PROJECT MANAGEMENT FUNDAMENTALS (NWTC)

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CHAPTER OVERVIEW

1: Projects and the Project Manager

1.1: 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. Explain the difference between a Project Lifecycle and the PMI Project Processes.
4. 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 building 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, 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 processes 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).

Watch the Video: Projects vs Operations to understand the differences and similarities.

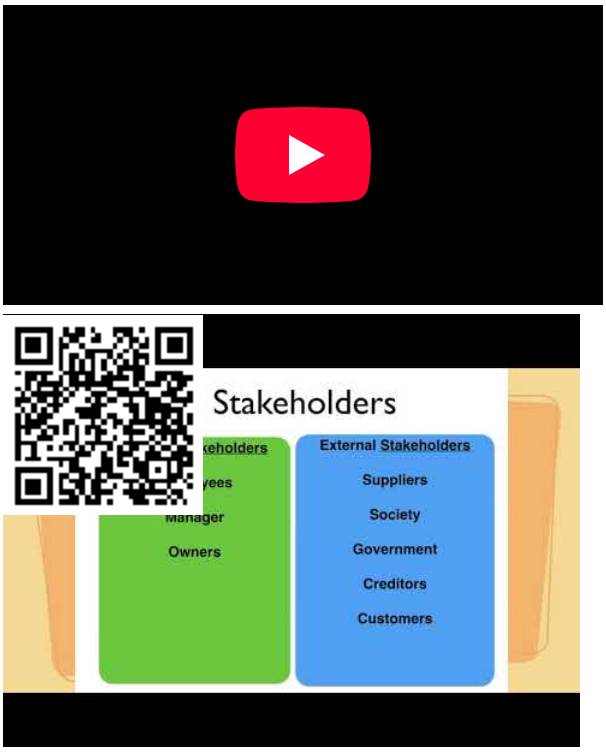
Definition of a Project

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.



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

Project Management

"Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements" (Project Management Institute, Inc., 2008). This simple definition represents a compromise that resulted from intense discussions within the Project Management Institute (PMI) during the 1980s. One of the priorities of PMI during this time was the development of project management as a profession. PMI developed *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* and the project management certifications to promote the understanding and development of the project management field and to share best practices, creating a common language among professionals.

Jack Meredith and Samuel Mantel (Meredith & Mantel Jr., 2006) discussed project management in terms of producing project outcomes within the three objectives of cost, schedule, and specifications. Project managers are then expected to develop and execute a project plan that meets cost, schedule, and specification parameters. According to this view, project management is the application of everything a project manager does to meet these parameters. This approach to defining project management shares PMI's focus on the project outcomes in terms of requirements.

Meredith and Mantel added a fourth aspect of project management—the expectations of the client. One client-centered definition of project management is the application of knowledge, skills, tools, and techniques to meet or exceed the expectations of the client. This definition focuses on delivering a product or service to the client that meets expectations rather than project specifications. It is possible to meet all project specifications and not meet client expectations or fail to meet one or more specifications and still meet or exceed a client's expectation (Darnall, 1996).

Meredith and Mantel discussed a tendency noted by Darnall (Darnall, 1996) that expectations often increase during the life of a project. Meredith and Mantel suggest that this is a form of scope increase. A project scope is a carefully crafted document that reflects the performance specifications of the project deliverables. Defining the project scope and managing scope change is a very different process from developing an understanding of a client's expectations and managing those expectations. Darnall focused on defining and managing client expectations as a critical project management skill that is distinct from scope development and management.

Client expectations encompass an emotional component that includes many client desires that are not easily captured within a specification document. Although closely correlated with project specifications, client expectations are driven by different needs. It is possible for a project team to exceed every project specification and end up with an unsatisfied client.

Highway Project

The Department of Highways in South Carolina was exploring ways to reduce the road construction costs and developed new contracting processes to allow the road builders to bring new ideas for cutting costs. On one project, the contractor proposed cost-cutting ideas throughout the life of the project. At each phase, the client accepted many of the ideas and then revised the budget. The client promoted the revised cost target of the project as an example of the success of the new process. By the end of the project, the final cost was less than 1 percent over the newest target. Although the total cost of the project was almost 10 percent less than the original cost projections and contract obligations, the success of the project was connected to the new expectations that developed during the life of the project. Even though this project performance exceeded the original goal, the client was disappointed.

The reverse is also true. A project can be late and over budget and the client can be satisfied. Although this may be counterintuitive, the response of a client to the events of a project is complex and goes beyond the data related in project specifications.

Biotech Project

A biotechnology company developed a new drug that proved to have a large market demand, and the team that developed the drug was assigned to build a new manufacturing facility to produce the drug. The project manager for the construction company that was awarded the contract to build the manufacturing facility managed the project effectively. Every request for a change in scope was approved, and the result was a 20 percent increase to the total cost of the project. On most projects, a 20 percent increase in the project cost would be considered poor performance. For the client's project team, who were accustomed to complex projects with a large number of unknown issues that increase the final cost of the project, a 20 percent overrun in cost was not unusual. Even though the project was 20 percent over budget, the client was happy. Client satisfaction is often tied to expectations about project performance. Identifying and managing those expectations is a primary responsibility of the project manager.

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.

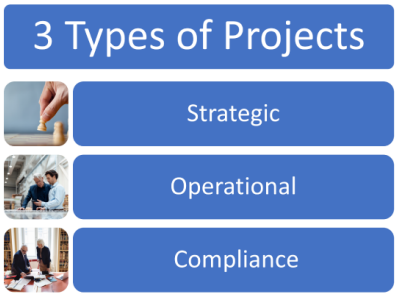


Figure 1.1: Three broad categories of projects

Traditional Project Management

The concept of work was first studied in 1880 by Frederick Taylor, who was also the first to consider process design. 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. In the 1950s we began to see project management concepts used to design the Polaris Missile. Henry Gantt's chart was created to manage Army Logistics and you could find War rooms with the Program Review Evaluation Technique (PERT) charts hanging from the walls. 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). Agile began with a manifesto. The Agile manifesto includes 4 main values: Individuals and interactions, working software, customer collaboration, and responding to change. Agile works well with very complex projects that have multiple deliverables. In a more traditional approach, change has to be managed and controlled. In an agile approach, change is encouraged and delivering value quickly is the main focus.

Imagine you waited in line to buy a new phone on its release date. You have all of your apps updated and are exploring the new functionality and a bug in the software was discovered. Now imagine waiting months to get that fixed. It would be unacceptable. When Google researchers discovered a vulnerability in Apple's software that was released in October 2023 exposing phones to a bug called Zero-Day, it took Apple under a week to fix the reported bug. Google had fixed their own Zero-Day vulnerability in Chrome in just 4 days. This is how quickly Agile project management techniques can work.

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.

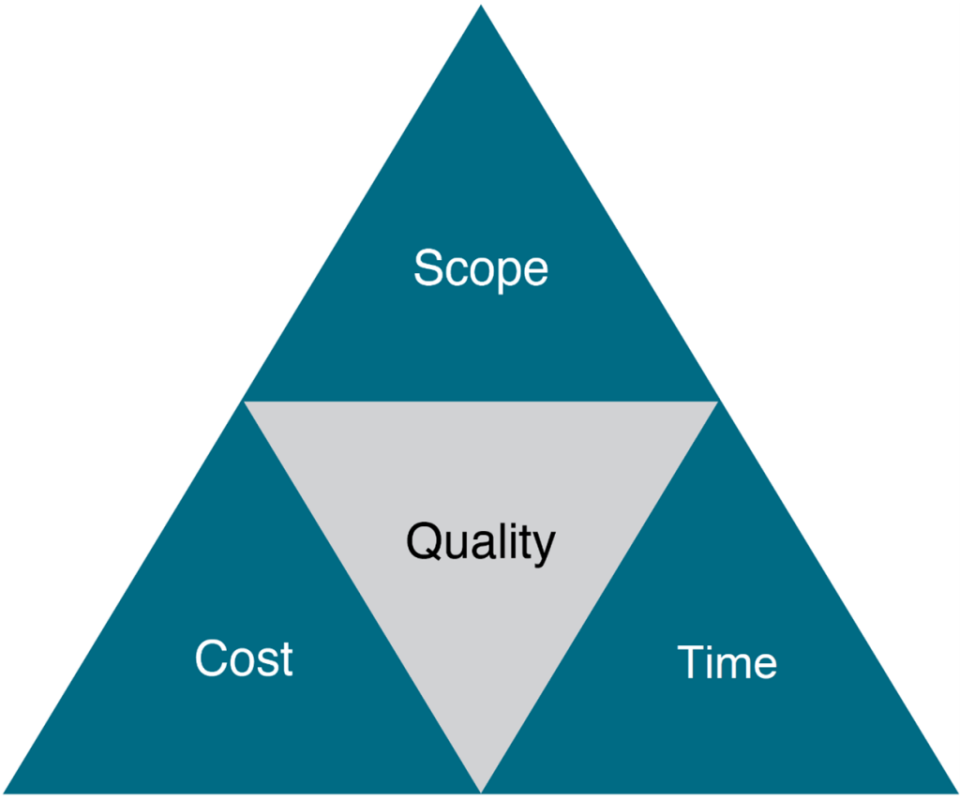


Figure 1.2: "The triad constraints" by John M. Kennedy T., CC BY-SA 3.0, adapted by Fanshawe College, CC BY-SA 3.0

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.

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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 1.4).

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.

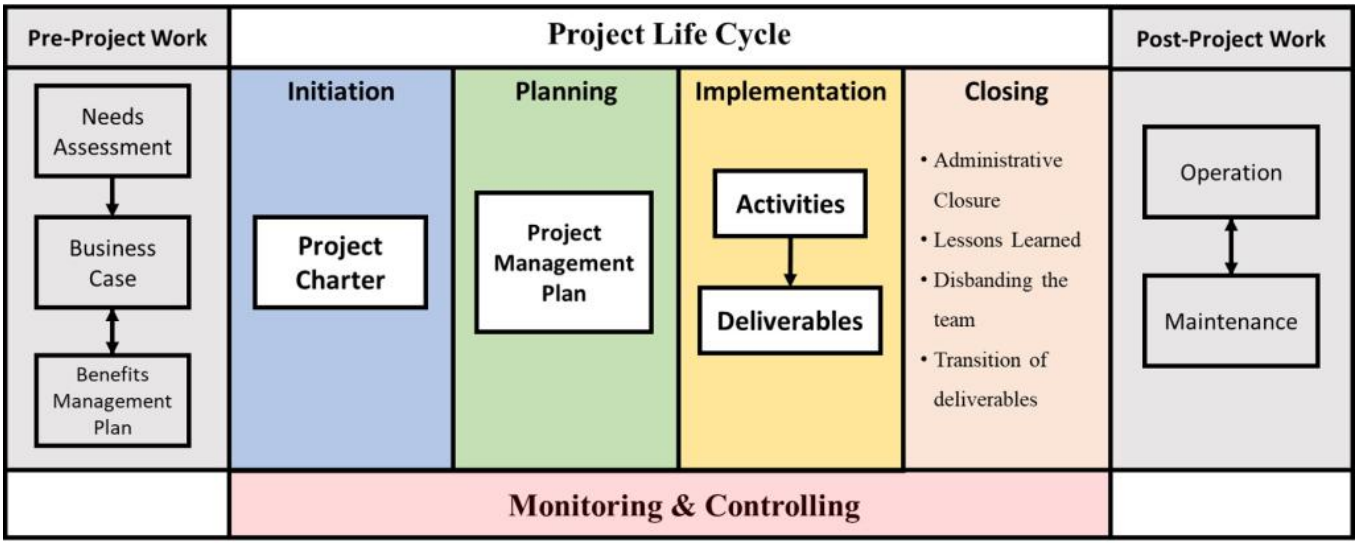

Figure 1.4: Pre-Project Work, Project Life Cycle, and Post-Project Work. Source: PMBOK Guide 6th Edition

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.

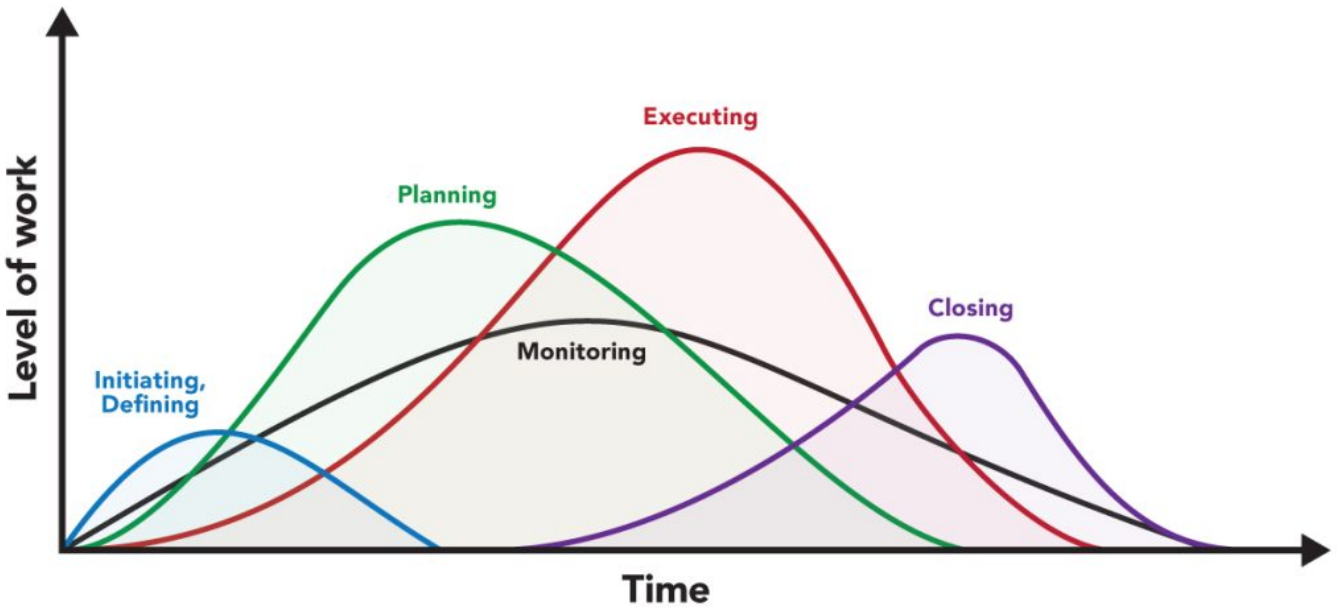

Figure 1.5: Illustration of work activity-time graph for a typical project life cycle.

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1.6: The Project Manager's Role

Project Management Skills

Every project is unique, and most projects will encounter unexpected technical challenges. Each project management team is a group of individuals who need motivation and coordination. Planning is vital, but the ability to adapt to changes and work with people to overcome challenges is just as necessary. A project manager must master the skills that are necessary to be successful in this environment.

Operational Management Skills

Often the difference between the project that succeeds and the project that fails is the leadership of the project manager. The leadership skills needed by the successful project manager include all the skills needed by operations managers of organizations. These skills include:

- Good communication
- Team building
- Planning
- Expediting
- Motivating
- Change Management
- Organizational Political sensitivity

Project Management Skills

Because project managers generally operate in a project environment that is more time sensitive and goal driven, the successful project manager requires additional knowledge, skills, and abilities.

Albert Einsiedel (Einsiedel, 1987) discussed leader-sensitive projects and defined five characteristics of an effective project leader. These characteristics were chosen based on some assumptions about projects. These characteristics include the project environment, which is often a matrix organization that results in role ambiguity, role conflict, and role erosion. The project environment is often a fluid environment where decisions are made with little information. In this environment, the five characteristics of an effective project leader include the following:

- Credibility
- Creativity as a problem solver
- Tolerance for ambiguity
- Flexibility in management style
- Effectiveness in communicating

Hans Thamhain (Thamhain, 1991) researched the training of project managers and, based on the finding, categorized project management into interpersonal, technical, and administrative skills:

- *Interpersonal skills*. These skills include providing direction, communicating, assisting with problem solving, and dealing effectively with people without having authority.
- *Technical expertise*. Technical knowledge gives the project manager the creditability to provide leadership on a technically based project, the ability to understand important aspects of the project, and the ability to communicate in the language of the technicians.
- *Administrative skills*. These skills include planning, organizing, and controlling the work.

Thamhain's work provides a taxonomy for better understanding the skills needed by project managers.

Traditionally, the project manager has been trained in skills such as developing and managing the project scope, estimating, scheduling, decision making, and team building. Although the level of skills needed by the project manager depends largely on the project profile, increasingly the people skills of the project manager are becoming more important. The skills to build a high-performing team, manage client expectations, and develop a clear vision of project success are the type of skills needed by project managers on more complex projects. "To say Joe is a good project manager except he lacks good people skills is like saying he's a good electrical engineer but doesn't really understand electricity" (Darnall, 1997).

Key Takeaways

- Project managers need the same skills as an operations manager, such as good communications, team building, planning, expediting, motivating, and political sensitivity.
- Project managers need additional skills in establishing credibility, creative problem solving, tolerance for ambiguity, flexible management, and very good people skills.

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1.7: 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.

1.8: Exercises

Exercises at the end of the chapter are designed to strengthen your understanding and retention of the information recently acquired in the chapter.

Essay Questions

Write several paragraphs to provide more in-depth analysis and consideration when answering the following questions.

1. If you were planning to change the landscaping around the location where you or a friend lives and decided to approach it like a project, describe the start-up activities you would use. Refer to the elements of a project start-up as described in this chapter.
2. Describe a project you have worked on where you experienced scope creep. Begin by defining scope creep in your own words. Describe the project, how the scope creep occurred, and the effect it had on the project cost, quality, and completion date.

Discussion

The exercises in this section are designed to promote exchange of information among students in the classroom or in an online discussion. The exercises are more open ended, which means that what you find might be completely different from what your classmates find, and you can all benefit by sharing what you have learned.

1. *Client satisfaction*. Should the project manager go beyond the written requirements in the project scope statement to satisfy the client? Does the answer to this question depend on the role of the project in the organization? For example, does it matter if the organization is a consulting firm that sells project management or if the project is done for another department in the same organization? Form an opinion on this topic, and write a few paragraphs on it to organize your thoughts on the subject. Be prepared to share your thoughts with classmates. Submit the work as directed by your instructor.
2. *Organizational priorities*. Consider that three different organizations are planning to construct a building for their own use. The organizations are a for-profit company, a religious group, and a local school district. Choose three project knowledge areas, and consider how the project might be affected in each of these areas by the different types of organizations behind the project. Write a few paragraphs on this topic to organize your thoughts on the subject, and be prepared to share your thoughts with classmates. Submit the work as directed by your instructor.

CHAPTER OVERVIEW

2: Project Environment and Project Initiation

2.1: 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
9. Explore the internal and external environment of a project

All projects are undertaken for a reason. Some projects can be initiated for business reasons (i.e., strategic objectives) such as increasing profits, decreasing customer wait time, and improving employee working conditions. Other projects exist for social reasons such as a municipal recycling system or installing clean energy solutions. Often, the pressure to produce results encourages people to identify possible solutions without fully understanding the needs and purposes of the project. This approach can create a lot of immediate activity, but it also creates the likelihood that the change initiative will fail to deliver the proposed organizational value.

One of the best ways to gain approval for a project is to clearly communicate the project's objectives and describe how the project provides a solution for an organizational need or how it capitalizes on a business opportunity. A needs analysis that accompanies a business case is often conducted to better understand the underlying organizational needs and how meeting these needs would help the organization achieve strategic objectives (e.g., increase profits, improve customer experience, develop new products). Once alternative solutions are identified, each solution is assessed to determine if it supports the organization's vision and strategies. Issues of justification ("should we do the project?") and feasibility ("can we do the project?") are addressed for each solution. Finally, some projects are selected to initiate. It is important to note that project justification is a key part of the project initiation phase: a project must have a reason to exist and, if no such justification can be determined, then it's best to stop the project before too much time, money, and resources are invested in it. If issues of justification are not adequately addressed, the project will lack the required organizational support and, therefore, will ultimately be unsuccessful.

2.2: 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.

@Lewis Hamilton Date: May 24, 2011 CC by 2.0

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.

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 new project endeavors, we need to find out if our project is financially feasible. We do that by using net present value (NPV), rate of return (ROI), and payback analysis. In order to do this we need to have clearly defined objectives and outcomes for our project. Often projects financial benefits or results will determine if it is undertaken by an organization.

2.3: Weighted Decisions Matrix

A **weighted decision matrix** is a decision tool used by nearly anyone, from C-Suite Leaders to Project Managers. This is often used when narrowing down project requirements to keep something within a time or budget constraint. It is also used in selecting vendors for a project. Often times it is also used to narrow down which project(s) a company will select to work on next.

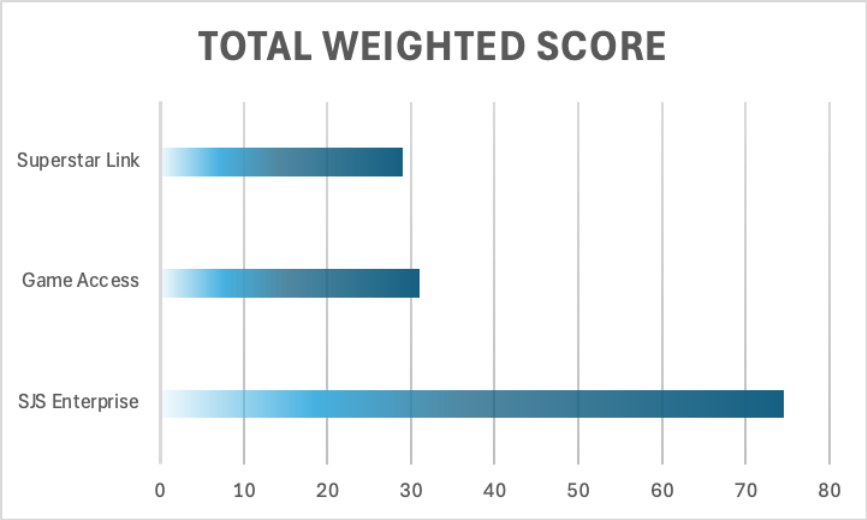
A decision matrix is basically an array presenting on one axis a list of alternatives, also called options or solutions. On the other axis, is a list of criteria, which are weighted depending on their respective importance in the final decision to be taken.

The example in Figure 2.1 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 2.1 Weighted Decision Matrix for Game Delivery System

Criteria	Weight	SJS Enterprises	Game Access	Superstar Link
Educational	15%	90	0	0
Sports-related	15%	90	90	90
Secure payment area with the ability to use Paypal, Venmo, bank payments, 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
Timely updates (bug fixes)	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 receive immediate download and post reviews	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 2.1



Comparing Options Using a Weighted Decision Matrix

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

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

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

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

A weighted decision matrix therefore allows decision-makers to structure and solve their 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.

2.4: Project Environment

When the business case and the project charter, and later, the project management plan and its subcomponents are prepared, the project environment surrounding the project should be examined thoroughly to delineate the factors that may have a negative or positive impact on the project activities and its outcomes. In PMBOK Guide 6th Edition, this environment is composed of enterprise environmental factors (EEFs) and organizational process assets (OPAs). PMBOK Guide 7th edition refers to them as the project environment. Remember the PMBOK is PMI (Project Management Institute's) is a set of terminology and guidelines for project management. The project environment is composed of two components – internal and external, which are described in detail in the following sections.

Internal Environment

The internal environment in which a project is developed consists of the factors that are internal to the organization, but outside the project itself. These factors include elements such as organizational culture, structure, and governance as well as security and safety measures. Other tangible elements include geographic location as well as distribution of facilities and resources, infrastructure, IT software and hardware, resource availability, and employee capability. The internal environment also includes organizational process assets, which are processes, policies, and procedures as well as organizational knowledge bases (e.g., financial data, historical information, lessons learned, project files from previous projects)[1].

Consider the project charter example above. While we are creating the business case as well as preparing the project charter and project management plans, it would be wise to incorporate all the factors that may affect the mobile app and website optimization project. We should enumerate the main properties of our grocery store chain, some of which are provided below:

- Strategic objectives, mission, and vision
- Organizational values and beliefs
- Cultural norms that influence the relationships among coworkers
- Code of conduct
- The number of employees
- Geographic locations and the size of the stores
- Variety of the products and services sold
- Financial situation

We should also take into account the organizational structure of the headquarters and all the branches. This also helps us identify internal and external stakeholders who are affected by our project and who may affect our project. Additionally, this helps us identify the dependencies among the departmental units, and also identify internal resources that might need to be utilized to complete the project. Reporting structure inside the organization could influence our project's decision-making and change request processes. When our project needs to utilize hardware and software tools to facilitate the activities, we can obtain them in an expedited way directly from the assets of our organization, which also saves the budget. When we need resources such as human resources, materials, and equipment, since we have already delineated the organizational structure with tasks and responsibilities of each unit, we can benefit from the agreements which have already been made with approved providers and subcontractors. Another advantage of listing all the capabilities of our organizations would be when we establish the project team. If our organization employs business or systems analysts, developers, user interface designers, or testers, we can ask their managers or executive-level managers above these managers to provide these qualified employees with specialized knowledge for our project. This may also reduce the external risks that we may face if we hire them from outside our organization. We will elaborate on the organizational structure in the "Organizational Structure" section below.

External Environment

A project's external environment consists of the factors that exist outside of the organization. It includes market conditions, social and cultural influences and issues, legal restrictions, commercial databases, academic research, government or industry standards, financial considerations, and physical environmental elements[2].

Figure 2.2 illustrates types of general macro environments and forces that are interrelated and affect organizations: sociocultural, technological, economic, government and political, natural disasters, and human-induced problems that affect industries and organizations. Macro environment refers to the outermost layer of elements in a firm's external environment that can impact a business but are generally beyond the firm's direct control, such as the economy and political activity. This environment can also

affect projects conducted by organizations. For example, economic environmental forces generally include such elements in the economy as exchange rates and wages, employment statistics, and related factors such as inflation, recessions, and other shocks—negative and positive. Additional factors include hiring and unemployment, employee benefits, factors affecting organizational operating costs, revenues, and profits, all of which are affected by global, national, regional, and local economies. Politics and governmental policies, international wars, natural disasters, technological inventions, and sociocultural forces could directly affect our organization and the projects or may interact with other forces such as economic forces.

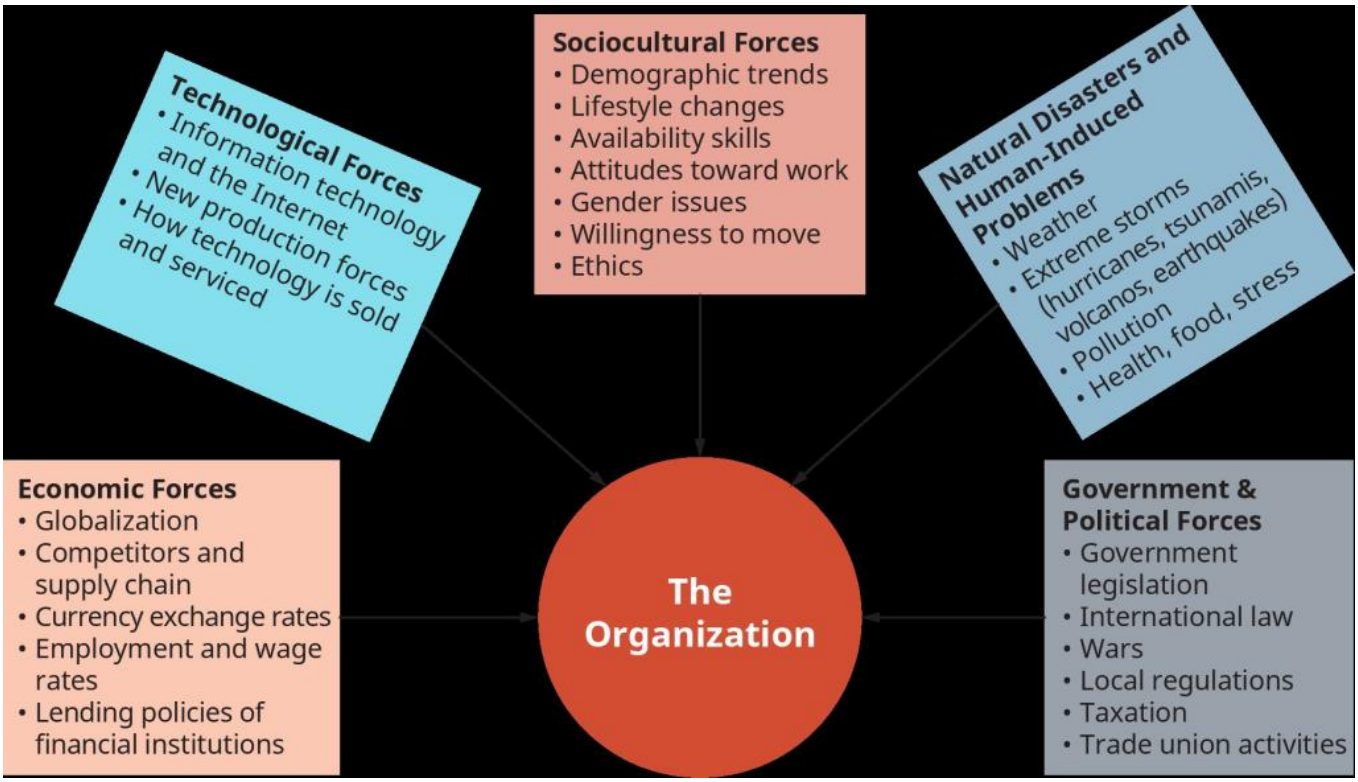


Figure 2.2: Macro Forces and Environments (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

Besides the macro environment as explained above and illustrated in Figure 3.2, the micro environment is another external environment element that refers to the middle layer of elements in a firm's external environment, primarily concerned with a firm's industry situation. Harvard strategy professor Michael Porter developed an analysis tool to evaluate a firm's micro environment. Porter's Five Forces is a tool used to examine different micro-environmental groups in order to understand the impact each group has on a firm in an industry (Figure 2.3). In this textbook, we will not explain each factor (See the reference link[3]). However, these five factors, industry rivalry, the threat of new entrants, threat of substitutes, supplier power, and buyer power, could have a substantial influence on a project. Therefore, we should take these external factors into account while assessing the factors that may affect our project from outside the organization.

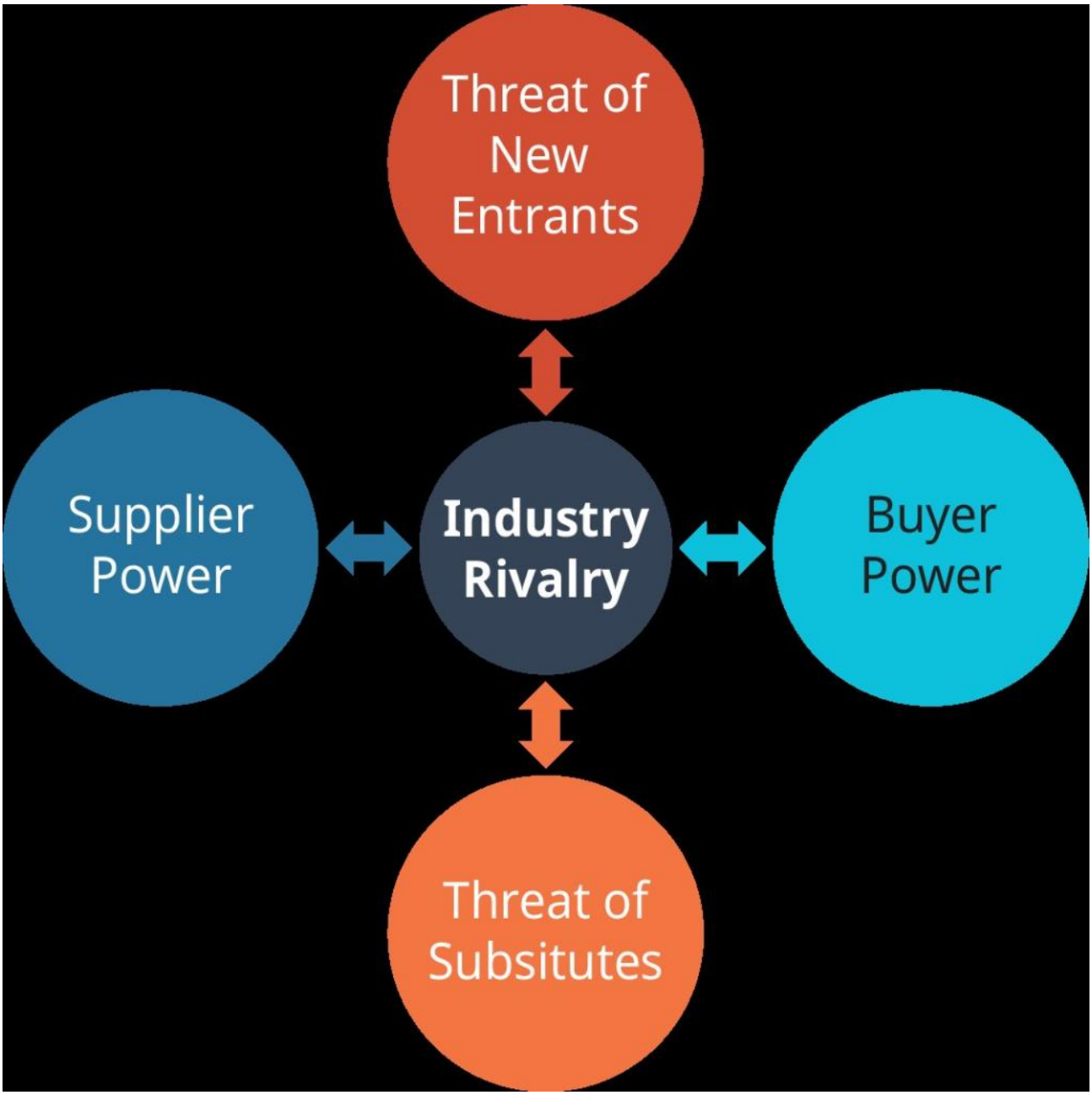


Figure 2.3: Porter's Five Forces Model of Industry Competition (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

It is important to keep these external factors in mind when preparing for and managing a project since many if not most of these external factors and any changes in these factors may have negative or positive impacts on projects. They could lead to risks that may put the project activities and deliverables, and the overall project in jeopardy.

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2021). A guide to the Project Management Body of Knowledge (PMBOK guide) (7th ed.). Project Management Institute. ↵
3. Principles of Management. (2019). Retrieved from https://openstax.org/books/principles-management/pages/8-4-a-firms-micro-environment-porters-five-forces?query=micro%20environment&target=%7B%22type%22%3A%22search%22%2C%22index%22%3A0%7D#fs-idm537041840↵

2.5: Organizational Dimensions and the Structure

Organizations have formal and informal subsystems that affect everything from big-picture strategic planning and execution to daily operations. Figure 2.4 shows internal organizational dimensions. Formal subsystems include leadership, strategy, management, goals, marketing, operations, technology, and structure. Informal subsystems consist of culture, norms, relationships, politics, and leadership skills. Understanding organizational dimensions – and how projects fit within them – gives project managers insights into managing projects more effectively and efficiently.

Figure 2.4: Internal Organization (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

Formal Subsystem

An organization's formal subsystems govern how various tasks are divided, resources are deployed, and how units/departments are coordinated in an organization. An organizational structure includes a set of formal tasks assigned to employees and departments, formal reporting relationship, and a design to ensure effective coordination of employees across departments/units with the help of authority, reliability, responsibility, and accountability, which are fundamental to developing organizational structures and workflow based on their clear understanding by all employees. In short, an organizational structure is the system of task and reporting relationships that control and motivate colleagues to achieve organizational goals. In discussing organizational structure, the following principles are important:

1. Authority is the ability to make decisions, issue orders, and allocate resources to achieve desired outcomes. This power is granted to individuals (possibly by the position) so that they can make full decisions.
2. Reliability is the degree to which the project team member can be dependent to ensure the success of the project with a sound and consistent effort.
3. Responsibility is an obligation incurred by individuals in their roles in the formal organization to effectively perform assignments or to work on the success of the project with or without guidance or authorization.
4. Accountability refers to the extent to which an individual or project team is answerable to the project stakeholders and provides visible evidence of action.

Authority and responsibility can be delegated to lower levels in the organization, whereas accountability usually rests with an individual at a higher level.

An organizational structure outlines the various roles within an organization, which positions report to specific individuals or departments, and how an organization segments its operations into a discrete department. An organizational structure is an arrangement of positions that is most appropriate for the company at a specific point in time. Given the rapidly changing environment in which organizations operate, a structure that works today might be outdated tomorrow. That's why we hear so often

about organizations restructuring—altering existing organizational structures to become more competitive/efficient once conditions have changed.

Organizational structures can be categorized in terms of a spectrum of a project manager's authority. This spectrum includes three main types as below:

1. Functional (Centralized)
2. Matrix
3. Project-oriented / Projectized

As illustrated in Figure 2.5, the project manager's authority is none or little in a functional organization whereas it is high to almost total in a project-oriented organization. However, each of the organization types has advantages and disadvantages, and some organizations can even be a mix of multiple types.

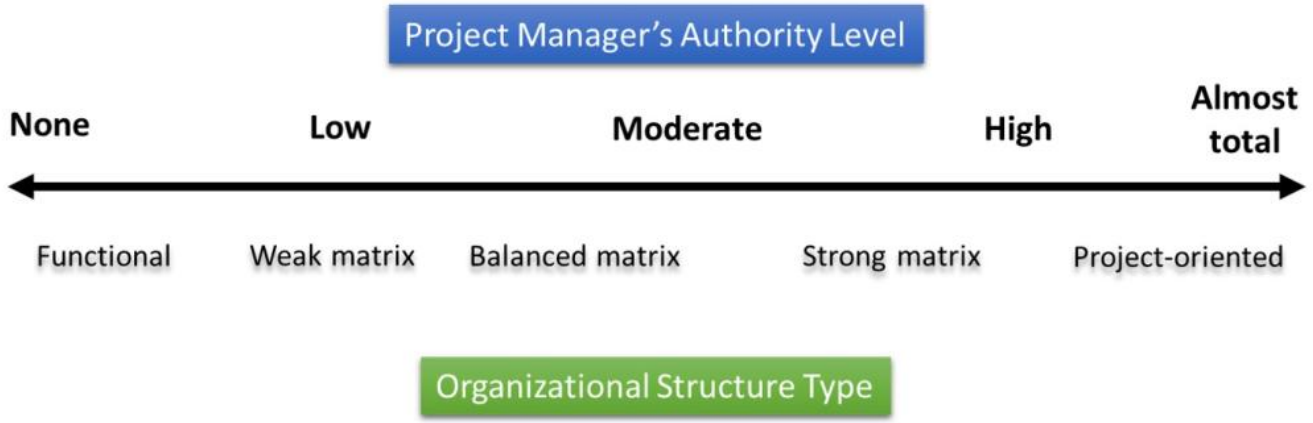


Figure 2.5: The Spectrum of Organizational Structure Types based on Project Manager's Authority Level

A functional organization has workgroups arranged by the tasks and jobs being performed by specialized departments such as manufacturing, marketing and sales, human resources, and finance as seen in Figure 2.6. Since there is not any project management department or office, a project manager or a coordinator is generally selected from the department that is primarily responsible for conducting a given project. However, this person may not have a designated project manager or coordinator role, and their service in this role is often temporary until the project is completed. This department is generally the main beneficiary of the project or it is the implementing department. For example, if the project's goal is to improve customer service, a project manager can be selected from among senior or experienced employees, who is also considered as a subject matter expert in the topic of the project, from the "Customer Service" division under the "Marketing & Sales" department. This person may not work full time as a project manager as they may still carry out the routine tasks of their division and department. Additionally, this project manager would be under the supervision of the "Marketing & Sales" department manager. When they need human resources and other resources, they may not be able to directly obtain them but should negotiate with their manager (Marketing & Sales department in our case) and other department managers (e.g., Manufacturing, Finance). Thus, the project budget is managed by the functional manager, not the project manager. Moreover, the project team may not have administrative staff. Therefore, the project manager may use their department's administrative staff on a part-time basis. The main advantage of this organization type is that the project manager can acquire qualified and experienced human resources from other functional departments.

Figure 2.6: Functional Organization Type

When we move to the right on the spectrum (Figure 2.5), we can arrive at a weak matrix organization where functional units still exist but the role of project manager also becomes more well-defined, and might even be its own role within the organization. In a weak matrix, the project manager still works part-time in their department while they have more authority than they have in a functional organization, but at a low level (Figure 2.7).

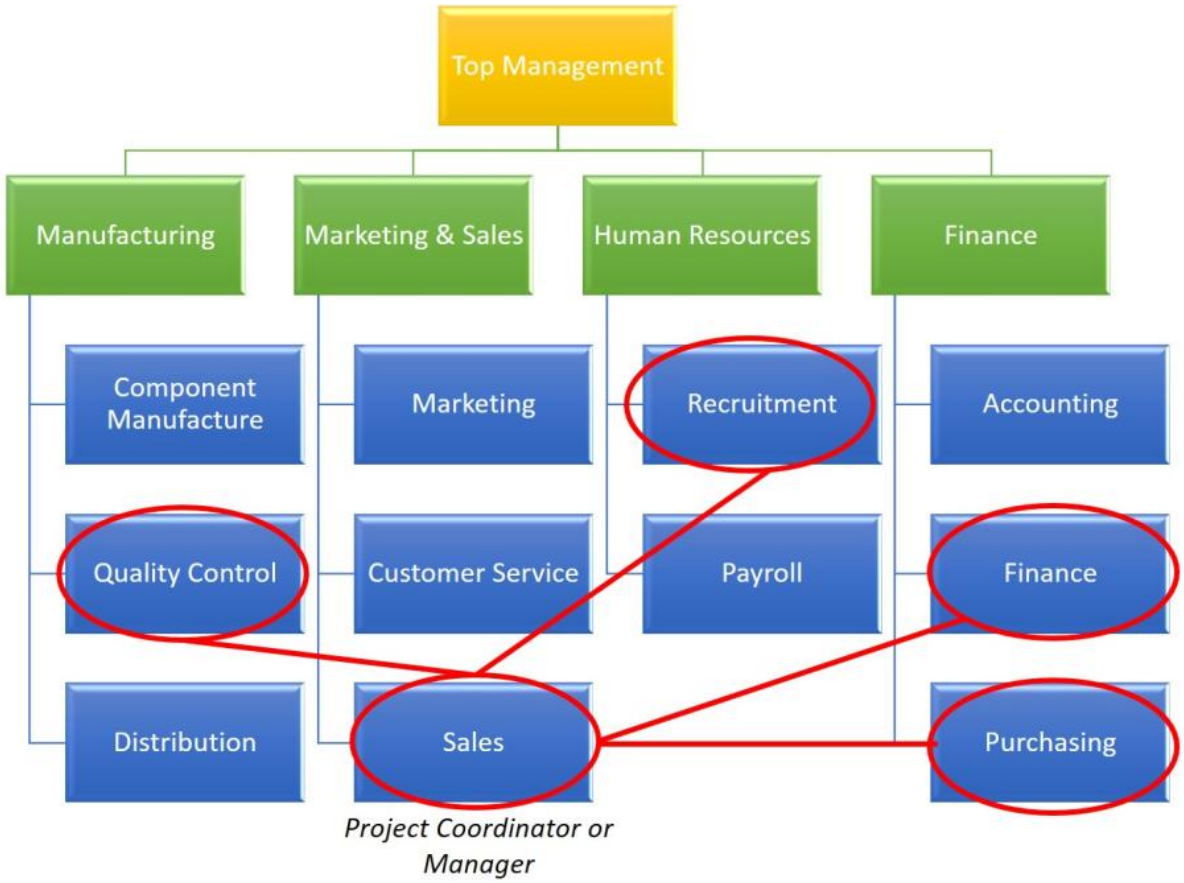


Figure 2.7: Weak Matrix Organization Type

As we continue across the spectrum, we now have a balanced matrix organization type in which we may have a designated project manager with a higher authority. The project manager may manage the project budget to some extent, not completely, although the functional manager has still more say.

As illustrated in Figure 2.8, in a strong matrix organization type, a Project Management Office (PMO) or a designated program management office is added besides functional departments. This department employs full-time project managers with a designated job role. They manage the project budget, and their authority becomes moderate to high. They can also have a full-time administrative staff. This organizational structure may be preferred by many project managers since they can acquire qualified and experienced team members from functional departments inside the organization while they have higher levels of authority.

Figure 2.8: Strong Matrix Organization Type

In a project-oriented or projectized organization type, tasks are arranged by projects, not functions (Figure 2.9). Project managers work independently with a very high authority having full-time designated job roles. However, they may have some challenges while acquiring human resources and other resources since the organization doesn't have specialized departments where skilled and experienced employees work.

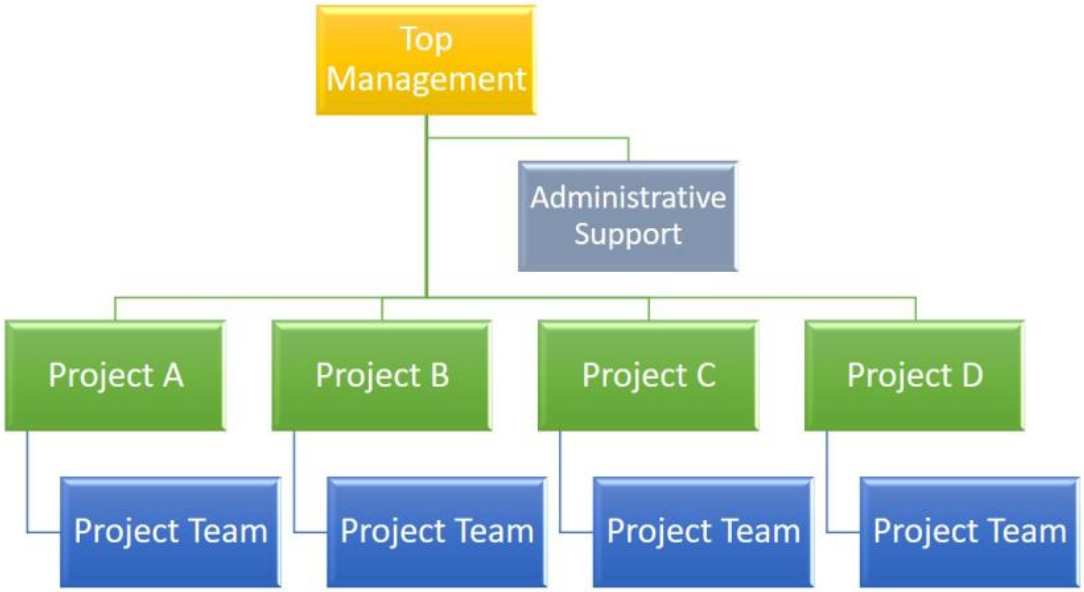


Figure 2.9: Project-Oriented Organization Type

Informal Subsystem

When working with internal stakeholders (those who are inside an organization) and external stakeholders (those who are outside an organization) on a project, it is essential to pay close attention to the hierarchy and authority relationships, relationships, context, history, and the corporate or organizational culture. Organizational (corporate) culture refers to the beliefs, attitudes, and values that the organization's members share and the behaviors consistent with them (which they give rise to). Organizational 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 also have a specific culture, work norms, and social conventions.

An organization's culture is defined by the shared values and meanings its members hold in common and that is articulated and practiced by an organization's leaders. Purpose, embodied in corporate culture, is embedded in and helps define organizations. Ed Schein, one of the most influential experts on culture, also defined organizational corporate culture as "a pattern of shared tacit assumptions learned or developed by a group as it solves its problems of external adaptation and internal integration that have worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.[1]" Some aspects of organizational culture are easily observed; others are more difficult to discern. We 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 subtler components of organizational culture, such as the values and overarching business philosophy, may not be readily apparent, but they are reflected in member behaviors, symbols, and conventions used. Organizational culture can give coworkers a sense of identity through which they feel they are an indispensable component of a larger and strong structure.

Some cultures are more conducive to project success than others. As a project leader, it is very important to understand the unique nature of the corporate culture that we operate in. This understanding allows us to put in place the processes and systems most likely to lead to project success.

Organizational culture is considered one of the most important internal dimensions of an organization's effectiveness criteria. Peter Drucker, an influential management guru, once stated, "Culture eats strategy for breakfast."[2] He meant that corporate culture is more influential than strategy in terms of motivating employees' beliefs, behaviors, relationships, and ways they work since culture is based on values. Strategy and other internal dimensions of an organization are also very important, but organizational culture serves two crucial purposes: First, culture helps an organization adapt to and integrate with its external environment by adopting

the right values to respond to external threats and opportunities. Secondly, culture creates internal unity by bringing members together so they work more cohesively to achieve common goals. Culture is both the personality and glue that binds an organization. It is also important to note that organizational cultures are generally framed and influenced by the top-level leader or founder. This individual's vision, values, and mission set the "tone at the top," which influences both the ethics and legal foundations, modeling how other officers and employees work and behave. A framework used to study how an organization and its culture fit with the environment is offered in the Competing Values Framework (Figure 2.10).

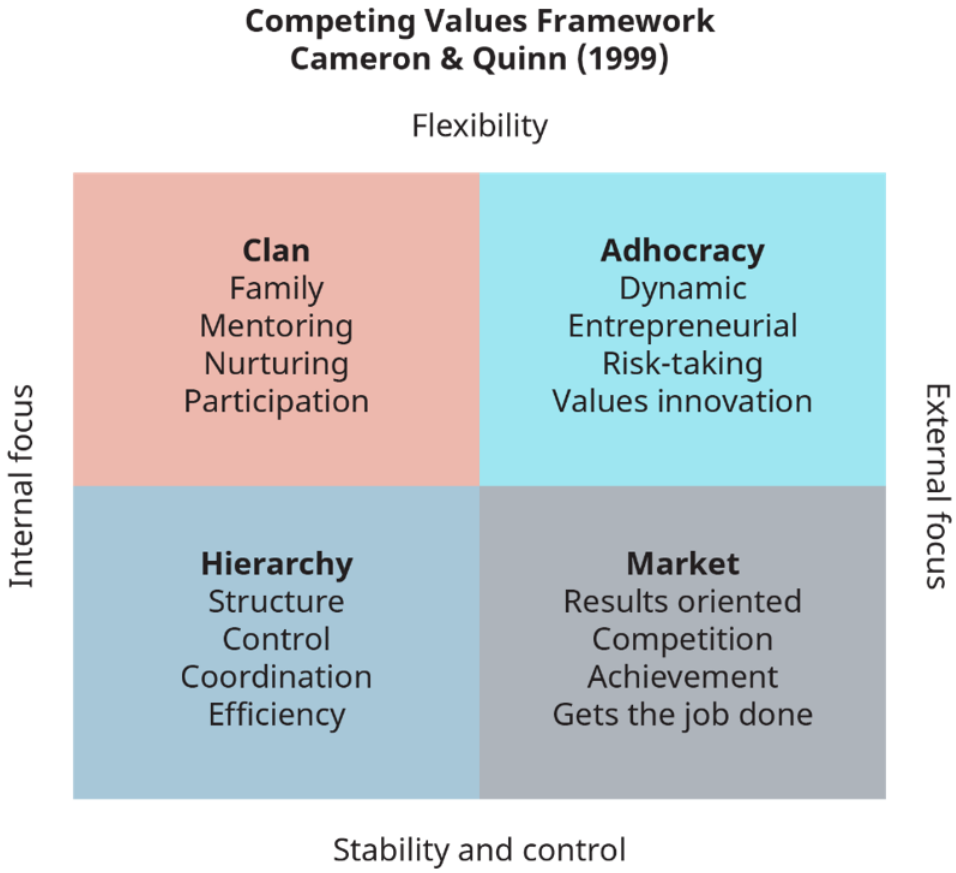


Figure 2.10: The Competing Values Framework as adapted from K. Cameron and R. Quinn, 1999. Diagnosing and Changing Organizational Culture, Addison-Wesley, p. 32.. (Attribution: Copyright Rice University, OpenStax, under CC-BY 4.0 license)

Assume that you are leading a project in an organization with a hierarchical culture. Projects are about changing the way an organization operates. Introducing change in an organization with this type of culture can be very challenging because they value caution, conservative approaches, and careful decision-making. If the project you are leading involves the introduction of innovative practices and technologies, it may be very difficult and time-consuming to get the approvals required to proceed with the project at its various stages. Innovative practices are not guaranteed to work; success requires a high degree of risk tolerance in decision-making processes. This may be difficult to achieve in organizations with this type of culture. Furthermore, the already aggressive schedule of employees in hierarchal organizations may not be able to accommodate the potential numerous and lengthy deliverable reviews required for innovative projects, causing project success to be viewed as unachievable. Project leaders in this type of culture are wise to speak openly and candidly about the project's risks and plan for additional deliverable reviews as a way of setting the project up for success. If this very same innovative project was being delivered in an organization with a market culture, the decision-making approach and the schedule are likely to be fundamentally different.

1. Schein, E. (2017). Organizational culture and leadership, 5th ed., Hoboken, N.J.: John Wiley & Sons. ↵
2. Hyken, S. (2015, December 5). Drucker said culture eats strategy for breakfast. Forbes. https://www.forbes.com/sites/shephyken/2015/12/05/drucker-said-culture-eats-strategy-for-breakfast-andenterprise-rent-a-car-proves-it/#7a7572822749↵

2.6: Project Management Office (PMO)

A project management office (PMO) is an organizational structure that standardizes the project-related governance processes and facilitates the sharing of resources, methodologies, tools, and techniques. The responsibilities of a PMO can range from providing project management support functions to the direct management of one or more projects.[1]

Many large and even medium-sized organizations have created a department to oversee and support projects throughout the organization. This is an attempt to reduce the high number of failed projects. These offices are usually called PMO. The PMO may be the home of all the project managers in an organization, or it may simply be a resource for all project managers, who report to their line areas. PMBOK Guide 6th Edition categorizes PMOs as supportive, controlling, and directive. Supportive PMOs provide a consultative role while controlling PMOs provide support and require compliance through various means. Directive PMOs have full-time project managers who participate in the projects and manage directly by taking full control of the projects.

In general, PMOs help ensure that projects are aligned with organizational objectives, provide templates and procedures for use by project managers, provide training and mentorship, provide facilitation, stay abreast of the latest trends in project management, and serve as a repository for project reports and lessons learned.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

2.7: 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?

2.8: Case Study- Project Charter

Case Study: Project Charter of Grocery LLC's Mobile-Commerce Project

In Chapter 1, we started evaluating the uniqueness and temporary nature of the two projects. The first project aimed to establish self-checkout areas at all fifty markets across five states to solve the problem of more than usual traffic between 4 pm and 7 pm during the weekdays (Case 1.1). The second project aimed to create a new mobile application and make the current website compliant with the smartphones (Case 1.2). In Chapter 2, we performed a weighted scoring model (Table 2.8) to compute the total scores of project candidates based on various criteria which are not only dependent on financial factors and chose projects A (self-checkout stations) and D (m-commerce). Project D addressed the problem of declining sales at Grocery LLC's all fifty markets in general with the onset of the COVID-19 pandemic. Considering the priority of the project and the pessimistic trends forecasted regarding the pandemic as well as the increasing digitalization of companies and consumers, we will use this project in this chapter and the following chapters.

1. **Project Purpose:**

To create solutions for customers who purchase goods and services from our grocery stores through their smartphones.

2. **Measurable Project Objectives:**

    i. To redesign the website in 2 months so it's more responsive and easier for the customers to place orders on their smartphones.
    ii. To create a new mobile application in 2 months that can work in both operating systems (Android and IOS).

In three months after the mobile website and the new mobile application go live, online sales will increase at least 25%, customer satisfaction will increase at least 20%, and we can retain our loyal customers.

- Online sales figures before the mobile solutions are introduced and three months after they go live will be compared.
- Two surveys (before the mobile solutions are introduced and three months after they go live) will be conducted by a market research company to measure the satisfaction level of customers.
- The customers who have bought items from our company for the last three years will be interviewed to understand if they still do their shopping at our grocery markets and on new mobile solutions.

3. **High-Level Requirements**

- The mobile website and smartphone application shall:
    - Include all the functions that a desktop website possesses.
    - Be accessed with the same login username and password.
    - Synchronize the customer profile and the cart with the desktop website.

4. **High-level project description, boundaries, and key deliverables**

Needs Statements are retrieved from the business cases if available.

There has been a steady decline for the last six months in online purchases. Our company lost many customers due to the pandemic. Customers prefer buying online instead of visiting a store in person since they have serious concerns to contract Covid-19. Our fifty stores in five states lost around 30% of regular customers, and the revenue declined by 25% since the start of the pandemic restrictions in March 2020. When our business analysts investigated the issue by conducting a root-cause analysis, they found that many customers use their smartphones to buy online rather than using their desktop or laptop computers. When the customers visited our company's website, they could not complete their online transactions since the website has not been optimized for mobile. Besides, we haven't had a mobile application that our customers can use on their smartphones. E-commerce websites such as Amazon, and brick and click stores such as Walmart and Target, and grocery chains such as Whole Foods (through Amazon) are strong competitors from which customers can do their online shopping conveniently.

Therefore, our project has been initiated to optimize the desktop website on both Android and IOS smartphones and to create a new smartphone application. In this project, we are not directly targeting tablets since their screen size would allow us to display the regular desktop website. Besides, the smartphone application can be used in tablets.

5. **Assumptions and Constraints**

- Assumptions:

i. A positive trend is expected in the long term that mobile e-commerce transactions will rise.
ii. Our current website will continue to function during the project.
iii. The owners and the top executives will continue to support this project.

- Constraints:
  i. Some loyal customers who prefer in-person shopping may be resistant to change so that they may not want to use online shopping.

6. **Overall project risk**
   - Shortage of web designers and mobile app developers
     - Due to the COVID-19 pandemic, there is a higher demand for web designers and mobile app developers. Besides, these qualified employees may not be available if they contract COVID-19 when they are working on our project.
   - During the execution of our project, customers may prefer to do their shopping on large e-commerce websites such as Amazon as they can find more varieties with lower prices and better deals. Therefore, our deliverables may not be utilized in the way that is desired.

7. **Summary Milestone Schedule**

The project starts on May 2, 2022, and finishes on July 1, 2022.

1. Kick-off: May 2, 2022
2. Finalization of requirements elicitation: May 10
3. Completion of analysis and design: May 25
4. Completion of coding and testing: June 15
5. Completion of alpha testing: June 20
6. Completion of beta testing: June 30
7. Customers can visit the mobile website and install the smartphone app: July 1, 2022

8. **Preapproved Financial Resources**

The initial budget for this project was determined as $200,000. Two similar projects conducted and completed by two other companies were used. The itemized budget will be available and can be revised when the analysis and design are completed.

9. **Key Stakeholder List**

1. Project manager (Senior Systems Analyst)
2. Project team members (The core team)
3. Project sponsor (Chief Operations Officer – COO)
4. Product owner (The representative from the operational department who was assigned by the COO)
5. IT Department
6. Sales Department
7. Marketing Department
8. HR Department
9. Store managers and employees
10. Suppliers
11. Online customers
12. Customers who visit the stores in person
13. Government agencies that announce the pandemic restrictions

10. **Project Approval Requirements**

The mobile website and the smartphone app will be subject to alpha testing first. Then, beta testing will follow, where customers can install the beta version on their smartphones and do their online shopping. During the implementation of the beta version, all the feedback from customers and their mobile devices will be evaluated and the bugs and problems will be corrected. When the mobile website and the app are fully functional, customers should log in with their usernames and passwords, browse items, add them to their carts, proceed to checkout, and complete their payment.

The sponsor must approve the sign-off after they receive the inspection and acceptance report.

11. **Project Exit Criteria**

- The project will be closed successfully if both deliverables pass beta testing and all the human resources working on this project are paid.
- The project will be canceled if the financial situation of our company worsens significantly so that it is not possible to fund the project.

12. **Project Team**

i. Project manager: Senior systems analyst
ii. Two systems (business) analysts
iii. Two UI/UX designers
iv. Three developers (including Android and IOS developers, and the backend developer)
v. Two testers (quality assurance engineers)
vi. Two sales and marketing experts

13. **Authority of the Sponsor**

The COO (Chief Operations Officer) of Grocery LLC is the sponsor. The project manager will have the full authority to identify the necessary tasks and resources needed to complete all the project activities and deliverables. The sponsor shall authorize the project and assign the project manager when they approve this project charter.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Charter template from www.projectmanagement.com↵

2.9: 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.

2.10: 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.

2.11: Developing your Charter with Scope Statement

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.

CHAPTER OVERVIEW

3: Project Planning and Scope

3.1: Introduction

Learning Objectives

1. Describe the process to create a project schedule.
2. Define activities based on Work Breakdown Structure (WBS).
3. Describe how activities can be sequenced.
4. Elaborate on the techniques to estimate activity duration.
5. Create a network diagram by identifying the early start and early finish times, late start and late finish times, floats (slacks), and the critical path.
6. Define terms related to scheduling.
7. Calculate parametric estimates.
8. Identify the difference between a deliverable and work package.
9. Discuss issues related to moving from the planning phase of a project to the scheduling phase.

Overview

The project schedule is one of the triple project constraints besides scope and cost (budget). A project manager is responsible for planning, developing, managing, monitoring, and controlling the project schedule to ensure that project objectives can be achieved, and project outcomes can be delivered to the client and customers on time. Effective schedule management is integral to overall project success. The objective is to create a schedule that effectively and efficiently uses allocated resources to complete the project in the shortest amount of time possible. In order to develop a schedule, we first need to create a plan that will guide us during the project. Afterward, we should define the activities based on the WBS, sequence them in the right order, estimate the time it will take to complete these activities, and develop a schedule by creating a network diagram and Gantt chart.

3.2: Project Schedule Management Plan

Project planning is at the heart of the project life cycle and tells everyone involved where we are going and how we are going to get there. It involves creating a set of plans to help guide our team through the implementation and closure phases of the project. The project schedule management plan is one of the sub-plans of our overall project plan. It provides the guidelines to project managers on how to develop a project schedule by defining and sequencing project activities and milestones, and by estimating activity durations. It is the process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule[1].

A project schedule management plan can consist of the following:

- **Unit of measurement**
  - Work hours, days, weeks, months
  - Daily working hours and shifts
  - Weekends and/or off-days
  - Local, national, and federal holidays
- **Creation of the activity list and attributes**
  - Describe how activities and their attributes will be defined, and who will be involved in this process.
- **Level of accuracy**
  - Acceptable range to ensure realistic activity duration estimates
  - Evaluation of the impact of risks on the overall project duration and each individual activity durations based on the project risk management plan
  - Methods describing how the schedule contingencies will be assessed.
- **Activity duration estimates**
  - Estimation methods (e.g., analogous, parametric, three-point, bottom-up)
- **Methods, tools, and software utilized to develop, manage, and monitor project schedule**
  - Specify the organization's procedures, policies, and resource calendars if they should be utilized.
  - Methods and tools such as Gantt Chart, WBS, project baseline, master and milestone schedule, Earned Value Management, and critical path method
  - Software such as Microsoft Project Professional, Excel, Visio, and Jira (for Kanban and Scrum), and online collaboration tools such as Monday, Trello, and Basecamp.
- **Rules and concepts to sequence activities and create an activity network diagram**
  - Critical path method (Forward pass, backward pass, slacks)
  - Critical chain method
  - Predecessor dependencies (e.g., finish-to-start, start-to-start)
- **Rules for monitoring schedule performance**
  - Earned Value Management (EVM)
  - Control thresholds for deviations from the parameters in the schedule baseline
  - Using software such as Microsoft Project
- **Reporting formats**
  - Reporting formats and frequency should be in alignment with other project plans.
- **Approval of the schedule baseline**
  - Who will be responsible for preparation and control?
  - Who will approve the schedule baseline?

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

3.3: 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.

Detailed planning begins by identifying all the tasks to be completed. The project team begins by reviewing the scope of the project which is found in the project scope statement (predictive/waterfall projects) or the product backlog. A WBS allows the team to have a visual representation of the forthcoming work. The WBS is a powerful planning tool. By breaking the project down into smaller, more manageable components, the WBS assists project managers in identifying the specific tasks. The team then determines how long it will take to complete the required tasks.

Expert judgment from project team members with prior experience and from stakeholders that can be consulted can help us define activities while developing project scope statements and WBS. If we are asked to manage a project in a new domain, we could use subject matter experts in that particular field to help define tasks so we can understand what activities are going to be involved. We may want to create an activity list and then have the expert review it and suggest changes. Alternatively, we could involve the experts from the very beginning.

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

When we identify activities for the work packages, we can detail the activities in a project activity list which is a list of everything that needs to be done to complete the project, including all the activities that must be accomplished to deliver each work package with activity attributes. This list can consist of, but is not limited to:

1. Activity identifier
2. WBS number
3. Activity title
4. Scope of Work
5. The person responsible (RACI chart can be used. See Chapter 5)
6. Related activities
    1. Higher level activities (WBS number)
    2. Lower level activities (WBS number)
    3. Predecessors (including dependencies, that are FS, FF, SF, SS)
    4. Successors (including dependencies, that are FS, FF, SF, SS)
7. Resource requirements
8. Activity location
9. Level of effort required
10. Activity assumptions
11. Activity constraints

The example in Table 3.1 is based on the project charter we developed in Chapter 2. In Table 3.1 we determin six activities that can serve as the lowest level of activities, which are work packages. That would make it possible for us to allocate resources.

Table 3.1: Activity List Template (Adapted from a template on www.projectmanagement.com)

Activity List for Project "Grocery LLC's M-Commerce Project"				
Activity identifier	**Activity title**	**Scope of Work**	**Person Responsible**	**Predecessors**

1.3	Preparation of Project Charter	The project charter that will authorize the project manager to undertake the responsibility of the project and apply the resources to project activities will be prepared.	Project Manager	1.1 1.2 1.3
1.3.1	Develop high-level scope	The high-level scope consists of the project purpose, measurable project objectives, high-level requirements, project description, boundaries, key deliverables, and assumptions and constraints.	Team Member 1	1.2
1.3.2	Identify overall project risks	This includes the identification of the risks that affect the project in general.	Team Member 2	1.3.1
1.3.3	Develop high-level schedule	This includes the estimation of the overall schedule with summary milestones.	Team Member 1	1.3.1
1.3.4	Identify main resources and develop a high-level budget	This includes the initial estimation of all resources (human resources, physical resources, and services), and the budget.	Team Member 2	1.3.3

1.3.5	Identify key stakeholders and project team member roles	Stakeholders with high-interest levels and/or power levels will be identified. The project team's composition will be created. The qualifications required should be detailed. The project sponsor's authority will be detailed.	Team Member 3	1.3.1 1.3.2
1.3.6	Develop project approval requirements and project exit criteria	Based on the project scope and other sections of the project charter, project approval requirements and exit criteria should be detailed. Exit criteria include the conditions that describe the early termination of the project.	Team Member 1, 2, 3	1.3.1 1.3.2 1.3.3 1.3.4 1.3.5

We can explain each column available in Table 3.1 as below:

Activity Identifier: Once the WBS is created for the project, the list of activities required to complete each work package needs to be developed by the project team. Each activity then needs to be assigned an Activity ID, which is placed in this column. The activity ID serves as a reference identification number during planning, developing, and controlling the project schedule.

Activity List: The name/unique label for the activity (in brief) is placed in this column.

Scope of Work: The description of work required to be done to complete the activity is placed in this column (in as much detail as possible).

Person Responsible: One person or more than one who will be responsible for delivering the activity must be mentioned in this column. It is always good to have a primary and an alternate team member assigned to this responsibility.

3.4: Estimating Activity Durations

After we define the lowest level of activities in an activity list, each activity is reviewed and evaluated to determine the duration (how long it will take to accomplish from beginning to end) and what resources (e.g., human resources, materials, facilities, and equipment) are needed. An estimate is an educated guess based on knowledge, experience, and inference—the process of deriving conclusions based on assumptions. The accuracy of the estimate is related to the quality of the knowledge and how that knowledge is applied. The person with the most knowledge may not be the most objective person to provide duration estimates. The person responsible for the work may also want to build in extra time. Therefore, multiple inputs into the duration estimate and a more detailed WBS help reduce bias—the making of decisions based on a prejudged perspective.

It is of high importance here to highlight how a milestone is different from an activity. A milestone is a significant point or event in a project. Milestones have zero duration because they represent a significant point or event. A milestone list identifies all project milestones and indicates whether the milestone is mandatory, such as those required by contract, or optional, such as those based on historical information[1].

The unit of time used to develop the activity duration is a function of the level of detail needed by the user of the schedule. The larger and more complex the project, the greater the need for detail, which usually translates into shorter durations for activities. However, it is common to use two types of units – one is days or weeks for activities, and hours to display the work hours.

In this textbook, we can elaborate on five types of estimation methods:

1. **Expert judgment:** The project team consults domain and implementation subject matter experts who have technical knowledge and experience in the areas the project activities are related to. If we are developing a new mobile application, we can consult software engineers, developers and testers, and systems analysts who were involved in activities to develop other mobile applications. They can provide us with the information regarding scheduling estimates for each activity we are planning to carry out.
2. **Appropriation method (Analogous estimating):** Actual durations from similar projects are reviewed, and the same proportions are applied to the current project. However, internal and external factors that affected the previous projects, and those that may affect the current project should be taken into account. Identified risks with their probability and impact considered could have a significant influence on duration estimates for the current project.
3. **Parametric estimating:** In this estimation technique, we can use equations and algorithms to calculate the duration based on the resources we use and how many hours they need to work, or how many of them we need to use. This method is quantitative. We can multiply the quantity of work to be performed by the number of hours per unit of work. If we can estimate the amount of the work, we can divide it by the work that can be done in an hour. For example, let's assume that, in our m-commerce project, we estimated that software developers need to create 200 lines of code for a module. Based on the previous projects and the feedback we received from the subject matter experts, we have estimated that a developer can finish 40 lines in an hour. Therefore, a developer needs 5 hours to finish all 200 lines. We can also add a one-hour break and two-hour review for this task. Therefore, the total work hours amount to 8 hours which is translated to one day in our schedule. Another example can be regarding the installation of cables in an infrastructure project. If workers can install 100 feet of cable per hour, the duration required to install 1,000 feet would be 10 hours (1,000 feet divided by 100 feet per hour). This technique can produce higher levels of accuracy depending on the sophistication and underlying data built into the model. Parametric schedule estimates can be applied to a total project or segments of a project, in conjunction with other estimating methods[2]. Entering data about the project into a formula, spreadsheet, or computer program produces a duration estimate by extrapolating information from a database of actual durations from past projects.
4. **Three-point estimates:** Duration estimates are done based on three scenarios:
    a. A realistic estimate (most likely to occur – m)
    b. An optimistic estimate (best-case scenario – o)
    c. A pessimistic estimate (worst-case scenario – p)

In the three-point estimation method, two distributions are possible – triangular and beta. In triangular distribution, all three duration estimates get the same weight. In a beta distribution, the realistic estimate gets four-sixths of the weight whereas the other two estimates have one-sixth of the weight.

Triangular distribution:

$$tE = \frac{(o+m+p)}{3}$$

Beta distribution:

$$tE = \frac{(o+4m+p)}{6}$$

Let's estimate the duration of Project Charter sub-activities. Our team gathered together in a meeting to review and discuss alternative durations. We also consulted subject matter experts who work in relevant departments in our organization and also external stakeholders who have an interest and/or power. Our organization and the team had implemented software and website development projects as well as several mobile application development projects. Therefore, we have reports including information regarding the realized durations and lessons learned. So, we can start with analogous estimating first. As we have already worked on similar projects, that would facilitate the estimation process both for schedule and budget. We can place the historical information on the Most Likely column. Based on the expert judgment, lessons learned, and discussions during our team meeting, we determined pessimistic and optimistic durations in Table 3.2.

Table 3.2: Estimating Activity Duration by Applying Three-Point Estimate Method

Duration Estimation (in business days)					
Activity identifier	**Activity title**	**Optimistic**	**Most Likely**	**Pessimistic**	**Duration**
1.3.1	Develop high-level scope	3	4	6	4.17
1.3.2	Identify overall project risks	3	5	9	5.33
1.3.3	Develop high-level schedule	4	6	10	6.33
1.3.4	Identify main resources and develop a high-level budget	1	2	5	2.33
1.3.5	Identify key stakeholders and project team member roles	5	7	12	7.50
1.3.6	Develop project approval requirements and project exit criteria	3	5	9	5.33

The computation of the duration for Activity 3.2 is shown below:

$$tE = \frac{(o+4m+p)}{6} = \frac{(3+4*5+9)}{6} = 5.33\ days$$

We can roll the duration estimates down or up to the nearest integral number.

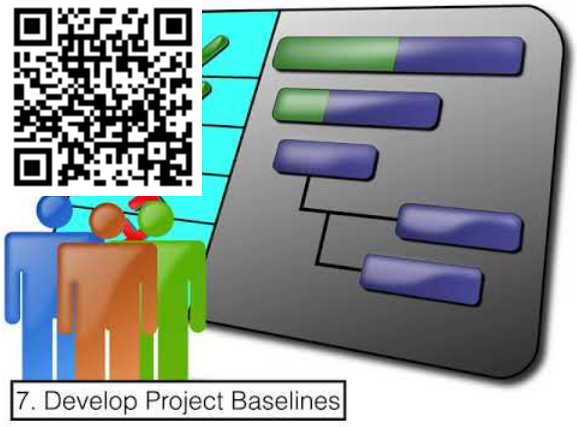
5. **WBS method (Bottom-up estimating):** In this method, we start from the lowest level activities in the WBS – work packages. After we estimate the duration for all six activities (Table 3.2), we can find the duration of the parent activity, 1.3 "Preparation of Project Charter". The addition of duration for all six activities wouldn't be an operation of adding all numbers (4+5+6+2+8+5), which is equal to 30 days. We must consider the dependencies between the activities, which are detailed in

sections numbered 7.4 and 7.5 of this chapter. Hence, we can find 22 days for 1.3. The same bottom-up estimating is applied to the activities (1.1., 1.2, 1.3, 1.4, 1.5), and the duration for “1. Scope” is found as 35 days. “1.6 Completion of the Scope Phase” is a milestone and has a duration of zero. The overall duration for “1. Scope” is computed as 35 days as seen in Table 3.3.

Table 3.3. Schedule for Scope activities with durations rolled up in the higher levels

WBS	Activity Name	Duration	Start	Finish	Predecessors
1	**Scope**	**35 days**	**Mon 5/2/22**	**Mon 6/20/22**	
1.1	Clarify project purpose and determine project scope	5 days	Mon 5/2/22	Fri 5/6/22	
1.2	Secure project sponsorship	1 day	Mon 5/9/22	Mon 5/9/22	1.1
1.3	**Preparation of project charter**	**22 days**	**Tue 5/10/22**	**Wed 6/8/22**	
1.3.1	Develop high-level scope	4 days	Tue 5/10/22	Fri 5/13/22	1.2
1.3.2	Identify overall project risks	5 days	Mon 5/16/22	Fri 5/20/22	1.3.1
1.3.3	Develop high-level schedule	6 days	Mon 5/16/22	Mon 5/23/22	1.3.1
1.3.4	Identify main resources and develop a high-level budget	2 days	Tue 5/24/22	Wed 5/25/22	1.3.3
1.3.5	Identify key stakeholders and project team member roles	8 days	Mon 5/23/22	Wed 6/1/22	1.3.1 1.3.2
1.3.6	Develop project approval requirements and project exit criteria	5 days	Thu 6/2/22	Wed 6/8/22	1.3.1 1.3.2 1.3.3 1.3.4 1.3.5
1.4	Approval of project charter by the sponsor	2 days	Thu 6/9/22	Fri 6/10/22	1.3.6
1.5	Secure core resources	5 days	Mon 6/13/22	Fri 6/17/22	1.4
1.6	Completion of the scope phase	0 days	Mon 6/20/22	Mon 6/20/22	1.5

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.



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 3.1). Definitive estimates are within a range from -5 to +10 percent of the actual or final cost.

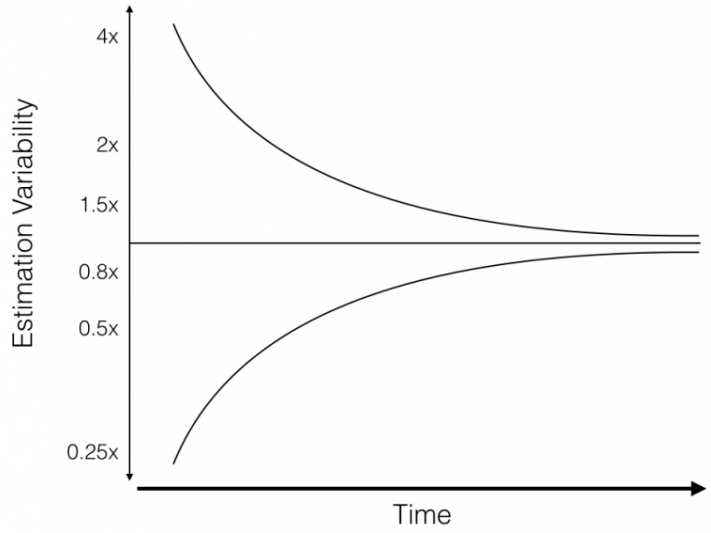


Figure 3.1: Estimates contain a high degree of variability at the inception of a project, and that variability decreases as the project is defined and moves toward completion.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

3.5: Creating an Activity Network Diagram

After we define the activities and estimate their duration, we are ready to create an activity network diagram which is a graphical representation of the logical relationship (i.e., dependencies) among the project activities[1]. Duration estimation can also accompany the creation of an activity network. The process can be iterative, and the project team can move back and forth to refine the activities, durations, and their relationships with other activities.

Activities are carried out in order. Therefore, they have predecessors and successors. They have logical relationships or dependencies which show the sequence in which the activities are to be performed[2]. There are four relationships between activities, which can be indicated as “Finish-to-Start” (FS), “Finish-to-Finish” (FF), “Start-to-Start” (SS), and “Start-to-Finish” (SF). The most common relationship is Finish-to-Start at which we start a successor activity once we finish the predecessor activity. Microsoft Project also uses FS as the default relationship. In the MS Project tutorial below, this topic has been also discussed. A start-to-Finish relationship is very rarely used.

Showing the activities in rectangles or circles, and their relationships (dependencies) as arrows is called a precedence diagramming method (PDM). This kind of diagram is also called an activity-on-node (AON) diagram (Figure 3.2). Another way to show how tasks relate is with the activity-on-arrow (AOA) diagram (Figure 3.2). AOA diagram is traditionally drawn using circles as the nodes, representing the beginning and ending points, and the arrows representing activities. AON is more commonly used and is supported by all project management programs. In this textbook, as is also used by PMBOK Guide Sixth Edition, we are using AON diagrams for creating activity network diagrams. Although we used circles in Figure 3.2 for AON, the most common implementation is to use rectangles. Microsoft Project uses rectangles as well.

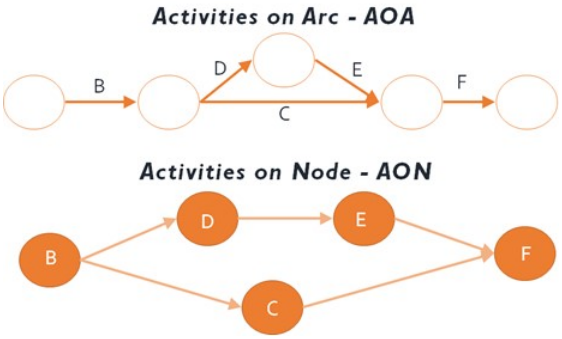


Figure 3.2: Activity Networks (either on Arc or Node)

Logical Relationships / Dependencies

As explained above, four logical relationships can be used in the precedence diagraming method while creating activity network diagrams. Besides these relationships, we will also discuss lags and leads.

Finish-to-Start (FS) Relationship

In this relationship, a predecessor activity should be finished in order to start the successor activity. This is the most common relationship between activities. As seen in Figure 3.3, Activity A must be finished to start Project B.

Figure 3.3: Finish-to-Start

Examples:

- We need to assemble all hardware and network components of a laptop (predecessor) to install the operating system on this laptop (successor).
- We must finish cooking all our meals (predecessor) to start serving them in the dinner (successor).
- We should finish packing all the luggage to start driving to the airport for the holiday.

Lag

A lag is the amount of time a successor activity can be delayed with respect to a predecessor activity[3]. Consider that we should paint one room in our house. We need to apply plaster to walls first (predecessor). When the walls dry, we can paint them (successor). It is an FS relationship. However, we need to wait for two days for the walls to dry. This causes a two-day delay between two activities which is called a lag (Figure 3.4).

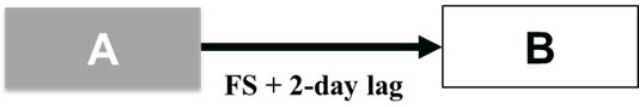


Figure 3.4: Finish-to-Start with a Lag

Lead

A lead is the opposite of a lag. A lead is the amount of time a successor activity can be advanced with respect to a predecessor activity[4]. In Figure 3.5, Activity B (successor) can start three days before Activity A (predecessor) finishes. For example, in the project, we should elicit the requirements of stakeholders first. Then, we can start designing the product based on the requirements. If we have ten stakeholder groups, and five of them are key stakeholders, we can start the design before we finish all the elicitation.

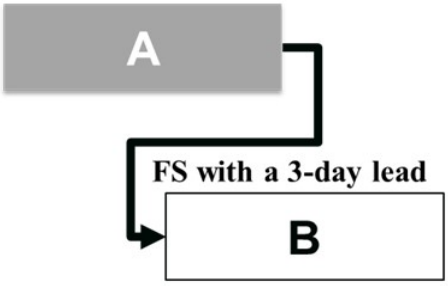


Figure 3.5: Finish-to-Start with a Lead

Finish-to-Finish (FF) Relationship

In this relationship, we cannot finish a successor activity (Activity B) if we don't finish a predecessor activity (Activity A). Therefore, Activity A must be finished to ensure that we can finish Activity B as well (Figure 3.6). These tasks can be carried out in parallel. It is common to have a lag between the predecessor and successor.

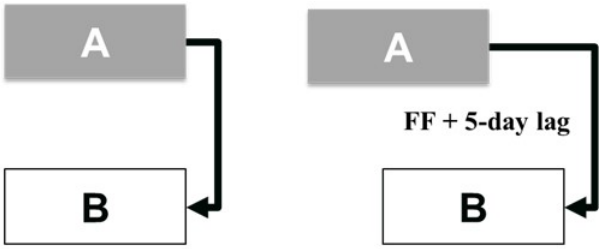


Figure 3.6: Finish-to-Finish

Examples:

- We are writing a new textbook, and it has 15 chapters. When we finish writing Chapter 15, we can complete the book.
- The contractor is finishing the installation of gas lines and plumbing in our new house (predecessor – Activity A). Another contractor who will install the kitchen appliances can finish the installation of these appliances (successor – Activity B) when gas lines and plumbing are done. The second contractor will finish the installation of appliances five days after the predecessor activity is completed. So, there is a lag of five days (Figure 3.9).

Start-to-Start (SS) Relationship

In this relationship, a successor activity (B) cannot start until we start the predecessor activity (A). Like a finish-to-finish relationship, it is possible to see a lag between these two activities. In Figure 3.7, the relationship on the right illustrates a 5-day lag. Activity B can start five days after Activity B starts.

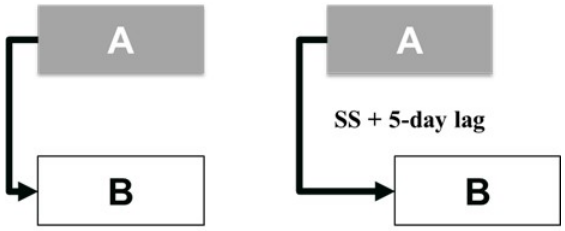


Figure 3.7: Start-to-Start

Examples:

- When developers start coding in a software project, testers may not need to wait until they finish all the coding. They can start testing after the coding starts. However, they may need to wait for several hours or days to start testing since some of the coding should be done so that the testers have an adequate number of lines to test. This delay is named “lag” as explained above and also in the “Finish-to-Finish” relationship.
- We are drafting a user manual for our product (predecessor). This manual must be also reviewed to make it ready for publishing (successor). In order to start this review, we should start drafting the manual.

Start-to-Finish (SF) Relationship

This is the rarest relationship between project activities. Activity B (successor) cannot finish until Activity A (predecessor) activity has started (Figure 3.8). Consider that we developed a new order processing software. In the meantime, we still need to use the current software not to cause any interruptions in our operations. Activity A is “Shutting down the current software” while Activity B is “Making the new software operational”. We can finish Activity B when we start Activity A.

Figure 3.8: Start-to-Finish

Exercise to Create an Activity Network Diagram

Our exercise to create an activity network diagram starts with Table 3.4 below. We are assuming that all the dependencies are finish-to-start, and there are no lags or leads in this exercise.

Table 3.4: Activities

Activity	Duration (week)	Predecessors
A	1	–
B	2	–
C	2	A
D	4	A
E	1	B
F	2	C, D
G	3	E
H	1	G
I	4	G
J	1	F
K	3	J, H
L	4	I
M	1	K, L

We are using rectangular nodes for each activity with labels on them. Different software programs can be utilized to create these nodes. In this exercise, we are using Microsoft Visio. When we click “New” and search “PERT Chart” on Visio, we can select “PERT Chart” to open a new sheet. PERT stands for “Program Evaluation Review Technique”. It was developed by Booz-Allen and Hamilton as part of the United States Navy’s Polaris missile submarine program. PERT is a method for analyzing the tasks involved in completing a project, especially the time needed to complete each task, the dependencies among tasks, and the minimum time needed to complete the total project. Another method, CPM, the critical path method was developed in a joint venture by DuPont Corporation and Remington Rand Corporation for managing plant maintenance projects. The critical path determines the float, or schedule flexibility, for each activity by calculating the earliest start date, earliest finish date, latest start date, and latest finish date for each activity. This will be discussed in detail in the following sections. Rather than dealing with both methods separately, project managers use these methods together as they have been treated as a single method over time.

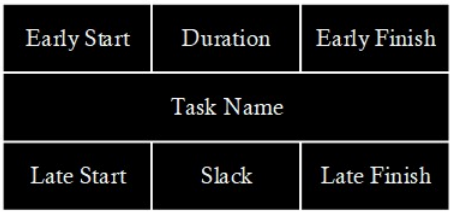


Figure 3.9: Activity Node with Labels

An activity node includes the labels as seen in Figure 3.9.

- Early Start (ES): The earliest time we can start an activity.
- Duration: How long it takes to finish all the tasks in an activity. It can be hours, days, weeks, or months.
- Early Finish (EF): The earliest time we can finish an activity.
- Late Start (LS): The latest time we can start an activity. Some activities may have some flexibilities (slacks or floats) that allow us to have some delay to start without affecting the overall project duration and other activities.
- Late Finish (LF): The latest time we can finish an activity. Based on the slacks (floats), we can finish an activity later than its scheduled completion time.
- Slack (Float): It is the difference between LS and ES, or between LF and EF. Both subtractions generate the same result.

Figure 3.10. Connecting a Predecessor to its Successor (FS dependency)

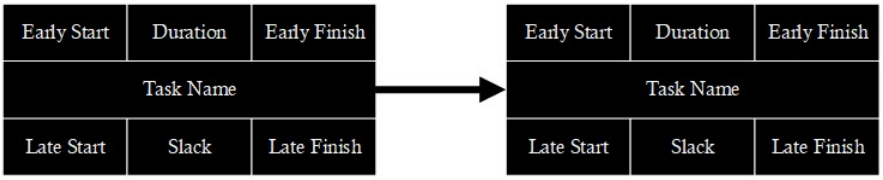


Figure 3.10. Connecting a Predecessor to its Successor (FS dependency)

We should place each activity node on the diagram by adhering to their precedence relationships with other activities (Table 3.4). After we connect all the nodes, we can type the duration for each activity as can be seen in Figure 3.11. All other parts in the nodes are zero for now. Besides, as all the dependencies are finish-to-start, the arrows (connectors) start from the right side of a predecessor activity and finish on the left side of a successor activity. For instance, when we finish Activity A, we can start both Activity C and Activity D. When we finish both, we can start Activity F.

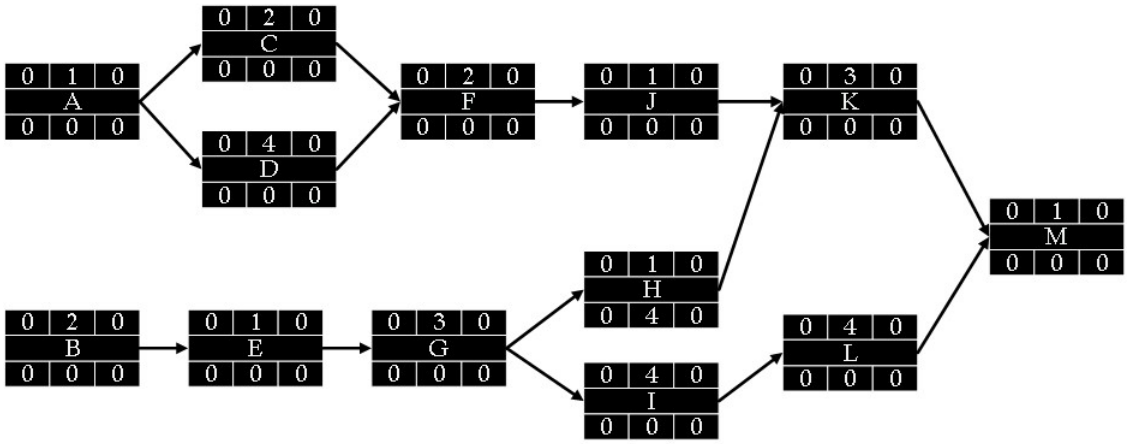
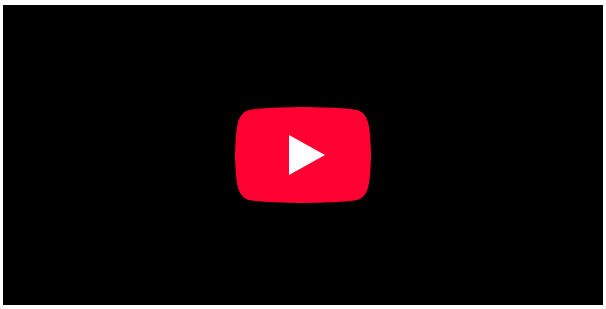


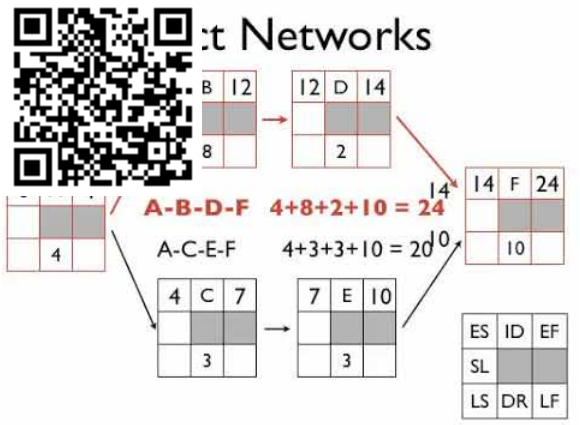
Figure 3.11: Activity Network Diagram with Durations

Forward and Backward Pass

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.





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.

Forward Pass:

Now, we can start with a forward pass to determine the early start and early finish dates, and on the last activity, the overall time to finish the whole project. It is an additive move through the network from start to finish.

1. For two starting activities (A and B), ES is marked zero, which means that it is the very first day of the project (Figure 3.12).

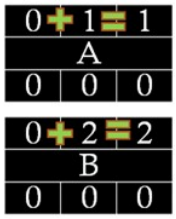


Figure 3.12: ES and EF times

2. We add ES to the duration for each activity to find EF. For A, EF is (0+1) = 1 week, and for B, it is (0+2) = 2 weeks. It means that we can finish A at the end of the first week, and finish B at the end of the second week (Figure 3.15).
3. Then, we carry the EF time to the nodes immediately succeeding the recently completed nodes (predecessors). C and D inherit 1 (EF) from A, and it becomes ES for both successor activities. For E, we pass 2 (EF for B) to E as the ES time. Then, we add new ES times to the duration of activities to find the EF for new successors (Figure 3.13).

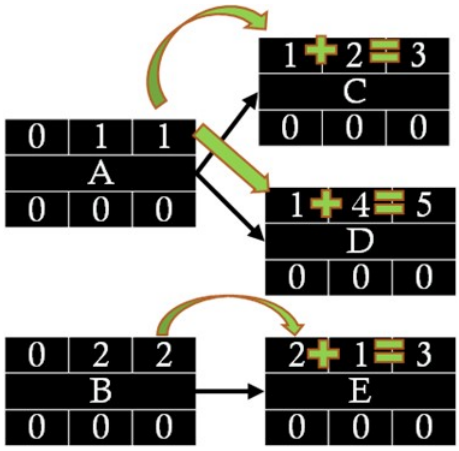


Figure 3.13: Passing predecessor ES times to successors as EF times

4. At a merge point, as is the case when C and D merge at F, we pass the highest EF time of predecessors (C and D) to the successor activity (F) (Figure 3.14). EF time of D becomes ES time for F.

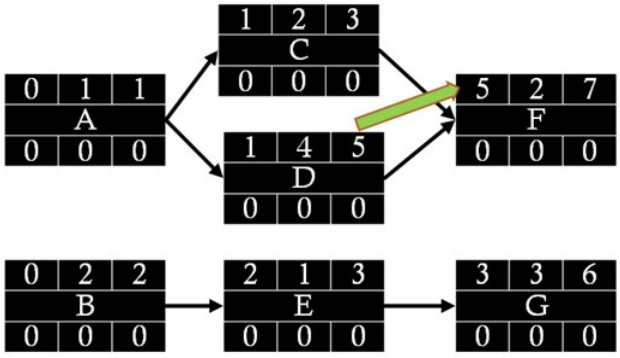


Figure 3.14: Passing predecessor ES times at merge points

5. When the forward pass is done, we can generate all ES and EF times for all the activities. The EF of the last activity (M) gives us the overall duration of the project which is 15 weeks (Figure 3.15).

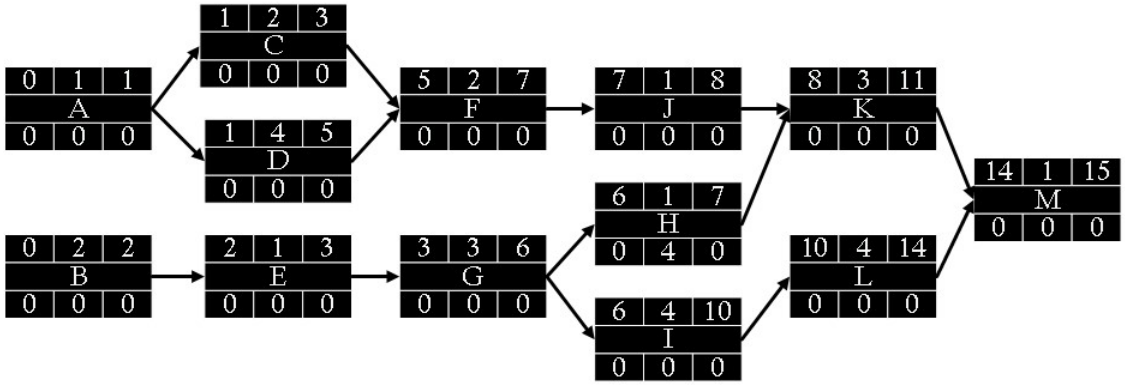


Figure 3.15: Completion of the forward pass

The Critical Path

The critical path describes the sequence of tasks that would enable the project to be completed in the shortest possible time. It is based on the idea that some tasks must be completed before others can begin. A critical path diagram is a useful tool for scheduling dependencies and controlling a project. In order to identify the critical path, the length of time that each task will take must be calculated. We can add the amount of time estimated for the duration of each activity to the previous activity to determine which path through the network has the longest total duration. It's also the longest path on your network diagram. It is useful to understand the critical path as any delay in these tasks will cause other tasks to be delayed and will impact your project completion date. As we will explain below, slack will be zero for all the activities on the critical path.

Backward Pass

After we complete the forward pass process for all the activities, we can start backward pass by moving from the last activity to the starting activities. It is a subtractive move through the network from finish to the start. In our exercise, the last activity is M with a one-week duration, an ES of 14 weeks, and an EF of 15 weeks which also indicates the overall duration of the project.

1. Late Finish (LF) for the last activity M is passed from EF (15 weeks). Then, we subtract LF from the activity duration to find the Late Start (LS). It is (15-1) = 14 weeks (Figure 3.16).

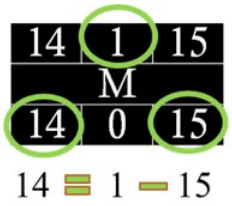


Figure 3.16: Starting backward pass at the last activity

2. Now, it is possible to compute slacks for each activity. It is the difference between LS and ES, or between LF and EF. Both calculations will generate the same result. For Activity M, it is (14-14) or (15-15), which is zero. Therefore, there are no slacks for this activity. We don't have any flexibility for this activity. We cannot have any delays to start the activity or to finish it. The activities where slack is zero are critical.
3. Then, we carry back the LS time to the nodes immediately preceding the successor node. K and L inherit 14 (LS) from M, and it becomes LF for both predecessor activities. Then, we subtract LF times from the duration of activities to find the LS for these predecessors (Figure 7.16). The slack for L is (10-10) or (14-14), which is zero. Therefore, L is also a critical activity. The slack for K is (11-8) or (14-11), which is 3. It means that we can wait for an additional three weeks to start K because we need to wait until week 14.

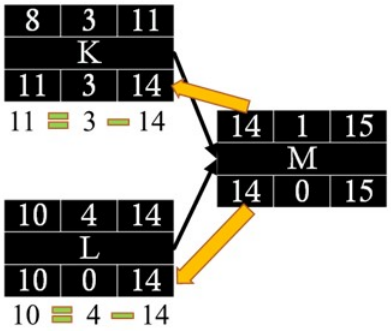


Figure 3.17: Passing LS times to successors as LF times

Figure 3.17: Passing LS times to successors as LF times

4. At a burst point, as is the case when G is followed by two successors, H and I, we pass the lowest LS time of successors (H and I) to the predecessor activity G as its LF time. Therefore, 6 becomes the LF for Activity G (Figure 3.18).

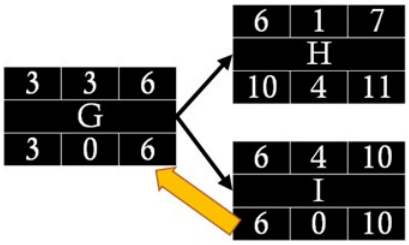


Figure 3.18: Passing successor LS times at burst points as LF times

5. When the backward pass is done for all the activities, we can generate all LS and LF times as well as slack times for all of them (Figure 3.19). Thus, we can determine the critical path where the total slack is zero.

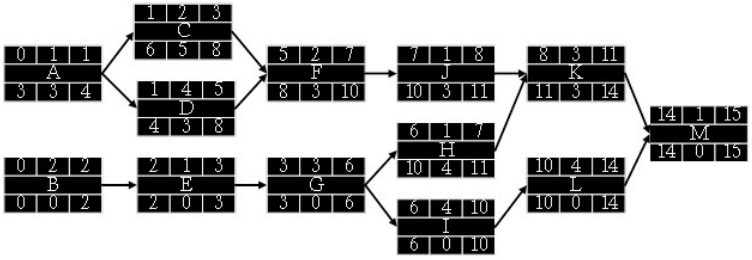


Figure 3.19: Completion of the backward pass

The critical path of this project is B – E – G – I – L – M. It is also the longest path. We need to start and finish all these six activities on their scheduled time not to cause any delay in the overall project. Non-critical paths are:

1. A – C – F – J – K – M: 1+2+2+1+3+1=10 weeks
2. A – D – F – J – K – M: 1+4+2+1+3+1=12 weeks
3. B – E – G – H – K – M: 2+1+3+1+3+1=11 weeks

We should always keep in mind that the WBS is not a schedule, but it is the basis for it. The network diagram is a schedule but is used primarily to identify key scheduling information that ultimately goes into user-friendly schedule formats, such as milestone and Gantt charts. The network diagram provides important information to the project team. It provides information about how the tasks are related, 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.

Schedules must be communicated to project stakeholders. Generally speaking, stakeholders want to know when the work will be completed. Once the completion date is determined, it is important to confirm whether this date can meet the expectations of the stakeholders, in particular the project sponsor, and internal or external clients. Once timeline commitments have been made, stakeholders must be kept up to date on any delays that will cause deviation from the agreed-upon schedule.

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.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
3. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
4. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

3.6: Creating a 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 project activities. 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 3.23). 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. The detailed Gantt chart is usually constructed after all WBS activities are identified, an activity list is created, activity durations are estimated, and predecessors are determined.

Let's continue with our example in table 3.4. The Gantt Chart for the Scope activities was created by using MS Project (Figure 3.20).

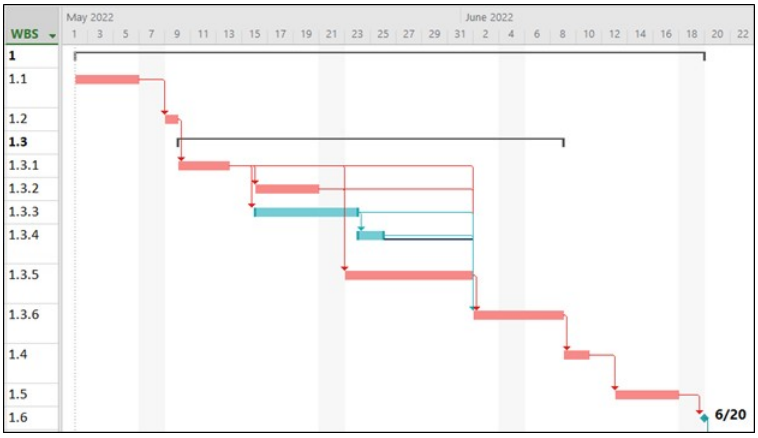

Figure 3.20: Gantt Chart for the "Scope" activities

In the Gantt chart in Figure 3.20, red bars show the critical tasks whereas blue bars illustrate the non-critical tasks. Dependencies between all the activities are Finish-to-Start, which is the most common dependency and the default relationship in MS Project.

3.7: 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 3.21 shows how the project is broken down into major deliverables and then into sub-deliverables and work packages.

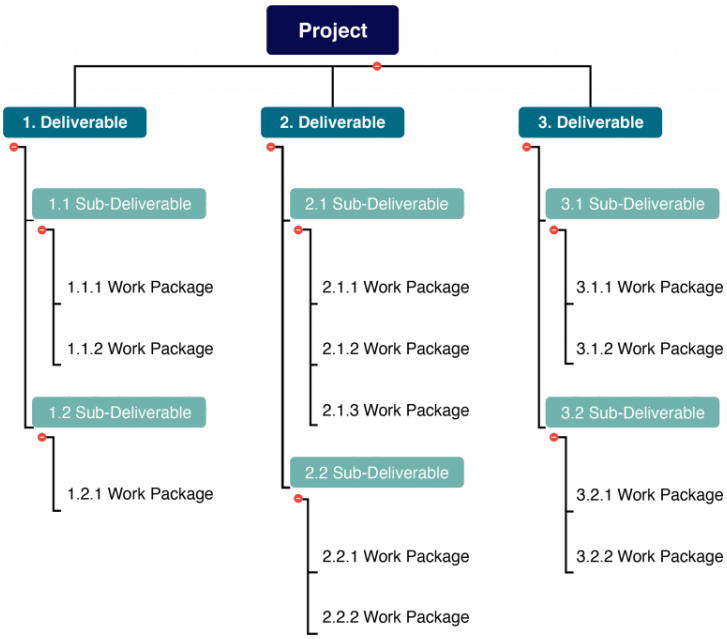

Figure 3.21 The WBS is an outline that shows how the deliverables, sub-deliverables and work packages relate to the final project.

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 3.22). 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 3.22). The cost of a deliverable is the sum of all of its related sub-deliverables.

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.

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.

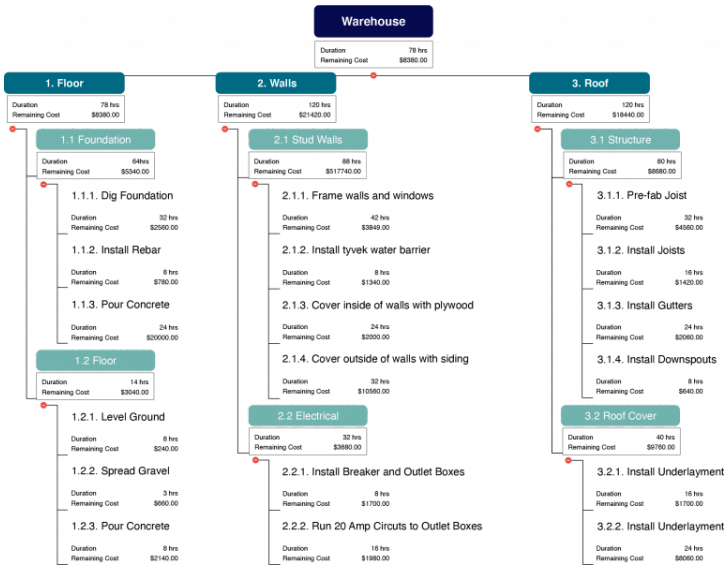

Figure 3.22: WBS for New Warehouse Project

In the example in Figure 3.22, 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 3.5 is an example of a WBS Dictionary entry; note that several items will be added later in the planning process.

Table 3.5 WBS Dictionary Entry Example

Hammer and Chisel Incorporation
WBS Dictionary

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

3.8: 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.

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CHAPTER OVERVIEW

4: Stakeholder Management / Communication Management

4.1: Introduction

Learning Objectives

1. Describe the process to identify stakeholders in a project and create a stakeholder register.
2. Explain the management of stakeholders to meet their needs and expectations, address issues, and foster appropriate stakeholder engagement involvement.
3. List the conditions when project managers need to update the stakeholder engagement plan.
4. Evaluate the importance of good communication in project management
5. Create a communication management plan.
6. Describe the interpersonal and technical skills that project managers need to lead project teams and manage the projects effectively.
7. Explain how project managers can create a culture pertinent to a project.
8. Describe the virtual project teams that are exponentially utilized worldwide by all types of organizations, and compare in-person and virtual teams.

Overview

A project is successful when it achieves its objectives and meets or exceeds the expectations of the stakeholders who are individuals, groups, teams, businesses, corporations, communities, government organizations, or non-governmental organizations who either care about or have a vested interest in a project. They may affect the whole project, its outcomes, some activities, or even only a decision, an activity, or an outcome of the project negatively or positively. Stakeholders may be actively involved with project activities or have something to either gain or lose as a result of the project. Project managers and their teams spent most of their time communicating and collaborating with the stakeholders. Indeed, project managers, themselves, spent 90% of their time communicating[1]. This chapter discusses stakeholder management and how project managers should pay attention to while they communicate with the stakeholders including their key stakeholders such as project team members, sponsors, internal or external clients, customers, end-users, and regulatory and government agencies.

Project managers and their teams spend most of their time communicating and collaborating with the stakeholders. Indeed, project managers, themselves, spend 90% of their time communicating[1]. Therefore, we will also address the aspects of communication which is necessary to sustain a healthy relationship with all the stakeholders besides project team members. In this chapter, we are also focusing on the team management that elaborates on the relationships between the project manager and other team members as well the relationships among all team members. Working with people, inside and outside the project team, 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.

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

4.2: Identifying Stakeholders and Managing Their Expectations

A project starts with two processes – developing the project charter and identifying stakeholders[1]. Triple constraints (scope, schedule, cost) and stakeholders constitute the main pillars of a project. If stakeholders are not identified properly, the project and its outcomes cannot address all the stakeholders' expectations and concerns. Incomplete elicitation of the requirements from stakeholders might leave some key requirements out of the equation, putting the project and its outcomes in danger.

Stakeholders are those who have a positive or negative influence on the project, or who are or might be positively or negatively affected by the project, or its activities, decisions, and outcomes. Stakeholders can be anyone including, but not limited to, individuals, groups, teams, businesses, corporations, communities, government agencies, not-for-profit organizations, international bodies, and non-governmental organizations. They may affect the whole project, or only one or some of the decisions or activities, or the outcomes of the project negatively or positively. Stakeholders may be involved actively or passively in the project, or its activities and decisions. When you manage a project to add lanes to a highway, motorists are stakeholders who are positively affected by the outcome of this project whereas they may be affected negatively during the construction due to the closed roads and detours. However, your project may negatively affect residents who live near the highway during your project (with construction noise) and after your project with far-reaching implications (increased traffic noise and pollution). Stakeholders can be inside the implementing or client organization (e.g., subcontractors who undertake the construction work of additional lanes) or outside it (e.g., motorists, residents).

Internal stakeholders which are inside the organization, but not limited to, are:

- Project sponsor
- Project manager
- Project team members
- PMO (Project Management Office)
- Program manager
- Project/Portfolio steering committee
- Board of trustees
- Company owners/founders
- Top management (e.g., C-level executives)
- Project managers of other projects in the organization
- Functional departments/units in the organization, their managers, and all employees (e.g., research & development, finance, accounting, human resources, sales, marketing, manufacturing)
- End users in functional departments, regional offices, and international offices of the organization
- Regional offices/branches of the organization
- International offices/branches of the organization

External stakeholders which are outside the organization, but not limited to, are:

- Customers
- End users outside the organization
- Suppliers
- Contractors and subcontractors
- Shareholders
- Regulatory bodies
- Government agencies (e.g., federal, state, local, county)
- Current and potential competitors

Often there is more than one major stakeholder in the project. An increase in the number of stakeholders adds stress to the project and influences the project's complexity level. The business or emotional investment of the stakeholder in the project and the ability of the stakeholder to influence the project outcomes or execution approach also impact the stakeholder complexity of the project. In addition to the number of stakeholders and their level of investment, the degree to which the project stakeholders agree or disagree also influences the project's complexity and outcomes.

While identifying stakeholders, in the initiation stage of a project, a project charter generally consists of key stakeholders whose power or interest levels are at a high level. Key stakeholders can make or break the success of a project. Even if all the deliverables

are met and the objectives are satisfied, if your key stakeholders aren't happy, nobody's happy. This is why all the key stakeholders must be identified before proceeding with the preparation of the project management plan. However, identifying the stakeholders doesn't finish in the initiation stage, but is an ongoing process through which project managers should review and analyze their interests, involvement, interdependencies, influences, and potential impact on project success regularly during the project life cycle[2]. Data representation techniques such as stakeholder power/interest grid/matrix help a lot to review where stakeholders are positioned based on the criteria used and be prepared and implement strategies to manage stakeholders. In the following subsection, we will discuss one of the common data representation techniques, power/interest grid (matrix) based on a scenario.

There are many project decelerators, one of which is the lack of stakeholder support. Whether the stakeholders support our project or not, if they are important to the project, we must secure their support. How do you we that? First, we must identify who our stakeholders are. Just because they are important in the organization does not necessarily mean they are important to our project. Just because they think they are important does not mean they are. Just because they don't think they need to be involved does not mean they do not have to be. The typical suspects that we should consider would be our top managers, relevant departments' managers, supervisors or key employees, and the project sponsor (champion), our internal or external client, subject matter experts (SMEs) we need to consult, and the selection or steering committee reviewing and approving our project. In some situations, some think they are stakeholders in our project. Even though they aren't, as they perceive that they are affected by the project and its activities and decisions, we should consider them as stakeholders. From our perspective, they may not be, but we should be careful while handling them. They could be influential with those who have the power to impact our project. We shouldn't dismiss them out of hand.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

4.3: Stakeholder Analysis

After the initial assessment has been completed, stakeholder prioritization can occur. A power/interest grid would be a very helpful tool for prioritization (Figure 4.1). It helps project managers categorize stakeholders and create effective communication strategies for each category of stakeholder on the project. This tool is one of the most common techniques utilized to group stakeholders according to their level of authority (power) and their level of concern about the project's activities and outcomes (interest)[1]. Besides the power/interest grid, other techniques can be used such as power/influence grid, impact/influence grid, stakeholder cube, and salience model. In this book, we will not cover these techniques.

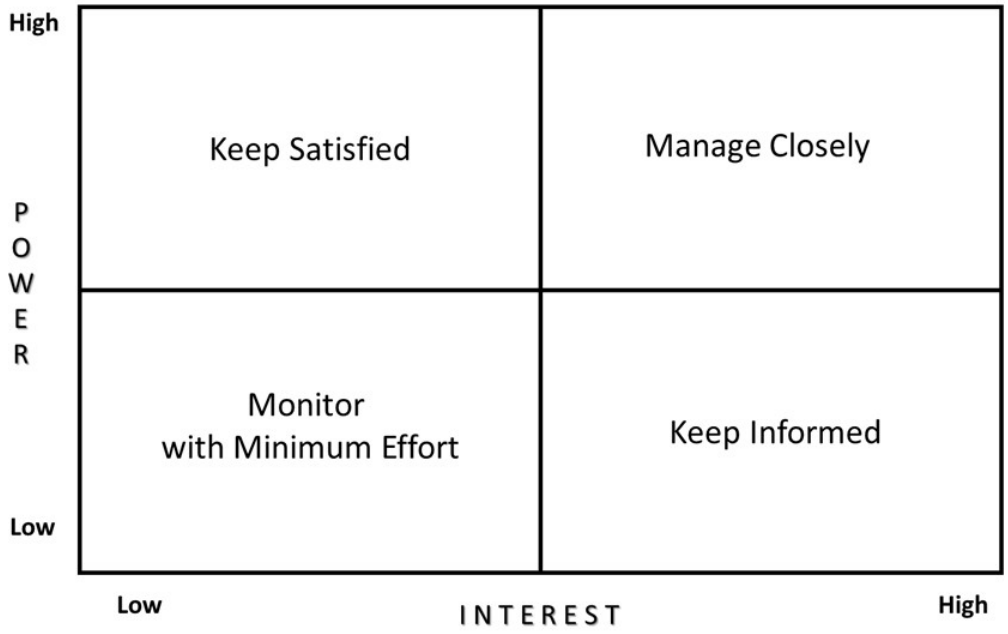

Figure 4.1. Stakeholder Matrix: Power/Interest Grid and the Strategies to Deal with the Stakeholders

The stakeholder power/interest grid is a two-dimensional matrix with four quadrants. Power refers to the authority of stakeholders through which they can affect the course of activities and decisions and may block or facilitate and accelerate them. Interest refers to stakeholders' level of concern about the project's activities and outcomes, and how they are affected by them, either negative or positive. While carrying out the activities to identify stakeholders, we should make our research and investigation thoroughly to determine and prioritize the stakeholders. Some stakeholders would have more power and interest in our project. Therefore, we should identify them, and create a strategy to engage them during the project. These strategies have been indicated in Figure 4.1 for each quadrant based on the level of power and interest.

Properties of each quadrant with the potential stakeholder inside them have been described below:

1. High power – High interest: These stakeholders are decision-makers and have the biggest impact on the project's success and hence we must closely manage their expectations[2]. We should work closely with them to ensure that they agree with and support the change[3]. The project sponsor, project manager, and the team can be included in this quadrant.
2. High power – Low Interest: These stakeholders need to be kept satisfied even though they aren't interested because they yield power. This type of stakeholders should be dealt with cautiously as well since they may use their power in a not desired way in the project if they become unsatisfied. Government and regulatory agencies which inspect the quality of your work in compliance with legal provisions and standards can be included in this quadrant.
3. Low power – High interest: We should keep these stakeholders adequately informed and talk to them to ensure that no major issues are arising. They are likely to be very concerned and may feel anxious about a lack of control. They can often be very helpful with the detail of your project. Our customers or end-users who are willing to purchase the outcome of the project (e.g., a product or a service) can be included in this quadrant.
4. Low power – Low interest: We should monitor these stakeholders, but do not bore them with excessive communication. The public and the customers who are not willing to purchase our products can be included in this quadrant. We can send them newsletters once every month, but not every week. We should monitor their interest and power level in case they may change.

When considering a stakeholder's interest, we should assess the following:

- How is their performance evaluated?
- Will their performance be impacted by the project and/or the project's outcomes?
- Are they needed to help produce the project's outcomes?

When considering a stakeholder's power, we should assess the following:

- What position do they currently hold in our organization or their organizations?
- How much authority does this position afford them over the project?
- Can they influence people in positions of high power?

Tools such as stakeholder power/interest grid help project managers prioritize stakeholders. Some stakeholders have little interest and little power in a project and as a result, do not require as much contact from the project team. Understanding who these stakeholders are allows the project team to spend more time with the stakeholders that have a significant interest in the project and who exert significant influence over the project. Project teams assess the interest and power of project stakeholders by researching their current positions and their actions in previous change initiatives, and by directly speaking with them about the project.

Below, let's consider a fictitious case study of a vehicle rental company to elaborate on the stakeholder power/interest grid.

Case Study 4.1: A Vehicle Rental Company's Project for their Booking System

Our car rental company, Best Rental Company Worldwide (BRCW), has a serious problem. Our booking system crashes frequently. The employees working in the relevant departments, branches, and the call center cannot process the information properly. Besides, there are significant errors in scheduling and pricing while individual and corporate customers are renting vehicles on the company's website, and when they reach the call center to book a vehicle. The company's IT director, who is CTO (Chief Technology Officer), asked us to initiate a project that would address the problems, and solve them. First, we should create a business case that should investigate the problem thoroughly. We should figure out the underlying reasons. In order to dig into the reasons, we should first identify the stakeholders to whom we should consult to learn what they experience with the current system, and what their concerns and expectations are. Our team targets to develop a new booking module in the ERP system, a website, and a mobile application our customers will access and use to book vehicles. We identified the stakeholders as follows:

1. Project manager
2. Project team members
3. Project sponsor: IT Director – Chief Technology Officer (CTO)
4. Steering Committee (composed of car rental company managers)
5. IT Department
6. HR Department
7. Sales Department
8. Marketing Department
9. Maintenance / Repair Department
10. Call Center and its managers and employees
11. Branches across the USA (and their managers and employees)
12. Branches outside the USA
13. Individual Customers
14. Organizational Customers (Corporates that rent vehicles based on a contract with BRCW)
15. Insurance companies
16. Travel agencies (including e-commerce agencies such as Expedia)
17. Vehicle manufacturers
18. Suppliers of vehicle spare parts and consumables for offices at the central units and branches
19. Government agencies (e.g., Department of Transportation, US Environmental Protection Agency)
20. Google Play store (for Android phones and tablets) and App Store (for Apple phones and tablets)
21. Not-for-profit organizations (e.g., associations that were established to reduce carbon emissions)

Project sponsor, project manager, project team members, steering committee, IT, sales, marketing and maintenance/repair departments, call center, and branches all across the USA are our internal stakeholders that are inside our company, BRCW. Although it may look counterintuitive to include the manager and team members, they are also stakeholders. Indeed, they are the

most important stakeholders who have a strong impact on project activities, milestones, decisions, deliverables, outcomes, and the overall project.

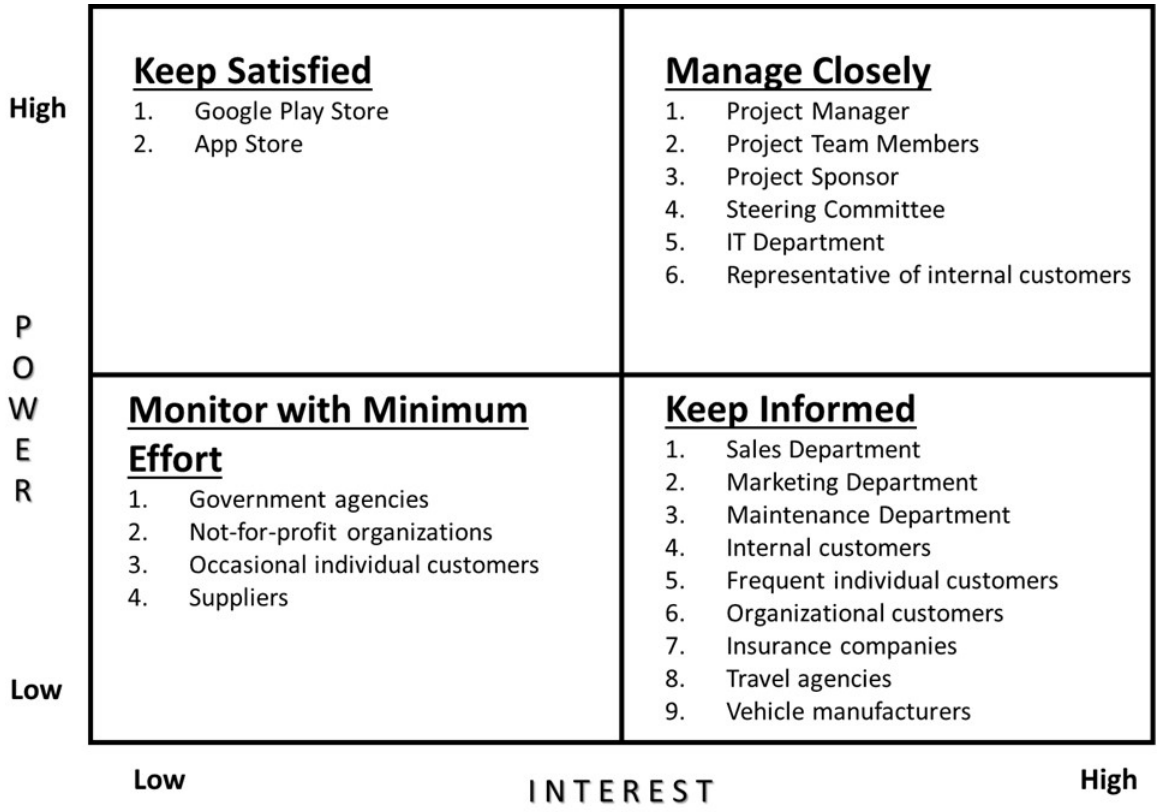

Figure 4.2. Stakeholder Power/Interest Grid for Rental Car Company's Project

Project Sponsor

The project sponsor is typically the most powerful stakeholder. In our case, CTO is the sponsor. Sponsors have high power and high interest. They are the decision-makers and act as a supervisor and controller of the project. Sponsors often initiate the project by signing off and approving the project charter and authorizing the project manager to form and lead the team, start planning, define the scope, activities, schedule, and risks, and allocate and utilize the budget and resources. A sponsor is the authority superior to the project manager inside the organization and acts as a supervisor and facilitator during the project. A sponsor releases the budget for the team to use for the project activities. If the project client is one of the units of the organization, that is an internal client, the project sponsor also becomes the funder. If the client is outside the organization, this external client becomes the funder while the sponsor should be still inside the organization that is implementing the project. A legal contract is created between the organization (where the project sponsor, project manager, and team are), and the external client (funder). While the contract is a legally binding agreement, we still need a project charter that should be signed by the sponsor who is in our organization where the team resides. The charter should be based on the contract, and it regulates the requirements and resource allocations on the organization's side. As discussed in Chapter 2 regarding the project charter, the project sponsor can be referred to as the "initiating sponsor." They have the authority to start and stop the project and will support the achievement of project objectives by removing the barriers to success. They can be regarded as the "external champion" because they often serve as the last escalation point when the project team needs support bringing an off-track project back on track. Successful project teams know how to leverage the power and position of the project sponsor and will proactively ask them to deliver influencing communications throughout the organization in order to maintain the project's momentum and high morale within the team. Project sponsors can assign one or more sustaining sponsors to act as the "internal champion(s)" of the project. These sponsors are often leaders of the internal departments that are most affected by the project, such as a marketing manager or human resources manager. When the project sponsor selects the sustaining sponsor(s), one of their goals is to ensure that the project team frequently considers the organizational impacts of the changes being introduced. By keeping the sustaining sponsor(s) actively engaged in the project, they will ensure their teams are intently participating in the project and identifying the operational impacts that must be considered in order for the change to be sustained once the project has been completed.

Project Manager and Project Team

The project manager and the team members have high power and high interest since they are responsible for conducting all the teamwork and project activities, and they define and sequence activities, estimate their duration, budget, and resources, identify resources and allocate them, identify and manage risks, and monitor and control all project activities. They are those who are held accountable in the first place for the success of the project. Project managers have to deal with stakeholders external to the organization as well as the internal environment, certainly more complex than what a manager in an internal environment faces. For example, suppliers who are late in delivering crucial parts may blow the project schedule. To compound the problem, project managers generally have little or no direct control over any of these stakeholders. Therefore, it is a challenging process for project managers and the team.

Top Management and Steering Committee

Top management may include the president of the company, vice-presidents, directors, division managers, and the corporate operating committee. They direct the strategy and development of the organization. Project managers should have top management support, which means it will be easier to recruit the best staff to carry out the project and acquire needed material and resources. Moreover, visibility can enhance a project manager's professional standing in the company. On the minus side, failure can be quite dramatic and visible to all, and if the project is large as is in our case and expensive, the cost of failure will be more substantial than for a smaller, less visible project. Therefore, while dealing with top management, project managers should develop in-depth plans and major milestones that must be approved by top management during the planning and design phases of the project. They should ask top management associated with the project for their information reporting needs and frequency. They should also develop a status reporting methodology to be distributed on a scheduled basis, and keep them informed of project risks and potential impacts at all times. In our case study, the steering committee which is composed of top managers and their representatives plays a crucial role during the project.

Functional Departments

In our case study, we have functional departments, which are the IT, sales, marketing, and maintenance/repair departments as well as branches all across the USA. In general, central functional units have more authority than the regional offices have. All these units have managers and employees at various hierarchical levels. Among the central units, the IT department is the one that we should work with more closely since the project is directly related to their responsibilities, and most of the human and physical resources we need for the project activities reside in the IT department. Therefore, the IT department has high power and high interest. The project also needs human resources from the sales, marketing, and maintenance departments. We need to consult subject matter experts in these departments. Therefore, these department heads control their resources, and we rely on them. If we have a good relationship with them, they may be able to consistently provide the best staff and the best equipment for our project. Employees from these departments may be in our core team, or they may attend the project activities. Since the booking system directly affects their day-to-day operations, they have a higher interest. However, their power level may not be very high all the time. It may fluctuate from moderately high levels to lower interest levels though it is generally not very low.

Internal Customers: Branches and Call Center

The branches in our case, and also the call center, are the internal customers of our project. They will be the end-users of the new ERP module when our individual customers and employers of our organizational customers visit the branches or call the call center to book a vehicle or to talk about another issue related to the booking (e.g., complaints, roadside assistance). These two categories of internal customers are those who hold the power to accept or reject the deliverables of activities and the overall project when completed. However, they are generally represented by their managers, a product owner, or an inspection and acceptance committee who have high power and naturally very high interest. Therefore, we should place them in the quadrant that makes us manage them closely. Early in the relationship, the project manager will need to negotiate, clarify, and document project specifications and deliverables. After the project begins, the project manager must stay tuned in to the customer's concerns and issues and keep the customer informed. If call center agents don't find the new system user-friendly and easy to use, they may resist using it. They must be kept informed frequently, and their feedback should be sought especially in critical decisions. Their resistance and dissatisfaction may lead to rework, which may cause the project to have budget overruns and schedule slippages. This is why continuous user involvement and feedback are crucial during the project to minimize the risk of unacceptance.

While dealing with internal customers, the project manager and the team should pay attention to ensuring clarity about what stakeholders, in particular customers, want precisely. This is a part of product and project scope management. Project managers should assign business and/or systems analysts who can elicit requirements utilizing techniques such as surveys, interviews, focus

group meetings, workshops, root and cause analysis, and document analysis. Project managers should be aware of any issues regarding the lack of documentation for what is wanted, lack of knowledge of the customer's organization and operating characteristics, unrealistic deadlines, budgets, or specifications requested by the customer, hesitancy of the customer to sign off on the project or accept responsibility for decisions, and changes in project scope. As explicated in Chapter 2 "Project Initiation" and Chapter 3 "Project Planning", project managers should address the needs and expectations of stakeholders such as customers, clients, or owners, and be sure to do the following:

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

External Customers

Providing clarity about what stakeholders want precisely, as explained above for internal customers, is true for external customers too. Business and/or systems analysts should also elicit requirements from external customers by utilizing techniques such as surveys, interviews, focus group meetings, workshops, root and cause analysis, and document analysis. External customers are outside our organization. Therefore, they are within the external stakeholders. In our case, external customers are individual customers (people who rent vehicles for leisure or work) and organizational customers (corporates that rent vehicles based on a contract). When we finalize our project, they can book the rental vehicles on our website and mobile app, call the call center to reserve a vehicle or talk about another issue related to the booking (e.g., complaints, roadside assistance) or they can visit a branch to reserve, pick up or return a rental vehicle. Organizational customers, in general, have a contractual relationship with our company as they regularly and frequently rent vehicles with better prices and conditions. They will be interested in our new booking system since a more effective system helps them have a smoother process with minimum flaws. Most of the individual customers may not be frequent customers. They may pursue lower prices by comparing the prices based on the vehicle type. Therefore, their interest in our new system may not be high most of the time. We can name them as occasional individual customers. However, the customers who rent their vehicles from our company regularly may be interested in our project, and they may be willing to receive newsletters, for example, once every month in their email accounts. The power level for both individual and organizational customers would be low since they don't have the authority and decision-making authority to significantly affect the course of the project (Figure 4.2).

External Stakeholders

In our case, individual customers, organizational customers, mobile app stores, insurance companies, travel agencies (including e-commerce agencies), vehicle manufacturers, suppliers, government agencies, and not-for-profit organizations are our external stakeholders.

An important stakeholder group in our case would be two common **mobile application stores** – Android's Google Play and Apple's App Store. Our mobile app developers and testers will use their SDKs (Software Development Kits), and they should authenticate the app before it can be used by the customers on their smartphones. There will be also standards such as regarding privacy and security that we need to comply with. Thus, these two stores will have high power in our project. However, their interest level may not be high as they are not impacted by this project and its outcomes. We should keep them satisfied by complying with their standards, and terms and conditions.

Government and regulatory agencies are generally considered to have high power and low interest if they have an inspection and approval authority in the project. Project managers working in certain heavily regulated environments (e.g., pharmaceutical, banking, or military industries) will have to deal with government regulators and departments. These can include all or some levels of government from municipal, provincial, federal, to international. Besides, constructors are subject to permits and inspections from the local (city and county offices such as Public Works, Fire, and Health Departments) and federal agencies regarding the quality and legal standards they need to adhere to in their constructions (e.g., building permits, fire evacuation plan, fire and smoke equipment, safety). This is why these agencies' power level is high. In our case, government agencies were listed as the Department of Transportation and the US Environmental Protection Agency. Although these agencies may perform controls and inspections, and release permits for our operations, they may not have power and interest in our booking system. Thus, they are inside the low-power and low-interest quadrant in Figure 4.2. If there is a function or condition that need to be added to our system, and these agencies should approve before we make the system available, then we can include them inside the high-power and low-interest quadrant.

In our booking system project, we also have **not-for-profit organizations** such as associations that were established to reduce carbon emissions. Similar to government agencies in our case, these organizations may not have power in our project. However, they may have a low or moderate level of interest since the system could include the fuel efficiency rates for each car. In Figure 4.2, they were placed within the low-power and low-interest quadrant.

Insurance companies and travel agencies may be interested in our new booking system since some of them have an ongoing contractual relationship with our company. When a customer wants to rent a vehicle, they can select an insurance plan during their rental time. Travel agencies, and/or travel websites (e.g., Expedia, Priceline) communicate with our company's system to check the availability of our rental cars. Therefore, both insurance companies and travel agencies may be interested in our project. However, their power level would be at a low level as they don't have the decision-making authority to affect the project activities.

Another stakeholder would be **vehicle manufacturers** from which our company, BRCW, purchases the vehicles to rent to the customers. Although they have a high interest in our vehicle portfolio, and they have an ongoing relationship with our company, they may not have a high-level interest in the booking system. Indeed, vehicle manufacturers prefer their vehicles to appear in the booking system with high-quality pictures and accurate technical information. This is why they may have a moderate level of interest in our booking system. They would be willing to see the same look and feel or the picture and information quality available in our current system. Therefore, they were placed in the low-power and high-interest quadrant in Figure 4.2. We can also use the maintenance and service points of these vehicle manufacturers. However, this wouldn't be related to the booking system.

Another stakeholder, **suppliers** of vehicle spare parts and consumables for offices at the central units and branches, wouldn't have a high interest in our booking system. They may have a moderate level of interest in the functions and conditions in our ERP module if spare parts and consumables are included. Neither do they have power in our project. Many projects heavily depend on goods provided by outside suppliers. This is true for example of construction projects where lumber, nails, brick, and mortar come from outside suppliers. If the supplied goods are delivered late or in short supply or of poor quality or if the price is greater than originally quoted, the project may suffer. Therefore, their interest level would be high. However, in our case, their interest level wouldn't be high. Hence, they were replaced in the low-power and low-interest quadrant in Figure 4.2.

We didn't include any contractors in our case study. However, there are times when organizations don't have in-house expertise. Thus, available resources and work is farmed out to contractors or subcontractors for the whole project or some of the activities. In a construction project, these subcontractors may be consultants, electricians, carpenters, and architects. Managing them requires many of the skills needed to manage full-time project team members. We may have problems with them regarding the quality of the work, cost overruns, and schedule slippage.

Stakeholder Register

In order to have a better picture of stakeholders, we should have a stakeholder register accompanied by the power/interest grid we delineated above. This register should include information about all our stakeholders, both key and those with low interest and low power. Table 4.1 illustrates an example of a stakeholder register based on our case study about a rental vehicle booking system implemented at BRCW.

Table 4.1. Stakeholder Register

ID	Stakeholder Name, Title, and Contact Information	Organization Name	Power Level (H/M/L)	Interest Level (H/M/L)	Current Level of Support	Level of Support Required	Risk Rating (H/M/L)	Related Stakeholders	Issues & Concerns	Engagement Strategy & Tactics

1	Project Sponsor CTO	BRCW	H	H	Supports Actively	Supports Actively	L	• Project Team • Steering Committee • IT Department	Committed to the project and wants to ensure the external resources the organization provides deliver on expectations.	Should be managed closely. Signs off the project charter and the plan, and authorizes the project manager. Releases the budget and resources. Very frequent communication.
2	Google Play Store	Google (Android)	H	L	Neutral	Supports	M	• App Store • Project Team	Should authenticate our	Google Play guidelines

									app before it can be used by our customers on their smartphones. Google Play's SDK will be used. App features, privacy, and security issues should be complied with. New apps must targ	must be followed for compliance.

									et at least Android 11 (API level 30).	
3	Organizational Customer	Company X	L	H	Opposes	Supports	H	• Project Team • Sales Department • Call Center • Branches	Company X managers raised some issues in the recent meetings to terminate the contract with BRCW. They don't think that BRCW can create a new	The project team and sales department must communicate with this stakeholder's top management frequently to show BRCW's commitment to this

									effective app.	project. Each increment of the website and mobile app should be shown to receive feedback.
4	Occasional individual customers	NA	L	L	Neutral	Supports	L	• Project Team • Call Center • Branches	They try to find the most affordable price among many rental companies' offers.	The new booking system should be optimized to show the best offers to these customers.

Level of support (either current or desired) can be evaluated in five levels[4]:

1. Supports Actively: Anticipates and feels the need for change, actively works with the project team.
2. Supports: Anticipates and feels the need for change, but does not involve in the project team.
3. Neutral – Neither supporting nor opposing.
4. Opposes – Neither feels the need for change nor tries to prevent the change.
5. Opposes Actively – Doesn't see the need for change, actively working to prevent the change.

In some cases, it isn't uncommon for project managers to be working with stakeholders that are not supportive of the project. They may feel the project is not going to benefit them or their organizations. They may also resist making the changes that are necessary to support the project's outcomes. Some stakeholders are very upfront about their resistance and others are not. In these situations, the project sponsor may be integral to winning these stakeholders over. Knowing when to tactfully involve others in stakeholder management is another key success factor for effective project management.

Stakeholders are critical factors to be taken into account while identifying the risks. Their risk rating helps the team determine individual and overall project risks. The project manager and the team should use judgment in deciding how to handle each stakeholder by evaluating their current and desired support level, the potential impact on the project activities, decisions and outcomes, and their issues and concerns regarding the project and other stakeholders.

Stakeholders may convey their issues regarding the project explicitly or implicitly. Therefore, the team should attempt to analyze and list what kind of issues and concerns are available and may emerge during the implementation of the project. Based on all the inputs discussed, the team should carry out brainstorming sessions and come up with strategies for the stakeholders whose lack of support significantly might impact the project's success, how to gain their support, and how to engage them effectively in the project. Table 4.1 includes issues and concerns with four stakeholders in the rental booking system project, and engagement strategy and tactics.

Furthermore, we should consider the relationship among stakeholders. Can we improve the project's chances by working with those who support us to improve the views of those who oppose? Therefore, as indicated in Table 4.1, it would be helpful for the team to have information regarding the relationships among the stakeholders. For example, related stakeholders have been indicated as the project team, sales department, call center, and branches for organizational customers.

A stakeholder register is a living document that should be reassessed regularly as is done for other plans and documents such as risk register and issue log (see Chapter 10). Thus, the project team should assign some time in their weekly or monthly meetings to discuss whether revisions are required to do in the stakeholder register. Stakeholders' power and interest levels, support levels, risk ratings, issues and concerns, and accordingly engagement strategies and tactics could change throughout the project. Besides, new stakeholders may be added later. This process is discussed in the section "Managing and Monitoring Stakeholders".

Stakeholder Engagement Assessment Matrix

Another data representation tool that can be used is a Stakeholder Engagement Assessment Matrix. It can also be incorporated into the stakeholder register. In Table 4.1 above, the level of support was indicated in five levels: (1) Supports actively, (2) supports, (3) neutral, (4) opposes, and (5) opposes actively[5]. Besides this, another matrix can be used as detailed in the PMBOK Guide 6th Edition. C indicates the current engagement level whereas D indicates desired level.

Table 4.2 Stakeholder Engagement Assessment Matrix (Adopted from PMBOK Guide 6th Edition)

Stakeholder ID	Unaware	Resistant	Neutral	Supportive	Leading
1		C	D		
2	C			D	
3				C	D

**C: Current, D: Desired*

As indicated in Table 4.2, stakeholders are evaluated based on five levels of engagement. They may be unaware of the project and its potential impacts. They may be aware of the project and potential impacts but resistant to any changes that may occur as a result of the work or outcomes of the project. These stakeholders will be unsupportive of the work or outcomes of the project. When stakeholders are aware of the project but neither supportive nor unsupportive, we can classify them as neutral. When they are aware of the project and potential impacts and supportive of the work and its outcomes, we can classify them as supportive. Eventually,

stakeholders are classified as leading when they are aware of the project and potential impacts and actively engaged in ensuring that the project is a success.

Responsibility Assignment Matrix (RACI Chart)

Another data representation technique that can be used to illustrate each team member's and relevant stakeholders' roles and responsibilities in each project activity can be a responsibility assignment matrix. It shows the project resources assigned to each work package (lowest level activities in a WBS). One of the common responsibility assignment matrices is RACI (responsible, accountable, consult, and inform) chart. A RACI chart is a useful tool to ensure clear assignment of roles and responsibilities when the team consists of internal and external resources[6]. As seen in Table 4.3, a RACI chart displays the activities associated with team members and stakeholders.

In order to avoid confusion about who is ultimately in charge of supervision and/or decision-making for an activity, there should be only one person associated with accountability[7]. A role that is "Accountable" has the final authority or accountability for the task's completion. This role is generally assumed by the project sponsor, project manager, or a supervisor or team members delegated by the project manager for an activity. As seen in Table 4.3, for each activity, we have only one role that assumes an accountability role. For example, in the "Collect Requirements" activity, Jim is the team member who is responsible for coordinating the whole activity and/or performing the tasks directly. Jim can consult Jane and Anna who may be subject matter experts who have a substantial amount of experience and knowledge or those who are affected significantly by the activity and have an interest in this activity and the overall project. Thus, Jim can interview Jane and Anna, and learn about their needs, expectations, and concerns. Mary can be the project manager or the supervisor in the team that audits and approves the activity and its deliverables. Tom could be a stakeholder with high interest and low power. We should keep him informed about what is going on in this activity. We can also receive feedback from Tom to improve the tasks in this activity.

Table 4.3 RACI Chart

	Team Member or Stakeholder					
Activity	Jim	Mary	Chris	Jane	Anna	Tom
Plan Scope Management	A	R	R	I	C	C
Collect Requirements	R	A	I	C	C	I
Define Scope	A	R	R	I	C	C
Create WBS	A	R	R	R	I	

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. https://www.projectmanagement.com/wikis/368897/stakeholder-analysis--using-the-power-interest-grid ↵
3. International Institute of Business Analysis. (2015). A guide to the Business Analysis Body of Knowledge (BABOK Guide), version 3.0. Toronto, Ont: International Institute of Business Analysis. ↵
4. Anupam (n.d.). Stakeholder Analysis Register. Retrieved from https://www.projectmanagement.com/ ↵
5. Anupam (n.d.). Stakeholder Analysis Register. Retrieved from https://www.projectmanagement.com/ ↵
6. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
7. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

4.4: Managing and Monitoring Stakeholder Engagement

After we identify the stakeholders, analyze their positions in terms of interests, power, influence, involvement, interdependencies, and potential impact on the project success, and accordingly develop strategies to involve them in the project to make them supportive of the project (and at least not opposing the project), we can manage and monitor their engagement[1]. This engagement should be detailed in a stakeholder engagement plan which is a component of the project management plan that identifies the strategies and actions required to promote the productive involvement of stakeholders in decision making and execution[2]. The stakeholder power/interest grid, stakeholder register, and other data gathering and analysis techniques are included in this plan created to guide the project team throughout the project to identify the strategies and approaches for engaging stakeholders.

During the execution of project activities, the project manager allocates most of the workforce and resources required for activities and spends a substantial amount of the budget. Based on the stakeholder engagement plan and its components, project managers should communicate and work with stakeholders to meet their needs and expectations, address issues, and foster appropriate stakeholder involvement[3]. This plan helps us while eliciting stakeholders' requirements, expectations, and concerns, having meetings, interviews, and workshops with them, sending them periodic newsletters to keep them updated about the progress of our project, carrying out the activities to create deliverables that can satisfy their needs, and closing out the project after the approval of the client.

Identification of stakeholders brings about another key aspect of stakeholder management – communication with them. The communication protocol must be incorporated into the stakeholder engagement plan. Communication methods can be adapted to suit the unique nature of the project. This adaptation will also strongly affect project success. Key questions the project team needs to address are:

- Which stakeholders will make the decision in the organization on a specific issue, and which of them should be involved in this process? In particular, to whom we should consult about an issue, and inform?
- What type of communication types and methods should we utilize? Do the stakeholders want lengthy documents? Formal or informal communication? Is "short and sweet" the typical standard?
- What medium of communication is preferred? What kind of medium is usually chosen for various situations? Check the lessons learned repositories to see what past projects have done.

Although project managers keep each stakeholder's expectations and needs in mind throughout each conversation, report or email, we should always remember that the interests of both our company and the client are more important than any stakeholder's interests. However, preferring our company's or client's interests over other stakeholders' may lead to failure during the implementation or after the deliverables of the project are made available for the clients and customers in the market. Market demand is a critical determinant of the success of our project outcome.

No matter what stakeholders' needs or wants are, all of them will respect the project manager who:

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

Achieving a project's objectives takes a focused, well-organized project manager who can engage with a committed team and gain the support of all stakeholders. Building strong, trusting relationships with interested parties from the start can make the difference between project success and failure. Managing stakeholder engagement helps to ensure that stakeholders clearly understand the project goals, objectives, benefits, and risks for the project, as well as how their contribution will enhance project success[4].

The project manager's interpersonal skills are needed especially while communicating with the stakeholders (see Chapter 6 for more discussion of interpersonal and leadership skills). Project managers must rely on their soft skills to be effective. Effective project management spends a significant amount of time building relationships with stakeholders. It is of high importance for a project manager to obtain, confirm, and maintain stakeholders' commitment to the success of the project. Project managers manage their expectations through negotiation and communication. Building trust and maintaining an open line of communication are critical in working with all stakeholders. Keeping stakeholders involved is essential and it requires more than simply sharing information. The project manager must ask for their input and demonstrate an understanding of a stakeholder's unique business challenges. This level of understanding is often done through simple and regular check-ins with stakeholders. Project managers

who are successful in relationship building understand each stakeholder's capacity to participate and honor their time constraints. Then, addressing risks or potential concerns and anticipating future issues that may be raised by stakeholders would be less challenging for a project manager equipped with effective interpersonal skills. Finally, project managers can clarify and resolve issues that have been identified.

Besides managing stakeholder engagement, project managers should assure that they and their teams monitor stakeholder relationships, and modify engagement strategies and plans during the project when needed. As is the case for all knowledge areas, project managers have a critical responsibility to track, review and regulate the progress and performance of the project, and accordingly to identify areas where modifications are required in the plan, and to perform corrective and preventive actions if needed. Stakeholders' interests and power levels may change during the project. This leads to a change in strategies to engage them. Moreover, a stakeholder's support of the project objectives and outcomes may change in an opposite direction. It may move from supportive to resistant due to various factors. Supporting stakeholders may find new information that isn't in favor of their interests, and even may give harm. In our rental vehicle booking case, assume that one of the insurance companies that we work with is not included in the new system as an insurance provider. This company's representatives thought that their company's partnership with BRCW would continue. However, they were informed that their company's offer will be listed as an alternative to another insurance company's offer. Therefore, their attitudes may change to oppose the project when they are informed about it.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
3. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
4. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

4.5: Communications Management

Projects require teamwork, and team members must communicate with each other in a variety of ways. The documents they produce must be collected, distributed, and stored in an appropriate manner to assure timely and accurate communication between team members. This process is often assisted by a variety of technologies including computer and smartphone software programs and applications. The advent of the Internet accompanied by various ICTs (Information and Communication Technologies), and the emergence of the COVID-19 pandemic by the end of 2019 accelerated the process of digitalization for people, and all organizations including the companies, multinational corporates, non-governmental organizations, governments, and international bodies. Thus, the adoption and spread of ICTs worldwide across organizations and countries increased exponentially. The utilization of global virtual teams in organizations increased to unprecedented levels. 94% of the respondents of CultureWizard's Global Virtual Work Survey indicated that employees want to continue working from home—at least part time[1]. More virtual presence has brought about new challenges as detailed in the "Virtual Teams" section in this chapter.

ICTs can facilitate faster and better communication, or they can become a barrier if they are not well understood and applied appropriately. Besides, the project manager and the team should be in ongoing contact with all the stakeholders based on their power and interest levels, and other factors such as influence, involvement, support required, and interdependencies. This necessitates the manager to choose an optimal portfolio of communication technologies and methodologies. Therefore, these issues should be well-thought by the project manager while preparing the project plan and its subcomponent "Project Communications Management Plan".

Communication Management Plan

Communications management is about keeping everybody in the loop. The communications planning process concerns defining the types of information we will deliver, who will receive it, the format for communicating it, and the timing of its release and distribution. Hence, it is of high importance to make sure everybody gets the right message at the right time.

As is the case for all knowledge areas (e.g., scope, schedule, cost, resource, risk, communication, stakeholder), the first step is to plan so that we can delineate the guidelines that we should follow during the execution of the project activities, and while we monitor and control them. This provides us a direction based on the information needs of each stakeholder, available organizational assets, and the needs of the project[2]. All projects require a sound communication plan, but not all projects will have the same types of communication or the same methods for collecting, analyzing, and distributing the information. The communication plan documents the types of information needs the stakeholders have, when the information should be distributed, how the information will be delivered with which frequency, who will receive it, and the format and technologies we will use to communicate.

First off, we should figure out what kind of communication our stakeholders (including the project team) need so they can make good decisions and they are well-informed. This is called the communications requirements analysis. Our project will produce a lot of information, so we don't want to overwhelm the stakeholders with all of it. Our job is to figure out what they feel is valuable. Therefore, the stakeholder power/interest grid (matrix) and the stakeholder engagement assessment matrix would be very helpful to determine the priorities of each stakeholder, and how we can communicate with each of them, Communicating valuable information doesn't mean we always paint a rosy picture. Communications to stakeholders may consist of either good news or bad news. The point is that we don't want to bury stakeholders in too much information but we do want to give them enough so that they're informed and can make appropriate decisions. ICTs have a major impact on how we keep people in the loop. Therefore, our analysis and the plan should include them.

We should answer the questions below in our communications management plan:

- What are the methods of communicating that we need to consider? Which methods can we choose to transfer information?
  - It can take many forms, such as written reports, conversations, email, formal status reports, meetings, online databases, online schedules, and project websites.
- How should we arrange the timing of the information exchange or need for updates? What is the reporting frequency for each stakeholder according to the expectations and concerns of stakeholders?
  - Based on the role and responsibilities of team members, and the interest and power levels of stakeholders, methods, and frequency should be identified for each stakeholder.
- Who is the person responsible for communicating the information? Who authorizes the release of confidential information? Who receives the information according to their needs, expectations, and concerns?

- Do we need to procure new technology or systems, or are there systems already in place that will work?
  - This is also a part of enterprise environmental factors and organizational process assets to take into consideration while planning any knowledge areas in project management[3].
  - The technologies available to us help plan how we will keep everyone notified of project status and issues.
- What is the experience of our staff with the technology? Are there project team members and stakeholders experienced at using this technology, or should we need to train them?
- How does the project team function? Are they located together or spread out across several locations in a country or the world?
- What are the resources, time, and budget allocated for communication activities?

The answers to these questions should be documented in the communication plan. Keep in mind that all the components of a project management plan are interrelated. A communication plan cannot be prepared independently of other components such as the plans for the scope, schedule, cost, risk, and stakeholders. For example, concerning ICTs, we should consider if the technology we are choosing would work throughout the life of the project or we should upgrade or update it at some point.

The types of information we will communicate typically include project status, project scope statements and updates, project baseline information, risks, action items, performance measures, project acceptance, and so on. We should also consider the language, format, content, and level of detail. The information needs of the stakeholders must be determined as early in the planning phase of the project management life cycle as possible so that as we develop project planning documents, we already know who should receive copies of them and how they should be delivered.

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1. CultureWizard. 2020 Trends in Global Virtual Work: Metamorphosis of the Global Workplace. 2020. https://www.rw-3.com/virtual-teams-exec-report-2020↵
2. PMBOK 6th edition. ↵
3. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

4.6: 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, and what behaviors are expected. Edgar Schein defined culture as a pattern of basic assumptions formed by a group on how to perceive and address problems associated with both internal adaptation and external integration (Schein, 1990)[1]. While organizational culture constrains, stabilizes, and provides structure to the organization, it is being constantly enacted, created, and shaped by leadership behavior.

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 project are important project management abilities. Culture is developed through the communication of the priority, the given status, and 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. In addition to official and operational rules, the project leadership can communicate what is important by the use of symbols, storytelling, rituals, rewards or punishments, and taboos.

Operational Rules on a Project in India [2]

During the initiation of a project in India, members of the project team were given a policy that stated all travel expense claims must be submitted within three days of completion of travel. During the first few weeks, the administrative team began to understand that this was a difficult policy to enforce without creating moral problems on the project. Instead of changing the official rule, it was seldom enforced. The official rules and operational rules differed.

Later in the project, a worker was injured after crossing an area that was marked as unsafe. Workers indicated that they knew the official rules but it took too much time to go around the unsafe area. They assumed that official rules could be ignored if they were difficult to obey. The difference between official rules and operational rules of the project created a culture that made the communication of the priorities more difficult.

Creating a Culture of Safety [3]

A project manager in South America who wanted to create a strong safety culture on a construction project with significant safety concerns used several methods to create the desired culture. The very first meeting that project team members attended was a safety orientation. Members were issued a card—a symbol—after the meeting granting permission to participate in the project. The project leadership team told stories of previous projects where people were fired for breaking safety rules and often warned that the fastest way to get fired on the project was to break a safety rule—an example of storytelling. Every project meeting started with a discussion of a safety topic—a ritual—and any discussion of lessening the safety rules was forbidden—taboo—and was quickly and strongly cut off by the project leadership if it occurred.

As can be seen in both examples above, culture guides behavior and communicates what is important and is useful for establishing priorities. On projects that have a strong safety culture, team members feel free to challenge anyone who breaks a safety rule, even managers. The safety aspects of culture are stronger than the cultural aspects of the power of management.

Culture of Stakeholders

When project stakeholders do not share a common culture, project management must adapt its organizations and work processes to cope with cultural differences. Three major aspects of cultural difference that can affect a project are communications, negotiations, and decision-making. Communication is perhaps the most visible manifestation of culture. Project managers encounter cultural differences in communication in language, context, and candor. Language is clearly the highest barrier to communication. When project stakeholders do not share the same language, communication slows down and is often filtered to share only information that is deemed critical. The barrier to communication can influence project execution where quick and accurate exchange of ideas and information is critical. The interpretation of information reflects the extent that context and candor influence cultural expressions of ideas and understanding of information. In some cultures, an affirmative answer to a question does not always mean yes. The cultural influence can create confusion on a project where project stakeholders share more than one culture. It is of high importance to keep in mind that not all cultural differences are related to international projects. Corporate cultures and even regional differences can create cultural confusion on a project.

Culture Affects Communication in Mumbai [4]

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

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1. Schein, E. H. (1990). Organizational culture (Vol. 45, No. 2, p. 109). American Psychological Association. ↵
2. Retrieved from the OER titled “Principles of Management” on https://openstax.org/books/principles-management/pages/13-1-the-nature-of-leadership↵
3. Retrieved from the OER titled “Principles of Management” on https://openstax.org/books/principles-management/pages/13-1-the-nature-of-leadership↵
4. Retrieved from the OER titled “Project Management from Simple to Complex” on https://open.lib.umn.edu/projectmanagement/chapter/5-3-creating-a-project-culture/↵

4.7: Developing and Managing a Project Team

A team is “a group of individuals who interact interdependently and who are brought together or come together voluntarily to achieve certain outcomes or accomplish particular tasks” (Berry, 2011, p.136)[1]. Teams are utilized in organizations to establish novel combinations of people who would work on unique problems and generate critical decisions as outcomes (Gersick, 1988)[2]. Much of the work that is performed today in organizations requires a focus on teamwork. The ability to work successfully as a team member, as well as the ability to lead teams, is an ultimate advantage within the workforce. Teams themselves must be managed, in addition to managing just the individuals, to be successful. We’ve all heard the quote originally coined by Aristotle that states that “the whole is greater than the sum of its parts.” This captures the nature of the team perfectly—there is such a synergy that comes from a team that the individuals alone are not able to create.

A team is a collaboration of people with different personalities that is led by a person with a favored leadership style. Managing the interactions of these personalities and styles as a group is an important aspect of project management. The project team is made up of people dedicated to the project. These people, team members, are generally borrowed from other departmental units in an organization or are recruited from outside the organization. They may work full-time, part-time, or in some of the activities when their skills are needed. As discussed in Chapter 2 “Project Initiation”, the formal organizational structure would have a substantial impact on how project teams are created and managed. In a functional organization, project managers may have low authority and control over the resources and budget. Besides, they may not work full time as a project manager as they may still carry out the routine tasks of their functional unit. The main advantage of a functional organization type is that the project manager can acquire qualified and experienced human resources from other functional departments. In a strong matrix organization type, a Project Management Office (PMO) or a designated program management office is added besides functional departments. This department employs full-time project managers with a designated job role. They manage the project budget, and their authority becomes moderate to high. They can also have a full-time administrative staff. This organizational structure may be preferred by many project managers since they can still acquire qualified and experienced team members from functional departments inside the organization. Among functional, weak matrix, strong matrix, and project-oriented organization types, a strong matrix structure may suggest more opportunities for a project manager. However, it is of high importance for a project manager to keep in mind and consider various internal and external factors as well as organizational politics.

In particular, in the functional, weak matrix, and balanced matrix organization types, there may be some difficulties for project managers while dealing with project team members. Since these members are borrowed from other units, they may work at the project less than 100% of their working time, and project managers may not be their direct supervisors. Their priorities may be elsewhere. Thus, their dedication to the project objectives and activities couldn’t reach the level project managers expect from them to accomplish their tasks and responsibilities as desired. They may be juggling more than one project as well as their full-time job and have difficulty meeting deadlines.

Project managers need to provide leadership, direction, and above all, support to team members as they go about accomplishing their tasks. Working closely with the team to solve problems can help project managers learn from the team and build rapport. As some of them have been explained above in the “Leadership Skills” section, managing project team members requires interpersonal skills. Here are some suggestions that can help with more effective team management:

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

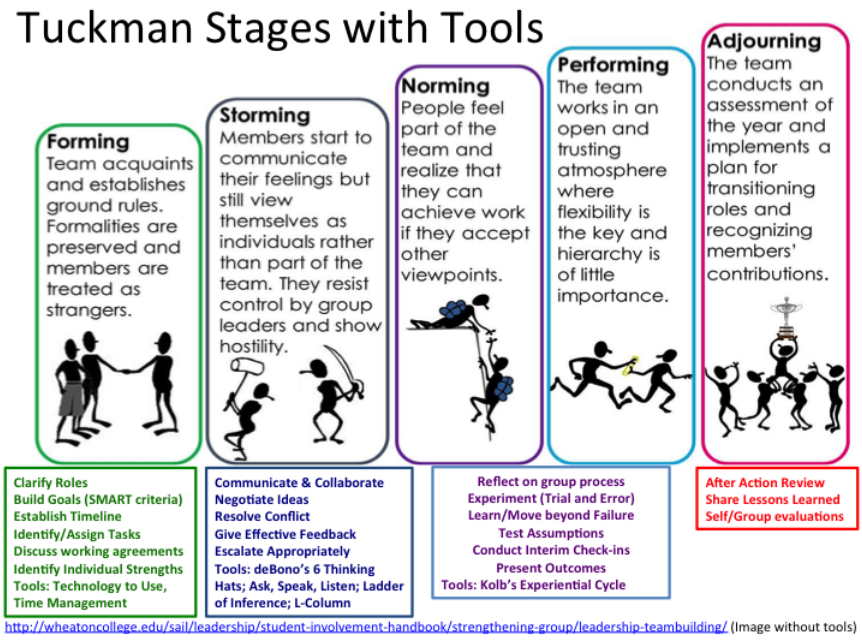
Team Development Stages

One of the models used to describe team development is the Tuckman ladder. According to Tuckman (1965), small groups go through four stages of development which are forming, storming, norming, and performing[3]. As a result of a literature review of fifty-five articles, Tuckman (1965) proposed a model of developmental stages for group settings over time. In respect to the group structure, he labeled these stages as (1) testing and dependence, (2) intragroup conflict, (3) development of group cohesion, and (4) functional role relatedness. Accordingly, he labeled the stages of task activity as (1) orientation to task, (2) emotional response to task demands, (3) open exchange of relevant interpretations, and (4) emergence of solutions. An essential correspondence between the perspectives of group structure and task activity caused Tuckman to summarize the group stages as “forming,” “storming,”

"norming," and "performing." These four stages covered both group interpersonal and task activities. Tuckman and Jensen (1977) added the fifth stage as adjourning after they reviewed twenty-two studies[4].

The first stage, forming, is characterized by orientation to the group setting, testing the boundaries of interpersonal and task behaviors of other members, and a dependency relationship with the leader. The storming stage following the forming stage is characterized by conflict and polarization around interpersonal issues, with concomitant emotional responses in the task sphere. These behaviors with hidden agendas and prejudices serve as resistance to group influence and task requirements. In the third stage, norming, resistance to authority is overcome, in-group feeling and cohesiveness develop, new standards evolve, and new roles are adopted. In the performing stage, group energy is channeled into the task after the structural issues are resolved and the structure becomes supportive of task performance. The last stage, adjourning, indicates the completion of the project where groups disband, and team members are reassigned to other projects or tasks.

Although these classic stages in group development may not be apparent for all groups, and not all groups may follow them, they would be useful for predicting team performance (Mannix and Jehn, 2004) as well as conflicts and harassment cases within an organized framework[5]. Besides, not all the teams could experience all stages and they may spend different times in stages (Ayoko et al., 2012)[6]. Some teams may also face challenges in the transition process from one stage to another, such as moving toward the norming stage from the storming stage. Nevertheless, all teams can find themselves in the performing stage while some of them would spend substantially longer times which could lead them to a higher achievement rating in the end. Johnson et al. (2002) proposed an iterative group development model based on Tuckman's model[7]. In their model based on student virtual learning teams, there was no evidence of the storming stage for all student teams due to rapid movement between each stage given the limited time in accomplishing assignments. Thus, teams moved along forming, norming, and performing stages and they resolved the conflict when it arose among team members. After the conflict was resolved, teams continued the process of forming, norming, and performing.



http://wheatoncollege.edu/sail/leadership/student-involvement-handbook/strengthening-group/leadership-teambuilding/ (Image without tools)

Virtual Teams

Advances in ICTs have enabled the creation and utilization of virtual teams (VTs) within organizations in the last three decades (Alsharo et al., 2017)[8]. The advent of the Internet accompanied by various ICTs, and the emergence of the COVID-19 pandemic by the end of 2019 accelerated the process of digitalization for people, organizations, and governments. Thus, the adoption and spread of ICTs worldwide across organizations and countries increased exponentially. The utilization of global virtual teams in organizations increased to unprecedented levels. 94% of the respondents of CultureWizard's Global Virtual Work Survey indicated that they want to continue working from home—at least part time[9]. These advances ensured the organizations to design their teams composed of members from different geographic locations and organizations virtually beyond a setting of the same location (Berry, 2011)[10]. Nevertheless, even though ICTs are prerequisites of VTs, other factors were also prominent in the process of shifting from traditional face-to-face teams to VTs. Some of these factors could be listed as increased use of horizontal

organizational structure, the emergence of environments that require inter-organizational cooperation, continued shift from production to service and knowledge-intense work environments, and increasing globalization of trade and corporate activity (Townsend et al., 1998)[11].

Virtual interactions and virtual teams cannot be considered identical concepts. Virtual interactions also occur in collocated teams extensively, such as the widespread exchange of emails in the same office (Berry, 2011). A VT can be distinguished from a face-to-face team in terms of several factors. The most prominent factor would be the use of ICTs as the primary communication and collaboration media. Taking into consideration the utilization of ICTs, VT members are less likely to observe physical behaviors (e.g., gestures and intonation), which face-to-face team members rely upon to establish and sustain trust (Alsharo et al., 2017)[12]. Virtual teams have various benefits such as task, resource and schedule flexibility, access to and bringing specialized skills and diverse experiences together in a relatively short time, enhanced knowledge sharing and repository, easier documentation of performance outcomes, and opportunities for accelerated problem solving and solution finding (Jimenez et al., 2017)[13]. Virtual teams employ experts who have acquired more flexibility in temporal and spatial aspects since they save time by not traveling to meet their teammates. These time and cost-saving effects and flexible work schedule benefits are also commonly observed for the teleworkers who work outside of the office by means of virtual communication tools such as teleconferences, videoconferences, and intranets with remote log-in (Coenen and Kok, 2014)[14]. The ability to bridge time and space provides the team with the capability to respond and adjust to new tasks more rapidly, and human resources can be distributed more efficiently without physical relocation of employees thus leading to better utilization of human resources. Although flexibility is assumed to generate positive outcomes, it may cause inherent obstacles for virtual teams. The lack of shared work history among team members as well as less face-to-face interaction could bring about trust issues in virtual teams (Coenen and Kok, 2014).

While virtual teams can be confined to a region in a country or the entire country, they can extend beyond national and continental borders when members of VTs work and live in different countries (Pinjani and Palvia, 2013)[15]. One of the advantages of flexibility in Global Virtual Teams (GVTs) is easier access to skilled experts all around the world. This ensures the availability of resources in other parts of the world when scarcity exists in the organization's or project's geographical area. The dispersed structure of GVT members around the globe allows a 24-hour relay workflow (Carmel et al., 2010)[16]. For instance, members located in Asia and Australia can work on the project during their business hours. They can pass the work on to their colleagues in Europe and Africa for further processing, and then, they can pass it on to the colleagues in the Americas, who can work on it while their more eastern team members are asleep. This follow-the-sun approach creates a cycle of work through which GVT members pass the work on to the members in Asia and Australia, where 24-hour relay starts again (Carmel et al., 2010).

Despite the unprecedented benefits mostly owing to the developments in ICTs, the virtual nature of these teams is not immune to the challenges to effective collaboration and team outcomes (Alsharo et al., 2017). One of the essential challenges in virtual work is the elimination of face-to-face meetings that would otherwise help team members build interpersonal relationships (Cummings and Dennis, 2018)[17]. Lack of first impressions of other team members might have a substantial impact on the formation and functioning of the team, and the outcome of the teamwork. Cummings and Dennis (2018) contended that virtual team members examine each other's profiles on enterprise social networking sites to get acquainted with them, otherwise not possible in a dispersed team. Some of the problems that GVTs and their members might encounter can be enumerated as lack of trust, language and time barriers, cultural differences, lack of onsite monitoring, lack of tone and body language, and different interpretations by the members due to the lack of cues. Eventually, if these likely challenges are not addressed by the GVT leaders and upper hierarchical levels in the organization, virtual teams may cause disadvantages to the team members' well-being and job satisfaction, and team performance.

Team diversity or heterogeneity might have either a positive or negative impact on a team's performance. Although team diversity could exacerbate the conflict and emotional reactions in GVTs (Ayoko et al., 2012)[18], and team members can build higher trust and cohesiveness in homogeneous teams (Drescher and Garbers, 2016)[19], team diversity, on the contrary, could improve GVT effectiveness (Jimenez et al., 2017). The diverse backgrounds of team members could provide representation and exchange of different opinions and perspectives within the team. Hence, this process can create value by providing a more extensive range of information sources and thus aiding creativity and problem solving, and a higher level of organizational learning and synergy (Berry, 2011; Jimenez et al., 2017).

CultureWizard's Global Virtual Work Survey pointed to complications in global virtual teams such as difficulty in building relationships (37%), managing conflict (33%), and lack of responsiveness from team members (20%). The survey also highlighted an issue with the technology as it cannot completely erase the barriers of miscommunication. The survey indicated that 75% of respondents use webcams to compensate for lack of face-to-face contact, but webcams come with their complications, such as

ambient noise, feeling pressure to look attentive and professional on camera, and technical issues such as insufficient bandwidth or difficulty in operating new software.

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4.8: Communications Management Protocol

The communication management plan should include a protocol that delineates all the critical communication channels for the team and stakeholders, such as the purpose of communication, ICTs utilized, frequency of communications, and types of information to be communicated. An example of a Communications Management Protocol has been provided in Table 4.3 which includes only four purposes of communication.

Table 4.3. Communications Management Protocol

Purpose of Communication	**Schedule Frequency**	**ICTs or Other Means Utilized**	**Types of Information**	**Participants: Team Members and Stakeholders**
Planning	Every week on Monday	Microsoft Teams Zoom OneDrive Emails	Requirements Project activities Schedule Cost Risks and issues	All the team members
Retrospective	Every week on Friday	Microsoft Teams Zoom OneDrive Emails	Status updates Lessons learned	All the team members
Emergency	As needed	Zoom or In-person	Depends on the reason for emergency	All the team members
Status updates	Every week after the retrospective meeting Or as needed	Emails Zoom or In-person meetings	Progress report Tracking Gantt Chart Comparison of baselines with the latest situation	Project sponsor Client All team members

4.9: Communication Types

The communication management plan should address the needs, expectations, and concerns of the project team and the stakeholders by considering the communication types. 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 places like meeting rooms and even in the kitchen and next to the coffee machine. Many projects are performed by teams that interact primarily through electronic communication and are, therefore, called virtual teams. However, virtual interaction has been exponentially prevalent for many organizations and collocated project 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 and asynchronous.

Synchronous Communications

If all the parties to the communication are taking part in the exchange at the same time, the communication is synchronous. The following are examples of synchronous communications:

- In-person meetings: This is the traditional meeting method utilized by collocated teams. Some virtual teams may also prefer in-person meetings several times (e.g., kick-off and closing meetings) during the project life cycle to socialize and build trust.
- One-on-one and conference phone (audio) calls: These calls would be effective if there is an urgent need to meet, and participants are not available for video calls.
- Video conferences: These meetings have prevailed with the widespread utilization of virtual teams and the emergence of the COVID-19 pandemic. Online tools such as Skype, Zoom, Google Meet, and WhatsApp are used for video conferences.
- Integrated solutions such as Microsoft Teams: Teams can use synchronous communication tools such as video conferences and instant messaging, and they can share the files with other team members (asynchronous).
- IM (instant messaging): Team members can exchange text or voice messages on computers and mobile devices. They can also have group pages on which more than two members can chat and share documents, pictures, and videos. IM may not be synchronous all the time, and it provides an opportunity for the team members to reply later, and keep the records of the chat logs.

Asynchronous Communications

Getting a team together at the same time can be a challenge—especially if they are spread out across time zones. Many types of communication do not require that the parties are present at the same time. This type of communication is asynchronous. There are several choices of asynchronous communications such as mails and faxes. Recently, asynchronous communication has also been transferred mostly to online communication. In many projects, there is a need to deliver mails and packages to other team members or sub-teams, and stakeholders in different locations. Physical signatures can be still demanded to comply with the legal requirements. However, online tools have been allowing people to sign electronically, which is also legally acceptable (e.g., Adobe Acrobat, DocuSign). Therefore, this provides time and cost-saving opportunities to the project teams. Electronic mail (email) is widely used to coordinate projects and for the communication and collaboration between team members and with stakeholders. Emails have several valuable characteristics for project management. Information can be sent to a list of team members. Messages can be saved to document the process in case of a misunderstanding or miscommunication. Files can be attached and distributed.

4.10: Leadership Skills

Project managers, as leaders, spend 90% of their time communicating with team members and stakeholders. Therefore, communication is the most important leadership skill a project manager should possess, but not the only one. Project managers need a large number of skills which 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 size and complexity of the project. This is why each project needs tailoring according to various factors including the purpose, objectives, business field, size, complexity, and stakeholders. Although project managers always need to possess interpersonal skills to communicate and collaborate effectively with the team members and stakeholders, on smaller, less complex projects, they need a greater degree of technical skills. On larger, more complex projects, project managers need more organizational skills to deal with the complexity.

PMBOK Guide 6th Edition differentiates among three skill sets project managers should possess – technical project management, leadership, and strategic and business management. Contrary to the name as is referred to as technical, it doesn't indicate the skills regarding product and industry expertise. This expertise is included inside strategic and business management skills. PMBOK Guide highlights this skill set as "technical project management skills", and defines them as the skills to effectively apply project management knowledge to deliver the desired outcomes for projects and programs. Organizations look for project managers who are competent in implementing a systematic project management approach applying the right artifacts and methods to achieve the project objectives. Accordingly, project managers should be able to define critical success factors for the project, create plans for all the knowledge areas (i.e., integration, scope, schedule, cost, quality, resource, communications, risk, procurement, stakeholders), create, manage and monitor the project team, conduct all project management processes, monitor and control all the project work, close out the project, and disband the team. Besides, project managers should have the capability to decide which development approach would be the best for the project. Therefore, they should know the development approaches including traditional (waterfall or predictive) and agile (adaptive) tools, techniques, and methods. As indicated, strategic and business management skills include developing and applying pertinent product and industry expertise. They involve the ability to see the high-level overview of the organization and effectively negotiate and implement decisions and actions that support strategic alignment and innovation. This ability may include a working knowledge of other functions such as finance, marketing, and operations. This business knowledge is also known as domain knowledge[1].

The third skillset, leadership skills, involves the ability to guide, motivate, and direct a team. Leadership is defined as a social (interpersonal) influence relationship between two or more persons who depend on each other to attain certain mutual goals in a group situation. Effective leadership helps individuals and groups achieve their goals by focusing on the group's maintenance needs (the need for individuals to fit and work together by having, for example, shared norms) and task needs (the need for the group to make progress toward attaining the goal that brought them together)[2]. These skills include negotiation, resilience, communication, problem-solving, critical thinking, and interpersonal skills.

Projects have become increasingly more complicated as more businesses execute their strategies through projects. Project management is more than just working with numbers, templates, charts, graphs, and computing systems. Though they can be counted, a common denominator in all projects is people. But they are not just numbers. A large part of the project manager's role involves dealing with people. Hence, project managers should study people's behaviors and motivations. Project managers must be perceived to be credible by the project team and stakeholders. They should detect and clarify the ambiguities effectively to remove the obstacles. On projects, the environment changes frequently, and the project manager must apply the appropriate leadership approach for each situation. They must have good communication skills. Lack of communication skills and team-building skills as well as organizational skills would cause problems in a project and could lead to failure.

PMBOK Guide 6th Edition makes an analogy of a music conductor for the project managers. This analogy is a perfect example describing the responsibilities and skills of project managers. An orchestra conductor coordinates a variety of performers who play different instruments and should ensure that the audience enjoys the music on the day of the performance. It may be a chamber orchestra composed of 25 musicians, or a large one like a symphony orchestra with up to 100 members. The conductor cannot know how to play all the instruments in an orchestra, but only one of them or a few of them. However, the conductor must assure that all the performers playing the instruments including but not limited to violins, violas, cellos, double basses, flutes, oboes, clarinets, kettledrums, and harps must create a piece of music in harmony that the audience can enjoy. Conductors perform many rehearsals with all the performers to achieve this harmony. During these rehearsals and the performance, most of the work of the conductor would be regarding communication with all the performers.

The project manager leads the project team during a project life cycle. As explained in Chapter 2, project managers may start working in the pre-project phase (preparation of a need statement, business case, and benefits realization management plan) to assess the feasibility of candidate projects, especially when the organization has a dedicated PMO (Project Management Office) or has a strong matrix or project-oriented structure. However, in general, project managers are assigned in the initiation (starting, conceptualization) phase, or the planning phase after the project charter is approved by the project sponsor. A project manager may be involved after the project is closed out to evaluate the performance of the outcome, and more importantly to evaluate if the outcome can generate the expected value (both tangible and intangible values as detailed in measurable project objectives). Although we use the term "project manager" in this textbook, you can come across a variety of concepts such as project leader, project lead, and project coordinator in other resources and also in this textbook in different sections. We assume in this textbook that a project manager is also a project leader, and should possess interpersonal leadership skills.

In the following subsections, we will focus on leadership and interpersonal skills a project manager should possess.

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, observing and paying attention to the body language and other environmental cues, and striving not just to hear, but to understand. Active listening takes focus and practice to become effective. It enables a project manager to go beyond the basic information that is being shared and to develop a more complete understanding of the information.

Example: Client's Body Language [3]

We work with a client on a project. The person in charge of the project in the client company just returned from a trip to Australia where he reviewed the progress of the project with his company's board of directors. Then, he visited our office for a meeting with our project team. The project manager listened and took notes on the five concerns expressed by the board of directors to him during his visit to Australia.

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

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

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

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

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

Therefore, as can be seen in the example above, active listening was important in establishing a common understanding from which an effective project plan could be developed.

Negotiation

When multiple people are involved in an endeavor, differences in opinions and desired outcomes naturally occur. Negotiation is a process for developing a mutually acceptable outcome when the desired outcome for each party conflicts. A project manager will

often negotiate on different aspects of a project (e.g., scope, schedule, budget, quality, purchases, conflicts with stakeholders) with the 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. Negotiation is used to achieve support or agreement that supports the work of the project or its outcomes and to resolve conflicts within the team or with other stakeholders.

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 acceptable solutions.
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 managers to successfully negotiate issues on the project, they should first seek to understand the position of the other party. They should figure out the concerns and expectations of team members or stakeholders with whom they will negotiate, as well as the business drivers and personal drivers that are important to them. Without this understanding, it is difficult to find a solution that will satisfy them. Project managers 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.

Conflict Management

Conflict on a project can be expected because of a variety of reasons such as the level of stress, lack of information in particular during the early phases of the project, personal differences, role conflicts, and limited resources. Although good planning, effective communication, and healthy team building can reduce the amount of conflict, the 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.

One of the well-known conflict management models is the Thomas-Kilmann Conflict Mode Instrument (TKI) which assesses an individual's behavior in conflict situations when the concerns of two people appear to be incompatible[4]. This model is based on two dimensions that describe a person's behavior in conflict.

1. Assertiveness: The extent to which the individual attempts to satisfy his or her own concerns.
2. Cooperativeness: The extent to which the individual attempts to satisfy the other person's concerns.

According to different levels of these two dimensions, the model defined five methods of dealing with conflict (Figure 4.4).

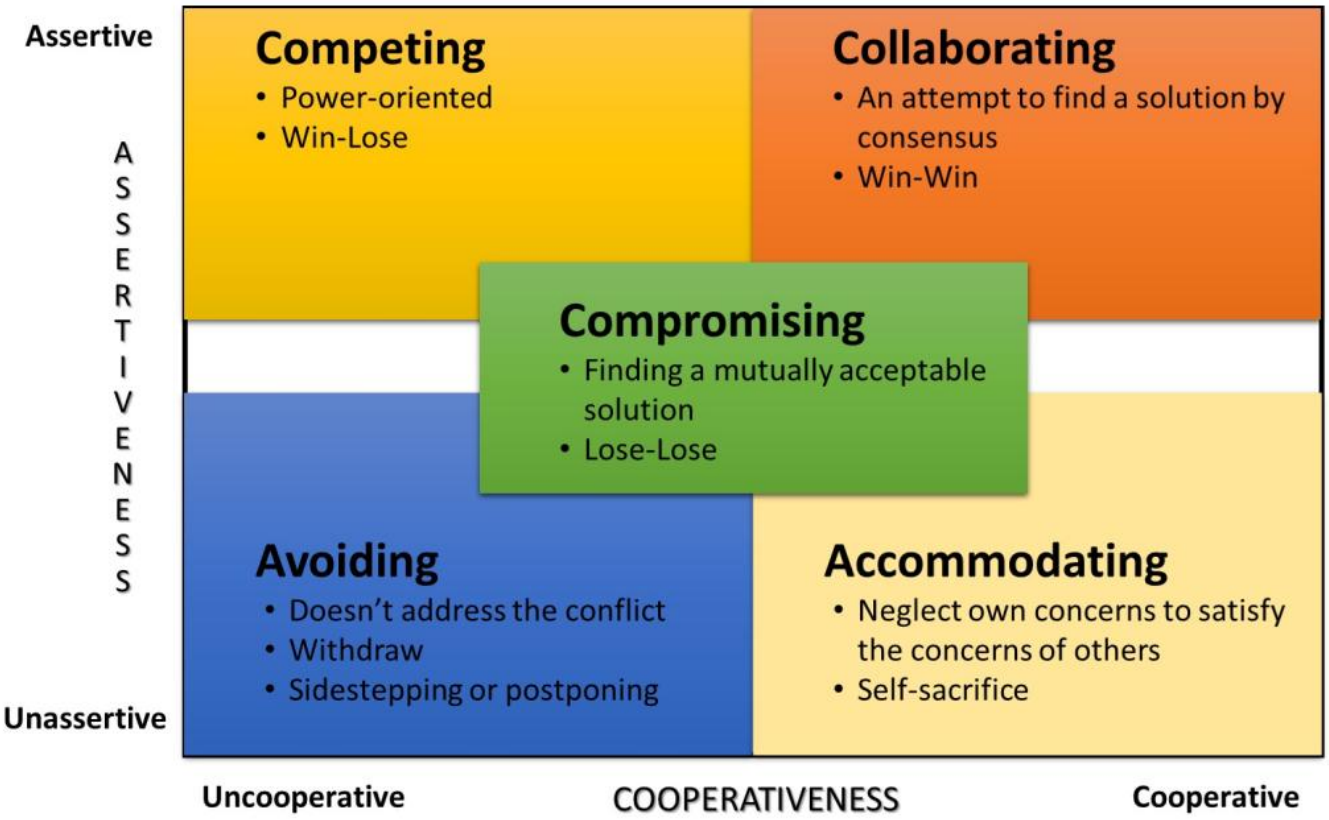

Figure 4.4 Thomas-Kilmann Conflict Mode Instrument

Competing (forcing) is assertive and uncooperative. It is a power-oriented mode. An individual pursues his or her own concerns at the other person's expense, using whatever power seems appropriate to win his or her position.

Collaborating is both assertive and cooperative. An individual attempts to work with the other person to find a solution that fully satisfies the concerns of both. It involves digging into an issue to identify the underlying concerns of the two individuals and to find an alternative that meets both sets of concerns.

Compromising is intermediate in both assertiveness and cooperativeness. The objective is to find an expedient, mutually acceptable solution that partially satisfies both parties. Compromising might mean splitting the difference, exchanging concessions, or seeking a quick middle-ground position.

Avoiding is unassertive and uncooperative. When avoiding, an individual does not immediately pursue his or her own concerns or those of the other person. He or she does not address the conflict. Avoiding might take the form of diplomatically sidestepping an issue, postponing an issue until a better time, or simply withdrawing from a threatening situation.

Accommodating is unassertive and cooperative, which is the opposite of competing. An individual neglects his or her own concerns to satisfy the concerns of the other person. Therefore, there is an element of self-sacrifice in this mode.

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 competing as the default approach to resolve conflict. The competing approach often succeeds in a situation where a quick resolution is needed, and the investment in the decision by the parties involved is low. Some project managers find accommodating with the client the most effective approach to dealing with client conflict.

Two examples have been provided below in order to elaborate on the conflict resolution methods in projects.

Resolving an Office Space Conflict [5]

Two senior managers both want the office with the window. The project manager intercedes with little discussion and assigns the window office to the manager with the most seniority. The situation was a low-level conflict with no long-range consequences for the project and a solution all parties could accept. Therefore, the project manager applied the competing (forcing) method. Sometimes office size and location are culturally important, and this situation would take more investment to resolve.

Conflict Over a Change Order [6]

In another example, the client rejected a request for a change order because she thought the change should have been foreseen by the project team and incorporated into the original scope of work. The project controls manager believed the client was using her power to avoid an expensive change order and suggested the project team refuse to do the work without a change order from the client. This is a more complex situation, with personal commitments to each side of the conflict and consequences for the project. The project manager needs a conflict resolution approach that increases the likelihood of a mutually acceptable solution for the project.

One conflict resolution approach involves evaluating the situation, developing a common understanding of the problem, developing alternative solutions, and mutually selecting a solution. Evaluating the situation typically includes gathering data. In this example, gathering data would include a review of the original scope of work and possibly of people's understandings, which might go beyond the written scope.

The second step in developing a resolution to the conflict is to restate, paraphrase, and reframe the problem behind the conflict to develop a common understanding of the problem. In our example, the common understanding may explore the change management process and determine that the current change management process may not achieve the client's goal of minimizing project changes. This phase is often the most difficult and may take an investment of time and energy to develop a common understanding of the problem.

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

Trust

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

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

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

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

Emotional Intelligence (EQ)

Emotions are neither positive nor negative. Emotions are both a mental and physiological response to environmental and internal stimuli. Project managers need to understand and value their emotions to appropriately respond to the client, project team, stakeholders, and project environment. Daniel Goleman (Goleman, 1995) discussed emotional intelligence quotient (EQ) as a factor more important than IQ in predicting leadership success[7]. Emotional intelligence is the ability to sense, understand, and effectively apply the power and acumens of emotions as a source of human energy, information, connection, and influence (Cooper and Sawaf, 1997)[8].

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 open dialogue with project stakeholders. Emotional intelligence is a critical ability for project managers, and the more complex the project profile, the more important the project manager's EQ becomes to project success.

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4.11: Leadership Styles and Servant Leadership

Leadership is a function of both the personal characteristics of the leader and the environment in which the leadership must occur. Several researchers have attempted to understand leadership from the perspective of the characteristics of the leader and the environment of the situation. These researchers described leaders as either autocratic or democratic (Tannenbaum & Schmidt, 1958)[1], as pathfinders (visionaries), problem solvers (analytical), or implementers (team-oriented) (Leavitt, 1986)[2], and as either transactional (focused on actions and decisions) or transformational (focused on the long-term needs of the group and organization) (Burns, 1978)[3].

Fred Fiedler introduced contingency theory and the ability of leaders to adapt their leadership approach to the environment (Fiedler, 1971)[4]. Most leaders have a dominant leadership style that is most comfortable. For example, most engineers spend years training in analytical problem solving and often develop an analytical approach to leadership. A leadership style reflects personal characteristics and life experiences. Although a project manager's leadership style may be predominantly a pathfinder (using Leavitt's taxonomy), most project managers become problem solvers or implementers when they perceive the need for these leadership approaches. The leadership approach incorporates the dominant leadership style and Fiedler's contingency focus on adapting to the project environment.

PMBOK Guide 6th Edition provides a list of leadership styles as below:

1. Laissez-faire: Leaders allow the team to make their own decisions and establish their own goals. It is also referred to as taking a hands-off style.
2. Transactional: Leaders focus on goals, feedback, and accomplishment to determine rewards.
3. Servant: Leaders demonstrate a commitment to serve and put other people first. They focus on other people's growth, learning, development, autonomy, and well-being. They concentrate on relationships, community, and collaboration.
4. Transformational: Leaders empower followers through idealized attributes and behaviors, inspirational motivation, encouragement for innovation and creativity, and individual consideration.
5. Charismatic: Leaders are able to inspire with high energy. They are enthusiastic and self-confident and hold strong convictions.
6. Interactional: This leadership style is a combination of transactional, transformational, and charismatic leadership styles.

Among them, the "Agile Practice Guide" accompanying PMBOK Guide Sixth Edition highlights the servant leadership style in particular for the agile project management approach. Although servant leadership isn't unique to agile, project managers and organizations can observe and experience that this leadership style integrates into the agile mindset value. As the name refers, servant leaders serve those on the team by promoting self-awareness, listening, helping team members and stakeholders improve themselves, coaching rather than controlling, facilitating coordination, removing obstacles and organizational impediments in front of the team, the members, and the project, promoting safety, respect, and trust, and promoting the energy and intelligence of others[5].

No particular leadership approach is specifically appropriate for managing a project. Each project has a unique set of circumstances because, by definition, projects are unique endeavors. The leadership approach and the management skills required to be successful vary depending on the complexity profile of the project. The Project Management Institute published research that studied project management leadership skills and concluded that project managers needed good communication skills and the ability to build harmonious relationships and motivate others (Shi & Chen, 2006)[6]. Beyond this broad set of leadership skills, the successful leadership approach will depend on the profile of the project.

A transactional project manager with a strong command and control leadership approach may be very successful on a small software development project or a construction project, where tasks are clear, roles are well understood, and the project environment is cohesive. This same project manager is less likely to be successful on a larger, more complex project with a diverse project team and complicated work processes.

Each project phase may also require a different leadership approach. During the start-up phase of a project, when new team members are first assigned to the project, the project may require a command and control leadership approach. Later, as the project moves into the conceptual development phase, creativity becomes important, and the project management takes on a more transformational type leadership approach. Most experienced project managers can adjust their leadership approach to the needs of the project phase. Occasionally, on very large, complex projects, some companies will change project managers after the conceptual phase of the project to bring in a different project leadership approach or change project managers to manage the closeout of a project. Changing project managers may bring the right level of experience and the appropriate leadership approach

but is also disruptive to a project. Senior management must balance the benefit of matching the right leadership approach with the cost of disrupting the project.

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CHAPTER OVERVIEW

5: Resource Management, Budget and Procurement

5.1: Introduction

Learning Objectives

After reading this chapter, you will be able to:

1. Describe how to create a project resource plan.
2. Define the resources that will be utilized in a project, including the project team members.
3. Elaborate on resource loading, leveling, and crashing to conduct resource allocation effectively.
4. Define basic terms such as budget, estimate, price, cost, and value.
5. Discuss the relationship between cost and budget.
6. Explain basic concepts related to budgeting.
7. Identify different types of costs, and discuss issues related to contingency funds, profit, and cost estimating.
8. Explain the benefits of contingencies.

Overview

A project manager is responsible for planning, developing, managing, and monitoring and controlling the resources to ensure that project objectives can be achieved. Effective resource management is integral to overall project success. The objective is to identify and allocate resources effectively and efficiently to project activities to complete the project to the satisfaction of the stakeholders, in particular, clients and customers. Whereas scope, time, and cost are the main constraints of a project, they are tightly linked to the resources. After the scope and schedule are delineated, the project manager can continue with the identification and allocation of resources based on the scope (product requirements and project activities) and the schedule (how project activities are sequenced on a timescale). Allocation of resources allows the project manager to determine the overall project budget most of which is spent on resources.

While performing the planning of all the knowledge areas (e.g., scope, schedule, cost, quality, stakeholders, risks), the project manager should be aware of the fact that all knowledge areas are tightly linked to each other. That is, it is not possible to start with cost or quality first. The scope is the starting point when project managers with the help of business analysts, subject matter experts, clients, the project sponsor, and various stakeholders identify the project purpose, measurable objectives, requirements, deliverables, and WBS activities. Whereas scope, time, and cost are the main constraints of a project, all three are tightly linked to the resources, which are other constraints that include time and cost as critical resources. After the scope and schedule are delineated, the project manager can continue with the identification and allocation of resources based on the scope (requirements and project activities) and the schedule (how project activities are sequenced with duration for each of them). Allocation of resources provides the project manager to determine the overall project budget most of which is spent on resources.

Every project boils down to money. If we had a bigger budget, we could probably get more people to do the project more quickly and deliver more. That’s why no project plan is complete until we come up with a budget. But no matter whether the project is big or small, and no matter how many resources and activities are in it, the process for figuring out the financial bottom line is always the same. This chapter starts with defining the project cost and its types, then elaborates on the cost management plan, continues with how to estimate costs and determine the budget, and ends with project procurement management.

5.2: Resource Availability

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.

5.3: Resource Management

Resource management is the efficient and effective deployment of an organization's resources when they are needed. We can classify the resources into three main categories:

1. Human resources (HRs)
    a. Project team members (core team)
    b. HRs outside the core team required for project activities
2. Physical resources
    a. Equipment
    b. Materials (Raw materials, supplies, consumables)
    c. Inventory
    d. Facilities
    e. Infrastructure
    f. IT hardware
    g. IT software
    h. Cloud computing resources
3. Services
    a. Contractors and subcontractors
    b. Consulting

Every activity in our activity list needs to have resources assigned to it. Before we can assign resources to the project, we need to know their availability. To assess resource availability, a project manager needs information about what resources we can use on our project when they're available to us, and the conditions of their availability. This is why a WBS and an activity list are critical in our project to plan for the resources.

The most important resource to a project is its people—the project team. Projects have a core team that includes a project manager and key members with functional expertise. There may be also administrative personnel and members who assist the project manager. Core team members provide continuity and "corporate memory" throughout the project, particularly to external hires who may not be as familiar with the strengths and weaknesses of the organization's previous projects. Projects require specific expertise at specific moments in the schedule, depending on the milestones being delivered or the given phase of the project. An organization can host several strategic projects concurrently over the course of a budget year, which means that its employees can be working on more than one project at a time. Alternatively, an employee may be seconded away from his or her role within an organization to become part of a project team because of 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.

5.4: Project Resource Management Plan

Project planning is at the heart of the project life cycle and tells everyone involved where we are going and how we are going to get there. It involves creating a set of plans to help guide the project team through the implementation and closure phases of the project. The project resource management plan is one of the sub-plans of the overall project plan. It provides the guidelines to project managers on how to estimate, acquire, manage and utilize physical and team resources[1]. It is the process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project resources[2].

The resource management plan can consist of the following:

- Project Organization Charts
  - Project team members and their reporting relationships are displayed in these charts.
  - A team charter is prepared to establish team values, agreements, communication guidelines, decision-making criteria and processes, and operating guidelines for the team[3].
- Resource requirements
  - Types of resources (e.g., human resources, physical resources, services)
  - Human resources (Core team members and people for all project activities)
    - Required skills and competencies
    - Roles and responsibilities
    - Authority level (e.g., decision-making, inspecting, and accepting deliverables)
    - Effort in hours (e.g., daily working hours – full-time or part-time, the total amount of work hours)
    - Source (e.g., PMO – Project Management Office, other functional units, regional offices, outsourcing, offshoring)
    - WBS activity link
  - Required features for physical resources (e.g., equipment, materials, facilities, infrastructure, supplies)
- Project team resource management
  - Methods for developing and managing the project team
  - The decision criteria when to use project team human resources and the human resources outside the team.
- Resourcing strategy
  - How will resources be acquired and released from the project?
- Resourcing assumptions
  - Are there any assumptions about the resource requirement estimates?
  - Vacations, holidays, training, meetings, interruptions, sick leave.
- Rewards and recognition
  - Define the criteria for rewarding project team members for the work that they have done.
  - Which rewards will be given and when?
  - How much money is set aside for the project?
- Resource control
  - Which methods will be used to monitor and control the project resources?
- Health and safety
  - Are there specific health and safety practices that will be followed on the project?

In the resource management plan, including a Resource Breakdown Structure would help the team substantially to illustrate the needs in a hierarchical structure. An example is given in Figure 5.1 of a Resource Breakdown Structure.

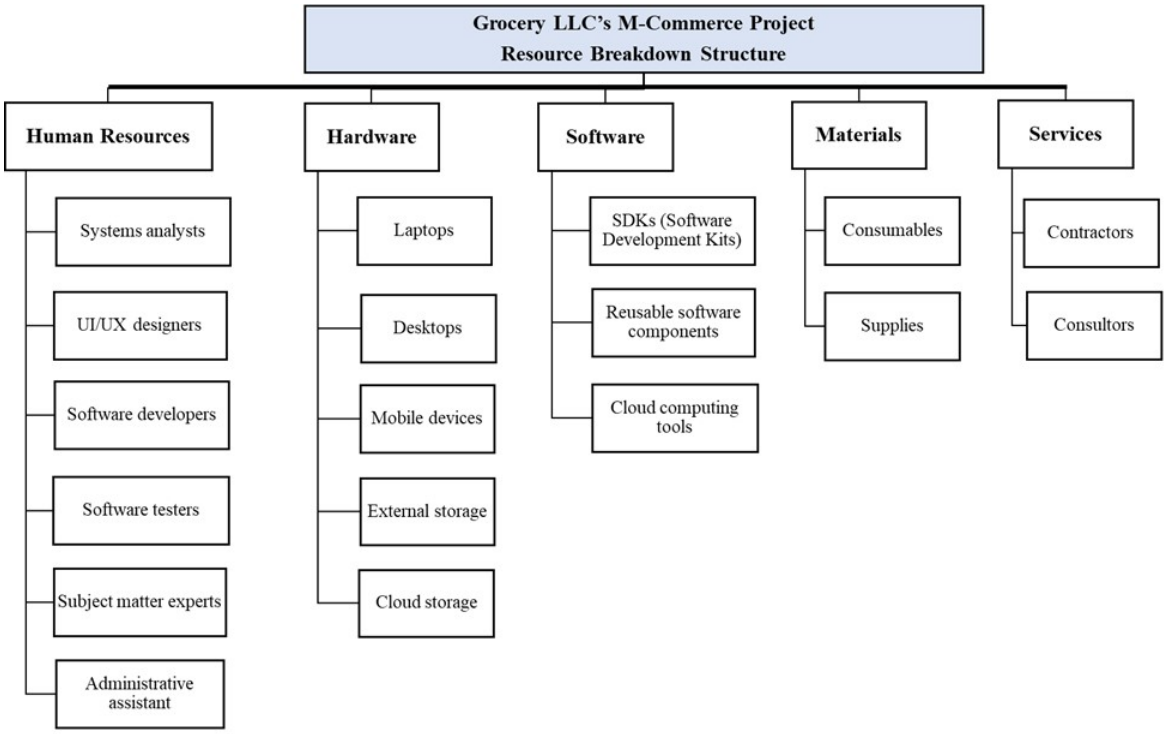

Figure 5.1: Resource Breakdown Structure (RBS) for M-Commerce Project

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
3. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

5.5: Resource Allocation

Based on the Resource Management Plan and according to the estimation methods, the project team should identify the resources necessary for the project activities and should allocate them to execute the project activities. Allocation of resources is named “Resource Loading”. Then, the project team can have a resource usage calendar that exhibits the amounts of resources assigned to each activity during the project. Let’s continue with an activity list and begin to add resources.

Table 5.1: Resource Loading for 1.3 “Preparation of Project Charter”

Activity List for Project “Grocery LLC’s M-Commerce Project”					
Activity identifier	**Activity title**	**Scope of Work**	**Person Responsible**	**Predecessors**	**Resources**
1.3	Preparation of Project Charter	The project charter that will authorize the project manager to undertake the responsibility of the project and apply the resources to project activities will be prepared.	Project Manager	1.1 1.2	
1.3.1	Develop high-level scope	The high-level scope consists of the project purpose, measurable project objectives, high-level requirements, project description, boundaries, key deliverables, and assumptions and constraints.	Systems Analyst 1	1.2	Systems Analyst 1
1.3.2	Identify overall project risks	This includes the identification of the risks that affect the project in general.	Systems Analyst 2	1.3.1	Systems Analyst 2
1.3.3	Develop high-level schedule	This includes the estimation of the overall schedule with summary milestones.	Team Member 1	1.3.1	Systems Analyst 1
1.3.4	Identify main resources and develop a high-level budget	This includes the initial estimation of all resources (human resources, physical resources, and services), and the budget.	Team Member 2	1.3.3	Systems Analyst 1 Systems Analyst 2
1.3.5	Identify key stakeholders and project team member roles	Stakeholders with high-interest levels and/or power levels will be identified. The project team’s composition will be created. The qualifications required should be detailed. The project sponsor’s authority will be detailed.	Team Member 3	1.3.1 1.3.2	Systems Analyst 1 Systems Analyst 2 Sales & Marketing Expert 1 Sales & Marketing Expert 2
1.3.6	Develop project approval requirements and project exit criteria	Based on the project scope and other sections of the project charter, project approval requirements and exit criteria should be detailed. Exit criteria include the conditions that describe the early termination of the project.	Team Member 1, 2, 3	1.3.1 1.3.2 1.3.3 1.3.4 1.3.5	Systems Analyst 1 Systems Analyst 2

In Table 5.1, we only assigned human resources. We also assume that all the people work full-time, which is 8 hours a day. They work during the weekdays, which makes the weekly total work hours forty. In Table 5.2, we can see how human resources are distributed to the tasks by week.

Table 5.2: Resource Usage Calendar

Resource Name	**Work**	**May 2**	**May 9**	**May 16**	**May 23**	**May 30**	**June 6**
Systems Analyst 1	**240 hrs**	**40**	**32**	**40**	**64**	**40**	**24**

Resource Name	Work	May 2	May 9	May 16	May 23	May 30	June 6
Clarify project purpose and determine project scope	*40 hrs*	*40*					
Develop high-level scope	*32 hrs*		*32*				
Develop high-level schedule	*48 hrs*			*40*	*8*		
Identify main resources and develop a high-level budget	*16 hrs*				*16*		
Identify key stakeholders and project team member roles	*64 hrs*				*40*	*24*	
Develop project approval requirements and project exit criteria	*40 hrs*					*16*	*24*
Systems Analyst 2	**200 hrs**	**40**	**0**	**40**	**56**	**40**	**24**
Clarify project purpose and determine project scope	*40 hrs*	*40*					
Identify overall project risks	*40 hrs*			*40*			
Identify main resources and develop a high-level budget	*16 hrs*				*16*		
Identify key stakeholders and project team member roles	*64 hrs*				*40*	*24*	
Develop project approval requirements and project exit criteria	*40 hrs*					*16*	*24*
Sales & Marketing Expert 1	**104 hrs**	**40**	**0**	**0**	**40**	**24**	**0**
Clarify project purpose and determine project scope	*40 hrs*	*40*					
Identify key stakeholders and project team member roles	*64 hrs*				*40*	*24*	
Sales & Marketing Expert 2	**104 hrs**	**40**	**0**	**0**	**40**	**24**	**0**
Clarify project purpose and determine project scope	*40 hrs*	*40*					
Identify key stakeholders and project team member roles	*64 hrs*				*40*	*24*	

Resource usage calendars help project teams evaluate whether resources are assigned without conflicts. As can be seen in Table 5.0, System Analyst 1 (SA1) and 2 (SA2), both, have resource overallocation problems on May 23rd week. SA1 works 64 hours on that week while SA2 works 56 hours. Both work more than 40 hours (8 hours per weekday) assuming that overtime work is not allowed. In the next section, we will discuss how to solve this overallocation by means of resource leveling.

5.6: Solving Resource Overallocation- Resource Leveling

One of the techniques to solve resource conflicts is implementing resource leveling which is used to examine the unbalanced use of resources (usually people or equipment) over time and for resolving overallocation or conflicts. When performing project planning activities, the manager will attempt to schedule certain tasks simultaneously. When more resources are needed than are available, or perhaps a specific person is needed in both tasks, the tasks will have to be rescheduled sequentially to manage the constraint. Resource leveling during project planning is the process of resolving these conflicts. It can also be used to balance the workload of primary resources throughout the project, usually at the expense of one of the triple constraints (scope, schedule, cost).

As we discussed briefly in the previous section, both systems analysts are overallocated. Therefore, we should correct this issue since they cannot work more than 40 hours a week. Resource leveling would be one of the techniques to eliminate this problem. In resource leveling, we still use the same resources without adding new resources. However, this comes with a risk of schedule delay. Gantt Chart for the weeks of May 16, May 23, and May 30 is shown in Figure 5.2. As can be seen in the figure, 1.3.3 and 1.3.5 overlap on May 23, and SA1 works full time in two activities on the same day, which is not possible. Besides, 2-day activity 1.3.4 overlaps with 1.3.5, and both SA1 and SA2 work on both of the activities.

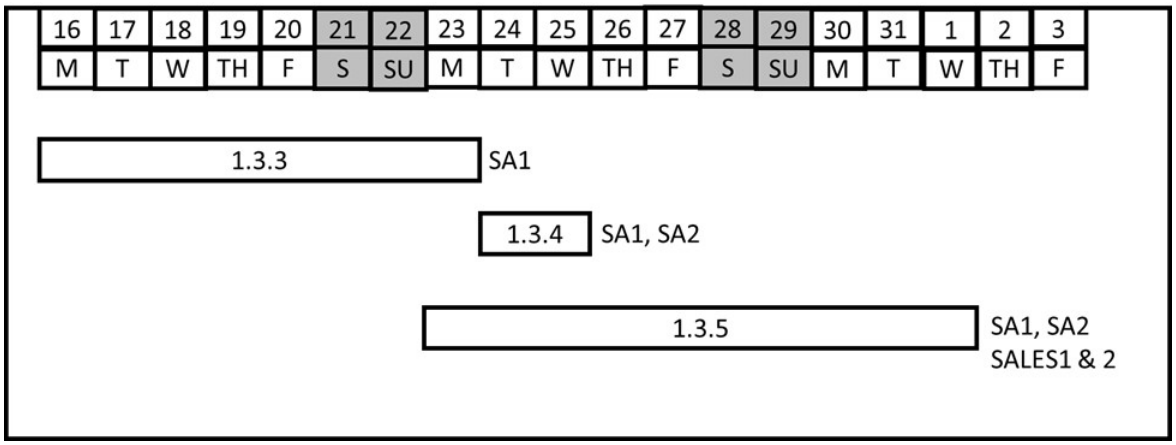

Figure 5.2: Gantt Chart before Resource Leveling

Since resource leveling utilizes the same resources, it may create schedule delays as seen in Figure 5.3. Activity 1.3.4 had to be moved to June 2 from May 24 to prevent any conflicts with 1.3.3 and 1.3.5. Its duration was also increased to 3 days from 2 days. Activity 1.3.5 starts on the same day, May 23. However, its duration was also increased to 9 days from 8 days. Therefore, it finishes on May 2 instead of May 1. For these three activities, we have a three-day delay in total after resource leveling. Sometimes, splitting the tasks could be another option if the activities allow us to do so. This resource leveling could also affect the following activities, which may create a chain effect with more schedule slippages.

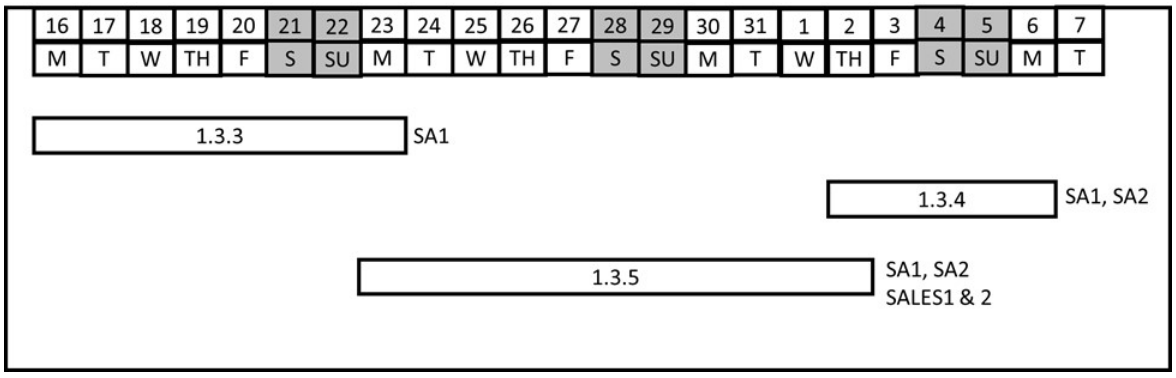

Figure 5.3: Gantt Chart after Resource Leveling

Another option to resolve conflicts would be assigning new resources to prevent schedule slippages. A third systems analyst can be assigned to activity 1.3.3 by removing SA1. With the new SA3, we can reallocate SA1 and SA2 in 1.3.4 and 1.3.5 by replacing them with SA3 for the days when SA1 and SA2 have conflicts with other activities. Apparently, this situation would impose additional costs on the project by adding a new systems analyst. However, we can avoid schedule slippages. Thus, the project manager should evaluate all the trade-off options between the schedule and the cost.

5.7: Schedule Compression Techniques

While resource leveling is mostly implemented during the planning stage of activities, schedule compression techniques such as crashing and fast-tracking are utilized during the execution of activities to accelerate the project. With crashing, the project manager adds additional resources to the critical activities (zero-slack activities) and saves time by spending more money on the additional resources. In this technique, existing resources can be asked to work overtime or we can add new resources. As seen in Figure 5.4, we assigned new resources to the three activities. With the added resources, and accordingly with more cost, we now had the opportunity to finish these activities in 8 days instead of 12 days.

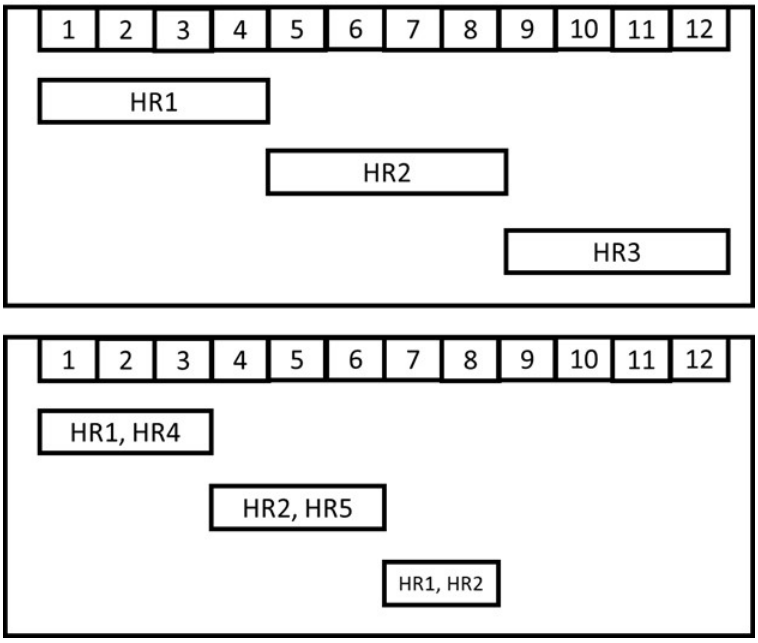

Figure 5.4: Crashing

Project managers should ponder all the alternatives and outcomes before deciding on crashing since adding new resources may not shorten the duration all the time. If overtime is approved, people who work overtime may be less productive after a while with increased tiredness and less satisfaction. Besides, there may be internal and external dependencies. For example, we may be still waiting for a material ordered from a supplier which cannot deliver earlier. Regarding the equipment, we may not be able to increase the operating time if the equipment cannot work more than a certain number of hours a day. If the activities in which we crash resources are not critical, we cannot shorten the duration. Let's consider the project activity network diagram in Figure 5.5.

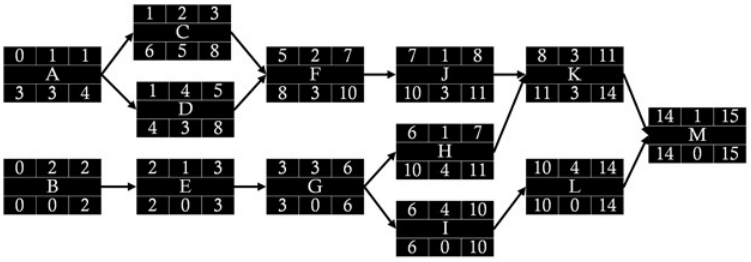

Figure 5.5: Activity Network Diagram

Let's perform crashing in Activity D and Activity K. Each of D and K has a three-day slack. Let's assume that with additional resources, we can finish D in 3 weeks instead of 4 weeks, and the K in 1 week instead of 3 weeks. The new activity network diagram is in Figure 5.6. The total duration of the project remains the same, 15 weeks. D and K, the both, have one more day slack while it hasn't influenced the project duration. Therefore, we have just paid more for nothing.

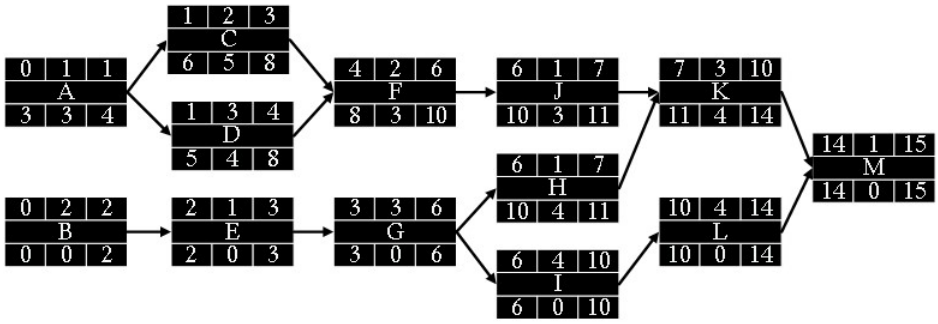

Figure 5.6: Activity Network Diagram after Crashing D and K

If we crash critical activities, we can save time on the project. Let's add new resources to Activity I and Activity L. The new duration for I and L is 3 weeks for each. As seen in Figure 5.7, the total duration of the project was reduced to 13 days from 15 days.

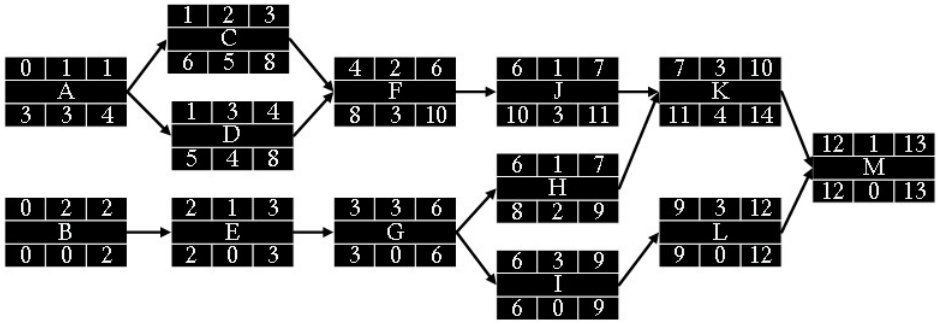

Figure 5.7: Activity Network Diagram after Crashing I and L

Another option to shorten the duration of a project is to implement fast-tracking. If some parts of the activities can be carried out in parallel, we can shorten the total duration. Let's use the example in Figure 5.4. In fast-tracking, we don't assign new resources. With the same resources, we can execute some parts of three activities in parallel. Let's assume that the first activity is coding and HR1 is working in this activity. The second activity is testing and HR2 is working in this activity. We don't need to wait for the first activity to be completed to start the second activity. We can add two-day leads (negative lags) between activities (Figure 5.8). After developers finish some of the codings, testers can start the testing. In this case, we can finish three activities in 8 days instead of 12 days as seen in Figure 6.8. However, using leads increases the coordination efforts. Therefore, the project manager should exert more concentrated efforts for coordination to prevent any quality risks. It may be still possible to increase the project costs although the probability is less when compared with crashing. It is of high importance to bear in mind that not all activities can be fast-tracked. The sequencing of the activities should be such that fast-tracking is permissible.

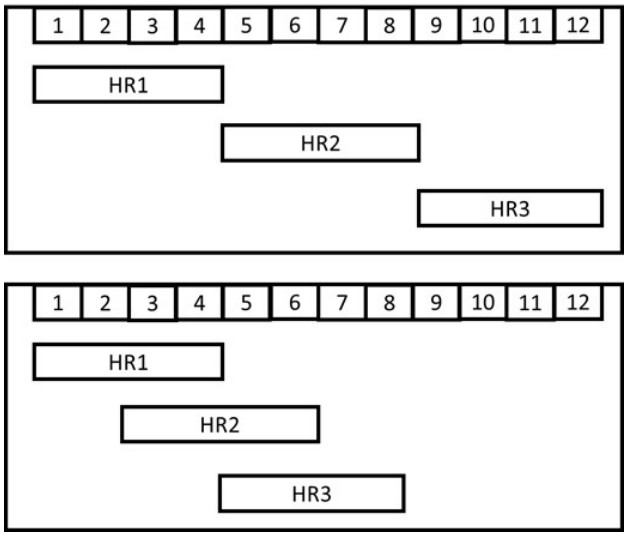

Figure 5.8: Fast Tracking

5.8: 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 5.3). 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

Category	Description	Activity	Quantity	Unit Price	Cost
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 5.3 John's Move example – Detailed Costs Associated with Activities.

5.9: 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 elsewhere.

Project Cost Management Plan

Project planning is at the heart of the project life cycle and tells everyone involved where we are going and how we are going to get there. It involves creating a set of plans to help guide our team through the implementation and closure phases of the project. The project cost management plan is one of the sub-plans of our overall project plan. It provides guidelines to project managers on how to estimate, budget, manage, monitor, and control project costs[1].

A project cost management plan consists of similar items that we have in a schedule management plan. This plan can consist of the following[2]:

- **Process descriptions** [3]
  - What processes will be used for cost management?
  - These processes include planning, estimating costs, and establishing the overall budget.
- **Unit of measurement**
  - Daily working hours and shifts for human resources and equipment
  - Weekends and/or off-days for especially human resources
  - Metric (e.g., meter, liter, kilogram) or imperial (e.g., inch, gallon, pound) system measurement units
- **Level of accuracy**
  - Acceptable range to ensure realistic cost estimates (e.g., ±10%, ±20)
  - Evaluation of the impact of risks on the costs of each activity and overall project based on the project risk management plan
  - Methods describing how the cost contingencies will be assessed.
  - Procedure to account for fluctuations in currency exchange rates
- **Level of precision**

- The degree to which cost estimates will be rounded up or down (e.g., $95.55 to $96; $95.45 to $95; $495.75 to $496 or $500)
- Evaluated based on the scope, size, and complexity of the project.

- **Cost estimation methods**
  - Estimation methods (e.g., expert judgment, analogous, parametric, three-point, bottom-up), and when they will be utilized.
- **Methods, tools, and software utilized to develop, manage, and monitor project cost**
  - Specify the organizational procedures and policies if they should be utilized.
  - Methods and tools such as control accounts, WBS, project baseline, Earned Value Management, and critical path method
  - Reserve analysis to set aside some money for cost overruns due to risks in order to implement risk mitigation strategies.
  - Software such as Microsoft Project Professional, Excel, Visio, and Jira (for Kanban and Scrum), and online collaboration tools such as Monday, Trello, and Basecamp.
- **Rules for monitoring cost performance**
  - Earned Value Management (EVM)
  - Defining the points in the WBS at which measurement of control accounts will be performed
  - How strategic funding choices would be managed.
  - Control thresholds for deviations from the parameters in the cost baseline
  - Using software such as Microsoft Project
- **Reporting formats**
  - Reporting formats and frequency should be in alignment with other project plans.
  - When, how frequently, and to whom are we reporting?[4]
- **Approval of the cost baseline**
  - Who will be responsible for preparation and control?
  - Who will approve the cost baseline?

✔ 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.

5.10: Contingencies

Once the cost of each activity is estimated, it is possible to determine how much money is needed for each activity and component, and the whole project. The process of subtotaling costs by category or activity is called cost aggregation. PMBOK Guide Sixth Edition defines this process as “Determine Budget” which is a process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline[1]. This baseline is a time-phased budget that can be used to measure and monitor cost performance after it has been approved by the key project stakeholders. The aggregated budget is integrated with the project schedule in order to produce the time-phased budget. Costs are associated with tasks, and since each task has a start date and a duration period, it is possible to calculate how much money will be spent by any particular date during the project. Recognizing that all the money required to deliver the project is not needed upfront, allows the cash flow needs of the project to be effectively managed. For smaller organizations facing cash flow challenges, this can result in significant savings as the money required to pay for resources can be transferred to the project account shortly before it is needed.

Figure 5.9 illustrates the project budget components. While estimating the costs, the project team should take into account the uncertainties that may affect the costs. This requires a reserve analysis which is conducted in line with risk management. Therefore, cost estimates are accompanied by contingency reserves for each activity and work package, if applicable. As can be seen in Figure 5.9, contingency reserve is included within the cost baseline. Therefore, these reserves must be incorporated into the baseline that ensures the monitoring and controlling of the project cost performance.

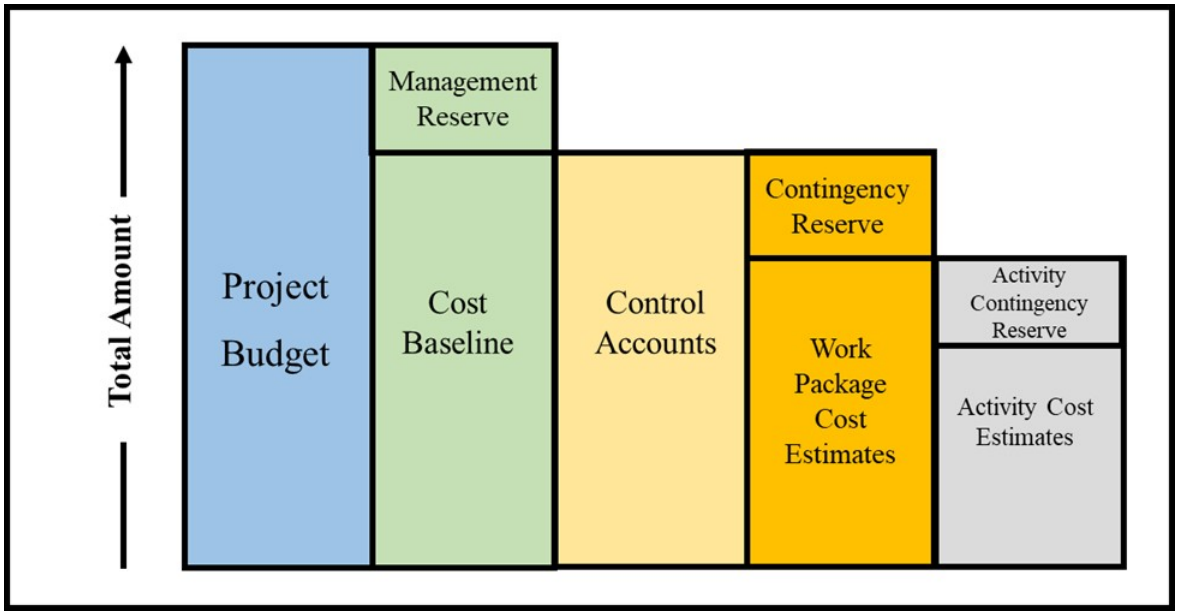

Figure 5.9: Project Budget Components. Adapted from PMBOK Guide Sixth Edition

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. 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 modeling 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.

The amount of a contingency reserve for each activity or a higher WBS level is determined after the risks and the strategies are identified and detailed (see Chapter 10). For instance, if an activity to test a website's functions and security is estimated to cost $10,000, the project team can put an additional budget of $2,000 to ensure an effective response to the security gaps if occurs. Then, the cost baseline of this activity becomes $12,000 ($10,000 + $2,000). It can be adjusted when more information becomes available as time passes and activities are conducted and completed. It is also possible that new risks may emerge which has not been forecasted while the project management plans were being prepared. This is why project teams have regular meetings at which all the project components, issues, and risks are reviewed, which allows the team to take timely actions.

Let's assume that the project team agreed on contingency reserves for three activities as shown in Table 5.4. Therefore, the cost baseline increases from $23,920 to $24,920.

Table 5.4: Cost Estimates and Contingency Reserves for "Scope" component

WBS	Activity Name	Cost	Contingency Reserve	Cost Baseline
1.1	Clarify project purpose and determine project scope	$4,000.00	$300.00	$4,300.00
1.2	Secure project sponsorship	$0.00	$0.00	$0.00
1.3	Preparation of project charter	$7,920.00	$0.00	$7,920.00
1.3.1	Develop high-level scope	$960.00	$0.00	$960.00
1.3.2	Identify main resources and develop a high-level budget	$1,200.00	$0.00	$1,200.00
1.3.3	Develop high-level schedule	$1,440.00	$0.00	$1,440.00

1.3.4	Identify main resources and develop a high-level budget	$960.00	$400.00	$1,360.00
1.3.5	Identify key stakeholders and project team member roles	$2,160.00	$300.00	$2,460.00
1.3.6	Develop project approval requirements and project exit criteria	$1,200.00	$0.00	$1,200.00
1.4	Approval of project charter by the sponsor	$0.00	$0.00	$0.00
1.5	Secure core resources	$0.00	$0.00	$0.00
1.6	Initiation stage complete	$0.00	$0.00	$0.00
	Project Manager's Salary	$12,000.00	$0.00	$12,000.00
	TOTAL COST OF SCOPE	**$23,920.00**	**1,000.00**	**$24,920.00**

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

5.11: 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.

5.12: Project Procurement Management

The procurement effort on projects varies widely and depends on the type of project. The “procurement cycle” reflects all procurement-related activities from when the decision is made to outsource equipment through to the payment of bills and closing of procurement contracts.

In less complex projects, the project team performs the work associated with procurement management. The procurement cycle includes:

- Identifying the required materials, equipment, and supplies
- Identifying the potential vendors
- Preparing requests for quotes (RFQs) and requests for proposals (RFPs), which include product/service specifications and a detailed delivery schedule
- Evaluating RFQs and RFPs to select the most suitable vendors
- Awarding and signing contracts
- Administering the contract and monitoring vendors’ performance
- Managing contract changes
- Closing out the contract upon work completion

On more complex projects, procurement professionals may be assigned to assist the team throughout the project’s lifetime.

Procurement Management Plan

In order to manage the process effectively and efficiently, we need to plan as we did for all the other knowledge areas (i.e., scope, schedule, cost, stakeholders, communication, resources). Therefore, we need to prepare a procurement management plan to document project procurement decisions, specify the approach, and identify potential sellers[1]. We need to think about all of the work that we will contract out before doing anything else. We will want to plan for any purchases and acquisitions. Here’s where we take a close look at our needs, to be sure that we need to create a contract. Therefore, we should figure out what kinds of contracts make sense for our project, and we try to define all of the parts of our project that will be contracted out. We work out how we manage contracts, what metrics contracts should meet to be considered successful, how we will pick a seller, and how we will administer the contract once the work is happening.

The procurement management plan details how the procurement process will be managed. It can include the following information:

- Roles and responsibilities of the project team and procurement professionals
- The types of contracts we plan to use, and any metrics that will be used to measure the contractor’s performance.
- The planned delivery dates for the work or products we are contracting.
- The organization’s standard procurement documents and processes that our project must use and comply with.
- How many vendors or contractors are involved and how they will be managed.
- How purchasing may impact the constraints and assumptions of the project plan.
- Coordination of purchasing lead times with the development of the project schedule.
- 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 we may use during the procurement planning stage include make or buy analysis and defining the contract type.

Make or Buy Analysis

This means figuring out whether or not we should be contracting the work or doing it ourselves. It could also mean deciding whether to build a solution for the organization’s or client’s needs or buy one that is already available in the market. Most of the same factors that help us make every other major project decision will help us with this one. How much does it cost to build it as opposed to buy it? How will this decision affect the scope of the project? How about the project schedule? Do we have time to do the work and still meet our commitments? As we plan out what we will and won’t contract, we need to have thought through our reasoning pretty carefully.

There are some resources (like heavy equipment) that our company can buy, rent, or lease depending on the situation. We need to examine leasing versus buying costs and determine the best way to go forward.

Contract Types

We should know a little bit about the major kinds of contracts so that we choose the one that creates the fairest and most workable deal for us and the contractor. Some contracts are fixed price. No matter how much time or effort goes into them, we always pay the same (Figure 5.10). The cost (or revenue to the vendor) is constant regardless of the effort applied or the delivery date. Some contracts are cost reimbursable also called cost plus (Figure 5.11). This is where the seller charges us for the cost of doing the work plus some fee or rate. In a cost reimbursable or cost-plus contract, the seller is guaranteed a specific fee. The third major kind of contract is time and materials (Figure 5.12). That's where the buyer pays a rate for the time spent working on the project and also pays for all the materials used to do the work. In a time and materials contract, the cost (or revenue to the vendor) increases with increased effort.

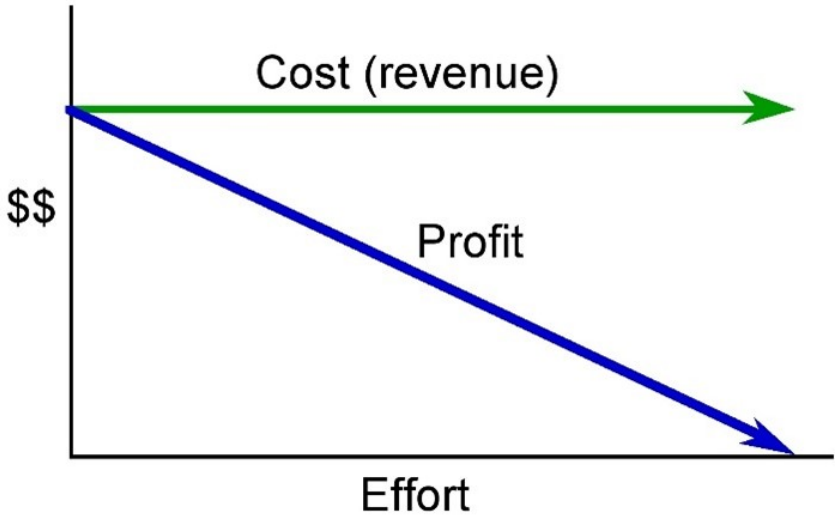

Figure 5.10: A fixed-price contract

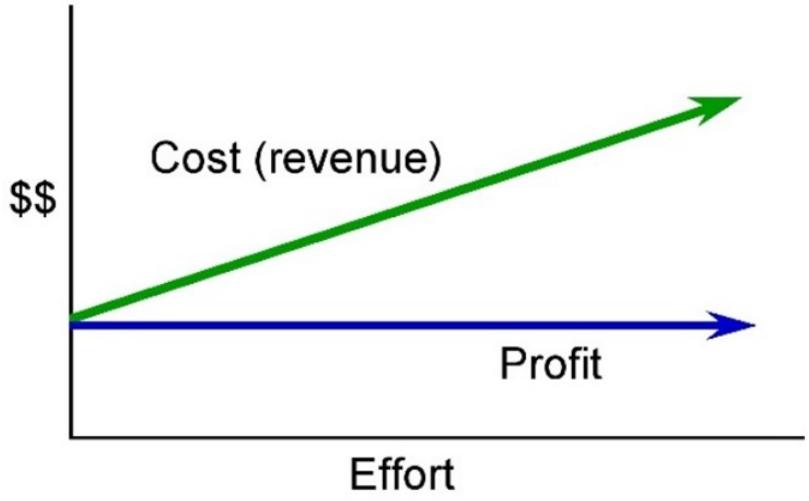

Figure 5.11: A cost reimbursable or cost plus

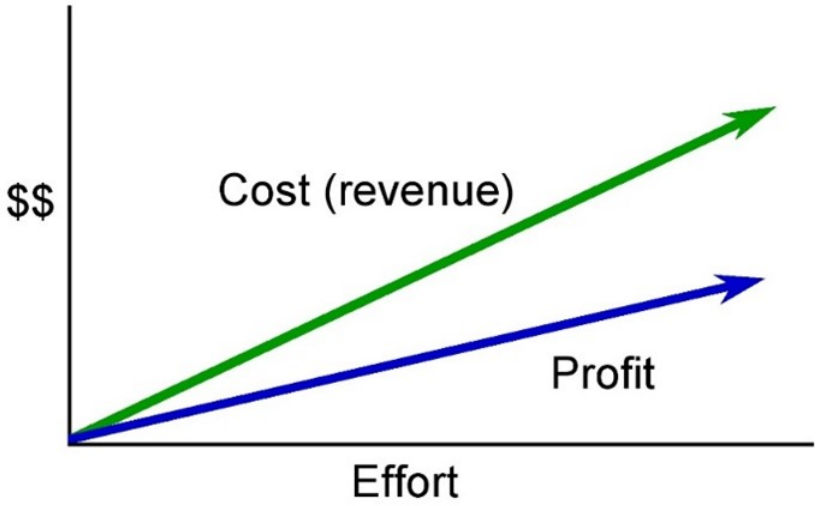

Figure 5.12: A time and materials contract

Contractual agreements with vendors often require partial payment of their costs during the project. Those contracts can be managed more conveniently if the unit of measure for partial completion is the same as that used for cost budgeting. For example, if a graphic designer is putting together several pieces of artwork for a textbook, their contract may call for partial payment after 25% of their total number of drawings is complete.

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1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

5.13: 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?

1. Securing financial resources
2. Monitoring financial resources
3. Allocating financial resources
4. Forecasting costs and benefits
5. 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?

1. 30.5%
2. 84%
3. 58%
4. 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.

1. 30%
2. 50%
3. 80%
4. 45%

4) Calculate the fixed expenses.

1. $14,000
2. $15,000
3. $16,000
4. $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?

1. 5
2. 3
3. 6.5
4. 4.85
5. 32.5

CHAPTER OVERVIEW

6: Project Risk

6.1: Introduction

Learning Objectives

- After reading this chapter, you will be able to:
- Distinguish between risks and issues.
- Describe the role of risk management in project success.
- Identify types of risks based on the project phases.
- Explain the risk management process.
- Describe the five responses in risk management.

Overview

Although project managers can prepare a well-thought-out and comprehensive project scope, schedule and cost management plans, they cannot ensure that all these plans are free of problems that may occur due to numerous reasons during the project. Even the most carefully planned projects can run into trouble. No matter how well we plan, our project can always encounter unexpected problems. Team members get sick or quit, resources that we depend on turn out to be unavailable, even the weather can throw us for a loop (e.g., a snowstorm). So, does that mean that we are helpless against unknown problems? No! We can use risk planning to identify potential problems that could cause trouble for the project, analyze how likely they are to occur, take action to prevent the risks we can avoid, and minimize the ones that we can't. In this chapter, we will discuss both negative risks (i.e., threats) and positive risks (i.e., opportunities). A project manager must always keep in mind that risks mean uncertainties, not solely problems or threats all the time, since they are sometimes opportunities that we should consider exploiting. There are no risk-free projects because there is an infinite number of events that can have a negative or positive effect on projects. Project managers must be prepared to deal with uncertainties. Planning for events that can delay a project, decrease its quality, or increase its budget is a necessary part of project planning.

6.2: 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 6.1, in which the probability of the risk is multiplied by the severity of consequences if the risk does indeed materialize.

		IMPACT				
		A	B	C	D	E
		Negligible	Minor	Moderate	Major	Severe
PROBABILITY 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 6.1: 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.

6.3: 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 6.1. 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 6.1 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 6.2). These become the critical few.

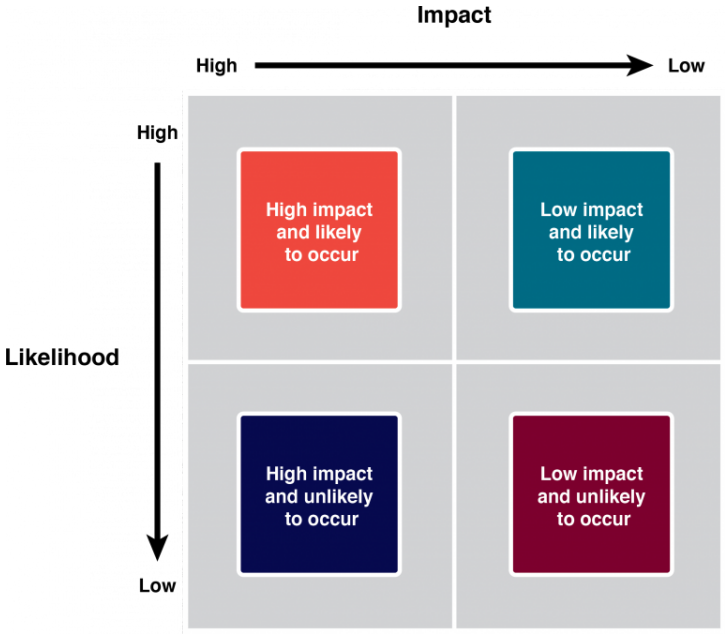

Figure 6.2: Risk and Impact

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.

6.4: 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.

6.5: 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 6.2 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 6.2.

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.

6.6: 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".

6.7: 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 6.5, 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 6.3 and 6.4 below.

Table 6.3: 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 6.4: 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 for more than 72 hours.
Critical	Isolated deaths and/or multiple injuries and illnesses; major or long-term property damage; and/or interruption of essential facilities and services for 24-72 hours.
Limited	Minor injuries and illnesses; minimal property damage; and/or interruption of essential facilities and services for less than 24 hours.
Negligible	No or few injuries or illnesses; minor quality of life loss; little or no property damage; and/or brief interruption of essential facilities and services.

Table 6.5: 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?

6.8: Key Takeaways

Key Takeaways

- Project risk is an uncertain event or condition that, if occurs, has a positive or negative effect on one or more project objectives.
- Contingency reserve is allocated for known-unknowns whereas management reserve is allocated for unknown-unknowns.
- The risk management plan is a component of the project management plan that describes how risk management activities will be structured and performed.
- When risks are identified, they are recorded in a risk register. It is a key tool that helps project teams keep track of the status of risks, ensure response plans are effectively implemented, and new risks are managed.
- Project teams perform qualitative risk analysis in order to prioritize individual project risks by assessing their probability of occurrence and impact.
- The strategies to respond negative risks are escalation, avoidance, transfer, mitigation, and acceptance.
- The strategies to respond positive risks are escalation, exploitation, sharing, enhancing, and acceptance.
- The project team develops contingency plans as an alternative method for accomplishing a project goal when a risk event has been identified.

CHAPTER OVERVIEW

7: Monitoring, Controlling, Closing

7.1: Introduction

Learning Objectives

1. Explain the monitoring and controlling process and differentiate between monitoring and controlling.
2. Describe qualitative monitoring for project management knowledge areas except for schedule and cost.
3. Describe Earned Value Management (EVM), a quantitative monitoring tool, to monitor and control of the progress of project activities.
4. Define the change control process.
5. Discuss the importance of getting the fundamentals right and keeping them right throughout a project.
6. Explain the value of project reviews and audits.
7. Describe issues related to correcting course mid-project and decisions about terminating a project.
8. Discuss the project closure phase.
9. Recognize the importance of concluding a project with lessons learned.

Overview

The monitoring and controlling process differentiates from other processes (i.e., initiating, planning, executing, and closing out), in that, it spans throughout the whole project. Project managers should ensure that everything is on track (e.g., scheduled activities are completed on time, there is no budget overrun), and take the project back on track if it deviates from its three main baselines, which are triple (iron) constraints, scope, schedule and cost, and other constraints such as quality and resources, and the satisfaction of the client and stakeholder eventually. Project managers implement a holistic approach by focusing on all the aspects of a project to keep the project on track and accomplish a successful closeout where the client and stakeholders are satisfied with the project outcomes. There are various techniques utilized to monitor and control the projects.

7.2: Monitoring and Controlling Project Work

Before the project gets approval to continue, business (or systems) analysts, or a team of analysts and product owners combined with representatives of business units and other relevant stakeholders create a business case and benefits realization management plan. Project managers may also participate in this process if the organization has a PMO. At the very beginning of the project, that is the initiation phase, the project charter is prepared, and with the approval of the project sponsor and the client, project plans are built upon those documents and processes in order to elaborate on the main pillars of the project (i.e., scope, schedule, cost, quality, risks, resources, and stakeholders). While establishing a strong baseline is a key factor in project success, ineffective monitoring and controlling can spoil all the efforts that were done to establish this strong baseline. Let's not forget all of the challenges involved in managing projects. According to the PMI 2020 Pulse of the Profession report[1], the factors responsible for the failure were listed as a lack of clearly defined and/or achievable milestones and objectives to measure progress (37%), poor communication (19%), lack of communication by senior management (18%), employee resistance (14%), and insufficient funding (9%). The monitoring and controlling process relies on clearly defined milestones and objectives to measure progress. One of the key responsibilities of a project manager is to monitor and control all the project work and ensure that everything is on track. This process consists of tracking, reviewing, and reporting the overall progress to meet the performance objectives defined in the project management plan[2].

It is important to note that it is much easier to monitor project success on small projects. Due to far fewer team members, stakeholders, and complexities to consider, the project's progress is more easily observed. However, on higher complexity projects that require many people, who are often spread out over different locations, project leaders are unable to use simple observation to assess progress. In these instances, it is important to have more robust tools and techniques that monitor the success of the full project team.

The project team evaluates its performance against the plans that have been developed. Every project requires a monitoring and control system. This system considers the following:

1. What information is needed and how should it be collected?
2. When (and with what frequency) should this information be collected?
3. Who should collect and analyze this information?
4. How should this information be represented from a reporting perspective?
5. Who should prepare the reports?
6. Who should receive the reports?

Monitoring and controlling project work allows stakeholders to understand the current state of the project, recognize the actions taken to address any performance issues, and have visibility into the future project status with cost and schedule forecasts[3]. It is important to note that it is much easier to monitor the progress and performance issues on small projects. Due to far fewer team members, stakeholders, and complexities to consider, the project's progress is more easily observed. However, in more complex projects that require many people, who are often spread out over different locations, project leaders are unable to use simple observation to assess progress. In these instances, it is important to have more robust tools and techniques that monitor the success of the full project team.

The Difference between Monitoring and Controlling

Although the process is traditionally named "monitoring and controlling", we should know that there are differences between these two concepts. Controlling cannot be carried out by the project team if monitoring has not been done properly or at all. Thus, monitoring leads to controlling while controlling may require more monitoring if controlling determines that sufficient information couldn't be derived from the monitoring process.

Let's clarify the distinction between monitoring and controlling.

Monitoring [4]

- Collecting project performance data
- Producing performance measures
- Reporting and disseminating performance information

Controlling [5] **:**

- Comparing actual performance with planned performance

- Analyzing variances
- Assessing trends to affect process improvements
- Evaluating possible alternatives
- Recommending appropriate corrective action as needed

As seen above, we collect the data and analyze them to create performance measures. For example, our project dashboard can indicate our current status regarding the schedule and budget. We can also have a detailed Excel file exhibiting our day-to-day activities and actual costs. If this data is produced properly, we can continue with the controlling first by comparing the actual performance with planned performance, that is the project baseline. After we evaluate the variances and trends, we can evaluate possible alternatives to recommend corrective actions.

Monitoring and controlling process involves regularly measuring progress on a project to ensure it continues meeting objectives and addressing current organizational needs. It involves determining what corrective action is required, when it must occur, and who must do it. Monitoring begins at the very beginning of the project (initiation) and increases in density in the planning phase because it is easy to get off track with planning efforts (Figure 7.1). Besides, the execution of project activities would need a considerable amount of attention from the project manager and team to monitor and control activities and performance measures (Figure 7.1). When the traditional predictive/waterfall development methodology is used, the team monitors performance against the timeline, budget, scope, and quality objectives for the entire project. When an adaptive approach is used, progress within the iteration is assessed.

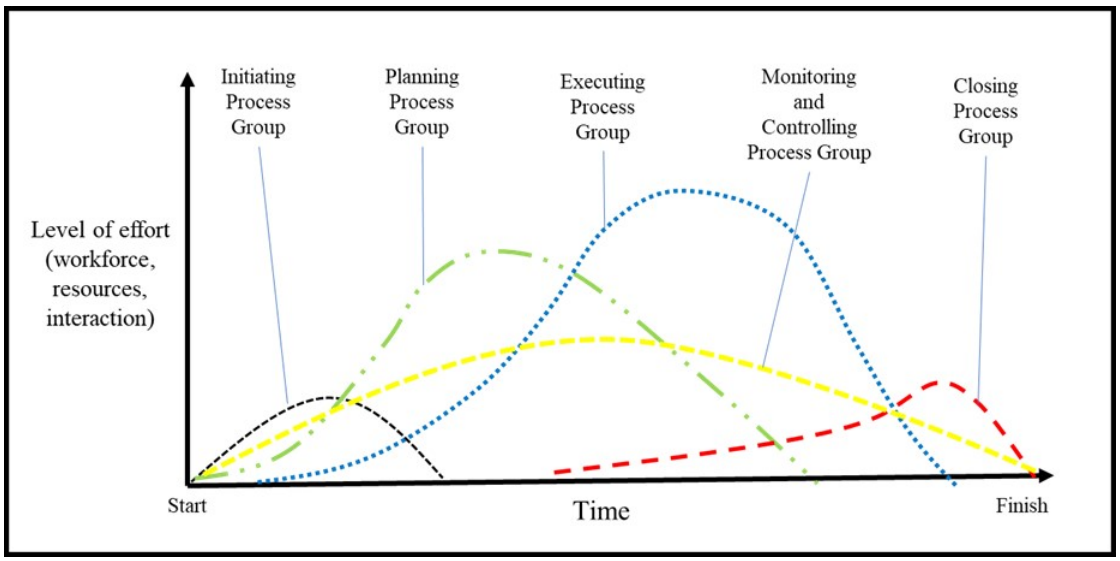

Figure 7.1: Project Management Process Groups . **(Adapted from PMBOK Guide 6th Edition)**

Tools Utilized to Conduct Effective Monitoring

Effective monitoring requires an effective system that allows the project team to collect performance data accurately and with minimum errors. The commonly collected information includes the status of the project budget and the project schedule. The work completed to date, what has yet to be completed, and the likelihood of completing the project on time and within budget are of particular interest. How this monitoring is performed quantitatively will be detailed below in “Earned Value Management”. In addition, it is important to identify the risks and issues that require attention. Whenever possible, information technology should be used to collect and analyze the information and distribute the reports. Different organizations require different roles to collect and analyze the project information. In organizations with a project management office (PMO), PMOs may be accountable for progress reporting in an “end-to-end” way, meaning they would be involved from information collection all the way to report distribution. Organizational policies (from a formal perspective) and organizational culture (from an informal perspective) influence who and how progress monitoring is performed.

One of the common methods used to monitor progress is team meetings. Team meetings are highly collaborative and serve many purposes, including information sharing and team development. Depending on the nature of the project, these meetings may be focused exclusively on sharing the status of tasks underway. It is also possible for status discussions to lead to team planning. The individuals who participate in these meetings vary depending on many factors, such as development methodology in use, organizational culture, project complexity, and status of the overall project. The frequency of team meetings is pretty higher in agile

(adaptive) projects than the traditional (predictive/waterfall) projects in order to ensure agility, flexibility, on-time interventions, and timely feedback from team members and the product owner. For example, agile teams, in particular Scrum teams, have daily standups to discuss what has been completed since the last standup meeting, what is planned to complete until the next meeting, and what the impediments, risks, and problems that members may encounter are.

Project teams typically develop different reports for different stakeholders. Stakeholders who have a high interest and high power/influence will receive more information, more frequently (recall the stakeholder power/interest grid). Depending on the priority and duration of the project, the reporting frequency could be daily, weekly, monthly, or quarterly.

We can mention three different types of project reports as follows:

1. Status reports – where the project stands at a specific point in time
2. Progress reports – what the project team has accomplished during a certain period
3. Forecast reports – future project status based on current project status and known trends

Tables 7.1, 7.2, and 7.3 exhibit short examples of status, progress and forecast reports, respectively, based on our example of the overall case discussed throughout the book (see Section 1.2.4 “Case Study 1.2: Characteristics of Another Project Undertaken by Grocery LLC (M-Commerce Project)”).

Table 7.1: An Example of an Overview based on a Status Report [6]

Period	*May 27, 2022 – July 7, 2022*		
Team Name	*Grocery LLC M-Commerce Project Team*		
Status Report Prepared by:	*Project Manager*		
Overall Status:	☒ **Green — On Track**	☐ **Yellow — Caution**	☐ **Red – Problem**

Table 7.2: An Example of a Progress Report [7]

Activities/Deliverables Completed Since Last Reporting Period

WBS #	Activity Name	Duration	Date Completed	Comments
2.1	Review needs analysis based on the business case	3 days	Tue 5/31/22	*The review has some issues due to the missing key points in the preceding activities. However, the team worked very well to compensate for the delay. No delay was experienced.*
2.2	Elicit requirements from stakeholders	10 days	Sun 6/10/22	*It finished two-day earlier than its planned 6/14 schedule.*
2.3	Draft preliminary stakeholder specifications	7 days	Tue 6/21/22	*An additional two days were added from 2.2.*
2.4	Review specifications with team and stakeholders	5 days	Tue 6/28/22	*Finished on time.*
2.5	Incorporate feedback on the specifications	3 days	Fri 7/1/22	*Finished on time.*
2.6	Develop a preliminary budget and delivery timeline	3 days	Wed 7/6/22	*The one-day delay was experienced due to the absence of a representative from the budget department.*
2.7	Obtain approvals to proceed (concept, timeline, budget, resources)	1 day	Wed 7/6/22	*The meeting with the sponsor took 3 hours. The sponsor was convinced that we could proceed with the activities under the third component “Design”.*

2.8	Analysis complete	0 days	Thu 7/7/22	*Milestone achieved.*

Table 7.3: An Example of a Forecast Report [8]

Activities & Deliverables for the Next Reporting Period

WBS#	Activity Name	Duration	Date to be Completed	Comments
3.1	Review preliminary stakeholder specifications	3 days	Mon 7/11/22	*Stakeholder Z (high power, high interest) notified us of some serious conflicts in the preliminary stakeholder specifications. We may expect a 2-day delay. The sponsor should be informed immediately.*
3.2	Develop solution (functional and non-functional) specifications	5 days	Mon 7/18/22	*Developer 1 may not be available during this activity. Therefore, a developer must be kept as a substitute to ensure attendance.*
3.3	Develop transition requirements	2 days	Wed 7/20/22	*No delay is expected.*
3.4	Develop design mockups based on specifications	5 days	Wed 7/27/22	*Stakeholder Z may have some objections. Project member 2 will be assigned to communicate with this stakeholder.*
3.5	Review specifications	2 days	Fri 7/29/22	*The same issue with Stakeholder Z.*
3.6	Incorporate feedback into specifications	2 days	Tue 8/2/22	*The same issue with Stakeholder Z.*
3.7	Finalize project management plan	8 days	Fri 8/12/22	*Based on the stakeholders' feedback, we may experience delays.*
3.8	Design complete	0 days	Mon 8/15/22	*No comments.*

1. PMI (2020). Ahead of the Curve: Forging a Future-Focused Culture. Pulse of the Profession. Retrieved from https://www.pmi.org/learning/library/forging-future-focused-culture-11908↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
3. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
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5. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
6. Interthink. (n.d.). Project HEADWAY Project Team Status Report. Retrieved from https://www.projectmanagement.com/deliverables/235123/project-headway-project-team-status-report↵
7. Interthink. (n.d.). Project HEADWAY Project Team Status Report. Retrieved from https://www.projectmanagement.com/deliverables/235123/project-headway-project-team-status-report↵
8. Interthink. (n.d.). Project HEADWAY Project Team Status Report. Retrieved from https://www.projectmanagement.com/deliverables/235123/project-headway-project-team-status-report↵

7.3: Qualitative Monitoring

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 7.4.

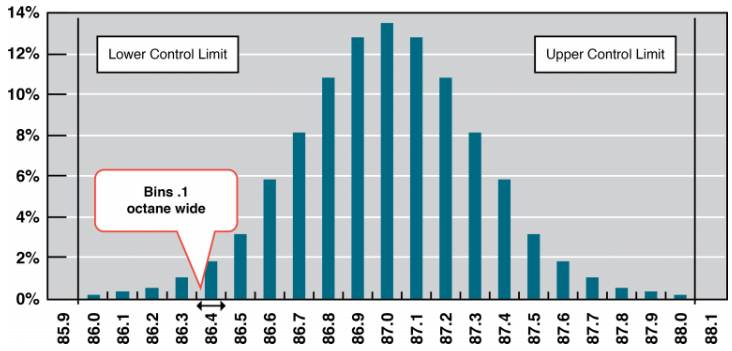


Figure 7.4: Normal Distribution of Measurements

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 8.2 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 7.5).

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.

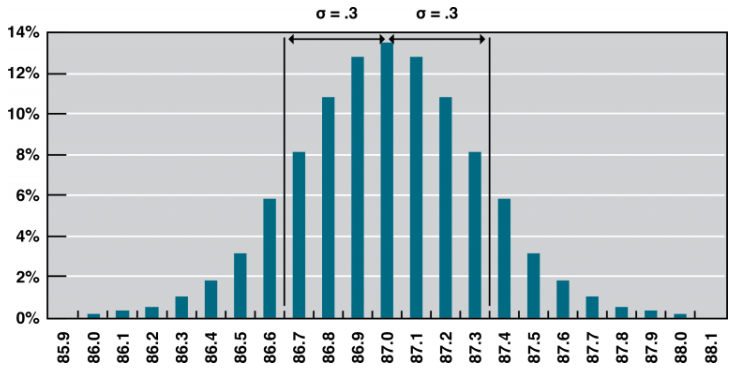


Figure 7.5: One Sigma Range Most of the measurements are within 0.3 octane of 87

Qualitative monitoring, as its name implies, involves measuring quality rather than quantity. In the context of project management, qualitative monitoring addresses the following questions:

- **Scope:** Is the team delivering on the intended scope in order to fulfill the project's objectives and organizational needs?
- **Quality:** Is the quality of the deliverables meeting stakeholder expectations?
- **Stakeholders:** Are stakeholders engaged?
- **Communications:** Are project communications effective?
- **Risks:** Are risks and opportunities being effectively managed by the team?
- **Resources:** Are resources being effectively managed and available as expected?
- **Procurement:** Are the expectations outlined in procurement contracts being adhered to by vendors?

- **Team Management:** Has the team become high-performing and are individual team members meeting performance expectations?

Validating and Controlling Scope

The approach taken to monitor and control scope depends on the development methodology used. The predictive/waterfall approach involves a sequential definition of requirements and scope, which then leads to solution development. This approach is commonly utilized when the organization has a clear vision of the project's end outcome. Given this, monitoring and controlling scope occurs with the premise that significant scope changes are not expected. Validating scope involves formal acceptance of the completed project deliverables by the project sponsor and their assigned designates. Acceptance often requires deliverable reviews where the quality of the work is inspected before sign-off is provided. Changes may be required. These changes can be a result of poor quality (which leads to re-work) or new requirements intended to improve the organizational value of the project's outcomes. New requirements are carefully controlled. This is necessary because once solution development begins, the project's resources, timelines, and budget were all defined with a specific scope in mind. A scope change may mean those resources, timelines, and budgets are now insufficient to deliver on the increased scope. Controlling scope in this situation requires the project team to assess the impact of the new requirement on all the project's constraints. If necessary, the team will seek approval for additional funding, time, and/or resources to pursue the new requirement. Project leaders need to reserve judgment on scope changes until the impact and benefits are clearly understood. The term "scope creep" refers to the poorly controlled expansion of scope over time. This means that the scope expands, perhaps unintentionally, without an understanding of its impact on the project's other constraints, such as time and budget. Therefore, utilizing an integrated approach for change management is a critical success factor for projects using the predictive/waterfall approach.

Projects that follow an adaptive development methodology, such as agile, view scope change very differently. Scope definition, as well as solution development and testing, occur in an iterative or incremental fashion. As new requirements are identified, they are evaluated from a cost/complexity and benefit perspective, and if worth pursuing, they will be scheduled into a future iteration. A continuous improvement mindset encourages scope definition to occur in cycles.

Controlling Quality

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

Quality is about ensuring the expectations of the project sponsor have been met. This involves ensuring the expectations of the end-user community are well understood. High quality is achieved by planning for it (proactive) rather than by reacting to problems after they are identified (reactive).

Standards are chosen and processes are established to achieve those standards in the planning phase. Project quality focuses on the end deliverables that reflect the purpose of the project. The project leader is responsible for developing a quality management plan that defines the quality expectations and for ensuring the specifications and expectations are met. In the execution phase, the project team attempts to prevent quality issues from occurring with the use of quality management techniques, such as checklists, assessments, and lean six-sigma tools. Lean six-sigma tools are focused on creating efficient and effective processes that involve error-proofing methods.

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.

In the monitoring and control phase, the project team reviews the project deliverables to ensure they are ready for review and sign-off. Ideally, this review leads to deliverable acceptance. However, the team may encounter problems that they are unable to prevent. When this occurs, the team's objective is to determine how to fix these problems. One of the most effective ways to address a

problem is to begin by understanding its root cause(s). Cause-and-effect diagrams, which are also referred to as fishbone or Ishikawa diagrams, are very effective for this purpose.

Monitoring Stakeholder Engagement

Project teams cannot control stakeholders. However, they can significantly influence their level of engagement. During the planning phase of a project, the stakeholder register is created which is an effective tool for keeping track of a project's stakeholders, their relative interest in the project, and their level of power/influence over the project's outcomes. The register provides an effective starting place for determining how to engage stakeholders according to their power and interest levels if a Power/Interest Grid is used.

During the monitoring and control phase, the project team looks for new stakeholders and monitors the engagement level of existing stakeholders. Engagement techniques will vary from one organization to another as their respective cultural norms and values influence how individuals work together. Some organizations prefer face-to-face interaction while others prefer the use of electronic messaging and project team websites. Whatever the methods are used to engage stakeholders, it is important to keep stakeholders informed of the project's progress and to find the right approaches for meaningfully involving stakeholders throughout the life of the project.

A project leader's interpersonal skills are critical in stakeholder management. Some stakeholders may have become unresponsive to the project team's requests. When this occurs, the project leader's relationship-building skills will be put to the test as they attempt to understand the stakeholder's actions. Conflict resolution skills, such as negotiating, are vital because stakeholders are very likely to have differing priorities, and successfully navigating these conflicts can be the difference between project success and project failure.

Monitoring Communications

Communication is one of the most effective ways to keep team members and all other stakeholders engaged. In order for this communication to be effective, it must be developed and delivered in ways that consider stakeholder roles and communication preferences. During the planning phase, a communication plan would be created to guide the project team's communication efforts throughout the project. It is important for project leaders to proactively determine if the selected communication methods will be suitable for the key stakeholders. This is done by directly asking them and monitoring their responsiveness to the communication delivered. Another important way to determine if project stakeholders are well-informed is to pay careful attention to the questions they ask. Questions about project progress that have been addressed in recent project communications are a good sign that the communication techniques may not be effective for a particular stakeholder. When this occurs, it is time to revisit the communication plan and make the appropriate adjustments.

Controlling Procurements

Monitoring procurement includes ensuring the vendors' performance meets the agreed-upon, often contractual, requirements. The complexity of the project determines the number and type of vendors procured. This, in turn, determines the nature of the monitored activities. For instance, projects that only require supplies to be purchased externally will have much simpler vendor management processes than projects that had to outsource the completion of some of the work to external consultants.

Key tools and techniques that may be used in procurement management include inspections, audits, formal change control methods, vendor-produced performance reports, payment systems, and contract administration.

Monitoring Risks

Monitoring and controlling risks involves implementing a risk management plan. A key aspect of this plan is often the risk register, which helps the team keep track of the project risks, triggers (early warning signs), and risk responses. Risk responses can be implemented in any phase of the project as long as documentation is kept up to date.

Many project teams establish contingency plans and contingency funds to account for all types of risks (e.g., negative and positive risks, individual and overall project risks). When these risks materialize, the project team determines if the contingency plans and/or funds will address these risks and, if so, they will be implemented. If contingency plans/funds don't suffice, the project team must identify workarounds. Contingency plans and workarounds are then monitored to determine if they were effective. Additional corrective action may be required.

Controlling Resources

Projects require human resources, physical resources, and services in order to produce the desired outcomes. During monitoring and controlling, the project leader assesses the effectiveness of all types of resources.

With respect to the project team, effective project managers continuously assess the performance of the team and its members. Effective coaching and mentoring skills are essential and can be the difference between project success and failure. In addition, a project leader must sometimes make the difficult decision to replace team members when they are not able to perform as expected or the ensuing conflicts cannot be resolved. Conflict management skills are important in this regard. Proactive conflict management requires the project leader to continuously monitor stress levels in the team in an attempt to anticipate the likelihood of rising conflict. Monitoring resource utilization levels in the project schedule and staying connected to project team members are also critical activities that the project leader must perform. Lastly, many projects require people with different skills at different times. Project leaders should be actively monitoring when these skills will be required and ensuring people join/transition off the project at the appropriate times.

The availability and effectiveness of physical resources are also closely monitored. In some instances, faulty or ineffective equipment has to be replaced. If the scope of the project changes, new equipment and technology may be required, which, in turn, may lead to additional work in procurement management.

Monitoring and controlling is about integrating all the teams while assuring that work is being completed at a steady rate to keep the project on track. This phase is vital to the overall success of the project. Thus, requiring additional, highly-skilled resources, is a key consideration during the planning phase.

7.4: Earned Value Management (EVM)

A project manager must regularly compare the amount of money spent with the budgeted amount and report this information to key stakeholders. In addition, project managers must also compare the progress of the actual work completed with the estimated durations in the project schedule. One of the quantitative monitoring techniques project managers utilize is Earned Value Management (EVM) which combines scope, schedule and cost baselines to determine the project's well-being and to decide whether an action is required in case of problems. EVM is essential to project success. It is used extensively in many business fields and organizations such as the Department of Defense (DOD) and construction industries while the IT industry has not due to the reasons such as practicing agile (adaptive) project management and hence lack of a fixed baseline[1].

EVM is a quantitative monitoring technique that uses metrics and indexes to assess project performance. Earned value analysis compares the performance measurement baseline to the actual schedule and cost performance. EVM integrates the scope baseline with the cost baseline and schedule baseline to form the performance measurement baseline [2][ii]. The application of earned value in the early initiation and planning phases of a project increases the validity and usefulness of the cost and schedule baseline and is an excellent verification of the project scope assumptions and the scope baseline. Once established, these baselines become the best source for understanding project performance during execution. A comparison of actual performance (both cost and schedule) against this baseline provides feedback on project status and data, not only for projecting probable outcomes but also for management to make timely and useful decisions using objective data[3]. EVM, known as "management with the lights on", is based on the principle that past patterns and trends can indicate future conditions. EVM helps us clearly and objectively see where our project is headed compared to where it's supposed to be[4].

EVM can help answer the questions below[5]:

- Are we delivering more or less work than planned?
- When is the project likely to be completed?
- Are we currently over or under budget?
- What is the remaining work likely to cost?
- What is the entire project likely to cost?
- How much will we be over or under budget at the end of the project?
- What is driving the significant cost and/or schedule variances?

In EVM, there is an important point that must be clarified. We will always see monetary amounts even though we are measuring the scope or schedule performance. The denominator for all of them is the currency we are using for our project. If we are using the US dollar, the denominator would be the US dollar. The analogy for EVM would be doing shopping in a market. We buy different items such as olive oil, cookies, milk, eggs, and laundry detergent. All these items are converted to a monetary value, and it allows us to compare the prices between different brands. In the end, we know the total amount in dollars. This is exactly what is happening for EVM. Therefore, when we see a result showing dollars, it doesn't necessarily mean that it is related to the cost. It can indicate a problem in scope (e.g., not all planned activities have been completed) or schedule (e.g., the project is behind schedule).

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 7.1. The amount that the project team thinks an activity will cost is called the planned value for that activity.

Table 7.1: 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**

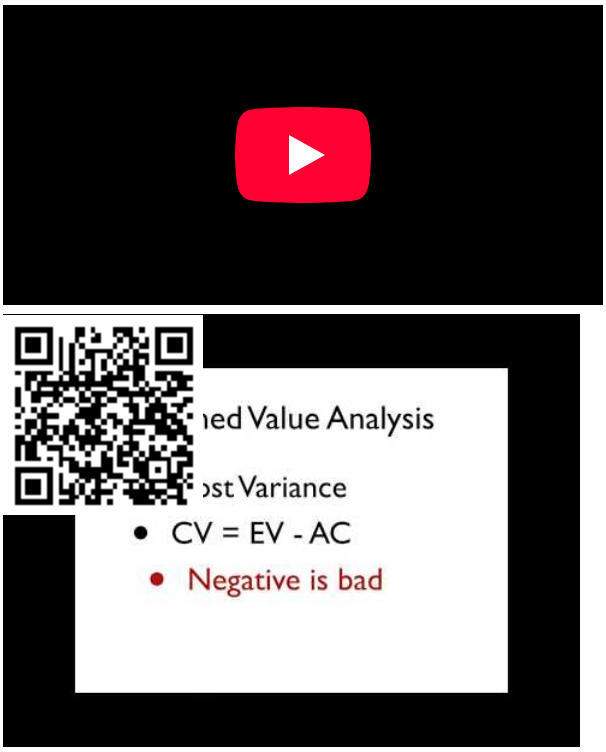
One thing to watch out for is that the calculation of EV is not time-dependent; it uses the total PV for an activity, not the value for PV at a certain point in time as found on a time-phased budget. For example, if Activity 1 is 100% complete at the end of period one, then EV = $50 × 100%, or EV = $50 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.



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.

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

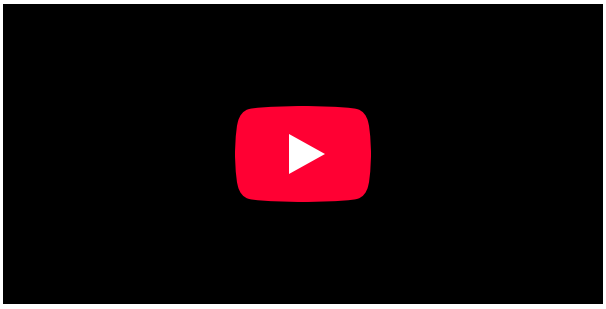
Cost Performance Index (CPI)

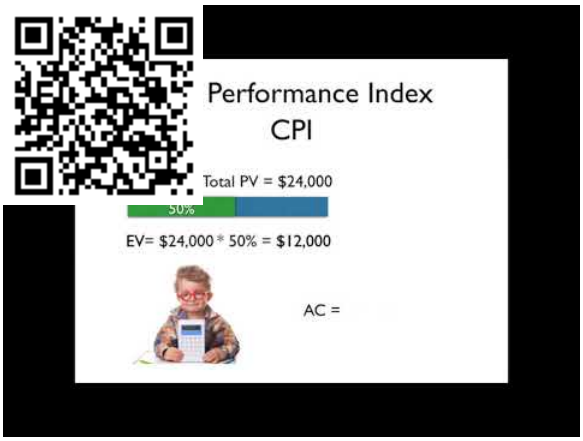
While CV provides a dollar amount that reflects how much over or under the project is at a particular point in time, The **Cost Performance Index (CPI)** provides an indicator of the overall cost performance to date and a good idea of how the project work is trending with regard to cost performance.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





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.

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

7.5: Change Control Process

The monitoring and controlling process is a constant process starting at the very beginning of the project, and it finishes when the project is closed out. Monitoring and controlling involves regularly measuring progress on a project to ensure it continues meeting objectives and addressing current organizational needs. Project managers monitor the project work by collecting project performance data, producing performance measures, and reporting and disseminating performance information. Then, they compare actual performance with planned performance, analyze variances and assess trends to affect process improvements, and finally evaluate possible alternatives and recommend appropriate corrective action as needed[1].

In order to manage the control process effectively, projects must have a change management plan and a configuration management plan which are sub-plans of the overall project management plan. A change management plan provides the direction for managing the change control process and documents the roles and responsibilities of the approval authority or the change control board if available. The configuration management plan describes the configurable items of the project and identifies the items that will be recorded and updated so that the product of the project remains consistent and operable[2]. Therefore, these plans guide project managers and teams while they need to make a change in the project, and configure primarily the product scope.

When we find a problem, we can't just make a change since we should evaluate possible alternatives and consider risk response strategies and the availability of contingency reserves. What if corrective actions exceed our schedule or budget constraints? We need to evaluate triple constraint elements (scope, schedule, and cost) and other constraints such as resources and quality. Compromising the quality of the outcomes and deliverables would endanger the approval process, and hence lead to a project failure. Therefore, we have to figure out if it is worth making the change. Change control is a set of procedures that let us make changes in an organized way.

Anytime we need to make a change to our project management plan, we need to start with a change request. This request is generally in the form of a document. Any change to the project needs to be documented so we can figure out what needs to be done, by when, and by whom. Any stakeholder can request a change. Once the change request is documented, it is submitted to a change control board, in particular, if the project is within a program or portfolio, and this necessitates the submission of change requests exceeding a specified cost. A change control board is a group of people who consider changes for approval. Not every change control system has a board. The change control system is designed based on various factors such as the size and complexity of the project, organizational policies, business field, and contract requirements. The change requests are generally submitted to the project sponsor by the project manager for review and approval. The project manager is responsible to monitor the change process from the very beginning to the very end. Putting the recommended changes through change control will help us evaluate the impact and update all the necessary documents. Not all changes are approved, but if the changes and repairs are approved, we send them back to the team to put them in place.

Table 7.2: Change Request Form Template

Project Name:	
Project Number:	
Project Manager:	
Requestor Name:	
Request Date:	
Resolution Requested	
Description of Change:	
Reason for Change:	
Impact on Scope and/or Deliverables:	
Impact on Resources and Quality:	

Impact on Time and Cost:		
Disposition of Change Resolution:	**Accepted:**	**Denied:**
Project Manager Name & Signature	Date:_____	
Project Sponsor Name & Signature	Date:_____	

Change requests (Table 7.2) are made to modify documents, deliverables, and baselines. They are issued to expand, adjust, or reduce project scope, product scope, or quality requirements and schedule or cost baselines. They can include corrective actions, preventive actions, defect repairs, and updates[3]. Project teams may need to assess the product and project scope, and this may require the teams to discuss the issues with stakeholders to determine if there is a need to revise requirements or add new ones.

In order to keep the track of change requests and actions taken, a “Project Change Request Tracking Log” (Table 7.3) can be held along with an “Issue Log”.

Although monitoring and controlling process is performed throughout the project, most of the effort would be expended especially during the execution (implementation) phase. Resources outside the core project team are assigned, and costs are usually the highest during this phase. Besides, scheduling issues would arise in this phase as project activities are carried out and human and physical resources are assigned. Project managers experience the greatest conflicts over the schedule in this phase. Some activities may take longer than estimated. Some risks may occur creating schedule slippages. Project managers first apply techniques without the need for a change request if triple constraints aren’t affected. Nevertheless, project managers should implement a holistic approach by taking into account all constraints and knowledge areas.

Table 7.3: Project Change Request Tracking Log Template

Project Change Request Tracking Log									
Project Name:									
Project Manager									
Submission Data			Impact Analysis			PM Review and Approval			
Request#	Submitted By:	Date	Date Assigned to Analyst	Assigned to	Date Analysis Completed	Date Reviewed	Committee Decision	Date Approved	Date Request Integrated into Project Plan

1. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
2. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵
3. Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th ed.). Project Management Institute. ↵

7.6: 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

Contract Closure

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.

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.

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

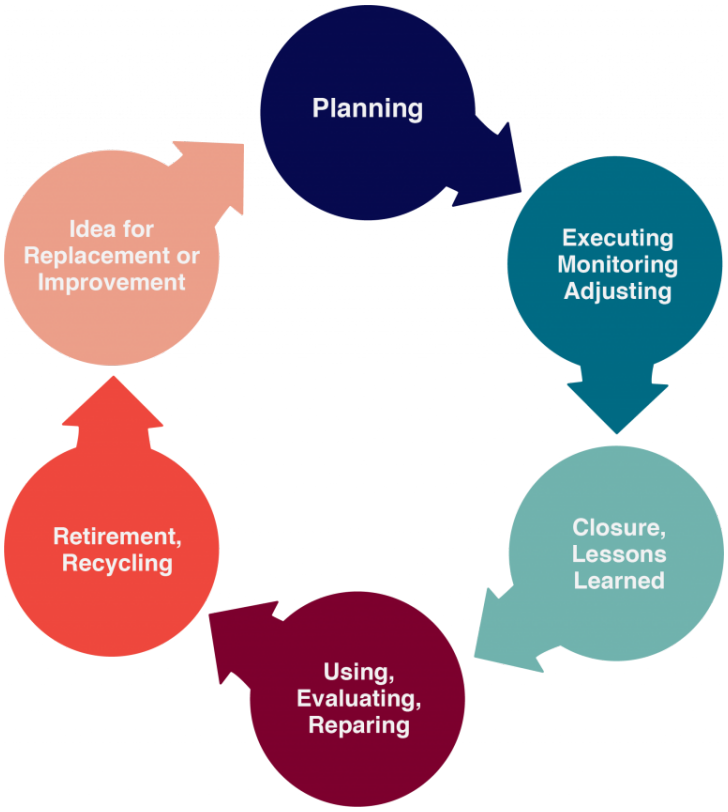


Figure 7.6: Seen from a living order perspective, closure is an extension of the learning and adjusting process that goes on throughout a project.

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.

7.7: 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?

Project Failure

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.

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Essentials of Project Management

Glossary

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