Essentials of Project Management

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Contents

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Collaborators

This project was a collaboration between the author and the team in the OER Design Studio at Fanshawe. The following staff and students were involved in the creation of this project:

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- Cher Powers, Research Coordinator and Professor, Loyalist College

About This Book

This textbook is an adaptation of other open educational resources (OER), but specifically designed for students at an introductory level of project management (PM). The purpose of this textbook is to provide a free resource that is dedicated to college's students and as a gateway to understanding PM principals. It consists of; the text body which is structured into fourteen chapters to be delivered over a fourteen-week semester, where each chapter discusses the concept of one topic related to PM. The chapters themselves cover the definition of PM and its types, as well as differentiating PM from common activities. It then describes PM from an organizational perspective including the effect of culture and structure on PM. The five steps of the PM processes are then discussed individually in different chapters, in the addition to sub-processes such as budgeting, scheduling, procurement and communication. Both project manager and project team are introduced separately so that their characteristics and relationship are appreciated. Thereafter, in the last chapter, Agile PM is presented as a contrast to conventional PM.

At the end of each chapter, a business case is presented to demonstrate the concept in real-life scenarios allowing the instructor to present the topic concept in a real business world context, and hence the relation between the concept and application is clear. The business case is also included to provide an opportunity for group discussions and develop peer-to-peer interactions and collaboration. Following the business case, a set of interactive exercises, designed with H5P, are included for a quick assessment of the understanding of the topic. In support of this textbook, a set of slides for each chapter is prepared for online/in-class teaching. Therefore, for the best utilization of the book, the instructor should employ all elements of this OER in order to reach the course learning outcomes.

For the Student

Each chapter in this text begins with a list of the relevant learning objectives and ends with a case study. Each chapter also includes interactive knowledge check questions.

For the Instructor

Please share your adoption, and any feedback you have about the book with us at oer@fanshawec.ca

The following resources are available:

- **Interactive exercises** for students to check their knowledge are provided at the end of each chapter.
- **Slide decks** can be found under ancillary resources in the appendix.
- **Video resources** have been embedded in the text where applicable.

CHAPTER 1 - INTRODUCTION TO PROJECT MANAGEMENT

Chapter Overview

1.1. Chapter Introduction

Learning Objectives

By the end of this chapter, you should be able to:

1. Define the characteristics of a project.
2. Compare the difference between traditional and Agile project management.
3. Describe how program management differs from project management.
4. List the functions of a Project Management Office and Project Portfolio Management.
5. Explain the difference between a Project Lifecycle and the PMI Project Processes.
6. Explain the three broad categories of projects.

There is no greater example of the art and science of project management (PM) than those demonstrated in the building of the Pyramids of Egypt. Since then, builders and engineers have applied specific processes systematically which have evolved into PM. Today, in every field of work, PM is an essential practice to achieve project success. The objective, in general, is to establish and deliver the customer objectives in an organized and detailed manner. Whether the business is in production, construction, or service delivery, the need for planning and carrying out a project requires clearly defined processes.

While the general management function may include many tasks, PM is specifically oriented toward processes and requires a specific set of tools and skills. When PM is performed correctly, organizations gain greatly. PM can reduce risk and improve the likelihood of success. It approaches tasks in an organized, detailed, and accountable way. Even when organizations have limited resources and a small chance of success, PM experts can help in leading through recessions and economic uncertainty, and ensure future strategic goals are met. Therefore, performing PM requires dedicated individuals with good discipline who understand the processes, and are able to follow through to completion. Good project managers keep the project on track and ensure the alignment of project objectives within the strategic objectives of the organization.

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.

1.2. Project Management (PM) Definition

Project

A **project** has distinctive attributes that distinguish it from ongoing work or business operations. Specifically, projects are temporary in nature. Therefore, they are not an everyday business process but they are unique 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 has not existed before. In this sense, a project is unique. Unique means that this is new; it has never been done before. Maybe it's been done in a very similar fashion before but never exactly in this way. For example, although the Ford Motor Company is in the business of designing and assembling many kinds of vehicles, each model that Ford designs and produces can be considered a unique 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).

Program

When a group of projects is arranged towards achieving a certain goal this is said to be a **program**. It is a collection of small projects to deliver or achieve certain higher goals. The simplest example of a program is the degree program in a school or college, where multiple courses correspond to the projects. In this, a program will be completed when all projects are completed and the certificate/degree is awarded.

Operation

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 objectives. 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.

Definition of a Project

There are many written definitions of a project. All of them contain the key elements described above. However, for those looking for a formal definition of a project, the Project Management Institute (PMI) defines a project as a temporary endeavour 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 when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists.

The term "project" is used in several ways in popular culture, from describing everyday tasks (planting a garden, hanging a picture, running errands) to large-scale enterprises (building a house, constructing a new highway). However, when professional project managers talk about projects, they use a narrower definition. Let's start out with the six defining characteristics of a project. Just about every book, organization, or standards body in the project management field agrees that a project:

- is a temporary endeavour, with a defined start and end.
- has a specific objective.
- has customers or stakeholders.
- has constraints, such as time, cost, and scope.
- has measures for success.
- includes some amount of uncertainty.

Watch the video: What is a Project for more information on how these six aspects help define what a project is and is not.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=85#oembed-1

Watch this Video: What is a Project? by Prof C [3:23] (Transcript Available).

Operations vs. Projects

Projects are different from ongoing operations, even though some techniques (such as network diagramming) overlap. Project management addresses temporary endeavours, with a start and end date, while operations management focuses on improving ongoing operations. For example, constructing a new factory is a project, while producing bicycle tires in that factory is an operation. This textbook concentrates on traditional project management techniques. Adaptations related to Agile project management, which is often used for software development, are mentioned along the way, but Agile is not a main topic in this chapter. It is discussed in chapter 14.

"2. Project Management Overview" from Project Management – 2nd Edition by Adrienne Watt; Merrie Barron;

1.3. Types of Projects

There are three broad categories of projects to consider: Strategic Projects, Operational Projects, and Compliance Projects (Figure 1.1).

- **Strategic** Projects involve creating something new and innovative. A new product, a new service, a new retail location, a new branch or division, or even a new factory might be a strategic project because it will allow an organization to gain a strategic advantage over its competitors.
- **Operational** Projects improve current operations. These projects may not produce radical improvements, but they will reduce costs, get work done more efficiently, or produce a higher-quality product.
- **Compliance** Projects must be done in order to comply with an industry or governmental regulation or standard. Often there is no choice about whether to implement a project to meet a regulation, but there may be several project options to consider, any of which would result in meeting compliance requirements.

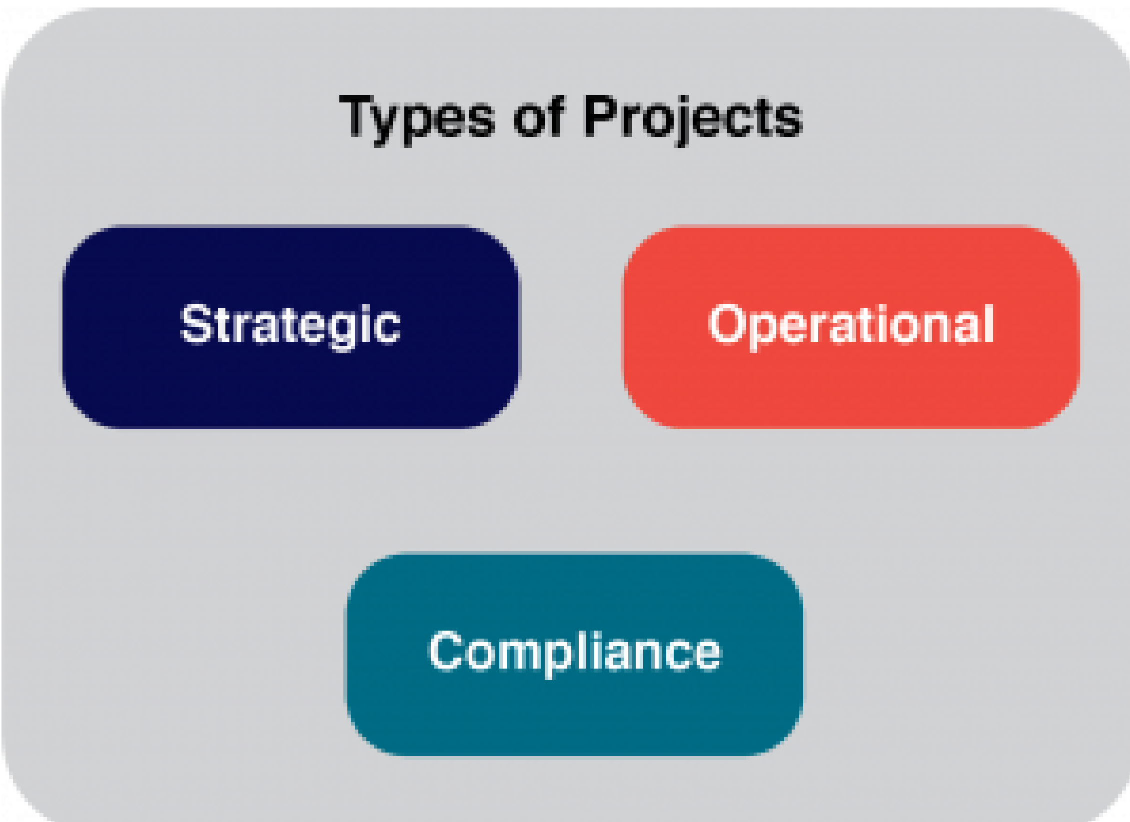

Figure 1.1: Three broad categories of projects

Traditional Project Management

While project management can be traced back to the building of the Great Pyramids in Egypt, it was really in the post-WW2 industrial boom of the 1950s that project managers started to develop the tools and techniques used in modern project management. These tools were used to complete large industrial and military projects, where the scope of work (what we need to accomplish in a project) was well defined. For example, the scope of what we have to do can be planned out well when we are constructing an apartment building, making a nuclear submarine missile, or building an oil refinery.

These traditional techniques have been elaborated and standardized by organizations such as the Project Management Institute (PMI) in the US, The International Project Management Association (headquartered in Switzerland), and AXELOS (the organization behind the PRINCE2 certification used in Great Britain). These traditional techniques were also adapted to software development. Techniques such as **waterfall** (where phases are sequential) and **function point analysis** (a set of rules to measure functionality to users) were advanced as effective ways to manage software development projects. However, as the world of software development changed—from large, time-consuming projects that were loaded on mainframe computers to fast-moving, fast-changing, internet-based applications many programmers found waterfall and similar methods to be limiting. These techniques lacked flexibility and were inadequate to deal with a rapidly changing, competitive landscape. As a result, a “revolution” of sorts was mounted, and out of that revolution came several so-called Agile project management methods.

Agile Project Management

Agile is a broad term for project management techniques that are **iterative** in nature. Rather than trying to develop all aspects of a project or software application and then presenting that result to the customer after a long development cycle (6 to 24 months), Agile techniques use short development cycles in which features of high value are developed first and a working product/software can be reviewed and tested at the end of the cycle (20-40 days).

1.4. Aspects of Project Management

The Science of Project Management

Project management has been around for centuries if not millennia. From the building of the pyramids to the construction of the great buildings of 19th century London, people have developed ways to break down large projects into smaller more manageable chunks, schedule the work, and obtain the materials needed for the projects. During that time, many tools were developed to manage projects. However, it was not until the large, highly complex defense projects undertaken by the United States during the 1950s drove a push for a more scientific and data-driven, management approach to projects, which was the beginning of the science of modern-day project management.

Project Management Institute

The [Project Management Institute](#) (PMI) started in 1969 as an effort to share best practices, and today, it is a non-profit organization with over 500,000 members. PMI has chapters throughout the world, each offers additional benefits in the form of professional development and networking opportunities.

Project Management Body of Knowledge

PMI has codified the standards for project management in the [Project Management Body of Knowledge (PMBOK) guide](#). The PMBOK is best used as a reference guide; it is not recommended for cover-to-cover reading. The PMBOK Guide has been recognized as a Standard by the American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE).

The PMBOK guide is organized into nine knowledge domains:

1. Project Integration Management
2. Project Scope Management
3. Project Time Management
4. Project Cost Management
5. Project Quality Management
6. Project Human Resource Management
7. Project Communications Management
8. Project Risk Management
9. Project Procurement Management
10. Project Stakeholder Management

Project Constraints

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 mutually agreed-upon goals 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.

- **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 for and the purpose of the project.
- **Time/Schedule** 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.
- **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 underspending 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.
- **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.

Project Priority

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 1.2).

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. On the other hand, if they cut the budget, you will have to reduce the quality of your scope.

Project constraints should be defined by certain criteria such as acceptance, enhanced, and/or constrained. Each of these criteria represents a degree of priority to the project and hence assigning the resources. Such constraints are necessary to establish project priorities before the project begins. To explain this, consider a project to develop a vaccine during a pandemic time, the cost of such a project would not be of concern, since the vaccine is needed and therefore the cost is less priority and will be acceptable. Meanwhile, the project scope in achieving a vaccine with high efficacy is more priority than cost, and hence the priority of the scope is constrained. The priority of time in this case can be enhanced allowing for limited time extension necessary to fulfill the scope. Therefore, for such a project we would say the scope is constrained; the time is enhanced and the cost is accepted.

Further, 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.

In summary, the constraints are all dependent on each other. Think of all of these constraints as the classic carnival game of 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.

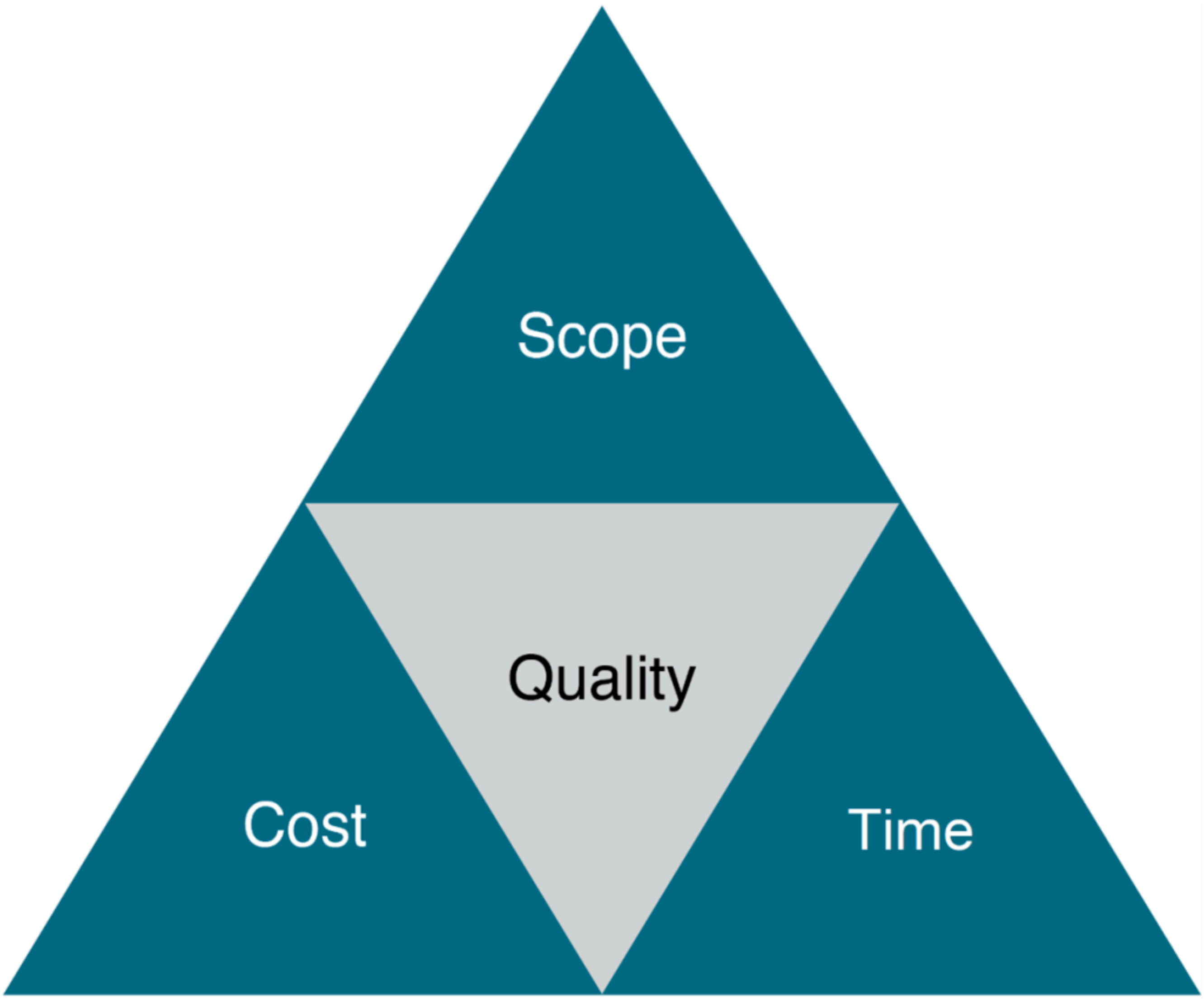

Figure 1.2: "The triad constraints" by John M. Kennedy T., CC BY-SA 3.0, adapted by Fanshawe College, CC BY-SA 3.0

In 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 side. 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.

Project Example

Here is an example of a project that cut quality because the project costs were fixed. The P-36 oil platform (Figure 1.3) 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 (Offshore Technology, 2021).

Figure 1.3: "P36 No 010" by Richard Collinson, CC-BY-ND 2.0.

"1.3: Project Management Standards and Certifications" from Project Management Fundamentals by J Scott

1.5. Life Cycle

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 beginning and middle periods, during which activities move the project towards completion and an ending that is 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's "**life cycle**."

A traditional project will go through different (overlapped) phases, while the monitoring process takes place continuously from the initiation phase to the closing phase. Monitoring her can be considered as a floating process required to ensure the alignment of the project processes with the project scope. During the life cycle, the execution phase will require the most effort from the project team and hence can be seen as the most productive phase (Figure 1.5).

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. Thereafter, 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 on to the detailed planning phase.

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 timeframes. The project manager coordinates the preparation of a project budget by providing cost estimates for the labour, 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.

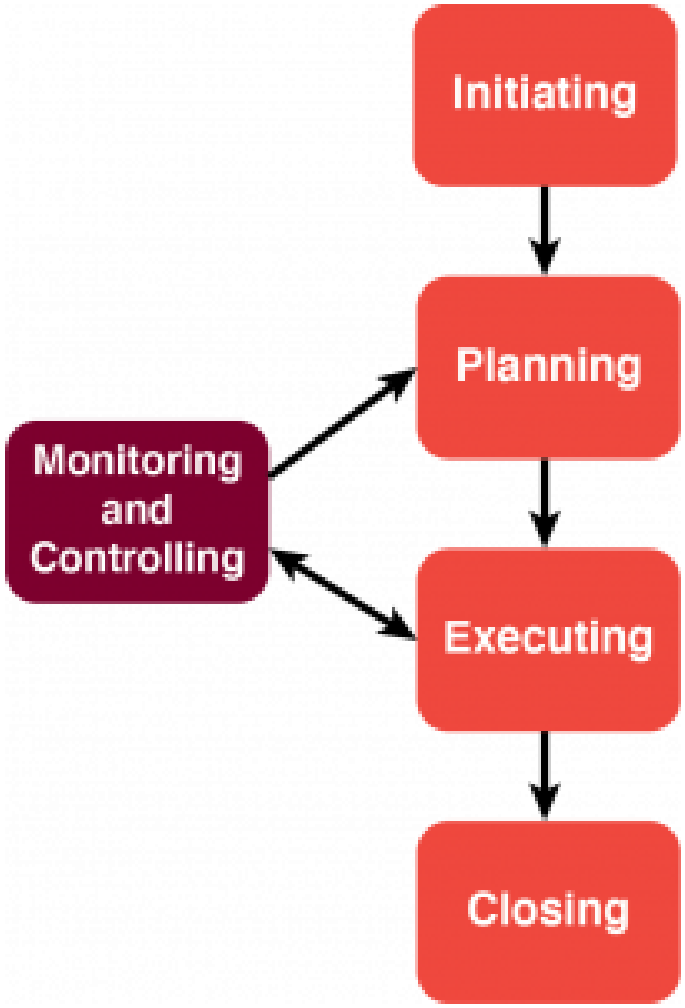

Figure 1.4: "Project management phases", [CC-BY-SA 3.0](#)

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 endpoint 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.

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.

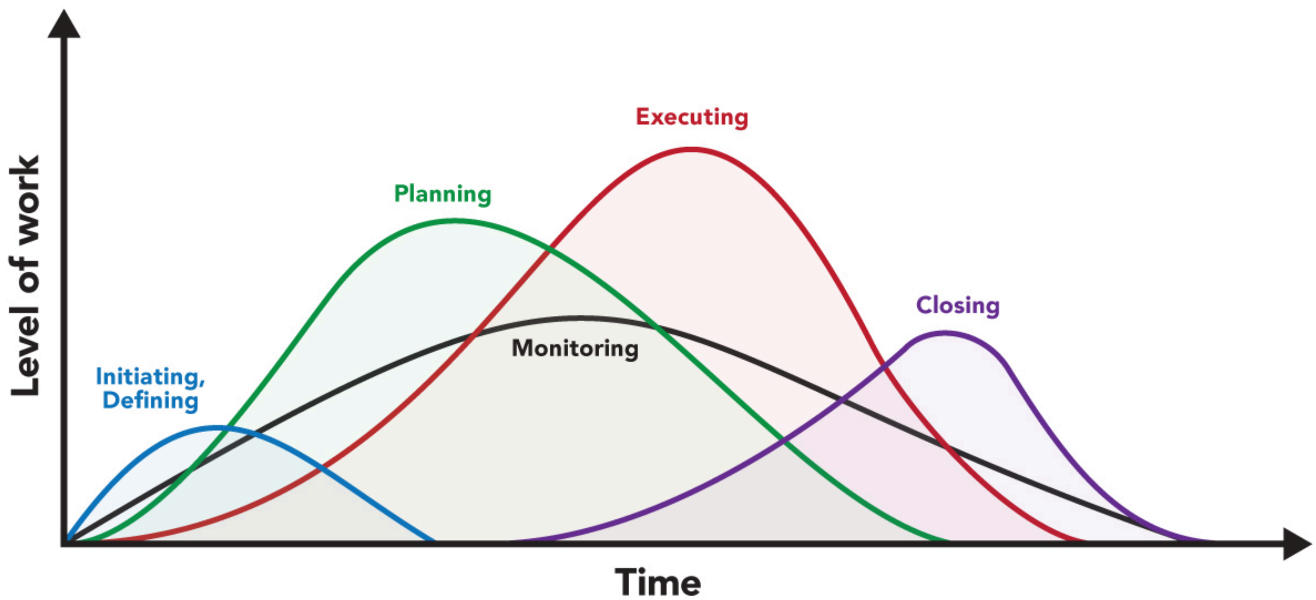

Figure 1.5: Illustration of work activity-time graph for a typical project life cycle.

1.6. Business Case

Copper Mining in Latin America

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 a 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 developing 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 labour projections; refine the construction schedule; and set up the construction site. Although planning is a never-ending process on a project, the planning phase focuses 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, labour 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 were 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 were written and distributed, and the project manager started on a new project.

Questions

1. Have the six defining characteristics of a project been met in this case? Explain your answer.
2. What type of project is the copper mining in this case? Explain your answer
3. How do you describe the priority of this project?

4. Identify the project life cycle phases in this case based on the activities.
5. How was the close-out phase started and completed

1.7. Key Terms

Key Terms

- **Agile**: is a broad term for project management techniques that are iterative.
- **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.
- **Compliance Projects:** This must be done to comply with industry or governmental regulations or standards.
- **Cost**: The budget approved for the project includes all necessary expenses needed to deliver the project.
- **Function Point Analysis:** a set of rules to measure the functionality to users
- **Implementation:** the project plan is put into motion and the project's work is performed.
- **Initiation:** the project objective or need is identified; this can be a business problem or opportunity.
- **Iterative**: repetitive
- **Life Cycle**: The project manager and project team have one shared goal: to carry out the work of the project to meet the project's objectives.
- **Operations:** Involve continuous work without an ending date and with the same processes repeated to produce the same results.
- **Operational Projects:** Improve current operations. These projects may not produce radical improvements, but they will reduce costs, get work done more efficiently, or produce a higher-quality product.
- **Planning**: 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.
- **Program**: When a group of projects is arranged towards achieving a specific goal. A cluster of interconnected projects.
- **Project(s):** Temporary initiatives that companies implement alongside their ongoing operations to achieve specific goals. They are clearly defined packages of work, bound by deadlines and endowed with resources, including budgets, people, and facilities.
- **Project constraints:** Needs from a project they are cost, scope, quality, risk, resources, and time.
- **Quality:** A combination of the standards and criteria to which the project's products must be delivered for them to perform effectively.
- **Quality Assurance (QA)**: is the process of evaluating overall project performance regularly to provide confidence that the project will satisfy the relevant quality standards.
- **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.

- **Scope:** This 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.
- **Scope Management:** a project plan is created outlining the deliverables, milestones, constraints, activities, tasks, lesson plans (if a training plan), dependencies, and timeframes.
- **Strategic projects**: Involve creating something new and innovative. A new product, a new service, a new retail location, a new branch or division, or even a new factory might be a strategic project because it will allow an organization to gain a strategic advantage over its competitors.
- **Time**: is defined as the time to complete the project. Time is often the most frequent project oversight in developing projects.
- **Triple constraint**: which traditionally consisted of only time, cost, and scope.
- **Waterfall:** where phases are sequential

1.8. Chapter Questions

Knowledge Check 1

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https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=878#h5p-9

Knowledge Check 2

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https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=878#h5p-12

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=878#h5p-13

CHAPTER 2 - ORGANIZATION

Chapter Overview

2.1. Chapter Introduction

Learning Objectives

By the end of this chapter, you will be able to:

1. Outline the different types of organizational structures
2. Explain the relative advantages and disadvantages of each structure as it relates to project management
3. Define terms related to strategy and portfolios
4. Discuss basic concepts related to strategy
5. Distinguish between strategy and operational effectiveness
6. Discuss issues related to aligning projects with strategy
7. Explain the three broad categories of projects
8. Identify project selection methods.

2.2. Structures

There are three broad structures by which an organization can be organized: functional, matrix, and projectized. These structures represent a continuum, from structures where the project manager has very little authority (functional) to those where project managers have very broad power (projectized) (See Figure 2.1).

There have been many studies about the impact that organizational structure has on project success, and it is not uncommon for corporations to change their organizational structure in order to increase their relative success in executing projects on time and within budget. This type of change takes great effort and may take a long period of time to fully implement. Instead of changing their entire structure, an organization may elect to create a dedicated project team in order to carry out a critical project without reorganizing the entire enterprise. This way, they can get many of the same benefits of the projectized organization without reorganizing the enterprise. This approach is not without risk, as we'll explore in the section on dedicated project teams.

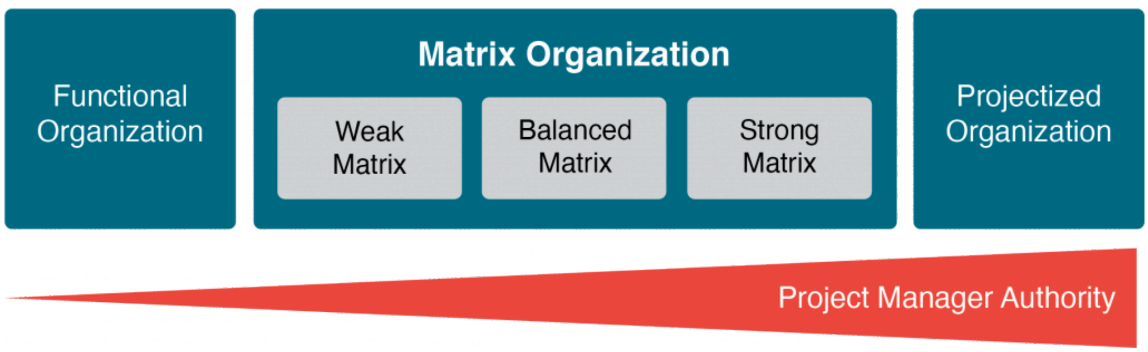

Figure 2.1: Project Manager Authority and Organization Type

Functional Organizations

Perhaps the least project-focused type of organization is **functional organization**. Large organizations are traditionally organized by function into various departments, with staff in each department reporting to a departmental manager or head of department. This allows for groupings of specialists within the organization where they can work together, share knowledge, and prioritize their work. Traditional functional departments might include:

- Human resources
- Accounting
- Procurement
- Marketing
- Sales
- Shipping

These functional units work independently of each other, and the **functional managers** serve as conduits for communications and collaboration (See Figure 2.2). This type of structure is very efficient for operations management where continuous process improvement can be conducted on all regular departmental operations. However, it is not optimal for the completion of projects.

Projects often require work across disciplines. In the functional organization, with staff isolated inside their departmental "silos," communication is directed through the functional managers. These managers often have differing priorities, which can make communications slow and error-prone in a functional organization.

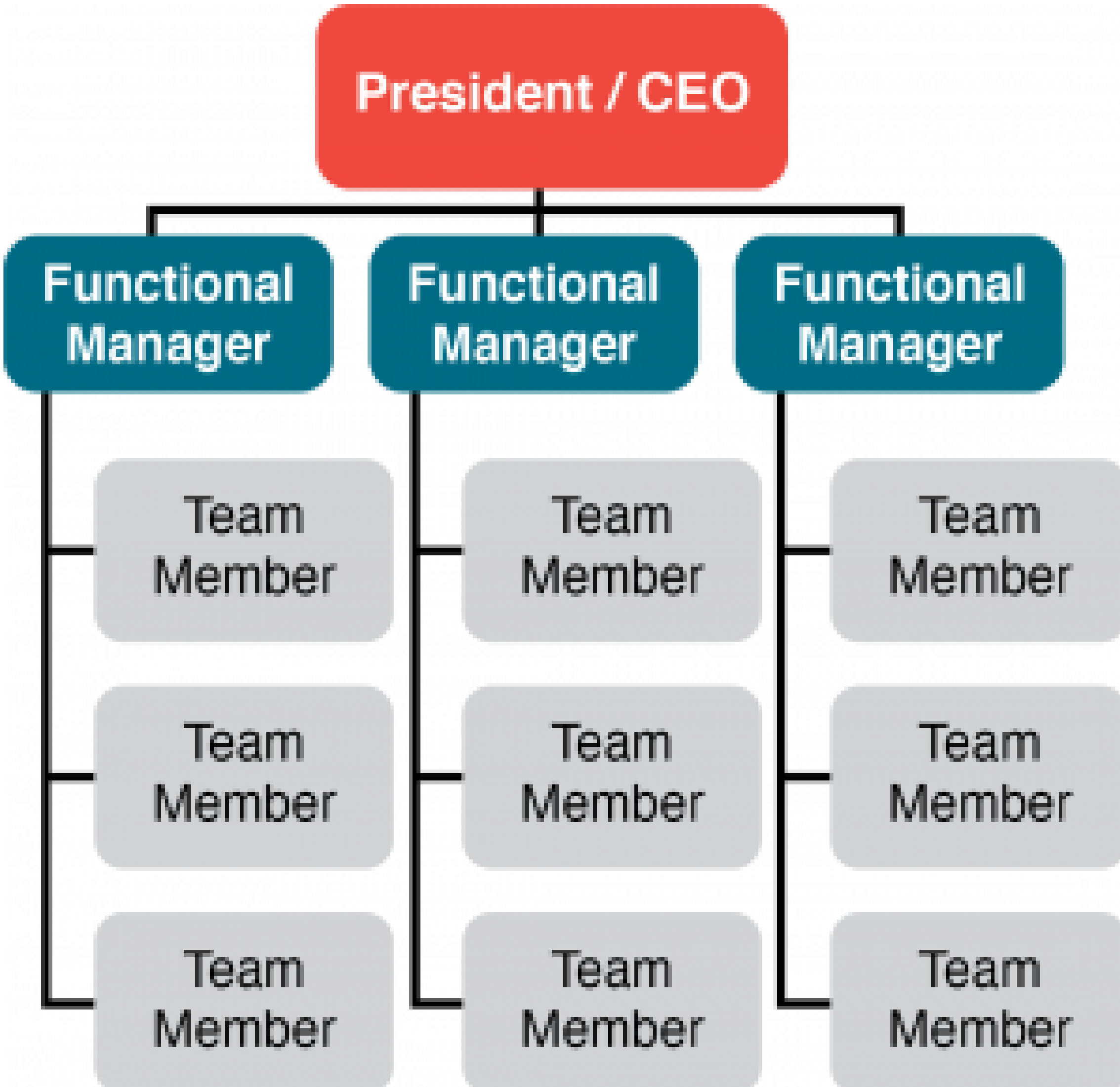

Figure 2.2: Functional Organization Structure

The success of projects within a functional organization depends on functional managers working together and cooperating. While someone may be designated as the project manager for a particular project, that person may not have much authority (See Figure 2.3). Often titles such as Project Coordinator, Project Scheduler, or Project Expediter will be used instead. Regardless of title, those in charge of projects are often put in the role of simply trying to maintain a schedule of what is happening.

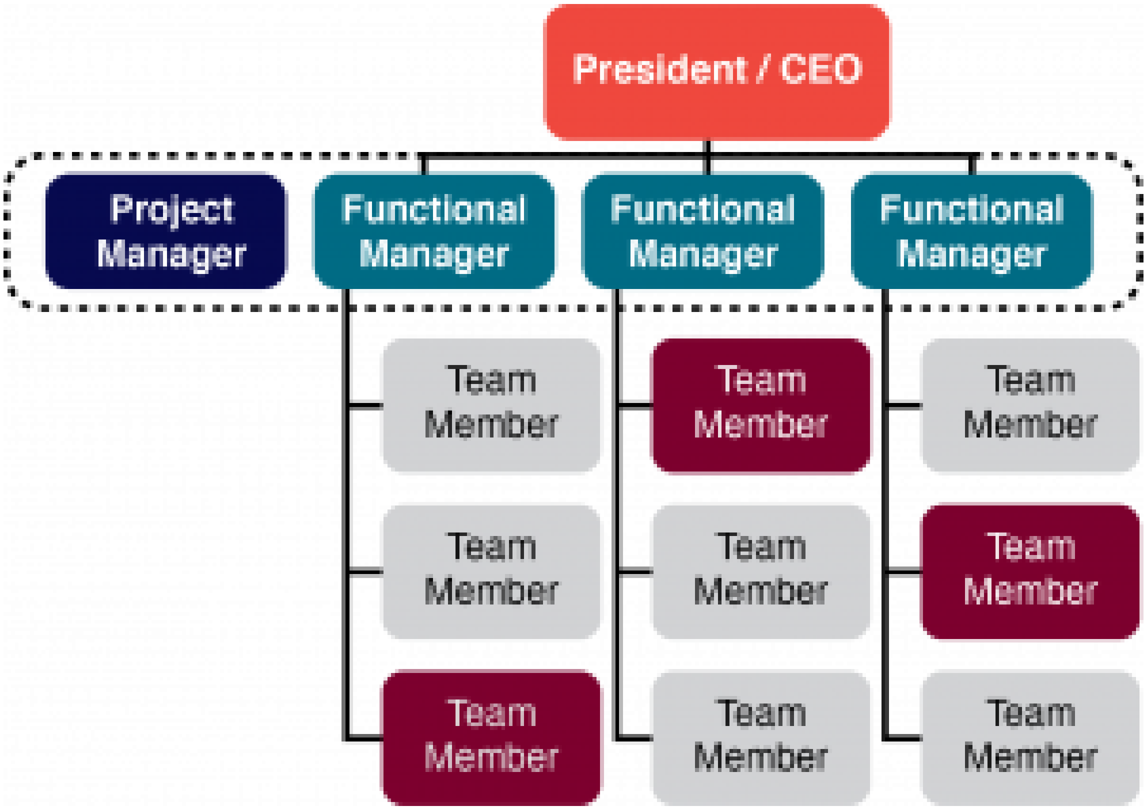

Figure 2.3: A "Project Manager" in a functional organization

PMI identifies the following project characteristics for projects conducted in functional organizations:

- Project Manager's Authority: Little or None
- Resource Availability: Little or None
- Who Manages the Project Budget: Functional Manager
- Project Manager's Role: Part-time
- Project Management Administrative Staff: Part-time

Projectized Organizations

Projectized organizations are at the opposite end of the organizational spectrum from functional organizations. Organizational energy and resources are focused on completing projects rather than ongoing operations. In a **projectized organization**, operations are minimal and the project manager has great authority over resources and personnel decisions. Projectized organizations may have organizational units called departments and these groups either report directly to the project manager or provide support services to projects. In the project-based structure, personnel are specifically assigned to the project and report directly to the project manager (See Figure 2.4).

As you can imagine, employees in this type of environment are able to focus their loyalty on a project rather than their particular discipline. Not all people can succeed in such an organization, as they must adapt to the leadership styles and organizational skills of different project managers.

This is the most efficient organizational type for conducting projects, and it is used in those types of organizations that bid on and undertake large projects—military, industrial, scientific, etc.— that may last several years.

Examples of project-based organizations include construction companies, aeronautical manufacturers such as Lockheed Martin, and many software development companies. This type of organizational structure can put additional stress on employees as they have no home to return to once their project is over if they are not selected for a subsequent project. However it is generally considered ideal for project management since there is a significant reduction in the layers of bureaucracy that a project manager must navigate. PMI identifies the following project characteristics for projects conducted in projectized organizations:

- Project Manager's Authority: High or Absolute
- Resource Availability: High or Absolute
- Who Manages the Project Budget: Project Manager
- Project Manager's Role: Full-time
- Project Management Administrative Staff: Full-time

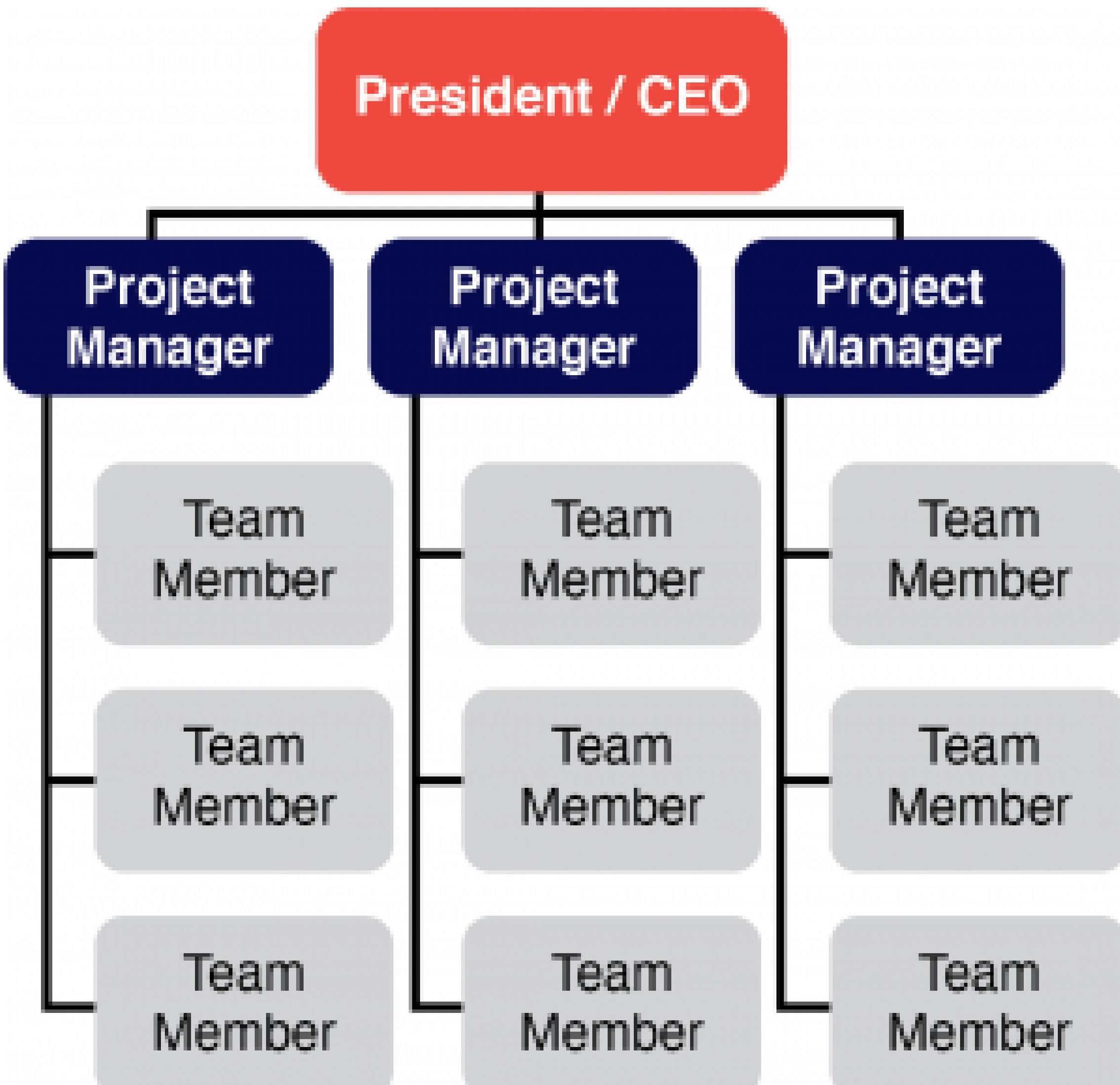

Figure 2.4: Projectized Organizations

Matrix Organizations

While the functional structure may work well in times of little change, it has some serious limitations when the success of a company depends on being adaptable. A **matrix structure** tries to combine the strengths a functional organization provides for operations management with the strengths a projectized organization provides for project management. In a matrix organization, the functional and project manager share authority and responsibility. This can lead to several negatives:

- Employees can have two supervisors to whom they have to report, breaking the rule of a solitary chain of command.
- Employees have to balance their work between the needs of the projects, they are working on, and their functional unit.
- Supervisors may find that it is more difficult to achieve a consistent rate of progress since employees are often pulled in different directions.
- Costs and communication channels can increase.

However, there are several advantages to a matrix structure in terms of projects:

- It significantly disrupts the communication “silos” of a functional organization, creating a more horizontal structure for teams and increasing the flow of information.
- It allows people to concentrate on their areas of specialty and bring that strength to current projects.

PMI recognizes three types of matrix structures, as described below (See also Figure 2.5).

- **Weak Matrix:** The project manager has less authority over resources and people than the functional managers. Project managers in a weak matrix may go by other titles such as a project coordinator or project scheduler.
- **Balanced Matrix:** In a balanced matrix, the project manager and functional managers equally share authority over resources and staff. This allows the organization to experience the “best of both worlds” by receiving the benefits of a projectized organization and functional organization at the same time. However, this system presents many challenges:
    - Functional managers and project managers have to work well together and maintain regular communications. Staff will have two managers to whom they have to report, breaking the concept of the chain of command and organization.
    - If functional and project managers have conflicting priorities, subordinates may be unable to meet expectations.

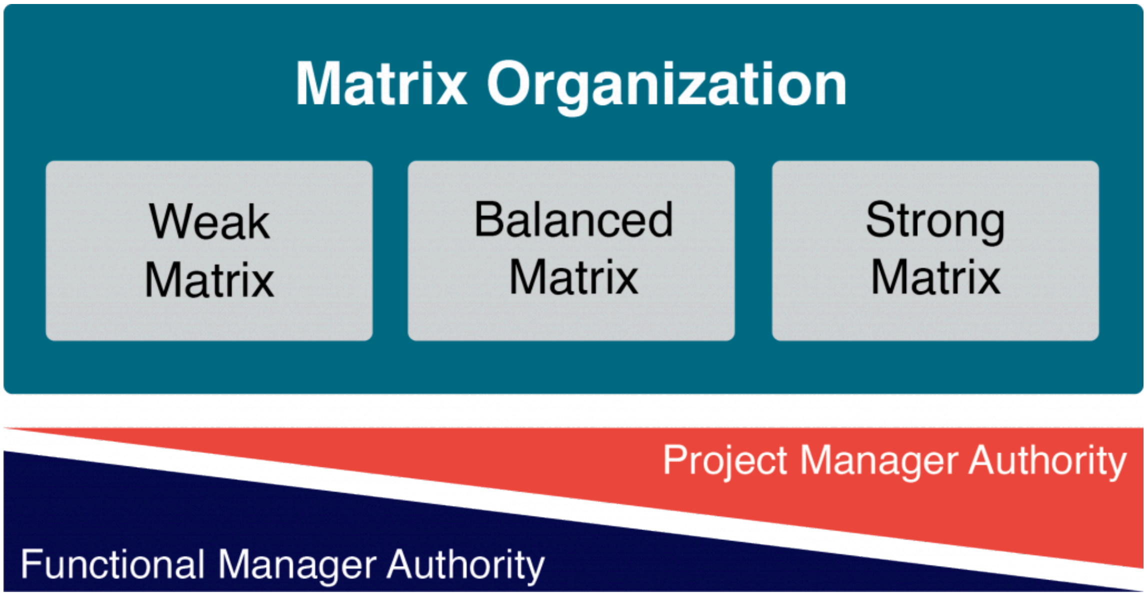

Figure 2.5: Matrix Organization

- **Strong Matrix:** In a strong matrix, the project manager has more direct control over resources and staffing, while the functional manager will provide support to the project staff in terms of hiring, technical expertise, and professional development. Of all the matrix structures, this is the one in which the project manager has the most authority, and the functional manager has the least.

Dedicated Project Team

Many functional organizations find that they often need to carry out important projects but do not want to change their entire organizational structure. Recognizing the advantages that are achieved by giving authority to a project manager, functional organizations often organize **dedicated project teams** where a project manager can have authority over the staff assigned to that particular project. The project manager and project team members are sometimes located in a special office, away from the desks and duties that they normally have within the functional organization (See Figure 2.6). This can be a very effective way to complete projects. However, some difficulties can arise:

- Temporary loss of staff from the functional groups.
- Integration of project team members back into the functional organization after the project is completed can be difficult.
- An “us versus them” mentality, where the people on the project team are deemed to be more special than those working in the functional departments. There have been numerous case studies of conflict arising from dedicated project teams.

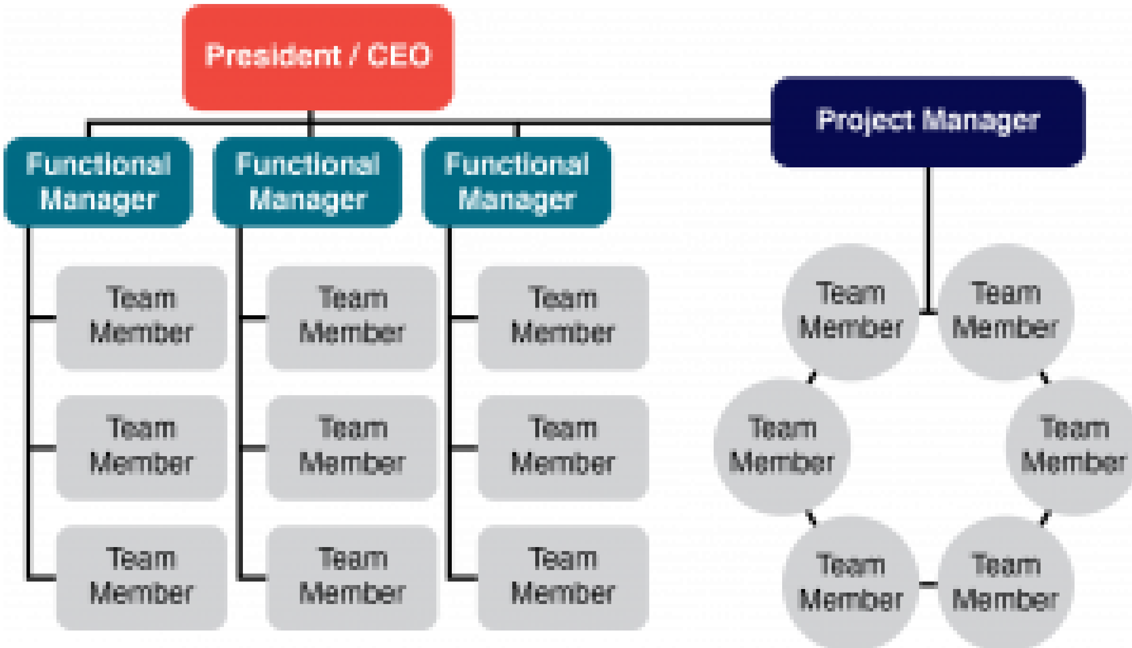

Figure 2.6: Dedicated Project Team

A classic case of the use of a dedicated project team—and the problems it can cause to the functional organization—was when Steve Jobs picked the best and brightest engineers from Apple to work on the development of the Macintosh computer. The project was very successful, but there was a lot of tension between the project team and the functional organization.

2.3. Culture

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 corporate culture. **Corporate culture** refers to the beliefs, attitudes, and values that the organization's members share and the behaviours 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 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 behaviours, symbols, and conventions used.

Many factors need to be understood within your project environment (Figure 2.7). 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 different countries' cultural influences. Furthermore, the **physical environment** of the project requires you to consider the impact of time zones. Think about how your project will be executed differently 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.

Culture and Environments

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 they have 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.

Project Environment	
Cultural	Social
International	Political
Physical	

Figure 2.7: The important factors to consider within the project environment.
Table from "[Project Management for Scientists and Engineers]" by Barron & Barron, [CC BY 4.0]

How a product is received can be very dependent on 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 thing 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 simplest: date formats. What day and month is 2/8/2021? Of course, it depends on 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. When schedules and deadlines are being defined everyone must be 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. Colours 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 favoured background colour in North America, signifies death in Japan (e.g., a burial shroud).

Project managers in multicultural projects must appreciate the cultural 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.

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 behaviours 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 behaviour. Shared basic assumptions are the deeply embedded, taken-for-granted behaviours that are usually unconscious, but constitute the essence of culture.

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.

Creating a Culture of Collaboration

A project manager met with his team before 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 behaviour 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 confidence, even managers. The culture of integrity is stronger than the cultural aspects of the power of management.

2.4. Strategy

An organization without a clearly defined strategy can never expect to navigate the permanent white-water of living order. This is especially true if the strategy is motivated by the organization attempting to push its vision onto customers, rather than pulling the customer's definition of value into its daily operations. An organization's strategy is an expression of its mission and overall culture. In a well-run company, every decision about a project, program, or portfolio supports the organization's strategy. The strategy, in turn, defines the company's portfolio and day-to-day operations. Projects and their budgets flow out of the organizational strategy. Morgan et al. (2007) emphasize the importance of aligning a company's portfolio with its strategy:

- Without clear leadership that aligns each activity and every project investment to the espoused strategy, individuals will use other decision rules in choosing what to work on: first in, first out; last in, first out; loudest demand; squeakiest wheel; boss's whim; least risk; easiest; best guess as to what the organization needs; most likely to lead to raises and promotion; most politically correct; wild guess—or whatever they feel like at the time. Portfolio management still takes place, but it is not necessarily aligned with strategy, and it occurs at the wrong level of the organization (2007, p. 5).

As a project manager, you should be able to refer to your organization's strategy for guidance on how to proceed. You should also be able to use your organization's strategy as a means of crossing possibilities off your list. Michael E. Porter, author of the hugely influential book Competitive Strategy, explains that strategy is largely a matter of deciding what your organization won't do. In an interview with Fast Company magazine, he puts it like this:

- The essence of strategy is that you must set limits on what you're trying to accomplish. A company without a strategy is willing to try anything. If all you're trying to do is essentially the same thing as your rivals, then it's unlikely that you'll be very successful. It's incredibly arrogant for a company to believe that it can deliver the same sort of product that its rivals do and actually do better for very long. That's especially true today when the flow of information and capital is incredibly fast (Hammonds, 2001).

Ultimately, strategy comes down to making trade-offs. It's about "aligning every activity to create an offering that cannot easily be emulated by competitors" (Porter, 2001). Southwest Airlines, which has thrived while most airlines struggle, is often hailed as an example of a company with a laser-like focus on a well-defined strategy. Excluding options from the long list of possibilities available to an airline allows Southwest to focus on doing a few things extremely well—specifically providing reliable, low-cost flights between mid-sized cities. As a writer for Bloomberg View puts it:

- By keeping the important things simple and implementing them consistently, Southwest manages to succeed in an industry better known for losses and bankruptcies than sustained profitability. Yet none of this seems to have gone to the company's head, even after 40 years. As such, the airline serves as a vivid—and rare—reminder that size and success need not contaminate a company's mission and mindset, nor erode the addictive enthusiasm of management and staff (El-Erian, 2014).

PMO Categories/Functions

Effective project management and execution start with choosing the right projects. While you might not have control over which projects your organization pursues, you do need to understand why your organization chooses to invest in particular projects so that you can effectively manage your projects and contribute to decisions about how to develop and, if necessary, terminate a project. Your study of technical project management will primarily focus on doing things the right way. In this chapter, we'll concentrate on doing the right thing from the very beginning.

As always, it's helpful to start with some basic definitions:

- **Project:** The "temporary initiatives that companies put into place alongside their ongoing operations to achieve specific goals. They are clearly defined packages of work, bound by deadlines and endowed with resources including budgets, people, and facilities" (Morgan et al., 2007, p. 3). Note that this is a more expansive definition than the Cambridge English Dictionary definition piece of planned work or activity that is completed over a period of time and intended to achieve a "particular aim". In this, lesson we focus on the trade-offs necessitated by deadlines and limited resources.
- **Program:** "A cluster of interconnected projects" (Morgan et al., 2007, p. 9).
- **Portfolio**: The "array of investments in projects and programs a company chooses to pursue" (Morgan et al., 2007, p. 3).
- **Strategy:** According to Merriam-Webster dictionary, it is "a careful plan or method for achieving a particular goal usually over a long period of time."

As shown in Figure 2.8, a portfolio is made up of programs and projects. An organization's strategy is the game plan for ensuring that the organization's portfolios, programs, and projects are all directed toward a common goal.

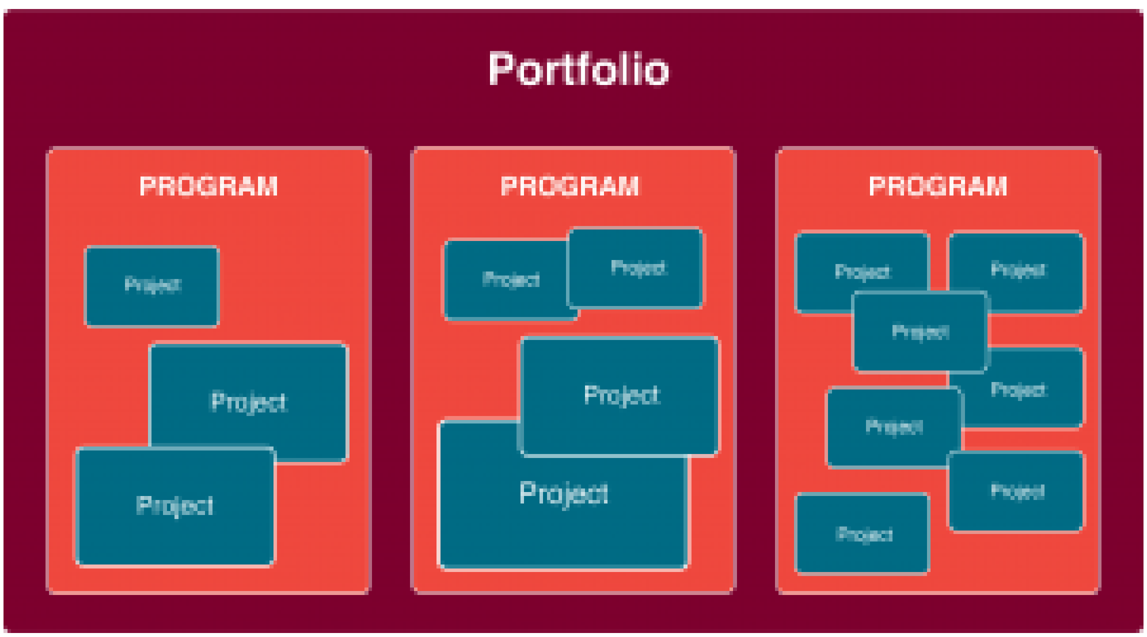

Figure 2.8: Relationship between a portfolio, programs, and projects

As depicted in Figure 2.9, the project context is largely defined by the organizational, social, and political structures in which a project occurs., you might think Project 2 is nearly identical to Project 1, but then a sudden shift in context can change everything.

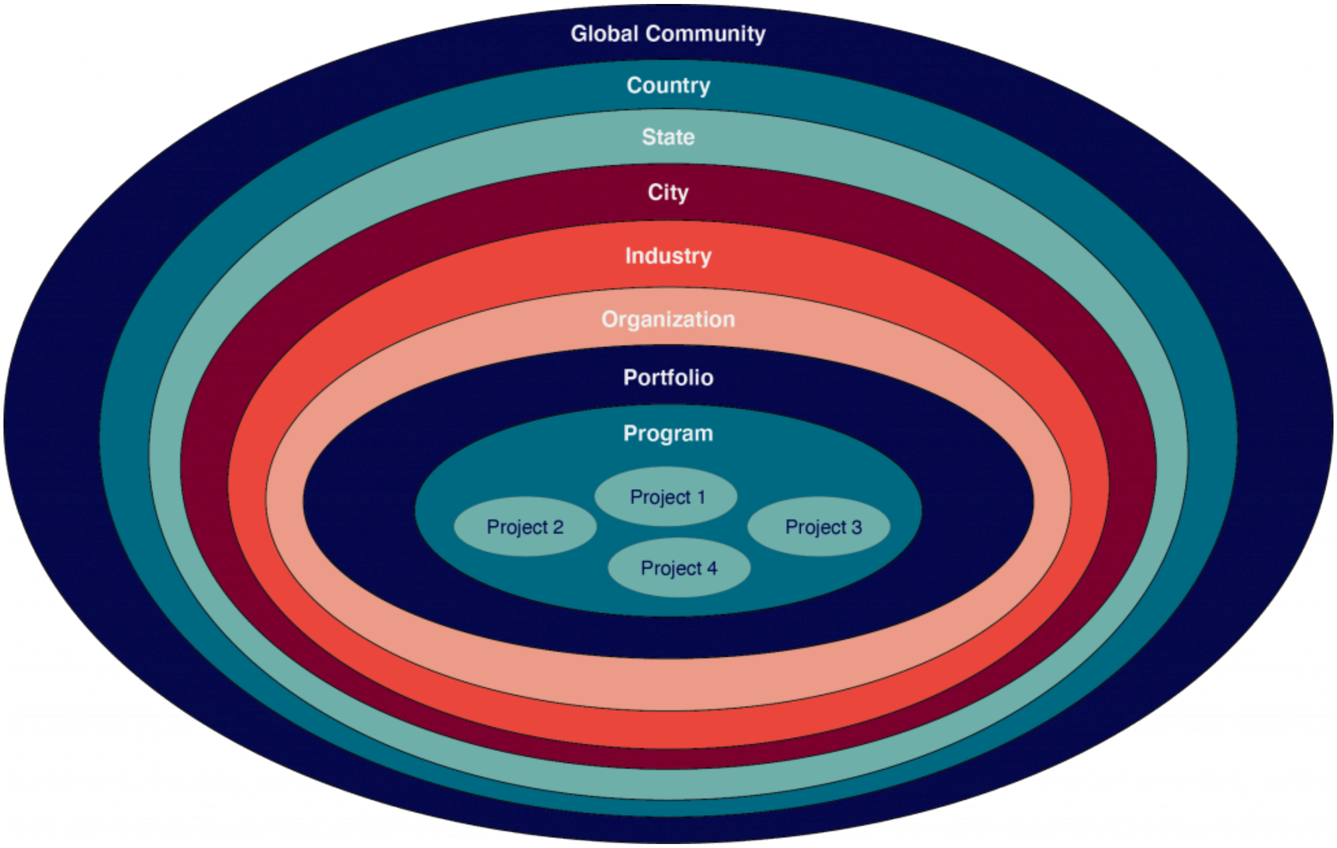

Figure 2.9 Project Context

Aligning Projects with Strategy Through Portfolio Management

Projects are the way organizations operationalize strategy. In the end, executing a strategy effectively means pursuing the right projects. In other words, it's a matter of aligning projects and initiatives with the company's overall goals. Keep in mind that taking a big-picture, long-term approach to executing a new organizational strategy requires a living order commitment to a certain amount of uncertainty in the short term. It can take a while for everyone to get on board with the new plan, and in the meantime, operations may not proceed as expected. But by keeping your eye on the North Star of your organization's strategy, you can help your team navigate the choppy waters of change.

Project selection proceeds on two levels: the portfolio level and the project level. On the **portfolio level**, management works to ensure that all the projects in a portfolio support the organization's larger strategy. In other words, management focuses on optimizing its portfolio of projects. According to Morgan et al. (2007, p. 167), portfolio optimization is "the difficult and iterative process of choosing and constantly monitoring what the organization commits to do".

Morgan et al (2007, p. 167). see portfolio management as the heart and soul of pursuing a strategy effectively:

- Strategic execution results from executing the right set of strategic projects in the right way. It lies at the crossroads of corporate leadership and project portfolio management—the place where an organization's purpose, vision, and culture translate into performance and results. There is simply no path to executing strategy other than the one that runs through project portfolio management. (2007, p. 4-5).

To manage portfolios effectively, large organizations often use scenario-planning techniques that involve sophisticated quantitative analysis. One such technique is based on the knapsack problem, a classic optimization problem. Various items, each with a weight and a value are available to be placed in a knapsack. The challenge of planning is an analogue to choose the types and numbers of items that can fit into the knapsack without exceeding the weight limit of the knapsack. Portfolio managers are faced with a similar challenge: choosing the number and types of projects, each with a given cost and value, to optimize the collective value without exceeding resource availability.

2.5. Project Selection

Factors that Affect Project Selection

In any organization, project selection is influenced by the available resources. When money is short, organizations often terminate existing projects and postpone investing in new ones. For example, in 2015, the worldwide drop in oil prices forced oil companies to postpone $380 billion in projects, such as new deep-water drilling operations (Scheck, 2016).

An organization's project selection process is also influenced by the nature of the organization. At a huge aerospace technology corporation, for example, the impetus for a project nearly always comes from the market and is loaded with government regulations. Such projects are decades-long undertakings, which necessarily require significant financial analysis. On the other hand, at a consumer products company, the idea for a project often originates inside the company as a way to respond to a perceived consumer demand. In that case, with less time and fewer resources at stake, the project selection process typically proceeds more quickly.

Size is a major influence on an organization's project selection process. At a large, well-established corporation, the entrenched bureaucracy can impede quick decision-making. By contrast, a twenty-person start-up can make decisions quickly and with great agility.

Effective project management and execution start with choosing the right projects. While you might not have control over which projects your organization pursues, you do need to understand why your organization chooses to invest in particular projects so that you can effectively manage your projects and contribute to decisions about how to develop and, if necessary, terminate a project. Your study of technical project management will primarily focus on doing things the right way. In this chapter, we'll concentrate on doing the right thing from the very beginning.

Value and Risk

Keep in mind that along with the customer's definition of value comes the customer's definition of the amount of risk he or she is willing to accept. As a project manager, it's your job to help the customer understand the nature of possible risks inherent in a project, as well as the options for and costs of reducing that risk. It's the rare customer who is actually willing or able to pay for zero risk in any undertaking. In some situations, the difference between a little risk and zero risk can be enormous. This is true, for instance, in the world of computer networking, where a network that is available 99.99% of the time (with 53 minutes and 35 seconds of downtime a year) costs much less than a network that is 99.999% available (with only 5 minutes and 15 seconds of downtime a year) (Dean, 2013, p. 645). If you're installing a network for a small chain of restaurants, shooting for 99.99% availability is a waste of time and money. By contrast, on a military or healthcare network, 99.999% availability might not be good enough.

Identifying the magnitude and impact of risks, as well as potential mitigation strategies, are key elements of the initial feasibility analysis of a project. Decision-makers will need that information to assess whether the potential value of the project outweighs the costs and risks. Risk analysis will be addressed further in chapter nine. For some easy-to-digest summaries of the basics of risk management, check out the many YouTube videos by David Hillson, who is known in the project management world as the Risk Doctor. Start with his video named "Risk Management Basics: What Exactly Is It?"

The Project Selection Process

No matter the speed at which its project selection process plays out, successful organizations typically build in a period of what Scott Anthony calls "staged learning," in which the project stakeholders expand their knowledge of potential projects. In an interesting article in the Harvard Business Review, Anthony compares this process to the way major leagues use the minor leagues to learn more about the players they want to invest in. In the same way, consumer product companies use staged learning to expose their products to progressively higher levels of scrutiny, before making the final, big investment required to release the product to market (Anthony, 2009).

You can think of the project selection process as a series of screens that reduce a plethora of ideas, opportunities and needs to a few approved projects. From all available ideas, opportunities, and needs, the organization selects a subset that warrants consideration given their alignment with the organization's strategy. As projects progress, they are subjected to a series of filters based on a variety of business and technical feasibility considerations. As shown in Figure 2.9, projects that pass all screens are refined, focused, and proceed to execution.

This same concept is applied in **Stage-Gate™ or Phase-Gate models**, in which a project is screened and developed as it passes through a series of stages/phases and corresponding gates. During each stage/phase, the project is refined, and at each gate, a decision is required as to whether the project warrants the additional investment needed to advance to the next stage/phase of development. "The typical Stage-Gate new product process has five stages, each stage preceded by a gate. Stages define best-practice activities and deliverables, while gates rely on visible criteria for Go/No Go decisions" (Cooper, et al., 2000).

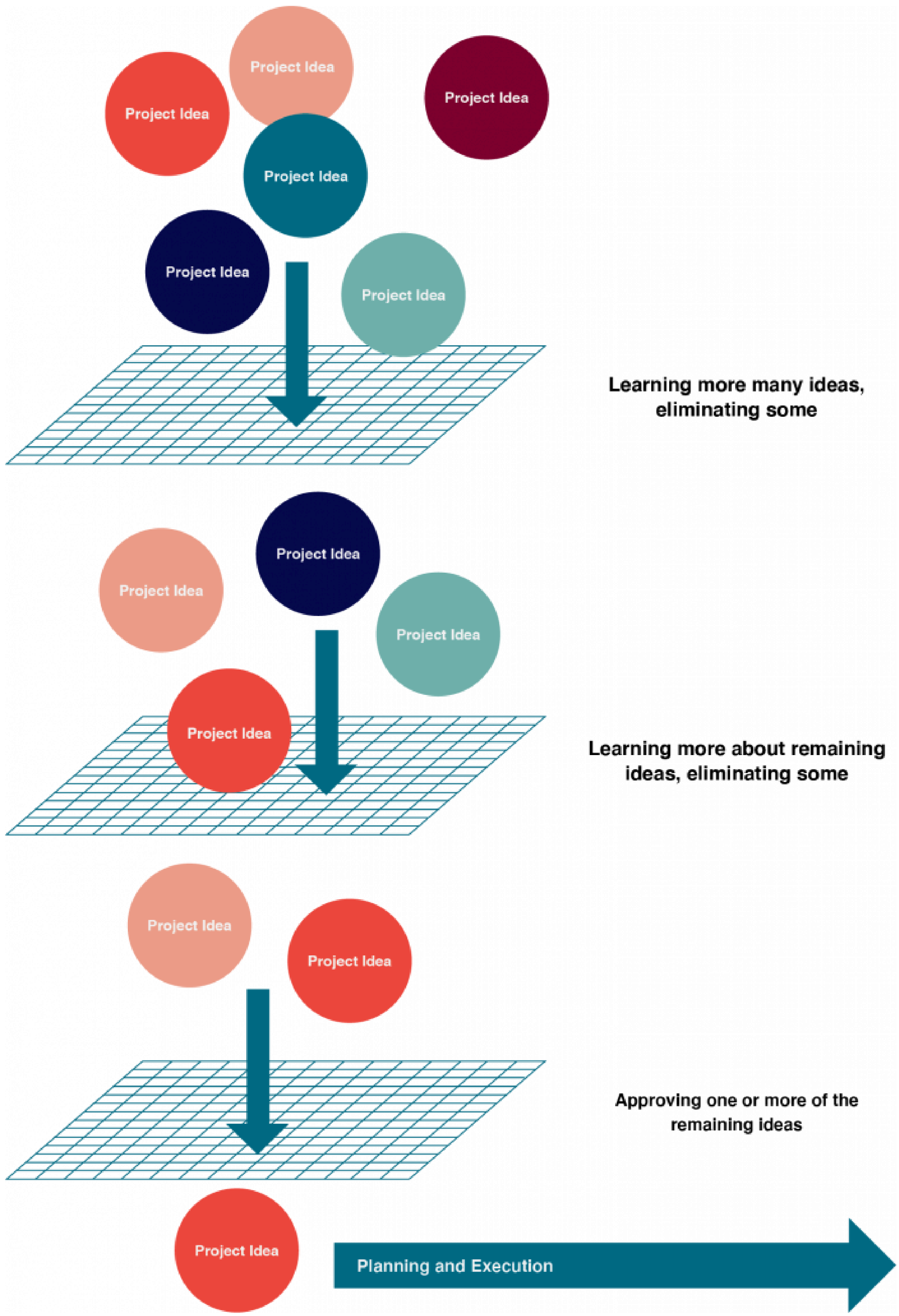

Figure 2.9: A project selection process can be seen as a series of screens

This approach is designed to help an organization make decisions about projects where very limited knowledge is available at the outset. The initial commitment of resources is devoted to figuring out if the project is viable. After that, you can decide if you are ready to proceed with detailed planning, and then, whether to implement the project. This process creates a discipline of vetting each successive investment of resources and allows safe places to kill the project if necessary.

Another approach to project selection, **set-based concurrent engineering**, avoids filtering projects too quickly, instead focusing on developing multiple solutions through to final selection just before launch. This approach is expensive and resource-hungry, but its proponents argue that the costs associated with narrowing to a single solution too soon—a solution that subsequently turns out to be sub-optimal—are greater than the resources expended on developing multiple projects in parallel. Narrowing down rapidly to a single solution is typical of many companies in the United States and in other Western countries. Japanese manufacturers, by contrast, emphasize developing multiple options (even to the point of production tooling).

In an article for the International Project Management Association, Joni Seeber discusses some general project selection criteria. Like Michael Porter, she argues that first and foremost, you should choose projects that align with your organization's overall strategy. She suggests a helpful test for determining whether a project meaningfully contributes to your organization's strategy:

A quick and dirty trick to determining the meaningfulness of a project is answering the question "So what?" about intended project outcomes. The more the project aligns with the strategic direction of the organization, the more meaningful. The higher the likelihood of success, the more meaningful.

To illustrate, developing a vaccine for HIV is meaningful; however, developing a vaccine for HIV that HIV populations cannot afford is not. Size matters as well since the size of a project and the amount of resources required are usually positively correlated. Building the pyramids of Egypt may be meaningful, but the size of the project makes it a high-stake endeavour only suitable to pharaohs and Vegas kingpins. (Seeber, 2011)

Project Selection Methods

Projects are selected by comparing the costs and benefits of potential projects. Some of the selection methods are more subjective than others, but all try to use a standard set of criteria

to determine which project is the best for an organization to pursue. Methods can include:

- **Scrub Down.** A group of experts (internal and external) attempt to "murder" a project proposal by pointing out its flaws and weaknesses. This can be very useful in high-risk projects where there is little data from previous projects from which we can learn, or in situations where the environment has changed significantly since the development of the original scope of the project. Participants in a murder board session are encouraged to be aggressive and not hold back in their attempt to murder the project.
- **Qualitative Scoring Methods**. Scoring methods can take a variety of factors into account. These can range from simple checklists to complex weighted scoring systems. Scoring systems can assist staff with evaluating the relative merit of different projects while limiting political influence. Scoring models might survey a wide variety of experts and have them rate the project in terms of importance to the company or relative chance of success.
- **Economic Scoring Methods.** These methods assess the ability of the project to help the bottom line, either by increasing profits or reducing costs. These models often look at the cash flow that a project will generate after it is completed. The final section of this chapter examines economic models in more detail.
- **Constrained Optimization Methods.** Constrained Optimization Methods of project selection are mathematically intensive means of analyzing a series of projects and are not easily generalized.

In project management, these methods can include:

- Linear Programming
- Dynamic Programming
- Branch and Bound Algorithms
- Integer Programming

We might also refer to Constrained Optimization Methods as mathematical approaches to project selection. These methods are beyond the scope of this text, but students preparing to take PMI exams should know that if they see any type of programming or algorithms used for project selection, a Constrained Optimization Method is being used.

2.6. Business Case

Toyota Motor Corporation

Toyota Motor Corporation (TYO: 7203) has often been referred to as the gold standard of the automotive industry. In the first quarter of 2007, Toyota (NYSE: TM) overtook General Motors Corporation in sales for the first time as the top automotive manufacturer in the world. Toyota reached success in part because of its exceptional reputation for quality and customer care. Despite the global recession and the tough economic times that American auto companies such as General Motors and Chrysler faced in 2009, Toyota enjoyed profits of $16.7 billion and sales growth of 6% that year. However, late 2009 and early 2010 witnessed Toyota's recall of 8 million vehicles due to unintended acceleration. How could this happen to a company known for quality and structured to solve problems as soon as they arise? To examine this further, one has to understand the Toyota Production System (TPS).

TPS is built on the principles of "just-in-time" production. In other words, raw materials and supplies are delivered to the assembly line exactly at the time they are to be used. This system has little room for slack resources, emphasizes the importance of efficiency on the part of employees, and minimizes wasted resources. TPS gives power to the employees on the front lines. Assembly line workers are empowered to pull a cord and stop the manufacturing line when they see a problem.

However, during the 1990s, Toyota began to experience rapid growth and expansion. With this success, the organization became more defensive and protective of information. Expansion strained resources across the organization and slowed response time. Toyota's CEO, Akio Toyoda, the grandson of its founder, has conceded, "Quite frankly, I fear the pace at which we have grown may have been too quick."

Vehicle recalls are not new to Toyota; after defects were found in the company's Lexus model in 1989, Toyota created teams to solve the issues quickly, and in some cases, the company went to customers' homes to collect the cars. The question on many people's minds is, how could a company whose success was built on its reputation for quality have had such failures? What is all the more puzzling is that brake problems in vehicles became apparent in 2009, but only after being confronted by United States Transportation Secretary Ray LaHood did Toyota begin issuing recalls in the United States. And during the early months of the crisis, Toyota's top leaders were all but missing from public sight.

The organizational structure of Toyota may give us some insight into the handling of this crisis and ideas for the most effective way for Toyota to move forward. A conflict such as this has the ability to paralyze productivity but if dealt with constructively and effectively, can present opportunities for learning and improvement. Companies such as Toyota that have a rigid corporate culture and a hierarchy of seniority are at risk of reacting to external threats slowly. It is not uncommon that individuals feel reluctant to pass bad news up the chain within a family company such as Toyota. Toyota's board of directors is composed of 29 Japanese men, all of whom are Toyota insiders. As a result of its centralized power structure, authority is not generally delegated within the company; all U.S. executives are assigned a Japanese boss to mentor them, and no Toyota executive in the United States is authorized to issue a recall. Most information flow is one-way, back to Japan where decisions are made.

Questions

Will Toyota turn its recall into an opportunity for increased participation for its international manufacturers? Will decentralization and increased transparency occur? Only time will tell.

1. What changes in the organizing facet might you make at Toyota to prevent future mishaps like the massive recalls related to brake and accelerator failures?
2. Do you think Toyota's organizational structure and norms are explicitly formalized in rules, or do the norms seem to be more inherent in the culture of the organization?
3. What are the pros and cons of Toyota's structure?
4. What elements of business would you suggest remain the same and what elements might need revising?
5. What are the most important elements of Toyota's organizational structure?

2.7. Key Terms

Key Terms

- **Artifacts and Behaviours:** Something valued by a certain culture. They are symbols and signs of an organization's culture. They are observable. ie. country's flag, how people dress; how people conduct. themselves around others, how people are greeted when entering a building.
- **Assumptions:** Unknown and generally not written down, employee's beliefs, perceptions, feelings.
- **Balanced Matrix:** In a balanced matrix, the project manager and functional managers equally share authority over resources and staff. This allows the organization to experience the "best of both worlds" by receiving the benefits of a projectized organization and functional organization at the same time.
- **Constrained Optimization Methods:** Constrained Optimization Methods of project selection are mathematically intensive means of analyzing a series of projects and are not easily generalized.
- **Corporate culture:** Refers to the beliefs, attitudes, and values that the organization's members share and the behaviors consistent with them.
- **Cultural and Social Environments:** people, demographics, and education.
- **Dedicated Project Teams:** Teams where a project manager can have authority over the staff assigned to that particular project.
- **Economic Scoring Methods:** These methods assess the ability of the project to help the bottom line, either by increasing profits or reducing costs. These models often look at the cash flow that a project will generate after it is completed.
- **Functional Managers (Regular Managers):** Serve as conduits for communications and collaboration. This type of structure is very efficient for operations management where continuous process improvement can be conducted on all regular departmental operations.
- **Functional Organizations:** Large organizations are traditionally organized by function into various departments, with staff in each department reporting to a departmental manager or head of a department.
- **Matrix Structure:** Tries to combine the strengths a functional organization provides for operations management with the strengths a projectized organization provides for project management.
- **Official Rules:** These are the rules that are stated.
- **Operational Rules:** These are the rules that are enforced.
- **Physical Environment:** Requires you to consider the impact of time zones.
- **Political Environment:** Where you need to understand different countries' cultural influences.
- **Portfolio Level:** Management works to ensure that all the projects in a portfolio support the organization's larger strategy. In other words, management focuses on optimizing its portfolio of projects.

- **Project Culture:** Represents the shared norms, beliefs, values, and assumptions of the project team. This is very similar to the corporate culture.
- **Projectized Organization:** Operations are minimal and the project manager has great authority over resources and personnel decisions. Projectized organizations may have organizational units called departments and these groups either report directly to the project manager or provide support services to projects.
- **Qualitative Scoring Methods:** Scoring methods can take a variety of factors into account. These can range from simple checklists to complex weighted scoring systems.
- **Scrub down:** A group of experts (internal and external) attempt to "murder" a project proposal by pointing out its flaws and weaknesses. This can be very useful in high-risk projects where there is little data from previous projects from which we can learn, or in situations where the environment has changed significantly since the development of the project's original scope.
- **Set-Based Concurrent Engineering:** Avoids filtering projects too quickly instead of focusing on developing multiple solutions through to final selection just before launch.
- **Stage-Gate™ or Phase-Gate Models:** In which a project is screened and developed as it passes through a series of stages/phases and corresponding gates.
- **Strong Matrix:** In a strong matrix, the project manager has more direct control over resources and staffing, while the functional manager will provide support to the project staff in terms of hiring, technical expertise, and professional development.

2.8. Chapter Questions

Knowledge Check 1

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Knowledge Check 2

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Knowledge Check 4

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CHAPTER 3 - PROJECT PROCESS

Chapter Overview

3.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Explain the four processes of project management.
2. Describe the documentation produced during the project initiation.
3. Describe the approach to project planning.
4. Identify the importance and the purpose of project planning.
5. Describe how project monitoring and controlling are simultaneous and continuous during project.
6. Identify the reasons for project closure.

3.2. Initiation

Project management has a dual nature; it is both a series of distinct phases with a clear beginning and end and a continuous, circular process in which each end leads to a new beginning. Throughout a project, a successful project manager strives to anticipate changing conditions, rather than simply responding to them as they arise.

Let's start with the more traditional view, which describes project management as a series of sequential phases, with project initiation coming right after project selection. You can think of these phases, shown in Figure 3.1, as the particle nature of project management.

But while project initiation marks the official beginning of a project, doing it well also requires looking past the making stage to the entire life cycle of the project's end result. You can think of this as the wave nature of project management. As illustrated in Figure 3.1, the making stage, in which a project is initiated and executed, is one part of the larger cycle that includes the operating/using/changing stage, in which the customer makes use of the project. Finally, the demolishing stage is when the project is retired so it can be replaced by something new and better.

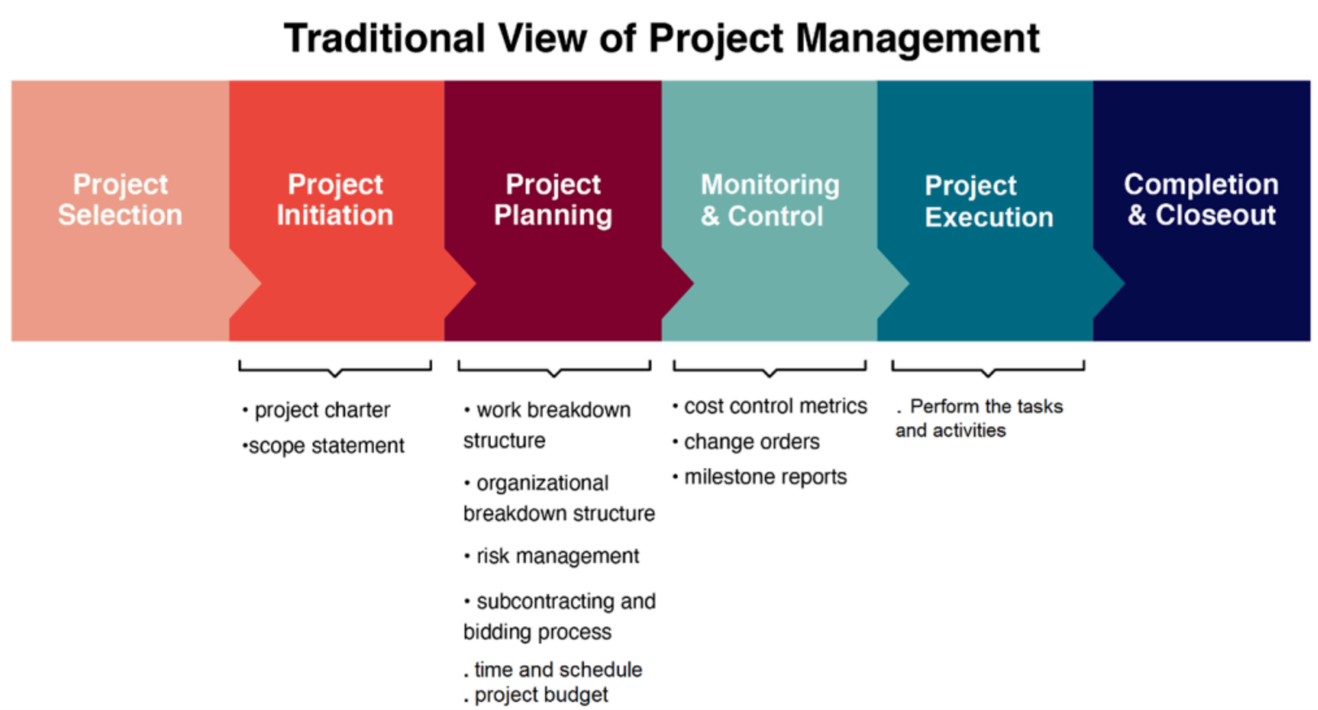

Figure 3.1: Project phases

3.3. Planning

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

Merriam-Webster's definition of **planning** is "the act or process of making a plan to achieve or do something." This suggests that the ultimate goal of planning is the plan itself. It also presumes that once a plan has been formulated, you only need to follow the plan to achieve the desired outcome. That's fine for ordinary conversation. But when we begin to think about living order project planning, a more expansive understanding of the nature of planning emerges. In living order, planning is a process that prepares the project team to respond to events as they actually unfold. The whole point of planning is to develop strategies to manage the:

- Changes to scope
- Schedule
- Cost
- Quality
- Resources
- Communication
- Risk
- Procurement
- Stakeholder engagement

Planning results in a plan, but the plan is not an end in itself. Rather, a plan is a strategic framework for the scheduling and execution of a project. It's only useful if it includes the information team members require to begin moving forward. And it only remains useful if team members modify the plan as they learn the following about the project:

- Key constraints such as the timeline, cost, and functional requirements.
- Information on project system issues, such as workflow and milestones, provides a broad look at the project as a whole.
- Plans for periodic check-ins that allow participants and leadership to re-evaluate the project and its

original assumptions

Die-hard geometric order planners take a **deterministic approach**, labouring under the false notion that once everyone agrees on a plan, the plan itself determines what comes next. Indeed, it is tempting to think you can nail down every detail at the beginning of a project and then get going without looking back. But effective living order planners understand that, especially early in a project, these details are nearly always provisional and subject to change. Thus, effective living order planners stand ready to alter their plans in response to what they learn in changing conditions. They also understand that the context in which a project unfolds has varying levels of detail and variability, with potentially thousands of decisions made over the project's life cycle.

As Alexander Laufer and Gregory Howell explained in an article for Project Management Journal, a project leader's work is founded in uncertainty (Howell et al., 1993). **Uncertainty** is not an exceptional state in an otherwise predictable process of work, they argue. Instead, it is a permanent feature of modern work. What's more, the longer the time between planning and implementation, the higher the uncertainty surrounding individual activities. Naturally, the higher the uncertainty in a project, the more difficult it is to plan and the less effective the plans will be at articulating actions and outcomes. Finally, they emphasize that no amount of planning can eliminate the variability intrinsic to the work of a complex project.

3.4. Execution

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 in order to make appropriate adjustments as required, which are then 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 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 endpoint 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.

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 a 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.

3.5. Monitoring

The best project managers succeed through an artful combination of leadership and teamwork, focusing on people and using their emotional intelligence to keep everyone on task and moving forward. But successful project managers also know how to gather data on the health of their projects, analyze that data, and then, based on that analysis, make adjustments to keep their projects on track. In other words, they practice project monitoring, analytics, and control.

Note that most project management publications emphasize the term monitoring and control to refer to this important phase of project management, with no mention of the analysis that allows a project manager to use monitoring data to make decisions. But of course, there's no point in collecting data on a project unless you plan to analyze it for trends that tell you about the current state of the project. For simple, brief projects, that analysis can be a simple matter—you're clearly on schedule, you're clearly under budget—but for complex projects, you'll need to take advantage of finely calibrated data analytics tools. In this chapter, we'll focus on tasks related to monitoring and control, and also investigate the kind of thinking required to properly analyze and act on monitoring data.

Generally speaking, project monitoring and control involves reconciling "projected performance stated in your planning documentation with your team's actual performance" and making changes where necessary to get your project back on track (Peterman, 2016). It occurs simultaneously with project execution because the whole point of monitoring and controlling is making changes as team members perform their tasks. The monitoring part of the equation consists of collecting progress data and sharing it with the people who need to see it in a way that allows them to understand and respond to it. The controlling part consists of making changes in response to that data to avoid missing major milestones. If done right, monitoring and controlling enable project managers to translate information gleaned by monitoring into the action required to control the project's outcome. A good monitoring and control system is like a neural network that sends signals from the senses to the brain about what's going on in the world. The same neural network allows the brain to send signals to the muscles, allowing the body to respond to changing conditions.

Because monitoring and controlling is inextricably tied to accountability, government websites are a good source of suggestions for best practices. According to the state of California, monitoring and controlling involves overseeing all the tasks and metrics necessary to ensure that the approved and authorized project is within scope, on time, and on budget so that the project proceeds with minimal risk. This process involves comparing actual performance with planned performance and taking corrective action to yield the desired outcome when significant differences exist. The monitoring and controlling process is continuously performed throughout the life of the project (California Office of Systems Integration, 2008).

In other words, monitoring is about collecting data. Controlling is about analyzing that data and making decisions about corrective action. Taken as a whole, monitoring and controlling is about gathering intelligence and using it in an effective manner to make changes as necessary. Precise data are worthless unless they are analyzed intelligently and used to improve project execution. At the same time, project execution is uninformed by the latest data on changing currents in the project can lead to disaster.

Active Control takes a two-pronged approach:

- **Controlling** what you can by making sure you understand what's important, taking meaningful measurements, and building an effective team focused on project success.
- **Adapting** to what you can't control through early detection and proactive intervention.

The first step in active control is ensuring that the monitoring information is distributed in the proper form and to the right people so that they can respond as necessary. In this way, you need to function as the project's nervous system, sending the right signals to the project's muscles (activity managers, senior managers, clients, and other stakeholders), so they can take action. These actions can take the form of minor adjustments to day-to-day tasks, or major adjustments, such as changes to project resources, budget, schedule, or scope.

3.6. Closure

Closing Processes

At the end of a phase of our project, or the entire project, we must get final approval from the customer, archive our records from the project, compile the lessons learned, and pay any outstanding bills. These and several other activities make up the closing processes. Closing processes include:

- Close project or phase
- Close procurements

3.7. Business Case

Questions

Use the same case (Copper Mining in Latin America), in Chapter 1.6, and discuss the following:

1. How was the close-out phase started and completed?
2. Identify the monitoring practices in this case.
3. What would be the most suitable items/processes to monitor in this case?
4. Can active control be used in this project? Explain your answer.

3.8. Key Terms

Key Terms

- **Active Control:** Takes a two-pronged approach: Controlling what you can by making sure you understand what's important, taking meaningful measurements, and building an effective team focused on project success. Adapting to what you can't control through early detection and proactive intervention.
- **Deliverable:** This 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.
- **Deterministic Approach:** Labouring under the false notion that once everyone agrees on a plan, the plan itself determines what comes next.
- **Planning:** The act or process of making a plan to achieve or do something. This suggests that the ultimate goal of planning is the plan itself. It also presumes that once a plan has been formulated, you only need to follow the plan to achieve the desired outcome.
- **Planning Phase:** 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.
- **Project Management:** Has a dual nature; it is both a series of distinct phases with a clear beginning and end and a continuous, circular process in which each end leads to a new beginning.
- **Project Planning:** At the heart of the project life cycle, and tells everyone involved where you're going and how you're going to get there.
- **Uncertainty:** Is not an exceptional state in an otherwise predictable process of work, they argue. Instead, it is a permanent feature of modern work. What's more, the longer the time between planning and implementation, the higher the uncertainty surrounding individual activities.

3.9. Chapter Questions

Knowledge Check 1

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Knowledge Check 2

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Knowledge Check 4

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Knowledge Check 5

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CHAPTER 4 - PROJECT INITIATION

Chapter Overview

4.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Explain the three broad categories of projects
2. Discuss SMART criteria for developing and defining projects
3. Explain the types of costs that need to be considered (Direct Costs, and Overhead Costs)
4. Describe the elements of a project charter and explain its role in the initiation phase
5. Identify the value of a project charter to project success
6. Explain issues related to the project scope
7. Use a simple checklist and a weighted scoring model
8. Identify project requirements

4.2. Strategic Alignment

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/proposal (sometimes called a feasibility study) is created to define the problem or opportunity in detail and identify a preferred solution for implementation. The business case/proposal 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

SMART Project Objectives

In the early 1980s, George T. Doran introduced the SMART set of criteria for projects, goals and objectives. **SMART** is an acronym for Specific, Measurable, Assignable, Realistic, and Time-Related. The smart criteria have been applied in many different areas of management, including project management. Let's take a look at each of Doran's criteria as they apply to project management.

Specific – A project needs to be specific about what it will accomplish. Unlike many organizational goals, the goal of a project should not be vague or nebulous. An organization may want to "make London, Ontario a great place to live," but its projects need to focus on a specific goal. For example, a more specific goal would be to build a downtown farmers' market. A project that is specific is one that can be clearly communicated to all team members and stakeholders. A specific project goal will answer the five 'W' questions:

1. **W**hat do we want to accomplish?
2. **W**hy are we undertaking this project?
3. **W**ho is involved or will be affected by the project?
4. **W**here will this project be conducted?
5. **W**hich constraints (scope, time, money, risk, etc.) have been placed on our project?

Measurable – How will project progress and success be measured? What will be the measurable difference once our project is completed successfully? These measures should be quantifiable.

Assignable – Who will do the work? Can people be identified who have the expertise in the organization to complete this work? Or can the expertise be hired from outside of the organization?

Realistic – Is it realistic that the organization can achieve this project, given its talents and resources? This is a very important consideration for businesses of all sizes. Yes, it would be great to produce a new driverless car, but is that realistic given the resources that the organization has available?

Time-related – when will the project be completed and how long will it take? These criteria can be very useful when defining a project. If the description for a project does not meet all these criteria, then it is time to go back to the drawing board and make sure that what is being described is really a project, rather than a program or strategic goal.

For example, an objective of the team principal (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)?

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 in 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 4.1). However, he achieved this on lap 23 of the race but crashed on lap 44 of a 77-lap race. While he achieved the 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 4.1). 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.

Figure 4.1: Monaco 2004 by Cord Rodefeld, CC BY 2.0 (top); Jarno Trulli by ph-stop, CC BY-SA 2.0 (middle); Jenson Button by Evoflash, CC BY 2.0 (bottom)

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.

Financial Considerations

In many new project endeavours, 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, as will be discussed later in chapters 6 and 10.

4.3. Weighted Decision Matrix

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. On the other axis, is a list of criteria, which are weighted depending on their respective importance in the final decision to be taken.

The example in Figure 4.2 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.

Table 4.1 Weighted Decision Matrix for Game Delivery System

Criteria	**Weight**	**SJS Enterprises**	**Game Access**	**DVD Link**
Educational	15%	90	0	0
Sports-related	15%	90	90	90
Secure payment area with the ability to use Paypal, bank payments, cheques, school payment systems as a payment source	10%	90	50	50
Live Support	15%	90	0	0
Search Option	5%	50	50	30
Games available for all platforms currently on the market including school learning systems	10%	60	30	30
Longer Rental Periods (1 to 2 weeks)	5%	40	20	40
Sidebar with categories such as most popular, multiplayer, and just released	5%	50	50	20
Registered customers must be able to order the videos, track delivery, return of videos and be able to provide reviews of views	10%	50	30	30
Age/grade appropriate section (can isolate certain games to certain ages or grade levels)	10%	70	5	0
Weighted Project Scores	**100%**	**74.5**	**31**	**29**

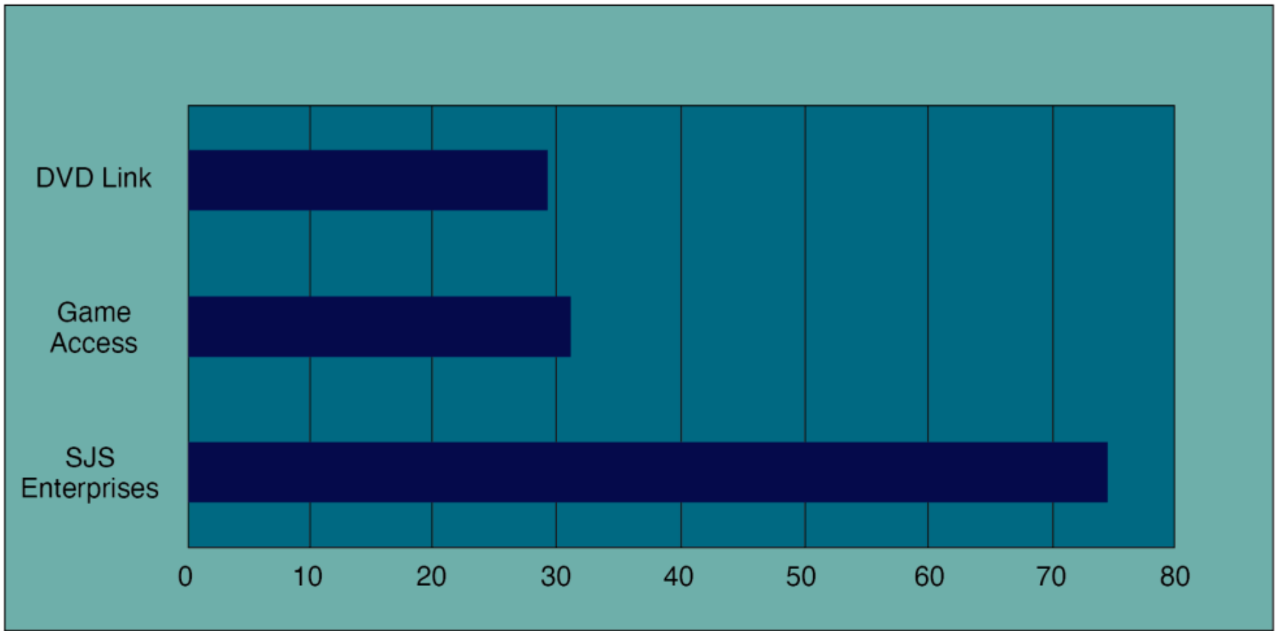

Figure 4.2

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 problems by:

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

4.4. Project Charter

What is the 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.

The charter document can be just a couple of pages in length or can be 50-100 pages. Ideally, it will be short (less than 5 pages) and written in clear and concise language so that anyone who reads it will have a clear understanding of the project, regardless of their technical background. Most project charters include a place at the end of the document for approval sign-off by the project sponsors or customers (i.e. those people who are paying for the project).

Purpose of the Project Charter

The project charter is used by the project manager during the planning process. The project charter informs the project manager about what skills will be required on the project team, as well as the general scope of work for the project. Some organizations forgo the creation of a project charter, viewing it as a document that merely takes time to create and contains information that "everyone already knows." This can be a big mistake. The charter can be referenced by the project manager and stakeholders if some of the goals of the project are not met or they are asked to do something outside the scope of the project. A well-drafted project charter can prevent political interference in achieving the goals of the project and reduce scope creep.

In summary, 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.

What Should Be in the Project Charter?

There are many templates available for project charters and these vary greatly in the content and level of detail. (The PMI affiliated website ProjectManagement.com offers a number of project charter templates) At a minimum, good project charters will contain the following sections.

Background

The background should provide a broad overview of the project and answer the following questions:

- What is the purpose of the project?

- Where did the project originate? Have we conducted similar projects in the past?
- Who is the project manager and what level of authority does the project manager have?

Business Case

The Business Case describes why this project was selected over others and answers the following questions:

- Why was this project selected to move forward (project justification)? What selection criteria were used? (Project selection techniques are covered in a later chapter.)
- What problems is this project solving or what opportunities is it creating? What are the high-level requirements?

Goals

Listing the goals for the project ensures that the stakeholders will not be disappointed when the project is completed. This section should answer the following questions:

- What are the broad goals of this project?
- How will we know if the project is a success (what are our metrics for success)?
- Are there industry standards that we are trying to meet or benchmarks for performance that we want this project to attain?

Key Stakeholders

This section describes the key stakeholders and their interest in the project. This doesn't have to be an exhaustive list of stakeholders, but should contain a list of people who are interested in the project, as well as people who will pay for, or benefit from, the project.

Deliverables

A project is said to have deliverables as products or services. They are things such as physical objects, software code, or events that make up the project and they are written in the form of nouns, for example, floor, walls, electrical…etc.

Major Milestones

This section provides a summary of the major milestones for the project. A listing of any hard deadlines for the project should be included. Milestones can relate to project work (when are major deliverables expected to be complete?) as well as invoicing and payment deadlines.

Project Budget

The project budget section should provide a summary of the budget for the project and information about how it was determined. It answers the following questions:

- What is the initial budget for this project?
- How was that budget developed?
- Are the numbers used for budgeting rough estimates based on top-down estimation techniques, such as analogous or parametric estimating, or are they hard constraints?
- What contingency funds have been allocated?

4.5. Project Scope

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 documented in the project's scope management plan.

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.

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 such as dimensions, ease of use, colour, and specific ingredients. 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, and colour choices.

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.

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.

Non-functional Requirements

Non-functional requirements specify criteria that can be used to judge the final product or service that your project delivers. There 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.

As mentioned earlier in Chapter 1, projects have constraints that can be categorized according to the type of requirements. There are three general types of non-functional development constraints:

- **Time:** When a deliverable should be delivered
- **Cost:** How much money is available to develop the deliverable
- **Quality:** Any standards that are used to develop the deliverable, development methods, etc.

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 the required functionality and fulfill the 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.

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.

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.

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.

Measuring Requirements

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 for business needs, opportunities, goals, and objectives
- Requirements for project objectives

- Requirements for project scope/work breakdown structure deliverables
- Requirements for product design
- Requirements for product development
- Requirements for 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.

4.6. Managing the Scope

Time, cost, and scope are known as the triple constraints of project management. It's not possible to change one without changing at least one of the others. If the project takes twice as long as expected to complete, then the cost will almost certainly go up. On the other hand, a decision to cut costs, perhaps by using less experienced labour, could lead to a work slowdown, extending the schedule. Such a decision might also result in a change to the project's scope, perhaps in the form of a lower-quality product.

The initiation phase is too early in the project to nail down precise details about time and cost, but it is a good time to think long and hard about scope, which is "all of the work that needs to be done to provide the product or service your project is delivering" (Martinez, n.d.). In this early stage, you and the project stakeholders might do some blue-sky thinking about what your project could possibly achieve, without regard to the constraints of time, cost, and scope. But before too long you'll need to zero in on a definition of the project's scope, formalizing it as a scope statement, using the information currently available to you.

Except for the simplest projects, any scope definition will almost certainly evolve as you learn more about the project and the customer's needs. The term **scope evolution** refers to changes that all stakeholders agree on, and that are accompanied by corresponding changes in budget and schedule. Scope evolution is a natural result of the kind of learning that goes on as a project unfolds. This includes learning that arises from fresh insights into the needs of the end user, new regulations, or upheaval in the marketplace. As long as all stakeholders agree on the scope changes (and the associated changes to the budget and schedule), scope evolution ensures that customers actually get what they want out of the project. The more you talk with the client and learn about their needs, the more you will be able to refine the scope.

Indeed, one of the main jobs of a project manager is managing scope evolution. However different types of projects will involve varying amounts of scope evolution. For example, if you're working on a project related to satisfying a specific environmental regulation, the initial definition of the project's scope might be clear, requiring little refinement as the project unfolds, as long as the regulation itself is not altered. But if you are working on a product designed to satisfy a brand-new market demand, you might need to refine the scope continually to ensure that you satisfy your customers' needs.

Perhaps the most common cause of **scope evolution** is a change in the context in which a project is planned and executed. Alterations in market forces, changing demographics, new or more vigorous competition, and technological advancements can all change a project's context, forcing you to rethink its scope. This potential for changing contexts means that no two projects are the same.

Scope evolution is managed change. It is an approved alteration to the project scope that occurs as the project participants learn more about the project. It results in an official change in the project scope, and therefore to the project budget or schedule, as agreed to by all project participants. This kind of managed change is a natural and rational result of the kind of learning that goes on throughout the course of a project. It is a conscious choice necessitated by new information forcing you to reconsider project essentials in order to achieve the intended project value.

Scope creep is unmanaged change. It is caused by uncontrolled changes to the project scope. Such changes might add value from the customer's perspective, but the time, money, and resources consumed by the change of scope lead to additional overruns. Scope creep tends to happen bit by bit because no one is paying close attention to the project's scope. For example, in a kitchen remodelling project intended to replace countertops and cabinets, deciding at the last minute to replace all appliances might be an example of scope creep.

Creating a Clear Scope Statement

The key to managing scope is a carefully crafted scope statement, which should be clear and precise. The details of how you plan to carry out a project may be vague at first, but what you want to achieve should be perfectly clear. Vagueness can lead to small changes to the project's scope, which in turn lead to other changes until the original project is no longer recognizable.

Writing a **scope statement**, the document that defines the project's scope is a major part of the initiation phase. However, according to Brad Bigelow (2012, p. 1) in an article for the Project Management Institute, it is "usually expressed in qualitative terms that leave room for interpretation and misunderstanding. Consequently, it's often the biggest source of conflicts in a project".

To avoid such problems, experienced project managers put a lot of effort into learning what should and shouldn't be included in the project, and then articulating these boundaries as clearly as possible in the form of a scope statement. According to Bigelow (2012, p. 2), this work is essential to ensuring a project's success: "No project's scope can ever be entirely free of fuzziness—free from subjectivity and imperfect definitions—as long as human beings are involved. On the other hand, it's also highly improbable that any project will ever survive initiation if its scope is entirely vague, undefined, and subject to unpredictable expectations".

If the scope is poorly defined, then what is or isn't within the project scope is reduced to a matter of perspective. Not surprisingly, these "different perspectives…can often be the root of conflicts within a project" Bigelow (2012, p. 2). Bigelow describes a project in which the team and the customer see things very differently:

When the scope is poorly defined, satisfying the customer can grow increasingly difficult, with the team going off and creating what it thinks the customer wants, only to be told, "No, that's not it."

Opinions vary on exactly what a scope statement should include, but at the very least it should contain the following:

- A brief justification of the project's purpose, including a summary of the business needs the project will address.
- An explanation of the project's goals.
- Acceptance criteria specify the conditions the product or service must satisfy before the customer will accept the deliverables.
- Deliverables are "the quantifiable goods or services that will be provided upon the completion of a project. Deliverables can be tangible or intangible parts of the development process, and they are often specified functions or characteristics of the project" (Bloomenthal, n.d., para. 1.).
- An explanation of anything excluded from the project—in other words, an explanation of what is out of scope for the project. This list should be "as detailed as is necessary to define the project boundaries to all stakeholders" (Feldsher, 2016, para. 11).
- Constraints, such as budget and schedule.
- Assumptions, including anything you currently believe to be true about the project. It's also helpful to include ideas "about how you will address uncertain information as you conceive, plan, and perform your project" (Portny n.d., 2018).
- An explanation of any new or unusual technology you plan to use throughout the project. This is not a typical part of a scope statement, but "it's likely that stakeholders will appreciate the transparency and feel more comfortable with the project moving forward" (Feldsher, 2016, para. 13).

Practical Tips

- **Engage all stakeholders:** Your goal is to keep people meaningfully engaged in your project. You don't want stakeholders showing up for ceremonial appearances at project meetings. Instead, you want them seriously focused on the prospects for project success.

- **Outcome clarity:** Ask your customer to define success right at the beginning. Then, working with the customer and other stakeholders, define how success will be measured.
- **Use a common vocabulary:** At the beginning of any project, go to your end customers and learn their vocabulary. Make sure you understand the terms that are important to them and what such terms mean to them. Whenever possible, use your customer's vocabulary, not yours. Also, strive to speak in plain English whenever you can, and avoid techno-speak.
- **Create a glossary of terms:** On projects with a lot of complex jargon, consider creating a glossary of terms. Then publish it in a way that makes it accessible to all stakeholders, updating it as needed. Here's an example of one such glossary: "COSO Framework ".
- Identify what you don't know: When you start a project, there are always things you don't know. The key is to know that you don't know them. The more you strive to recognize this, the better you will be at predicting those unknowns and making provisions for them.
- **Have key team members sign major project documents:** Research shows that the act of signing a document makes people much more committed to delivering on the promises described in the document. Consider asking the entire project team to sign the project charter and scope documents. This simple act can serve as a powerful inducement to complete the project successfully.
- **Proactive concurrency:** In the early stages, avoid the trap of plotting one thing after another, in a linear fashion. Instead, start fast, doing as many things as you can concurrently, as quickly as you can. This will give you a sense of whether or not the scope, budget, resources, and schedule are all in relatively close alignment at the macro scale. If you find they are not, report that to management right away.
- **Permanent urgency:** In the living order in which all modern projects unfold, permanent urgency is the new law of nature. In the traditional, geometric order form of project management, you could assume that you would have sufficient time and resources to do things in a linear, step-by-step manner. But in the modern world, that's rarely the case. Get used to an element of urgency in all projects. Try not to let this paralyze you and your team. Instead, let a sense of urgency spur you on to more agile, alert, and flexible project management techniques.
- **Post the project documents prominently:** Putting important documents front and centre helps a team stay focused, especially if you have everyone sign them first. It also encourages the team to update them when necessary.
- **Plan for errors:** You and your team will almost certainly make mistakes, especially in the early stages of a project. Therefore, you should plan for that. Keep thinking ahead to what might go wrong, and how you could correct course.

4.7. Business Case (In-class discussion)

Simple Example of a Project Charter

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

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.

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 when class starts in August 2010 with enough inventory (computer supplies, such as memory sticks, mouse pads, and cables) to last through the first two weeks of classes.

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:

1. Determine what supplies will be sold in the store.
2. Establish competitive prices for the computer supplies.
3. Source and secure supply vendors.
4. Establish marketing, procurement, operations, and any other necessary departments, schools, centres, 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

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

Major Deliverables

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

- 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

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.

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.

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.

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.

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 items, such as store shelves, will be delayed if a major hurricane occurs.

Project Charter Acceptance

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

Project Stakeholders

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

4.8. Key Terms

Key Terms

- **Assignable:** Who will do the work? Can people be identified who have the expertise in the organization to complete this work? Or can the expertise be hired from outside of the organization?
- **Business Requirements:** The needs of the sponsoring organization, always from a management perspective. Business requirements are statements of the business rationale for the project.
- **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.
- **Non-Functional Requirements:** Specify criteria that can be used to judge the final product or service that your project delivers.
- **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.
- **Project Scope Planning:** 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 documented in the project's scope management plan.
- **Realistic:** Is it realistic that the organization can achieve this project, given its talents and resources? This is a very important consideration for businesses of all sizes. Yes, it would be great to produce a new driverless car, but is that realistic given the resources that the organization has available?
- **Regulatory Requirements:** These 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. They required compliance for all, and standards must be met.
- **Scope Evolution:** Refers to changes that all stakeholders agree on, and that are accompanied by corresponding changes in budget and schedule. Scope evolution is a natural result of the kind of learning that goes on as a project unfolds.
- **Scope Statement:** The document that defines the project's scope, is a major part of the initiation phase.
- **SMART:** An acronym for Specific, Measurable, Assignable, Realistic, and Time-Related. The smart criteria have been applied in many different areas of management, including project

management. Let's take a look at each of Doran's criteria as they apply to project management.

- **Specific:** A project needs to be specific about what it will accomplish. Unlike many organizational goals, the goal of a project should not be vague or nebulous.
- **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.
- **Time-Related:** When will the project be completed and how long will it take? These criteria can be very useful when defining a project. If the description for a project does not meet all these criteria, then it is time to go back to the drawing board and make sure that what is being described is really a project, rather than a program or strategic goal.
- **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.
- **Weighted decision matrix:** A decision matrix is basically an array presenting on one axis a list of alternatives, also called options or solutions. On the other axis is a list of criteria, which are weighted depending on their respective importance in the final decision to be taken.

4.9. Chapter Questions

Knowledge Check 1

Refer to Knowledge Check 4 from Chapter 2 before completing this knowledge check.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=916#h5p-3

CHAPTER 5 - PROJECT PLANNING (SCHEDULING)

Chapter Overview

5.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Define terms related to scheduling.
2. Calculate parametric estimates.
3. Describe how cost and time are summarized in a WBS.
4. Outline the process of decomposition is used to create a WBS.
5. Identify the difference between a deliverable and work package.
6. Describe the WBS numbering system.
7. Outline top-down estimation methods.
8. Outline bottom-up estimation methods.
9. Be able to calculate learning curves and apply them.
10. Discuss issues related to moving from the planning phase of a project to the scheduling phase.
11. Explain concepts related to the critical path method including schedule compression.

5.2. Scheduling Terms

Making sure all stakeholders use the same terminology is crucial in all phases of project management, but it's especially important when you are trying to get a group of diverse people to agree to a schedule. After all, a schedule only works as a form of communication if it is written in a language everyone understands. And since contract terms are often tied to a schedule, a lack of common agreement on the meaning of specific terms in a schedule can have far-ranging effects.

Terminology is so important that many state governments around the United States publish their own project management glossaries. As you embark on a new project, you'd be wise to find out if the organization you work for, or the vendors you will be working with, have compiled such a glossary. If such organizational resources exist, use them as a starting point for your own project glossary. Otherwise, you can always turn to the Project Management Institute's lexicon (available here: "PMI Lexicon of Project Management Terms") or glossaries provided online by consulting firms or other project management resources such as the following:

Project Management Terms

- "Project Management Glossary of Terms"
- "Project Management Glossary"

The following definitions of scheduling-related terms are taken from a variety of sources.

- **milestone:** "A significant event in the project; usually completion of a major deliverable" (State of Michigan: Department of Technology, Management & Budget, 2013, p. 13). An important distinction is that a milestone is a zero-duration activity; e.g., "acceptance of software by client" is a milestone, preceded by many contributing activities.
- **activity:** "An element of work performed during the course of a project. An activity normally has an expected duration, an expected cost, and expected resource requirements" (Project-Management.com, 2016). Beware that some organizations subdivide activities into tasks while others use task and activity synonymously.
- **duration:** "The amount of time to complete a specific task given other commitments, work, vacations, etc. Usually expressed as workdays or workweeks" (State of Michigan: Department of Technology, Management & Budget, 2013, p. 9).
- **resource:** "Any personnel, material, or equipment required for the performance of an activity" (Project-Management.com, 2016).
- **cost:** "An expenditure, usually of money, for the purchase of goods or services" (Law, 2016).
- **slack:** "Calculated time span during which an event has to occur within the logical and imposed constraints of the network, without affecting the total project duration" (Project-Management.com, 2016). Put more simply, slack, which is also called float, is the amount of time that a task can be delayed without causing a delay to subsequent tasks or the project's overall completion date.

5.3. Defining Activities

The **activity** definition process is a further breakdown of the work package elements of the work breakdown structures (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.

5.4. Work Breakdown Structures

The WBS is a hierarchical outline of all the deliverables involved in completing a project. The WBS is part of a project scope statement. The creation of a WBS is one of the first steps in organizing and scheduling the work for a project.

The WBS is a breakdown of a project into sub-deliverables and eventually work-packages. Each level of the WBS, represents more detailed information about a project. Figure 5.1 shows how the project is broken down into major deliverables and then into sub-deliverables and work packages.

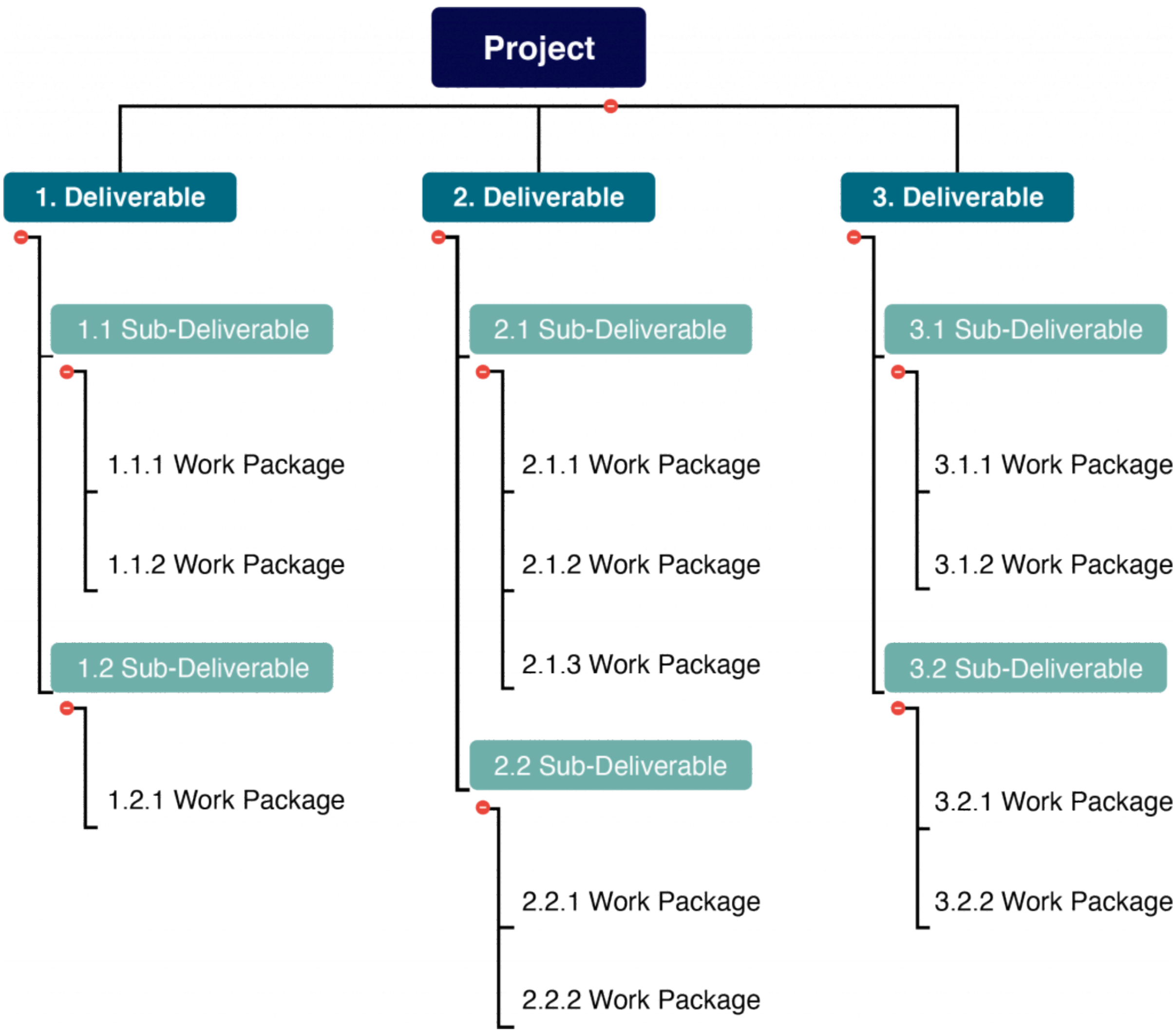

Figure 5.1: The WBS is an outline that shows how the deliverables, sub-deliverables and work packages relate to the final project.

Deliverables vs. Work Packages

Deliverables and sub-deliverables are things such as physical objects, software code, or events. In a WBS, deliverables and sub-deliverables are represented by nouns (see Figure 5.2). Work packages are assignable units of work that will be performed to create the related deliverable. A work package can be assigned to one particular project team member, one outside contractor, or another team. The work packages may be further broken down into activities or tasks by the project team or the experts who will perform that work (see WBS dictionary later in this section).

Work packages are action-oriented and will be represented by phrases containing verbs (see Figure 5.2). The cost of a deliverable is the sum of all of its related sub-deliverables.

In Figure 5.2, the cost of the Walls deliverable is the sum of the Stud Walls and the Electrical sub-deliverables ($17,740 + $3,680 = $21,420). Likewise, the cost of a sub-deliverable is a summary of all of the work packages that must be completed to complete the sub-deliverable.

In Figure 5.2, the cost and duration of the Stud Walls deliverable is a sum of all the related work packages ($3,840 + $1,340 + $2,000 +$10,560 = $17,740; 24hrs + 8hrs + 24hrs + 32hrs = 88hrs).

Since the WBS provides a natural way to summarize (or "rollup") the costs and labour involved for various sub deliverables, it also provides the project team with the information needed to determine whether some deliverables would be better performed by an outside specialist who could deliver the item or service more cost-effectively.

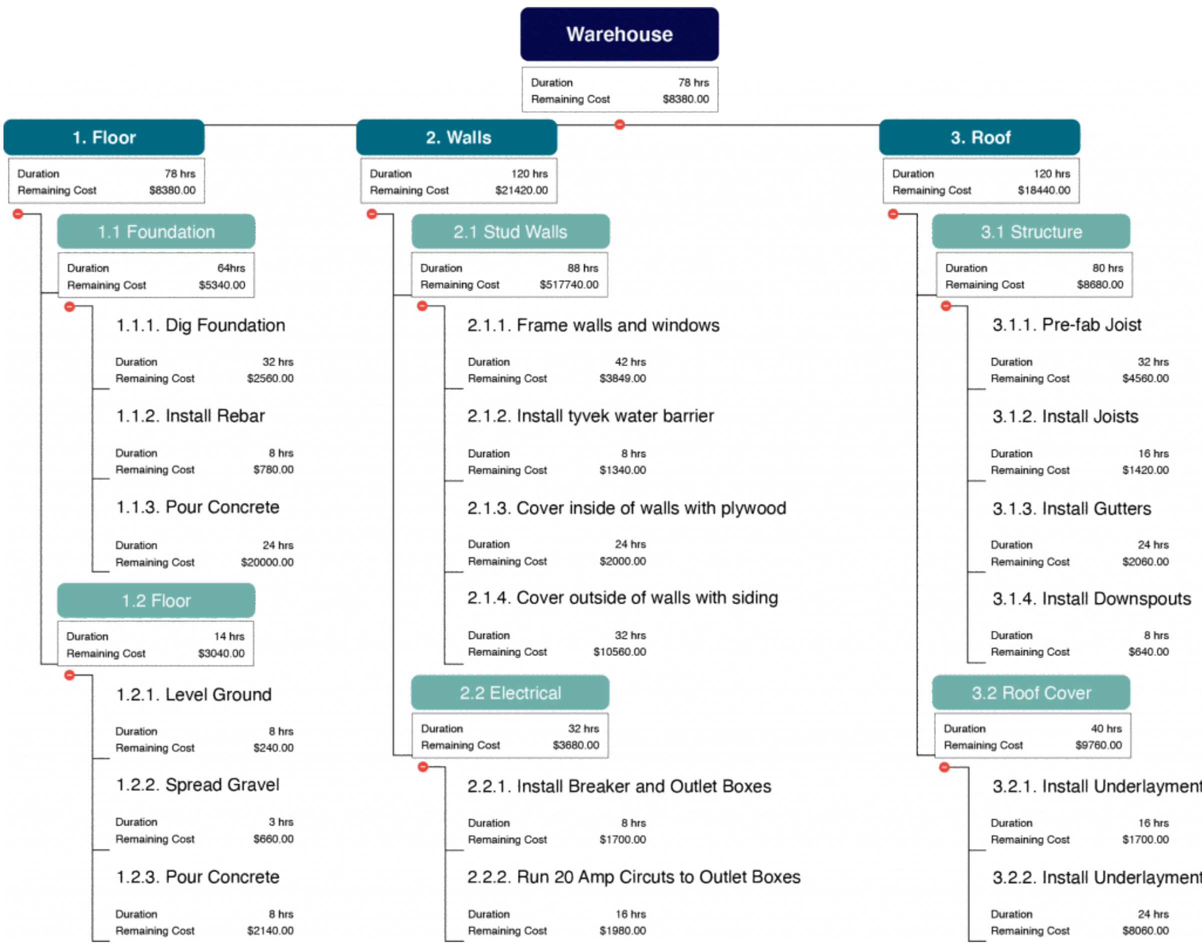

Figure 5.2: WBS for New Warehouse Project

In the example in Figure 5.2, if the project manager can find a roofing contractor that completes the roof in less than 15 days (120 hours) and for less than $18,440, then it would be better to outsource that part of the project.

Note that work packages are independent of each other in a WBS, and do not summarize or include the work from other work packages. Work packages are the lowest level of the WBS.

WBS Numbering

Project managers use the WBS during project execution to track the status of deliverables and work packages. The items in a WBS are numbered so it is easy to understand the deliverable, or sub-deliverable, to which any particular work package is related. Notice that in Figure 5.2 the Install Metal Roof item is numbered 3.2.2, so it is easy to see that this work package is related to the third major deliverable (Roof: 3.) and the second sub-deliverable (Roof Cover: 3.2.) and that it is also the second work package for the creation of the roof covering (3.2.2).

This numbering system allows for easy reference and filtering. For example, an electrician working on the Warehouse project only needs to receive details and updates that are related to work packages that start with 2.2 (the Electrical sub-deliverable).

Decomposition

Decomposition is the process used to break the project scope of work into the deliverables, sub-deliverables, and work packages involved in completing the project.

The process of decomposition begins with identifying the highest-level deliverables. These deliverables are then broken into sub-deliverables. Many layers of sub-deliverables may be needed for a project. A general rule of thumb is that if the WBS has more than 5 layers of sub-deliverables, the project team should reassess and try to simplify the WBS structure (often by changing the way higher-level deliverables are grouped and broken down).

Once the lowest level of deliverables has been reached, the next step is to break the sub-deliverables into work packages. The work packages describe the work that needs to be done to create the sub-deliverable. Remember that work packages typically contain verbs, and can be assigned to a person, team or contractor.

Once the project team has drafted the WBS, they should ask themselves: " If all the work packages were completed, and all the deliverables in this WBS were delivered, would the project be complete?" If the answer is no, then pieces of the WBS are still missing. If the answer is yes, then the project team can move on to creating the WBS dictionary, getting bottom-up estimates on time and resource requirements, and planning how to schedule the work.

The WBS Dictionary

The WBS dictionary provides detailed documentation about each work package including;

- Who is responsible for completing the work package?
- What resources will be needed to complete the work package?
- What deliverable(s) is the work package contributing to?
- What deadlines or milestones are associated with this work package?
- What are the acceptance criteria for this work package?

When the WBS is created, not all of the information about the work packages is known (for example, the estimates for labour and material costs). Remember from Chapter One that the planning process continues throughout the execution of the project. As a result, the WBS dictionary is a "living document" that will be augmented, edited and updated as the project moves forward. Table 5.1 is an example of a WBS Dictionary entry; note that several items will be added later in the planning process.

Table 5.1 WBS Dictionary Entry Example

Hammer and Chisel Incorporation
WBS Dictionary

Item Number	Description	Constraints	Responsible	Milestone	Schedule	Resources	Cost	Quality	Acceptance Criteria	References	Guidelin
1.1											
1.1.1											
1.1.2											
1.1.3											

5.5. Time Estimation

Estimates have a huge influence on a project and are a large source of project risk. Watch the video on time estimates to learn about how estimates are used for project planning.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=376#oembed-1

Watch this Video: Time Estimates by Prof C [3:04] (Transcript Available).

Top-down estimation	Also referred to as macro, estimation methods are used to determine if a project is feasible, to calculate funding requirements, and to determine the resources needed to complete a project. These methods are not extremely accurate but provide a relatively fast way to make an estimate of the time and costs required for a project.
Bottom-up estimation	Also referred to as micro, estimation methods are used to provide a detailed, and more accurate, estimate and are usually derived from the detailed list of work packages or activities found in the work-breakdown structure.

As the video mentions, all estimates contain risk. If estimates are too low, then a project will take more time and money to complete than what was budgeted. Obviously, a bad situation. If estimates are too high, then a project will take less time and money than originally estimated. This might seem to be a desirable situation, but good project managers will realize that estimates that are too high will cause an organization to over-allocate resources to a project, thereby preventing other projects from being pursued due to organizational resource shortages. Therefore, it is important to have the most accurate estimates possible. The project team needs to understand the value of accurate estimates and avoid the natural human tendency to pad estimates. Once unbiased estimates for a project have been generated, the project manager can calculate what time buffers and budgetary reserves should be added to the project plan to deal with uncertainty.

Accuracy of Estimates

Prior to project authorization, estimates for project cost need to be given, but these estimates can be rough estimates. As the project progresses, more definitive estimates will be needed and can be generated.

PMI defines the following ranges for estimates:

- Rough Order of Magnitude (ROM). ROM estimates are made at the initiation of the project and can be +/- 50 percent of the actual or final cost.
- Budget Estimate. Budget estimates are used in project planning and can be within a range from -10 to +25 percent of the actual or final cost.

- Definitive Estimate. Definitive estimates are generated as the project progresses and the variability of the estimate is reduced (see Figure 5.3). Definitive estimates are within a range from -5 to +10 percent of the actual or final cost.

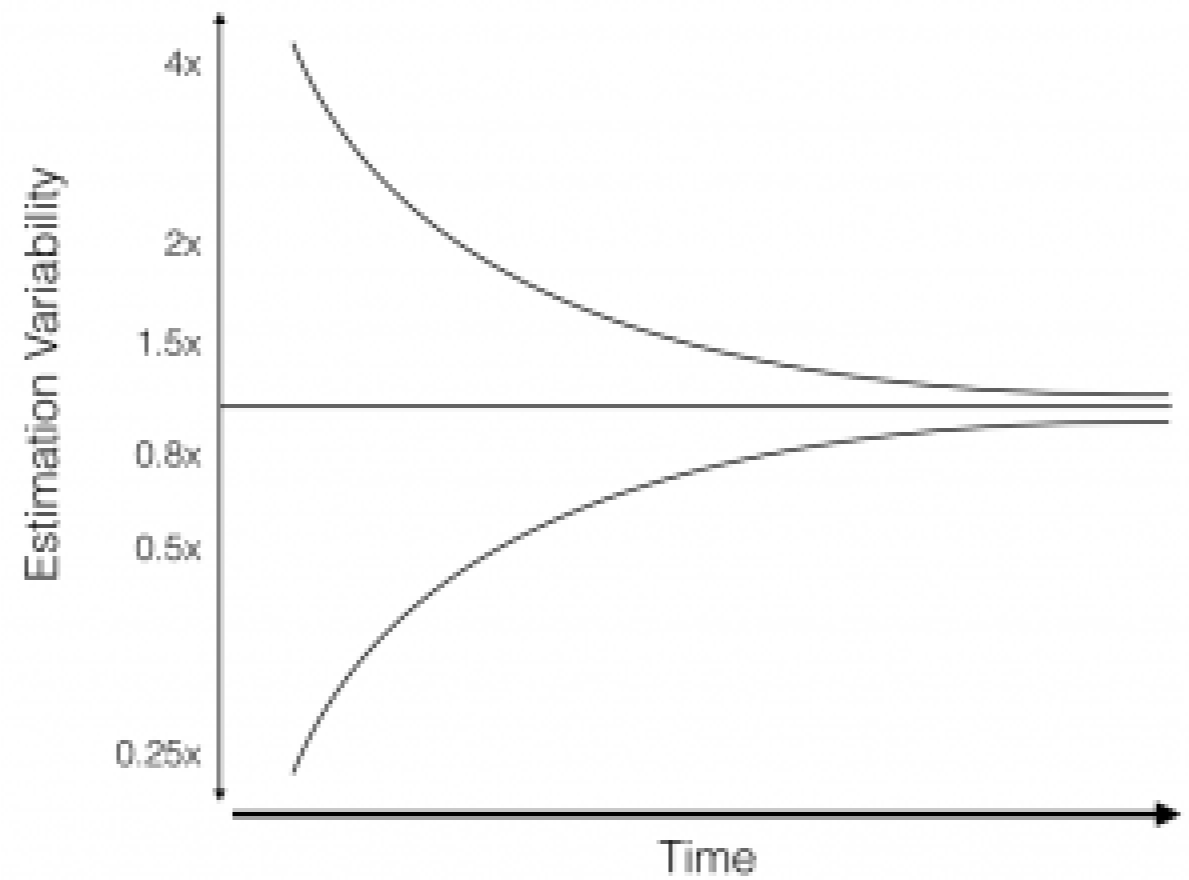

Figure 5.3: Estimates contain a high degree of variability at the inception of a project, and that variability decreases as the project is defined and moves toward completion.

Top Down (Macro) Estimation

Top-down, or macro, estimation methods allow for a quick estimate of project costs based on historical information.

Analogous Estimating

Analogous estimating uses information from a previous project to estimate the cost of completing a similar project in the future. This provides a quick estimate, but should be used with caution. Analogous estimating only works when comparing projects that are similar in scope and will be completed in similar conditions.

For example, a small IT business developed a website for a local restaurant for which they charged $4000. Another restaurant approaches the IT firm and asks for a rough cost estimate for a similar site. The IT firm can tell the second restaurant that such work will cost approximately $4000. Of course, the caveat is that this second website will have a similar number of pages, functions, and graphics as the first site.

The advantage of analogous estimating is that it allows for a very quick estimate to be provided for a customer. If in the example above, the second restaurant had only budgeted $200 for a website, they would have quickly determined that they have not budgeted enough, and the IT firm would be able to quickly determine that this is not a serious customer. However, if the second restaurant is okay with this approximate price, the IT firm can work with the restauranteur to develop a detailed cost proposal.

Analogous estimating is not accurate if:

- The projects differ in scope.
- There is a difference in the conditions under which the work will be performed.
- There is a difference in the cost of resources (materials, labour).

Learning Curves

Projects that require an activity to be repeated several times throughout the project will benefit from a so-called learning curve. Learning curves, also known as improvement curves or experience curves, are important when labour is one of our main resources.

Consider a large construction project for a new highway. The first hundred feet of highway may be fairly slow to complete. But as workers become more experienced, and figure out better ways to organize their work, the time required to construct the next one hundred feet of new highway will be less.

Learning curves were first observed in aircraft production and are also used heavily in operations management. Each time production doubles, a learning rate can be calculated. See Table 5.2 for the calculation of a learning curve. When output doubles, from the first screen installed to the second, a learning rate is calculated. Another learning rate is calculated when the output doubles from the second screen installed to the fourth, and so on. The average learning curve can then be calculated. Later, if this company is contracted to install projector screens as part of a project, they can use this learning curve in their labour estimates.

There is a limit to the improvement of a learning curve. Eventually, the learning curve will “bottom out” and no more improvement gains can be achieved.

Table 5.2

Number of screens installed	Time to install projector screen	Learning Rate
1	500	
2	440	88.0%
3	420	
4	400	90.9%
5	390	
6	380	
7	370	
8	360	90.0%
9	355	
10	350	
11	345	
12	344	
13	342	
14	340	
15	339	
16	338	93.9%
Average	90.7%	*Data from Ta Notice that th the less impro installation to*

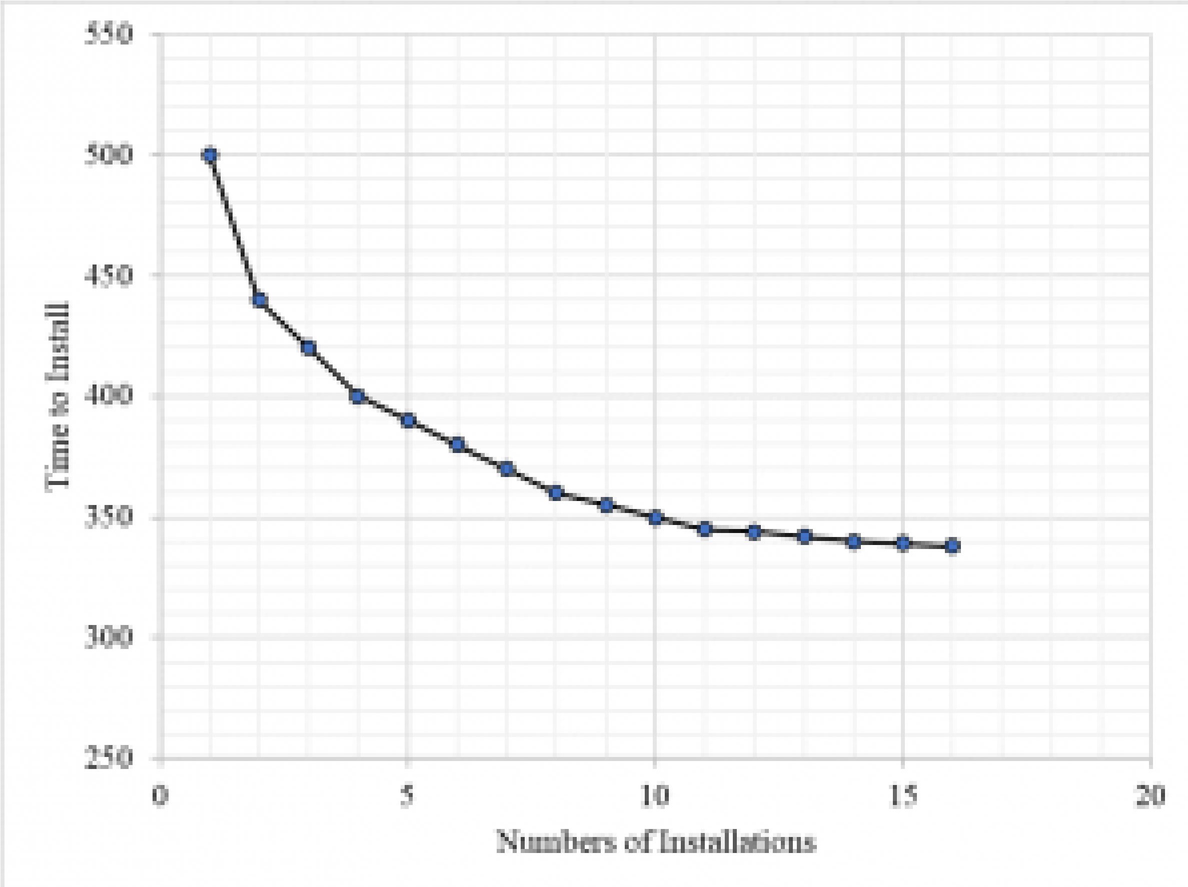

Figure 5.4: Learning curve calculation – Each time production is doubled, the learning rate for that doubling is calculated: (screen 2 time/screen 1 time), (screen 4 time/screen 2 time), (screen 8 time/screen 4 time), and (screen 16 time/screen 8 time).

However, there are several things that can be done to extend and improve the slope of a learning curve:

- Incentivize workers to improve the processes they are using to complete their tasks. These incentives are "built-in" for companies that are employee-owned, where employees share in the reward if profits increase.
- Make investments in new technology and equipment.
- Invest in training and education for new workers, so they are not "learning on the job."
- Give workers the flexibility to make changes to how materials are sourced, delivered, and organized.
- Re-engineer the deliverables so they are easier to produce.

Learning curves usually hold if the work is continuous. If there is a break in the work, gains in productivity when work resumes will not be as great as if the work had continued uninterrupted.

Bottom Up (Micro) Estimation

Bottom-up or micro 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 needs or costs 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 scheduled 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 calculation. The smaller and more detailed the activity, the greater the accuracy and cost of this technique.

The Bottom-up estimation techniques are used when the project is approved or is very likely to be approved. Bottom-up estimation techniques generate estimates for individual work packages or sub-deliverables, which are then summarized to reflect total costs. Bottom-up estimates are more accurate, and detailed and take more time to generate. Instead of relying on historical information, bottom-up estimates rely on people with experience who can provide time and cost estimates for a particular work package or sub-deliverable.

These basic guidelines should be followed when generating bottom-up estimates:

- Have people familiar with the work make the estimate.
- If possible, use several people to make estimates.
- Estimates should be based on normal conditions and a normal level of resources.
- Estimates should not make allowances for contingencies.

The project manager or team will add buffer times and contingency funds to the project after estimates are collected and analyzed.

Parametric Estimating

Parametric estimates, also called the ratio method, use historical information or industry benchmarks as the basis for making an estimate. Parametric estimates are made by multiplying the size of a project by an established cost per unit.

Table 5.3: Hospital construction costs – Data from Reed Construction 2014.

Cost Estimate (Union Labour)	**Cost per Square Foot**
Labour and Materials	$234.09
Contractor Fees (GC, Overhead, Profit)	$58.52
Architectural Fees	$26.34
Total Building Cost (per Square foot)	**$318.95**
Cost Estimate (Open Shop)	**Cost per Square Foot**
Labour and Materials	$217.51
Contractor Fees (GC, Overhead, Profit)	$54.38
Architectural Fees	$24.47
Total Building Cost (per Square foot)	**$296.36**

For example, industry data is available for the per-square-foot construction cost for many types of buildings. An architect can use this information to make a parametric estimate by multiplying the cost per square foot by the size of any new building being considered. If an organization wants to build a new hospital using union labour, a rough estimate of the construction cost can be calculated using the information in Table 5.2: 20,000 ft^2 clinic × $318.95/$ft^2$ = $6,379,000. The organization can then use this estimate as an approximate cost and start securing the money for the project. Once the funding is secured, an architect can develop a complete plan and produce a more accurate project budget, using a bottom-up estimation method.

Single Point Estimate

Single point estimation is an estimate obtained from just one estimator. This can work well with experienced estimators and work packages that are straightforward. Single-point estimates are quick to generate and summarize in a project plan. The risk with single-point estimates is that the estimator will overlook some aspects of the work and inadvertently provide an inaccurate estimate.

Three-points estimate

Instead of asking an estimator for just one estimate, a three-point estimate asks the estimator to provide three-time estimates for each activity:

- An optimistic time estimate (if all goes well, what is the shortest time period one could realistically expect for the completion of this activity?). This will be designated in calculations as ***a***.
- The most likely time estimate (if all goes normally, what is the average time one would expect it would take for an activity to be completed?). This will be designated in calculations as ***m***.
- A pessimistic time estimate (if work goes poorly, what is the longest time period one could realistically expect for the completion of this activity). This will be designated in calculations as ***b***.

These three estimates can be used as inputs to calculate an estimated time for the activity or work package to be completed, either through a simple average or through a weighted average known as **T_e,** where **T_e=(a+4m+b)÷6.**

Resource Levelling

Resource levelling is used to examine the 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 two tasks, the tasks will have to be rescheduled sequentially to manage the constraint. Resource levelling 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, levelling 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 levelling 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 levelling to be performed at the company level.

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

5.6. Managing the Schedule

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 scheduled 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 5.5). 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. Thus, the detailed Gantt chart is usually constructed after the main objectives have been determined.

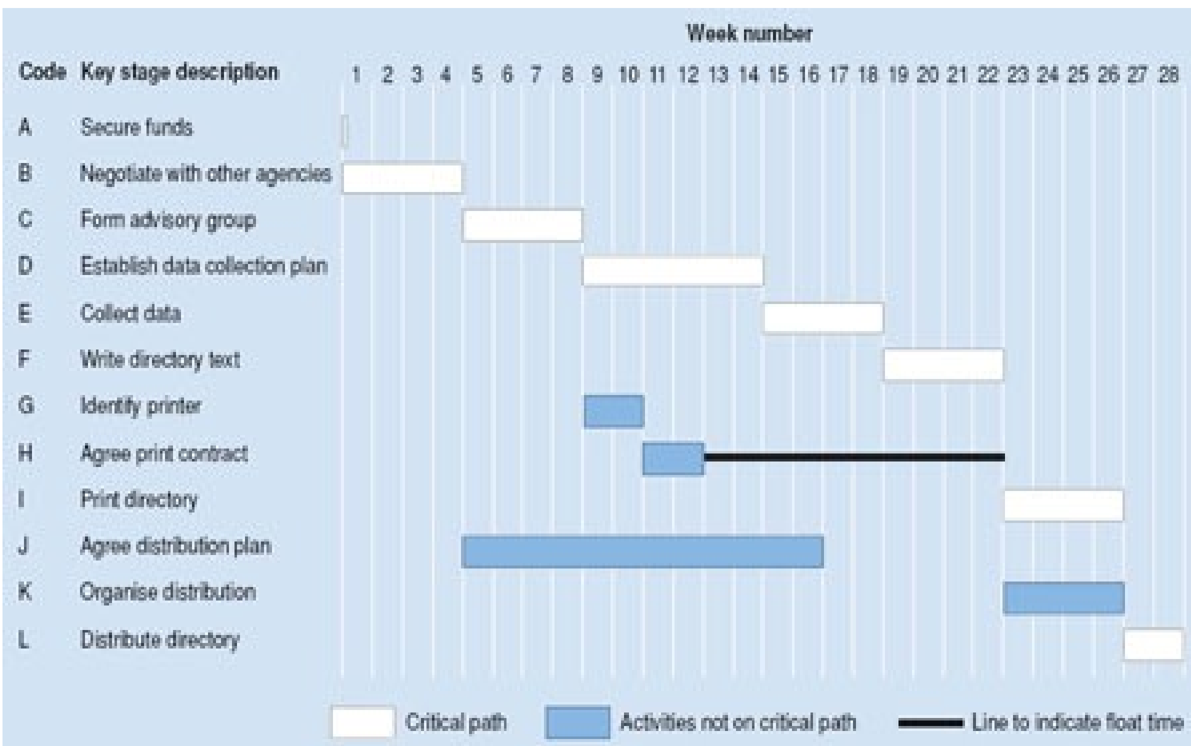

Figure 5.5: Gantt Chart

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 in creating a network diagram is to arrange the tasks from your WBS into a sequence. Some tasks can be accomplished at any time throughout the project whereas other tasks depend on input from another task or are constrained by time or resources.

The WBS is not a schedule, but it is the basis for one. 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 5.6), 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.

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.

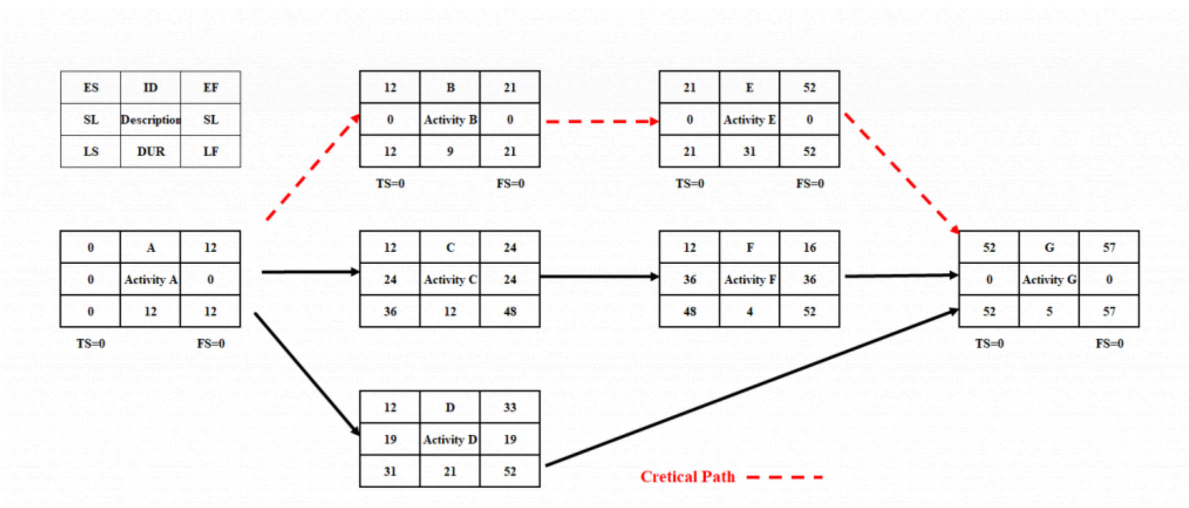

Figure 5.6: An example of an activity on node (AON) diagram

Forward and Backward Pass

Once a network diagram has been made and estimated activity durations have been assigned to each activity, the following attributes of each activity can be calculated:

- Early start time (ES)
- Late start time (LS)
- Early finish time (EF)
- Late finish time (LF)
- Slack or float (SL or FL)

These activity attributes are calculated using two processes: the forward pass and the backward pass.

Watch the video: Project Management Networks Part 2: Forward and Backward Pass to learn how to make these calculations.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=383#oembed-1

Watch this Video: Project Management Networks Part 2: Forward and Backward Pass by Prof C [7:08] (Transcript Available).

The forward and backward passes are also used to fully calculate the critical path(s) in a project. Note: there can be instances where the start of an activity is on the critical path, but the finish is not on the critical path. This is unusual but can happen depending on the types of relationships that are involved.

The Critical Path

The critical path (dashed red line as seen in figure 5.6) 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.

Milestones

One way to avoid getting lost in a sea of details is to focus on your project's milestones, which can serve as a high-level guide. You can use pull planning to identify your project's milestones, and then use the critical path to figure out how to hit those milestones. It gives a reality test to whether your milestones are in fact achievable. Then you're off and running, in living order.

In an excellent blog post on the usefulness of milestones, Elizabeth Harrin (2017) explains that milestones should be used "as a way of showing forward movement and progress and also show people what is going on, even if they don't have a detailed knowledge of the tasks involved to get there. In that respect, they are very useful for stakeholder communication and setting expectations" (Harrin, 2017). You can use milestones, she explains, to track your progress, focus on:

- starting of significant phases of work
- ending of significant phases of work
- marking the deadline for something
- showing when an important decision is being made. (Harrin, 2017)

Milestones are especially useful as a form of communication on the health of a project. A version of a project schedule that consists only of milestones allows stakeholders to get a quick sense of where things stand. You may want to report on milestones in the project's dashboard, which should serve as an at-a-glance update for the project.

5.7. Business Case

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.

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 you 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
- Reception venue preparation
- Transportation

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.

Questions

Please answer the following questions about the business case:

1. List some activities to accomplish the above to-do list and organize them under major deliverables in WBS.
2. What method should Sally estimate (bottom-up, top-down) the time for these activities? Explain.
3. Discuss what tools that Sally can use to manage the schedule.

5.8. Key Terms

Key Terms

- **Activity:** An element of work performed during the course of a project. An activity normally has an expected duration, an expected cost, and expected resource requirements.The process of further breakdown of the work package elements of the work breakdown structures (WBS).
- **Analogous Estimating:** Uses information from a previous project to estimate the cost of completing a similar project in the future. This provides a quick estimate but should be used with caution. Analogous estimating only works when comparing projects that are similar in scope and will be completed in similar conditions.
- **Bottom-Up, or Micro:** Techniques are used when the project is approved or is very likely to be approved. Bottom-up estimation techniques generate estimates for individual work packages or sub-deliverables, which are then summarized to reflect total costs.
- **Gantt Chart:** 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 scheduled activities. These charts display the start and finish dates of the terminal elements and summary elements of a project.
- **Network Diagram:** 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.
- **Single Point Estimation:** Estimate obtained from just one estimator. This can work well with experienced estimators and work packages that are straight forward.Three-Points Estimate: Instead of asking an estimator for just one estimate, a three-points estimate asks the estimator to provide three-time estimates for each activity.
- **Work Breakdown Structure (WBS):** Hierarchical outline of all the deliverables involved in completing a project. The WBS is part of a project scope statement. The creation of a WBS is one of the first steps in organizing and scheduling the work for a project.

5.9. Chapter Questions

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=962#h5p-22

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=962#h5p-23

CHAPTER 6 - PROJECT PLANING (RESOURCES, COST, AND BUDGET)

Chapter Overview

6.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Define basic terms such as budget, estimate, price, cost, and value.
2. Discuss the relationship between cost and budget.
3. Explain basic concepts related to budgeting.
4. Identify different types of costs, and discuss issues related to contingency funds, profit, and cost estimating.
5. Explain the benefits of contingencies.

6.2. Resource Estimation

Resources are people, equipment, places, 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.

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.

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 to 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 in 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.

Human Resources Management

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 work 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.

Techniques for Managing Resources

One resource management technique is **resource levelling**. 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.

6.3. Cost Estimation

Ultimately cost, the number management typically cares about most in a for-profit organization, is determined by the price. For many projects, it's impossible to know the exact cost of an endeavour until it is completed. Stakeholders can agree on the intended value of a project at the beginning, and that value has an expected cost associated with it. But you may not be able to pin down the cost more precisely until you've done some work on the project and learned more about it.

To estimate and manage costs effectively, you need to understand the different types of costs:

- **Direct Costs:** "An expense that can be traced directly to (or identified with) a specific cost centre or cost object such as a department, process, or product" (Business Dictionary, n.d.). Examples of direct costs include labour, materials, and equipment. A direct cost changes proportionately as more work is accomplished.
- **Direct Project Overhead Costs:** Costs that are directly tied to specific resources in the organization that are being used in the project. Examples include the cost of lighting, heating, and cleaning the space where the project team works. Overhead does not vary with project work, so it is often considered a fixed cost.
- **General and Administrative (G&A) Overhead Costs**: The "indirect costs of running a business," such as IT support, accounting, and marketing" (Tracy, n.d., para. 1).

The type of contract governing your project can affect your consideration of costs. The two main types of contracts are fixed-price and cost-plus. Fixed price is the more predictable of the two with respect to the final cost, which can make such contracts appealing to the issuing party. But "this predictability may come with a price. The seller may realize the risk that he is taking by fixing a price and so will charge more than he would for a fluid price, or a price that he could negotiate with the seller on a regular basis to account for the greater risk the seller is taking" (Symes, 2018).

Many contracts include both fixed-price and cost-plus features. For example, they might have a fixed price element for those parts of the contract that have low variability and are under the direct control of the project team (e.g., direct labour) but have variable cost elements for those aspects that have a high degree of uncertainty or are outside the direct control of the project team (e.g., fuel costs or market-driven consumables).

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 labour 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.

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.

Analogous Estimate

An estimate that is based on other project estimates is an **analogous estimate**. If a similar project costs 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 costs 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.

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 labour 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.

Activity-Based Estimates

An activity can have costs from multiple vendors in addition to internal costs for labour 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 6.1). The detailed cost estimates can be sorted and then subtotalled by activity to determine the cost for each activity.

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
Packing Materials	Rental	2.1			$400.00
Packing Materials	Gas at 10mpg	2.1	200	$2.25	$45.00

Table 6.1 John's Move example – Detailed Costs Associated with Activities.

6.4. Understanding Cost

Budgeting is an exercise in refining your focus. You start with a wide-angle estimate, in which the details are necessarily fuzzy, and bit by bit zero in on a sharper picture of project costs. You might be temperamentally inclined to try to nail down every figure in an early draft of a budget, but in fact, you should only develop a budget at the precision needed for current decisions. Your overall precision can and should advance as the project advances.

This is especially important in the earliest stages of the budgeting process when you are working out rough estimates. Take care to estimate at the appropriate level of precision: Don't make the mistake of thinking you can estimate costs to the exact penny or dollar. $378,333.27 is not a realistic or intelligent estimate. Ultimately, overly precise budgets represent a communication failure. By proposing a budget to the customer that contains overly precise figures, you risk giving a false sense of accuracy regarding your understanding of and knowledge of the project.

In the early stages of the budgeting process, when you are still working out estimates, it's helpful to include an uncertainty percentage. A typical approach is to include a +/- percentage, such as $400,000 +/- 10%. The percentage may initially be large but should gradually decrease as the project progresses and the level of uncertainty declines. For IT projects, which are notoriously difficult to estimate, consider going a step further and adding an uncertainty percentage to every line item. Some items, such as hardware, might be easy to estimate. But other items, such as labour to create new technology, can be extremely difficult to estimate. These line item variances can influence the total estimate variance by a significant amount in many projects.

But even when you have a final budget in hand, you need to prepare for uncertainty by including an official contingency fund, which is a percentage of the budget set aside for unforeseen costs. Contingency funds are described in more detail later in this chapter.

Successful project managers use the budgeting process as a way to create stakeholder buy-in regarding the use of available resources to achieve the intended outcome. By being as transparent as possible about costs and resource availability, you'll help build trust among stakeholders. By taking care to use the right kinds of contracts—for example, contracts that don't penalize stakeholders for escalating prices caused by a changing economy—you can create incentives that keep all stakeholders focused on delivering the project value, rather than merely trying to protect their own interests. The relationship between costs and contracts is discussed in more detail later in chapter 7.

Creating a Project Budget

This blog post by Tim Clark includes some helpful tips on creating a project budget: 7 Tips to Create a Budget for your Project.

6.5. Contingencies

In addition to creating the project plan, you need to create a **contingency plan**, which is a plan for addressing key possible obstacles to project success. A contingency plan defines alternate paths for the project in case various risks are realized.

A contingency plan typically includes a **contingency fund**, which is an amount of resources set aside to cover unanticipated costs. Contingency plans and funds are necessary because even the most seasoned project planner sometimes succumbs to excessive optimism, assuming everything will go well and that all resources will be available when needed. Also, no matter how thoroughly you plan a project, you will inevitably miss at least a few small issues.

Examples of issues that might necessitate the use of a contingency fund:

- Inadequate initial estimates
- Small items not covered in planning
- Errors in initial estimates
- Small deviations due to inevitable delays

Note that a contingency fund is not designed to manage major deviations or scope changes.

A simple and effective form of contingency planning is setting aside a contingency fund consisting of a fixed percentage of all resources (time, money, people) in addition to the amounts spelled out in the final budget. Ten percent is a typical amount, but that can vary depending on the size and type of project, as well as the type of industry.

One of the chief difficulties of contingency planning is getting people to agree on exactly what is and is not covered by a contingency fund, and how it applies in specific circumstances. A considerable amount of research has been done on this topic, but there is still no clear consensus. For that reason, before launching a major project, you would be wise to investigate the ins and outs of contingency planning at your organization in particular, and in your industry in general.

Contingency planning is closely related to risk management, which is discussed in Chapter 9. When you are working on small projects of limited complexity, you can probably assume that a fixed percentage contingency plan will cover most risks. However, for highly complex, technically challenging projects, it's important to distinguish between generic budget planning contingencies (using a fixed percentage) and the more sophisticated modelling of risk for uncertainty.

If money is not available from other sources, then cost overruns typically result in a change in the project's scope or a reduction in overall quality. To prevent this, organizations build contingency funds into their budgets. Technically, a contingency fund is a financial reserve that is allocated for identified risks that are accepted and for which contingent or mitigating responses are developed. The exact amount of a contingency is typically 10% to 15% of the total budget.

Contingency funds are often available to pay for an agreed-upon scope change. However, some project managers make a practice of treating a contingency fund as a "Get Out of Jail Free" card that they can use to escape any cost limitations. Some, as a practical matter, will artificially inflate a contingency fund to ensure that they have plenty of resources to draw to manage any unforeseen future risks. But that is never a good idea because if you wind up with a large contingency fund that you ultimately don't spend, you have essentially held that money hostage (i.e., lost opportunity costs) from the rest of the enterprise. That can be as damaging to your organization's mission as a cost overrun that prevents you from finishing a project.

As explained, contingency funds are a form of risk management. They are a necessary tool for dealing with uncertainty. Unfortunately, as necessary as they are, it's not always possible to build them into your approved budget. For example, if you are competitively bidding on a contract that will be awarded at the lowest cost, then including a contingency fund in your estimate will almost certainly guarantee that your company won't win the contract. It is simply not practical to include a contingency fund in a lump sum contract.

In the living order approach to this problem, the owner maintains a shared contingency fund instead and makes it available, upon justification, for all project stakeholders. This approach helps ensure that project participants will work collaboratively with the project sponsor to solve any problems they might notice, confident that there is money available to address problems that threaten project value or to leverage opportunities that will provide greater project value. For example, in a lecture on Lean and integrated project delivery, David Thomack, a long-time veteran of the construction industry, explained how the Boldt Company and other stakeholders involved in a $2 billion healthcare project protected millions of dollars in contingency funding, which was then ultimately shared among all stakeholders (Thomack, 2018). Such shared contingency funds are typically spelled out in the project contract and are an effective tool for managing risk and uncertainty. Although some organizations only manage out-of-pocket project costs, the best practice is to manage total costs, including costs associated with staff (engineering, purchasing, testing, etc.) working on the project.

6.6. Managing 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.

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.

Reporting Budget Progress on John's Move

In *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.

6.7. Business Case

Wedding Event for Cy's Catering

Background

Upon graduation, Jenny landed a junior marketing director position in the Cy's Catering department of a university in a midwestern state. As a division of the larger dining operation, Cy's Catering provides catering services for intermural events on campus and wedding events for off-campus clients (E. Laska, personal communication, August 14, 2018). Most off-campus clients are from the state's capital. Within a couple of months on the job, Jenny was asked to develop an income statement template for three new buffet menu themes developed for millennial clients. Jenny thought that this project would be a great opportunity for her to apply the concept of design thinking that she had learned from her event management class. The cost structure for each menu option will be first built based on the consultation with the catering and main kitchen managers. With the cost items laid out, she will incorporate them into an income statement template (see example) on a spreadsheet she will create. Then multiple simulations will be test-run by changing fixed costs and revenues for each menu item. The simulation results will be shared with the direct supervisors and kitchen management.

Design Thinking

Still a nascent idea in service management, design thinking is an effective iterative process for generating a new idea that focuses on customers (Liedtka, 2018). Today's customer demands change quickly, stemming from their constant exposure to trends through social media. Customers are increasingly looking for personalized and memorable wedding experiences. To stay current with changing customer preferences, agility in service offering is the key if an event business is to step ahead of its competition. Event organizers are keenly aware of the need to adapt rapidly to changes in the marketplace. Design thinking emphasizes the customer-centric management of service innovation. Customer needs remain central to designing service offerings. An innovative approach to meeting customer needs is achieved through the iterative process of design thinking that involves defining problems, determining needs, brainstorming, prototyping, and testing. Following the basics of design thinking that she had learned, Jenny laid out the process map with the design thinking steps that must be taken when developing an income statement for the new buffet themes:

1. **Define the problem** –Create a new set of buffet menus that appeal to the growing segment of millennial wedding clients.
2. **Determine needs** –Millennial clients are more open to international tastes and prefer options for personalization.
3. **Brainstorming**–Consult with the dining managers and executive chefs from the main kitchen.

4. **Prototyping** –Build a prototype income statement template for three different menu options.
5. **Testing**–Test the prototypes and adjust if needed.

Once all the items were incorporated into her prototype income statement, Jenny decided to test the prototype with one of the new menu options: East Meets West Buffet. After a series of discussions with her two dining managers, she ran a simulation with an $80 per meal option for 100 wedding guests. The total sales revenue from the event equals $8,000 ($80 per meal×100 guests). The simulation also generated an estimated dollar amount for each of the line items of the income statement, expressed as a percentage value of the event revenue. Based on the estimated event revenue given, fill in the blanks in the income statement below and answer the following key questions.

1. What is the contribution margin (CM)?
2. What is the contribution margin per guest for this buffet meal option?
3. What is the net profit for this simulation and the break-even point with regard to the number of guests required?

INCOME STATEMENT

Total Sales Revenue (R)	**$8,000.00**	$80 (per guest)	
Variable Costs			
Catering Costs	$______	27.5%	of V
Facilities Costs	$______	22.5%	of V
Labour (Payroll)	$______	35.0%	of V
Overhead (Linen and tablecloth cleaning)	$______	15.0%	of V
Total Variable Costs (V)	**$______**	**50%**	**of revenue**
Contribution Margin (CM = R – V)	**$______**		
CM per guest	**50%**		
Fixed Costs			
Advertising/Promotion	$______	5.0%	of F
Payroll (Office personnel)	$______	15.0%	of F
Rent	$______	30.0%	of F
Supplies (Audio/Visual)	$______	25.0%	of F
Taxes	$______	7.5%	of F
Insurance	$______	7.5%	of F
Utilities (Water, Electric etc.)	$______	10.0%	of F
Total Fixed Cost (F)	**$______**	**25.0%**	**of revenue**
Profit (CM – F)	**$______**		
Break-even	______	**as number of guests served**	

Specific Questions/Choices

1) Which of the following is NOT an activity of event financial management?

a. Securing financial resources
b. Monitoring financial resources
c. Allocating financial resources
d. Forecasting costs and benefits
e. Minimizing the recurring natural events

2) As a wedding planner, your recent wedding event had 120 guests in attendance and charged $30 per guest.

Revenue: ————-Costs: $2,500 Profit: $1,100

Based on your calculation, what is the percentage of the profit made on the wedding event?

a. 30.5%
b. 84%
c. 58%
d. 85%

The next two questions are related to the following information:

Emory gathered the following information from her recent wedding event that she had managed:

Flat fee per guest: $200

Variable cost per guest: 50% of the fee

A total of 250 guests attended the wedding

The sales amounted to $50,000

Variable cost: $25,000

Net income: $3,000

3) Calculate the contribution margin ratio.

a. 30%
b. 50%
c. 80%
d. 45%

4) Calculate the fixed expenses.

a. $14,000
b. $15,000
c. $16,000

d. $22,000

5) The average fixed assets were $68,000 for Swartz's event planning company last year. The year's total revenues were $330,000. What is the fixed asset turnover ratio for the last year?

a. 5
b. 3
c. 6.5
d. 4.85
e. 32.5

6.8. Key Terms

Key Terms

- **Analogous Estimating:** Uses information from a previous project to estimate the cost of completing a similar project in the future. This provides a quick estimate but should be used with caution. Analogous estimating only works when comparing projects that are similar in scope and will be completed in similar conditions.
- **Contingency Fund:** This is a number of resources set aside to cover unanticipated costs.
- **Contingency Plan:** Which is a plan for addressing key possible obstacles to project success. As discussed in Ch. 6: Risk Management, a contingency plan defines alternate paths for the project in case various risks are realized.
- **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.
- **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 labour and materials will be.
- **Direct Cost:** "An expense that can be traced directly to (or identified with) a specific cost center or cost objects such as a department, process, or product" (Business Dictionary, n.d.).
- **Direct Project Overhead Costs:** Costs that are directly tied to specific resources in the organization that is being used in the project. Examples include the cost of lighting, heating, and cleaning the space where the project team works.
- **General and Administrative (G&A) Overhead Costs:** The "indirect costs of running a business," such as IT support, accounting, and marketing" (Tracy, n.d., para. 1).
- **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.
- **Resource Leveling:** aims at smoothing the stock of resources on hand, reducing both excess inventories and shortages.
- **Resource Management:** 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.
- **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.

6.9. Chapter Questions

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=1003#h5p-24

CHAPTER 7 - PROJECT PROCUREMENT

Chapter Overview

7.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Discuss issues related to supply chain management and procurement throughout an enterprise.
2. Explain the role of building effective client-supplier relationships in procurement.
3. Discuss issues related to procurement waste, and describe the advantages of emphasizing value over price.
4. Describe different types of contracts and the types of behaviours they encourage.
5. Give examples of how procurement issues vary from one context/domain to the next.
6. Discuss issues related to sustainable procurement.

7.2. Procurement Management

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 the definition of the contract type.

7.3. Procurement Role in Supply Chain Management

Maintaining a healthy supply chain—that is, cultivating a network of "activities, people, entities, information, and resources" that allows a company to acquire what it needs in order to do business—is a major concern for any effective organization (Kenton, 2019). Supply chain management encompasses:

> The planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with…suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. (Vitasek, 2013, n.d., p. 187)

When done well, supply chain management "results in lower costs and a faster production cycle" (Kenton, 2019). It is a living-order discipline focused on protecting a supply chain from the evolving threats to which it is vulnerable. For example, here are just a few recent threats to American industries:

- **National and Global Politics:** In the first half of 2019, tariffs on Chinese imports forced American companies to choose between raising prices or absorbing increased costs.
- **Production Shutdown at Key Supplier:** A 2018 fire at a Michigan parts plant cut off supply of parts for Ford F-150 trucks.
- **Changing Government Regulations:** New restrictions on hazardous substances imposed by the European Union limited chemicals U.S. companies could import from the EU after 2017.
- **Extreme Weather Events:** Flooding in Thailand in 2011 shut down computer parts factories, crippling hard drive suppliers worldwide.
- **Shortage of Skilled Manufacturing Labour:** Starting in 2018, American electronics suppliers found that a tight labour market meant they couldn't produce circuit boards on schedule.

As a project manager, you will often have to focus on a core element of the supply chain—procurement. In its simplest usage, the term procurement means acquiring something, usually goods or services. For example, as a project manager, you might need to procure any of the following:

- Commodities: Fuel oil, computer hardware
- Services: Legal and financial services, insurance
- Expertise: Special technical know-how needed for marketing and communications, public engagement, project design and reviews, or assisting with project approvals
- Outcomes: A specified amount of thrust hours produced by a jet engine; a net reduction in energy usage generated by improving a heating system; conformance to a government regulation

In the construction field, project managers may spend a good deal of their time managing the entire procurement process, selling goods or services in some situations and purchasing goods or services in others. If that's your situation, you might have to create proposals for the work you hope to do and then negotiate the contracts that will set the project in motion. On other projects, you might have to review proposals submitted by potential suppliers and then oversee the final contract with the selected supplier. Throughout, you'll have to navigate the ins and outs of many relationships. By contrast, in manufacturing and product development, project managers often have little to do with procurement. In IT, project management is often closely tied to purchasing and overseeing the implementation of new software products. Whatever your procurement duties are, it's essential to understand overall expectations and the established processes for procurement throughout your organization.

7.4. 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.

7.5. 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.

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.

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.

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.

After an idea makes it through the project selection process and becomes a funded project, an organization typically issues an RFP, which is a "document that describes a project's needs in a particular area and asks for proposed solutions (along with pricing, timing, and other details) from qualified vendors. When they're well crafted, RFPs can introduce an organization to high-quality vendor-partners and consultants from outside their established networks and ensure that a project is completed as planned" (Peters, 2011). The exact form of an RFP varies from one industry to the next and from one organization to another. You can find many templates for RFPs on the web.

In response to an RFP, other organizations submit proposals describing, in detail, their plan for executing the proposed project, including budget and schedule estimates, and a list of final deliverables. Officially, the term proposal is defined by Merriam-Webster as "something (such as a plan or suggestion) that is presented to a person or group of people to consider." Depending on the nature of your company, this "something" might consist of little more than a few notes in an email, or it might incorporate months of research and documentation, costing hundreds of thousands of dollars to produce. When creating a proposal, you should seek to clearly understand and address your client's needs and interests, convincingly demonstrate your ability to meet their needs (quality, schedule, price), and prepare the proposal in a form that meets requirements.

After reviewing all submitted proposals, the organization that issued the RFP accepts one of the proposals and then proceeds with negotiating a contract with the vendor. The term contract is more narrowly defined as "an agreement with specific terms between two or more persons or entities in which there is a promise to do something in return for a valuable benefit known as consideration" (contract, n.d., para 1). As with proposals, however, a contract can take many forms, ranging from a submitted invoice which can serve as a binding agreement) to several hundred pages of legal language.

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 enables them to better manage the risk associated with the contracted work.

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.

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 bidder's 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. The 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 bidder's 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

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.

7.6. Contracts

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 pays the same. In Figure 7.1 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 7.2 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 7.3 shows that as costs to the client go up, so does the profit for the contractor.

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 a 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 additional risk.

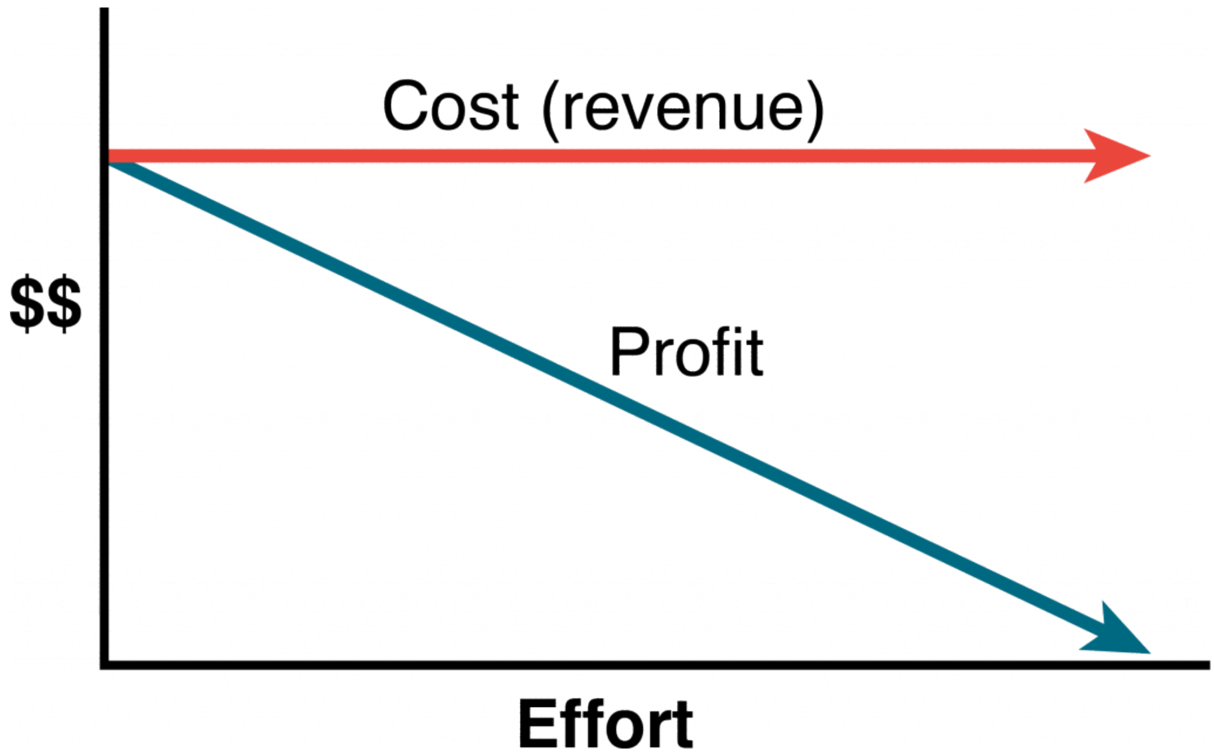

Figure 7.1: In a fixed-price contract the cost to the client is constant regardless of effort applied or the delivery date.

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 an incentive fee	High	Mostly project	High	Medium-high
Fixed fee with price adjustment	High	Mostly project	Low	Medium

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.

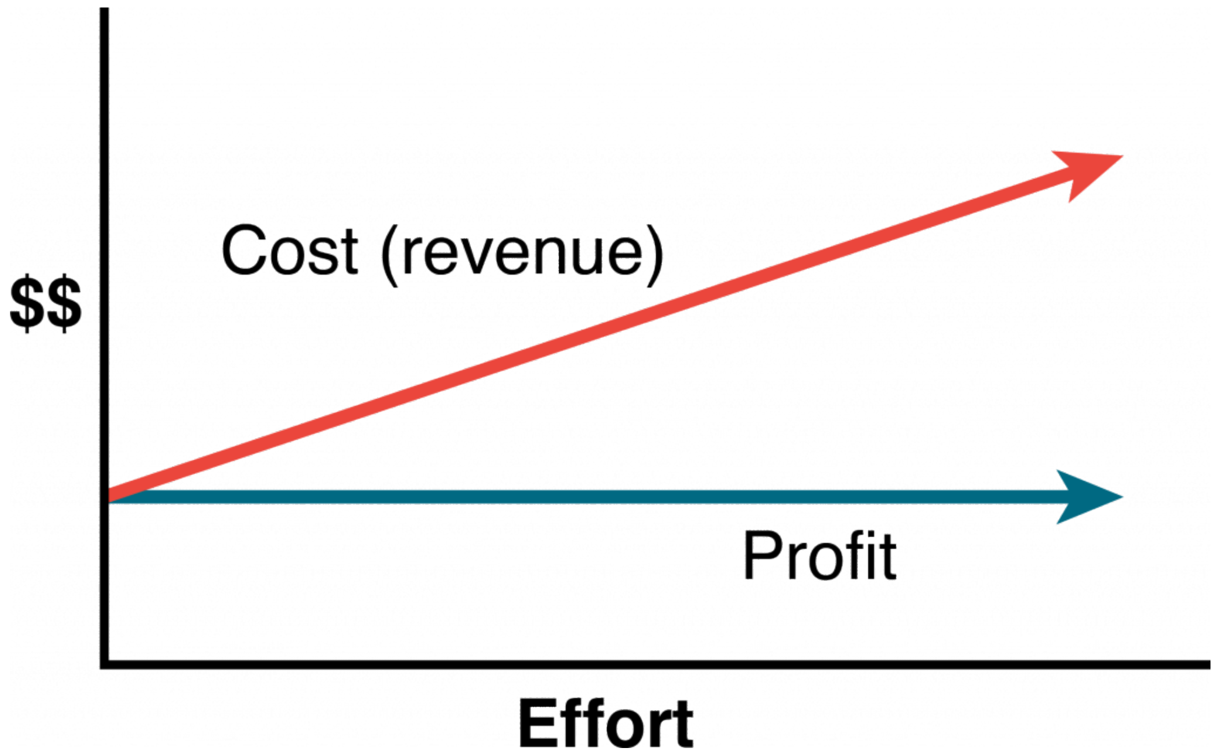

Figure 7.3: In a cost-reimbursable or cost-plus contract, the contractor is guaranteed a fee, but the client's costs can increase based on effort.

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 labour and materials that are needed to provide the service or materials and, in the materials, and timeliness needed.

The Fixed-Price Contract with Price Adjustment 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 labour. 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 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.

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.

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 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 behaviours.
- **A Cost-Reimbursable Contract with an 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 high uncertainty, the contractor might charge an hourly rate for labour, 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.

7.7. Business Case

Thermal's T6 Container by Thermal Mugs, Inc

Thermal Mugs, Inc., manufactures various types of leak-proof personal drink carriers. Thermal's T6 container, its most insulated carrier, maintains the temperature of the liquid inside for 6 hours. Thermal has designed a new lid for the T6 carrier that allows for easier drinking and pouring. The cost to produce the new lid is $2.19:

Direct materials	$0.87
Direct labour	0.45
Fixed overhead	0.51
Variable overhead	0.36
Total unit cost	**$2.19**

Plato Plastics has approached Thermal and offered to produce the 120,000 lids Thermal will require for current production levels of the T6 carrier, at a unit price of $1.75 each. Is this a good deal? Should Thermal buy the lids from Plato rather than produce them themselves? Initially, the $1.75 presented by Plato seems like a much better price than the $2.19 that it would cost Thermal to produce the lids. However, more information about the relevant costs is necessary to determine whether the offer by Plato is the better offer. Remember that all the variable costs of producing the lid will only exist if the lid is produced by Thermal, thus the variable costs (direct materials, direct labour, and variable overhead) are all relevant costs that will differ between the alternatives.

What about the fixed costs? Assume all the fixed costs are not tied directly to the production of the lid and therefore will still exist even if the lid is purchased externally from Plato. This means the fixed costs of $0.51 per unit are unavoidable and therefore are not relevant. Calculations show that when the relevant costs are compared between the two alternatives, it is more cost-effective for Thermal to produce the 120,000 units of the T6 lid internally than to purchase it from Plato.

	Relevant Costs	
	Make Internally	**Buy from Plato**
Direct materials	$0.87	
Direct labour	0.45	
Variable overhead	0.36	
Total unit relevant cost	1.68	$1.75
Units required	120,000	120,000
Total relevant costs	**$201,600**	**$210,000**

By producing the T6 lid internally, Thermal can save $8,400 ($210,000 – $201,600). How would the analysis change if a portion of the fixed costs were avoidable? Suppose that, of the $0.51 in fixed costs per unit of the T6 lid, $0.12 of those fixed costs are associated with interest costs and insurance expenses and thus would be avoidable if the T6 lid is purchased externally rather than produced internally. How does that change the analysis?

	Relevant Costs	
	Make Internally	**Buy from Plato**
Direct materials	$0.87	
Direct labour	0.45	
Variable overhead	0.36	
Avoidable fixed costs	0.12	
Total unit relevant cost	1.80	$1.75
Units required	120,000	120,000
Total relevant costs	**$216,000**	**$210,000**

In this scenario, it is more cost-effective for Thermal to buy the T6 lid from Plato, as Thermal would save $6,000 ($216,000 – $210,000). The difference in these two presentations of the data emphasizes the importance of defining which costs are relevant, as improper cost identification can lead to bad decisions.

These analyses only considered the quantitative factors in a make-versus-buy decision, but there are qualitative factors to consider as well, including:

- Will the T6 lid made by Plato meet the quality requirements of Thermal?
- Will Plato continue to produce the T6 lid at the $1.75 price, or is this a teaser rate to obtain the business, with the plan for the rate to go up in the future?
- Can Plato continue to produce the quantity of the lids desired? If more or fewer are needed from Plato, is the adjusted production level obtainable, and does it affect the cost?
- Does using Plato to produce the lids displace Thermal workers or hamper morale?
- Does using Plato to produce the lids affect the reputation of Thermal?

In addition, if the decision is to buy the lid, Thermal is dependent on Plato for quality, timely delivery, and cost control. If Plato fails to deliver the lids on time, this can negatively affect Thermal's production and sales. If the lids are of poor quality, returns, replacements, and damage to Thermal's reputation can be significant. Without long-term agreements on price increases, Plato can increase the price they charge Thermal, thus making the entire drink container more expensive and less profitable. However, buying the lid likely means that Thermal has excess production capacity that can now be applied to making other products. If Thermal chooses to make the lid, this consumes some of the productive capacity and may affect the relationship Thermal has with the outside supplier if that supplier is already working with Thermal on other products.

Questions

1. Based on the analysis above, should Thermal buy the lid from Plato?
2. What would the process of buying should include?
3. Describe an RFP that Thermal should issue to Plato and other companies alike?

7.8. Key Terms

Key Terms

- **Bidders:** are people or organizations capable of providing the materials or performing the work required for the project.
- **Cost-reimbursable contract or Cost-Plus contract:** the organization agrees to pay the contractor for the cost of performing the service or providing the goods. Cost-reimbursable contracts are most often used when the scope of work or the costs for performing the work are not well known.
- **Evaluation of bids:** is 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.
- **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.
- **Procurement management:** plan details how the procurement process will be managed.
- **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.
- **Request for Proposal or RFP:** accounts for price but focuses on meeting the project quality or schedule requirements.
- **Request for Quote or RFQ:** focuses on price; type of materials or service is well-defined and can be obtained from several sources.
- **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.

7.9. Chapter Questions

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=984#h5p-25

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=984#h5p-43

CHAPTER 8 - PROJECT COMMUNICATION

Chapter Overview

8.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Identify types of communications.
2. Recognize the importance of the level of detail in communication for project success.
3. Describe the role of communication in the procurement process.
4. Discuss the special challenges of virtual teams.
5. Discuss the role of communication in building trust, and describe behaviours that help build trust.

8.2. Role of Communication in PM

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. Furthermore, 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, emails, 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 the 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 in 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.

8.3. 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.

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.

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 be present at the same time. This type of communication is asynchronous.

There are several choices of asynchronous communication.

- Mail and Package Delivery
- Fax
- Email
- 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; therefore, and reflecting on previous decisions to develop this decision-making skill is important to growth as a project manager.

8.4. Communication and Project Manager

As a project manager, you might be responsible for writing RFPs for your organization's projects, or proposals in response to RFPs publicized by other organizations. You might also be responsible for drafting parts of a contract such as language describing the scope of work. At the very least, you will need to be conversant enough with contract terminology so that you can ensure that a contract proposed by your organization's legal department adequately translates the project requirements into legal obligations. Whatever form they take, to be useful, RFPs, proposals, and contracts must be specific enough to define expectations for the project, yet flexible enough to allow for the inevitable learning that occurs as the project unfolds in the uncertain, living order of the modern world. All three types of documents are forms of communication that express a shared understanding of project success, with the level of detail increasing from the RFP stage to the contract.

Throughout the proposal and contract stages, it's essential to be clear about your expectations regarding:

- Deliverables
- Schedule
- Expected level of expertise
- Price
- Expected quality
- Capacity
- Expected length of relationship (short- or long-term)

Take care to spell out:

- Performance requirements
- Basis for payment
- Process for approving and pricing changes to the project plan
- Requirements for monitoring and reporting on the project's health

At a minimum, a proposal should discuss:

- **Scope:** At the proposal stage, assume you can only define about 80% of the scope. As you proceed through the project, you'll learn more about it and be better able to define the last 20%.
- **Schedule:** You don't necessarily need to commit to a specific number of days at the proposal stage, but you should convey a general understanding of the overall commitment, and whether the schedule is mission-critical. In many projects, the schedule can turn out to be somewhat arbitrary, or at least allow for more variability than you might be led to believe at first.
- **Deliverables:** Make it clear that you have some sense of what you are committing to, but only provide as many details as necessary.
- **Cost/Resources:** Again, make clear that you understand the general picture, and provide only as many specifics as are helpful at the proposal stage.
- **Terms:** Every proposal needs a set of payment terms, so it's clear when payments are due. Unless you include "net 30" or "net 60" to a proposal, you could find yourself in a situation in which customers refuse to part with their cash until the project is complete.
- **Clarifications and Exclusions:** No proposal is perfect, so every proposal needs something that speaks to

the specific uncertainty associated with that particular proposal. Take care to write this part of a proposal in a customer-friendly way and avoid predatory clarifications and exclusions. For example, you might include something like this: "We've done our best to write a complete proposal, but we have incomplete knowledge of the project at this point. We anticipate working together to clarify the following issues"—and then conclude with a list of issues.

If you are on the receiving end of a proposal, remember a potential supplier probably has far more experience than you do in its particular line of business. Keep the lines of communication open and engage with suppliers to use their expertise to help refine deliverables and other project details.

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:

- 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?

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 the 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 communicate each message (who).
7. Document items – templates, formats, or documents the project must use for communicating.

8.5. Virtual PM

Managing a team of people who work side-by-side in the same office is difficult enough. But what about managing a virtual team—that is, a team whose members are dispersed at multiple geographical locations? In the worldwide marketplace, such teams are essential. Deborah L. Duarte and Nancy Tennant Snyder explain the trend in their helpful workbook, Mastering Virtual Teams:

> Understanding how to work in or lead a virtual team is now a fundamental requirement for people in many organizations…. The fact is that leading a virtual team is not like leading a traditional team. People who lead and work on virtual teams need to have special skills, including an understanding of human dynamics and performance without the benefit of normal social cues, knowledge of how to manage across functional areas and national cultures, skill in managing their careers and others without the benefit of face-to-face interactions, and the ability to use leverage and electronic communication technology as their primary means of communicating and collaborating. (Duarte & Tennant Snyder, 2006, p. 4)

When properly managed, collaboration over large distances can generate serious advantages. For one thing, the diversity of team members as per Siebdrat et al. (2009) "exposes members to heterogeneous sources of work experience, feedback, and networking opportunities." At the same time, the team's diversity enhances the "overall problem-solving capacity of the group by bringing more vantage points to bear on a particular project" (Siebdrat et al., 2009, p. 65). Often, engaging with stakeholders via email allows for more intimacy and understanding than face-to-face conversations, which, depending on the personality types involved, can sometimes be awkward or ineffective.

However, research consistently underscores the difficulties in getting a dispersed team to work effectively. In a widely cited study of 70 virtual teams, Vijay Govindarajan and Anil K. Gupta (2001) found that "only 18% considered their performance 'highly successful' and the remaining 82% fell short of their intended goals. In fact, fully one-third of the teams … rated their performance as largely unsuccessful". Furthermore, research has consistently shown that virtual team members are "overwhelmingly unsatisfied" with the technology available for virtual communication and do not view it "as an adequate substitute for face-to-face communication" (Purvanova, 2014).

Given these challenges, what's a virtual team manager to do? It helps to be realistic about the barriers to collaboration that arise when your team is scattered around the office park or around the globe.

The Perils of Virtual Distance

Physical distance—the actual space between team members—can impose all sorts of difficulties. Most studies have shown that teams who are located in the same space, where members can build personal, collaborative relationships with one another, are usually more effective than teams that are dispersed across multiple geographical locations.

> Potential issues include difficulties in communication and coordination, reduced trust, and an increased inability to establish a common ground…. Distance also brings with it other issues, such as team members having to negotiate multiple time zones and requiring them to reorganize their work days to accommodate others' schedules. In such situations, frustration and confusion can ensue, especially if coworkers are regularly unavailable for discussion or clarification of task-related issues. (Siebdrat, et. al., 2009, p. 64)

Even dispersing teams on multiple floors of the same building can decrease the team's overall effectiveness, in part because team members "underestimate the barriers to collaboration deriving from, for instance, having to climb a flight of stairs to meet a teammate face-to-face." Team members end up behaving as if they were scattered across the globe. As one team leader at a software company noted, teams spread out within the same building tend to "use electronic communication technologies such as e-mail, telephone, and voicemail just as much as globally dispersed teams do" (Siebdrat, et. al., 2009, p. 64).

Communication options like video conferences, text messages, and email can do wonders to bridge the gap. But you do need to make sure your communication technology is working seamlessly. Studies show that operational glitches (such as failed Skype connections or thoughtlessly worded emails) can contribute to a pernicious sense of distance between team members. Karen Sobel-Lojeski and Richard Reilly coined the term virtual distance to refer to the "psychological distance created between people by an over-reliance on electronic communications" (2008, xxii). Generally speaking, it is tough to build a team solely through electronic communication. That's why it's helpful to meet face-to-face occasionally. A visit from a project manager once a year or once a quarter can do wonders to nurture relationships among all team members and keep everyone engaged and focused on project success.

In their book Uniting the Virtual Workforce, Sobel-Lojeski and Reilly document some "staggering effects" of virtual distance:

- 50% decline in project success (on-time, on-budget delivery).
- 90% drop in innovation effectiveness.
- 80% plummet in work satisfaction.
- 83% fall off in trust.
- 65% decrease in role and goal clarity.
- 50% decline in leader effectiveness (2008, xxii).

The Special Role of Trust in a Virtual PM

So, what's the secret to making virtual teams work for you? We've already discussed the importance of building trust on any team. But on virtual teams, building trust is a special concern. Erin Meyer describes the situation like this: "Trust takes on a whole new meaning in virtual teams. When you meet your workmates by the water cooler or photocopier every day, you know instinctively who you can and cannot trust. In a geographically distributed team, trust is measured almost exclusively in terms of reliability" (Meyer, 2010).

All sorts of problems can erode a sense of reliability on a virtual team, but most of them come down to a failure to communicate. Sometimes the problem is an actual, technical inability to communicate (for example, because of unreliable cell phone service at a remote factory); sometimes the problem is related to scheduling (for example, a manager in Japan being forced to hold phone meetings at midnight with colleagues in North America); and sometimes the problem is simply a failure to understand a message once it is received. Whatever the cause, communication failures have a way of eroding trust among team members as they begin to see each other as unreliable.

As illustrated in Figure 8.1, communicating clearly will lead your team members to perceive you as a reliable person, which will then encourage them to trust you.

Figure 8.1: The benefits of clear communication

Leigh Thompson, a professor at Northwestern University's Kellogg School of Management, offers a number of practical suggestions for improving virtual teamwork, including the following:

- Verify that your communication technology works reliably, and that team members know how to use it.
- Take a few minutes before each virtual meeting to share some personal news, so that team members can get to know each other.
- Use video conferencing whenever possible, so everyone can see each other. The video image can go a long way toward humanizing your counterparts in distant locales. If video conferencing is not an option, try at least to keep a picture of the person you're talking to visible, perhaps on your computer. Studies have shown that even a thumbnail image can vastly improve your ability to reach an agreement with a remote team member. (Thompson, 2015)

8.6. Business Case

Discussion: The Ultimate Cost of Poor Communication

Preparation:

Research an example from the news of a situation in which a breakdown of teamwork and/or communication had serious or disastrous consequences. For example, in this article from the Daily Mail, a two-year-old boy died from internal bleeding as the direct result of a total breakdown in communication between his physicians:

General Discussion Instructions:

Write a minimum of one short paragraph and a maximum of two paragraphs. Word totals for this post should be in the 100–200-word range. Whether you agree or disagree, explain why with supporting evidence and concepts from the readings or a related experience. Include a reference, link, or citation when appropriate.

Discussion Questions:

1. Provide a brief description of the situation. Include a link to the article or site, as I have above, where we can find and read the details. (In order to insert this link, copy and paste the URL from your browser window into the text box where you are making your post. You do not have to do anything special; it will automatically be converted to a Web link.)
2. Describe or discuss the result of the breakdown in communication and/or teamwork.
3. What, if anything, do you believe could have been done to prevent this breakdown?
4. What can we learn from your example?

8.7. Key Terms

Key Terms

- **Communications Management:** This 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.
- **Communications Requirements Analysis:** 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.

8.8. Chapter Questions

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=700#h5p-29

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=700#h5p-30

Knowledge Check 3

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=700#h5p-28

Knowledge Check 4

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=700#h5p-27

Knowledge Check 5

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=700#h5p-26

CHAPTER 9 - RISK MANAGEMENT

Chapter Overview

9.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Distinguish between risks and issues.
2. Describe the role of risk management in project success.
3. Identify types of risks based on the project phases.
4. Explain the risk management process.
5. Describe the five responses in risk management.

9.2. Risk Management and Project Success

Successful project managers manage the differing perceptions of risk, and the widespread confusion about its very nature, by engaging in systematic risk management. According to the Financial Times (n.d.), **risk management** is "the process of identifying, quantifying, and managing the risks that an organization faces". In reality, the whole of project management can be thought of as an exercise in risk management because all aspects of project management involve anticipating change and the risks associated with it.

The tasks specifically associated with risk management include "identifying the types of risk exposure within the company; measuring those potential risks; proposing means to hedge, insure, or mitigate some of the risks; and estimating the impact of various risks on the future earnings of the company" (Financial Times, n.d.). Engineers are trained to use risk management tools like the risk matrix shown in Figure 9.1, in which the probability of the risk is multiplied by the severity of consequences if the risk does indeed materialize.

IMPACT

PROBABILITY		A	B	C	D	E
		Negligible	Minor	Moderate	Major	Severe
E	Very Likely	Low Medium	Medium	Medium High	High	High
D	Likely	Low	Low Medium	Medium	Medium High	High
C	Possible	Low	Low Medium	Medium	Medium High	Medium High
B	Unlikely	Low	Low Medium	Low Medium	Medium	Medium High
A	Very Unlikely	Low	Low	Low Medium	Medium	Medium

Figure 9.1: A risk matrix is a tool engineers often use to manage risk.

This and other risk management tools can be useful because they provide an objective framework for evaluating the seriousness of risks to your project. But any risk assessment tool can do more harm than good if it lulls you into a false sense of security so that you make the mistake of believing you really have foreseen every possible risk that might befall your project. You don't want to make the mistake of believing that the tools available for managing risk can ever be as precise as the tools we use for managing budgets and schedules, even as limited as those tools are.

Perhaps the most important risk management tool is your own ability to learn about the project. The more you know about a project, the better you will be at foreseeing the many ways the project could go awry and what the consequences will be if they do, and the better you will be at responding to unexpected challenges.

9.3. 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 risks 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.

Risk Identification

A more disciplined process involves using checklists of potential risks and evaluating the likelihood that those events might happen to 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 risks on a project.

Identifying the sources of risk by category is another method for exploring potential risks in 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 Table 9.1. 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.

Table 9.1 Risk Breakdown Structure (RBS)

Level 1	Level 2	Level 3
Plan Move	Contact Dion and Carlita	Dion backs out
		Carlita backs out
		No common date available
	Host Planning Lunch	Restaurant full or closed
		Wrong choice of ethnics food
		Dion or Carlita have special food allergies preferences
	Develop and Distribute Schedule	Printer out of toner
		Out of paper

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 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 possibility of occurring and can have the greatest negative impact on the project (Figure 9.2). These become the critical few.

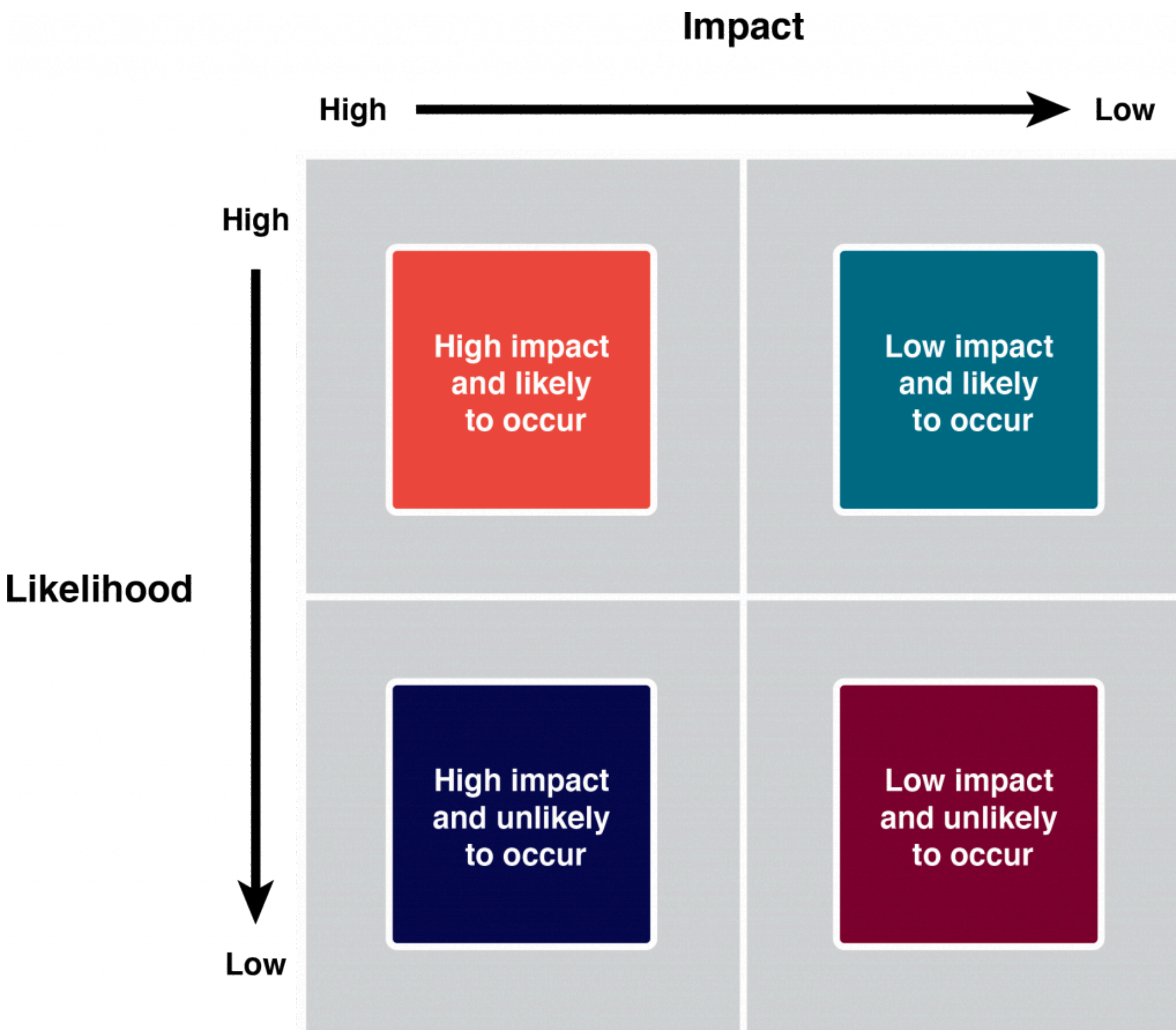

Figure 9.2: Risk and Impact

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 of a high impact. The other two pieces of equipment had 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 benefits of a structured analysis of project risks (Parker & Mobey, 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.

Generally, for 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.

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 risky activities. Many organizations that work on international projects will reduce political, legal, labour, and other 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 the 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 of 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 confidence in that plan and reduce the project risk. Assigning highly skilled project personnel to manage 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 labour strikes are examples of events that can significantly impact the project and that are outside the control of the project team.

9.4. Contingency Planning

The project risk plan balances the investment of the mitigation against the benefit of 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 driver's 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 the approval of the project manager required before contingency funds can be used.

9.5. Risks in Project Phases

Project risk is dealt with in different ways depending on the phase of the project.

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. Let's 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 likelihood 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 was 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 them 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.

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.

Table 9.2 Risk Breakdown Structure (RBS) for Packing John's Apartment

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 glass (RA)
		Transporting alcoholic beverages	Give open 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 centre	Buy a 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	Broken mirror	Buy or rent a mirror box with Styrofoam blacks at each corner (RR)
		Lose prescription drugs or pack them where they cannot be found quickly	Separate prescription drugs from transportation in the car (RA)
	Pack Remaining Items	Damage to house plants	Ask Carlita to care for them and bring them with her in the van when she visits in exchange for half of them (RS)
		Transportation of flammable liquids from charcoal grill	Give to Dion or Carlita (RA)
Legend: *RA* – Risk Avoidance; *RS*– Risk Sharing; *RR* – Risk Reduction; *RT* – Risk Transfer			

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 Table 9.2.

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.

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 is done, the result can be compared to the predicted result.

9.6. Ethics and Risk Management

Engineering and ethics have been in the news a great deal in recent years, in stories about the BP oil spill, the Volkswagen emissions-control software scandal, and the General Motors ignitions switch recall. These stories remind us that decisions about risk inevitably raise ethical questions because the person making the decision is often not the one who will actually suffer the consequences of failure. At the same time, unethical behaviour is itself a risk, opening an organization to lawsuits, loss of insurance coverage, poor employee morale (which can lead to more unethical behaviour), and diminished market share, just to name a few potentially crippling problems.

An article on the website of the International Risk Management Institute explains the link between risk management and ethics as essentially a matter of respect:

Ethics gives guidelines for appropriate actions between persons and groups in given situations—actions that are appropriate because they show respect for other's rights and privileges, actions that safeguard others from embarrassment or other harm, or actions that empower others with the freedom to act independently. Risk management is based on respect for others' rights and freedoms: rights to be safe from preventable danger or harm, and freedom to act as they choose without undue restrictions.

- Both ethics and risk management foster respect for others, be they neighbours, employees, customers, fellow users of a good or service, or simply fellow occupants of our planet—all sharing the same rights to be safe, independent, and hopefully happy and productive. Respect for others, whoever they may be, inseparably links risk management and ethics (Head, 2005).

Why do people behave unethically? That's a complicated, interesting question—so interesting, in fact, that it has been the motivation for a great deal of human art over many centuries, from Old Testament stories of errant kings to Shakespeare's histories to modern TV classics like The Sopranos.

Sometimes, the upper managers of an organization behave, collectively, as if they have no empathy or conscience. They set a tone at the top of the organizational pyramid that makes their underlings think bad behaviour is acceptable, or at least that it will not be punished. For example, the CEO of Volkswagen said he didn't know his company was cheating on diesel engine emission tests. Likewise, the CEO of Wells Fargo said he didn't know his employees were creating fake accounts in order to meet pressing quotas. One can argue whether or not they should have known, but it's clear that, at the very least, they created a culture that not only allowed cheating but rewarded it. Sometimes the answer is to decentralize power, in hopes of developing a more open, more ethical decision-making system. However, Volkswagen is currently discovering as they attempt to decentralize their command-and-control structure that organizations have a way of resisting this kind of change (Cremer, 2017).

Still, change begins with the individual. The best way to cultivate ethical behaviour is to take some time regularly to think about the nature of ethical behaviour and the factors that can thwart it. Therefore, it is fair to say, "Let's start with the question of personal values, in order to reach an ethical society".

9.7. Business Case

Aspen Music Festival and School

Disclaimer: This case study is formulated to be used solely for educational purposes and is based on both factual and fictional information.

Background

The Aspen Music Festival and School (AMFS) is an annual classical music festival held in Aspen, Colorado. The history of this world-renowned music festival goes back to its inception in 1949. The 8-week-long music extravaganza highlights more than 400 musical events. The event programming is diverse in size and type, ranging from orchestral performances to solo performances. The AMFS has four featured orchestras performing each summer; two are entirely composed of Aspen Music School students. This annual festival draws more than 70,000 attendees, young and old, to Aspen for many unforgettable summer days of classical music.

The festival occurs on the pastoral 38-acre Bucksbaum Campus located just outside of Aspen. The grounds are surrounded by groves of aspen and fields bordered by a little creek. The event features family concerts and other daytime programming designed specifically for children as pre-concert activities in the Meadows hospitality tent. One of the highlights of this year is Beauty and the Beast presented by The Aspen Musical Production Group.

Aspen has a public transportation system that is free within city limits. In the summer, it operates special routes and schedules to serve concertgoers until 7 p.m. on weekdays and 6 p.m. on weekends. Each night during the festival, two or three events are performed after dusk that end almost at the same time. The festival organizers states that many festival attendees have preferred to walk along the path between the venues and the town centre after the events, as the distances are short (about 20 minutes) and downhill for most visitors. The sidewalk is well-lit after dark, but on one side of the two-lane road, some sections of the sidewalk are too narrow for four people to walk comfortably abreast. There is no physical separation between the sidewalk and roadway except for the dividing lines. The speed limit in the area is 25 miles per hour; the local traffic is sparse after 6 p.m.

Facilities

The facilities available are as follows:

- Benedict Music Tent accommodates 2,050 seats
- David Karetsky Music Lawn, open fields outside the Music Tent
- Harris Concert Hall holds 500 seats
- Castle Creek Campus, a 38-acre site with teaching studios, 68 practice rooms, two rehearsal halls

Food and Drinks

Food consumption is allowed only at the designated dining facilities in the concert venues. Food concessions, giveaways, and preparations are not permitted in the event area. No drinks are permitted in the event area. Similarly, no alcohol is distributed or sold in the event area. Bottled water is allowed in the concert venues.

Town of Aspen

Aspen is located in Pitkin County, Colorado, United States. As of 2015, 6,658 residents resided in Aspen. During the summer season, however, the population can increase to more than 16,000. Aspen is 8,000 feet (2,400 m) above sea level and a 3.5-hour drive from Denver, Colorado. The average daily high is usually around 76 degrees.

Geologic Hazards

In Table 9.5, the 2017 risk mitigation report prepared by the country officials lists the following hazards relative to their possible occurrence and severity. For further information, please refer to tables 9.3 and 9.4 below.

Table 9.3: Categories for Estimating Probability of Future Hazard Occurrences

Probability Categories	
Highly Likely	Near 100% chance of occurrence next year or it happens every year.
Likely	10-100% chance of occurrence next year or it has a recurrence interval of 10 years or less.
Occasional	1-10% chance of occurrence in the next year or it has a recurrence interval of 11 to 100 years.
Unlikely	Less than 1% chance of occurrence next 100 years (recurrence interval of greater than every 100 years).

Table 9.4: Categories for Estimating Magnitude of Future Hazard Occurrences

Magnitude Categories	
Catastrophic	Multiple deaths; property destroyed and severely damaged; and/or interruption of essential facilities and service f 72 hours.
Critical	Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage; and/or interruption o facilities and services for 24-72 hours.
Limited	Minor injuries and illnesses; minimal property damage; and/or interruption of essential facilities and services for le hours.
Negligible	No or few injuries or illnesses; minor quality of life loss; little or no property damage; and/or brief interruption of es facilities and services.

Table 9.5: The 2017 Pitkin County's Report of Aspen Natural Hazards – Estimated Probability and Magnitude

Hazard	Probability	Magnitude
Avalanche	Highly Likely	Critical
Wildfire	Likely	Critical
Flood	Occasional	Catastrophic
Winter Storm	Highly Likely	Limited
Lightning	Likely	Catastrophic
Dam Failure Flooding	Unlikely	Catastrophic
Drought	Occasional	Limited

Note. Probability refers to how likely the hazard is to occur in the future, accounting for historical frequencies or statistical assessment of probability. Magnitude is defined as the degree to which a hazardous event is severe in terms of its impacts on public safety, community, and personal assets and properties, key infrastructures, and natural resources.

Questions

1. What types of risk are particularly pertinent to this event in the process of risk identification? Select all that apply
2. Once the types of risk are determined for an event, they can be organized according to two key dimensions of risk. This method of risk organization allows the event management team to conduct an accurate assessment of the risks. Which of the following are the two key dimensions of risk considered in the risk assessment?
3. Based on your answers to Questions 1 and 2, rate the likelihood and consequence of each risk identified in Question 1 on the scale of 1 (e.g., rare) to 5 (e.g., almost certain).
4. In the hierarchy of risk controls, which of the following is the measure of risk control applied when power cords and electrical wires are properly covered, and uneven surface areas are visibly marked.?
5. Which of the plans should contain the measures taken to safeguard files relevant to event management?

9.8. Key Terms

Key Terms

- **Contingency Plans:** 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.
- **Risk Avoidance:** This 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.
- **Risk Management:** The process of identifying, quantifying, and managing the risks that an organization faces.
- **Risk Reduction:** This 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.
- **Risk Sharing:** Involves partnering with others to share responsibility for risky activities. Or, hiring someone else to take on that part of the project.
- **Risk Transfer:** 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.

9.9. Chapter Questions

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=1051#h5p-8

Knowledge Check 2

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=1051#h5p-10

CHAPTER 10 - PROJECT QUALITY AND CONTROL

Chapter Overview

10.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Explain the importance of designing good monitoring practices.
2. Describe elements of effective project monitoring and controlling.
3. Detail how to decide what to monitor and when, and list some useful items to monitor.
4. Distill monitoring information into reports that are useful to different stakeholders.
5. Describe the process of quality planning.
6. Explain how linearity bias can mislead assessment of project progress.
7. Describe the inputs required for an earned value analysis.
8. Explain a time-phased budget.
9. Calculate and interpret the various earned value analysis metrics.

10.2. Quality in PM

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. However, 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 the quality of 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 they 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 is 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.

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 contaminated with dirt would be of low quality.

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 decided 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 affect 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 10.1.

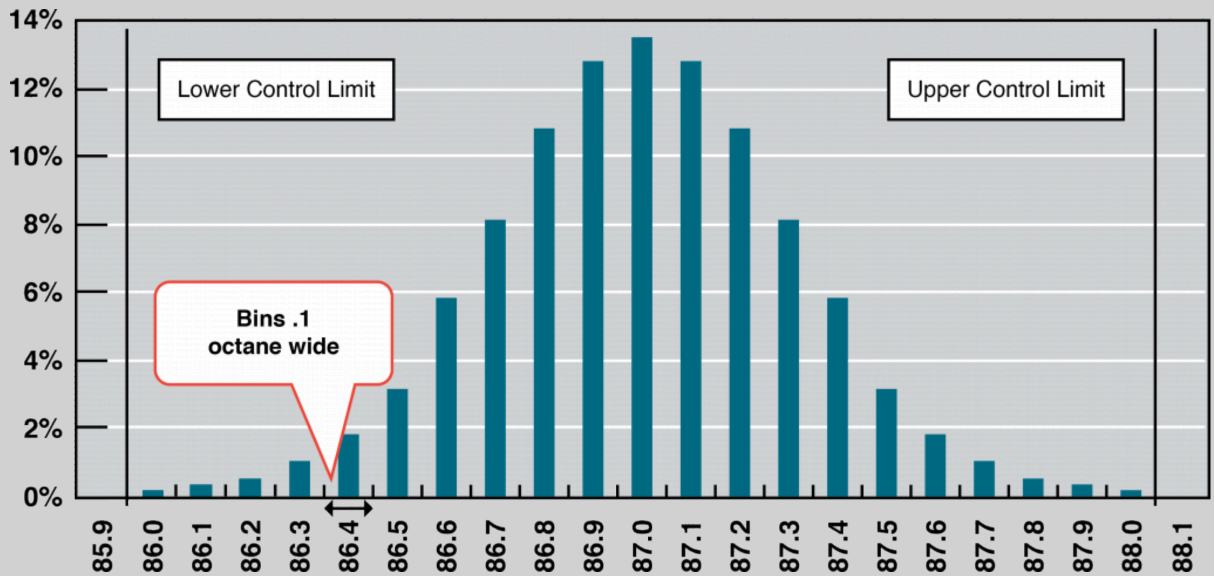

Figure 10.1: Normal Distribution of Measurements

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 centre of the distribution as they are in Figure 10.1, the average of those measurements is also the centre 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 (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 10.1 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 10.2).

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 adult men in the United States are 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.

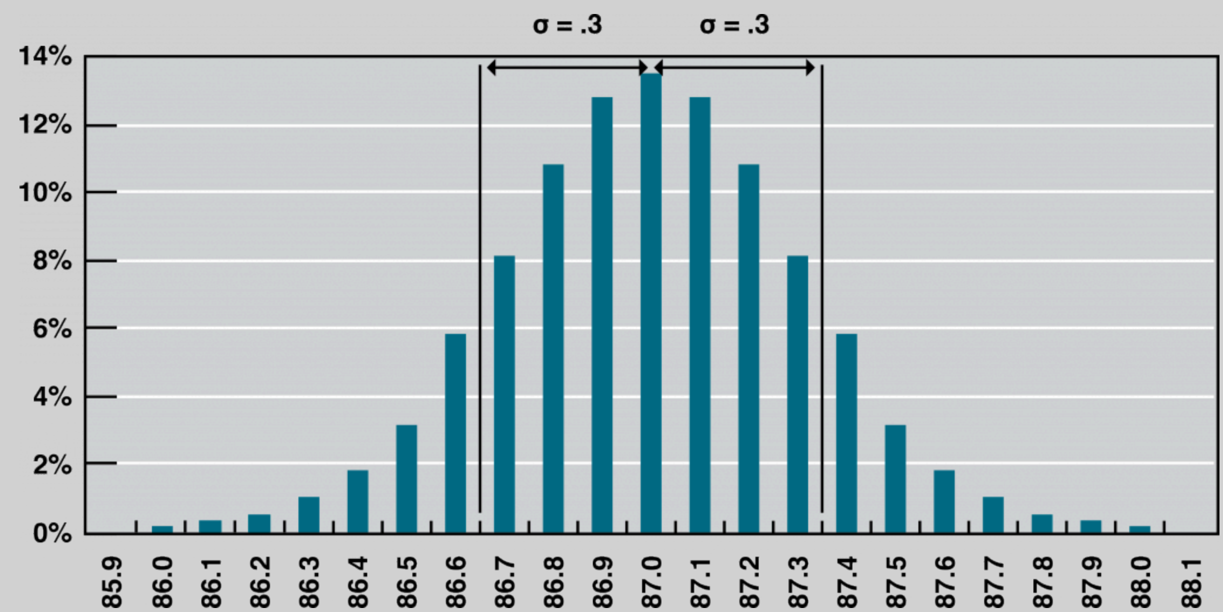

Figure 10.2: One Sigma Range Most of the measurements are within 0.3 octane of 87

10.3. Quality Planning

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 separate 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.

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.

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.

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 into 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, and 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.

10.4. Monitoring for Active Control

When setting up monitoring and controlling systems for a new project, it's essential to keep in mind that not all projects are the same. What works for one project might not work for another, even if both projects seem similar. Also, the amount of monitoring and controlling required might vary with your personal experience. If you've never worked on a particular type of project before, the work involved in setting up a reliable monitoring and controlling system will typically be much greater than the up-front work required for a project that you've done many times before. For projects you repeat regularly, you'll typically have standard processes in place that will make it easy for you to keep an eye on the project's overall performance.

Exactly which items you need to monitor will vary from project to project, and from one industry to another. But in any industry, you usually only need to monitor a handful of metrics. There's no need to over-complicate things. For example, when managing major construction projects for the Wisconsin Department of Transportation, Gary Whited, focused on these major items:

- Schedule
- Cost/budget
- Issues specific to the project
- Risk

He also recommends monitoring the following:

- Quality
- Safety
- Production rates
- Quantities

In other kinds of projects, you will probably need to monitor different issues. But it's always a good idea to focus on information that can serve as early warnings, allowing you to change course if necessary. This typically includes the following:

- Current status of schedule and budget
- Expected cost to complete
- Expected date(s) of completion
- Current/expected problems, impacts, and urgency
- Causes for schedule/cost overruns

As Whited explains, the bottom line is this: "If it's important to the success of your project, you should be monitoring it" (Whited, 2014).

Note that measuring the percent complete on individual tasks is useful in some industries, where tasks play out over a long period of time. According to Dave Pagenkopf, in the IT world, the percent completion of individual tasks is meaningless: "The task is either complete or not complete. At the project level, the percent complete may mean something. You really do need to know which tasks/features are 100% complete. However sloppy progress reports can generate confusion on this point. 100% of the functions in a software product 80% complete is not the same as having 80% of the features 100% complete. A poorly designed progress report can make these can look the same, when they most definitely are not" (pers. comm., November 13, 2017).

In addition to deciding what to monitor, you need to decide how often to take a particular measurement. As a general rule, you should measure as often as you need to make meaningful course corrections. For some items, you'll need to monitor continuously; for others, a regular check-in is appropriate. Most projects include major milestones or phases that serve as a prime opportunity for monitoring important indicators. As Gary Whited notes, "The most important thing is to monitor your project while there is still time to react. That's the reason for taking measurements in the first place" (2014).

10.5. Earned Value Analysis

Earned value analysis (EVA) is a monitoring and controlling process that compares project progress to the project baseline (original plan). EVA measures the performance of a project in terms of cost and schedule. It can tell the project team if a project is:

- Behind Schedule
- Ahead of Schedule
- Under Budget
- Over Budget

EVA provides hard numbers for making these judgements and can be used to forecast where a project will end up in terms of time and cost. As a result, EVA helps the project manager clearly communicate project progress to all stakeholders and can focus the attention of the project team on any changes needed for the project to be completed on time and on budget. Most project management information systems (PMIS), can calculate earned value metrics if a baseline is properly set and the earned value inputs are provided. Project managers who do not conduct an earned value analysis run the risk of misinterpreting or miscommunicating the meaning of the project information that is collected during the execution phase.

EVA Example

For example, assume that the direct costs of a project are budgeted at $100,000, and the project is scheduled to take 12 months. If it is three months into the project and $25,000 has been spent, a naive project manager might assume that the project is 25% done and is on track to finish within the project timeline and budget.

In this example, the project is certainly 25% done as far as the time allowed for the project, and 25% done with the budget, but what is not known is which activities have been worked on and if those activities are complete or still in progress. If only 10% of the scheduled work has actually been completed, then the project may be in trouble. Alternatively, if 50% of the scheduled work has been completed, then the project may end up being done much earlier and with much less expense than planned. Either situation requires action:

- If a project is going to be over budget and/or take more time, the project manager needs to figure out if what can be done to correct the situation. Should they try to get more resources and time, or should they re-evaluate the project entirely?
- If a project is going to be done in significantly less time and/ or with significantly less cost, then the project manager should see if some of the resources allocated for the project can be released to other projects and priorities in the organization, and the impact of an earlier completion date should be evaluated.

Before attempting the calculations involved in an earned value analysis of a project, it is important to understand the three basic inputs for EVA calculations. The three basic inputs are Planned Value (PV), Actual Costs (AC), and Earned Value (EV).

Planned Value (PV)

Planned Value—Refers to the expected cost that will be spent on the project over its lifetime. For each activity, there is a total Planned Value (cost). More importantly, the amount that was going to be spent on each activity over time is also known.

Consider the information presented on Project Breakdown in Table 10.1. The amount that the project team thinks an activity will cost is called the planned value for that activity.

Table 10.1: Project Breakdown

Sequence Order	Activity	Planned Value (PV)	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
1	Design celebratory cake	$50	$50					
2	Order ingredients and equipment	$225	$150	$75				
3	Mix cake ingredients	$50		$50				
4	Bake cake	$120		$120				
5	Cool cake	$0						
6	Mix frosting	$20			$20			
7	Apply frosting	$80			$50	$20	$10	
8	Cool frosting							
9	Apply decorations	$25					$25	
10	Pack and ship cake	$100					$100	
11	Confirmation of receipt							
12	Bill customer	$10						$10
	Total	$680	$200	$245	$70	$20	$135	$10

Actual Costs (AC)

The **Actual Costs**—this refers to the completed work—is the easiest of the inputs to understand. AC refers to any given activity cost at specific time. Actual costs don't reflect what was planned to be spent, but rather what was spent. This information is obtained from the accounting department and the data is based on invoices, paychecks and receipts related to the activity. While the project manager may have been planning to spend $78 on Activity 1 by the end of period one, the accounting department may inform him or her that the actual cost (AC) at the end of period one for Activity 1 is $50!!

However, the project manager still doesn't know if spending $50 on Activity 1 by the end of period one is good or bad, since he or she doesn't yet know how much work has been performed on Activity 1. The next basic input, earned value, will tell the project manager what percentage of the activity is completed and they will then know how well the project is progressing.

Earned Value (EV)

Earned Value—refers to the cost of work completed on an activity which can be found by multiplying the percentage of completed work for a given activity by the planned value for the same activity.

EV = PV for the Activity × Percentage Complete

One thing to watch out for is that the calculation of EV is not time-dependent; it uses the total PV for an activity, not the value for PV at a certain point in time as found on a time-phased budget. For example, if Activity 1 is 100% complete at the end of period one, then EV = $50 × 100%, or EV = $50 On the other hand, if no progress has been made on this activity (0% complete), then $50 × 0%, or EV = $0.00

Cost Variance (CV)

CV is the first of two basic variances that can be calculated once EV, PV and AC have been determined for an activity or project. CV is simply the Earned Value minus the Actual Costs.

CV = EV – AC

If CV is negative, that means that the project work is costing more than planned. If CV is positive, then the project work is costing less than planned. CV can be calculated for each activity, for segments of a project (for example a deliverable or sub-deliverable) or for the entire project. Watch the video: Calculating and Understanding Cost Variance for an explanation of how to calculate and interpret CV.

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Video: Calculating and Understanding Cost Variance by Prof C [3:32] Transcript available.

Schedule Variance (SV)

SV is the second of two basic variances that can be calculated once EV, PV, and AC have been determined for an activity or project. SV is simply the Earned Value minus the Planned Value.

SV = EV – PV

If SV is negative, that means that less work has been performed than what was planned. If SV is positive, then more work has been done than planned.

Like CV, SV can be calculated for each activity, for segments of a project (for example a deliverable or sub-deliverable) or for the entire project. Watch the video: Calculating and Understanding Schedule Variance for an explanation of how to calculate and interpret SV.

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Video: Calculating and Understanding Schedule Variance by Prof C [4:14] Transcript available.

Cost Performance Index (CPI)

While CV provides a dollar amount that reflects how much over or under the project is at a particular point in time, The **Cost Performance Index (CPI)** provides an indicator of the overall cost performance to date and a good idea of how the project work is trending with regard to cost performance. CPI is calculated as follows:

CPI = EV ÷ AC

- A CPI that is < 1 means that the cost of completing the work is higher than planned.
- A CPI that is = 1 means that the cost of completing the work is right on plan.
- A CPI that is > 1 means that the cost of completing the work is less than planned.

Watch the video: Cost Performance Index (CPI) for a basic walk-through of CPI calculations and the interpretation of the results.

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Video: Cost Performance Index (CPI) by Prof C [3:47] Transcript available.

Schedule Performance Index (SPI)

While SV provided a dollar amount that reflected well the project is doing at turning dollars into completed activities on schedule, **Schedule Performance Index (SPI)** provides an indicator of the overall schedule performance to date. Remember that there are some limitations on using money to measure time. Those limitations apply to SPI as well. To know whether a project is really behind or ahead of schedule, a project manager will also look at the planned start and finish dates, milestones, etc.

SPI is calculated as follows:

SPI = EV ÷ PV

- An SPI that is < 1 means that the project is behind schedule.
- An SPI that is = 1 means that the project is on schedule.
- An SPI that is > 1 means that the project is ahead of schedule.

Watch the video: Schedule Performance Index (SPI) for a basic introduction to SPI calculations and the interpretation of the results.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=532#oembed-4

Video: Schedule Performance Index (SPI) by Prof C [7:09] Transcript available.

10.6. 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.

10.7. Business Case

The Space Shuttle Challenger Disaster

In a detailed report by Jeff Forest(1996) at the Metropolitan State College, the factors that contributed to the Challenger disaster summed to environmental and human errors. The Space Shuttle Challenger 51-L was the 25th mission in NASA's STS program. On Jan. 28, 1986, STS 51-L exploded shortly after liftoff, destroying the vehicle and all of its seven crew members.

On the evening of January 27, 1986, Thiokol was providing information to NASA regarding concerns for the next day's planned launch of STS 51-l. Thiokol engineers were very concerned that the abnormally cold temperatures would affect the "O" rings to non-performance standards. The mission had already been cancelled due to weather, and, as far as NASA was concerned, another cancellation due to weather was unthinkable. Both parties were already aware that the seals on the SRB needed upgrading but did not feel that it was critical. Though the information provided by the Group Decision Support System (GDSS) (with an associated expert system) showed that the "O" rings would perform under the predicted temperatures, Thiokol engineers questioned their own testing and data that were programmed into the GDSS. Thus, on the eve of the Challenger launch, NASA was informed that their GDSS had a flawed database.

At this point, NASA requested a definitive recommendation from Thiokol on whether to launch. Thiokol representatives recommended not to launch until the outside air temperature reached 53 °F. The forecast for Florida did not show temperatures reaching this baseline for several days. NASA responded with pressure on Thiokol to change their decision. NASA's level III manager, Mr. Lawrence Mulloy, responded to Thiokol's decision by asking, "My God, Thiokol, when do you want me to launch, next April?".

After this comment, the Thiokol representatives requested five minutes to go off-line from the GDSS. During this period the Thiokol management requested the chief engineer to "take off his engineering hat and put on his management cap," suggesting that organizational goals be placed ahead of safety considerations. Thiokol re-entered the GDSS and recommended that NASA launch. NASA asked if there were any other objections from any other GDSS member, and there was not.

First, **Thiokol was aware of the "O" ring problem at least several months before the Challenger launch. However, the goal was to stay on schedule**. NASA was made aware of the problem but it was "down-played" as a low-risk situation. Here is the first element of flawed information that was input into the GDSS. If NASA had been aware of the significance of the "O" ring situation, they probably would have given more credence to the advice of the Thiokol engineers' recommendations. However, the data transmitted during the GDSS meeting from Thiokol did say that it would be safe to launch for the forecasted temperatures. NASA was frustrated over the conflicting advice from the same source.

Second, the decision to **delay a Shuttle launch had developed into an "unwanted" decision by the members of the Shuttle team**. In other words, suggestions made by any group member that would ultimately support a scheduled launch were met with positive support by the group. Any suggestion that would lead to a delay was rejected by the group.

Finally, **the GDSS was seriously flawed. As already mentioned, the database contained erroneous information regarding the "O" rings**. Ideas, suggestions and objections were solicited but not anonymously.

The factors which led to the Challenger incident can be traced back to the inception of the shuttle program. **NASA and Thiokol failed to maintain a quality assurance program through management support systems (MSS)**, as was initiated in the Apollo program, due to multiple source demands and political pressures. The GDSS used for the launch decision contained inaccurate data. Engineering members of the GDSS did not believe in the testing procedures used to generate the data components in the GDSS. And, the entire meeting was mismanaged.

Questions

1. What action should be taken to prevent this from happening again, in terms of management decision?
2. Discuss the constraints of this project and how quality is related to this constraint?

10.8. Key Terms

Key Terms

- **Actual Costs:** this refers to the completed work. Is the easiest of the inputs to understand.
- **Benchmarking:** means using the results of quality planning on other projects to set goals for your own.
- **Cause-and-effect Diagrams:** help in discovering problems based on variation.
- **Control Charts**: used to define acceptable limits.
- **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.
- **Cost Performance Index (CPI):** provides an indicator of the overall cost performance to date and a good idea of how the project work is trending with regard to cost performance.
- **Cost Variance (CV):** is the first of two basic variances that can be calculated once EV, PV and AC have been determined for an activity or project. CV is simply the Earned Value minus the Actual Costs.
- **Cost-benefit analysis:** is looking at how much your quality activities will cost versus how much you will gain from doing them.
- **Design of Experiments:** is the list of all the kinds of tests you are going to run on your product.
- **Earned Value**: Refers to the cost of work completed on an activity which can be found by multiplying the percentage of completed work for a given activity by the planned value for the same activity.
- **Earned Value Analysis (EVA):** is a monitoring and controlling process that compares project progress to the project baseline (original plan). EVA measures the performance of a project in terms of cost and schedule.
- **Planned Value:** Refers to the expected cost that will be spent on the project over its lifetime.
- **Quality:** is “the degree to which a set of inherent characteristics fulfill requirements.”
- **Schedule Performance Index (SPI):** provides an indicator of the overall schedule performance to date.
- **Schedule Variance (SV):** is the second of two basic variances that can be calculated once EV, PV, and AC have been determined for an activity or project. SV is simply the Earned Value minus the Planned Value.
- **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.
- **Tolerances**: are often written as the mean value, plus or minus the tolerance. The plus and minus signs are written together, ±.

10.9. Chapter Questions

Knowledge Check 1

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Knowledge Check 2

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Knowledge Check 3

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Knowledge Check 4

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Knowledge Check 5

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Knowledge Check 6

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CHAPTER 11 - PROJECT CLOSURE

Chapter Overview

11.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Discuss the importance of getting the fundamentals right and keeping them right throughout a project.
2. Explain the value of project reviews and audits.
3. Describe issues related to correcting course mid-project and decisions about terminating a project.
4. Discuss the project closure phase.
5. Recognise the importance of concluding a project with lessons learned.

11.2. Reasons for Closing Projects

If an audit reveals the painful truth that it's time to terminate a project, then it's important to realize that this is not necessarily a bad thing. Cancelling a project may seem like a failure, but for a project to be successful, it must provide value to all parties. The best value is to minimize the project's overall negative impact on all parties in terms of both time and money. If the only option is to proceed with a scaled-down project, one that delivers late, or one that costs significantly more, the result may be worse than cancelling the It may be more prudent to invest the time and resources on an alternate endeavour or to reconstitute the project in the future using a different team and revised parameters. (Williams, 2011)

When considering terminating a project, it's helpful to ask the following questions:

- Has the project been made obsolete or less valuable by technical advances? For instance, this might be the case if you're developing a new cell phone and a competitor releases new technology that makes your product undesirable.
- Given progress to date, updated costs to complete, and the expected value of the project's output, is continuation still cost-effective? Calculations about a project's cost-effectiveness can change over time. What's true at the beginning of the project may not be true a few months later. This is often the case with IT projects, where final costs are often higher than expected.
- Is it time to integrate the project into regular operations? For example, an IT project that involves rolling out a new network system will typically be integrated into regular operations once network users have transitioned to the new system.
- Are there better alternative uses for the funds, time, and personnel devoted to the project? As you learned in Chapter 2, on project selection, the key to successful portfolio management is using scarce resources wisely. This involves making hard choices about the relative benefits of individual projects. This might be an especially important concern in the case of a merger when an organization has to evaluate competing projects and determine which best serves the organization's larger goals.
- Has a strategic inflection point, caused by a change in the market or regulatory requirements, altered the need for the project's output?
- Does anything else about the project suggest the existence of a strategic inflection point—and therefore a need to reconsider the project's fundamental objectives?

Determining whether to terminate a project can be a very difficult decision for people close to a project to make. Your perspective on a project has a huge effect on your judgment of its overall success. That is why a review conducted by an objective, external auditor can be so illuminating.

Common Reasons for Project Termination

- Low profitability and or lowered market potential
- Competing projects become a higher priority

- Severe delays to the schedule
- Change of market needs
- Technical issues that can not be resolved
- Low profitability and or lowered market potential
- Increase in damaging cost
- High uncertainty of technical success or commercial gain

11.3. Contract Closing

Just as a project comes to a close contract also comes to a close. **Contract closure** is concerned with completing and settling the terms of the contracts 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 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.

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.

11.4. Releasing the Resources

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.

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.

11.5. Lesson Learned

Project closure is traditionally considered the final phase of a project. It includes tasks such as

- Transferring deliverables to the customer
- Cancelling supplier contracts
- Reassigning staff, equipment, and other resources
- Finalizing project documentation by adding an analysis summarizing the project's ups and downs
- Making the documentation accessible to other people in your organization as a reference for future projects
- Holding a close-out meeting
- Celebrating the completed project

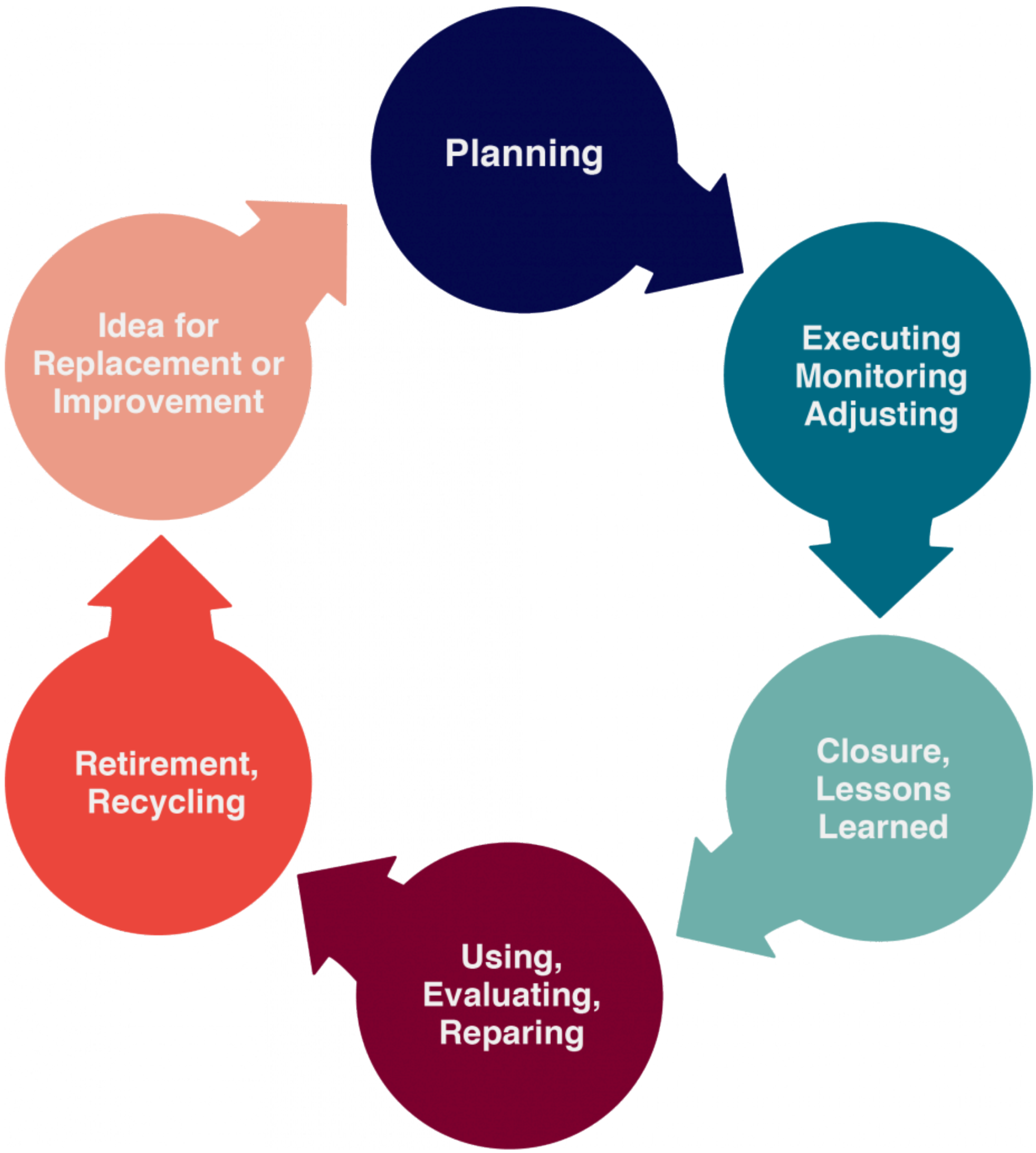

Figure 11.1: Seen from a living order perspective, closure is an extension of the learning and adjusting process that goes on throughout a project.

The Close-Out Meeting is an opportunity to end a project the way you started it—by getting the team together. During this important event, the team should review what went well, and what didn't go well, and identify areas for improvement. All of this should be summarized in the final close-out report. A final close-out meeting with the customer is also essential. This allows the organization to formally complete the project and lay the groundwork for potential future work.

The Close-Out Report provides a final summary of the project performance. It should include the following:

- Summary of the project and deliverables

- Data on performance related to schedule, cost, and quality
- Summary of the final product, service, or project and how it supports the organization's business goals
- Risks encountered and how they were mitigated
- Lessons learned

Exactly where your work falls in the project's life cycle depends on your perspective as to what constitutes "the project" in the first place. The designers and constructors of a building might consider the acceptance of the building by the owner as project closure. However, the results of the project—that is, the building—live on. Another contractor might be hired later to modify the building or one of its systems, thus starting a new project limited to that work.

If project closure is done thoughtfully and systematically, it can help ensure a smooth transition to the next stage of the project's life cycle, or to subsequent related projects. A well-done project closure can also generate useful lessons learned that can have far-reaching ramifications for future projects and business sustainability. The closeout information at the end of a project should always form the basis of initial planning for any future, similar projects.

Although most project managers spend time and resources on planning for project start-up, they tend to neglect the proper planning required for project closure. Ideally, project closure includes documentation of results, transferring responsibility, reassignment of personnel and other resources, closing out work orders, preparing for financial payments, and evaluating customer satisfaction. Of course, less complicated projects will require a less complicated close-out procedure. As with project audits, the smooth unfolding of the project closure phase depends to a great degree on the manager's ability to handle personnel issues thoughtfully and sensitively. In large, ongoing projects, the team may conduct phase closures at the end of significant phases in addition to a culminating project closure.

11.6. Business Case

The following are some examples of situations where projects have been terminated. Please read through the articles and answer the questions below.

- **The End of an Era – Greyhound Canada ends its operation in South Western Ontario.**
- **$2.4B Nuclear waste project terminated.**
- **Renewable Energy Projects terminated in Ontario.**

Questions

After reading the articles, conduct additional research and then write a paragraph (less than 500 words) incorporating the following:

1. State the reason(s) of termination.
2. Were they justifiable reasons?
3. Was the cause(s) of termination avoidable?
4. What steps a project manager will take to close the project?
5. Suggest lessons learned from these cases.

11.7. Key Terms

Key Terms

- **Close-Out Meeting:** is an opportunity to end a project the way you started it—by getting the team together. During this important event, the team should review what went well, and what didn't go well, and identify areas for improvement.
- **Close-Out Report:** provides a final summary of the project performance.
- **Contract Closure:** 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.
- **Project Closure:** is traditionally considered the final phase of a project.
- **Punch List:** List of issues/items that require immediate attention; and building a small schedule to complete the remaining work.
- **Purposes of The Contract:** The 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.

11.8. Chapter Questions

Knowledge Check 1

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Knowledge Check 2

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Knowledge Check 3

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Knowledge Check 5

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CHAPTER 12 - PROJECT LEADERSHIP

Chapter Overview

12.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Identify four roles of a project manager.
2. Discuss the essential skills of good project managers.
3. Discuss the important factors needed in managing a team.
4. Describe the five responses to conflict.
5. List advantages of teams and strong leadership.

12.2 Diversity and Leadership

The Power of Diversity

The rationale for putting together a team is to combine different people, personalities, and perspectives to solve a problem. The difference is the whole point. Diverse teams are more effective than homogeneous teams because they are better at processing information and using it to come up with new ideas. According to David Rock and Heidi Grant, diverse teams tend to focus more on facts, process those facts more carefully, and are more innovative (Rock, 2016). What's more, researchers investigating creativity and innovation have consistently demonstrated "the value of exposing individuals to experiences with multiple perspectives and worldviews. It is the combination of these various perspectives in novel ways that results in new ideas 'popping up.' Creative 'aha' moments do not happen by themselves" (Viki, 2016). In his book: *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*, Scott Page (2007) puts it like this:

> As individuals, we can accomplish only so much. We're limited in our abilities. Our heads contain only so many neurons and axons. Collectively, we face no such constraint. We possess an incredible capacity to think differently. These differences can provide the seeds of innovation, progress, and understanding.

Considerations of Leadership

Good teamwork depends, ultimately, on a leader with a clear understanding of what it means to lead. To judge by the countless books on the topic, you'd think the essential nature of leadership was widely understood. However, few people really understand the meaning of "leadership."

In his book, Leadership Theory: Cultivating Critical Perspectives, John P. Dugan (2017) examines "core considerations of leadership," zeroing in on misunderstood terms and also false dichotomies that are nevertheless widely accepted as accurate explanations of the nature of leadership. Dugan argues that a confused understanding of these essential ideas makes becoming a leader seem like a far-off dream, which only a select few can attain. But in fact, he argues, anyone can learn how to be a better leader.

Here's what Dugan has to say about core considerations of leadership:

- **Born Versus Made:** This is one of the most pernicious false dichotomies regarding leadership. Dugan explains, "that there is even a need to address a consideration about whether leaders are born or made in this day and age is mind-numbingly frustrating. Ample empirical research illustrates that leadership is unequivocally learnable when defined according to most contemporary theoretical parameters."
- **Leader Versus Leadership:** People tend to conflate the terms leader and leadership, but, according to Dugan (2017), "Leader refers to an individual and is often, but not always, tied to the enactment of a particular role. This role typically flows from some form of formal or informal authority (e.g., a supervisor, teacher, or coach). When not tied to a particular role, the term leader reflects individual actions within a larger group, the process of individual leader development, or individual enactments attempting to leverage movement on an issue or goal. Leadership, on the other hand, reflects a focus on collective processes of people working together toward common goals or collective leadership development efforts."
- **Leader Versus Follower**: "The conflation of leader and leadership makes it easier to create an additional false dichotomy around the terms leader and follower," with follower considered a lesser role. "The label of leader/follower, then, is tied solely to positional authority rather than the contributions of individuals within

the organization. If we flip the example to one from social movements, I often see an interesting shift in labelling. In the Civil Rights Movement in the United States, there are multiple identified leaders (e.g., Martin Luther King, Jr., Malcolm X, Rosa Parks, James Baldwin) along with many followers. However, the followers are often concurrently characterized as being leaders in their own right in the process. In social movements, it seems we are more willing to simultaneously extend labels of leader and follower to a person."

- **Leadership Versus Management:** "Also tied up in leader/leadership and leader/follower dichotomies are arguments about whether leadership and management represent the same or unique phenomena. Once again, the role of authority gets tied up in the understanding of this. Many scholars define management as bound to authority and focused on efficiency, maintenance of the status quo, and tactics for goal accomplishment. An exceptional manager keeps systems functioning through the social coordination of people and tasks. Leadership, on the other hand, is less concerned with the status quo and more attentive to issues of growth, change, and adaptation."

12.3. Roles of Project Manager

In an article for MIT Sloan Management Review, Alexander Laufer, Edward Hoffman, Jeffrey Russell, and Scott Cameron show how successful project managers combine traditional management methods with newer, more flexible approaches to achieve better outcomes (Laufer et al., 2015). Their research shows that successful project managers adopt these four vital roles:

1. **Develop Collaboration Among Project Participants:** "Most projects are characterized by an inherent incompatibility: the various parties to the project are loosely coupled, whereas the tasks themselves are tightly coupled. When unexpected events affect one task, many other interdependent tasks are quickly affected. Yet the direct responsibility for these tasks is distributed among various loosely coupled parties, who are unable to coordinate their actions and provide a timely response. Project success, therefore, requires both interdependence and trust among the various parties" (Laufer et al., 2015, p. 46).
2. **Integrate Planning with Learning:** "Project managers faced with unexpected events employ a 'rolling wave' approach to planning. Recognizing that firm commitments cannot be made on the basis of volatile information, they develop plans in waves as the project unfolds and information becomes more reliable. With their teams, they develop detailed short-term plans with firm commitments while also preparing tentative long-term plans with fewer details" (Laufer et al., 2015, p. 46).
3. **Prevent Major Disruptions:** Successful project managers "never stop expecting surprises, even though they may affect major remedial changes only a few times during a project. They're constantly anticipating disruptions and maintaining the flexibility to respond proactively…. When change is unavoidable, a successful project manager acts as early as possible, since it is easier to tackle a threat before it reaches a full-blown state" (Laufer et al., 2015, p. 47).
4. **Maintain Forward Momentum:** "When unexpected events affect one task, many other interdependent tasks may also be quickly impacted. Thus, solving problems as soon as they emerge is vital for maintaining work progress" (Laufer et al., 2015, p. 48).

Adopting these four roles will set you on the road toward delivering more value in your projects, with less waste, which is also the goal of both Lean project management and Agile project management.

12.4. Project Manager Characteristics

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 represent a lack of team-building skills
- Role confusion represents the lack of organizational skill

Project managers need a large number 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.

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.

Negotiation

When multiple people are involved in an endeavour, 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, they 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 negotiation 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.

Conflict Resolution

Conflict on a project is to be expected because of the level of stress, lack of information during the 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.

Conflict is the common side-effect of working in a team or group, and will inevitably happen at any time of the project life cycle. The sources of conflict in a team are generally related to:

- difference of personalities,
- undefined expectations
- lack of communications

- distrust between members of the team and others
- priorities

To address conflict, one must establish responses to the above resources, so conflicts can be turned into beneficial to the individual, project and the organization. A few responses and approaches are identified to handle conflicts can be summarized as follows:

- Withdrawing or avoiding
- Forcing or competing
- Smoothing or accommodating
- Compromising (share the differences)
- Collaborating and confronting

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 so" is the mantra for project managers who use forcing as the default approach to resolving conflict. Some project managers find accommodating 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.

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 with and work to improve those styles so that they can be used when they are more appropriate than your default style.

12.5. 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, establish a positive team environment and a healthy communication climate, work properly, and 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 behaviour (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

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.

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.

Working with Groups and Teams

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

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
- 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. 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:

Personality Types

Personality types refer to the differences among people, including in such matters as what motivates them, how they process information, and how they handle conflict. 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 the 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, 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. The 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.

12.6. Business Case

Discussion: How Great Leaders Inspire Action

This discussion is based on a TED Talk by Simon Sinek, as well as drawing on readings from the management chapter. Fascinated by leaders with the capacity to inspire and have an impact on the world, Sinek has discovered some remarkable patterns in how these leaders think, act, and communicate. He wrote Start With Why: How Great Leaders Inspire Everyone to Take Action to explore the idea of the "golden circle," which is what he calls "a naturally occurring pattern, grounded in the biology of human decision-making, that explains why we are inspired by some people, leaders, messages, and organizations over others."

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=566#oembed-1

Video: How great leaders inspire action by TEDx|Simon Sinek [17:43] Transcript Available

Discussion:

1. Select the portion of Sinek's TED Talk that made the greatest impact on you personally as you listened. You can read the transcript to find his exact words and make sure you capture his message. Why did you select this portion?
2. Thinking about what you learned from the readings in this chapter, answer the following question: How important is it for managers and leaders in business to understand Sinek's concluding statement, below?

"Because there are leaders and there are those who lead. Leaders hold a position of power or authority, but those who lead inspire us. Whether they're individuals or organizations, we follow those who lead, not because we have to, but because we want to. We follow those who lead, not for them, but for ourselves."

12.7. Key Terms

Key Terms

- **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.
- **DISC Method:** Which rates people's personalities by testing a person's preferences in word associations in the following four areas: Dominance/drive, Inducement/ influence, submission/ steadiness and, compliance/ conscientiousness.
- **Emotional Intelligence:** This 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 open dialogue with project stakeholders.
- **Focus on Common Interests:** By avoiding the focus on differences, both parties are more open to finding solutions that are acceptable.
- **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.
- **Myers-Briggs Type Indicator (MBTI):** It is a tool that can be used in project management training to develop an awareness of preferences for processing information and relationships with other people. Myers-Briggs identifies 16 personality types based on four preferences derived from the questionnaire.
- **Separate People From The Problem:** Framing the discussions in terms of desired outcomes enables the negotiations to focus on finding new outcomes.

12.8. Chapter Questions

Knowledge Check 1

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=1082#h5p-41

CHAPTER 13 - PROJECT TEAM

Chapter Overview

13.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Outline the basic needs of team members.
2. Explain the stages that a project team goes through and be able to identify the role that a project manager should try to play during each stage.
3. Discuss the role of trust in building a team, and describe behaviours that help build trust.
4. List motivators and demotivators that can affect a team's effectiveness.
5. Explain issues related to managing transitions on a team.
6. Describe the advantages of diverse teams and provide some suggestions for managing them.

13.2. Successful Team

As Laufer et al. (2018) explain in their book, *Becoming a Project Leade*r, “When it comes to projects, one thing is very clear: ‘right’ does not mean ‘stars.’ Indeed, one of the primary reasons for project ‘dream teams’ to fail is ‘signing too many all-stars.’” More important than an all-star is a project team member fully committed to the project goals. Chuck Athas was one such team member. He worked for Frank Snow, the Ground System and Flight Operations Manager at NASA’s Goddard Space Flight Center. Officially listed as the project scheduler and planner, Chuck was eager to help Frank once the schedule was completed and needed less attention. “Anything that needed to be done, and he didn’t care what it was, he would attack with the same gusto and unflappable drive to succeed,” says Frank. “Whatever it took to get the job done, Chuck would do. Was there anything he couldn’t make happen? Probably something. But with Chuck on the team I felt like I could ask for Cleveland, and the next day he would show up with the deed” (Snow, 2003).

Chuck demonstrated a lack of ego that most all-stars don’t have. His can-do attitude is the antidote to the not-my-job thinking that can sometimes cause team cohesiveness and project completion to falter. His adherence to the project goals over his own goals made him an ideal team member (Laufer et al., 2018).

13.3. Developing Team

The project team works with the project manager to develop the project management plans, schedule the work of the project, acquire the needed resources, monitor project progress and see the project through to its successful completion. Team members may be devoted solely to working on the management aspects of a project, or may also be performing the work of the project. How well the project team works together will determine the success or failure of a project.

Team Member Motivation

In regard to how project managers may view the motivation of team members, let's take a look at what motivates individuals, teams, and organizations.

Basic Needs: Maslow's Hierarchy of Needs

Abraham Maslow provided a model to understand basic human needs which is usually represented as a pyramid (see Figure 13.1). Each need builds on the others: A person's esteem needs are not that important if they are struggling with meeting the biological need to eat. Here are each of the levels in Maslow's hierarchy:

1. **Biological and Physiological:** What a person needs to survive, such as food, water, and shelter.
2. **Safety:** The need to be safe in your person, have financial security, and protect against accidents and illness.
3. **Love and Belongingness:** The need to be loved by one's family and community.
4. **Esteem:** The need to be respected and valued by others.
5. **Self-Actualization:** At the top of the pyramid is the desire to become the best self that you can. For example, working hard to become the best artist, parent, or project manager you can become.

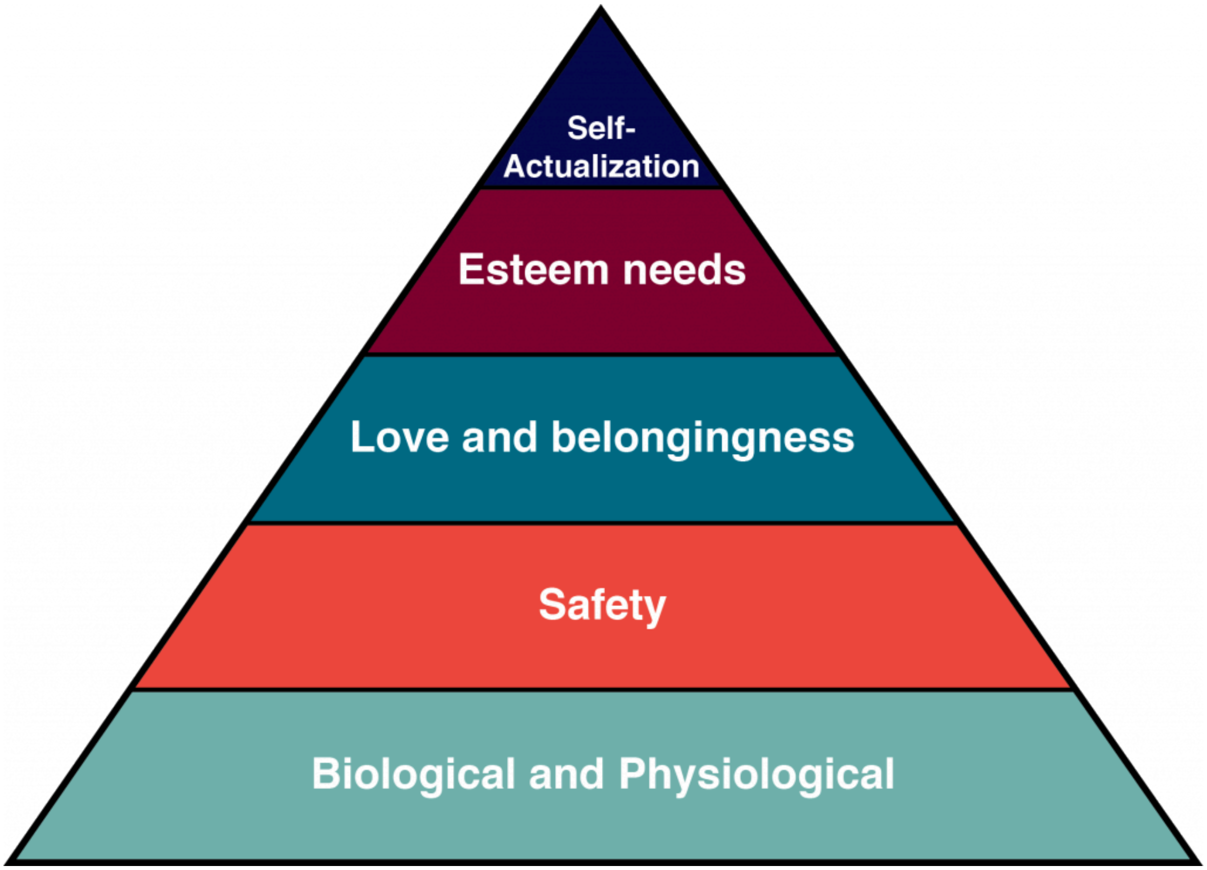

Figure 13.1: Maslow's Hierarchy of Needs

For project managers, this model is useful in several ways. It explains why team members who have problems with their health, family relations or other "lower" needs, will have a problem performing their best on the job. Project managers will also try to meet the esteem needs of their team members by acknowledging their contributions and celebrating successes. This can be an award formally presented at a celebration dinner, or a simple email expressing thanks. Anecdotally, it doesn't seem that the size or formality of the acknowledgement matters much, what is important is that it is given sincerely.

Understanding Team Development

A number of management professionals and academics have studied project team development. Let's review the model that PMI considers the most valuable in understanding team development.

Tuckman's Stages of Team Development

Dr. Bruce Tuckman observed that teams go through a series of developmental stages: Forming, Storming, Norming, Performing, and Adjourning. Each stage has predictable characteristics.

Forming: The group is brought together for the first time. The team is orienting themselves to the task at hand. At this stage, there may be little agreement on how to approach the project and team members may struggle with understanding the purpose of the project. The project manager needs to provide guidance and direction during this stage.

Storming: Team members are trying to figure out their roles in the group. Conflict and power struggles are common, but so is a clearer vision for the group. During this time of intergroup conflict, the project manager needs to provide support and coaching.

Norming: At this stage, the team will have developed a consensus regarding roles, processes and approaches to the work ahead. The project manager should participate by working as a facilitator for the group.

"Tuckman's Model of Group Development" by eCampusOntario, CC BY-SA 4.0

Performing: At this point, the group has a clear vision and purpose and is focused on meeting performance goals, project milestones and other benchmarks. The project manager should be able to delegate more and more responsibility to the team, with less supervision.

Adjourning: Once the project is completed, the team should collect lessons learned and transition to other projects or roles. The project manager should provide recognition of the work done by the team and help them transition to their next project (provide recommendations, etc.)

Fast-Tracking Team Development

Project managers who can quickly move the team from the Forming stage to the Performing stage will have huge advantages in terms of performance. To do this, project managers incorporate team-building activities into the project. Starting the project with some team-building activities will let the team start to form, resolve interpersonal conflicts and develop norms of behaviour in a low-risk environment. Unfortunately, some project managers perceive taking time for team building as a waste of time. However, the time invested here pays off with a much more motivated and better-performing team. There are lots of opportunities to incorporate team-building activities into the planning process. Perhaps the most important process a project manager can facilitate is helping team members learn to trust each other.

13.4. Team Communication

Reliable promises, emotional intelligence, and a realistic outlook are all meaningless as trust-building tools if you don't have the skills to communicate with your team members. In his book Mastering the Leadership Role in Project Management, Alexander Laufer explains the vital importance of team communication:

> Because a project functions as an ad hoc temporary and evolving organization, composed of people affiliated with different organizations, communication serves as the glue that binds together all parts of the organization. When the project suffers from high uncertainty, the role played by project communication is even more crucial. (Laufer, 2012, p. 230)

Unfortunately, many people think they are better communicators than they actually are. Sometimes a person will excel at one form of communication but fail at others. For instance, someone might be great at small talk before a meeting but continually confuse co-workers with poorly written emails. This is one area where getting feedback from your co-workers can be especially helpful. Another option is taking a class, or at the very least, consulting the numerous online guides to developing effective communication skills. To help you get started, here are a few quick resources for improving vital communication skills:

Making Small Talk—People often say they dislike small talk, but polite conversation on unimportant matters is the lubricant that keeps the social gears moving, minimizing friction, and making it possible for people to join forces on important matters. If you're bad at small talk, then put some time into learning how to improve; you'll get better with practice. There's no better way to put people at ease. This article includes a few helpful tips: "An Introvert's Guide to Small Talk: Eight Painless Tips."

Writing good Emails—An ideal email is clear, brief, calm, and professional. Avoid jokes, because you can never be certain how team members (especially team members in other countries) will interpret them. A good emailer also understands the social rules that apply to email exchanges, as explained here: "The Art of the Effective Business Email."

Talking One-on-One—Nothing beats a face-to-face conversation for building trust and encouraging an efficient exchange of ideas, as long as both participants feel comfortable. In fact, Alexander Laufer suggests using face-to-face conversation as the primary communication mode for your team (2012, 230). As a team leader, it's your job to be aware of the many ways conversations can go awry, particularly when subordinates fear speaking their mind. This excellent introduction to the art of conversation includes tips for recognizing signs of discomfort in others: "The Art of Conversation: How to Improve Face-to-Face Communication in a Digital World."

Telling stories is an especially helpful way to share experiences with your team. Indeed, stories are "a form of communication that has been used to entertain, persuade, inspire, impart wisdom, and teach for thousands of years. This wide range of uses is due to a story's remarkable effect on human emotion, experience, and cognition" (Kerby et al., 2018).

You've probably experienced the way people lower their defences when they realize they are hearing a tale about specific characters, with an uncertain outcome, rather than a simple recitation of events, or worse, a lecture. Master storytellers seem to do it effortlessly, but in fact, they usually shape their stories around the same basic template. Holly Walter Kerby, executive director of Fusion Science Theater, and a long-time science educator, describes the essential story elements as follows:

A Main Character Your Audience can Identify with—Include enough details to allow your audience to feel a connection with the main character, and don't be afraid to make yourself the protagonist of your own stories.

A Specific Challenge—Set up the ending of the story by describing a problem encountered by the main character. This will raise a question in the minds of the audience members and make them want to listen to the rest of the story to find out what happens.

- Can Sam and Danielle recover from a supplier's bankruptcy and figure out how to get three hundred light fixtures delivered to a new office building in time for the grand opening?
- Can Hala, a mere intern, prevent seasoned contractors from using an inferior grade of concrete?

Three to Five Events Related by Cause and Effect—The events should build on each other, and show the characters learning something along the way. Describe the events in a way that helps build a sense of tension.

One or two physical details—People tend to remember specific physical details. Including one or two is a surprisingly effective way to make an entire story more memorable.

- The first new vendor Sam and Danielle contacted agreed to sell them all the light fixtures they needed but ended up sending only one fixture in a beaten-up box with the corners bashed in.
- Hala, a small person, had to wear an oversized helmet and vest on the job site, which emphasized that she was younger and less experienced than the contractors.

An Outcome that Answers the Question—The outcome should be simple and easy to understand. Most importantly, it should answer the question posed at the beginning of the story.

- Yes—by collaborating with a new supplier, Sam and Danielle were able to acquire the light fixtures in time for the grand opening.
- No—Hala could not stop the contractors from using inferior concrete, but she did report the problem to her boss, who immediately halted construction until the concrete could be tested, and, in the end, replaced.

Satisfying Ending—Explain how the events in the story led to some kind of change in the characters' world.

- – Sam and Danielle learned to focus on building relationships with reliable, financially stable vendors.
- – Hala learned that even an intern can safeguard a project by speaking up when she sees something wrong.

Keep in mind that in some high-stakes situations, the last thing you want is more tension. In that case, you want the opposite of a story—a straightforward recitation of the facts. For example, when confronting a team member about poor work habits, or negotiating with an unhappy client, it's best to keep everything simple. Draining the drama from a situation helps everyone stay focused on the facts, keeping resentment and other negative emotions to a minimum (Manning, 2018, p. 64). For more on good techniques for difficult conversations, see Trevor Manning's book *Help! I need to Master Critical Conversations*.

[1] Thanks to Hala Nassereddine for sharing her story of her experience as an intern on a construction site in Beirut, Lebanon.

The Beauty of Face-to-Face Communication

As Laufer et al. point out in their book Becoming a Project Leader, “In contrast to interactions through other media that are largely sequential, face-to-face interaction makes it possible for two people to send and receive messages almost simultaneously. Furthermore, the structure of face-to-face interaction offers a valuable opportunity for interruption, repair, feedback, and learning that is virtually instantaneous. By seeing how others are responding to a verbal message even before it is complete, the speaker can alter it midstream in order to clarify it. The immediate feedback in face-to-face communication allows understanding to be checked, and interpretation to be corrected. Additionally, face-to-face communication captures the full spectrum of human interaction, allowing multiple cues to be observed simultaneously. It covers all the senses—sight, hearing, smell, taste, and touch—that provide the channels through which individuals receive information” (Laufer et al., 2018).

Certainly, in today’s world of project management, in which distributed digital teams are becoming common practice, it may be impossible to sit down in the same room with all team members. But as much as possible, project managers should push for using technology that allows a fuller communication environment—one in which interactions are not just isolated to text.

13.5. Team Motivation

To build believable performances, actors start by figuring out their characters' motivations—their reasons for doing what they do. As a team leader, you can use the same line of thinking to better understand your team members. Start by asking this question: Why do your team members do what they do? Most people work because they have to, of course. Their contributions to a team are motivated by issues that go way beyond the economic pressures of holding onto a job.

In their book *The Progress Principle: Using Small Wins to Ignite Joy, Engagement, and Creativity at Work*, Teresa Amabile and Steven Kramer argue that the most important motivator for any team is making meaningful daily progress toward an important goal. In their study of 12,000 daily journal entries from team members in a variety of organizations and industries, they found that a sense of accomplishment does more to encourage teamwork, on-the-job happiness, and creativity than anything else. "Even when progress happens in small steps," Amabile et al. (2011) explain, "a person's sense of steady forward movement toward an important goal can make all the difference between a great day and a terrible one" (Amabile et al., 2011, p. 77).

According to Amabile and Kramer 2011, the best managers focus on facilitating progress by removing roadblocks and freeing people up to focus on work that matters:

> When you do what it takes to facilitate progress in work people care about, managing them—and managing the organization—becomes much more straightforward. You don't need to parse people's psyches or tinker with their incentives, because helping them succeed at making a difference virtually guarantees a good inner work life and strong performance. It's more cost-effective than relying on massive incentives, too. When you don't manage for progress, no amount of emotional intelligence or incentive planning will save the day (Amabile et al., 2011, p. 10).

As you might expect, setbacks on a project can have the opposite effect, draining ambition and creativity from a team that, only days before, was charging full steam ahead toward its goal. However, setbacks can be counterbalanced by even small wins— "seemingly minor progress events"—which have a surprising power to lift a team's spirits, making them eager to get back to work the next day (Amabile et al., 2011, p. 80). You've probably experienced the pleasure that comes from checking at least one task off your to-do list. Even completing a small task can generate a sense of forward momentum that can propel a team toward larger achievements.

Through years of practical experience as an executive, consultant, project engineer, and project manager, John Nelson has gained a finely honed understanding of how to manage teams. According to Nelson's lecture on reliable promising for EPD612: Technical Project Management, University of Wisconsin-Madison (2017), the following are essential motivators for any team:

A sense of Purpose—Individually, and as a whole, a team needs an overarching sense of purpose and meaning. This sense of purpose should go beyond each individual's project duties. On the macro level, the sense of purpose should align with the organization's strategy. But it should also align, at least sometimes, with each individual's career and personal goals.

- Clear performance metrics—How will the team and its individual members be evaluated? What does success look like? You need to be clear about this, but you don't have to be formulaic. Evaluations can be as subjective as rating a dozen characteristics as good/not good, or on a score of 1-5.

Assigning the Right Tasks to the Right People—People aren't commodities. They aren't interchangeable, like a router or a hand saw. They are good at specific things. Whenever possible, avoid assigning people to project tasks based on capacity—that is, how much free time they have—and instead try to assign tasks that align with each individual's goals and interests.

Encouraging Individual Achievement—Most people have long-term aspirations, and sometimes even formalized professional development plans. As team leader, you should be on the lookout for ways to nudge team members toward these goals. It's not your job to ensure that they fully achieve their personal goals, but you should try to allow for at least a little forward movement.

Sailboat Rules Communication, in which no one takes offence for clear direction—On a sailboat, once the sail goes up, you need to be ready to take direction from the captain, who is responsible for the welfare of all on board, and not take offence if he seems critical or unfriendly. In other words, you can't take things personally. Likewise, team members need to set their egos aside and let perceived slights go for the sake of the team. When you start a big project, explain that you are assuming sailboat rules communication. That means that, in a meeting, no one has the privilege of taking anything personally.

Mentorship—Team members need to be able to talk things over with more experienced people. Encourage your team to seek out mentors. They don't necessarily have to be part of the project.

Consistency and Follow-Through—Team morale falls off when inconsistency is tolerated or when numerous initiatives are started and then abandoned. Encourage a team environment in which everyone does what they commit to do, without leaving loose ends hanging. Be on the lookout for gaps in a project, where things are simply not getting done. (Nelson, 2017)

13.6. Business Case

Tokyo 2020 Summer Olympics Case Study

This case study and the case problems that follow were adapted from the publicly available volunteer strategy for the 2020 Tokyo Olympics.

Japan will host the 2020 Summer Olympics from July 24 to August 9 in Tokyo. The event, commonly known as Tokyo 2020, will be the second hosting by the country after the 1964 Tokyo Olympics. Most games will be played at venues within the prefecture of Tokyo or areas nearby. Twenty-eight of 32 competition venues are clustered around Tokyo within a 5-mile radius of the Olympic Village, the residence facilities for athletes and staff. Eleven new venues are currently under construction. The Tokyo Metropolis is the largest metropolitan city in Japan. In fact, the Greater Tokyo area and its surrounding cities represent the most populous city in the world. Tokyo has a population of 39 million residents, with an economy equivalent in size to the eighth-largest economy in the world.

Volunteer Program

The Tokyo 2020 Olympics has a vision statement, "Unity in Diversity." The 2020 Olympic Committee promotes this vision in the volunteer program by encouraging volunteer participation from people with diverse backgrounds. One of the program's goals is that through the volunteering experience, people will continue to remain active in their volunteering roles in their communities after the games.

The committee has implemented the volunteer program of the London 2012 Games as its template for running its volunteer program. The program has volunteers organized into two groups with different roles for the games: game volunteers and city volunteers.

Game Volunteers aid in the operation at the competition venues, media centres, and Olympic villages. The tasks involve providing support in the following areas: operation of games at the venues, security checks at the Olympic facilities, operation of the Olympic village, registration and issuance of IDs for the Olympic athletes and staff, and equipment checks and distribution of them to the venues. They are active prior to and for the duration of the games. Table 13.1 depicts a sample of the job descriptions and specifications for "games volunteers" for the 2020 Tokyo Olympics.

City Volunteers guide those visitors with tourism and transportation information and, provide them with directions to game venues. City volunteers are deployed for athletes, staff members, and visitors at major transportation points, such as airports, major train stations, and popular tourist attractions. Special booths are set up at those locations to welcome athletes, staff personnel, and spectators to Japan.

Volunteer leaders of either group are responsible for checking the attendance of team members and acting as liaisons in the event of emergencies.

Table 13.1 ***Note. The table content of job descriptions and specifications came from the publicly available volunteer strategy provided by the Tokyo Metropolitan Government and Tokyo Organizing Committee of the Olympic and Paralympic Games 2020.***

Activity	**Description (Examples)**
Guidance at venues	Guide spectators and those affiliated with the games at venues, check tickets, provide support for regulating entrance to venues, etc.
Doping control	Provide support for doping inspectors as they test athletes who have finished the competition.
Driver	Transport those affiliated with the games between venues by car.
Workforce registration	Sign-in workforce at venues. Check the workforce member's shift by referring to their personal ID and relay necessary information to them.
Uniform distribution	Pass out uniforms to workforce members (volunteers and others) at a uniform distribution facility.
Media support	Provide support to Japanese and foreign media covering the games at venues, the Press Centre, and other locations.
Language services	Provide communication support to those affiliated with the games, including athletes, the media, and foreign dignitaries.
Support for teams	Support the teams that come from around the world. Start preparations prior to the teams entering the Olympic Village to facilitate a comfortable stay.
Logistics support	Support the management and organization of goods brought to competition venues, the Olympic Village, etc.

Case Problems

The Olympic Committee has approached you as an event volunteer/team program manager to develop a plan for recruiting a team of volunteers in accordance with the Olympic vision of "Unity in Diversity." The committee is interested in how to encourage people with diverse backgrounds to volunteer for the games. Particularly, they aim to achieve two specific goals: 1) enlist first-time volunteers and 2) reach out to groups, such as seniors or new immigrants, who have been largely neglected as potential volunteers.

1. Discuss the role of trust in building this team of volunteers.
2. How would you plan motivation for this team?
3. According to the literature on volunteers for a major sports game, seven benefit categories were identified that volunteers experienced from participating in a major sports event (Doherty, 2009; Kim et al., 2018).

Match each benefit category on the left with corresponding items (two items per benefit) on the right.

An interactive H5P element has been excluded from this version of the text. You can view it online here: [*https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=585#h5p-44*](https://ecampusontario.pressbooks.pub/essentialsofprojectmanagement/?p=585#h5p-44)

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13.7. Key Terms

Key Terms

- **A Sense of Purpose:** Individually, and as a whole, a team needs an overarching sense of purpose and meaning. This sense of purpose should go beyond each individual's project duties.
- **Adjourning:** Once the project is completed, the team should collect lessons learned and transition to other projects or roles. The project manager should provide recognition of the work done by the team and help them transition to their next project (provide recommendations, etc.).
- **Assigning the Right Tasks to the Right People:** People aren't commodities. They aren't interchangeable, like a router or a hand saw. They are good at specific things. HR Specialists are trained to find the right people for teams and align them with the right team tasks.
- **Consistency and Follow:** Through the team, morale falls off when inconsistency is tolerated or when numerous initiatives are started and then abandoned.
- **Encouraging Individual Achievement:** Most people have long-term aspirations, and sometimes even formalized professional development plans. As a team leader, you should be on the lookout for ways to nudge team members toward these goals. It's not your job to ensure that they fully achieve their personal goals, but you should try to allow for at least a little forward movement.
- **Forming:** The group is brought together for the first time. The team is orienting themselves to the task at hand. At this stage, there may be little agreement on how to approach the project and team members may struggle with understanding the purpose of the project. The project manager needs to provide guidance and direction during this stage.
- **Mentorship:** Team members need to be able to talk things over with more experienced people. Encourage your team to seek out mentors. They don't necessarily have to be part of the project.
- **Norming:** At this stage, the team will have developed a consensus regarding roles, processes and approaches to the work ahead. The project manager should participate by working as a facilitator for the group.
- **Performing:** At this point, the group has a clear vision and purpose and is focused on meeting performance goals, project milestones and other benchmarks. The project manager should be able to delegate more and more responsibility to the team, with less supervision
- **Sailboat Rules Communication**: No one takes offence for clear direction—On a sailboat, once the sail goes up, you need to be ready to take direction from the captain, who is responsible for the welfare of all on board, and not take offence if he seems critical or unfriendly.
- **Storming:** Team members are trying to figure out their roles in the group. Conflict and power struggles are common, but so is a clearer vision for the group. During this time of intergroup conflict, the project manager needs to provide support and coaching.

13.8. Chapter Questions

Knowledge Check 1

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CHAPTER 14 - AGILE PM

Chapter Overview

14.1. Chapter Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Outline the difference between traditional and Agile project management.
2. Explain the fundamentals of Agile software development, including sprints and product stories.
3. Explain the Agile project scope.
4. Discuss issues related to sustainable procurement in an Agile project.
5. Explain the role of self-organizing teams in Agile.
6. Describe challenges related to resource allocation in Agile.

14.2. Definition

Agile is an iterative short process focused on customer feedback and satisfaction. In such processes, the customer is allowed to verify that the features are being developed as they want and to suggest improvements. It also offers the customer the opportunity to release the product or software earlier than originally planned if the version presented at the end of a cycle is deemed good enough. This is one of the many reasons Agile is favoured for software development. Agile products can be brought to market quickly and then continuously improved with subsequent updates. For many years, some "traditional" and Agile project managers viewed each other with a certain amount of skepticism about the value of each other's methods. However, in recent years, project managers have seen the value of the techniques used in both of these two "camps" of project management. As a result, it is not unusual to see the design of a building using Agile techniques, and software development projects conducting a traditional risk analysis.

Figure 14.1: Agile projects are iterative

In the world of software development, a related methodology, Agile, is becoming increasingly popular. Although Agile had its roots in software development, companies have also expanded its use into a variety of project types, including product development, capital projects, and service projects.

There are many types of Agile processes including:

- **Agile Scrum**: Designed for completing complex projects, as described on [ScrumGuides](), Scrum is the most widely used form of Agile. When people talk about Agile, they are usually talking about Scrum, which means a framework that people choose to conduct projects in an agile way. In the scrum framework, people and teams are optimally structured to deliver value in a collaborative way. Scrum includes Values, Developers, Owners, Teams and Masters. The scrum master here is equivalent to the project manager in traditional PM, while the scrum team is the project team and the customer is the product owner.
- **Extreme Programming**: Emphasizes short development cycles with frequent releases of software for evaluation, after which a new development cycle begins. It is the most successful of agile types as it focuses on customer satisfaction. You can read more about extreme programming at "Extreme Programming: A Gentle Introduction"
- **Rapid Product Development**: Emphasizes "simultaneous, coordinated activities by multi-functional teams, striving for smooth transitions between phases for the most rapid time-to-market" (ORC International: Expert Advisory Services, n.d.). You can read more about Rapid Product Development in this "Introduction to Rapid Product Development."

All forms of Agile emphasize an iterative approach (Figure 14.1) to product development, with the project specifications evolving along with the customer's notion of the software requirements. A project starts with a conversation between the developer and the product owner about what the customer wants the software to do. In Scrum terminology, the customer is the product owner, and the features that the product owner wants in the software are known as product stories.

With a description of the product stories in hand, the Agile developer gets to work, creating pieces of software that address individual product stories. After a one- to two-week cycle of development (known in Scrum as a sprint) the developer hands off the new software to the product owner so she can try it out and make suggestions for improvement. The developer then begins another sprint, incorporating those suggestions into a new iteration. After every sprint, the product owner has the chance to redirect the team to new product stories or to revise the team's understanding of the existing product stories. Through these repeated interactions, which provide fast, focused feedback, the developer and the product owner zero in on a software application that does what the product owner needs it to do. If time and money are tight, as they often are, the product owner has regular opportunities to make choices about which product stories are the most important, and which can be dispensed with if necessary.

Agile development is essentially a learning process through which the developer and the product owner create a shared understanding of how many features they can create, given the allotted time and money. It's very much a living order approach to project management, in that the early stages involve some ambiguity and many unknowns. According to Robert Merrill (2017), a Senior Business Analyst at the University of Wisconsin-Madison, and an Agile coach, "Agile is a way to manage projects in the face of unpredictability and constraints—often very rigid time and budget constraints. The fast feedback allows the team to create the best possible software within the given constraints" (Merrill, 2017).

14.3. Scope in Agile

Robert Merrill, a Senior Business Analyst at the University of Wisconsin-Madison, and an Agile coach, advises taking a three-part approach to scope on Agile projects, determining the following:

1. Minimum viable features—If we can't deliver this much within schedule and budget constraints, the project should be cancelled.
2. Features we can't think about now—Although these might be featuring the client's wants, they are not something we can create, and so we can't waste time and mental energy thinking about them.
3. Everything else—This is our unpredictability buffer, which we maintain to protect the schedule and budget.

Note that these categories are not frozen; they can be changed during each iteration planning cycle. Scope in an Agile project is variable, but carefully and visibly managed.

The Agile Perspective on Scope Creep

Agile welcomes changes to product requirements even late in the development process. Indeed, the founders of Agile made an openness to late-breaking changes one of their "Principles Behind the Agile Manifesto." which you can read here: "Principles Behind the Agile Manifesto."

In this environment of constant iterations and revisions, Agile developers have a different perspective on **scope creep**. A blog post for OptiSol spells out some ways to identify what is and isn't scope creep in Agile. Making changes "before the team has started to think about the details" would not be considered scope creep in Agile, nor would replacing one feature with another, as long as the new feature doesn't add new work for the team. However, swapping a new feature for a feature that is already complete is definitely a form of scope creep, because it creates new work. The same is true of replacing a small feature with something more complex (OptiSol, 2015). You can read the complete blog post here: "What is Scope Creep in Agile Development?"

14.4. Agile Procurement

Robert Merrill, a Senior Business Analyst at the University of Wisconsin-Madison, and an Agile coach, points out that “many procurement processes naturally follow or even mandate a negotiation-based approach that is directly at odds with the kind of living order thinking found in the Agile Manifesto, which emphasizes ‘collaboration over contract negotiation’” (pers. comm., June 15, 2018). Nevertheless, some organizations and governments are beginning to rethink their procurement processes in hopes of making them more Agile and, as a result, less costly.

One interesting example is an ongoing overhaul of the State of Mississippi’s child welfare information system. After some initial missteps, the state emphasized identifying and contracting with many qualified vendors on portions of the project, rather than attempting to hire a single entity to create the entire information system. A blog post published by 18F, an arm of the U.S. government’s General Services Administration, which guided the project, describes Mississippi’s new approach to an age-old software development dilemma:

- Mississippi’s initial response to solving this problem was a classic waterfall approach: Spend several years gathering requirements then hire a single vendor to design and develop an entirely new system and wait several more years for them to deliver a new complete solution. According to the project team at Mississippi’s Department of Child Protection Services (2016), this “sounds like a good option, but it takes so long to get any new functionality into the hands of our users. And our caseworkers are clamouring for new functionality.” (Cohn & Boone, 2016, para. 2). Instead, they’re taking this opportunity to build the first Agile, modular software project taken on within the Mississippi state government. They’re starting with how they award the contracts to build it.
- Once this pool of vendors is selected, instead of awarding the entire contract to a single company, Mississippi will release many smaller contracts over time for different sections of the system. This is great for Mississippi. Inspired by the Agile approach, they’ll only need to define what needs to be built next, rather than defining the entire system all up front.
- This is also great for vendors. More minor contracts mean smaller vendors can compete. Small businesses can’t manage or deliver on large multimillion-dollar software development contracts and so are often precluded from competing. But with this approach, many contracts could end up in the single-digit millions (or less!). Smaller contracts mean more small businesses can compete and deliver work, resulting in a larger and more diverse pool of vendors winning contracts and helping the state.
- Approaching the project in a modular, Agile fashion can be more cost-effective and less risky than a monolithic undertaking. To do it, they plan to take an approach called the “encasement strategy,” under which they will replace the system slowly over time while leaving the legacy system in place. It will work like this: The old database will have an API layered on top of it and then a new interface will be built, one component at a time, without risking the loss of data or major disruptions to their workflow. Each module will be standalone with an API interface to interact with the data and the other modules. If they decide to replace a module five years from now, it won’t really impact any of the others. (Cohn & Boone, 2016)

14.5. Agile Teams

Agile software development was founded as a way to help team members work together more efficiently and companionably. In fact, three of the twelve founding principles of the methodology focus on building better teams:

- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
- The best architectures, requirements, and designs emerge from self-organizing teams.
- At regular intervals, the team reflects on how to become more effective, and then tunes and adjusts its behaviour accordingly (Beedle et al., 2001).

The term "self-organizing teams" is especially important to Agile. Nitin Mittal (2013), writing for Scrum Alliance, describes a self-organizing team as a "group of motivated individuals, who work together toward a goal, have the ability and authority to take decisions, and readily adapt to changing demands" (Mittal, 2013).

But that doesn't mean Agile teams have no leaders. On the contrary, the Agile development process relies on the team leader (known as the ScrumMaster in Scrum) to guide the team, ideally by achieving "a subtle balance between command and influence" (Cohn, 2010). Sometimes that means moving problematic team members to new roles, where they can be more effective, or possibly adding a new team member who has the right personality to interact with the problematic team member. In a blog for Mountain Goat Software, Mike Cohn (2010) puts it like this:

- There is more to leading a self-organizing team than buying pizza and getting out of the way. Leaders influence teams in subtle and indirect ways. It is impossible for a leader to accurately predict how a team will respond to a change, whether that change is a different team composition, new standards of performance, a vicarious selection system, or so on. Leaders do not have all the answers. What they do have is the ability to agitate teams (and the organization itself) toward becoming more agile. (Cohn, 2010)

14.6. Estimating Resources

In theory, resource management in Agile should be simple. After all, in Agile, resources and time are usually fixed. The team has a fixed budget, a fixed number of programmers, and a fixed amount of time to create working software. The variable in all this is the software itself. Throughout the cycle of sprints—as the customer tries out new software, and requests alterations—the software features can change dramatically. When the budget is exhausted, the project ends. However, because Agile developers create working software bit-by-bit, the customer is assured of having at least some usable features by that point.

So again, resource management in Agile should be simple—in theory. But in reality, the key resource in software development is the people who create the software. In addition, where people are concerned, things rarely go as planned. Some programmers work faster than others, and individuals can vary tremendously in their output from one week to the next, especially when dealing with personal problems, like illness or family conflict. Robert Merrill (2017), a Senior Business Analyst at the University of Wisconsin-Madison, and an Agile coach, puts it like this:

> Agile is more about people than computers. People are not interchangeable; they have good days and bad days. They get along or they don't. Cognitive abilities vary tremendously. If you aren't successful in helping teams gel and stay focused, you're going to spend lots of extra money, or the project may blow up. You need to get the teams right. (Merrill, 2017)

As Gareth Saunders (2015) explains in a thoughtful blog post on the topic, this is all complicated by the amount of "business as usual" tasks that developers typically have to fit into their schedules on top of their work on specific Agile projects. This includes tasks like "admin, team communications, support, mentoring, meetings, and consultancy—offering our input on projects managed by other teams" (Saunders, 2015). As a result, as a project manager, Saunders (2015) struggles to answer the following questions:

1. How do we know how much time each team member has to work on projects?
2. When we're planning the next sprint, how do we track how much work has been assigned to a team member, so that they have neither too little nor too much work? (Saunders, 2015)

In theory, answering these questions should not be difficult. For instance, if you have, "five developers, each with 6 hours available for work each day". That gives us 30 hours per day, and assuming 9 days of project work (with one full day set aside for retrospective and planning) then within each two-week sprint we should be able to dedicate 270 hours to development work" (Saunders, 2015). In reality, however, business-as-usual tasks can eat up 40% of a programmer's working week, with that percentage varying from week to week or month to month.

Difficulties in estimating a team member's capacity for work on a project are something every project manager faces. In Agile, estimating capacity can be especially difficult. In Agile, project managers (or Scrum masters) ideally exert minimal direct influence on day-to-day work, because teams are supposedly self-organizing—that is, free to manage their work as a group and pull work when they are ready for it. This means Agile project managers need to take the long view on resource management by practicing good resource capacity management, which involves "planning your workforce and building a skill inventory in exact proportion to the demand you foresee. It lets you optimize productivity and as a concept perfectly complements the Agile methodology" (Gupta, 2017).

Interested in learning more about managing resources in Agile? Start with these links:

- You can read more about resource capacity management from Project Management.com.
- Gareth Saunders' blog post, and the accompanying comments, walk you through some of the challenges of Agile resource management.

14.7. Business Case

Read the following case study: PM Governance Combined with Agile Tools Improves Delivery and Quality of Financial Services Programs and answer the questions below.

Questions

1. What are some of the agile tools and techniques that PM Solutions could have proposed?
2. What is the Kanban approach?
3. For the proposed solution to work, what style of governing should the team should adapt?

14.8. Key Terms

Key Terms

- **Agile Scrum**: designed for completing complex projects, as described on ScrumGuides.
- **Extreme Programming**: emphasizes short development cycles with frequent software releases for evaluation, after which a new development cycle begins.
- **Rapid Product Development:** Emphasizes "simultaneous, coordinated activities by multi-functional teams, striving for smooth transitions between phases for the most rapid time-to-market" (ORC International: Expert Advisory Services, n.d.).
- **Scope creep:** an uncontrolled cascade of changes to the scope with no corresponding authorized changes in budget and schedule.
- **Scrum:** is the most widely used form of Agile, which means a framework that people choose to conduct projects in an Agile way.

14.9. Chapter Questions

Knowledge Check 1

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Ancillary Resources

Slide Decks

- Essentials of Project Management Chapter 1
- Essentials of Project Management Chapter 2
- Essentials of Project Management Chapter 3
- Essentials of Project Management Chapter 4
- Essentials of Project Management Chapter 5
- Essentials of Project Management Chapter 6
- Essentials of Project Management Chapter 7
- Essentials of Project Management Chapter 8
- Essentials of Project Management Chapter 9
- Essentials of Project Management Chapter 10
- Essentials of Project Management Chapter 11
- Essentials of Project Management Chapter 12
- Essentials of Project Management Chapter 13
- Essentials of Project Management Chapter 14

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Versioning History

This page provides a record of edits and changes made to this book since its initial publication. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.1. If the edits involve a number of changes, the version number increases to the next full number.

The files posted alongside this book always reflect the most recent version.

Version	Date	Change	Affected Web Page
1.0	03 January 2022	First Publication	N/A
1.1	22 August 2023	1. Added content 2. Removed content 3. Changed subsection titles 4. Changed chapter titles 5. Updated image 6. Added new image 7. Moved image 8. Updated learning objectives 9. Moved section from chapter 13 to chapter 12. 10. Renumbers chapters 12 & 13 to account for section movement 11. Updated ancillary resources	1. 1.4. Aspects of Project Management; 1.5. Life Cycle; 2.4. Strategy; 2.5. Project Selection; 4.4. Project Charter; 5.5. Time Estimation; 7.5. Procurement Process; 12.1. Chapter Introduction; 14.2. Definition 2. 1.4. Aspects of Project Management; 2.2. Structures; 2.3. Culture; 4.3. Weighted Decision Matrix; 5.5. Time Estimation; 6.2. Resource Estimation; 7.5. Procurement Process; 7.6. Contracts 3. 5.5. Time Estimation 4. Chapter 2 – Organization; Chapter 3 – Project Process; 4.2. Strategic Alignment; 4.7. Business Case (In-class discussion); Chapter 5 – Project Planning (Scheduling); Chapter 6 – Project Planing (Resources, Cost, and Budget); 6.4. Understanding Cost; Chapter 12 – Project Leadership 5. 1.4. Aspects of Project Management; 3.1. Chapter Introduction; 9.2. Risk Management and Project Success 6. 1.5. Life Cycle 7. 2.4. Strategy; 4.6. Managing the Scope 8. 3.1. Chapter Introduction; 12.1. Chapter Introduction; 13.1. Chapter Introduction 9. 12.2 Diversity and Leadership 10. Chapter 12 – Project Leadership; Chapter 13 – Project Team 11. Ancillary Resources
1.2	October 2023	Moved all references to the back matter. Updated all attributions on each page. Fixed spelling and grammar issues. Replaced images with Tables. Edited some learning outcomes to make them measurable	