have captured the attention of upper management, the evidence of problems is the increase in project costs and the slippage in the project schedule. The underlying cause is usually blamed on communication breakdown. With deeper investigation, the communication breakdown is associated with a breakdown in trust.

On projects, trust is the filter through which we screen information that is shared and the filter we use to screen information we receive. The more trust that exists, the easier it is for information to flow through the filters. As trust diminishes, the filters become stronger and information has a harder time getting through, and projects that are highly dependent on an information-rich environment will suffer from information deprivation.

11.19.2 Contracts and Trust Relationships

A project typically begins with a charter or contract. A contract is a legal agreement that includes penalties for any behavior or results not achieved. Contracts are based on an adversarial paradigm and do not lend themselves to creating an environment of trust. Contracts and charters are necessary to clearly establish the scope of the project, among other things, but they are not conducive to establishing a trusting project culture.

A relationship of mutual trust is less formal but vitally important. When a person or team enters into a relationship of mutual trust, each person's reputation and self-respect are the drivers in meeting the intent of the relationship. A relationship of mutual trust within the context of a project is a commitment to an open and honest

relationship. There is nothing that enforces the commitments in the relationship except the integrity of the people involved. Smaller, less complex projects can operate within the boundaries of a legal contract, but larger, more complex projects must develop a relationship of mutual trust to be successful.

11.19.3 Types of Trust

Svenn Lindskold describes four kinds of trust (1978):

- *Objective credibility.*A personal characteristic that reflects the truthfulness of an individual that can be checked against observable facts.
- *Attribution of benevolence*. A form of trust that is built on the examination of the person's motives and the conclusion that they are not hostile.
- *Non-manipulative trust*. A form of trust that correlates to a person's self-interest and the predictability of a person's behavior in acting consistent in that self-interest.
- *High cost of lying*. The type of trust that emerges when persons in authority raise the cost of lying so high that people will not lie because the penalty will be too high.

11.19.4 Creating Trust

Building trust on a project begins with the project manager. On complex projects, the assignment of a project manager with a high trust reputation can help establish the trust level needed. The project manager can also establish the cost of lying in a way that communicates an expectation and a value for trust on the project. Project managers can also assure that the official goals (stated goals) and operational goals (goals that are reinforced) are aligned. The project manager can create an atmosphere where informal communication is expected and reinforced.

The informal communication is important to establishing personal trust among team members and with the client. Allotting time during project start-up meetings to allow team members to develop a personal relationship is important to establishing the team trust. The informal discussion allows for a deeper understanding of the whole person and creates an atmosphere where trust can emerge.

Example: High Cost of Lying in a Charleston Project

On a project in Charleston, South Carolina, the client was asking for more and more backup to information from the project. The project manager visited the client to better understand the reporting requirements and discovered the client did not trust the reports coming from the project and wanted validating material for each report. After some candid discussion, the project manager discovered that one of the project team members had provided information to the client that was inaccurate. The team member had made a mistake but had not corrected it with the client, hoping that the information would get lost in the stream of information from the project. The project manager removed the team member from the project for two main reasons. The project manager established that the cost of lying was high. The removal communicated to the project team an expectation of honesty. The project manager also reinforced a covenant with the client that reinforced the trust in the information the project provided. The requests for additional information declined, and the trust relationship between project personnel and the client remained high.

Small events that reduce trust often take place on a project without anyone remembering what happened to create the environment of distrust. Taking fast and decisive action to establish a high cost of lying, communicating the expectation of honesty, and creating an atmosphere of trust are critical steps a project manager can take to ensure the success of complex projects.

Project managers can also establish expectations of team members to respect individual differences and skills, look and react to the positives, recognize each other's accomplishments, and value people's self-esteem to increase a sense of the benevolent intent.

11.19.5 Managing Team Meetings

Team meetings are conducted differently depending on the purpose of the meeting, the leadership style that is appropriate for the meeting, and the personality types of the members of the team.

11.20 Action Item Meetings

Action item meetings are short meetings to develop a common understanding of what the short-term priorities are for the project, individual roles, and expectations for specific activities. This type of meeting is for sharing, not problem solving. Any problems that emerge from the discussion are assigned to a person, and another meeting is established to address the issue. Action item meetings focus on short-term activities, usually less than a week in duration.

The action item meeting is fact based and information oriented. It is a left-brain-type focus. The action item meeting has very little dialogue except to ask clarification questions. If discussion is needed or disagreement is not easily resolved, another problem-solving meeting is established to deal with that issue. On smaller topics, that meeting might take place immediately after the action item meeting and only include those people with an interest in the outcome of the discussion.

The project manager keeps the successful action item meeting short in duration and focused on only those items of information needed for the short-term project plan. The project manager will restate the common understandings of what activities are priorities and who will be responsible for the activities. Often these meetings can include a review of safety procedures or security procedures when these issues are important to the project. The leadership approach to action item meetings focuses on data, actions, and commitments. Although the project manager may observe stresses between project team members or other issues, they are not addressed in this meeting. These are fact-based meetings. If issues begin to arise between people, the project manager will develop other opportunities to address these issues in another forum. Using the Myers-Briggs descriptions, team members who favor thinking more than feeling and judging more than perceiving are more comfortable with this type of meeting.

11.21 Management Meetings

Management meetings are longer in duration and are focused on planning. They are oriented toward developing plans, tracking progress of existing plans, and making adjustments to plans in response to new information.

These meetings include focused discussion on generating a common understanding of the progress of the existing plan. This discussion is based on quantitative information provided on the progress of the schedule and other data, but the discussion is qualitative in evaluating the data to develop a more complete understanding of the data. The experience and opinions of the project leaders are solicited, and disagreement about meaning of the data is even encouraged to develop a deeper understanding of the data. Through this discussion, a common

understanding of the status of the project should emerge, and the project manager invites discussion, invites people to offer their thoughts, and assures that disagreements are positive discussions about interpretation of the information and that disagreements do not become personal.

Management meetings also focus on developing mid-term goals. For larger, more complex projects, the goals may be monthly or even quarterly. For smaller or less complex projects, weekly goals will provide the focus. The project manager focuses the discussion on the broad priorities for the next period and includes all the functional leaders in the discussion. The goals that emerge from the discussion should represent a common understanding of the priorities of the project for the next term.

For example, during the early phases of a project, the team is focused on developing a conceptual understanding of the project. A major milestone on complex projects is typically the completion of the conceptual plan. The project manager would lead a discussion on what needs to be accomplished to meet the project milestone and asks what potential barriers exist and what key resources are needed. From the discussion, the project team develops a few key goals that integrate the various functions of the project team and focus the team on priorities.

The following are some examples of goals during the conceptual phase:

- Developing a list of the procurement long-lead items and defining critical dates
- Developing a human resources plan that identifies critical positions
- Developing and building agreement with the client on the project scope of work

Each of these goals is measurable and has a time frame specified. They can be developed as positive motivators and will take the project leaders and most of the project team to accomplish. They develop a general understanding of the priorities and are easy to remember.

Management meetings are a combination of left-brain thinking, which is fact based, and right-brain thinking, which is creative and innovative. Using the Myers-Briggs terminology, team members who prefer feeling over thinking and perceiving over judging can contribute ideas and perspectives on the project that the more fact-oriented members might miss.

The project manager allows and encourages conversation in developing and evaluating the goals but focuses the discussion on the goals and obstacles. Management meetings take on a different focus during the month. Meetings at the beginning of the month spend time addressing the progress and potential barriers to the goals developed the previous month. During the middle of the month, the project manager leads the team to develop next month's goals as the team also works on the current month's goals. Toward the end of the month as the goals for the month are accomplished, the meeting focuses more on the next month, enabling the team to remain goal focused during the life of the project.

Management meetings are also an opportunity to discover obstacles to goal achievement. The project team reallocates resources or develops alternative methods for accomplishing the goals. As the project team discusses the progress of project goals, the project manager explores possible obstacles and encourages exposing

potential problems in achieving goals. The project manager focuses the team on finding solutions and avoids searching for blame.

The project manager uses a facilitative leadership approach, encouraging the management team to contribute their ideas, and builds consensus on what goals will bring the appropriate focus. The project manager keeps the focus on developing the goals, tracking progress, identifying barriers, and making adjustments to accomplish the management goals. Although there are typically meetings for scheduling and procurement and other meetings where goals are established and problems solved, the management meeting and the goal development process create alignment among the project leadership on the items critical to the project's success.

11.22 Leadership Meetings

Leadership meetings are held less frequently and are longer in length. These meetings are used by the project manager to reflect on the project, explore the larger issues of the project, and back away from the day-to-day problem solving. The project manager will create a safe environment for sharing thoughts and evaluations of issues that are less data oriented. This is a right-brained, creative meeting that focuses on the people issues of the project: the relationship with the client, vendors, and project team. Team members who favor feeling, perceiving, and intuition often contribute valuable insights in this type of meeting. The team might also share perceptions by upper management and perceptions of the community in which the project is being executed. Where the time frame for action item meetings is in weeks and management meetings is in months, the time frame for leadership meetings is longer and takes in the entire length and impact of the project.

The project manager's meeting management skill includes creating the right meeting atmosphere for the team discussion that is needed. For discussions based on data and facts, the project manager creates the action item type meeting. The conversation is focused on sharing information and clarification. The conversation for leadership meetings is the opposite. Discussion is more open ended and focused on creativity and innovation. Because each type of meeting requires a different meeting atmosphere, mixing the purposes of a meeting will make it difficult for the project manager to develop and maintain the appropriate kind of conversation.

Skilled project managers know what type of meeting is needed and how to develop an atmosphere to support the meeting type. Meetings of the action item type are focused on information sharing with little discussion. They require efficient communication of plans, progress, and other information team members need to plan and execute daily work. Management type meetings are focused on developing and progressing goals. Leadership meetings are more reflective and focused on the project mission and culture.

These three types of meetings do not cover all the types of project meetings. Specific problem-solving, vendor evaluation, and scheduling meetings are examples of typical project meetings. Understanding what kinds of meetings are needed on the project

and creating the right focus for each meeting type is a critical project management skill.

11.23 Types of Teams

Teams can outperform individual team members in several situations. The effort and time invested in developing a team and the work of the team are large investments of project resources, and the payback is critical to project success. Determining when a team is needed and then chartering and supporting the development and work of the team are other critical project management abilities.

Teams are effective in several project situations:

- When no one person has the knowledge, skills, and abilities to either understand or solve the problem
- When a commitment to the solution is needed by large portions of the project team
- When the problem and solution cross project functions
- When innovation is required

Individuals can outperform teams on some occasions. An individual tackling a problem consumes fewer resources than a team and can operate more efficiently—as long as the solution meets the project's needs. A person is most appropriate in the following situations:

- When speed is important
- When one person has the knowledge, skills, and resources to solve the problem
- When the activities involved in solving the problem are very detailed
- When the actual document needs to be written (Teams can provide input, but writing is a solitary task.)

In addition to knowing when a team is appropriate, the project manager must also understand what type of team will function best.

11.23.1 Functional Teams

A functional team refers to the team approach related to the project functions. The engineering team, the procurement team, and the project controls team are examples of functional teams within the project. On a project with a low complexity profile that includes low technological challenges, good team member experience, and a clear scope of work, the project manager can utilize well-defined functional teams with clear expectations, direction, and strong vertical communication.

11.23.2 Cross-Functional Teams

Cross-functional teams address issues and work processes that include two or more of the functional teams. The team members are selected to bring their functional expertise to addressing project opportunities.

Example: Cross-Functional Teamwork

A cross-functional project team in Tennessee was assigned to develop a project approach to drafting, shooting, and editing educational videos without storing the videos on the school server. Although the complexity of this goal is primarily related to creating the videos and procuring editing equipment, the planning involved coordination of the script drafting, procurement of equipment and talent, and establishment of project controls. Team members from each of these functions developed and tracked a plan to meet the project goal. Because they communicated so frequently and clearly, the cross-functional team was successful in designing a process and executing the plan in a way that saved three weeks on the video schedule and several thousand dollars in cost by hosting off-site.

11.23.3 Problem-Solving Teams

Problem-solving teams are assigned to address specific issues that arise during the life of the project. The project leadership includes members that have the expertise to address the problem. The team is chartered to address that problem and then disband.

11.24 Qualitative Assessment of Project Performance

Project managers should provide an opportunity to ask such questions as “What is your gut feeling about how the project going?” and “How do you think our client perceives the project?” This creates the opportunity for reflection and dialogue around larger issues on the project. The project manager creates an atmosphere for the team to go beyond the data and search for meaning. This type of discussion and reflection is very difficult in the stress of day-to-day problem solving.

The project manager has several tools for developing good quantitative information—based on numbers and measurements—such as the project schedules, budgets and budget reports, risk analysis, and goal tracking. This quantitative

information is essential to understanding the current status and trends on the project. Just as important is the development of qualitative information—comparisons of qualities—such as judgments made by expert team members that go beyond the quantitative data provided in a report. Some would label this the “gut feeling” or intuition of experienced project managers.

The Humm Factor is a survey tool developed by Russ Darnall to capture the thoughts of project participants. It derived its name from a project manager who always claimed he could tell you more by listening to the hum of the pro ject than reading all the project reports. “Do you feel the project is doing the things it needs to do to stay on schedule?” and “Is the project team focused on project goals?” are the types of questions that can be included in the Humm Factor. It is distributed on a weekly or less frequent basis depending on the complexity profile of the project. A project with a high level of complexity due to team-based and cultural issues will be surveyed more frequently.

The qualitative responses are converted to a quantitative value as a score from 1 to 10. Responses are tracked by individuals and the total project, resulting in qualitative comparisons over time. The project team reviews the ratings regularly, looking for trends that indicate an issue may be emerging on the project that might need exploring.

Example: Humm Survey Uncovers Concerns

On a project in South Carolina, the project surveyed the project leadership with a Humm Survey each week. The Humm Factor indicated an increasing worry about the schedule beginning to slip when the schedule reports indicated that everything was according to plan. When the project manager began trying to understand why the Humm Factor was showing concerns about the schedule, he discovered an apprehension about the performance of a critical project sup plier. When he asked team members, they responded, "It was the way they answered the phone or the hesitation when providing information—something didn't feel right."

The procurement manager visited the supplier and discovered the company was experiencing financial problems and had serious cash flow problems. The project manager was able to develop a plan to help the supplier through the period, and the supplier eventually recovered. The project was able to meet performance goals. The Humm Factor sur vey provided a tool for members of the project team to express concerns that were based on very soft data, and the project team was able to discover a potential problem.

Another project team used the Humm Factor to survey the client monthly. The completed surveys went to a person who was not on the project team to provide anonymity to the responses. The responses were discussed at the month ly project review meetings, and the project manager summarized the results and addressed all the concerns expressed in the report. "I don't feel my concerns are being heard" was one response that began increasing during the project, and the project manager spent a significant portion of the next project review meeting attempting to understand what this meant. The team discovered that as the project progressed toward major milestones, the project team became more focused on solving daily problems, spent more time in meetings, and their workday was becoming longer. The result was fewer contacts with the clients, slower responses in returning phone calls, and much fewer coffee breaks where team members could casually discuss the project with the client.

The result of the conversation led to better understanding by both the project team and client team of the change in behavior based on the current phase of the project and the commitment to developing more frequent informal discussion about the project.

11.25 Creating a Project Culture

Project managers have a unique opportunity during the start-up of a project. They create a project culture, something organizational managers seldom have a chance to do. In most organizations, the corporate or organizational culture has developed over the life of the organization, and people associated with the organization understand what is valued, what has status, and what behaviors are expected. Edgar Schein identified three distinct levels in organizational culture.

1. Artifacts and behaviours
2. Espoused values
3. Assumptions

Artifacts are the visible elements in a culture and they can be recognized by people not part of the culture. Espoused values are the organization's stated values and rules of behavior. Shared basic assumptions are the deeply embedded, taken-for-granted behaviors that are usually unconscious, but constitute the essence of culture.

11.25.1 Characteristics of Project Culture

A project culture represents the shared norms, beliefs, values, and assumptions of the project team. Understanding the unique aspects of a project culture and developing an appropriate culture to match the complexity profile of the project are important project management abilities.

Culture is developed through the communication of:

- The priority
- The given status
- The alignment of official and operational rules

Official rules are the rules that are stated, and operational rules are the rules that are enforced. Project managers who align official and operational rules are more effective in developing a clear and strong project culture because the project rules are among the first aspects of the project culture to which team members are exposed when assigned to the project.

Example: Operational Rules on a Multi-site Project

During an instructional design project that required individuals to collaborate remotely, an official rule had been established that individuals would back up their work in a location other than the shared folders they were using every week. It did not take long, however, for everyone involved to see that one member was actively backing up all work. Believing that was sufficient, the operational rule became simply leaving the backing up to a single individual. They assumed that official rules could be ignored if they were difficult to obey.

When this individual fell ill, however, no one picked up the slack and followed the official rule. When some files were corrupted, the team found that their most recent backups were weeks old, resulting in redoing a lot of work. The difference between the official rules and the operational rules of the project created a culture that made communication of the priorities more difficult.

In addition to official and operational rules, the project leadership communicates what is important by the use of symbols, storytelling, rituals, rewards or punishments, and taboos.

Example: Creating a Culture of Collaboration

A project manager met with his team prior to the beginning of an instructional design project. The team was excited about the prestigious project and the potential for career advancement involved. With this increased competitive aspect came the danger of selfishness and backstabbing. The project leadership team told stories of previous projects where people were fired for breaking down the team efforts and often shared inspirational examples of how teamwork created unprecedented successes—an example of storytelling. Every project meeting started with teambuilding exercises—a ritual—and any display of hostility or separatism was forbidden—taboo—and was quickly and strongly cut off by the project leadership if it occurred.

Culture guides behavior and communicates what is important and is useful for establishing priorities. On projects that have a strong culture of trust, team members feel free to challenge anyone who breaks a confidence, even managers. The culture of integrity is stronger than the cultural aspects of the power of management.

11.26 Innovation on Projects

The requirement of innovation on projects is influenced by the nature of the project. Some projects are chartered to develop a solution to a problem, and innovation is a central ingredient of project success. The lack of availability of education to the world at large prompted the open education movement, a highly innovative endeavor, which resulted in the textbook you are now reading. Innovation is also important to developing methods of lowering costs or shortening the schedule. Traditional project management thinking provides a trade-off between cost, quality, and schedule. A project sponsor can typically shorten the project schedule with an investment of more money or a lowering of quality. Finding innovative solutions can sometimes lower costs while also saving time and maintaining the quality.

Innovation is a creative process that requires both fun and focus. Stress is a biological reaction to perceived threats. Stress, at appropriate levels, can make the work environment interesting and even challenging. Many people working on projects enjoy a high-stress, exciting environment. When the stress level is too high, the biological reaction increases blood flow to the emotional parts of the brain and decreases the blood flow to the creative parts of the brain, making creative problem solving more difficult. Fun reduces the amount of stress on the project. Project managers recognize the benefits of balancing the stress level on the project with the need to create an atmosphere that enables creative thought.

Example: Stress Managed on a Website Design Project

When a project manager visited the team tasked with designing the website for a project, she found that most of the members were feeling a great deal of stress. As she probed to find the reason behind the stress, she found that in addition to designing, the team was increasingly facing the need to build the website as well. As few of them had the necessary skills, they were wasting time that could be spent designing trying to learn building skills. Once the project manager was able to identify the stress as well as its cause, she was able to provide the team with the support it needed to be successful.

Exploring opportunities to create savings takes an investment of time and energy, and on a time-sensitive project, the project manager must create the motivation and the opportunity for creative thinking.

11.27 References

Burns, J.M. (1978). *Leadership.*New York: Harper & Row.

Fiedler, F.E. (1971). Validation and Extension of the Contingency Model of Leadership Effectiveness. *Psychological Bulletin, 76(*2), 128–48.

Leavitt, H. (1986). *Corporate Pathfinders.*New York: Dow-Jones-Irwin and Penguin Books.

Lindskold, S. (1978). Trust Development, the GRIT Proposal, and the Effects of Conciliatory Acts on Conflict and Corporation. *Psychological Bulletin 85*(4), 772–93.

Shi, Q., & Chen, J. (2006). *The Human Side of Project Management: Leadership Skills.* Newtown Square, PA: Project Management Institute, Inc.

Tannenbaum, R., & Schmidt, W. (1958). How to Choose a Leadership Pattern. *Harvard Business Review 36*, 95–101.

Whetton, D., & Cameron, K. (2005). *Developing Management Skills.*Upper Saddle River, NJ: Pearson Education.

11.28 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported, Project Management/PMBOK/Human Resources Management and Development Cooperation Handbook/How do we manage the human resources of programmes and projects?/Manage the Project Team by Wikibooks licensed under Creative Commons Attribution-Share Alike 3.0, Resource Management and Resource Leveling by Wikipedia licensed under Creative Commons Attribution-Share Alike 3.0, Resource Management, and Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional Designers. Retrieved from http://pm4id.org/ under Creative Commons Attribution 3.0 Unported and http://en.wikipedia.org/wiki/ Edgar_Schein.

Chapter 12 Budget Planning

Adrienne Watt

Every project boils down to money. If you had a bigger budget, you could probably get more people to do your project more quickly and deliver more. That's why no project plan is complete until you come up with a budget. But no matter whether your project is big or small, and no matter how many resources and activities are in it, the process for figuring out the bottom line is always the same.

It is important to come up with detailed estimates for all the project costs. Once this is compiled, you add up the cost estimates into a budget plan. It is now possible to track the project according to that budget while the work is ongoing.

Often, when you come into a project, there is already an expectation of how much it will cost or how much time it will take. When you make an estimate early in the project without knowing much about it, that estimate is called a rough order-of-magnitude estimate (or a ballpark estimate). This estimate will become more refined as time goes on and you learn more about the project. Here are some tools and techniques for estimating cost:

- **Determination of resource cost rates**: People who will be working on the project all work at a specific rate. Any materials you use to build the project (e.g., wood or wiring) will be charged at a rate too. Determining resource costs means figuring out what the rate for labor and materials will be.
- **Vendor bid analysis:** Sometimes you will need to work with an external contractor to get your project done. You might even have more than one contractor bid on the job. This tool is about evaluating those bids and choosing the one you will accept.
- **Reserve analysis**: You need to set aside some money for cost overruns. If you know that your project has a risk of something expensive happening, it is better to have some cash available to deal with it. Reserve analysis means putting some cash away in case of overruns.
- **Cost of quality**: You will need to figure the cost of all your quality-related activities into the overall budget. Since it's cheaper to find bugs earlier in the project than later, there are always quality costs associated with everything your project produces. Cost of quality is just a way of tracking the cost of those activities. It is the amount of money it takes to do the project right.

Once you apply all the tools in this process, you will arrive at an estimate for how much your project will cost. It's important to keep all of your supporting estimate information. That way, you know the assumptions made when you were coming up with the numbers. Now you are ready to build your budget plan.

12.1 Estimating Costs to Compare and Select Projects

During the conceptual phase when project selection occurs, economic factors are an important consideration in choosing between competing projects. To compare the simple paybacks or internal rates of return between projects, an estimate of the cost of each project is made. The estimates must be accurate enough so that the comparisons are meaningful, but the amount of time and resources used to make the estimates should be appropriate to the size and complexity of the project. The methods used to estimate the cost of the project during the selection phase are generally faster and consume fewer resources than those used to create detailed estimates in later phases. They rely more on the expert judgment of experienced managers who can make accurate estimates with less detailed information. Estimates in the earliest stages of project selection are usually based on information from previous projects that can be adjusted—**scaled**—to match the size and complexity of the current project or developed using standardized formulas.

12.2 Analogous Estimate

An estimate that is based on other project estimates is an **analogous estimate**. If a similar project cost a certain amount, then it is reasonable to assume that the current project will cost about the same. Few projects are exactly the same size and complexity, so the estimate must be adjusted upward or downward to account for the differences. The selection of projects that are similar and the amount of adjustment needed is up to the judgment of the person who makes the estimate. Normally, this judgment is based on many years of experience estimating projects, including incorrect estimates that were learning experiences for the expert.

Less-experienced managers who are required to make analogous estimates can look through the documentation that is available from previous projects. If projects were evaluated using the Darnall-Preston Complexity Index (DPCI), the manager can quickly identify projects that have profiles similar to the project under consideration, even if those projects were managed by other people.

The DPCI assesses project attributes, enabling better-informed decisions in creating the project profile. This index assesses the complexity level of key components of a project and produces a unique project profile. The profile indicates the project complexity level, which provides a benchmark for comparing projects and information about the characteristics of a project that can then be addressed in the project execution plan. It achieves this objective by grouping 11 attributes into four broad categories: internal, external, technological complexity, and environmental.

Comparing the original estimates with the final project costs on several previous projects with the same DPCI ratings gives a less-experienced manager the perspective

that it would take many years to acquire by trial and error. It also provides references the manager can use to justify the estimate.

Example: Analogous Estimate for John's Move

John sold his apartment and purchased another one. It is now time to plan for the move. John asked a friend for advice about the cost of his move. His friend replied, "I moved from an apartment a little smaller than yours last year and the distance was about the same. I did it with a 14-foot truck. It cost about $575 for the truck rental, pads, hand truck, rope, boxes, and gas." Because of the similarity of the projects, John's initial estimate of the cost of the move was less than $700 so he decided that the cost would be affordable and the project could go forward.

12.3 Parametric Estimate

If the project consists of activities that are common to many other projects, average costs are available per unit. For example, if you ask a construction company how much it would cost to build a standard office building, the estimator will ask for the size of the building in square feet and the city in which the building will be built. From these two factors—size and location—the company's estimator can predict the cost of the building. Factors like size and location are **parameters**—measurable factors that can be used in an equation to calculate a result. The estimator knows the average cost per square foot of a typical office building and adjustments for local labor costs. Other parameters such as quality of finishes are used to further refine the estimate. Estimates that are calculated by multiplying measured parameters by cost-per-unit values are **parametric estimates**.

Example: Parametric Estimate for John's Move

To estimate the size of the truck needed for John's move, the parameter used by a truck rental company is the number of bedrooms (Figure 12.1 Parametric Cost). The company assumes that the number of bedrooms is the important parameter in determining how big a truck is needed for a move. John has a one-bedroom apartment, so he chooses the 14-foot truck. Once the size is determined, other parameters, such as distance and days, are used to estimate the cost of the truck rental.

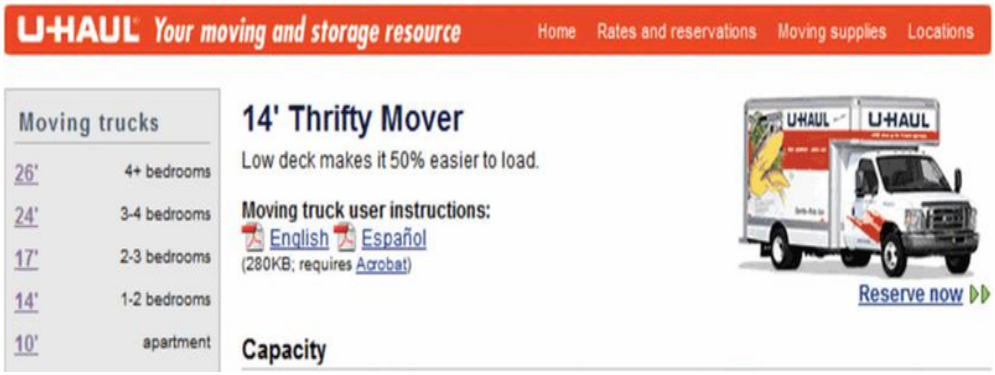


Figure 12.1 Parametric Cost

(http://pm4id.org/9/1/) .

12.4 Bottom-Up Estimating

The most accurate and time-consuming estimating method is to identify the cost of each item in each activity of the schedule, including labor and materials. If you view the project schedule as a hierarchy where the general descriptions of tasks are at the top and the lower levels become more detailed, finding the price of each item at the lowest level and then summing them to determine the cost of higher levels is called **bottom-up estimating**.

Example: Bottom-Up Estimate for John's Move

After evaluating the bids by the moving companies, John decides the savings are worth his time if he can get the packing done with the help of his friends. He decides to prepare a detailed estimate of costs (Figure 12.3 Detailed Cost Estimate) for packing materials and use of a rental truck. He looks up the prices for packing materials and truck rental costs on company websites and prepares a detailed list of items, quantities, and costs.

This type of estimate is typically more accurate than an analogous or parametric estimate. In this example, the sum of packing materials and truck expenses is estimated to be $661.25.

The estimate can be rolled up—subtotaled—to display less detail. This process is made easier using computer software. On projects with low complexity, the cost estimates can be done on spreadsheet software. On larger projects, software that manages schedules can also manage costs and display them by activity and category. For example, the subtotal feature could be used in Excel and collapsed to show the subtotals for the two categories of costs (Figure 12.2 Sum of Detailed Costs by Type).

	A	B	C	D	E
1	Type	Description	Quantity	Unit Price	Cost
13	Packing Materials Total				$216.65
16	Truck Total				$445.00
17	Grand Total				$661.65
18					

Figure 12.2 Sum of Detailed Costs by Type

(http://pm4id.org/9/1/) .

Category	Description	Quantity	Unit Price	Cost
Packing Materials	Small Boxes	10	$1.70	$17.00
Packing Materials	Medium Boxes	15	$2.35	$35.25
Packing Materials	Large Boxes	7	$3.00	$21.00
Packing Materials	Extra Large Boxes	7	$3.75	$26.25
Packing Materials	Short Hanger Boxes	3	$7.95	$23.85
Packing Materials	Box Tape	2	$3.85	$7.70
Packing Materials	Markers	2	$1.50	$3.00
Packing Materials	Mattress/Spring Bags	2	$2.95	$5.90
Packing Materials	Lift Straps per Pair	1	$24.95	$24.95
Packing Materials	Bubble Wrap	1	$19.95	$19.95
Packing Materials	Furniture Pads	4	$7.95	$31.80
Truck	Rental			$400.00
Truck	Gas at 10mpg	200	$2.25	$45.00

Figure 12.3 Detailed Cost Estimate

(http://pm4id.org/9/1/) .

12.5 Activity-Based Estimates

An activity can have costs from multiple vendors in addition to internal costs for labor and materials. Detailed estimates from all sources can be reorganized so those costs

associated with a particular activity can be grouped by adding the activity code to the detailed estimate (Figure 12.4 Detailed Costs Associated with Activities).

Category	Description	Activity	Quantity	Unit Price	Cost
Packing Materials	Small Boxes	2.1	10	$1.70	$17.00
Packing Materials	Medium Boxes	2.1	15	$2.35	$35.25
Packing Materials	Large Boxes	2.1	7	$3.00	$21.00
Packing Materials	Extra Large Boxes	2.1	7	$3.75	$26.25
Packing Materials	Short Hanger Boxes	2.1	3	$7.95	$23.85
Packing Materials	Box Tape	2.1	2	$3.85	$7.70
Packing Materials	Markers	2.1	2	$1.50	$3.00
Packing Materials	Mattress/Spring Bags	2.1	2	$2.95	$5.90
Packing Materials	Lift Straps per Pair	2.1	1	$24.95	$24.95
Packing Materials	Bubble Wrap	2.1	1	$19.95	$19.95
Packing Materials	Furniture Pads	2.1	4	$7.95	$31.80
Truck	Rental	2.2			$400.00
Truck	Gas at 10mpg	2.2	200	$2.25	$45.00

Category	Activity	Cost
Packing Materials	2.1	$216.65
Truck	2.2	$445.00

Figure 12.4 Detailed Costs Associated with Activities
Source : http://pm4id.org/9/1/

Figure 12.4 Detailed Costs Associated with Activities

(http://pm4id.org/9/1/) .

The detailed cost estimates can be sorted and then subtotaled by activity to determine the cost for each activity.

12.6 Managing the Budget

Projects seldom go according to plan in every detail. It is necessary for the project manager to be able to identify when costs are varying from the budget and manage those variations.

12.6.1 Managing Cash Flow

If the total amount spent on a project is equal to or less than the amount budgeted, the project can still be in trouble if the funding for the project is not available when it is needed. There is a natural tension between the financial people in an organization, who do not want to pay for the use of money that is just sitting in a checking account, and the project manager, who wants to be sure that there is enough money available to pay for project expenses. The financial people prefer to keep the company's money working in other investments until the last moment before transferring it to the project account. The contractors and vendors have similar concerns, and they want to get paid as soon as possible so they can put the money to work in their own organizations. The project manager would like to have as much cash available as possible to use if activities exceed budget expectations.

12.6.2 Contingency Reserves

Most projects have something unexpected occur that increases costs above the original estimates. If estimates are rarely exceeded, the estimating method should be reviewed because the estimates are too high. It is impossible to predict which activities will cost more than expected, but it is reasonable to assume that some of them will. Estimating the likelihood of such events is part of risk analysis, which is discussed in more detail in a later chapter.

Instead of overestimating each cost, money is budgeted for dealing with unplanned but statistically predictable cost increases. Funds allocated for this purpose are called **contingency reserves**. Because it is likely that this money will be spent, it is part of the total budget for the project. If this fund is adequate to meet the unplanned expenses, then the project will complete within the budget.

12.6.3 Management Reserves

If something occurs during the project that requires a change in the project scope, money may be needed to deal with the situation before a change in scope can be negotiated with the project sponsor or client. It could be an opportunity as well as a challenge. For example, if a new technology were invented that would greatly enhance your completed project, there would be additional cost and a change to the scope, but it would be worth it. Money can be made available at the manager's discretion to meet needs that would change the scope of the project. These funds are called **management reserves**. Unlike contingency reserves, they are not likely to be spent and are not part of the project's budget baseline, but they can be included in the total project budget.

12.6.4 Evaluating the Budget During the Project

A project manager must regularly compare the amount of money spent with the budgeted amount and report this information to managers and stakeholders. It is necessary to establish an understanding of how this progress will be measured and reported.

Example: Reporting Budget Progress on John's Move

In the John's move example, he estimated that the move would cost about $1,500 and take about 16 days. Eight days into the project, John has spent $300. John tells his friends that the project is going well because he is halfway through the project but has only spent a fifth of his budget. John's friend Carlita points out that his report is not sufficient because he did not compare the amount spent to the budgeted amount for the activities that should be done by the eighth day.

As John's friend pointed out, a budget report must compare the amount spent with the amount that is expected to be spent by that point in the project. Basic measures such as percentage of activities completed, percentage of measurement units completed, and percentage of budget spent are adequate for less complex projects, but more sophisticated techniques are used for projects with higher complexity.

12.6.5 Earned Value Analysis

A method that is widely used for medium-and high-complexity projects is the **earned value management (EVM)** method. EVM is a method of periodically comparing the budgeted costs with the actual costs during the project. It combines the scheduled activities with detailed cost estimates of each activity. It allows for partial completion of an activity if some of the detailed costs associated with the activity have been paid but others have not.

The **budgeted cost of work scheduled (BCWS)** comprises the detailed cost estimates for each activity in the project. The amount of work that should have been done by a particular date is the **planned value (PV)**. These terms are used interchangeably by some sources, but the planned value term is used in formulas to refer to the sum of the budgeted cost of work up to a particular point in the project, so we will make that distinction in the definitions in this text for clarity.

Example: Planned Value on Day Six of John's Move

On day six of the project, John should have taken his friends to lunch and purchased the packing materials. The portion of the BCWS that should have been done by that date (the planned value) is shown in Figure 12.5 Planned Value for Lunch and Packing Materials . This is the planned value for day six of the project.

The **budgeted cost of work performed (BCWP)** is the budgeted cost of work scheduled that has been done. If you sum the BCWP values up to that point in the project schedule, you have the **earned value (EV)**. The amount spent on an item is often more or less than the estimated amount that was budgeted for that item. The **actual cost (AC)** is the sum of the amounts actually spent on the items.

Example: Comparing PV, EV, and AC in John's Move on Day Six

Dion and Carlita were both trying to lose weight and just wanted a nice salad. Consequently, the lunch cost less than expected. John makes a stop at a store that sells moving supplies at discount rates. They do not have all the items he needs, but the prices are lower than those quoted by the moving company. They have a very good price on lifting straps so he decides to buy an extra pair. He returns with some of the items on his list, but this phase of the job is not complete by the end of day six. John bought half of the small boxes, all of five other items, twice as many lifting straps, and none of four other items. John is only six days into his project, and his costs and performance are starting to vary from the plan. Earned value analysis gives us a method for reporting that progress (Figure 12.6 Planned Value, Earned Value, and Actual Cost).

The original schedule called for spending $261.65 (PV) by day six. The amount of work done was worth $162.10 (EV) according to the estimates, but the actual cost was only $154.50 (AC).

12.6.6 Schedule Variance

The project manager must know if the project is on schedule and within the budget. The difference between planned and actual progress is the **variance**. The **schedule variance (SV)** is the difference between the earned value (EV) and the planned value (PV). Expressed as a formula, SV = EV − PV. If less value has been earned than was planned, the sched ule variance is negative, which means the project is behind schedule.

Description	Quantity	Cost
Lunch	3	$45.00
Small Boxes	10	$17.00
Medium Boxes	15	$35.25
Large Boxes	7	$21.00
Extra Large Boxes	7	$26.25
Short Hanger Boxes	3	$23.85
Box Tape	2	$7.70
Markers	2	$3.00
Mattress/Spring Bags	2	$5.90
Lift Straps per Pair	1	$24.95
Bubble Wrap	1	$19.95
Furniture Pads	4	$31.80
	Total	$261.65

Figure 12.5 Planned Value for Lunch and Packing Materials

(http://pm4id.org/9/2/) .

Project Earned Value Analysis—Day 6						
	Budgeted Cost of Work Scheduled (BCWS)		Budgeted Cost of Work Performed (BCWP)		Actual Cost (AC)	
Description	Quantity	Cost	Quantity	Cost	Quantity	Cost
Lunch	3	$45.00	3	$45.00	3	$35.00
Small Boxes	10	$7.00	5	$8.50	5	$9.50
Medium Boxes	15	$35.25	15	$35.25	15	$28.00
Large Boxes	7	$21.00				
Extra Large Boxes	7	$26.25				
Short Hanger Boxes	3	$23.85				
Box Tape	2	$7.70	2	$7.70	2	$5.50
Markers	2	$3.00	2	$3.00	2	$2.00
Mattress/Spring Bags	2	$5.90	2	$5.90	2	$7.50
Lift Straps per Pair	1	$24.95	1	$24.95	2	$38.50
Bubble Wrap	1	$19.95				
Furniture Pads	4	$31.80	4	$31.80	4	$28.50
	PV	$261.65	EV	$162.10	AC	$154.50

Figure 12.6 Planned Value, Earned Value, and Actual Cost

(http://pm4id.org/9/2/) .

Example: Schedule Variance on John's Move

Planning for John's move calls for spending $261.65 by day six, which is the planned value (PV). The difference between the planned value and the earned value is the scheduled variance (SV). The formula is SV = EV – PV. In this example, SV = $162.10 – $261.65 = ($99.55) A negative SV indicates the project is behind schedule.

The difference between the earned value (EV) and the actual cost (AC) is the **cost variance (CV)**. Expressed as a formula, CV = EV – AC. A positive CV indicates the project is under budget.

Example: Cost Variance on John's Move

The difference between the earned value of $162.10 and the actual cost of $154.50 is the cost variance (CV). The formula is CV = EV – AC. In this example, CV = $162.10 – $154.50 = $7.60.

Variance Indexes for Schedule and Cost

The schedule variance and the cost variance provide the amount by which the spending is behind (or ahead of) schedule and the amount by which a project is exceeding (or not fully using) its budget. They do not give an idea of how these amounts compare with the total budget.

The ratio of earned value to planned value gives an indication of how much of the project is completed. This ratio is the schedule performance index (SPI). The formula is SPI = EV/PV. In the John's move example, the SPI equals 0.62 (SPI = $162.10/$261.65 = 0.62) An SPI value less than 1 indicates the project is behind schedule.

The ratio of the earned value to the actual cost is the **cost performance index (CPI)**. The formula is CPI = EV/ AC.

Example: Cost Performance Index of John's Move

In the John's move example, CPI = $162.10/$154.50 = 1.05. A value greater than 1 indicates that the project is under budget.

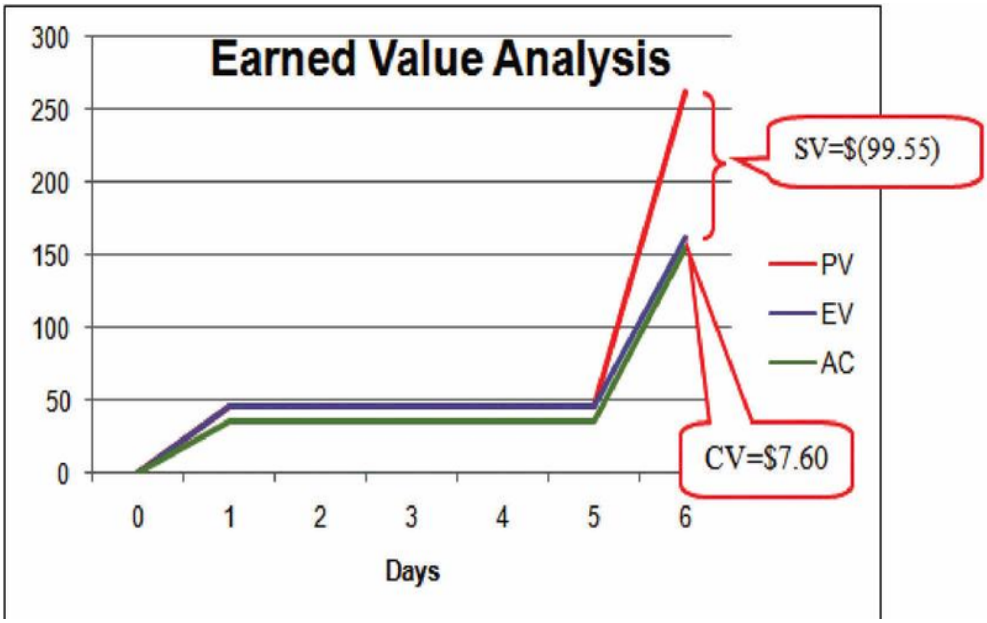


Figure 12.7 Schedule Variance and Cost Variance

(http://pm4id.org/9/2/) .

The cost variance of positive $7.60 and the CPI value of 1.05 tell John that he is getting more value for his money than planned for the tasks scheduled by day six. The schedule variance (SV) of negative $99.55 and the schedule performance index (SPI) of

0.62 tell him that he is behind schedule in adding value to the project (Figure 12.7 Schedule Variance and Cost Variance).

During the project, the manager can evaluate the schedule using the schedule variance (SV) and the schedule performance index (SPI), and the budget using the cost variance (CV) and the cost performance index (CPI).

12.6.7 Estimated Cost to Complete the Project

Part way through the project, the manager evaluates the accuracy of the cost estimates for the activities that have taken place and uses that experience to predict how much money it will take to complete the unfinished activities—**the estimate to complete (ETC)**.

To calculate the ETC, the manager must decide if the cost variance observed in the estimates to that point are representative of the future. For example, if unusually bad weather causes increased cost during the first part of the project, it is not likely to have the same effect on the rest of the project. If the manager decides that the cost variance up to this point in the project is atypical—not typical—then the estimate to complete is the difference between the original budget for the entire project—the **budget at completion (BAC)**—and the earned value (EV) up to that point. Expressed as a formula, ETC = BAC − EV.

Example: Estimate to Complete John's Move

For his move, John was able to buy most of the items at a discount house that did not have a complete inventory, and he chose to buy an extra pair of lift straps. He knows that the planned values for packing materials were obtained from the price list at the moving company where he will have to buy the rest of the items, so those two factors are not likely to be typical of the remaining purchases. The reduced cost of lunch is unrelated to the future costs of packing materials, truck rentals, and hotel fees. John decides that the factors that caused the variances are atypical. He calculates that the estimate to complete (ETC) is the budget at completion ($1,534) minus the earned value at that point ($162.10), which equals $1,371.90. Expressed as a formula, ETC = $1,534 − $162.10 = $1,371.90.

If the manager decides that the cost variance is caused by factors that will affect the remaining activities, such as higher labor and material costs, then the estimate to complete (ETC) needs to be adjusted by dividing it by the cost performance index (CPI). For example, if labor costs on the first part of a project are estimated at $80,000 (EV) and they actually cost $85,000 (AC), the cost performance (CPI) will be 0.94. (Recall that the CPI = EV/AC.)

To calculate the estimate to complete (ETC), assuming the cost variance on known activities is typical of future cost, the formula is ETC = (BAC − EV)/CPI. If the budget at completion (BAC) of the project is $800,000, the estimate to complete is ($800,000 − $80,000)/0.94 = $766,000.

12.6.8 Estimate Final Project Cost

If the costs of the activities up to the present vary from the original estimates, this will affect the total estimate of the project cost. The new estimate of the project cost is the estimate at completion (EAC). To calculate the EAC, the **estimate to complete (ETC)** is added to the actual cost (AC) of the activities already performed. Expressed as a formula, EAC = AC + ETC.

Example: Estimate at Completion for John's Move

The revised estimate at completion (EAC) for John's move at this point in the process is EAC = $154.50 + $1,371.90 = $1,526.40.

Term	Acronym	Description	Formula	John's Move
Actual Cost	AC	The money actually spent on projects up to the present		$154.50
Budget at Completion	BAC	Original budget for the project (same as BCWS)		$1,534.00
Cost Performance Index	CPI	Ratio of earned value to actual cost	CPI = EV / AC	1.05
Cost Variance	CV	Difference between earned value and actual cost	CV = EV – AC	$ 7.60
Earned Value	EV	Sum of estimates for work actually done up to the present		$162.10
Estimate at Completion	EAC	Revised estimate of total project cost	EAC = AC + ETC	$1,526.40
Estimate to Complete	ETC	Money to complete the project if early cost variance is atypical	ETC = BAC – EV	$1,371.90
Estimate to Complete	ETC	Money to complete the project if early cost variance is typical	ETC = (BAC – EV) / CPI	N/A
Planned Value	PV	Sum of the estimates for work done up to the present		$261.65
Schedule Performance Index	SPI	Ratio of earned value to planned value	SPI = EV / PV	.62
Schedule Variance	SV	Difference between earned value and planned value	SV = EV – PV	$(99.55)

Figure 12.8 Summary of Terms and Formulas for Earned Value Analysis

(Source: http://pm4id.org/9/2/) .

To summarize (Figure 12.8 Summary of Terms and Formulas for Earned Value Analysis):

- Extra money is allocated in a contingency fund to deal with activities where costs exceed estimates. Funds are allocated in a management reserve in case a significant opportunity or challenge occurs that requires change of scope but funds are needed immediately before a scope change can typically be negotiated.
- Schedule variance is the difference between the part of the budget that has been spent so far (EV) versus the part that was planned to be spent by now (PV). Similarly, the cost variance is the difference between the EV and the actual cost (AC).
- The schedule performance index (SPI) is the ratio of the earned value and the planned value. The cost performance index (CPI) is the ratio of the earned value (EV) to the actual cost (AC).
- The formula used to calculate the amount of money needed to complete the project (ETC) depends on whether or not the cost variance to this point is expected to continue (typical) or not (atypical). If the cost variance is atypical, the ETC is simply the original total budget (BAC) minus the earned value (EV). If they are typical of future cost variances, the ETC is adjusted by dividing the difference between BAC and EV by the CPI.
- The final budget is the actual cost (AC) to this point plus the estimate to complete (ETC).

12.6.9 Establishing a Budget

Once you have broken your project down into activities, you will be able to calculate your overall project costs by estimating and totaling the individual activity costs.

This process of subtotaling costs by category or activity is called **cost aggregation**.

12.6.10 Budget Timeline

Costs are associated with activities, and since each activity has a start date and a duration period, it is possible to calculate how much money will be spent by any particular date during the project. The money needed to pay for a project is usually transferred to the project account shortly before it is needed. These transfers must be timed so that the money is there to pay for each activity without causing a delay in the start of the activity. If the money is transferred too far in advance, the organization will lose the opportunity to use the money somewhere else, or they will have to pay unnecessary interest charges if the money is borrowed. A schedule of money transfers is created that should match the need to pay for the activities. The process of matching the schedule of transfers with the schedule of activity payments is called **reconciliation**. Refer to Figure 12.9 Fund Transfers and Expenditures , which shows the costs of 10 major activities in a project. Funds are transferred into the project account four times. Notice that during most of the project, there were more funds available than were spent except at activity 6 when all the available funds were spent.

In the project budget profile shown in Figure 12.9 Fund Transfers and Expenditures , there is no margin for error if the total of the first six activities exceeds the amount of funding at that point in the project.

Contractual agreements with vendors often require partial payment of their costs during the project. Those contracts can be managed more conveniently if the unit of measure for partial completion is the same as that used for cost budgeting. For example, if a graphic designer is putting together several pieces of artwork for a textbook, their contract may call for partial payment after 25% of their total number of drawings is complete.

Activity	1	2	3	4	5	6	7	8	9	10
Cost	50	200	50	300	500	200	100	400	300	500
Total Spent	50	250	300	600	1,100	1,300	1,400	1,800	2,100	2,600
Transfers	400			900			700		600	
Total Funding	400	400	400	1,300	1,300	1,300	2,000	2,000	2,600	2,600
Cash in Account	350	150	100	700	200	-	600	200	500	-

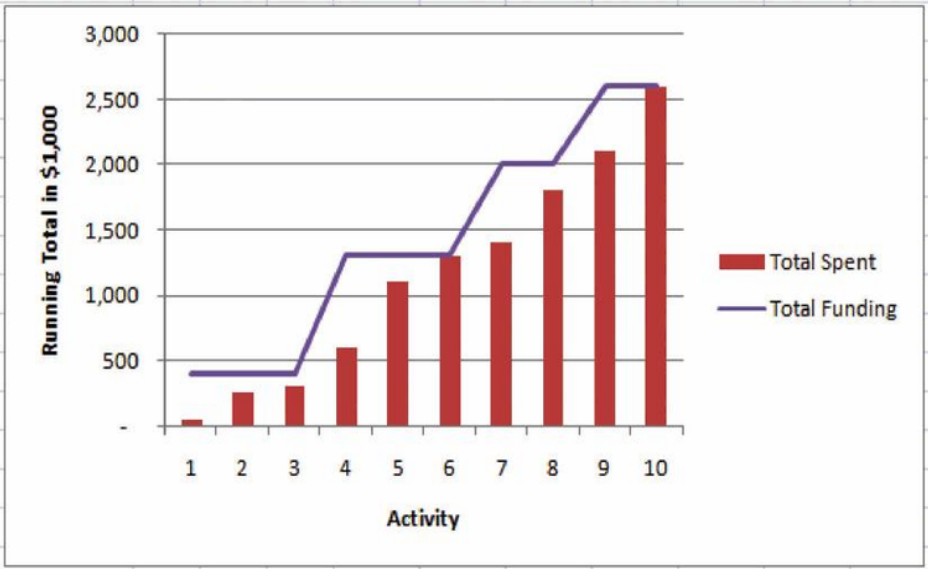


Figure 12.9 Fund Transfers and Expenditures

(Source: http://pm4id.org/9/1/) .

12.7 Attribution

This chapter of *Project Management* is a derivative copy of Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional Designers. Retrieved from http://pm4id.org/ under Creative Commons Attribution 3.0 Unported.

Chapter 13 Procurement Management

Adrienne Watt

Procurement management follows a logical order. First, you plan what you need to contract; then you plan how you'll do it. Next, you send out your contract requirements to sellers. They bid for the chance to work with you. You pick the best one, and then you sign the contract with them. Once the work begins, you monitor it to make sure that the contract is being followed. When the work is done, you close out the contract and fill out all the paperwork.

You need to start with a plan for the whole project. Before doing anything else, you need to think about all of the work that you will contract out for your project. You will want to plan for any purchases and acquisitions. Here's where you take a close look at your needs to be sure that contracting is necessary. You figure out what kinds of contracts make sense for your project, and you try to define all of the parts of the project that will be contracted out.

Contract planning is where you plan out each individual contract for the project work. You work out how you'll manage the contract, what metrics it will need to meet to be considered successful, how you'll pick a seller, and how you'll administer the contract once the work is happening.

The procurement management plan details how the procurement process will be managed. It includes the following information:

- The types of contracts you plan to use and any metrics that will be used to measure the contractors' performance
- The planned delivery dates for the work or products you are contracting
- The company's standard documents you will use
- The number of vendors or contractors involved and how they will be managed
- How purchasing may impact the constraints and assumptions of the project plan
- The coordination of purchasing lead times with the development of the project schedule
- The identification of prequalified sellers (if known)

The procurement management plan, like all other management plans, becomes a subsidiary of the project management plan. Some tools and techniques you may use during the procurement planning stage include make-or-buy analysis and definition of the contract type.

13.1 Make-or-Buy Analysis

This means figuring out whether or not you should be contracting the work or doing it yourself. It could also mean deciding whether to build a solution to your problem or buy one that is already available. Most of the same factors that help you make every other major project decision will help you with this one. How much does it cost to build it as opposed to buying it? How will this decision affect the scope of your project? How will it affect the project schedule? Do you have time to do the work and still meet your commitments? As you plan out what you will and won't contract, you need to think through your reasoning very carefully.

There are some resources (like heavy equipment) that your company can buy, rent, or lease depending on the situation. You'll need to examine leasing-versus-buying costs and determine the best way to go forward.

13.2 Contract Types

You should know a little bit about the major kinds of contracts available to you (the client) so that you choose the one that creates the most fair and workable deal for you and the contractor. Some contracts are fixed price: no matter how much time or effort goes into them, the client always pay the same.Figure 13.1 A fixed-price contract the cost to the client is constant regardless of effort applied or delivery date. the cost to the client stays the same, but as more effort is exerted the profit to the contractor goes down. Some are cost reimbursable also called cost plus. This is where the seller charges you for the cost of doing the work plus some fee or rate. Figure 13.3 In a cost-reimbursable or cost-plus contract, the contractor is guaranteed a fee, but the client's costs can increase based on effort illustrates this by showing that as efforts increase, costs to the client go up but the contractor's profits stay the same. The third major kind of contract is time and materials. That's where the client pays a rate for the time spent working on the project and also pays for all the materials used to do the work. Figure 13.4 In a time-and-materials contract the profit to the contractor increases with increased effort, as does the costs to the client. shows that as costs to the client go up, so does the profit for the contractor.

13.2.1 Fixed-Price Contracts

The **fixed-price contract** is a legal agreement between the project organization and an entity (person or company) to provide goods or services to the project at an agreed-on price. The contract usually details the quality of the goods or services, the timing needed to support the project, and the price for delivering goods or services.

There are several variations of the fixed-price contract. For commodities and goods and services where the scope of work is very clear and not likely to change, the fixed-price contract offers a predictable cost. The responsibility for managing the work to meet the needs of the project is focused on the contractor. The project team tracks the quality and schedule progress to ensure the contractors will meet the project needs. The risks associated with fixed-price contracts are the costs associated with project change. If a change occurs on the project that requires a change order from the contractor, the price of the change is typically very high. Even when the price for changes is included in the original contract, changes on a fixed-price contract will create higher total project costs than other forms of contracts because the majority of the cost risk is transferred to the contractor, and most contractors will add a contingency to the contract to cover their addition al risk.

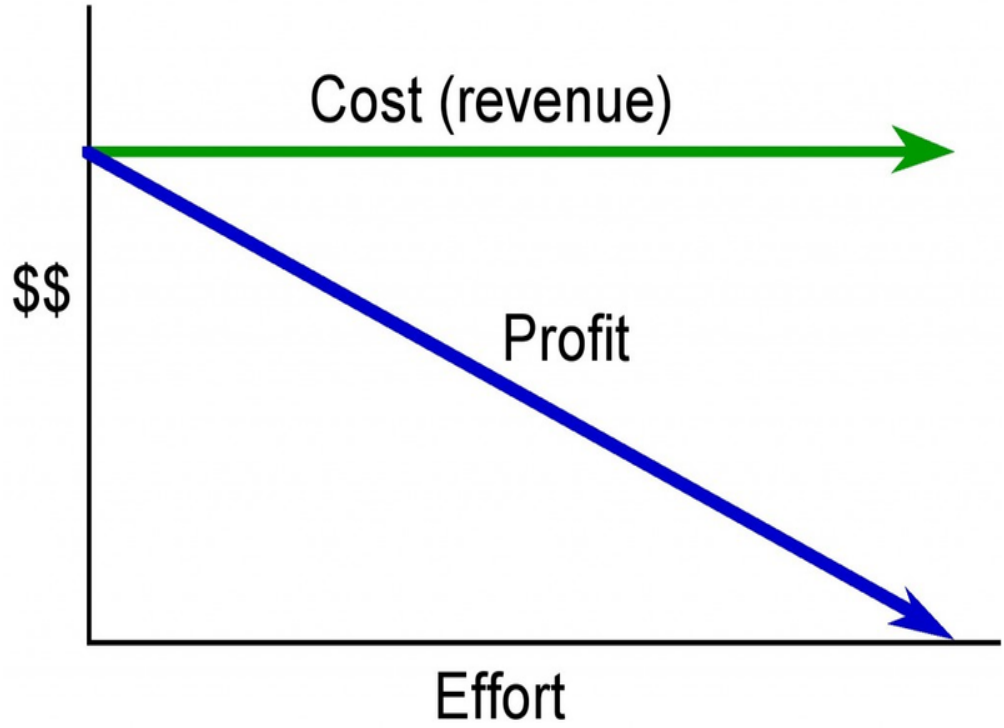


Figure 13.1 A fixed-price contract the cost to the client is constant regardless of effort applied or delivery date. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Fixed-price contracts require the availability of at least two or more suppliers that have the qualifications and performance histories that ensure the needs of the project can be met. The other requirement is a scope of work that is most likely not going to change. Developing a clear scope of work based on good information, creating a list of highly qualified bidders, and developing a clear contract that reflects that scope of work are critical aspects of a good fixed-priced contract.

If the service provider is responsible for incorporating all costs, including profit, into the agreed-on price, it is a **fixed-total-cost contract**. The contractor assumes the risks for unexpected increases in labor and materials that are needed to provide the service or materials and in the materials and timeliness needed.

The **fixed-price contract with price adjustmen**t is used for unusually long projects that span years. The most common use of this type of contract is the inflation-

adjusted price. In some countries, the value of its local currency can vary greatly in a few months, which affects the cost of local materials and labor. In periods of high inflation, the client assumes the risk of higher costs due to inflation, and the contract price is adjusted based on an inflation index. The volatility of certain commodities can also be accounted for in a price-adjustment contract. For example, if the price of oil significantly affects the costs of the project, the client can accept the oil price volatility risk and include a provision in the contract that would allow the contract price adjustment based on a change in the price of oil.

The **fixed-price contract with incentive fee** provides an incentive for performing on the project above the established baseline in the contract. The contract might include an incentive for completing the work on an important milestone for the project. Often contracts have a penalty clause if the work is not performed according to the contract. For example, if the new software is not completed in time to support the implementation of the training, the contract might penalize the software company a daily amount of money for every day the software is late. This type of penalty is often used when the software is critical to the project and the delay will cost the project significant money.

If the service or materials can be measured in standard units, but the amount needed is not known accurately, the price per unit can be fixed—a **fixed-unit-price contract**. The project team assumes the responsibility of estimating the number of units used. If the estimate is not accurate, the contract does not need to be changed, but the project will exceed the budgeted cost.

Type	Known Scope	Share of Risk	Incentive for Meeting Milestones	Predictability of Cost
Fixed Total Cost	Very High	All Contractor	Low	Very High
Fixed Unit Price	High	Mostly Project	Low	High
Fixed price with Incentive Fee	High	Mostly Project	High	Medium-high
Fixed Fee with Price Adjustment	High	Mostly Project	Low	Medium

Figure 13.2 Table of Fixed Price Contracts and Characteristics

(Source: http://pm4id.org/9/5/) .

13.2.2 Cost-Reimbursable Contracts

In a **cost-reimbursable contract**, the organization agrees to pay the contractor for the cost of performing the service or providing the goods. Cost-reimbursable contracts are also known as **cost-plus contracts**. Cost-reimbursable contracts are most often used when the scope of work or the costs for performing the work are not

well known. The project uses a cost-reimbursable contract to pay the contractor for allowable expenses related to performing the work. Since the cost of the project is reimbursable, the contractor has much less risk associated with cost increases. When the costs of the work are not well known, a cost-reimbursable contract reduces the amount of money the bidders place in the bid to account for the risk associated with potential increases in costs. The contractor is also less motivated to find ways to reduce the cost of the project unless there are incentives for supporting the accomplishment of project goals.

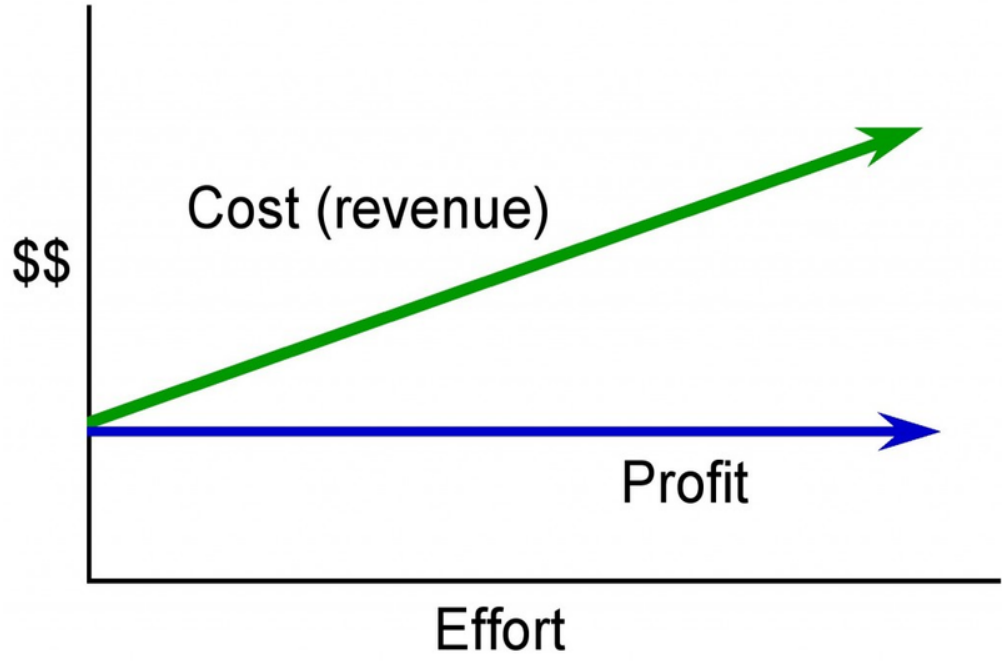


Figure 13.3 In a cost-reimbursable or cost-plus contract, the contractor is guaranteed a fee, but the client's costs can increase based on effort Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

Cost-reimbursable contracts require good documentation of the costs that occurred on the project to ensure that the contractor gets paid for all the work performed and to ensure that the organization is not paying for something that was not completed. The contractor is also paid an additional amount above the costs. There are several ways to compensate the contractor.

- A **cost-reimbursable contract with a fixed fee** provides the contractor with a fee, or profit amount, that is determined at the beginning of the contract and does not change.
- A **cost-reimbursable contract with a percentage fee** pays the contractor for costs plus a percentage of the costs, such as 5% of total allowable costs. The contractor is reimbursed for allowable costs and is paid a fee.
- A **cost-reimbursable contract with an incentive fee** is used to encourage performance in areas critical to the project. Often the contract attempts to motivate contractors to save or reduce project costs. The use of the cost reimbursable contract with an incentive fee is one way to motivate cost-reduction behaviors.

- A **cost-reimbursable contract with award fee** reimburses the contractor for all allowable costs plus a fee that is based on performance criteria. The fee is typically based on goals or objectives that are more subjective. An amount of money is set aside for the contractor to earn through excellent performance, and the decision on how much to pay the contractor is left to the judgment of the project team. The amount is sufficient to motivate excellent performance.

On small activities that have a high uncertainty, the contractor might charge an hourly rate for labor, plus the cost of materials, plus a percentage of the total costs. This type of contract is called **time and materials (T&M)**. Time is usually contracted on an hourly rate basis and the contractor usually submits time sheets and receipts for items purchased on the project. The project reimburses the contractor for the time spent based on the agreed-on rate and the actual cost of the materials. The fee is typically a percentage of the total cost.

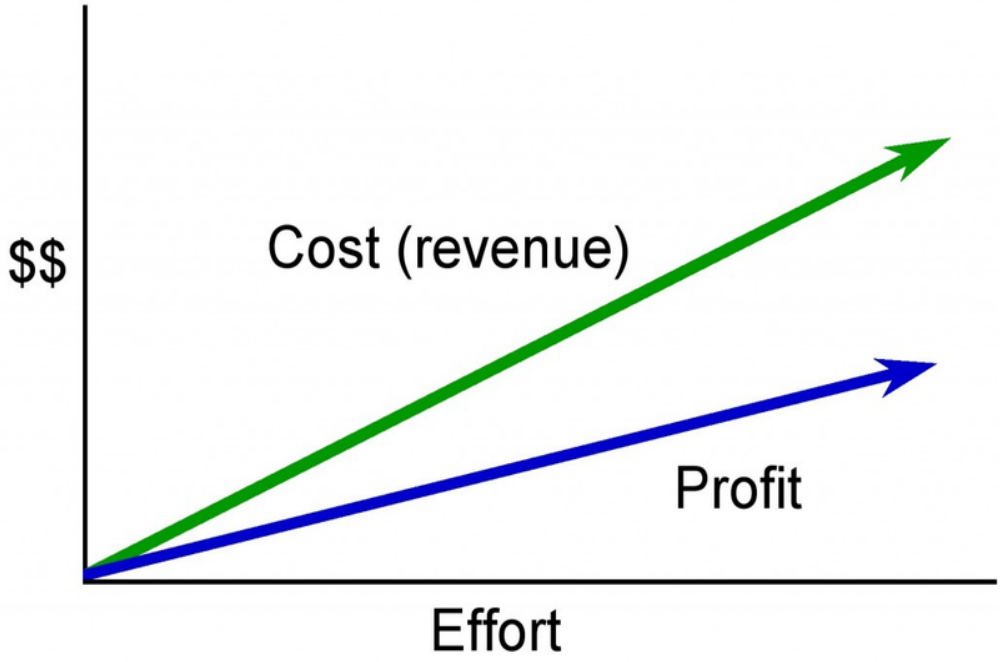


Figure 13.4 In a time-and-materials contract the profit to the contractor increases with increased effort, as does the costs to the client. Illustration from Barron & Barron Project Management for Scientists and Engineers

(http://cnx.org/content/col11120/1.4/) .

T&M contracts are used on projects for work that is smaller in scope and has uncertainty or risk. The project, rather than the contractor, assumes the risk. Since the contractor will most likely include contingency in the price of other types of contracts to cover the high risk, T&M contracts provide lower total cost to the project.

Cost Reimbursable (CR)	Known Scope	Share of Risk	Incentive for Meeting Milestones	Predictability of Cost
CR with Fixed Fee	Medium	Mostly Project	Low	Medium-high
CR with Percentage Fee	Medium	Mostly Project	Low	Medium-high
CR with Incentive Fee	Medium	Mostly Project	High	Medium
CR with Award Fee	Medium	Mostly Project	High	Medium
Time and Materials	Low	All Project	Low	Low

Figure 13.5 Table of cost-reimbursable contracts

(Source: http://pm4id.org/9/5/) .

To minimize the risk to the project, the contractor typically includes a not-to-exceed amount, which means the contract can only charge up to the agreed amount. The T&M contract allows the project to make adjustments as more information is available. The final cost of the work is not known until sufficient information is available to complete a more accurate estimate.

13.3 Progress Payments and Change Management

Vendors and suppliers usually require payments during the life of the contract. On contracts that last several months, the contractor will incur significant cost and will want the project to pay for these costs as early as possible. Rather than wait until the end of the contract, a schedule of payments is typically developed as part of the contract and is connected to the completion of a defined amount of work or project milestones. These payments made before the end of the project and based on the progress of the work are called *progress payments*. For example, the contract might develop a payment schedule that pays for the design of the curriculum, then the development of the curriculum, and then a final payment is made when the curriculum is completed and accepted. In this case there would be three payments made. There is a defined amount of work to be accomplished, a time frame for accomplishing that work, and a quality standard the work must achieve before the contractor is paid for the work.

Just as the project has a scope of work that defines what is included in the project and what work is outside the project, vendors and suppliers have a scope of work that defines what they will produce or supply to the company. (Partners typically share the project scope of work and may not have a separate scope of work.) Often changes occur on the project that require changes in the contractor's scope of work. How these changes will be managed during the life of the project is typically documented in the

contract. Capturing these changes early, documenting what changed and how the change impacted the contract, and developing a change order (a change to the contract) are important to maintaining the progress of the project. Conflict among team members may arise when changes are not documented or when the team cannot agree on the change. Developing and implementing an effective change management process for contrac tors and key suppliers will minimize this conflict and the potential negative effect on the project.

Source: http://pm4id.org/9/5/

13.4 Procurement Process

The project procurement cycle reflects the procurement activities from the decision to purchase the material or service through to the payment of bills and closing of procurement contracts.

13.4.1 Procurement Plan

After the decision has been made to purchase goods or outsource services, the procurement team develops a plan that includes the following:

- Selecting the appropriate relationships and contract approaches for each type of purchased goods or outsourced service
- Preparing requests for quotes (RFQs) and requests for proposals (RFPs) and evaluating partnership opportunities
- Evaluating RFQs, RFPs, and partnerships
- Awarding and signing contracts
- Managing quality and timely performance
- Managing contract changes
- Closing contracts

Depending on the complexity level of the project, each of these steps can take either hours or sometimes weeks of work to complete. Each of these steps is also included in the project master schedule. The time involved in the procurement cycle can influence the scheduling of critical activities, including the decision to self-perform the work or contract the work to others. The delivery dates for equipment and materials and the work completion dates for contracted works are placed on the project schedule. Any procurement activities that create a project delay or fall on the project critical path may require special attention.

13.4.2 Selecting the Contract Approach

The technical teams typically develop a description of the work that will be outsourced. From this information, the project management team answers the following questions:

- Is the required work or materials a commodity, customized product or service, or unique skill or relationship?
- What type of relationship is needed: supplier, vendor, or partnership?
- How should the supplier, vendor, or potential partner be approached: RFQ, RFP, or personal contact?
- How well known is the scope of work?
- What are the risks and which party should assume which types of risk?
- Does the procurement of the service or goods affect activities on the project schedule's critical path and how much float is there on those activities?
- How important is it to be sure of the cost in advance?

The procurement team uses the answers to the first three questions listed above to determine the approach to obtaining the goods or services and the remaining questions to determine what type of contract is most appropriate.

A key factor in selecting the contract approach is determining which party will take the most risk. The team determines the level of risk that will be managed by the project and what risks will be transferred to the contractor. Typically, the project management team wants to manage the project risk, but in some cases, contractors have more expertise or control that enable them to better manage the risk associated with the contracted work.

13.4.3 Soliciting Bids

A **solicitation** is the process of requesting a price and supporting information from bidders. The solicitation usually takes the form of either an RFQ or an RFP. Partnerships are pursued and established differently on a case-by-case basis by senior management.

13.4.4 Qualifying Bidders

Potential bidders are people or organizations capable of providing the materials or performing the work required for the project. On smaller, less complex projects, the parent company typically has a list of suppliers and vendors that have successfully provided goods and services in the past, and the project has access to the

performance record of companies on that list. On unique projects, where no supplier lists exist, the project team develops a list of potential suppliers and then qualifies them to become eligible to bid on project work. Eligible bidders are placed on the bidders list and provided with a schedule of when work on the project will be put out for bid.

The eligibility of a supplier is determined by the ability to perform the work in a way that meets project requirements and demonstrates financial stability. Ability to perform the work includes the ability to meet quality specifications and the project schedule. During times when economic activity is high in a region, many suppliers become busy and stretch their resources. The project team investigates the potential suppliers, before they are included on the bidder's list, to ensure that they have the capacity and track record to meet deadlines.

The potential supplier must also be financially stable to be included on the bidders list. A credit check or a financial report from Dun and Bradstreet (D&B)—a well-known provider of financial information about individual companies—will provide the project with information about the potential bidder's financial status. D&B services include the following:

- D&B proprietary rankings and predictive creditworthiness scores
- Public filings, including suits, liens, judgments, and UCC (uniform commercial code) filings—standardized financial disclosure documents that conform to the uniform commercial code
- Company financial statements and history

13.4.5 Request for Quote

An RFQ focuses on price. The type of materials or service is well defined and can be obtained from several sources. The bidder that can meet the project quality and schedule requirements usually wins the contract by quoting the lowest price.

13.4.6 Request for Proposal

An RFP accounts for price but focuses on meeting the project quality or schedule requirements. The process of developing a proposal in response to an RFP can be very expensive for the bidder, and the project team should not issue an RFP to a company that is not eligible to win the bid.

13.4.7 Evaluating Bids

Evaluation of bids in response to RFQs for commodity items and services is heavily graded for price. In most cases, the lowest total price will win the contract. The total price will include the costs of the goods or services, any shipping or delivery costs, the value of any warranties, and any additional service that adds value to the project.

The evaluation of bids based on RFPs is more complex. The evaluation of proposals includes the price and also an evaluation of the technical approach chosen by the bidder. The project team evaluating the proposal must include people with the expertise to understand the technical aspects of the various proposal options and the value of each proposal to the project. On more complex projects, the administrative part of the proposal is evaluated and scored by one team, and the technical aspect of the proposal is evaluated by another team. The project team combines the two scores to determine the best proposal for the project.

13.4.8 Awarding the Contract

After the project team has selected the bidder that provides the best value for the project, a project representative validates all conditions of the bid and the contract with the potential contractor. Less complex awards, like contracts for printed materials, require a reading and signing of the contract to ensure that the supplier understands the contract terms and requirements of the project schedule. More complex projects require a detailed discussion of the goals, the potential barriers to accomplishing those goals, the project schedule and critical dates, and the processes for resolving conflicts and improving work processes.

13.4.9 Managing the Contracts

The contract type determines the level of effort and the skills needed to manage the contract. The manager of supplier contracts develops detailed specifications and ensures compliance with these specifications. The manager of vendor contracts ensures that the contractors bidding on the work have the skills and capacity to accomplish the work according to the project schedule and tracks the vendor's performance against the project needs, supplying support and direction when needed. The manager of partnering arrangements develops alignment around common goals and work processes. Each of these approaches requires different skills and various degrees of effort.

Items that take a long time to acquire—**long-lead items**—receive early attention by the project leadership. Examples of long-lead items are equipment that is designed and built specifically for the project, curriculum that is created for training a new workforce, and a customized bioreactor for a biotech project. These items might require weeks, months, or years to develop and complete. The project team identifies long-lead items early to begin the procurement activities as soon as possible because those procured through the normal procurement cycle may cause delays in the project.

After the contract is awarded, the project team tracks the performance of the contractor against performance criteria in the contract and his or her contribution to the performance of the project. Usually, contractors deliver the product or service that meets the quality expectations and supports the project schedule. Typically, there are also one or two contractors that do not perform to project expectations. Some project managers will refer to the contract and use it to attempt to persuade the contractor to improve performance or be penalized. Other project managers will explore with the contractor creative ways to improve performance and meet project requirements. The contract management allows for both approaches to deal with non-performing contractors, and the project team must assess what method is most likely to work in each situation.

Managing contractor performance on a project is as important to the overall project outcomes as the work performed by the project team.

13.4.10 Logistics and Expediting

Equipment and materials that are purchased for use on the project must be transported, inventoried, warehoused, and often secured. This area of expertise is called *logistics*. The logistics for the project can be managed by the project team or can be included in the RFP or RFQ. On international projects, materials may be imported, and the procurement team manages the customs process. On smaller projects, the logistical function is often provided by the parent company. On larger projects, these activities are typically contracted to companies that specialize in logistical services. On larger, more complex projects, the procurement team will include logistical expertise.

The project work often depends on materials procured for the project. The delivery of these materials influences the scheduling of the project, and often some materials are needed earlier than normal procurement practices would deliver. On long-lead items, the project schedule is included in the contracting plans and contractors must explain how they will support the project schedule.

On large, complex projects, critical items might be scheduled for delivery after they are needed on the project. The procurement team then explores ideas with the contractor to expedite the manufacturing or transportation of the equipment or materials. The contract can often place a priority on the fabrication of the equipment and delivery of the equipment to meet the project schedule. The project logistics team can also explore ways of shortening the transportation time. For example, a project in

Argentina flew some critical equipment from Sweden rather than transport the equipment by ship to save several weeks in transit. The logistics costs were higher, but the overall value to the project was greater.

13.5 Attribution

This chapter of *Project Management* is a derivative copy of Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional Designers. Retrieved from http://pm4id.org/ under Creative Commons Attribution 3.0 Unported.

Chapter 14 Quality Planning

Adrienne Watt

It's not enough to make sure you get a project done on time and under budget. You need to be sure you make the right product to suit your stakeholders' needs. Quality means making sure that you build what you said you would and that you do it as efficiently as you can. And that means trying not to make too many mistakes and always keeping your project working toward the goal of creating the right product.

Everybody "knows" what quality is. But the way the word is used in everyday life is a little different from how it is used in project management. Just like the triple constraint (scope, cost, and schedule), you manage quality on a project by setting goals and taking measurements. That's why you must understand the quality levels your stakeholders believe are acceptable, and ensure that your project meets those targets, just like it needs to meet their budget and schedule goals.

Customer satisfaction is about making sure that the people who are paying for the end product are happy with what they get. When the team gathers requirements for the specification, they try to write down all of the things that the customers want in the product so that you know how to make them happy. Some requirements can be left unstated. Those are the ones that are implied by the customer's explicit needs. For example, some requirements are just common sense (e.g., a product that people hold can't be made from toxic chemicals that may kill them). It might not be stated, but it's definitely a requirement.

"Fitness to use" is about making sure that the product you build has the best design possible to fit the customer's needs. Which would you choose: a product that's beautifully designed, well constructed, solidly built, and all around pleasant to look at but does not do what you need, or a product that does what you want despite being ugly and hard to use? You'll always choose the product that fits your needs, even if it's seriously limited. That's why it's important that the product both does what it is supposed to do and does it well. For example, you could pound in a nail with a screwdriver, but a hammer is a better fit for the job.

Conformance to requirements is the core of both customer satisfaction and fitness to use, and is a measure of how well your product does what you intend. Above all, your product needs to do what you wrote down in your requirements document. Your requirements should take into account what will satisfy your customer and the best design possible for the job. That means conforming to both stated and implied requirements.

In the end, your product's quality is judged by whether you built what you said you would build.

Quality planning focuses on taking all of the information available to you at the beginning of the project and figuring out how you will measure quality and prevent

defects. Your company should have a quality policy that states how it measures quality across the organization. You should make sure your project follows the company policy and any government rules or regulations on how to plan quality for your project.

You need to plan which activities you will use to measure the quality of the project's product. And you'll need to think about the cost of all the quality-related activities you want to do. Then you'll need to set some guidelines for what you will measure against. Finally, you'll need to design the tests you will run when the product is ready to be tested.

14.1 Quality and Grade

According to the International Organization for Standardization (ISO), **quality** is "the degree to which a set of inherent characteristics fulfill requirements." The requirements of a product or process can be categorized or given a grade that will provide a basis for comparison. The quality is determined by how well something meets the requirements of its grade.

For most people, the term *quality* also implies good value—getting your money's worth. For example, even low-grade products should still work as expected, be safe to use, and last a reasonable amount of time. Consider the following examples.

Example: Quality of Gasoline Grades

Petroleum refiners provide gasoline in several different grades based on the octane rating because higher octane ratings are suitable for higher compression engines. Gasoline must not be contaminated with dirt or water, and the actual performance of the fuel must be close to its octane rating. A shipment of low-grade gasoline graded as 87 octane that is free of water or other contaminants would be of high quality, while a shipment of high-grade 93 octane gas that is contami nated with dirt would be of low quality.

Example: Quality of Furniture Packing

John has antique furniture in excellent condition that was left to him by his grandmother. The pieces are important to John for sentimental reasons, and they are valuable. John decides to hire movers (high-grade professionals) to load his furniture into the truck using appropriate padding and restraints to prevent dents and scratches during the move. John's standard for high quality is that no observable damage occurs to his large pieces of furniture, especially the antiques. If the furniture arrives in his new apartment without a single dent, scratch, or other damage, the activity will be of high quality. John's standard for packing his kitchen is lower. His dishes are old and cheap, so he decides to trust his inexperienced friends (low-grade amateurs) to help him pack his kitchen. If a few of the dishes or glassware are chipped or broken in the process, the savings in labor cost will more than make up for the loss and will be a good value.

14.2 Statistics

Determining how well products meet grade requirements is done by taking measurements and then interpreting those measurements. **Statistics**—the mathematical interpretation of numerical data—are useful when interpreting large numbers of measurements and are used to determine how well the product meets a specification when the same product is made repeatedly. Measurements made on samples of the product must be within **control limits**—the upper and lower extremes of allowable variation—and it is up to management to design a process that will consistently produce products between those limits.

Instructional designers often use statistics to determine the quality of their course designs. Student assessments are one way in which instructional designers are able to tell whether learning occurs within the control limits.

Example: Setting Control Limits

A petroleum refinery produces large quantities of fuel in several grades. Samples of the fuels are extracted and measured at regular intervals. If a fuel is supposed to have an 87 octane performance, samples of the fuel should produce test results that are close to that value. Many of the samples will have scores that are different from 87. The differences are due to random factors that are difficult or expensive to control. Most of the samples should be close to the 87 rating and none of them should be too far off. The manufacturer has grades of 85 and 89, so they decide that none of the samples of the 87 octane fuel should be less than 86 or higher than 88.

If a process is designed to produce a product of a certain size or other measured characteristic, it is impossible to control all the small factors that can cause the product to differ slightly from the desired measurement. Some of these factors will produce products that have measurements that are larger than desired and some will have the opposite effect. If several random factors are affecting the process, they tend to offset each other, and the most common results are near the middle of the range; this phenomenon is called the **central limit theorem**.

If the range of possible measurement values is divided equally into subdivisions called **bins**, the measurements can be sorted, and the number of measurements that fall into each bin can be counted. The result is a **frequency distribution** that shows how many measurements fall into each bin. If the effects that are causing the differences are random and tend to offset each other, the frequency distribution is called a **normal distribution**, which resembles the shape of a bell with edges that flare out. The edges of a theoretical normal distribution curve get very close to zero but do not reach zero.

Example: Normal Distribution

A refinery's quality control manager measures many samples of 87 octane gasoline, sorts the measurements by their octane rating into bins that are 0.1 octane wide, and then counts the number of measurements in each bin. Then she creates a frequency distribution chart of the data, as shown in Figure 14.1 Normal Distribution of Measurements .

It is common to take **samples**—randomly selected subsets from the total population—and measure and compare their qualities, since measuring the entire population would be cumbersome, if not impossible. If the sample measurements are distributed equally above and below the center of the distribution as they are in Figure 14.1 Normal Distribution of Measurements , the average of those measurements is also the center value that is called the *mean*, and is represented in formulas by the lowercase Greek letter μ (pronounced mu). The amount of difference of the measurements from the central value is called the *sample standard deviation* or just the *standard deviation*.

The first step in calculating the standard deviation is subtracting each measurement from the central value (mean) and then squaring that difference. (Recall from your mathematics courses that squaring a number is multiplying it by itself and that the result is always positive.) The next step is to sum these squared values and divide by the number of values minus one. The last step is to take the square root. The result can be thought of as an average difference. (If you had used the usual method of taking an average, the positive and negative numbers would have summed to zero.) Mathematicians represent the standard deviation with the lowercase Greek letter σ (pronounced sigma). If all the elements of a group are measured, instead of just a sample, it is called the standard deviation of the population and in the second step, the sum of the squared values is divided by the total number of values.

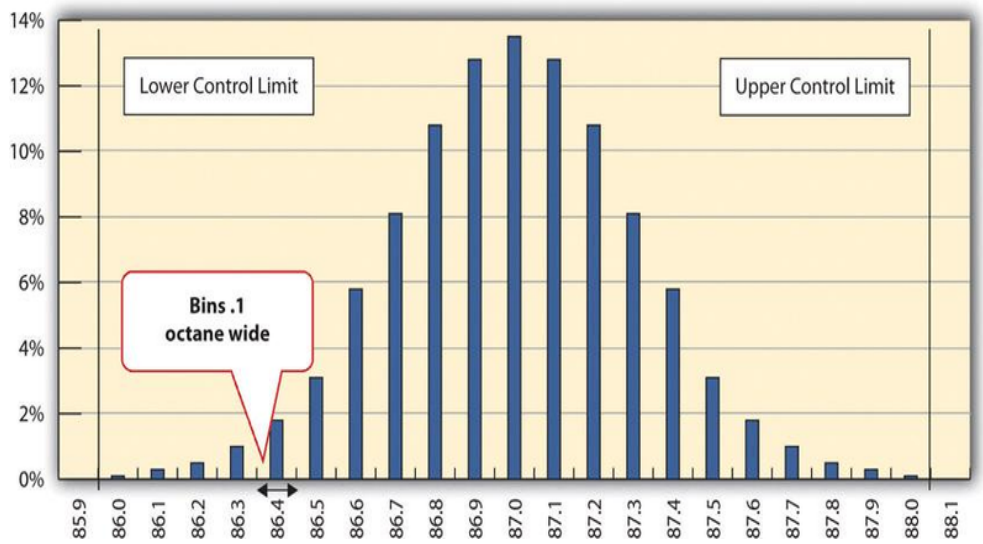


Figure 14.1 Normal Distribution of Measurements

(Source: http://pm4id.org/10/1/) .

Figure 14.1 Normal Distribution of Measurements shows that the most common measurements of octane rating are close to 87 and that the other measurements are distributed equally above and below 87. The shape of the distribution chart supports the central limit theorem's assumption that the factors that are affecting the octane rating are random and tend to offset each other, which is indicated by the symmetric shape. This distribution is a classic example of a *normal distribution*. The quality control manager notices that none of the measurements are above 88 or below 86 so they are within control limits, and she concludes that the process is working satisfactorily.

Example: Standard Deviation of Gasoline Samples

The refinery's quality control manager uses the standard deviation function in her spreadsheet program to find the standard deviation of the sample measurements and finds that for her data, the standard deviation is 0.3 octane. She marks the range on the frequency distribution chart to show the values that fall within one sigma (standard deviation) on either side of the mean (Figure 14.2 One Sigma Range Most of the measurements are within 0.3 octane of 87.).

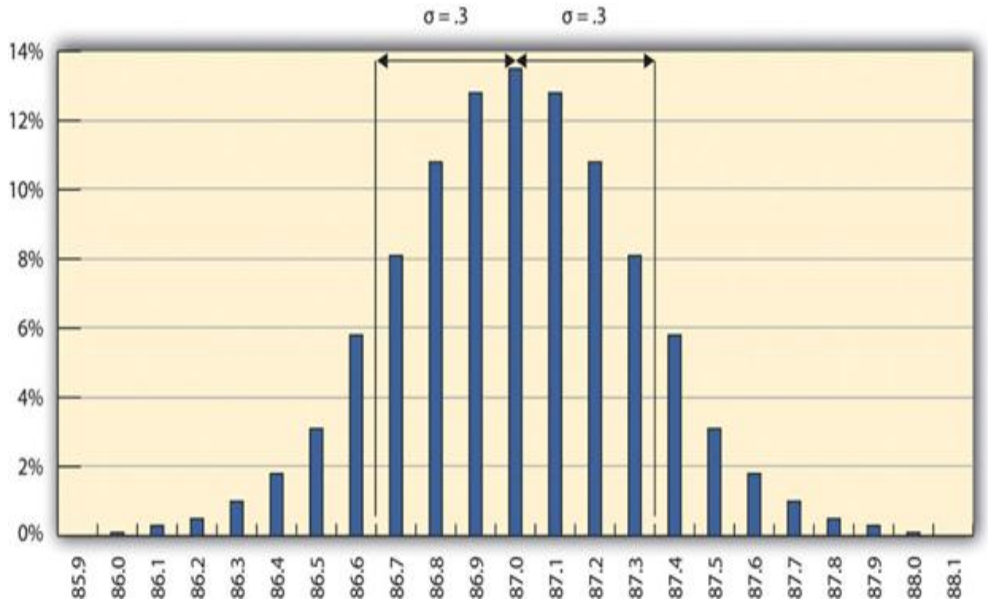


Figure 14.2 One Sigma Range Most of the measurements are within 0.3 octane of 87.

(Source: http://pm4id.org/10/1/) .

For normal distributions, about 68.3% of the measurements fall within one standard deviation on either side of the mean. This is a useful rule of thumb for analyzing some types of data. If the variation between measurements is caused by random factors that result in a normal distribution, and someone tells you the mean and the standard deviation, you know that a little over two-thirds of the measurements are within a standard deviation on either side of the mean. Because of the shape of the curve, the number of measurements within two standard deviations is 95.4%, and the number of measurements within three standard deviations is 99.7%. For example, if someone said the average (mean) height for adult men in the United States is 178 cm (70 inches) and the standard deviation is about 8 cm (3 inches), you would know that 68% of the men in the United States are between 170 cm (67 inches) and 186 cm (73 inches) in height. You would also know that about 95% of the adult men in the United States were between 162 cm (64 inches) and 194 cm (76 inches) tall, and that almost all of them (99.7%) are between 154 cm (61 inches) and 202 cm (79 inches) tall. These figures are referred to as the **68-95-99.7** rule.

Example: Gasoline Within Three Standard Deviations

The refinery's quality control manager marks the ranges included within two and three standard deviations, as shown in Figure 14.3 Th e 68-95-99.7 Rule . Some products must have less variability than others to meet their purpose. For example, if training designed to operate highly specialized and potentially dangerous machinery was assessed for quality, most participants would be expected to exceed the acceptable pass rate. Three standard deviations from the control limits might be fine for some products but not for others. In general, if the mean is six standard deviations from both control limits, the like lihood of a part exceeding the control limits from random variation is practically zero (2 in 1,000,000,000).

Example: A Step Project Improves Quality of Gasoline

A new refinery process is installed that produces fuels with less variability. The refinery's quality control manager takes a new set of samples and charts a new frequency distribution diagram, as shown in Figure 14.4 Smaller Standard Deviation .The refinery's quality control manager calculates that the new standard deviation is 0.2 octane. From this, she can use the 68-95-99.7 rule to estimate that 68.3% of the fuel produced will be between 86.8 and 87.2 and that 99.7% will be between 86.4 and 87.6 octane. A shorthand way of describing this amount of control is to say that it is a five-sigma production system, which refers to the five standard deviations between the mean and the control limit on each side.

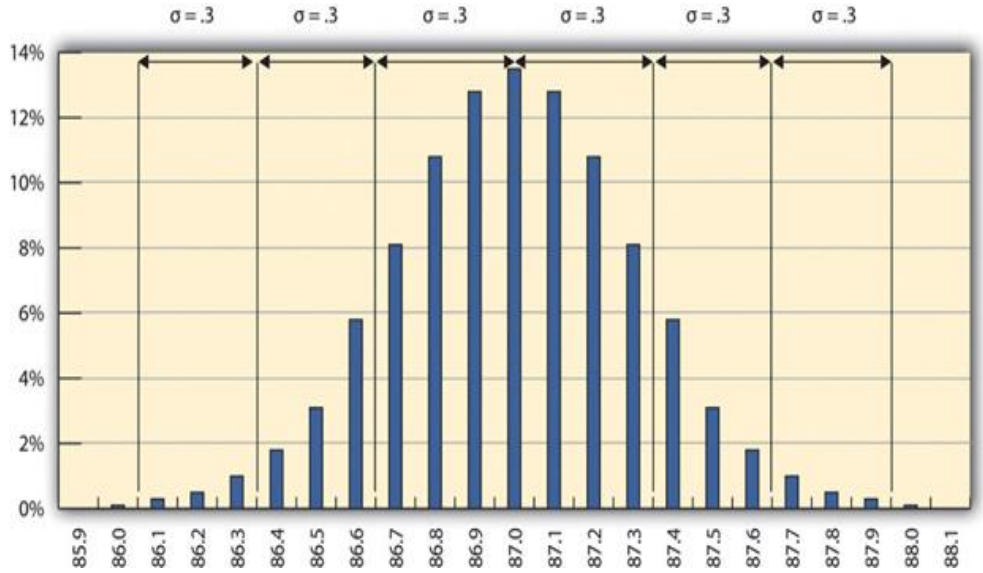


Figure 14.3 The 68-95-99.7 Rule

(Source: http://pm4id.org/10/1/) .

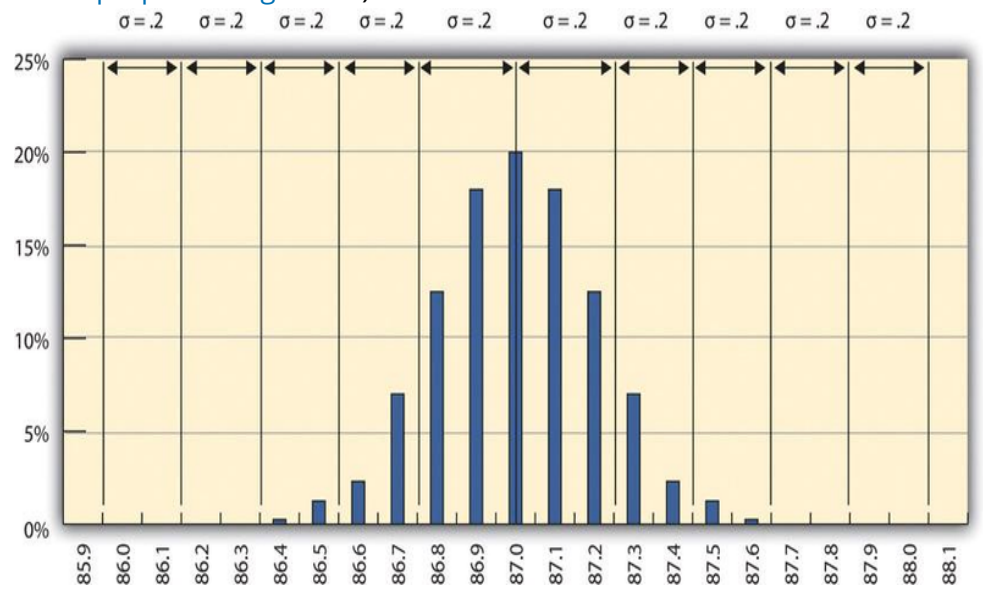


Figure 14.4 Smaller Standard Deviation

(Source: http://pm4id.org/10/1/) .

14.3 Quality planning tools

High quality is achieved by planning for it rather than by reacting to problems after they are identified. Standards are chosen and processes are put in place to achieve those standards.

Measurement Terminology During the execution phase of the project, services and products are sampled and measured to determine if the quality is within control limits for the requirements and to analyze causes for variations. This evaluation is often done by a sepa-rate quality control group, and knowledge of a few process measurement terms is necessary to understand their reports. Several of these terms are similar, and it is valuable to know the distinction between them.

The quality plan specifies the control limits of the product or process; the size of the range between those limits is the tolerance. **Tolerances** are often written as the mean value, plus or minus the tolerance. The plus and minus signs are written together, ±.

Example: Tolerance in Gasoline Production

The petroleum refinery chose to set its control limits for 87 octane gasoline at 86 and 88 octane. The tolerance is 87 ± 1.

Tools are selected that can measure the samples closely enough to determine if the measurements are within control limits and if they are showing a trend. Each measurement tool has its own tolerances.

The choice of tolerance directly affects the cost of quality (COQ). In general, it costs more to produce and measure products that have small tolerances. The costs associated with making products with small tolerances for variation can be very high and not proportional to the gains. For example, if the cost of evaluating each screen as it is created in an online tutorial is greater than delivering the product and fixing any issues after the fact, then the COQ may be too high and the instructional designer will tolerate more defects in the design.

14.4 Defining and Meeting Client Expectations

Clients provide specifications for the project that must be met for the project to be successful. Recall that meeting project specifications is one definition of project success. Clients often have expectations that are more difficult to capture in a written

specification. For example, one client will want to be invited to every meeting of the project and will then select the ones that seem most relevant. Another client will want to be invited only to project meetings that need client input. Inviting this client to every meeting will cause unnecessary frustration. Listening to the client and developing an understanding of the expectations that are not easily captured in specifications is important to meeting those expectations.

Project surveys can capture how the client perceives the project performance and provide the project team with data that are useful in meeting client expectations. If the results of the surveys indicate that the client is not pleased with some aspect of the project, the project team has the opportunity to explore the reasons for this perception with the client and develop recovery plans. The survey can also help define what is going well and what needs improvement.

14.5 Sources of Planning Information

Planning for quality is part of the initial planning process. The early scope, budget, and schedule estimates are used to identify processes, services, or products where the expected grade and quality should be specified. Risk analysis is used to determine which of the risks to the project could affect quality.

14.6 Techniques

Several different tools and techniques are available for planning and controlling the quality of a project. The extent to which these tools are used is determined by the project complexity and the quality management program in use by the client.

The following represents the quality planning tools available to the project manager.

Cost-benefit analysis is looking at how much your quality activities will cost versus how much you will gain from doing them. The costs are easy to measure; the effort and resources it takes to do them are just like any other task on your schedule. Since quality activities don't actually produce a product, it is sometimes harder for people to measure the benefit. The main benefits are less reworking, higher productivity and efficiency, and more satisfaction from both the team and the customer.

Benchmarking means using the results of quality planning on other projects to set goals for your own. You might find that the last project in your company had 20% fewer defects than the one before it. You should want to learn from a project like that and put in practice any of the ideas they used to make such a great improvement. Benchmarks can give you some reference points for judging your own project before you even start the work.

Design of experiments is the list of all the kinds of tests you are going to run on your product. It might list all the kinds of test procedures you'll do, the approaches you'll take, and even the tests themselves. (In the software world, this is called *test planning*.)

Cost of quality is what you get when you add up the cost of all the prevention and inspection activities you are going to do on your project. It doesn't just include the testing. It includes any time spent writing standards, reviewing documents, meeting to analyze the root causes of defects, reworking to fix the defects once they're found by the team: in other words, absolutely everything you do to ensure quality on the project. Cost of quality can be a good number to check to determine whether your project is doing well or having trouble. Say your company tracks the cost of quality on all of its projects; then you could tell if you are spending more or less than has been spent on other projects to get your project up to quality standards.

Control charts can be used to define acceptable limits. If some of the functions of a project are repetitive, statistical process controls can be used to identify trends and keep the processes within control limits. Part of the planning for controlling the quality of repetitive processes is to determine what the control limits are and how the process will be sampled.

Cause-and-effect diagrams can help in discovering problems. When control charts indicate an assignable cause for a variation, it is not always easy to identify the cause of a problem. Discussions that are intended to discover the cause can be facilitated using a cause-and-effect or **fishbone diagram** where participants are encouraged to identify possible causes of a defect.

Example: Diagramming Quality Problems

A small manufacturing firm tries to identify the assignable causes to variations in its manufacturing line. They assemble a team that identifies six possibilities, as shown in the fishbone diagram in Figure 14.5 Cause-and-Effect (Fishbone) Diagram .

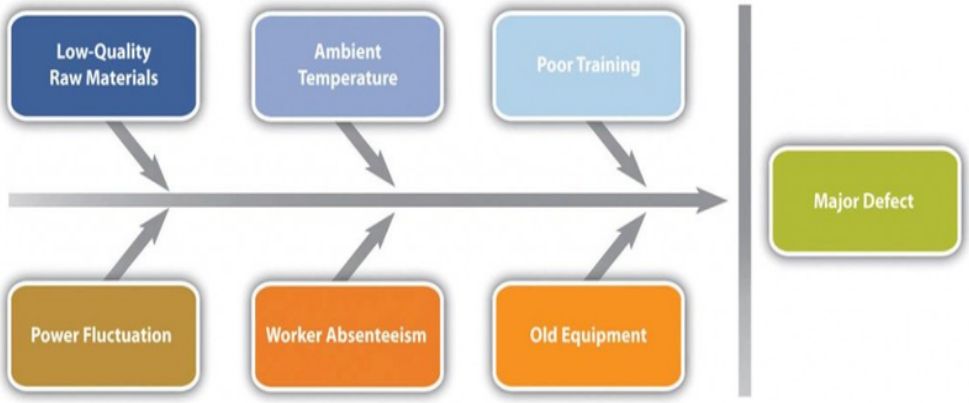


Figure 14.5 Cause-and-Effect (Fishbone) Diagram

(Source: http://pm4id.org/10/4/) .

Each branch of the diagram can be expanded to break down a category into more specific items. An engineer and an electrician work on one of the branches to consider

possible causes of power fluctuation and add detail to their part of the fishbone diagram, as shown in Figure 14.6 Possible Causes of Power Fluctuation . **Check sheets, histograms, and Pareto charts** are used to solve several quality problems. When a quality-control issue occurs, a project manager must choose which problem to address first. One way to prioritize quality problems is to determine which ones occur most frequently. These data can be collected using a **check sheet**, which is a basic form on which the user can make a check in the appropriate box each time a problem occurs or by automating the data collection process using the appropriate technology. Once the data are collected, they can be analyzed by creating a type of frequency distribution chart called a **histogram**. A true histogram is a column chart where the widths of the columns fill the available space on the *x*-axis axis and are proportional to the category values displayed on that axis, while the height of the columns is proportional to the frequency of occurrences. Most histograms use one width of column to represent a category, while the vertical axis represents the frequency of occurrences.

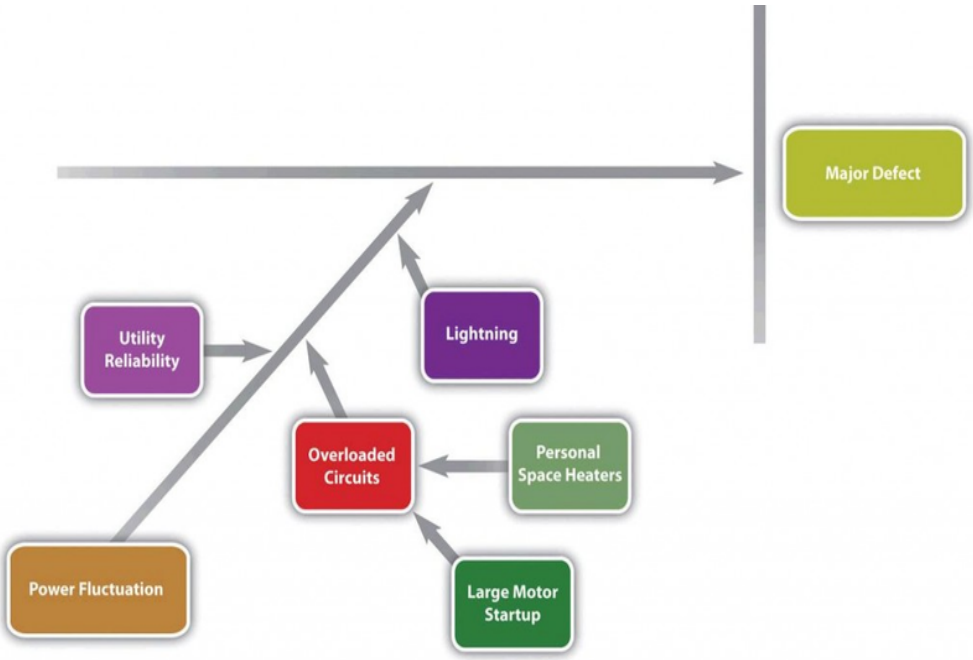


Figure 14.6 Possible Causes of Power Fluctuation

(Source: http://pm4id.org/10/4/) .

A variation on the histogram is a frequency distribution chart invented by economist Vilfredo Pareto known as a **Pareto chart**, in which the columns are arranged in decreasing order with the most common on the left and a line added that shows the cumulative total. The combination of columns and a line allows the user to tell at a glance which problems are most frequent and what fraction of the total they represent.

Once you have your quality plan, you know your guidelines for managing quality on the project. Your strategies for monitoring project quality should be included in the plan, as well as the reasons for all the steps you are taking. It's important that everyone on the team understand the rationale behind the metrics being used to judge success or failure of the project.

14.7 Quality Assurance

The purpose of quality assurance is to create confidence that the quality plan and controls are working properly. Time must be allocated to review the original quality plan and compare that plan to how quality is being ensured during the implementation of the project.

14.8 Process Analysis

The flowcharts of quality processes are compared to the processes followed during actual operations. If the plan was not followed, the process is analyzed and corrective action taken. The corrective action could be to educate the people involved on how to follow the quality plan, or it could be to revise the plan.

The experiments that sample products and processes and collect data are examined to see if they are following statistically valid sampling techniques and that the measurement methods have small enough tolerances to detect variation within control limits.

Because projects are temporary, there are fewer opportunities to learn and improve within a project, especially if it has a short duration. But even in short projects, the quality manager should have a way to learn from experience and change the process for the next project of a similar complexity profile.

Example: Analyzing Quality Processes in Safety Training

A technical college responsible for training employees in safe plant practices evaluates its instructor selection process at the end of the training to see if it had the best criteria for selection. For example, it required the instructors to have master's degrees in manufacturing to qualify as college instructors. The college used an exit survey of the students to ask what they thought would improve the instruction of future classes on this topic. Some students felt that it would be more important to require that the instructors have more years of training experience, while others recommended that instructors seek certification at a training center. The college considered these suggestions and decided to retain its requirement of a master's degree but add a requirement that instructors be certified in plant safety.

The purpose of quality assurance is to build confidence in the client that quality standards and procedures are being followed. This is done by an internal review of the plan, testing, and revisions policies or by an audit of the same items performed by an external group or agency.

14.9 Attribution

This chapter of *Project Management* is a derivative copy of Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional Designers. Retrieved from http://pm4id.org/ under Creative Commons Attribution 3.0 Unported.

Chapter 15 Communication Planning

Adrienne Watt

Communications management is about keeping everybody in the loop. The communications planning process concerns defining the types of information you will deliver, who will receive it, the format for communicating it, and the timing of its release and distribution. It turns out that 90% of a project manager's job is spent on communication so it's important to make sure everybody gets the right message at the right time.

The first step in defining your communication plan is figuring out what kind of communication your stakeholders need from the project so they can make good decisions. This is called the *communications requirements analysis*. Your project will produce a lot of information; you don't want to overwhelm your stakeholders with all of it. Your job is to figure out what they feel is valuable. Communicating valuable information doesn't mean you always paint a rosy picture. Communications to stakeholders may consist of either good news or bad news. The point is that you don't want to bury stakeholders in too much information but you do want to give them enough so that they're informed and can make appropriate decisions.

Communications technology has a major impact on how you keep people in the loop. Methods of communicating can take many forms, such as written reports, conversations, email, formal status reports, meetings, online databases, online schedules, and project websites. You should consider several factors before deciding what methods you'll choose to transfer information. The timing of the information exchange or need for updates is the first factor. Do you need to procure new technology or systems, or are there systems already in place that will work? The technologies available to you should figure into your plan of how you will keep everyone notified of project status and issues. Staff experience with the technology is another factor. Are there project team members and stakeholders experienced at using this technology, or will you need to train them? Finally, consider the duration of the project and the project environment. Will the technology you're choosing work throughout the life of the project or will it have to be upgraded or updated at some point? And how does the project team function? Are they located together or spread out across several campuses or locations?

The answers to these questions should be documented in the communication plan.

All projects require a sound communication plan, but not all projects will have the same types of communication or the same methods for distributing the information. The communication plan documents the types of information needs the stakeholders have, when the information should be distributed, and how the information will be delivered.

The types of information you will communicate typically include project status, project scope statements and updates, project baseline information, risks, action items,

performance measures, project acceptance, and so on. It's important that the information needs of the stakeholders be determined as early in the planning phase of the project management life cycle as possible so that as you and your team develop project planning documents, you already know who should receive copies of them and how they should be delivered.

15.1 Types of Communication

Completing a complex project successfully requires good communication among team members. If those team members work in the same building, they can arrange regular meetings, simply stop by each other's office space to get a quick answer, or even discuss a project informally at other office functions. Many projects are performed by teams that interact primarily through electronic communication and are, therefore, called *virtual teams*. To avoid miscommunication that can harm trust and to include team members in a project culture, the project team needs a plan for communicating reliably and in a timely manner. This planning begins with understanding two major categories of communication.

15.2 Synchronous Communications

If all the parties to the communication are taking part in the exchange at the same time, the communication is **synchronous**. A telephone or Skype conference call is an example of synchronous communication. The following are examples of synchronous communications:

- *Live meeting:* Gathering of team members at the same location
- *Conference call:* A telephone call in which several people participate
- *Audio conference:* Like a conference call, but conducted online using software like Skype
- *Computer-assisted conference:* Audio conference with a connection between computers that can display a document or spreadsheet that can be edited by both parties
- *Video conference:* Similar to an audio conference but with live video of the participants. Some laptop computers have built-in cameras to facilitate video conferencing
- *IM (instant messaging):* Exchange of text or voice messages using pop-up windows on the participants' computer screens
- *Texting:* Exchange of text messages between mobile phones, pagers, or personal digital assistants (PDAs)—devices that hold a calendar, a contact list, a task list, and other support programs

Modern communication technologies make it possible to assemble project teams from anywhere in the world. Most people work during daylight hours, which can make

synchronous meetings difficult if the participants are in different time zones. However, it can be an advantage in some circumstances; for example, if something must be done by the start of business tomorrow, team members in Asia can work on the problem during their normal work hours while team members in North America get some sleep.

15.3 Remember Time Zones

It is important to remember time zones and calculate the difference between yours and your associates' zones correctly so as not to miss important meetings or deadlines. Cities and countries to the north or south of each other all observe the same local time. Be aware that many well-educated people in the United States and Canada think of South America as directly south of North America. As you can see, South American countries can be up to five time zones east of North America. A helpful site to convert local time to another time zone is http://www.timezoneconverter.com/cgibin/tzc.tzc

Time zones are calculated in reference to the time zone of the Royal Observatory in Greenwich, England. The time at that location is Greenwich Mean Time (GMT). More recent references designate it as Coordinated Universal Time (UTC) instead of GMT. The time zones advance from Greenwich in an easterly direction (Figure 15.1 World Time Zones. Standard time zones of the world by TimeZonesBoy). However, at the international dateline (about the midpoint around the world from Greenwich), you subtract the time zone from GMT. To prevent confusion between a.m. and p.m., times are often given using a 24-hour clock. For example, midnight is indicated as 00:00, noon is 12:00 and 1 p.m. is 13:00.

Example: Conference Call between Toronto and Paris

A project manager for a software development project in Toronto is five time zones west of the reference zone, so the time is given as UTC−5 (or GMT−5). If it is noon in the reference zone, it is 7 a.m. (five hours earlier) in Toronto. The manager would like to contact a project team member in Paris, France. Paris is one time zone east of the reference zone (UTC+1 or GMT+1). If it is noon (12:00) in the reference zone, it is 1 p.m. (13:00) in Paris. This means that there is a six-hour difference between Toronto and Paris. If the project manager waits until after lunch to place the call (1 p.m. in Toronto), it will be too late in the day in Paris (7 p.m.) to reach someone.

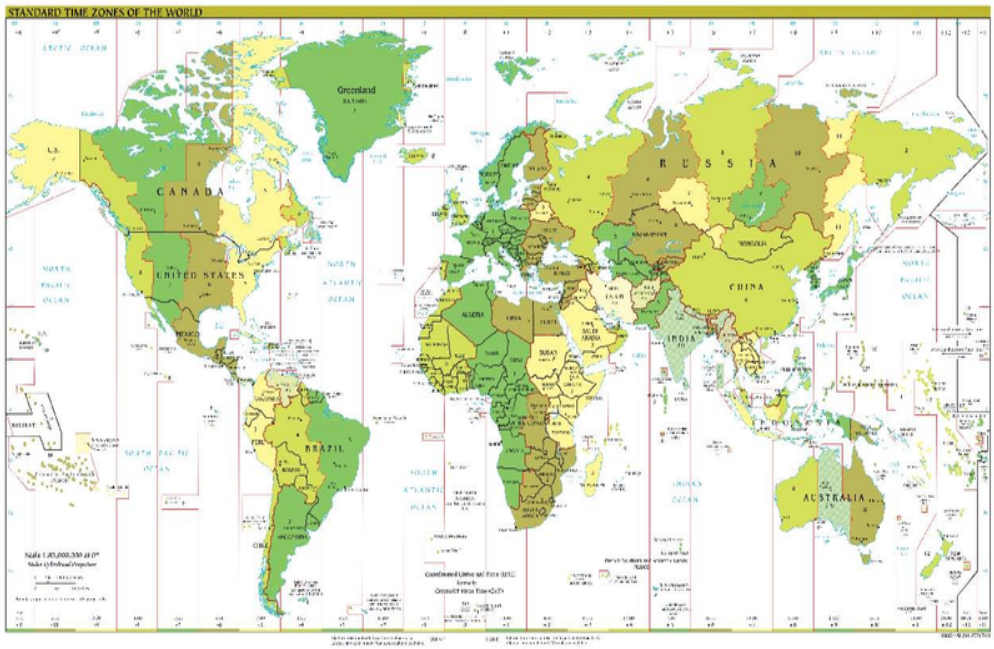


Figure 15.1 World Time Zones. Standard time zones of the world by TimeZonesBoy

((http://commons.wikimedia.org/wiki/ File:Standard_time_zones_of_the_world.png) under the Public Domain) .

15.4 Asynchronous Communications

Getting a team together at the same time can be a challenge—especially if they are spread out across time zones. Many types of communication do not require that the parties are present at the same time. This type of communication is asynchronous. There are several choices of asynchronous communications.

15.4.1 Mail and Package Delivery

Many companies prefer that final contracts are personally signed by an authorized representative of each party to the agreement. If several signatures are required, this can take weeks to get all the signatures if the contracts are transferred by a postal service. If this process is holding up the start of the project, you can use an overnight delivery service to minimize the time spent transferring the documents.

15.4.2 Fax

Fax machines have been around a long time and enjoy a high level of trust for transmitting documents accurately. Although it might seem archaic to still use fax

transmissions, in many countries a fax of a signed contract is legal, but a computer-scanned image is not.

15.4.3 Email

Electronic mail (email) is widely used to coordinate projects and to communicate between team members. It has several valuable characteristics for project management:

- Information can be sent to a list of team members.
- Messages can be saved to document the process in case of a misunderstanding or miscommunication.
- Files can be attached and distributed.

15.4.4 Project Blog

A **blog** is an online journal that can be private, shared by invitation, or made available to the world. Some project managers keep a journal in which they summarize the day's challenges and triumphs and the decisions they made. They return to this journal at a later date to review their decision-making process after the results of those decisions are known to see if they can learn from their mistakes. Many decisions in project management are made with incomplete knowledge, and reflecting on previous decisions to develop this decision-making skill is important to growth as a project manager.

15.4.5 Really Simple Syndication (RSS)

Some projects are directly affected by external factors such as political elections, economic trends, corporate mergers, technological or scientific breakthroughs, or weather. To keep informed about these factors, you can subscribe to online news sources. A technology that facilitates this process is Really Simple Syndication (RSS). Web pages with RSS news feeds have labeled links.

If the user clicks on the RSS feed, news from the website is automatically sent to the user's news reader, such as Google Reader. The news reader can be set to filter the news for key words to limit the stories to those that are relevant to the project.

15.5 Assessing New Communication Technologies

New technologies for communicating electronically appear with increasing frequency. Using a new technology that is unfamiliar to the team increases the technology complexity, which can cause delays and increase costs. To decide if a new technology should be included in a communications plan, seek answers to the following questions (Business Dictionary):

- Does the new communication technology provide a competitive advantage for the project by reducing cost, saving time, or preventing mistakes?
- Does the project team have the expertise to learn the new technology quickly?
- Does the company offer support such as a help desk and equipment service for new communication technology?
- What is the cost of training and implementation in terms of time as well as money

15.6 Communication Plan Template

So how do you create a communication plan?

1. Identify your stakeholders (to whom)
2. Identify stakeholder expectations (why)
3. Identify communication necessary to satisfy stakeholder expectations and keep them informed (what)
4. Identify time-frame and/or frequency of communication messages (when)
5. Identify how the message will be communicated (the stakeholder's preferred method) (how)
6. Identify who will communication each message (who)
7. Document items – templates, formats, or documents the project must use for communicating.

Figure 15.2 Communications Plan Template shows a communication plan template.

Figure 1
Communication plan template

Communications Plan	
Project Name:	Beginning Date:
Project Manager:	Completion Date:
Plan Owner:	
Planning	
Project objective and key message points (high level): • • •	
Stakeholders – target audience (list) • • •	

Outline				
Timeline (date)	**Team Member (responsible for communication)**	**Target (audience)**	**Tool (medium for communication delivery)**	**Messag Points**

Figure 15.2 Communications Plan Template

(http://inte5160.wikispaces.com/Communication+Plans) used under CC-BY-SA license (http://creativecommons.org/licenses/by-sa/3.0/)) .

15.7 Attribution

This chapter of *Project Management* is a derivative copy of Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional Designers. Retrieved from http://pm4id.org/ licensed under Creative Commons Attribution 3.0 Unported and Communication Plans by Inte6160 Wiki licensed under Creative Commons Attribution 3.0 Unported.

Chapter 16 Risk Management Planning

Adrienne Watt

Even the most carefully planned project can run into trouble. No matter how well you plan, your project can always encounter unexpected problems. Team members get sick or quit, resources that you were depending on turn out to be unavailable, even the weather can throw you for a loop (e.g., a snowstorm). So does that mean that you're helpless against unknown problems? No! You can use risk planning to identify potential problems that could cause trouble for your project, analyze how likely they are to occur, take action to prevent the risks you can avoid, and minimize the ones that you can't.

A risk is any uncertain event or condition that might affect your project. Not all risks are negative. Some events (like finding an easier way to do an activity) or conditions (like lower prices for certain materials) can help your project. When this happens, we call it an opportunity; but it's still handled just like a risk.

There are no guarantees on any project. Even the simplest activity can turn into unexpected problems. Anything that might occur to change the outcome of a project activity, we call that a risk. A risk can be an event (like a snowstorm) or it can be a condition (like an important part being unavailable). Either way, it's something that may or may not happen ...but if it does, then it will force you to change the way you and your team work on the project.

If your project requires that you stand on the edge of a cliff, then there's a risk that you could fall. If it's very windy out or if the ground is slippery and uneven, then falling is more likely (Figure 16.1 Risk Management Options).

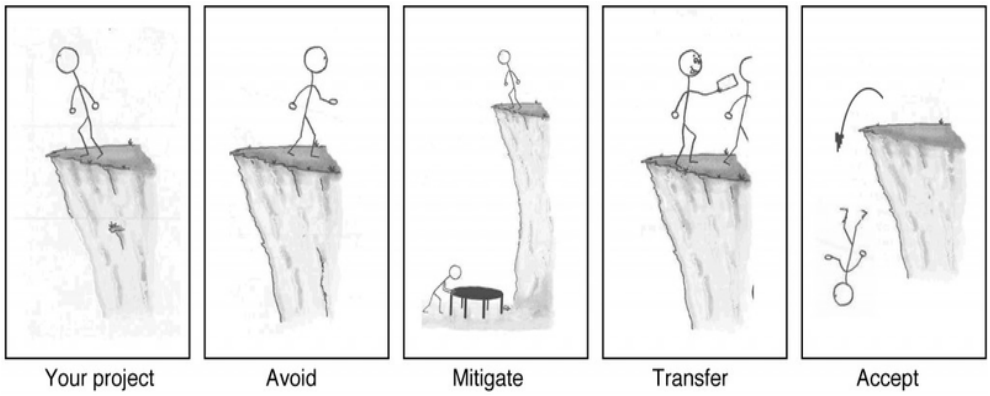


Figure 16.1 Risk Management Options Illustration from Barron & Barron Project Management for Scientists and Engineers,

(llustration from Barron & Barron Project Management for Scientists and Engineers, http://cnx.org/content/col11120/1.4/) .

When you're planning your project, risks are still uncertain: they haven't happened yet. But eventually, some of the risks that you plan for do happen, and that's when you have to deal with them. There are four basic ways to handle a risk.

1. Avoid: The best thing you can do with a risk is avoid it. If you can prevent it from happening, it definitely won't hurt your project. The easiest way to avoid this risk is to walk away from the cliff, but that may not be an option on this project.
2. Mitigate: If you can't avoid the risk, you can mitigate it. This means taking some sort of action that will cause it to do as little damage to your project as possible.
3. Transfer: One effective way to deal with a risk is to pay someone else to accept it for you. The most common way to do this is to buy insurance.
4. Accept: When you can't avoid, mitigate, or transfer a risk, then you have to accept it. But even when you accept a risk, at least you've looked at the alternatives and you know what will happen if it occurs. If you can't avoid the risk, and there's nothing you can do to reduce its impact, then accepting it is your only choice.

By the time a risk actually occurs on your project, it's too late to do anything about it. That's why you need to plan for risks from the beginning and keep coming back to do more planning throughout the project.

The risk management plan tells you how you're going to handle risk in your project. It documents how you'll assess risk, who is responsible for doing it, and how often you'll do risk planning (since you'll have to meet about risk planning with your team throughout the project).

Some risks are technical, like a component that might turn out to be difficult to use. Others are external, like changes in the market or even problems with the weather.

It's important to come up with guidelines to help you figure out how big a risk's potential impact could be. The impact tells you how much damage the risk would cause to your project. Many projects classify impact on a scale from minimal to severe, or from very low to very high. Your risk management plan should give you a scale to help figure out the probability of the risk. Some risks are very likely; others aren't.

16.1 Risk Management Process

Managing risks on projects is a process that includes risk assessment and a mitigation strategy for those risks. *Risk assessment* includes both the identification of potential risk and the evaluation of the potential impact of the risk. A **risk mitigation plan** is designed to eliminate or minimize the impact of the **risk events**—occurrences that have a negative impact on the project. Identifying risk is both a creative and a disciplined process. The creative process includes brainstorming sessions where the team is asked to create a list of everything that could go wrong. All ideas are welcome at this stage with the evaluation of the ideas coming later.

16.2 Risk Identification

A more disciplined process involves using checklists of potential risks and evaluating the likelihood that those events might happen on the project. Some companies and industries develop risk checklists based on experience from past projects. These checklists can be helpful to the project manager and project team in identifying both specific risks on the checklist and expanding the thinking of the team. The past experience of the project team, project experience within the company, and experts in the industry can be valuable resources for identifying potential risk on a project.

Identifying the sources of risk by category is another method for exploring potential risk on a project. Some examples of categories for potential risks include the following:

- Technical
- Cost
- Schedule
- Client
- Contractual
- Weather
- Financial
- Political
- Environmental
- People

You can use the same framework as the work breakdown structure (WBS) for developing a **risk breakdown structure (RBS)**. A risk breakdown structure organizes the risks that have been identified into categories using a table with increasing levels of detail to the right. The people category can be subdivided into different types of risks associated with the people. Examples of people risks include the risk of not finding people with the skills needed to execute the project or the sudden unavailability of key people on the project.

Example: Risks in John's Move

In John's move, John makes a list of things that might go wrong with his project and uses his work breakdown structure as a guide. A partial list for the planning portion of the RBS is shown in Figure 16.2 Risk Breakdown Structure (RBS) .

Source: http://pm4id.org/11/2/

Figure 16.2 Risk Breakdown Structure (RBS)

The result is a clearer understanding of where risks are most concentrated. This approach helps the project team identify known risks, but can be restrictive and less creative in identifying unknown risks and risks not easily found inside the WBS.

16.3 Risk Evaluation

After the potential risks have been identified, the project team then evaluates each risk based on the probability that a risk event will occur and the potential loss associated with it. Not all risks are equal. Some risk events are more likely to happen than others, and the cost of a risk can vary greatly. Evaluating the risk for probability of occurrence and the severity or the potential loss to the project is the next step in the risk management process. Having criteria to determine high-impact risks can help narrow the focus on a few critical risks that require mitigation. For example, suppose high-impact risks are those that could increase the project costs by 5% of the conceptual budget or 2% of the detailed budget. Only a few potential risk events meet these criteria. These are the critical few potential risk events that the project management team should focus on when developing a project risk mitigation or management plan. Risk evaluation is about developing an understanding of which potential risks have the greatest pos-sibility of occurring and can have the greatest negative impact on the project (Figure 16.3 Risk and Impact). These become the critical few.

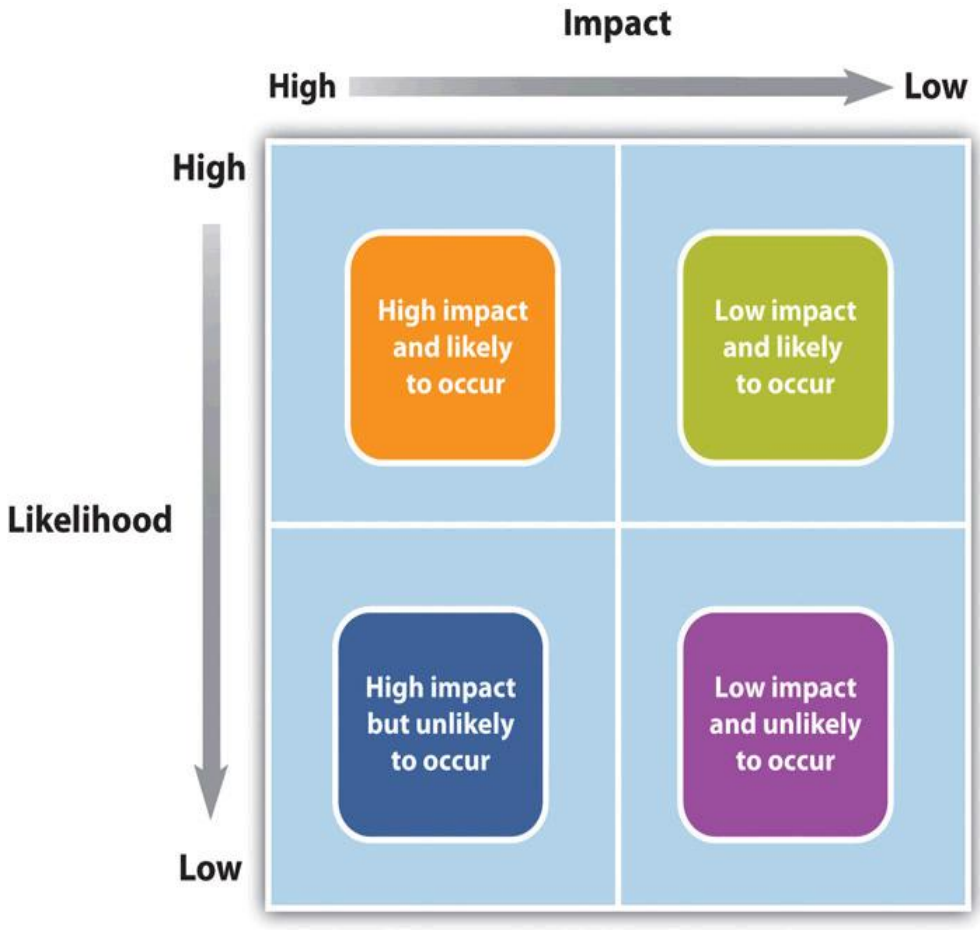


Figure 16.3 Risk and Impact

(http://pm4id.org/11/2/) .

There is a positive correlation—both increase or decrease together—between project risk and project complexity. A project with new and emerging technology will have a high-complexity rating and a correspondingly high risk. The project management team will assign the appropriate resources to the technology managers to ensure the accomplishment of project goals. The more complex the technology, the more resources the technology manager typically needs to meet project goals, and each of those resources could face unexpected problems.

Risk evaluation often occurs in a workshop setting. Building on the identification of the risks, each risk event is analyzed to determine the likelihood of occurrence and the potential cost if it did occur. The likelihood and impact are both rated as high, medium, or low. A risk mitigation plan addresses the items that have high ratings on both factors—likelihood and impact.

Example: Risk Analysis of Equipment Delivery

A project team analyzed the risk of some important equipment not arriving at the project on time. The team identified three pieces of equipment that were critical to the project and would significantly increase costs if they were late in arriving. One of the vendors, who was selected to deliver an important piece of equipment, had a history of being late on other projects. The vendor was good and often took on more work than it could deliver on time. This risk event (the identified equipment arriving late) was rated as high likelihood with a high impact. The other two pieces of equipment were potentially a high impact on the project but with a low probability of occurring.

Not all project managers conduct a formal risk assessment on a project. One reason, as found by David Parker and Alison Mobey in their phenomenological study of project managers, was a low understanding of the tools and bene fits of a structured analysis of project risks (2004). The lack of formal risk management tools was also seen as a barrier to implementing a risk management program. Additionally, the project manager's personality and management style play into risk preparation levels. Some project managers are more proactive and develop elaborate risk management programs for their projects. Other managers are reactive and are more confident in their ability to handle unexpected events when they occur. Yet others are risk averse, and prefer to be optimistic and not consider risks or avoid taking risks whenever possible.

On projects with a low-complexity profile, the project manager may informally track items that may be considered risk items. On more complex projects, the project management team may develop a list of items perceived to be higher risk and track them during project reviews. On projects of even greater complexity, the process for evaluating risk is more formal with a risk assessment meeting or series of meetings during the life of the project to assess risks at different phases of the project. On highly complex projects, an outside expert may be included in the risk assessment process, and the risk assessment plan may take a more prominent place in the project implementation plan.

On complex projects, statistical models are sometimes used to evaluate risk because there are too many different possible combinations of risks to calculate them one at a time. One example of the statistical model used on projects is the Monte Carlo simulation, which simulates a possible range of outcomes by trying many different combinations of risks based on their likelihood. The output from a Monte Carlo simulation provides the project team with the

probability of an event occurring within a range and for combinations of events. For example, the typical output from a Monte Carlo simulation may indicate a 10% chance that one of the three important pieces of equipment will be late and that the weather will also be unusually bad after the equipment arrives.

16.4 Risk Mitigation

After the risk has been identified and evaluated, the project team develops a risk mitigation plan, which is a plan to reduce the impact of an unexpected event. The project team mitigates risks in various ways:

- Risk avoidance
- Risk sharing
- Risk reduction
- Risk transfer

Each of these mitigation techniques can be an effective tool in reducing individual risks and the risk profile of the project. The risk mitigation plan captures the risk mitigation approach for each identified risk event and the actions the project management team will take to reduce or eliminate the risk.

Risk avoidance usually involves developing an alternative strategy that has a higher probability of success but usually at a higher cost associated with accomplishing a project task. A common risk avoidance technique is to use proven and existing technologies rather than adopt new techniques, even though the new techniques may show promise of better performance or lower costs. A project team may choose a vendor with a proven track record over a new vendor that is providing significant price incentives to avoid the risk of working with a new vendor. The project team that requires drug testing for team members is practicing risk avoidance by avoiding damage done by someone under the influence of drugs.

Risk sharing involves partnering with others to share responsibility for the risky activities. Many organizations that work on international projects will reduce political, legal, labor, and others risk types associated with international projects by developing a joint venture with a company located in that country. Partnering with another company to share the risk associated with a portion of the project is advantageous when the other company has expertise and experience the project team does not have. If a risk event does occur, then the partnering company absorbs some or all of the negative impact of the event. The company will also derive some of the profit or benefit gained by a successful project.

Risk reduction is an investment of funds to reduce the risk on a project. On international projects, companies will often purchase the guarantee of a currency rate to reduce the risk associated with fluctuations in the currency exchange rate. A project manager may hire an expert to review the technical plans or the cost estimate on a

project to increase the confidence in that plan and reduce the project risk. Assigning highly skilled project personnel to manage the high-risk activities is another risk-reduction method. Experts managing a high-risk activity can often predict problems and find solutions that prevent the activities from having a negative impact on the project. Some companies reduce risk by forbidding key executives or technology experts to ride on the same airplane.

Risk transfer is a risk reduction method that shifts the risk from the project to another party. The purchase of insurance on certain items is a risk-transfer method. The risk is transferred from the project to the insurance company. A construction project in the Caribbean may purchase hurricane insurance that would cover the cost of a hurricane damaging the construction site. The purchase of insurance is usually in areas outside the control of the project team. Weather, political unrest, and labor strikes are examples of events that can significantly impact the project and that are outside the control of the project team.

16.5 Contingency Plan

The project risk plan balances the investment of the mitigation against the benefit for the project. The project team often develops an alternative method for accomplishing a project goal when a risk event has been identified that may frustrate the accomplishment of that goal. These plans are called contingency plans. The risk of a truck drivers' strike may be mitigated with a contingency plan that uses a train to transport the needed equipment for the project. If a critical piece of equipment is late, the impact on the schedule can be mitigated by making changes to the schedule to accommodate a late equipment delivery.

Contingency funds are funds set aside by the project team to address unforeseen events that cause the project costs to increase. Projects with a high-risk profile will typically have a large contingency budget. Although the amount of contingency allocated in the project budget is a function of the risks identified in the risk analysis process, contingency is typically managed as one line item in the project budget.

Some project managers allocate the contingency budget to the items in the budget that have high risk rather than developing one line item in the budget for contingencies. This approach allows the project team to track the use of contingency against the risk plan. This approach also allocates the responsibility to manage the risk budget to the managers responsible for those line items. The availability of contingency funds in the line item budget may also increase the use of contingency funds to solve problems rather than finding alternative, less costly solutions. Most project managers, especially on more complex projects, manage contingency funds at the project level, with approval of the project man ager required before contingency funds can be used.

16.6 Project Risk by Phases

Project risk is dealt with in different ways depending on the phase of the project.

16.6.1 Initiation

Risk is associated with things that are unknown. More things are unknown at the beginning of a project, but risk must be considered in the initiation phase and weighed against the potential benefit of the project's success in order to decide if the project should be chosen.

Example: Risks by Phase in John's Move

In the initiation phase of his move, John considers the risk of events that could affect the whole project. Lets assume that John's move is not just about changing jobs, but also a change of cities. This would certainly incur more risks for the project. He identifies the following risks during the initiation phase that might have a high impact and rates the likeli hood of their happening from low to high.

1. His new employer might change his mind and take back the job offer after he's given notice at his old job: Low.
2. The current tenants of his apartment might not move out in time for him to move in by the first day of work at the new job: Medium.
3. The movers might lose his furniture: Low.
4. The movers might be more than a week late delivering his furniture: Medium.
5. He might get in an accident driving from Chicago to Atlanta and miss starting his job: Low.

John considers how to mitigate each of the risks.

1. During his job hunt, John had more than one offer, and he is confident that he could get another job, but he might lose deposit money on the apartment and the mover. He would also lose wages during the time it took to find the other job. To mitigate the risk of his new employer changing his mind, John makes sure that he keeps his relationships with his alternate employers cordial and writes to each of them thanking for their consideration in his recent interviews.
2. John checks the market in Atlanta to determine the weekly cost and availability of extended-stay motels.
3. John checks the mover's contract to confirm that they carry insurance against lost items, but they require the owner to provide a detailed list with value estimates and they limit the maximum total value. John decides to go through his apartment with his digital camera and take pictures of all of his possessions that will be shipped by truck and to keep the camera with him during the move so he has a visual record and won't have to rely on his memory to make a list. He seals and numbers the boxes so he can tell if a box is missing.
4. If the movers are late, John can use his research on extended-stay motels to calculate how much it would cost. He checks the moving company's contract to see if they compensate the owner for late delivery, and he finds that they do not.
5. John checks the estimated driving time from Chicago to Atlanta using an Internet mapping service and gets an estimate of 11 hours of driving time. He decides that it would be too risky to attempt to make the drive by himself in one day, especially if he didn't leave until after the truck was packed. John plans to spend one night on

the road in a motel to reduce the risk of an accident caused by driving while too tired.

John concludes that the medium-risks can be mitigated and the costs from the mitigation would be acceptable in order to get a new job.

16.6.2 Planning Phase

Once the project is approved and it moves into the planning stage, risks are identified with each major group of activities. A risk breakdown structure (RBS) can be used to identify increasing levels of detailed risk analysis.

Example: Risk Breakdown Structure for John's Move

John decides to ask Dion and Carlita for their help during their first planning meeting to identify risks, rate their impact and likelihood, and suggest mitigation plans. They concentrate on the packing phase of the move. They fill out a table of risks, as shown in Figure 16.4 Risk Breakdown Structure (RBS) for Packing John's Apartment .

Legend:
RA: Risk Avoidance RS: Risk Sharing RR: Risk Reduction RT: Risk Transfer

Level 1	Level 2	Level 3—Risks	Mitigation
Packing	Pack Kitchen	Cuts from handling sharp knives	Buy small boxes for packing knives (RR)
		Cuts from cracked glasses that break while being packed	Discard cracked glasses (RA)
		Transporting alcoholic beverages	Give opened bottles to Dion or Carlita (RA)
	Pack Living Room	Damage to antique furniture	Supervise wrapping and loading personally (RR) and require movers to insure against damage (RT)
		Lose parts while taking apart the entertainment center	Buy box of large freezer bags with a marker to bag and label parts (RR)
		Break most valuable electronics—TV, DVD, Tuner, Speakers	Buy boxes of the right size with sufficient bubble wrap (RR)
	Pack Bedroom	Break large mirror	Buy or rent a mirror-box with Styrofoam blocks at each corner (RR)
		Lose prescription drugs or pack them where they cannot be found quickly	Separate prescription drugs for transportation in the car (RA)
	Pack Remaining Items	Damage to house plants	Ask Carlita to care for them and bring them with her in her van when she visits in exchange for half of them (RS)
		Transportation of flammable liquids from charcoal grill	Give to Dion or Carlita (RA)

Figure 16.4 Risk Breakdown Structure (RBS) for Packing John's Apartment

(Source: http://pm4id.org/11/3/) .

16.6.3 Implementation Phase

As the project progresses and more information becomes available to the project team, the total risk on the project typically reduces, as activities are performed without loss. The risk plan needs to be updated with new information and risks checked off that are related to activities that have been performed.

Understanding where the risks occur on the project is important information for managing the contingency budget and managing cash reserves. Most organizations develop a plan for financing the project from existing organizational resources, including financing the project through a variety of financial instruments. In most cases, there is a cost to the organization to keep these funds available to the project, including the contingency budget. As the risks decrease over the length of the project, if the contingency is not used, then the funds set aside by the organization can be used for other purposes.

To determine the amount of contingency that can be released, the project team will conduct another risk evaluation and determine the amount of risk remaining on the project. If the risk profile is lower, the project team may release contingency funds back to the parent organization. If additional risks are uncovered, a new mitigation plan is developed including the possible addition of contingency funds.

16.6.4 Closeout Phase

During the closeout phase, agreements for risk sharing and risk transfer need to be concluded and the risk breakdown structure examined to be sure all the risk events have been avoided or mitigated. The final estimate of loss due to risk can be made and recorded as part of the project documentation. If a Monte Carlo simulation was done, the result can be compared to the predicted result.

Example: Risk Closeout on John's Move

To close out the risk mitigation plan for his move, John examines the risk breakdown structure and risk mitigation plan for items that need to be finalized. He makes a checklist to be sure all the risk mitigation plans are completed, as shown in Figure 16.5 Closeout of Risk Mitigation Plan for John's Move . Risk is not allocated evenly over the life of the project. On projects with a high degree of new technology, the majority of the risks may be in the early phases of the project. On projects with a large equipment budget, the largest amount of risk may be during the procurement of the equipment. On global projects with a large amount of political risk, the highest portion of risk may be toward the end of the project.

Risk	Mitigation	Closeout
Items lost by movers	Mover's insurance plus digital image inventory	Confirm all of the numbered boxes are present and still sealed
Antique furniture damaged	Mover's insurance plus personal supervision of wrapping and loading	Supervise unloading and unwrapping; visually inspect each piece
House plants	Ask Carlita to bring half of them in her van when she visits	Confirm that the plants are healthy and that Carlita brought about half of them

Figure 16.5 Closeout of Risk Mitigation Plan for John's Move

(Source: http://pm4id.org/11/3/) .

16.7 References

Parker, D., & Mobey, A. (2004). Action Research to Explore Perceptions of Risk in Project Management. *International Journal of Productivity and Performance Management 53*(1), 18–32.

16.8 Attribution

This chapter of *Project Management* is a derivative copy of Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional

Designers. Retrieved from http://pm4id.org/. licensed under Creative Commons Attribution 3.0 Unported.

Chapter 17 Project Implementation Overview

Adrienne Watt

After you have carefully planned your project, you will be ready to start the project implementation phase, the third phase of the project management life cycle. The implementation phase involves putting the project plan into action. It's here that the project manager will coordinate and direct project resources to meet the objectives of the project plan. As the project unfolds, it's the project manager's job to direct and manage each activity, every step of the way. That's what happens in the implementation phase of the project life cycle: you follow the plan you've put together and handle any problems that come up.

The implementation phase is where you and your project team actually do the project work to produce the deliverables. The word "deliverable" means anything your project delivers. The deliverables for your project include all of the products or services that you and your team are performing for the client, customer, or sponsor, including all the project management documents that you put together.

The steps undertaken to build each deliverable will vary depending on the type of project you are undertaking, and cannot therefore be described here in any real detail. For instance engineering and telecommunications projects will focus on using equipment, resources, and materials to construct each project deliverable, whereas computer software projects may require the development and implementation of software code routines to produce each project deliverable. The activities required to build each deliverable will be clearly specified within the project requirements document and project plan.

Your job as project manager is to direct the work, but you need to do more than deliver the results. You also need to keep track of how well your team performs. The implementation phase keeps the project plan on track with careful monitoring and control processes to ensure the final deliverable meets the acceptance criteria set by the customer. This phase is typically where approved changes are implemented.

Most often, changes are identified by looking at performance and quality control data. Routine performance and quality control measurements should be evaluated on a regular basis throughout the implementation phase. Gathering reports on those measurements will help you determine where the problem is and recommend changes to fix it.

17.1 Change Control

When you find a problem, you can't just make a change, because it may be too expensive or take too long to do. You will need to look at how it affects the triple constraint (time, cost, scope) and how it impacts project quality. You will then have to figure out if it is worth making the change. If you evaluate the impact of the change and find that it won't have an impact on the project triple constraint, then you can make the change without going through change control. Change control is a set of procedures that lets you make changes in an organized way.

Any time you need to make a change to your plan, you must start with a change request. This is a document that either you or the person making the request must complete. Any change to your project must be documented so you can figure out what needs to be done, by when, and by whom.

Once the change request is documented, it is submitted to a change control board. A change control board is a group of people who consider changes for approval. Not every change control system has a board but most do. The change request could also be submitted to the project sponsor or management for review and approval. Putting the recommended changes through change control will help you evaluate the impact and update all the necessary documents. Not all changes are approved, but if the changes are approved, you send them back to the team to put them in place.

The implementation phase uses the most project time and resources, and as a result, costs are usually the highest during this phase. Project managers also experience the greatest conflicts over schedules in this phase. You may find as you are monitoring your project that the actual time it is taking to do the scheduled work is longer than the amount of time planned.

When you absolutely have to meet the date and you are running behind, you can sometimes find ways to do activities more quickly by adding more resources to critical path tasks. That's called *crashing*. Crashing the schedule means adding resources or moving them around to bring the project back into line with the schedule. Crashing **always** costs more and doesn't always work. There's no way to crash a schedule without raising the overall cost of the project. So, if the budget is fixed and you don't have any extra money to spend, you can't use this technique.

Sometimes you've got two activities planned to occur in sequence, but you can actually do them at the same time. This is called *fast tracking* the project. On a software project, you might do both your user acceptance testing (UAT) and your functional testing at the same time, for example. This is pretty risky. There's a good chance you might need to redo some of the work you have done concurrently. Crashing and fast tracking are schedule compression tools. Managing a schedule change means keeping all of your schedule documents up to date. That way, you will always be comparing your results to the correct plan.

After the deliverables have been physically constructed and accepted by the customer, a phase review is carried out to determine whether the project is complete and ready for closure.

17.2 Attribution

Chapter 18 Project Completion

Adrienne Watt

Every project needs to end and that's what project completion is all about in the last phase of the project life cycle. The whole point of the project is to deliver what you promised. By delivering everything you said you would, you make sure that all stakeholders are satisfied and all acceptance criteria have been met. Once that happens, your project can end.

Project completion is often the most neglected phase of the project life cycle. Once the project is over, it's easy to pack things up, throw some files in a drawer, and start moving right into the initiation phase of the next project. Hold on. You're not done yet.

The key activities in project completion are gathering project records; disseminating information to formalize acceptance of the product, service, or project; and performing project closure. As the project manager, you will need to review project documents to make certain they are up-to-date. For example, perhaps some scope change requests were implemented that changed some of the characteristics of the final product. The project information you are collecting during this phase should reflect the characteristics and specifications of the final product. Don't forget to update your resource assignments as well. Some team members will have come and gone over the course of the project. You need to double-check that all the resources and their roles and responsibilities are noted.

Once the project outcomes are documented, you'll request formal acceptance from the stakeholders or customer. They're interested in knowing if the product or service of the project meets the objectives the project set out to accomplish. If your documentation is up-to-date, you'll have the project results at hand to share with them.

18.1 Contract Closure

Contracts come to a close just as projects come to a close. Contract closure is concerned with completing and settling the terms of the contracts let for the project. It supports the project completion process because the contract closure process determines if the work described in the contracts was completed accurately and satisfactorily. Keep in mind that not all projects are performed under contract so not all projects require the contract closure process. Obviously, this process applies only to those phases, deliverables, or portions of the project that were performed under contract.

Contract closure updates the project records, detailing the final results of the work on the project. Contracts may have specific terms or conditions for completion. You should be aware of these terms or conditions so that project completion isn't held up because you missed an important detail. If you are administering the contract yourself, be sure to ask your procurement department if there are any special conditions that you should be aware of so that your project team doesn't inadvertently delay contract project closure.

One of the purposes of the contract closure process is to provide formal notice to the seller, usually in written form, that the deliverables are acceptable and satisfactory or have been rejected. If the product or service does not meet the expectations, the vendor will need to correct the problems before you issue a formal acceptance notice. Before the contract is closed, any minor items that need to be repaired or completed are placed on a *punch list*, which is a list of all the items found by the client or team or manager that still remain to be done. Hopefully, quality audits have been performed during the course of the project, and the vendor was given the opportunity to make corrections earlier in the process than the closing phase. It's not a good idea to wait until the very end of the project and then spring all the problems and issues on the vendor at once. It's much more efficient to discuss problems with your vendor as the project progresses because it provides the opportunity for correction when the problems occur.

The project team will then work on all of the items on the punch list, building a small schedule to complete the remaining work. If the number of items on the punch list is too large or the amount of work is significant, the project team continues to work on the project. Once the punch list becomes smaller, the project manager begins closing down the project, maintaining only enough staff and equipment to support the team that is working on the punch list.

If the product or service does meet the project's expectations and is acceptable, formal written notice to the seller is required, indicating that the contract is complete. This is the formal acceptance and closure of the contract. It's your responsibility as the project manager to document the formal acceptance of the contract. Many times the provisions for formalizing acceptance and closing the contract are spelled out in the contract itself.

If you have a procurement department handling the contract administration, they will expect you to inform them when the contract is complete and will in turn follow the formal procedures to let the seller know the contract is complete. However, you will still note the contract completion in your copy of the project records.

18.2 Releasing the Project Team

Releasing project team members is not an official process. However, it should be noted that at the conclusion of the project, you will release your project team members, and they will go back to their functional managers or get assigned to a new project. You will want to keep their managers, or other project managers, informed as

you get closer to project completion, so that they have time to adequately plan for the return of their employees. Let them know a few months ahead of time what the schedule looks like and how soon they can plan on using their employees on new projects. This gives the other managers the ability to start planning activities and scheduling activity dates.

18.3 Final Payments

The final payment is usually more than a simple percentage of the work that remains to be completed. Completing the project might involve fixing the most difficult problems that are disproportionately expensive to solve, so the final payment should be large enough to motivate the vendor to give the project a high priority so that the project can be completed on time.

If the supplier has met all the contractual obligations, including fixing problems and making repairs as noted on a punch list, the project team signs off on the contract and submits it to the accounting department for final payment. The supplier is notified that the last payment is final and completes the contractual agreement with the project.

18.4 Post-Project Evaluations

Before the team is dissolved and begins to focus on the next project, a review is conducted to capture the lessons that can be learned from this project, often called a **lessons-learned meeting** or document. The team explores what went well and captures the processes to understand why they went well. The team asks if the process is transferable to other projects. The team also explores what did not go well and what people learned from the experience. The process is not to find blame, but to learn.

Quality management is a process of continual improvement that includes learning from past projects and making changes to improve the next project. This process is documented as evidence that quality management practices are in use. Some organizations have formal processes for changing work processes and integrating the lessons learned from the project so other projects can benefit. Some organizations are less formal in the approach and expect individuals to learn from the experience and take the experience to their next project and share what they learned with others in an informal way. Whatever type of approach is used, the following elements should be evaluated and the results summarized in reports for external and internal use.

18.5 Trust and Alignment Effectiveness

The project leadership reviews the effect of trust—or lack of trust—on the project and the effectiveness of alignment meetings at building trust. The team determines which problems might have been foreseen and mitigated and which ones could not have been reasonably predicted. What were the cues that were missed by the team that indicated a problem was emerging? What could the team have done to better predict and prevent trust issues?

18.6 Schedule and Budget Management

The original schedule of activities and the network diagram are compared to the actual schedule of events. Events that caused changes to the schedule are reviewed to see how the use of contingency reserves and float mitigated the disruption caused by those events. The original estimates of contingency time are reviewed to determine if they were adequate and if the estimates of duration and float were accurate. These activities are necessary for the project team to develop expertise in estimating schedule elements in future projects—they are not used to place blame.

A review of budget estimates for the cost of work scheduled is compared to the actual costs. If the estimates are frequently different from the actual costs, the choice of estimating method is reviewed.

18.7 Risk Mitigation

After the project is finished, the estimates of risk can be reviewed and compared to the events that actually took place. Did events occur that were unforeseen? What cues existed that may have allowed the team to predict these events? Was the project contingency sufficient to cover unforeseen risks? Even if nothing went wrong on this project, it is not proof that risk mitigation was a waste of money, but it is useful to compare the cost of avoiding risk versus the cost of unexpected events to understand how much it cost to avoid risk.

18.8 Procurement Contracts

The performance of suppliers and vendors is reviewed to determine if they should still be included in the list of qualified suppliers or vendors. The choice of contract for each

is reviewed to determine if the decision to share risk was justified and if the choice of incentives worked.

18.9 Customer Satisfaction

Relationships with the client are reviewed and decisions about including the client in project decisions and alignment meetings are discussed. The client is given the opportunity to express satisfaction and identify areas in which project communication and other factors could be improved. Often a senior manager from the organization interviews the client to develop feedback on the project team performance.

A general report that provides an overview of the project is created to provide stakeholders with a summary of the project. The report includes the original goals and objectives and statements that show how the project met those goals and objectives. Performance on the schedule and budget are summarized and an assessment of client satisfaction is provided. A version of this report can be provided to the client as a stakeholder and as another means for deriving feedback.

18.10 Senior Management

The report to senior management contains all the information provided to the stakeholders in a short executive summary. The report identifies practices and processes that could be improved or lessons that were learned that could be useful on future projects.

18.11 Archiving of Document

The documents associated with the project must be stored in a safe location where they can be retrieved for future reference. Signed contracts or other documents that might be used in tax reviews or lawsuits must be stored. Organizations will have legal document storage and retrieval policies that apply to project documents and must be followed. Some project documents can be stored electronically.

Care should be taken to store documents in a form that can be recovered easily. If the documents are stored electronically, standard naming conventions should be used so documents can be sorted and grouped by name. If documents are stored in paper form, the expiration date of the documents should be determined so they can be destroyed at some point in the future. The following are documents that are typically archived:

- Charter documents

- Scope statement
- Original budget
- Change documents
- DPCI ratings
- Manager's summary—lessons learned
- Final DPCI rating

18.12 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported and Project Management for Instructional Designers by Amado, M., Ashton, K., Ashton, S., Bostwick, J., Clements, G., Drysdale, J., Francis, J., Harrison, B., Nan, V., Nisse, A., Randall, D., Rino, J., Robinson, J., Snyder, A., Wiley, D., & Anonymous. (DATE). Project Management for Instructional Designers. Retrieved from http://pm4id.org/. Licensed under a Creative Commons Attribution NonCommercial Share-Alike (BY-NC-SA) license.

Chapter 19 Celebrate!

Adrienne Watt

The project team should celebrate their accomplishments, and the project manager should officially recognize their efforts, thank them for their participation, and officially close the project. A celebration helps team members formally recognize the project's end and brings closure to the work they've done. It also encourages them to remember what they've learned and start thinking about how their experiences will benefit them and the organization during the next project.

Figure 19.1 Celebrate! Your project is over... at least until the next one.

(Photo from Barron & Barron Project Management for Scientists and Engineers, http://cnx.org/content/col11120/1.4/) .

19.1 Attribution

This chapter of *Project Management* is a derivative copy of Project Management by Merrie Barron and Andrew Barron licensed under Creative Commons Attribution 3.0 Unported.

Appendix 1: Project Management PowerPoints

Chapter 4 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-1.pptx)

Chapter 5 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-2.pptx)

Chapter 6 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-3.pptx)

Chapter 7 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-4.pptx)

Chapter 8 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-5.pptx)

Chapter 9 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-6.pptx)

Chapter 10 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-7.pptx)

Chapter 11 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-8.pptx)

Chapter 12 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-9.pptx)

Chapter 13 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-10.pptx)

Chpater 14 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-11.pptx)

Chapter 15 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-12.pptx)

Chapter 16 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-13.pptx)

Chapter 17 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-14.pptx)

Chapter 18 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-15.pptx)

Chapter 19 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-16.pptx)

Chapter 20 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/06/Chapter-17.pptx)

Chapter 21 (http://opentextbc.ca/projectmanagement/wp-content/uploads/sites/3/2014/07/Chapter-18.pptx)

Appendix 2: Chapter Questions

Chapter 5: Project Management Overview

1. Everyone has been involved in projects. What is the largest project you have been involved in? (You do not have to have been the project manager, but could have played another role.)
    1. Write one sentence that describes the objective of the project.
    2. Describe specifically how this project meets the definition of a project used in this textbook. (How is it unique? What were the time constraints? If it is over, how did you know it was over? If it is ongoing, how will you know when it is over?
    3. What was your role? Were you the project manager, a volunteer, some other role? If you were not the project manager, who was?
    4. Was the project part of a larger portfolio or program of projects?
    5. Who else was involved?
    6. What was the budget?
    7. Did you anticipate any risks at the outset? Did the project experience any outside forces that caused a change in either the objectives or the approach to achieving those objectives?
2. In what ways can the following activities be seen as projects? In what ways do they resemble ongoing, routine business activities? Feel free to add assumptions and details to describe how the activity might be a project in one context and routine in another.
    1. Reading the chapter before attending a university lecture.
    2. Taking the bus to work each day.
    3. Piloting an aircraft between Vancouver and Fiji.
    4. Teaching a course for the first time; teaching the same course every semester.

Chapter 6: The Project Life Cycle (Phases)

1. Go online and search for project life cycle models. Identify at least two that are different from the PMI model, and compare and contrast the phases. Be sure to cite your sources.
2. How does the application of a phased approach to project management vary in different industries? Do you think that the phases work the same in construction as they do in event management ors oftware development? (which has already been broken down into pre-event publicity and post-event publicity.) Prepare a WBS for any single major deliverable on the list. Remember the 100 percent rule, and number your objectives.

Chapter 8: Stakeholder Management

1. Identify a major public infrastructure project that is either underway, complete, or proposed in your region. This could be a bridge, road, building, or something of that nature. For the project youhave identified, think of as many stakeholders and stakeholder groups as you can. Create a three column table. In column 1, list the stakeholders. In column 2, list what each stakeholder wants to get from the project. In column 3, list the influence each stakeholder has over the project.
2. How can the stakeholders change over the course of a project? Give examples of changes in who the stakeholders are, and also in how their interests or influence over the project might change throughout the term of the project.

Chapter 10: Project Initiation

1. Software project decision point.
    1. You need to determine an interest rate to use—select an interest rate and explain why you think this number should be used. Use it in your calculations in item 1.2.
    2. Given the information below on options 1 and 2, carry out three forms of analysis: breakeven, ROI, and NPV.
    3. Make a recommendation on which way to proceed, based on the TCO for each option.

- Option 1: Purchase the FunSoft package: Cost $200,000 for software and $85,000 for hardware in year one; with $50,000 to customize it and a $40,000 annual licensing fee for the life of the contract.
- There will be an annual saving of $61,000 due to the layoff of a clerk.
- Option 2: Purchase the SoftComm package, which will operate on the vendor's hardware: Cost $250,000 for a five-year license, payable half up front and half during the first year of implementation. The maintenance contract, at $75,000 a year, includes all currently identified modifications to the software for the first three years. The clerk's hours will be cut by half, for a saving of $25,000 a year.

In both cases, sales are expected to increase from the current $1 million a year, by 10% per year each year (over each year's previous year's sales) after full implementation.

Assume a five-year life for the software.

Chapter 12: Scope Planning

1. A project to put on a major international sporting competition has the following major deliverables: Sports Venues, Athlete Accommodation, Volunteer Organization, Security, Events, and Publicity (which has already been broken down into pre-event publicity and post-event publicity.) Prepare a WBS for any single major deliverable on the list. Remember the 100 percent rule, and number your objectives.

Chapter 13: Project Schedule Planning

Your team has been asked to test and document enhancements to a web application that allows buyers to purchase custom-printed canvas shoes. The tasks and dependencies are as follows:

- Create a testing plan

Once the testing plan is ready, your team can:

- Test the user interfaces
- Test the database
- Test the network
- Write the documentation first draft

When the user interface tests are complete, you can:

- Perform user testing—enlist some users to test the user interface

When the database and network testing are complete, you can:

- Perform integration testing—network with the database

When the user testing of the user interface and the database testing are complete, you can:

- Perform integration testing—database, network, and user interface

When all integration testing and user testing are complete, you can:

- Perform system testing

Then you can:

- Review and revise documentation

After all other tasks are complete, you can:

- Obtain management approval

Duration estimates for the tasks:

a.	3 days
b.	10 days
c.	6 days
d.	7 days
e.	20 days
f.	5 days
g.	3 days
h.	2 days
i.	8 days
j.	4 days
k.	5 days

1. Create a network diagram and a Gantt chart for the project tasks. Ask your instructor if you are permitted to use software such as Microsoft Project to help you prepare your diagrams.
    1. What is the planned duration for the testing project?
    2. What is the critical path for the testing project?
    3. For each task NOT on the critical path, calculate the amount of slack available.
    4. If the user testing of the user interface takes 15 days, what will the impact be on the project duration?
2. Go online and find at least two sites with definitions of fast tracking and crashing a project schedule.
    1. Prepare proper reference citations for the sites you located, using APA style.
    2. In your own words, write definitions for project fast tracking and project crashing.
    3. Consider the plan you prepared for the software system testing project in question 1 above. If you were informed by management that you must reduce the planned duration of the project by five days, describe how you, as

a project manager, could crash or fast track this project. Be specific in identifying exactly what could be changed in the project plan for each option.
4. (continuation of question 2.3) If the request to speed up the project occurs after day 25 of the original schedule, what is the only option available?

3. Go online and research the difference between total slack and free slack.
    1. Prepare proper reference citations for the sites you located, using APA style.
    2. Write definitions of total slack and free slack in your own words.
    3. Why would the distinction between different forms of slack be important to a project manager?

Chapter 15: Budget Planning

1. Wedding cost estimation: Given the following information, calculate the estimated costs for a wedding with 250 guests and a bridal party of six, using the methods indicated. Show your work. Note that members of the bridal party are already counted as guests, you don't need to add them twice.
    1. Parametric estimate
    2. Bottom-up estimate
    3. Analogous cost estimate
    4. You will probably notice some differences in the estimated values. Are these differences significant? What might cause the differences? If you were estimating a significant project in the future, which method(s) would you use and why?
    5. Your mother points out you should probably have valet parking, which will cost $500. Which estimate(s) will change?

Wedding Cost Estimates	
Item	Dollars
Groom's brother's wedding, last year, 175 guests, similar venue and style	$20,300
Catering	$65 per person
Photographer	$1,500
Rental of hall	$500
Clothing, bride	$2,000
Clothing, groom	$750
Flowers	$800
Other decor items	$500
Cake	$500
Gifts for bridal party	$80 each
Wedding planner	$2,000
Wedding planner's estimate of typical cost of this kind of wedding	$10,000 plus $75 per guest

2. Earned-value analysis. A project budget calls for the following expenditures:

Task	Date	Budgeted Amount
Build forms	April 1	$10,000
Pour foundation	April 1	$50,000
	May 1	$100,000
Frame walls	May 1	$30,000
	June 1	$30,000
Remaining tasks	July 1 and beyond	$500,000

Define each term in your own words, calculate these values for the above project, and show your work:

Chapter 16: Procurement Management

1. In addition to cost, what factors should be considered in selecting a building contractor? What can go wrong if the lowest bid is selected and nothing else is considered? (Answer in your own words, maximum 70 words.)

2. What is the difference between an RFP and an RFQ? Give two specific examples where an RFQ could be used and two specific examples where it is more likely that the organization will go with an RFP. (Use examples NOT from your textbook.)
3. Cost reimbursable contract calculation.
    1. A contract calls for a total payment of $800,000 with a guarantee. Essentially the contractor is guaranteed to **make** at least $200,000 above his costs. If the contractor can demonstrate his costs exceed $600,000, the project will pay the difference, with a $50,000 ceiling on the overage. The contractor demonstrates he spent $623,000. How much (gross) must the project remit to the contractor?
    2. Another option for the same contract has the contractor guaranteed to be paid his costs plus 20%, for costs that exceed $600,000. With the same initial assumption—guarantee of $800,000 gross payment (no requirement to itemize costs), but if the contractor can show that costs exceed $600,000, the project will pay $800,000 plus the costs that exceed $600,000, plus 20% of those excess costs, with a ceiling of $900,000 gross. The contractor demonstrates he spent $623,000. How much (gross) must the project remit to the contractor?
    3. Under option 3.2, at what dollar amount of total costs would the **contractor** be assuming all of the excess costs beyond that point?
    4. In which option did the project assume **more** of the risk of a cost overrun? Explain.

Chapter 17: Quality Planning

1. Prepare a Pareto chart of the possible causes for a student to fail a final examination in a university course.
2. Vehicles are identified by RFID tags in order to collect bridge tolls. The project manager is considering two different technologies for RFID readers. By sampling two different options, the following data are collected about the accuracy of the readers:

Option 1: 99, 98, 99, 94, 92, 99, 98, 99, 94, 90 Option 2: 98, 97, 97, 97, 98, 98, 97, 97, 98

Calculate the mean, mode, and standard deviation of the two options.

Chapter 19: Risk Management Planning

1. Describe the general processes that should be followed in managing risks throughout a project. Be sure to include the general sequence in which these processes are carried out.

2. Prepare a sample risk register for a project to put humans on Mars (four or five risks).
3. Prepare a probability versus impact matrix for your school's Winter Club ski trip (at least four identifiable risks).
4. For one of the risks you have identified in question 2 or 3, describe how it could be avoided, transferred, mitigated, or accepted.
5. What is the difference between qualitative and quantitative risk analysis? Which one is always done? Why is the other one *not* always done for every project?

Appendix 3: Chapter Audio Files

Chapter (https://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_jd385v6o/delivery/http) 4 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_jd385v6o/delivery/http)

Chapter 5 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_raidib55/delivery/http)

Chapter 6 (https://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_cq6yxpi8/delivery/http)

Chapter 7 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_an2k7a0a/delivery/http)

Chapter 8 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_q628azrk/delivery/http)

Chapter 9 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_vlpggqhr/delivery/http)

Chapter 10 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_oapqp1ni/delivery/http)

Chapter 11 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_gcsy009p/delivery/http)

Chapter 12 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_yhv1g4yz/delivery/http)

Chapter 13 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_tij3wt51/delivery/http)

Chapter 14 (Part1) (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_wdo2k9h7/delivery/http)

Chapter 14 (Part2) (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_h7qxm64v/delivery/http)

Chapter 15 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_6r7j7bxb/delivery/http)

Chapter 16 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_rtdfkbna/delivery/http)

Chapter 17 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_4egc0mdr/delivery/http)

Chapter 18 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_kv0bemzq/delivery/http)

Chapter 19 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_k53yrr86/delivery/http)

Chapter 20 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_6mg3flze/delivery/http)

Chapter 21 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_5ng7hngp/delivery/http)

Chapter 22 (http://admin.video.ubc.ca/index.php/kmc/preview/partner_id/122/uiconf_id/11170395/entry_id/0_j9hr9xhx/delivery/http)

About the Author

Adrienne Watt holds a Computer Systems Diploma (BCIT), a Bachelors in Technology (BCIT) and a Master's in Business Administration (City University).

Since 1989, Adrienne has worked as an educator and gained extensive experience developing and delivering business and technology curriculum to post-secondary students. During that time she ran a successful software development business. In the business she worked as an IT Professional in a variety of senior positions including Project Manager, Database Designer, Administrator and Business Analyst. Recently she has been exploring a wide range of technology related tools and processes to improve delivery methods and enhance learning for her students.