Project Planning

Project Planning

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NOVA SCOTIA COMMUNITY COLLEGE
NOVA SCOTIA

Contents

About the Book

Project Planning is a NSCC customized open textbook created for Project Planning in the xxxx program. It is a condensed remixed adapted version of NSCC Project Management by NSCC and Adrienne Watt, CC BY.

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Chapter 1: Project Management Overview

Learning Objectives

- Define projects and explain the characteristics of projects.
- Describe project management and its benefits.
- Identify primary project constraints.
- Identify factors for project success and project management success and explain how these factors affect either the success or failure of projects.
- Examine different types of expertise required in project management.
- Assess the significance of developing skills in both the technical and socio dimension aspects of project management.

Project managers can be seen in public and private sectors and many industries including IT, finance and banking, law enforcement agencies, constructions, municipalities etc. For several decades, public sector projects were managed by contractors whose primary objective was a profit motive. At the end of the project, the contractor would provide the public sector agency with a deliverable, but on many occasions the contractor would walk away with the project management best practices and lessons learned. Public sector agencies now require contractors to share all project management intellectual property accumulated during the course of the project with then. Also with limited resources in terms of time, personnel and finances, public sector agencies are becoming experienced in project management to the point where the projects are managed with internal personal rather than contractors.

Skills learned by your exposure to studying project management can be used in most careers as well as in your daily life. Strong planning skills, good communication, ability to implement a project to deliver the product or service while also monitoring for risks and managing the resources will provide an edge toward your career and professional success.

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

People have been undertaking projects since the earliest days of organized human activity. We use the term “project” frequently in our daily conversations. A husband, for example may tell his wife, “My main project for this weekend is to straighten out the garage.” Going hunting, building pyramids, and fixing faucets all share certain features that make them projects.

Project Attributes

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

Projects exist to bring about a product or service that hasn't existed before. In this sense, a project is unique. Unique means that this is new; this has never been done before. Maybe it's been done in a very similar fashion before but never exactly in this way.

In contrast with projects, operations are ongoing and repetitive. They involve work that is continuous without an ending date and with the same processes repeated to produce the same results. The purpose of operations is to keep the organization functioning while the purpose of a project is to meet its goals and conclude. Therefore, operations are ongoing while projects are unique and temporary.

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

Definition of a Project

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

Project Characteristics

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

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

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

Consider the following scenario: The deputy chief constable (DCC) approaches you with a fabulous idea. Obviously, it must be “fabulous” because he thought of it. He wants to set up kiosks in the local shopping malls as a community police office. The office will offer clients the ability to sign up for victim services volunteer work as well as provide information about their services. He believes that the exposure in the mall will increase awareness of the services provided by the police. He told you that senior management has already approved the project which aligns with the agencies strategic goals, and he’ll dedicate as many resources to this as he can. He wants the new kiosks in place in 4 selected malls by the end of the year. Finally, he has assigned you to head up this project.

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

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

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

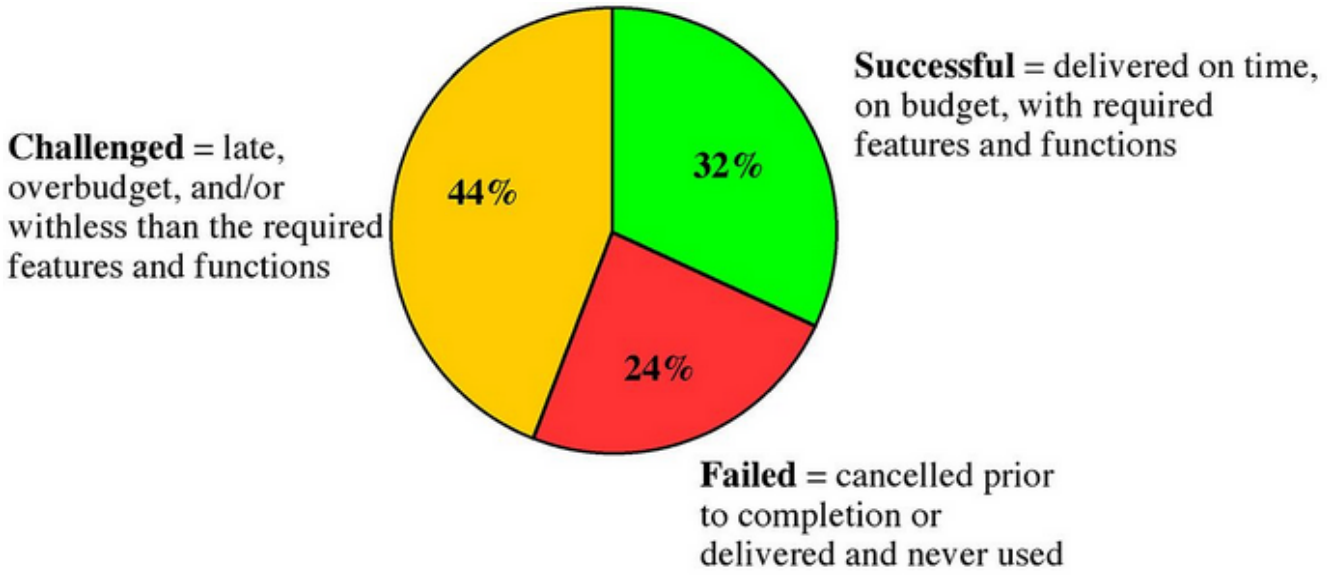
If the answer is yes to all these questions, then we have a project. Note that there are some activities which are routine operations and these are different from projects. What are the differences between projects and routine operations?

Comparing Projects with Operations

	Projects	Operations
Purpose		
Time		
Outcomes		
People		
Authority of Project Manager		

The Process of Project Management

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



Summary of 2009 Standish Group CHAOS report.

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

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

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

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

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

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

- **Cost** is the budget approved for the project including all necessary expenses needed to deliver the project. Within organizations, project managers have to balance between not running out of money and not under-spending because many projects receive funds or grants that have contract clauses with a "use it or lose it" approach to project funds. Poorly executed budget plans can result in a last-minute rush to spend the allocated funds. For virtually all projects, cost is ultimately a limiting constraint; few projects can go over budget without eventually requiring a corrective action.
- **Scope** is what the project is trying to achieve. It entails all the work involved in delivering the project outcomes and the processes used to produce them. It is the reason and the purpose of the project.
- **Quality** is a combination of the standards and criteria to which the project's products must be delivered for them to perform effectively. The product must perform to provide the functionality expected, solve the identified problem, and deliver the benefit and value expected. It must also meet other performance requirements, or service levels, such as availability, reliability, and maintainability, and have acceptable finish and polish. Quality on a project is controlled through quality assurance (QA), which is the process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

- **Risk** is defined by potential external events that will have a negative impact on your project if they occur. Risk refers to the combination of the probability the event will occur and the impact on the project if the event occurs. If the combination of the probability of the occurrence and the impact on the project is too high, you should identify the potential event as a risk and put a proactive plan in place to manage the risk.
- **Resources** are required to carry out the project tasks. They can be people, equipment, facilities, funding, or anything else capable of definition (usually other than labor) required for the completion of a project activity.
- **Time** is defined as the time to complete the project. Time is often the most frequent project oversight in developing projects. This is reflected in missed deadlines and incomplete deliverables. Proper control of the schedule requires the careful identification of tasks to be performed and accurate estimations of their durations, the sequence in which they are going to be done, and how people and other resources are to be allocated. Any schedule should take into account vacations and holidays.

You may have heard of the term "triple constraint," which traditionally consisted of only time, cost, and scope. These are the primary competing project constraints that you have to be most aware of. The triple constraint is illustrated in the form of a triangle to visualize the project work and see the relationship between the scope/quality, schedule/time, and cost/resource (Figure 1.1) [1].

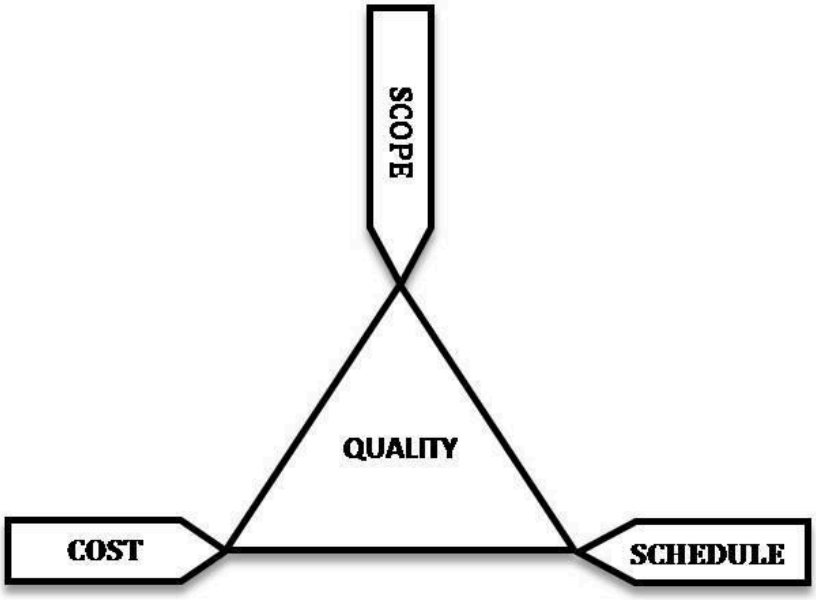


Figure 1.1 A schematic of the triple constraint triangle.

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 sides. The best projects have a perfectly balanced triangle. Maintaining this balance is difficult because projects are prone to change. For example, if scope increases, cost and time may increase disproportionately. Alternatively, if the amount of money you have for your project decreases, you may be able to do as much, but your time may increase.

1. The triad constraints by John M. Kennedy T. (http://commons.wikimedia.org/wiki/File:The_triad_constraints.jpg) used under CC-BY-SA license (https://creativecommons.org/licenses/by-sa/3.0/).

Your project may have additional constraints that you must face, and as the project manager, you have to balance the needs of these constraints against the needs of the stakeholders and your project goals. For instance, if your sponsor wants to add functionality to the original scope, you will very likely need more money to finish the project, or if they cut the budget, you will have to reduce the quality of your scope, and if you don't get the appropriate resources to work on your project tasks, you will have to extend your schedule because the resources you have taken much longer to finish the work.

The dynamic trade-offs between the project constraints values have been humorously and accurately described in Figure 1.2.[2]

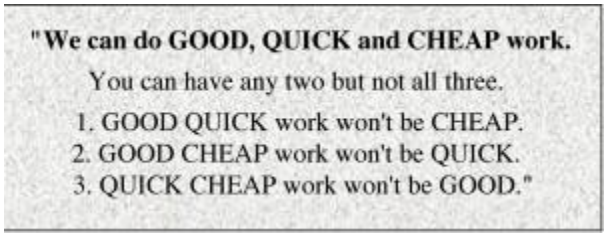


Figure 1.2: A sign seen at an automotive repair shop.

Project Management Expertise

In order for you, as the project manager, to manage the competing project constraints and the project as a whole, there are some areas of expertise you should bring to the project team (Figure 1.3)[3]. They are knowledge of the application area and the standards and regulations in your industry, understanding of the project environment, general management knowledge and skills, and interpersonal skills. It should be noted that industry expertise is not in a certain field but the expertise to run the project. So while knowledge of the type of industry is important, you will have a project team supporting you in this endeavor.

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

Application knowledge

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

2. Illustration from Barron & Barron Project Management for Scientists and Engineers. Source: http://cnx.org/content/m31508/latest/?collection=col11120/1.4
3. Figure 1.3 Table from Barron & Barron Project Management for Scientists and Engineers, Source: http://cnx.org/content/col11120/1.4/

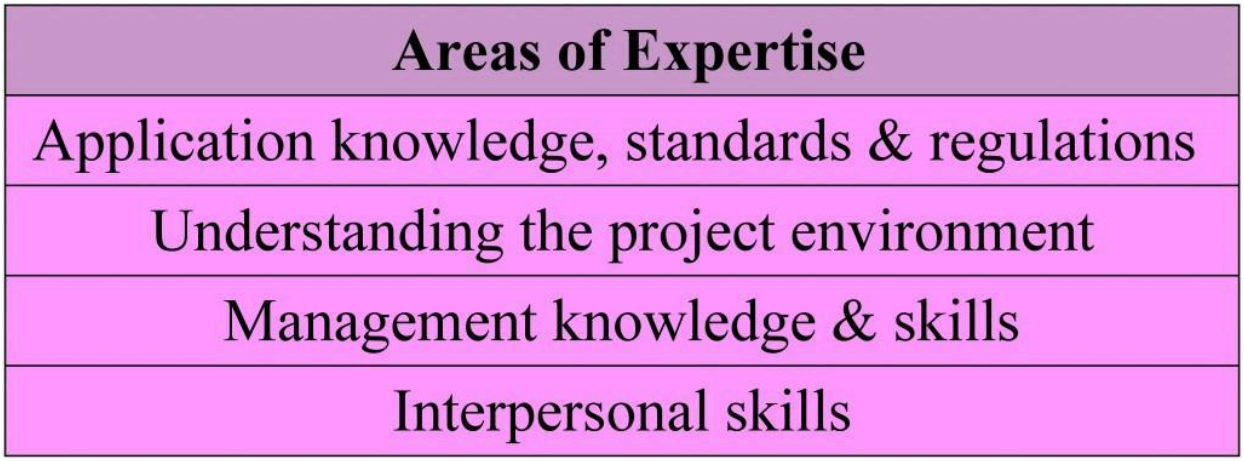


Figure 1.3: Areas of expertise that a project manager should bring to the project team.

Some projects require specific skills in certain application areas. Application areas are made up of categories of projects that have common elements. They can be defined by industry group (policing, emergency management, etc.), department (Administration, Street Crime Unit, Forensic, and Traffic Unit etc.). These application areas are usually concerned with disciplines, regulations, and the specific needs of the project, the customer/client, or the industry. For example, most government agencies have specific procurement rules that apply to their projects that wouldn't be applicable in the software industry. Since today's fast-paced advances can leave you behind fairly quickly if you don't stay abreast of current trends.

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

Understanding the Project Environment

There are many factors that need to be understood within your project environment (Figure 1.4)[4]. At one level, you need to think in terms of the cultural and social environments (i.e., people, demographics, and education). The international and political environment is where you need to understand about different countries' cultural influences. Then we move to the physical environment; here we think about time zones. Think about different countries and how differently your project will be executed whether it is just in your country or if it involves an international project team that is distributed throughout the world in five different countries.

4. Figure 1.4 Table from Barron & Barron Project Management for Scientists and Engineers, Source: http://cnx.org/content/col11120/1.4/

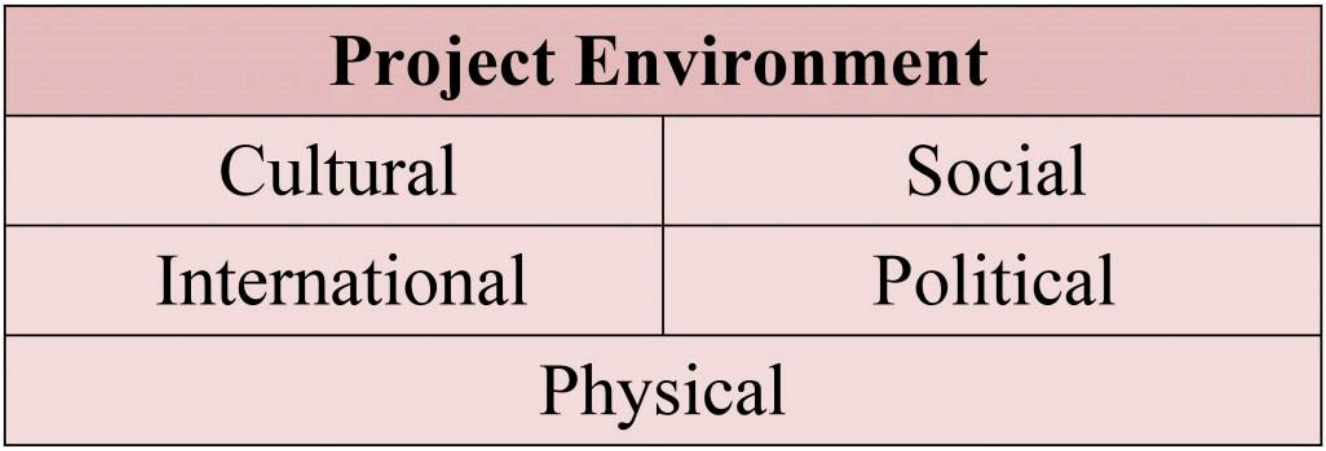


Figure 1.4: The important factors to consider within the project environment.

Of all the factors, the physical ones are the easiest to understand, and it is the cultural and international factors that are often misunderstood or ignored. How we deal with clients, customers, or project members from other countries can be critical to the success of the project. For example colours have different meanings in different cultures. White, which is a sign of purity in North America (e.g., a bride's wedding dress), and thus would be a favoured background colour in North America, signifies death in Japan (e.g., a burial shroud). Table 1.1
[5]Summarizes different meanings of common colours.

Table 1.1: The meaning of colours in various cultures.

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

Project managers in multicultural projects must appreciate the culture dimensions and try to learn relevant customs, courtesies, and business protocols before taking responsibility for managing an

5. Table 1.1 Adapted from P. Russo and S. Boor, How Fluent is Your Interface? Designing for International Users, Proceedings of the INTERACT '93 and CHI '93, Association for Computing Machinery, Inc. (1993). Table from Barron & Barron Project Management for Scientists and Engineers, Source: http://cnx.org/content/col11120/1.4/

international project. A project manager must take into consideration these various cultural influences and how they may affect the project's completion, schedule, scope, and cost.

Management Knowledge and Skills

As the project manager, you have to rely on your project management knowledge and your general management skills. Here, we are thinking of items like your ability to plan the project, execute it properly, and of course control it and bring it to a successful conclusion, along with your ability to guide the project team to achieve project objectives and balance project constraints.

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

Interpersonal Skills

Last but not least you also have to bring the ability into the project to manage personal relationships and deal with personnel issues as they arise. Here were talking about your interpersonal skills as shown in Figure 1.5.

Communication

Project managers spend 90% of their time communicating. Therefore they must be good communicators, promoting clear, unambiguous exchange of information. As a project manager, it is your job to keep a number of people well informed. It is essential that your project staff know what is expected of them: what they have to do, when they have to do it, and what budget and time constraints and quality specifications they are working toward. If project staff members do not know what their tasks are, or how to accomplish them, then the entire project will grind to a halt. If you do not know what the project staff is (or often is not) doing, then you will be unable to monitor project progress. Finally, if you are uncertain of what the customer expects of you, then the project will not even get off the ground. Project communication can thus be summed up as knowing "who needs what information and when" and making sure they have it. Figure 1.5[6]

6. Figure 1.5 Table from Barron & Barron Project Management for Scientists and Engineers, Source: http://cnx.org/content/col11120/1.4/

Interpersonal Skills	
Communication	Influence
Leadership	Motivation
Negotiation	Problem solving

Figure 1.5: Interpersonal skills required of a project manager.

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

Influence

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

Leadership

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

Motivation

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

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

Negotiation

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

Problem Solving

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

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

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

Technical & Socio–culture Dimension of Project Management

It is important that project managers are skilled in both the technical and socio dimension aspects of project management. Some commentators suggest that the technical dimension represents the "science" of project management while the sociocultural dimension represents the "art" of managing a project. To be successful, a manager must be a master of both. Unfortunately, some project managers become preoccupied with the planning and technical dimension of project management. Often their first real exposure to project management is through project management software, and they become infatuated with network charts, Gantt diagrams, and performance variances; they attempt to manage a project from a distance. Conversely, there are other managers who manage projects by the "seat of their pants," relying heavily on team dynamics and organizational politics to complete a project. Good project managers balance their attention to both the technical and socio-cultural aspects of project management.

Fig 1.6 Technical and Socio-culture Dimensions of Project Management.

Project and Project Management Success Factors

Project success and project management success are different. Project success deals with the impacts of a project's final product or service on stakeholders. Project management success focuses on the processes of a project including successful accomplishment of the scope, within budget (cost), within time (schedule), and quality aspects.

A project may be successfully managed but not meet the client or customer expectation. The definition of a project encompasses value creation and therefore the overall success factor of a project is the realized value of the project that can be measured by the project stakeholders. The following factors have been identified by research to lead to overall project failure:

- Absent or ineffective relations with the clients/customers and other stakeholders;
- Excessive cost and duration
- Insufficient resources
- Politics and conflicts
- Decreased profitability
- Unrealistic goals
- Competitive disadvantage

- Poor communications
- Customer dissatisfaction
- Errors in perceived value of the project
- Contracts and legal agreements.

Project management plays a role in project success but that role is affected by many other factors outside the direct control of the project manager. Therefore even if the project management process is a success in an agency, the accomplished project may be perceived as a failure. The factors that may cause project management to fail include:

- Inadequate rationale, objectives, tasks and goals
- Wrong project manager
- Unsupportive top management
- Lack or misuse of project management techniques
- Inadequate or incorrect communications
- Inadequate project planning
- Lack of commitment to the project.

Successful projects need successful project management. Successful project management requires good planning and require resources with a commitment to complete projects, a skilled project manager, good communications and information flows, great value to stakeholders and changing activities to accommodate the constant dynamism of projects.

Key Takeaways

- A project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end. Projects have constraints and objectives that includes scope, cost, schedule, resources, performance and customer satisfaction. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists. Projects also require teamwork.
- Organizations and agencies that work on various projects need to acquire good project management skills and techniques.
- For the project manager, to manage the competing project constraints and the project as a whole, there are some areas of expertise the project manager should bring to the project team. They are:
- particular industry standards and regulations
- understanding of the project environment
- general management knowledge and skills

- interpersonal skills
- It is important that project managers are skilled in both the technical and socio dimension aspects of project management.
- Project success depends on project management success. Project success deals with the impacts of a project's final product or service on stakeholders. Project management success focuses on the processes of a project including successful accomplishment of the scope, within budget (cost), within time (schedule), and quality aspects.

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Chapter 2: The Project Life Cycle (Phases)

Learning Objectives

- Explain the phases in the Project Life Cycles.
- Examine the significant activities and implication to the path a project takes from initiation to closure.

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

Initiation Phase

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

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

Planning Phase

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

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

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

Implementation (Execution) Phase

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

Status reports should always emphasize the anticipated end point in terms of cost, schedule, and quality of deliverable. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria. Once all of the deliverable 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 deliverable 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.

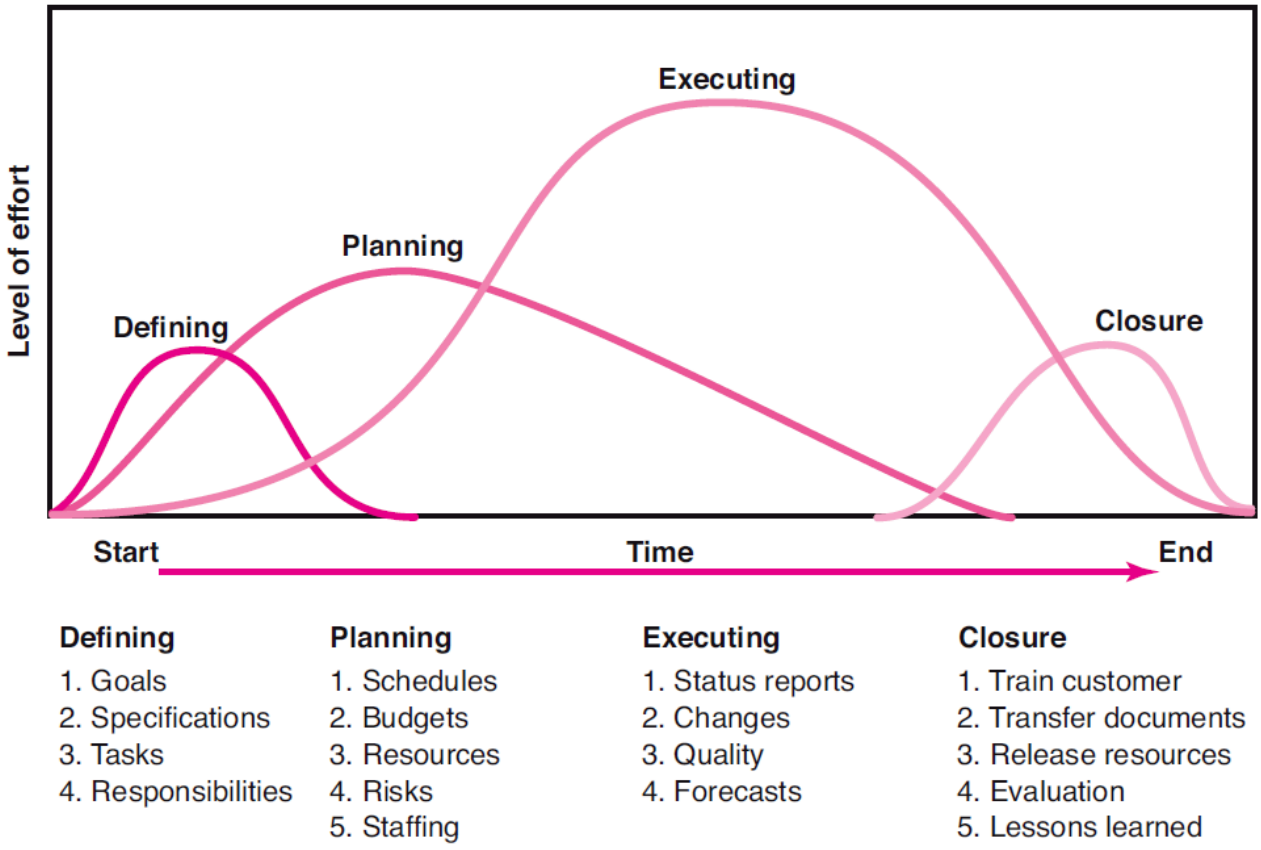

Figure 2.1: Project Life Cycle

Key Takeaways

A standard project typically has the following four major phases (each with its own agenda of tasks and issues): initiation, planning, implementation, and closure.

"Project life cycle" represents the path a project takes from the beginning to its end and it's usually the four phases taken together.

Though it would appear that the four phases should be handled one after another in a linear fashion, the reality of project work is seldom that tidy.

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Chapter 3: Framework for Project Management

Learning Objectives

- Define key elements of the project management framework.
- Outline project processes and knowledge areas and demonstrate how project activities are mapped to these processes for successful project management.
- Examine the effectiveness of project management methodology.
- Discuss how organizations benefits from adopting those processes oriented toward customer satisfaction.

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

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

Project Management Institute Overview

Five volunteers founded the Project Management Institute (PMI) in 1969. Their initial goal was to establish an organization where members could share their experiences in project management and discuss issues. Today, PMI is a non-profit project management professional association and the most widely recognized organization in terms of promoting project management best practices. PMI was formed to serve the interests of the project management industry. The premise of PMI is that the tools and techniques of project management are common even among the widespread application of projects from the software to the construction industry. PMI first began offering the Project Management

Professional (PMP) certification exam in 1984. Although it took a while for people to take notice, now more than 590,000 individuals around the world hold the PMP designation.

To help keep project management terms and concepts clear and consistent, PMI introduced – *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* in 1987. The most current version updated in 2013 is the fifth edition. At present, there are more than one million copies of the *PMBOK Guide* in circulation. Because of the importance of projects, the discipline of project management has evolved into a working body of knowledge known as PMBOK – Project Management Body of Knowledge. The PMI is responsible for developing and promoting PMBOK. PMI also administers a professional certification program for project managers, the PMP. So if you want to get grounded in project management, PMBOK is the place to start, and if you want to make project management your profession, then you should consider becoming a PMP.

What is Project Management?

PMI defines project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements.

What is the PMI Project Framework and Methodology?

The PMI project framework tells you what you have to do, to manage your projects from start to finish. It describes every step in the project life cycle in depth, so you know exactly which tasks to complete, when and how. The framework is made up of process groups (5), knowledge areas (10) and numerous activities.

Project management methodologies is a repetitive process which uses a set of forms, guidelines, templates and checklist and other tools that can be applied to specific projects or situations.

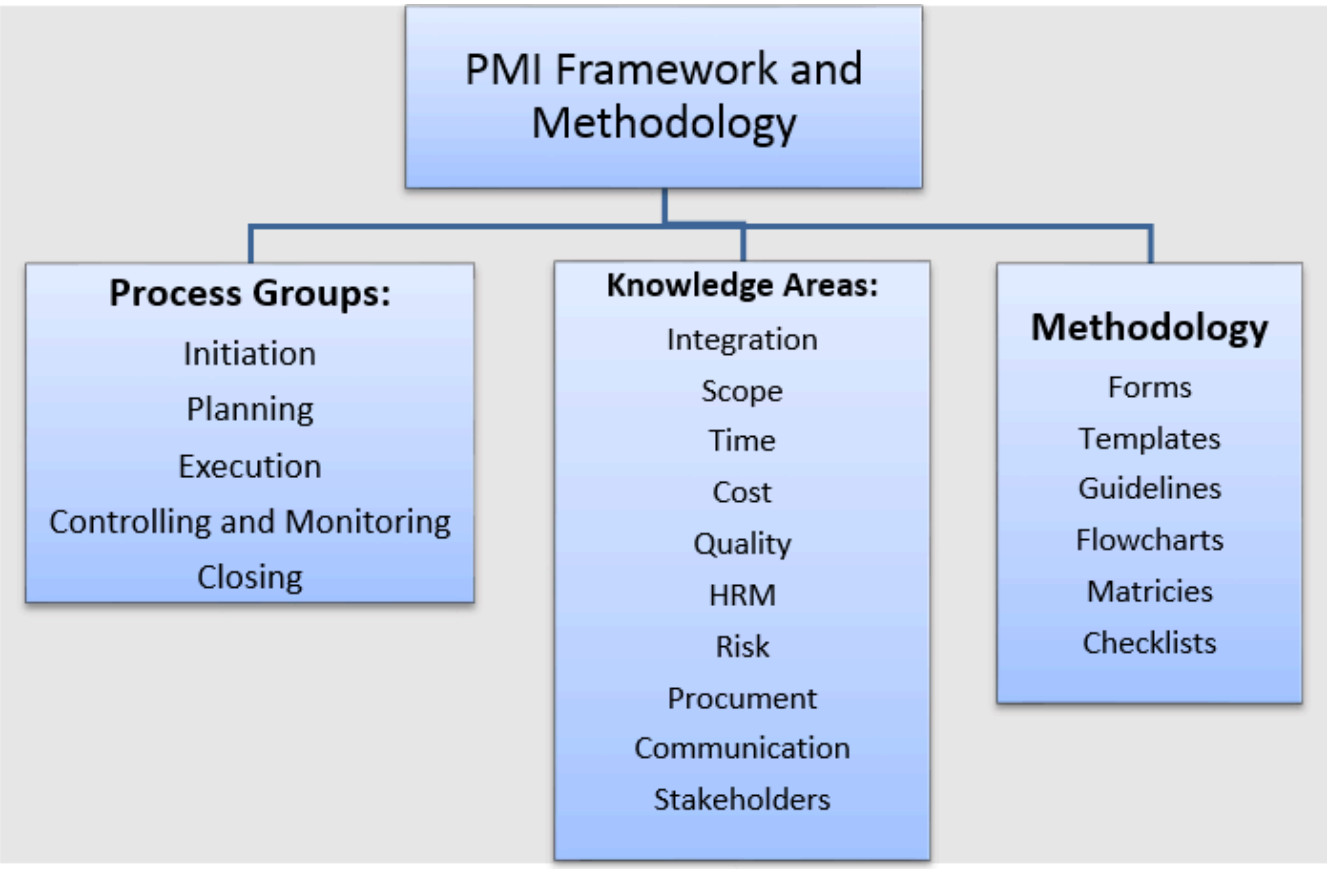

Figure 3.1 shows a summary of the framework and methodology.

What are PMBOK Process Groups?

The PMBOK is a collection of processes and knowledge areas generally accepted as best practice within project management discipline it provides the fundamentals and common vocabulary within the project management profession and identifies “good practices” of project management to apply skills, tools and techniques and enhances the prospects of project success. PMBOK identifies five basic process groups:

- Initiating
- Planning
- Executing
- Monitoring and Controlling
- Closing

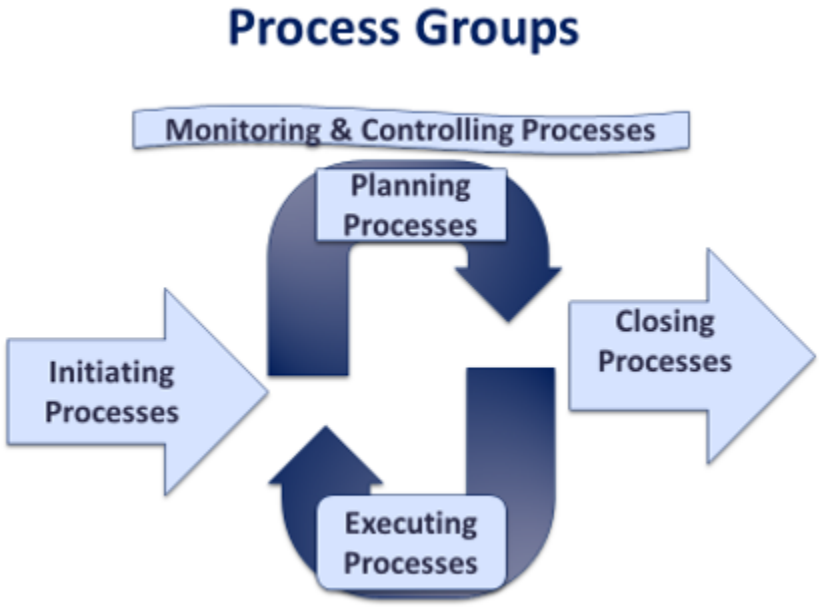

Fig 3.2 illustrates how the process groups interact and work together toward the success of a project.

Project initiation processes define a new project or a new phase of an existing project. Once the initiation is done, processes required to establish the scope of the project and the course of action to execute and complete the project are determined. The execution processes deals with all processes required to complete the project within the established scope and project specification. Processes required to finalized and close the projects are grouped as closing processes. To control the performance of the project, monitoring and controlling processes track, review, evaluate, monitor, control and manage the project. Monitoring and controlling processes need to re-planned as needed in order to execute a project successfully.

What are PMBOK Knowledge Areas?

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

Managing integration: Projects have all types of activities going on and there is a need to keep the "whole" thing moving collectively – integrating all of the dynamics that take place.

Managing scope: Projects need to have a defined parameter or scope, and this must be broken down and managed through a work breakdown structure or WBS. Managing scope is about planning, definition, WBS creation, verification, and control.

Managing time/schedule: Projects have a definite beginning and a definite ending date. Therefore, there is a need to manage the budgeted time according to a project schedule. Managing time/

schedule is about definition, sequencing, resource and duration estimating, schedule development, and schedule control.

Managing costs: Projects consume resources, and therefore, there is a need to manage the investment with the realization of creating value (i.e., the benefits derived exceed the amount spent). Managing costs is about resource planning, cost estimating, budgeting, and control.

Managing quality: Projects involve specific deliverables or work products. These deliverables need to meet project objectives and performance standards. Managing quality is about quality planning, quality assurance, and quality control.

Managing human resources: Projects consist of teams and you need to manage project team(s) during the life cycle of the project. Finding the right people, managing their outputs, and keeping them on schedule is a big part of managing a project. Managing human resources is about human resources planning, hiring, and developing and managing a project team.

Managing communication: Projects invariably touch lots of people, not just the end users (customers) who benefit directly from the project outcomes. This can include project participants, managers who oversee the project, and external stakeholders who have an interest in the success of the project. Managing communication is about communications planning, information distribution, performance reporting, and stakeholder management.

Managing risk: Projects are a discovery-driven process, often uncovering new customer needs and identifying critical issues not previously disclosed. Projects also encounter unexpected events, such as project team members resigning, budgeted resources suddenly changing, the organization becoming unstable, and newer technologies being introduced. There is a real need to properly identify various risks and manage these risks. Managing risk is about risk planning and identification, risk analysis (qualitative and quantitative), risk response (action) planning, and risk monitoring and control.

Managing procurement: Projects procure the services of outside vendors and contractors, including the purchase of equipment. There is a need to manage how vendors are selected and managed within the project life cycle. Managing procurement is about acquisition and contracting plans, sellers' responses and selections, contract administration, and contract closure.

Managing stakeholders: Every project impacts people and organizations and is impacted by people and organizations. Identifying these stakeholders early, and as they arise and change throughout the project, is a key success factor. Managing stakeholders is about identifying stakeholders, their interest level, and their potential to influence the project; and managing and controlling the relationships and communications between stakeholders and the project.

This is the big framework for managing projects and if you want to be effective in managing projects, then you need to be effective in managing each of the 10 knowledge areas that make up PMBOK.

Figure 3.3: The Project Management Framework: Process Groups and Knowledge Areas as Activities.

	Initiating	Planning	Executing	Controlling	Closing
Integration Management	Select project, develop charter, access, determine resources,	General project planning, choose processes and tools, estimate value, determine performance metrics.	Execute all activities and manage project progress.	Performance measurement, monitoring and control, perform change control.	Project closure, lessons learned added to process assets.
Scope Management	Determine objectives.	Create scope and work breakdown structures.	Execute with scope in mind.	Scope monitoring, control scope and ensure compliance with scope.	
Time Management	Determines initial deliverables	Develops schedules, milestones, and critical paths	Manage time.	Schedule, monitoring and control.	
Cost Management	Determine initial estimates	Create initial budget	Manage cost	Cost monitoring and control.	Financial closure.
Quality Management	Determines quality processes	Determines quality standards.	Manage quality and perform quality assurance.	Quality evaluations and control.	Final acceptance
Human Resources	Define roles and authority	Create project organizational structure and team	Develop and train resources, manage resources.	Resource monitory and control	Resource to other projects
Communications Management	Identify stakeholders	Kick-off meetings and plan all means of communications.	Hold progress meetings and communicate with all stakeholders.	Produce performance reports	Value and performance of project, survey satisfaction
Risk Management	Identify initial business risk.	Identify all risk, evaluations, and responses	Manage all risks.	Risk monitoring	
Procurement Management		Determine procurement needs	Manage procurements	Control procurements.	Procurements audits

Source Adapted from 2013 PMBOK Guide Fifth Edition

Figure 3.3: The Project Management Framework: Process Groups and Knowledge Areas as Activities.

Introduction to the Project Management Knowledge Areas

As discussed above, projects are divided into components, and a project manager must be knowledgeable in each area. Each of these areas of knowledge will be explored in more depth in subsequent chapters. For now, let's look at them in a little more detail to prepare you for the chapters that follow.

Project Start-Up and Integration

The start-up of a project is similar to the start-up of a new organization. The project leader develops the project infrastructure used to design and execute the project. An important document created at this stage is the **project charter.** The project charter is the document that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities.

The project management team must develop alignment among the major stakeholders—those who have a share or interest—on the project during the early phases or definition phases of the project. The project manager will conduct one or more kickoff meetings or alignment sessions to bring the various parties of the project together and begin the project team building required to operate efficiently during the project.

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

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

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

Project Scope

The project scope is a document that defines the parameters—factors that define a system and determine its behavior—of the project, what work is done within the boundaries of the project, and the work that is outside the project boundaries. The **scope of work (SOW)** is typically a written document that defines what work will be accomplished by the end of the project—the deliverables of the project. The project scope defines what will be done, and the project execution plan defines how the work will be accomplished.

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

Scope statement should include the following:

- Description of the scope
- Product acceptance criteria
- Project deliverable

- Project exclusions
- Project constraints
- Project assumptions

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

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

Project Schedule and Time Management

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

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

To develop a more detailed schedule, the project team first develops a **Work Breakdown Structure (WBS)** —a description of tasks arranged in layers of detail. Although the project scope is the

primary document for developing the WBS, the WBS incorporates all project deliverable and reflects any documents or information that clarifies the project deliverable. From the WBS, a project plan is developed. The project plan lists the activities that are needed to accomplish the work identified in the WBS. The more detailed the WBS, the more activities that are identified to accomplish the work.

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

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

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

Project Costs

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

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

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

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

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

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

Project Quality

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

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

Although any of the quality management techniques designed to make incremental improvement to work processes can be applied to a project work process, the character of a project (unique and relatively short in duration) makes small improvements less attractive on projects. Rework on projects, as with manufacturing operations, increases the cost of the product or service and often increases the time needed to complete the reworked activities. Because of the duration constraints of a project, the development of the appropriate skills, materials, and work processes early in the project is critical to project success. On more complex projects, time is allocated to developing a plan to understand and develop the appropriate levels of skills and work processes.

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

Project Team: Human Resources and Communications

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

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

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

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

Communications

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

Communicating can be divided into two categories: synchronous and asynchronous. If all the parties to the communication are taking part in the exchange at the same time, the communication is synchronous. A telephone conference call is an example of synchronous communication. When the participants are not interacting at the same time, the communication is asynchronous. (The letter *a* at the beginning of the word means *not*.) Communications technologies require a variety of compatible devices, software, and service providers, and communication with a global virtual team can involve many different time zones. Establishing effective communications requires a communications plan.

Project Risk

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

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

The project team analyzes the identified risks and estimates the likelihood of the risks occurring. The team then estimates the potential impact on project goals if the event does occur. The outcome from

this process is a prioritized list of estimated project risks with a value that represents the likelihood of occurrence and the potential impact on the project.

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

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

Project Procurement

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

On larger, more complex projects, personnel are dedicated to procuring and managing the equipment, supplies, and materials needed by the project.

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

Project Stakeholder Management

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

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

Knowledge Areas	Description	Tools/Techniques
1. Project Integration Management	Processes required to ensure the elements of the project are properly coordinated and changes are integrated.	❖ Project Charter ❖ Project Plan ❖ Change Request
2. Project Scope Management	Processes required to ensure that project includes all the work that is required and only the work that is required to complete the project successfully.	❖ Scope Statement ❖ Work Breakdown Structure ❖ Formal Acceptance
3. Stakeholders and/Sponsor Management	Processes required to manage stakeholders and sponsor expectations and involvement.	❖ Stakeholders Analysis ❖ Stakeholder Register ❖ The Power/Interest Grid ❖ Cooperation-Threat Matrix ❖ Communication Plan
4. Project Time Management	Processes required to ensure timely completion of the project.	❖ Gantt Charts ❖ Network Diagrams ❖ Task Estimates ❖ Project/Work Schedules
5. Project Cost Management	Processes required to ensure the project is completed within the approved budget.	❖ Resource Requirements ❖ Cost Estimates ❖ Project Budget
6. Project Quality Management	Processes required to ensure the project will satisfy the needs for which it was undertaken.	❖ Quality Management Plans ❖ Checklists ❖ Quality Reviews
7. Project Human Resources Management	Processes required to make the most effective use of the people involved with the project.	❖ Role and Responsibility Matrix ❖ Project Organization Chart ❖ Performance Evaluations
8. Project Communications Management	Processes required to ensure the timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information.	❖ Communication Plan-RACI ❖ Status Reports ❖ Presentations ❖ Lessons Learned
9. Project Risk Management	Processes concerned with identifying, analyzing, and responding to project risk.	❖ Risk Management Plan ❖ Risk Response Plan ❖ Risk Log.
10. Project Procurement Management	Processes required to acquire goods and services outside the performing organization.	❖ Procurement Plan ❖ Statement of Work ❖ Proposals and Contracts

Figure 3.4: Summary of Knowledge Areas – Tools and Technique

Key Takeaways

- Project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements. (PMBOK Guide 2013– Fifth edition)
- The PMI project framework tells you what you have to do to manage your projects from start to finish. It describes every step in the project life cycle in depth, so you know exactly which tasks to complete, when and how. The framework is made up of process groups (5), knowledge areas (10) and numerous activities.
- Project management methodology is a repetitive process which uses a set of forms, guidelines, templates and checklist and other tools that can be applied to specific projects or situations.
- One key benefit of using project management framework is that it's oriented towards customer satisfaction.

Attribution

Chapter 4: Project Initiation

Learning Objectives

- Identify the activities required to initiate a project.
- Write project objectives – SMART.
- Discuss the purpose of the project charter.
- Design a project charter.

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

A detailed description of the problem or opportunity with headings such as Introduction, Business Objectives, Problem/Opportunity Statement, Assumptions, and Constraints

- A list of the alternative solutions available
- An analysis of the business benefits, costs, risks, and issues
- A description of the preferred solution
- Main project requirements
- A summarized plan for implementation that includes a schedule and financial analysis.

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

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

The success of your project depends on the clarity and accuracy of your business case and whether people believe they can achieve it. Whenever you consider past experience, your business case is more

realistic; and whenever you involve other people in the business case's development, you encourage their commitment to achieving it.

Often the pressure to get results encourages people to go right into identifying possible solutions without fully understanding the need or what the project is trying to accomplish. This strategy can create a lot of immediate activity, but it also creates significant chances for waste and mistakes if the wrong need is addressed. One of the best ways to gain approval for a project is to clearly identify the project's objectives and describe the need or opportunity for which the project will provide a solution. For most of us, being misunderstood is a common occurrence, something that happens on a daily basis. At the restaurant, the waiter brings us our dinner and we note that the baked potato is filled with sour cream, even though we expressly requested "no sour cream." Projects are filled with misunderstandings between customers and project staff. What the customer ordered (or more accurately what they think they ordered) is often not what they get. The cliché is "I know that's what I said, but it's not what I meant." Figure 6.1 demonstrates the importance of establishing clear objectives.

The need for establishing clear project objectives cannot be overstated. An objective or goal lacks clarity if, when shown to five people, it is interpreted in multiple ways. Ideally, if an objective is clear, you can show it to five people who, after reviewing it, hold a single view about its meaning. The best way to make an objective clear is to state it in such a way that it can be verified. Building in ways to measure achievement can do this. It is important to provide quantifiable definitions to qualitative terms. [1]

1. FIgure 6.1 Project Management by Andreas Cappell (https://www.flickr.com/photos/cappellmeister/5921913/) used under CC-BY-NC-SA (https://creativecommons.org/licenses/by-nc-sa/2.0/)

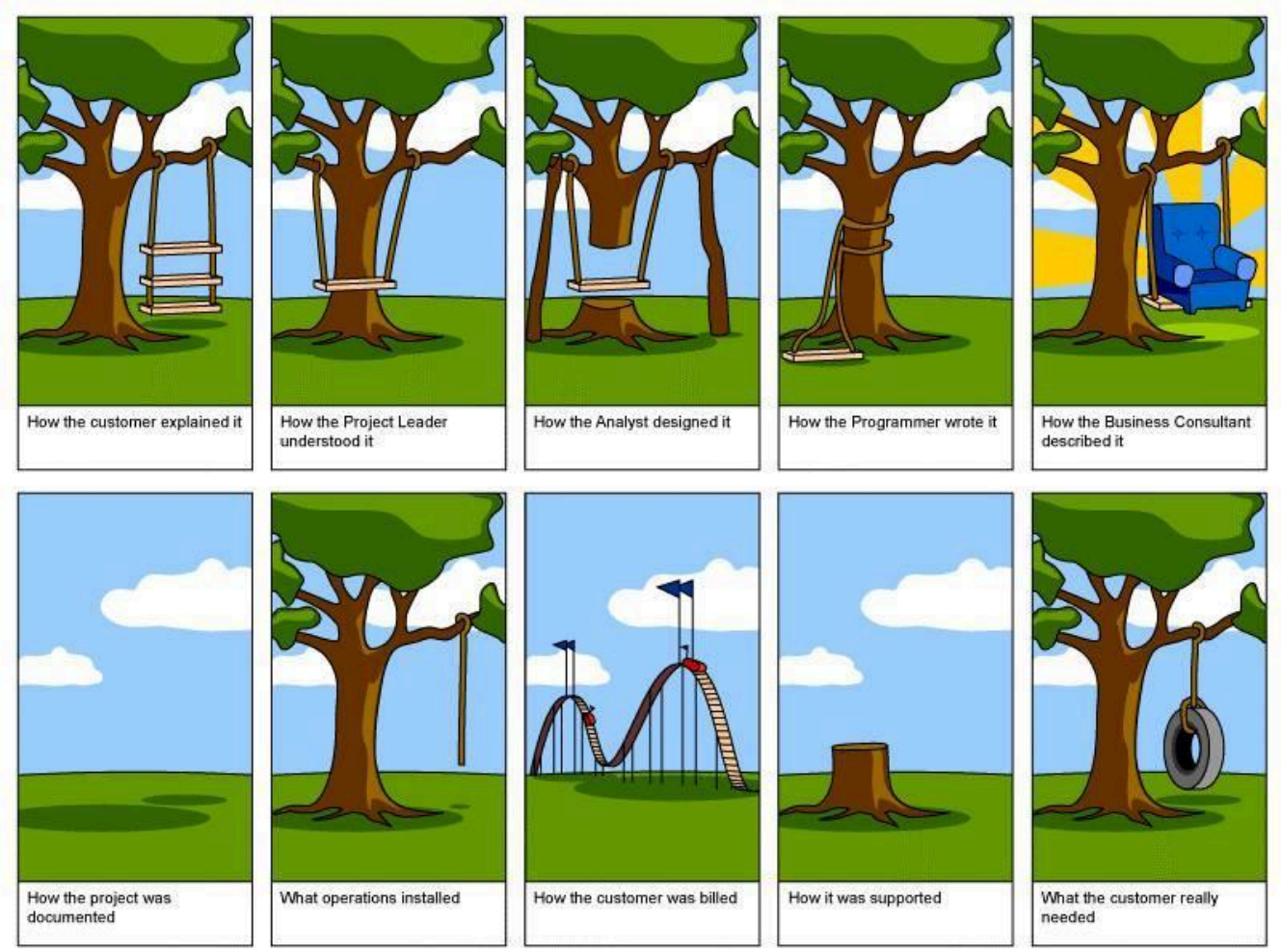

Figure 6.1: Project Management

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

Imagine an office manager has contracted a painter to paint his office. His goal or objective is to have the office painted a pleasing blue color. Consider the conversation that occurs in Figure 6.2[2] after the job was finished.

2. Figure 6.2: The consequence of not making your objective clear. Illustration from Barron & Barron Project Management for Scientists and Engineers, http://cnx.org/content/col11120/1.4/

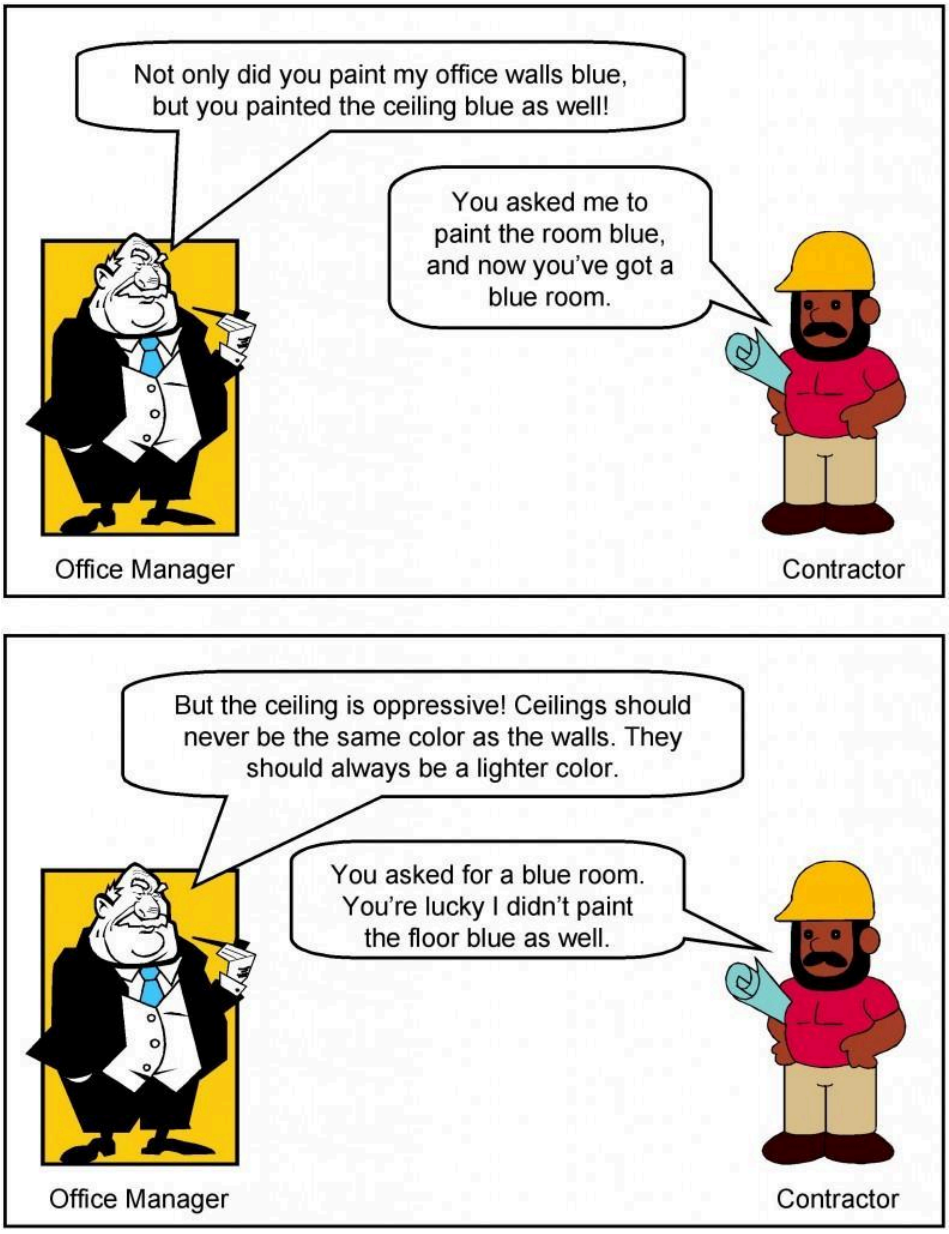

Figure 6.2: The consequence of not making your objective clear. [Image Description]

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

- Less is more
- Avoid technical jargon or acronyms
- Create SMART objects (See below)
- Make the objectives controllable

- Be sure all relevant parties agree on the project's objective

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.

Purpose of the Project Charter

The purpose of a project charter is to:

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

Simple example of Project Charter

***Front Page*:**

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: JIBC Computer Store Creation

Project Sponsor: Jane Epp, Facilities Manager

Date: Jan 12, 2016

Revision: 1

Project Manager: Monica Styles

***Record of Amendment* –**

Facilitate change management and revisions

Example:

Overview of the Project

Provide a simple but precise statement of the project.

Example:

JIBC is planning to create a store to sell computer supplies.

Objectives

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

Specific (get into the details)

Measurable (use quantitative language so that you know when you are finished)

Acceptable (to stakeholders)

Realistic (given project constraints)

Time based (deadlines, not durations)

Example:

The objective of this project is to implement a campus store that is ready to sell computer supplies such as memory sticks, mouse pads, and cables, when class starts in August 2017, with enough inventory 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:
- Determine what supplies will be sold in the store.
- Establish competitive prices for the computer supplies.
- Source and secure supply vendors.
- Establish marketing, procurement, operations, and any other necessary, schools, centers, and division.

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 institute store

Store design or construction

Major Milestones

List all major milestones needed to ensure project completion successfully.

Example:

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

Major Deliverables

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

Example:

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

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 JIBC student body and faculty.
- JIBC 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 JIBC 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 JIBC Student Support Center while supplying necessary items to students and faculty at competitive prices. The institute's 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 (Budget)

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 Student Services.

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 provincial election coming and the new government may change the taxation rules for institutes/colleges/ university retail outlets.

2. The cloud is changing student demand for media such as flash drives in somewhat unpredictable ways. If this happens faster than we forecast, we may be building a store that students don't need.

3. Deliveries of store shelves, etc. will be delayed if a major hurricane occurs.

Project Charter Acceptance

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

Project Stakeholders

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

Function	**Name**	**Role**
Project Manager	Monica Styles	Leads the project
Sponsor	Jane Epp	Project sponsor
etc.		

Approval

Name Project Leader……Date……..

Sponsor ……..Date……..

The project initiation phase addresses the following questions:

1. Why are we doing this project? (Purpose).

2. What organization level goals and objectives does this project support? (Alignment).
3. How does the project fit with other projects that are going on?
4. What is the expected benefit from the project (Value)?
5. What are we going to do? (Scope)?
6. How are we going to do it? (Strategy)?
7. Who is affected by this and who must be involved? (Stakeholders)?
8. How do we obtaining approval? (Project Charter)?
9. How will we know when we are done and successful? (Success Criteria)?

Key Takeaways

- Objectives provide quantifiable definitions to qualitative terms. Objectives must follow the SMART principles. Objectives must be:
    - Clear – no ambiguity
    - Stated in a way that can be verified
    - Stated in ways to measure achievements
- Project charter is a document that officially sanctions the project or it's a mandate for action. It spells out in writing the nature and scope of the work and the sponsor's expectations for results. It is a critical tool used by the project manager.
- The project initiation phase addresses nine key questions.

Attribution

This chapter is based on chapter 7 in Project Management by Adrienne Watt.

Chapter 5: Scope Planning

Learning Objectives

- Define project scope.
- Prepare a scope document.
- Develop a Work Breakdown Structure (WBS).
- Examine the significance of WBS

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

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

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 like dimensions, ease of use, color, specific ingredients, and so on. 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.

Computer System Example

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

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

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

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

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

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

For the customer records example, the constraints might be:

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

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

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

1. **Time**: When a deliverable should be delivered
2. **Resource**: How much money is available to develop the deliverable
3. **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 required functionality and fulfill required operational characteristics.

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

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.

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

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

Once the requirements are documented, have the stakeholders sign off on their requirements as a confirmation of what they desire.

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

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

Software Requirements Fundamentals

This section refers to requirements of “software” because it is concerned with problems to be addressed by software. A software requirement is a property that must be exhibited by software developed or adapted to solve a particular problem. The problem may be to automate part of a task of someone who will use the software, to support the business processes of the organization that has commissioned the software, to correct shortcomings of existing software, to control a device, etc. The functioning of users, business processes, and devices is typically complex. Therefore, the requirements on particular software are typically a complex combination of requirements from different people at different levels of an organization and from the environment in which the software will operate.

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

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

Measuring Requirements

As a practical matter, it is typically useful to have some concept of the volume of the requirements for a particular software product. This number is useful in evaluating the size of a change in requirements, in estimating the cost of a development or maintenance task, or simply in using it as the denominator in other measurements (see Table 8.1)

[table id=1 /]

Scope Inputs

The project manager gathers initial project facts from the project charter. In addition, background information on the stakeholder’s workplace, existing business model and rules, etc. assist in creating the vision of the final product/service, and consequently, the project scope.

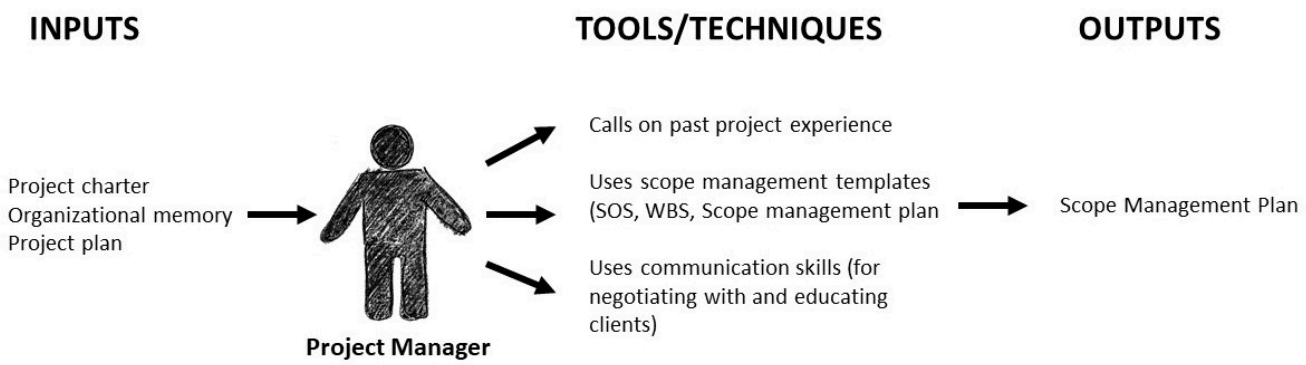

Figure 8.1: Scope input-output. [Image description]

Techniques

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

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

Requirements Traceability Matrix

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

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

Attributes associated with each requirement can be recorded in the requirements traceability matrix. These attributes help to define key information about the requirement. Typical attributes used in the requirements traceability matrix may include a unique identifier, a textual description of the requirement, the rationale for inclusion, owner, source, priority, version, current status (such as active, cancelled, deferred, added, approved), and date completed. Additional attributes to ensure that the requirement has met stakeholders' satisfaction may include stability, complexity, and acceptance criteria.[1]

Work Breakdown Structure

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

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

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

Overview

WBS is a hierarchical decomposition of the project into phases, deliverables, and work packages. It is a tree structure, which shows a subdivision of effort required to achieve an objective (e.g., a

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

program, project, and contract). In a project or contract, the WBS is developed by starting with the end objective and successively subdividing it into manageable components in terms of size, duration, and responsibility (e.g., systems, subsystems, components, tasks, subtasks, and work packages), which include all steps necessary to achieve the objective.

The WBS creation involves:

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

The purpose of developing a WBS is to:

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

Example of a WBS

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

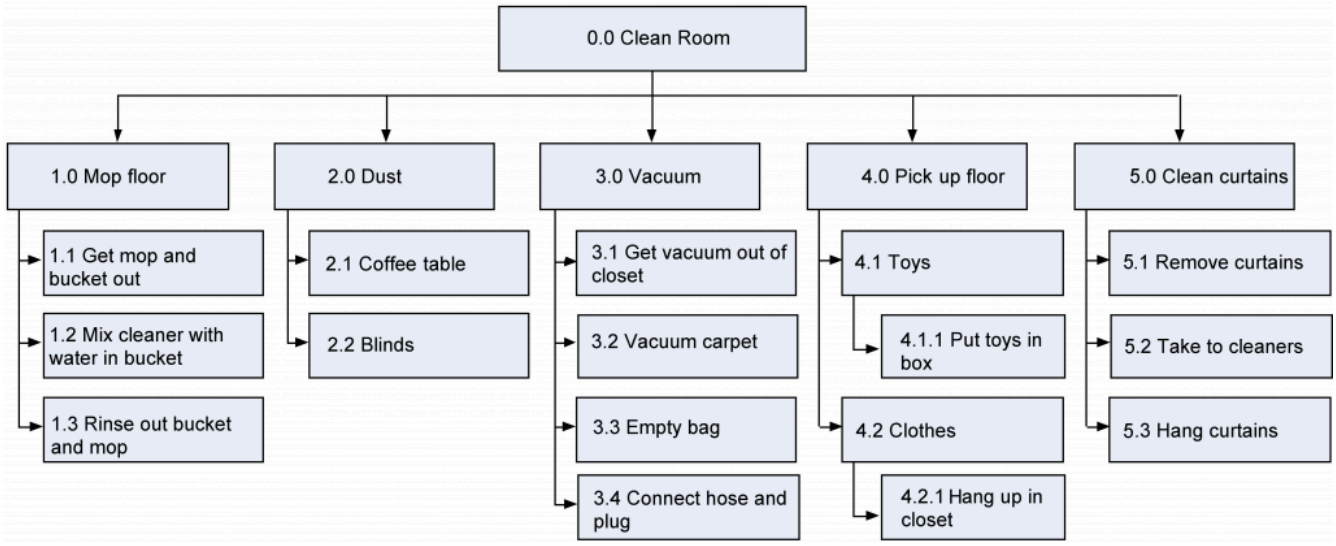

Figure 8.2 WBS format or cleaning a room.

It is very important to note that we do not worry about the sequence in which the work is performed or any dependencies between the tasks when we do a WBS. That will be worked out when we develop the schedule. For example, under 3.0 Vacuum, it would be obvious that 3.3 Vacuum carpet would be performed after 3.4 Connect hose and plug! However, you will probably find yourself thinking sequentially, as it seems to be human nature to do so. The main idea of creating a WBS is to capture all of the tasks, irrespective of their order. So if you find yourself and other members of your team thinking sequentially, don't be too concerned, but don't get hung up on trying to diagram the sequence or you will slow down the process of task identification. A WBS can be structured any way it makes sense to you and your project. In practice, the chart structure is used quite often but it can be composed in outline form as well.

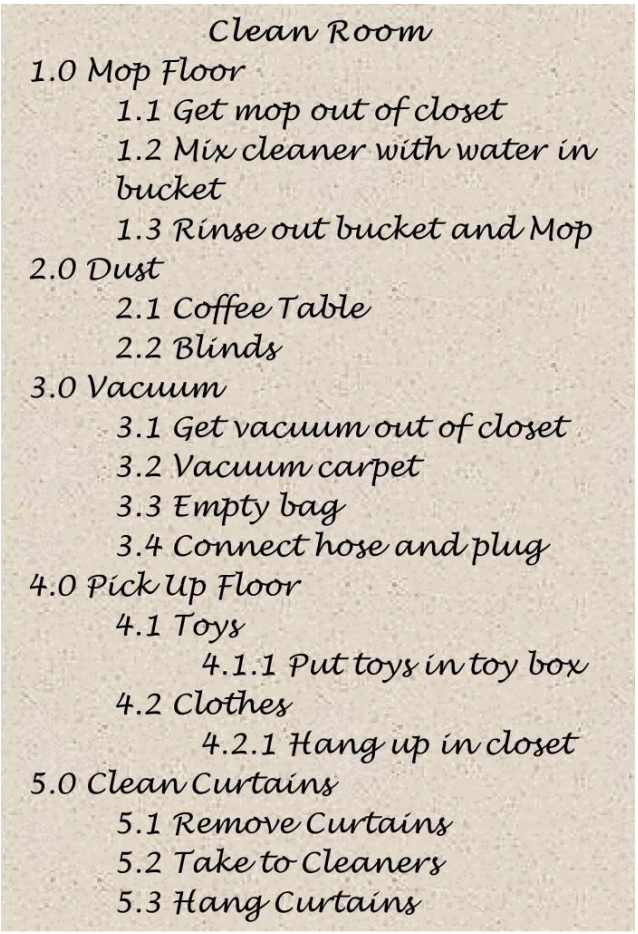

Figure 8.3: Clean Room in an outline view.

You'll notice that each element at each level of the WBS in both figures is assigned a unique identifier. This unique identifier is typically a number, and it's used to sum and track costs, schedules, and resources associated with WBS elements.

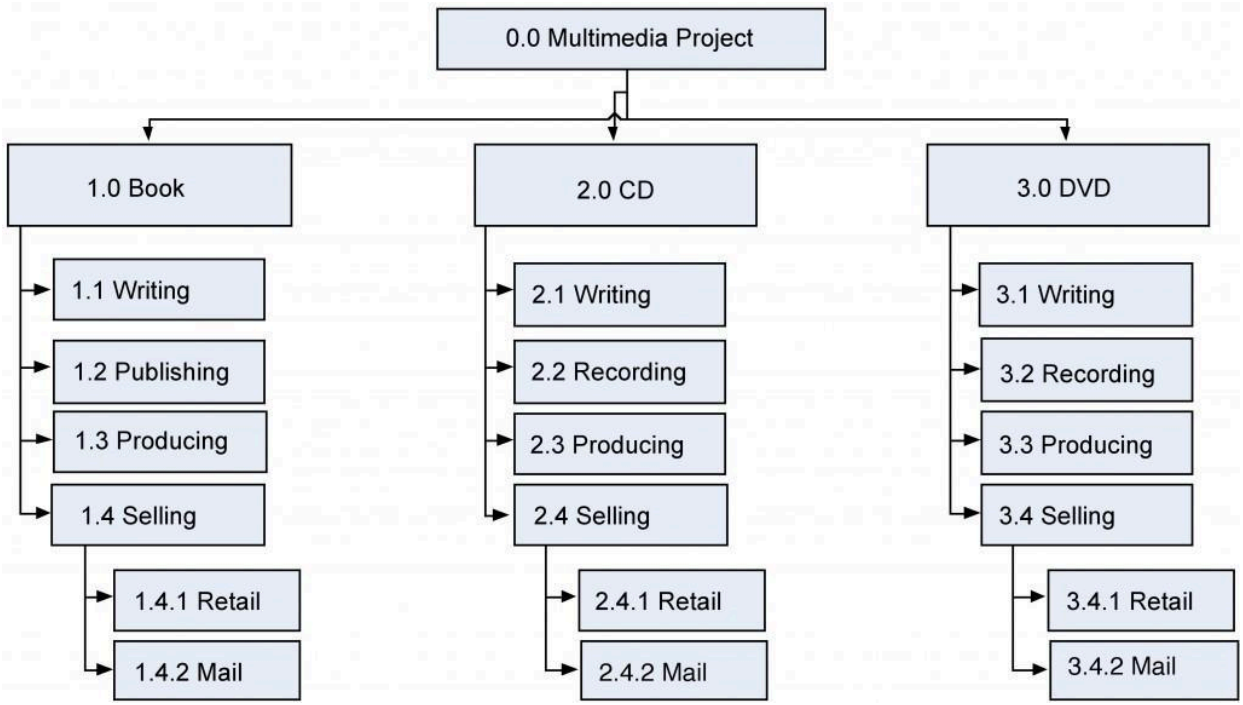

Figure 8.4: A WBS for a multimedia project

There are also many ways you can organize the WBS. For example, it can be organized by either deliverable or phase. The major deliverables of the project are used as the first level in the WBS. For example, if you are doing a multimedia project the deliverables might include producing a book, CD, and a DVD (Figure 8.4).

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

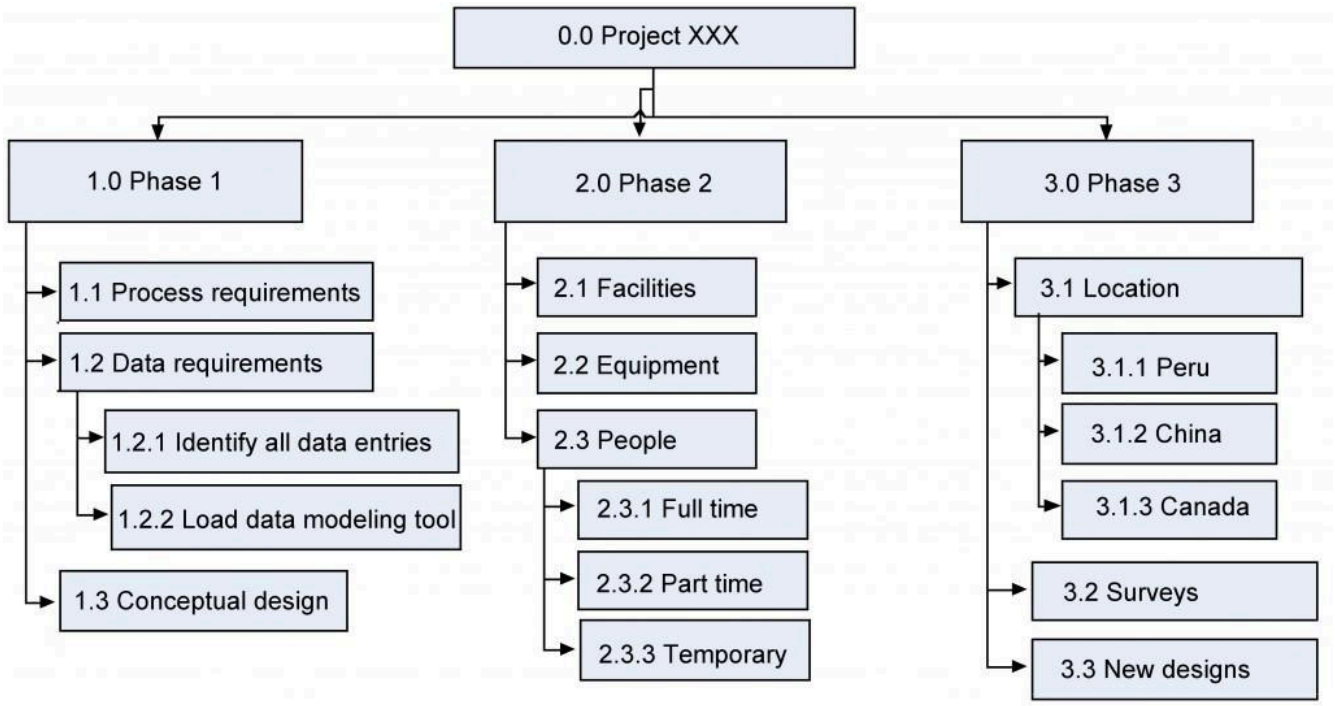

Figure 8.5: WBS Project Phases

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

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

100 Percent Rule

The 100 percent rule is the most important criterion in developing and evaluating the WBS. The rule states that each decomposed level (child) must represent 100 percent of the work applicable to the next higher (parent) element. In other words, if each level of the WBS follows the 100 percent rule down to the activities, then we are confident that 100 percent of the activities will have been identified when we develop the project schedule. When we create the budget for our project, 100 percent of the costs or resources required will be identified.

Scope Statement

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

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

As a baseline scope statements should contain:

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

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

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

Key Takeaways

- Project scope planning is concerned with the definition of all the work needed to successfully meet the project objectives.
- Requirements describe the characteristics of the final deliverable, whether it is a product or a service.
- Project deliverables are tangible outcomes, measurable results, or specific items that must be produced to consider either the project or the project phase completed.
- Work breakdown structure (WBS) is a technique used to decompose high-level project goals into the many tasks required to achieve them.
- WBS is a hierarchical decomposition of the project into phases, deliverables, and work packages. It is a tree structure, which shows a subdivision of effort required to achieve an objective.
- Once WBS is complete, managers can estimate the time and cost required to complete each task.

They can also assign people to the tasks they've identified.

- The development of a WBS should be a team effort whenever possible.
- The benefits of developing a WBS includes: defining task, identifying responsibility, aids project communication and provides an excellent graphical way to present the progress of the project.
- The WBS may reveal some challenging conclusion: The project will cost more than it's worth, the organization lacks the skills to do the job, or the project will take too long to complete.
- WBS follows 100% rule.
- There is no sequencing of tasks in the WBS.
- A scope statement captures, in very broad terms, the product or service of the project. A scope statement specify what is within the scope of the project and what is not. It should also include the list of users using the product or service as well as the features in the resulting product. This is important to avoid scope creep.

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Chapter 6: Project Schedule Planning

Learning Objectives

- Apply effective scheduling tools and techniques to sequence and accurately estimate activity duration.
- Outline the benefits of using scheduling tools such as Gantt chart and network diagrams.
- Create a draft schedule
- Optimize the schedule
- Examine the significance of the critical path.

Defining Activities

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

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

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

A Case Study

Susan and Steve have decided to tie the knot, but they don't have much time to plan their wedding. They want the big day to be unforgettable. They want to invite many people and provide a great time. They've always dreamed of a June wedding, but it's already January. Just thinking about all of the details involved is overwhelming. Susan has been dreaming of the big day since she was 12, but it seems that there's so little time for all the tasks to be completed. When they were choosing the paper for the invitations, the couple realized that they needed help.

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

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

- Invitations
- Flowers
- Wedding cake
- Dinner menu
- Band

Since many different people are involved in the making of the wedding, it takes much planning to coordinate all the work in the right order by the right people at the right time. Initially, Sally was worried that she didn't have enough time to make sure that everything would be done properly. However, she knew that she had some powerful time management tools on her side when she took the job, and these tools would help her to synchronize all the required tasks.

To get started, Sally arranged all the activities in a work breakdown structure. The next exercise presents part of the WBS Sally made for the wedding.

WBS Exercise [1]

Arrange the following activities into the WBS – Figure 9.1 to show how the work items decompose into activities.

1. Shop for shoes
2. Create guest list
3. Have the tailoring and fitting done
4. Shop for dress
5. Find caterer
6. Cater the wedding
7. Wait for RSVPs
8. Mail the invitations
9. Finalize the menu
10. Print the invitations
11. Choose the bouquet

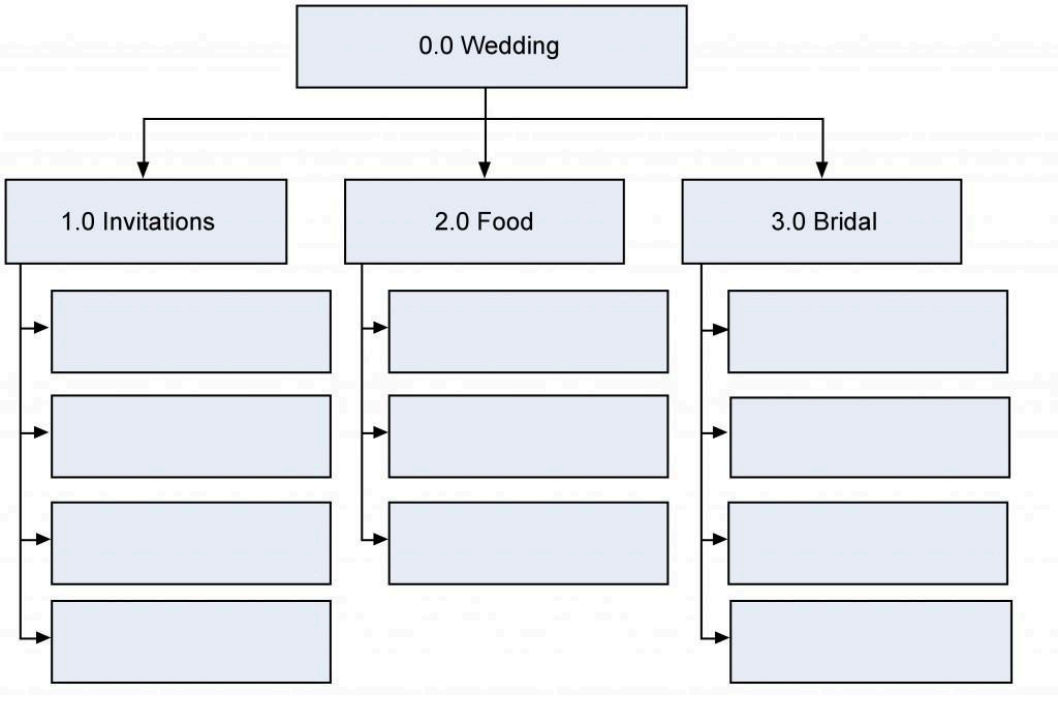

Figure 9.1: Work breakdown structure (WBS) based on project phase.

1. Wedding WBS Exercises and Wedding WBS Exercises Solution © Barron & Barron Project Management for Scientists and Engineers is licensed under a CC BY (Attribution) license

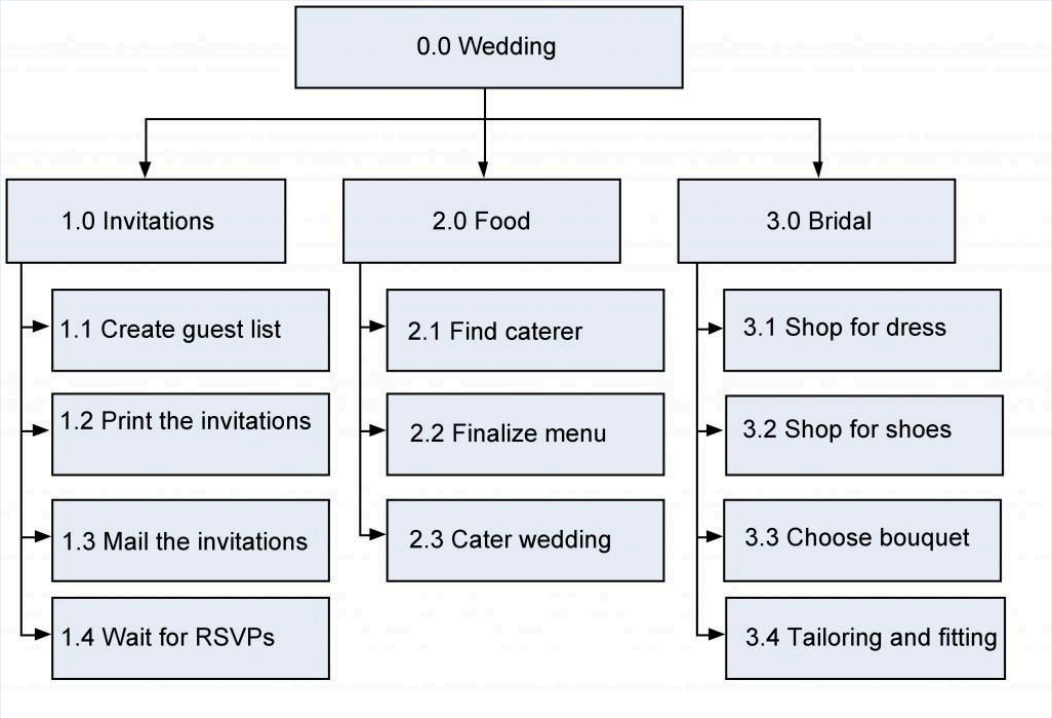

Figure 9.2: WSB Wedding Exercises Solution. [Image description]

Activity List

Now that the activity definitions for the work packages have been completed, the next task is to complete the activity list. The project activity list is a list of everything that needs to be done to complete your project, including all the activities that must be accomplished to deliver each work package. Next you want to define the activity attributes. Here's where the description of each activity is kept. It includes all the information you need to figure out plus the order of the work. Any predecessor activities, successor activities, or constraints should be listed in the attributes along with descriptions and any other information about resources or time that you need for planning. The three main kinds of predecessors are finish-to-start (FS), start-to-start (SS), and finish-to-finish (FF). The most common kind of predecessor is the finish-to-start. It means that one task needs to be completed before another one can start. When you think of predecessors, this is what you usually think of; one thing needs to end before the next can begin. It's called finish-to-start because the first activity's finish leads into the second activity's start (Figure 9.3).

Figure 9.3: An example of a finish-to-start (FS) predecessor.

The start-to-start predecessor is a little less common, but sometimes you need to coordinate activities so they begin at the same time (Figure 9.4).

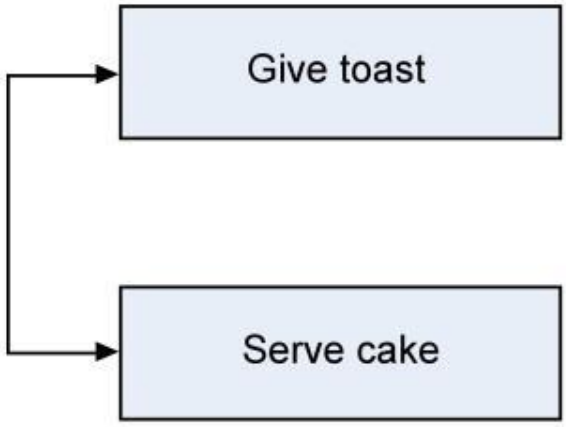

Figure 9.4: An example of a start-to-start predecessor.

The finish-to-finish predecessor shows activities that finish at the same time (Figure 9.5).

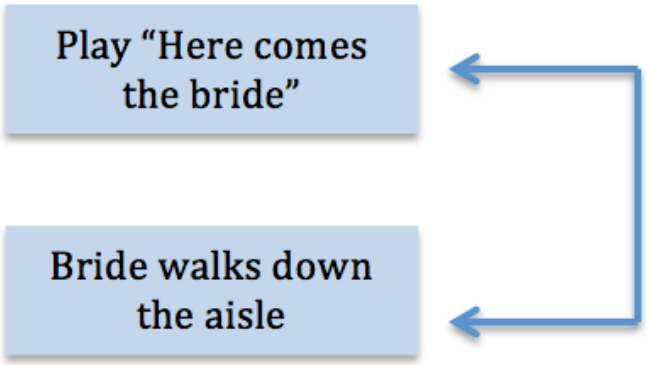

Figure 9.5: An example of a finish-to-finish (FF) predecessor.

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

External Predecessors

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

Discretionary Predecessors

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

Mandatory Predecessors

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

Leads and Lags

Sometimes you need to give some extra time between activities. Lag time is when you purposefully put a delay between the predecessor task and the successor. For example, when the bride and her father dance, the others wait awhile before they join them (Figure 9.6).

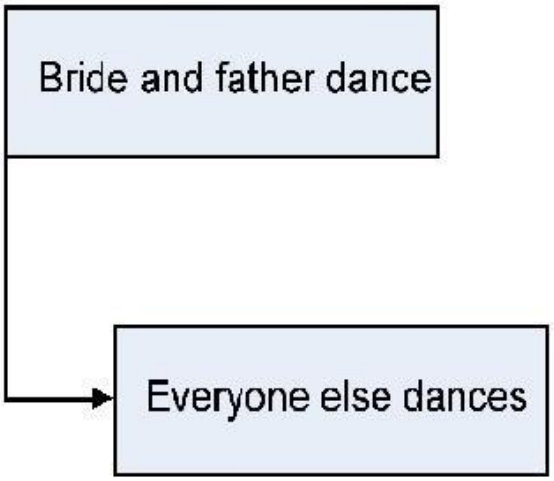

Figure 9.6: A lag means making sure that one task waits a while before it gets started.

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

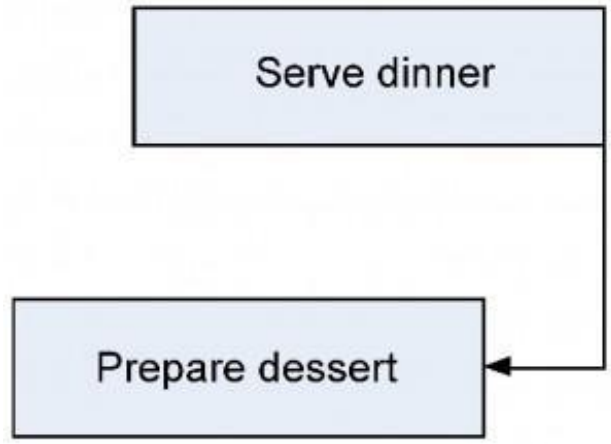

Figure 9.7: A lead is when you let a task get started before its predecessor is done.

Milestones

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

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

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

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

Some things that could go wrong:

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

The Activity Sequencing Process

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

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

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

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

Creating the Gantt chart

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

Gantt charts show all the key stages of a project and their duration as a bar chart, with the time scale across the top. The key stages are placed on the bar chart in sequence, starting in the top left corner and ending in the bottom right corner (Figure 9.8). A Gantt chart can be drawn quickly and easily and is often the first tool a project manager uses to provide a rough estimate of the time that it will take to complete the key tasks. Sometimes it is useful to start with the target deadline for completion of the whole project, because it is soon apparent if the time scale is too short or unnecessarily long. The detailed Gantt chart is usually constructed after the main objectives have been determined.

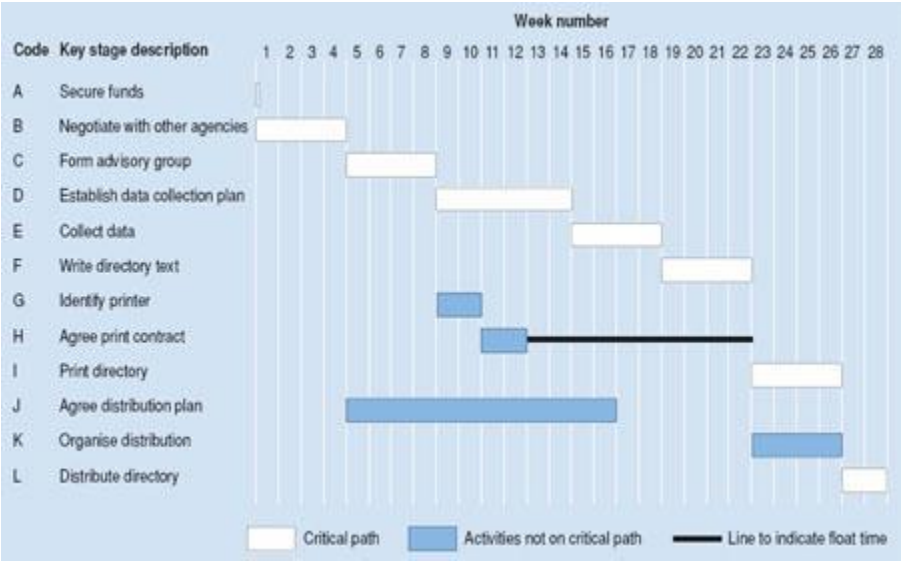

Figure 9.8 Gantt chart for directory production

In this example in Figure 9.8, key stage K (Organize distribution) starts at week 23 so that its end point coincides with key stage L (Distribute directory). However, K could begin as early as week 17, as soon as key stage J is completed. Key stage K is therefore said to have "slack." Key stage H (Agree print contract) has been placed to end at week 12. However, it could end as late as week 22, because key stage I (Print directory) does not begin until week 23. Key stage H is therefore said to have "float." Float time can be indicated on the chart by adding a line ahead of the bar to the latest possible end point. Slack and float show you where there is flexibility in the schedule, and this can be useful when you need to gain time once the project is up and running.

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

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

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

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

Creating the Network Diagram

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

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

The first step is to arrange the tasks from your WBS into a sequence. Some tasks can be accomplished at any time throughout the project where other tasks depend on input from another task or are constrained by time or resources.(Figure 9.9[2])

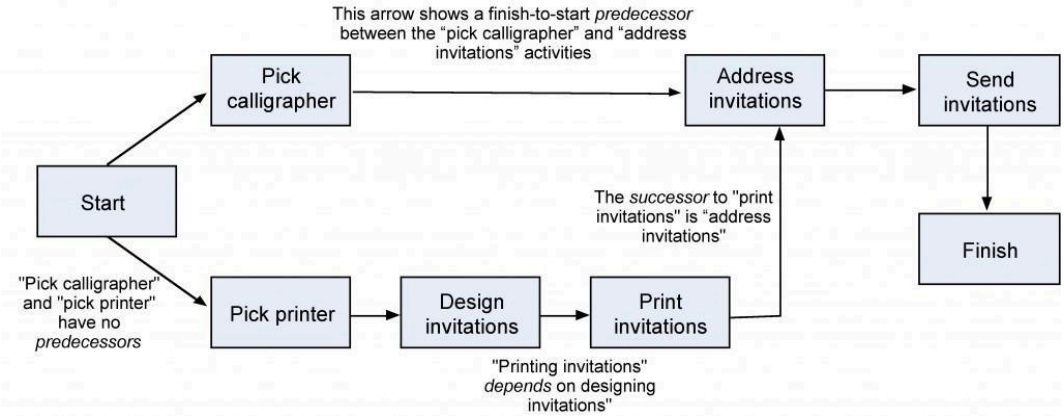

Figure 9.9: The relationship between the work breakdown structure (WBS) and the network diagram.

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

The network diagram provides important information to the project team. It provides information about how the tasks are related (Figure 9.9), where the risk points are in the schedule, how long it will take as currently planned to finish the project, and when each task needs to begin and end.

In our wedding planner example, Sally would look for relationships between tasks and determine what can be done in parallel and what activities need to wait for others to complete. As an example, Figure 9.10 shows how the activities involved in producing the invitations depend on one another. Showing the activities in rectangles and their relationships as arrows is called a precedence diagramming method (PDM). This kind of diagram is also called an activity-on-node (AON) diagram.

Another way to show how tasks relate is with the activity-on-arrow (AOA) diagram. Although AON is more commonly used and is supported by all project management programs, PERT is the best-known AOA-type diagram and is the historical basis of all network diagramming. The main difference is the AOA diagram is traditionally drawn using circles as the nodes, with nodes representing the beginning and ending points of the arrows or tasks. In the AOA network, the arrows represent the activities or tasks (Figure 9.11).

2. Illustration from Barron & Barron Project Management for Scientists and Engineers, http://cnx.org/content/col11120/1.4/

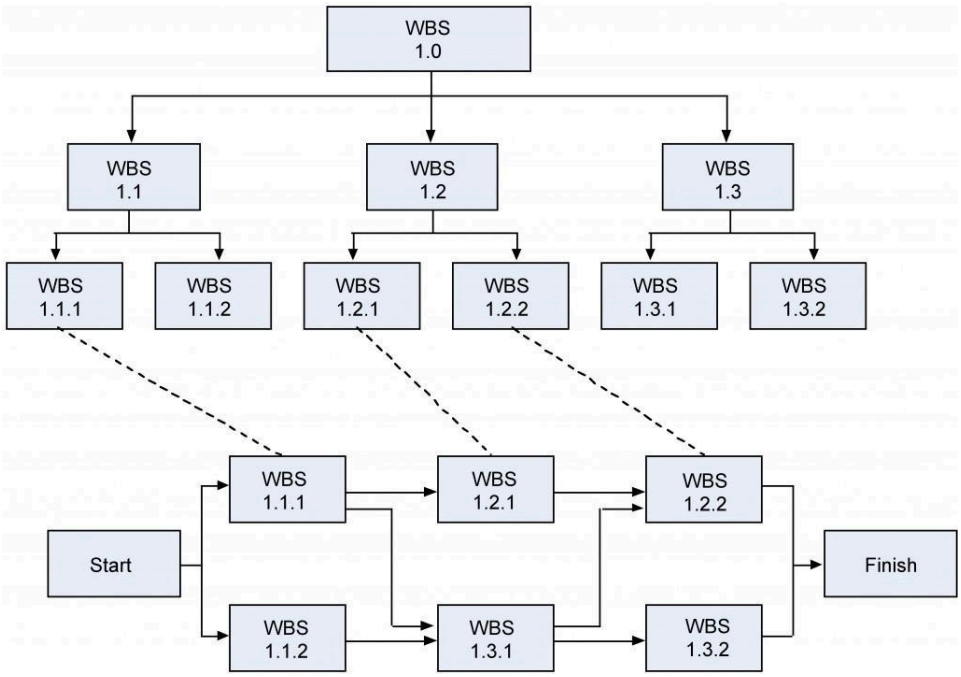

Figure 9.10: An example of an activity on node (AON) diagram.

All network diagrams have the advantages of showing task interdependencies, start and end times, and the critical path (the longest path through the network) but the AOA network diagram[3] has some disadvantages that limit the use of the method.

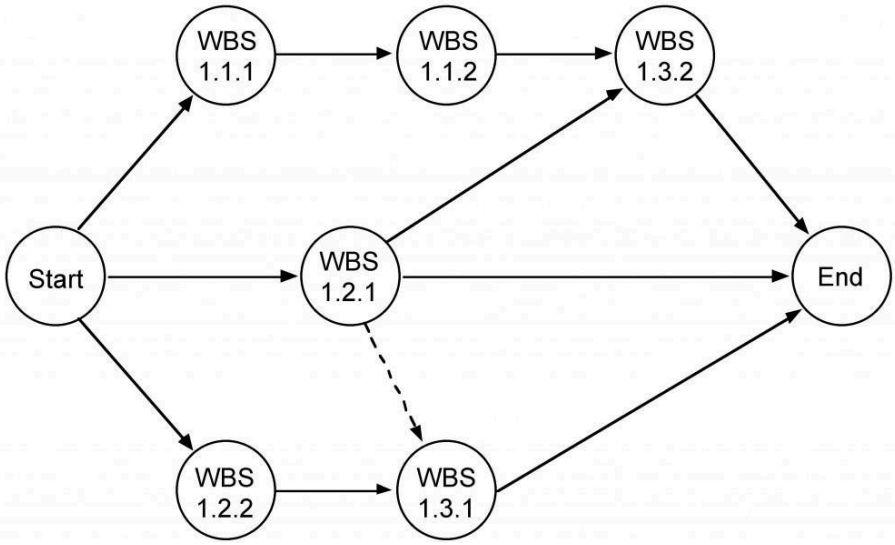

Figure 9.11: An example of an activity arrow (AOA) network diagram.

The three major disadvantages of the AOA method are:

1. The AOA network can only show finish-to-start relationships. It is not possible to show lead and lag except by adding or subtracting time, which makes project tracking difficult.
2. There are instances when dummy activities can occur in an AOA network. Dummy activities

3. Illustration from Barron & Barron Project Management for Scientists and Engineers, http://cnx.org/content/col11120/1.4/

are activities that show the dependency of one task on other tasks but for other than technical reasons. For example, one task may depend on another because it would be more cost effective to use the same resources for the two; otherwise the two tasks could be accomplished in parallel. Dummy activities do not have durations associated with them. They simply show that a task has some kind of dependence on another task.

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

The Critical Path

The critical path is the longest path through the project, and any delays along it will delay completion of the entire project. In this sense, there is zero slack time within the critical path. It is based on the idea that some tasks must be completed before others can begin, thus while some task can be sequenced with much flexibility, critical path tasks are locked in by task relationships . A critical path diagram is a useful tool for scheduling dependencies and controlling a project. In order to identify the critical path, the length of time that each task will take must be calculated.

Let's take a look at an example. The length of time in weeks for each key stage is estimated:[4]

Table 9.1 Stages of the Critical Path

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

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

We have given the key stage “Secure funds” an estimated time of zero weeks because the project cannot start without the availability of some funding, although estimates would provide detail at a later stage. The stages can now be lined up to produce a network diagram that shows that there are three paths from start to finish and that the lines making up each path have a minimum duration (Figure 9.12).

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

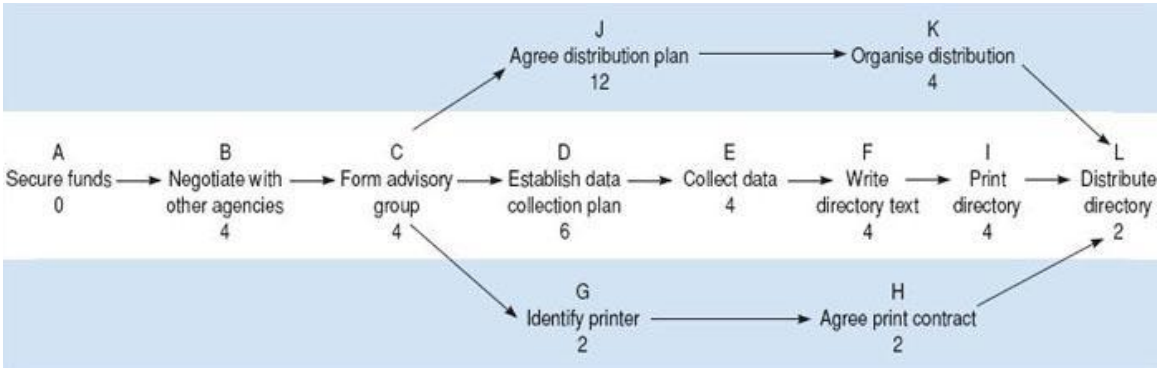

Figure 9.12: Critical Path Diagram

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

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

Optimize the schedule

Optimizing the schedule is the final step in the process where the project manager and team take a very critical look at the draft schedule and seek ways to improve it-that is, to make it more accurate, more realistic, more effective and faster.

Using Scheduling Software

There are different software packages available to the project manager and team to assist them in developing and managing the project schedule. To decide which software best meets your needs do your research and get recommendations from other users. However, ensure that the software is a good fit for you.

Any project planning software must do the following:

- Handle developments and changes to the Gantt charts and network diagrams and be able to calculate the critical path
- Produce schedules and budgets

- Integrate project schedules with calendar allowing for weekends and holidays
- Create “what if” scenarios for contingency planning and updating
- Check for overscheduling of individuals and groups.

Key Takeaways

- Activities are the individual units of work that must be completed to fulfill the deliverables. They are not the deliverables themselves.
- Once all the tasks and sub-tasks have been identified, examine the relationships between tasks to see which must follow a particular sequence and which can be worked in parallel.
- A draft project schedule includes the start and completion dates of all activities, recognizes task duration, and illustrates the dependencies between tasks.
- Gantt charts provides a useful visualization of project status, estimated project and task duration, and task sequences, but they do not reflect underlying task dependencies or critical path.
- The critical path is critical because every single activity on the path must finish on time in order for the project to come in on time. It is the longest path through a project. It represents the total project duration. A delay in any one of the critical path activities will cause the entire project to be delayed.
- Network diagrams shows activities and task graphically in order that they should be accomplished. They illustrates task relationships and connectors in terms of predecessors and successors, which creates the idea of “dependencies” between work packages. Dependencies are often the results of constraints.
- There are advantages and disadvantages for using Gantt charts and Network diagrams.
- Slack is the amount of time a task could be delayed without delaying the completion of the project.

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Chapter 7: Communication Planning

Learning Objectives

- Evaluate the importance of good communication in project management
- Create a communication plan.

Communication throughout the project includes within the team and with others outside the team. Communications management is about keeping everybody in the loop. The communications planning process concerns defining the types of information you will deliver, who will receive it, the format for communicating it, and the timing of its release and distribution. It turns out that 90% of a project manager's job is spent on communication so it's important to make sure everybody gets the right message at the right time.

The first step in defining your communication plan is figuring out what kind of communication your stakeholders need from the project so they can make good decisions. This is called the *communications requirements analysis*. Your project will produce a lot of information; you don't want to overwhelm your stakeholders with all of it. Your job is to figure out what they feel is valuable. Communicating valuable information doesn't mean you always paint a rosy picture. Communications to stakeholders may consist of either good news or bad news. The point is that you don't want to bury stakeholders in too much information but you do want to give them enough so that they're informed and can make appropriate decisions.

Communications technology has a major impact on how you keep people in the loop. Methods of communicating can take many forms, such as written reports, conversations, email, formal status reports, meetings, online databases, online schedules, and project websites. You should consider several factors before deciding what methods you'll choose to transfer information. The timing of the information exchange or need for updates is the first factor. Do you need to procure new technology or systems, or are there systems already in place that will work? The technologies available to you should figure into your plan of how you will keep everyone notified of project status and issues. Staff experience with the technology is another factor. Are there project team members and stakeholders experienced at using this technology, or will you need to train them? Finally, consider the duration of the project and the project environment. Will the technology you're choosing work throughout the life of the project or will it have to be upgraded or updated at some point? And how does the project team function? Are they located together or spread out across several campuses or locations?

The answers to these questions should be documented in the communication plan.

All projects require a sound communication plan, but not all projects will have the same types of communication or the same methods for distributing the information. The communication plan documents the types of information needs the stakeholders have, when the information should be distributed, and how the information will be delivered.

The types of information you will communicate typically include project status, project scope statements and updates, project baseline information, risks, action items, performance measures, project acceptance, and so on. It's important that the information needs of the stakeholders be determined as early in the planning phase of the project management life cycle as possible so that as you and your team develop project planning documents, you already know who should receive copies of them and how they should be delivered.

Types of Communication

Completing a complex project successfully requires good communication among team members. If those team members work in the same building, they can arrange regular meetings, simply stop by each other's office space to get a quick answer, or even discuss a project informally at other office functions. Many projects are performed by teams that interact primarily through electronic communication and are, therefore, called *virtual teams*. To avoid miscommunication that can harm trust and to include team members in a project culture, the project team needs a plan for communicating reliably and in a timely manner. This planning begins with understanding two major categories of communication.

Synchronous Communications

If all the parties to the communication are taking part in the exchange at the same time, the communication is **synchronous**. A telephone or Skype conference call is an example of synchronous communication. The following are examples of synchronous communications:

- *Live meeting:* Gathering of team members at the same location
- *Conference call:* A telephone call in which several people participate
- *Audio conference:* Like a conference call, but conducted online using software like Skype
- *Computer-assisted conference:* Audio conference with a connection between computers that can display a document or spreadsheet that can be edited by both parties
- *Video conference:* Similar to an audio conference but with live video of the participants. Some laptop computers have built-in cameras to facilitate video conferencing
- *IM (instant messaging):* Exchange of text or voice messages using pop-up windows on the participants' computer screens
- *Texting:* Exchange of text messages between mobile phones, pagers, or personal digital assistants (PDAs)—devices that hold a calendar, a contact list, a task list, and other support programs

Modern communication technologies make it possible to assemble project teams from anywhere in the world. Most people work during daylight hours, which can make synchronous meetings difficult if the participants are in different time zones. However, it can be an advantage in some circumstances; for

example, if something must be done by the start of business tomorrow, team members in Asia can work on the problem during their normal work hours while team members in North America get some sleep.

Remember Time Zones

It is important to remember time zones and calculate the difference between yours and your associates' zones correctly so as not to miss important meetings or deadlines. Cities and countries to the north or south of each other all observe the same local time. Be aware that many well-educated people in the United States and Canada think of South America as directly south of North America. As you can see, South American countries can be up to five time zones east of North America.

> A helpful site to convert local time to another time zone is Time Zone Convertor

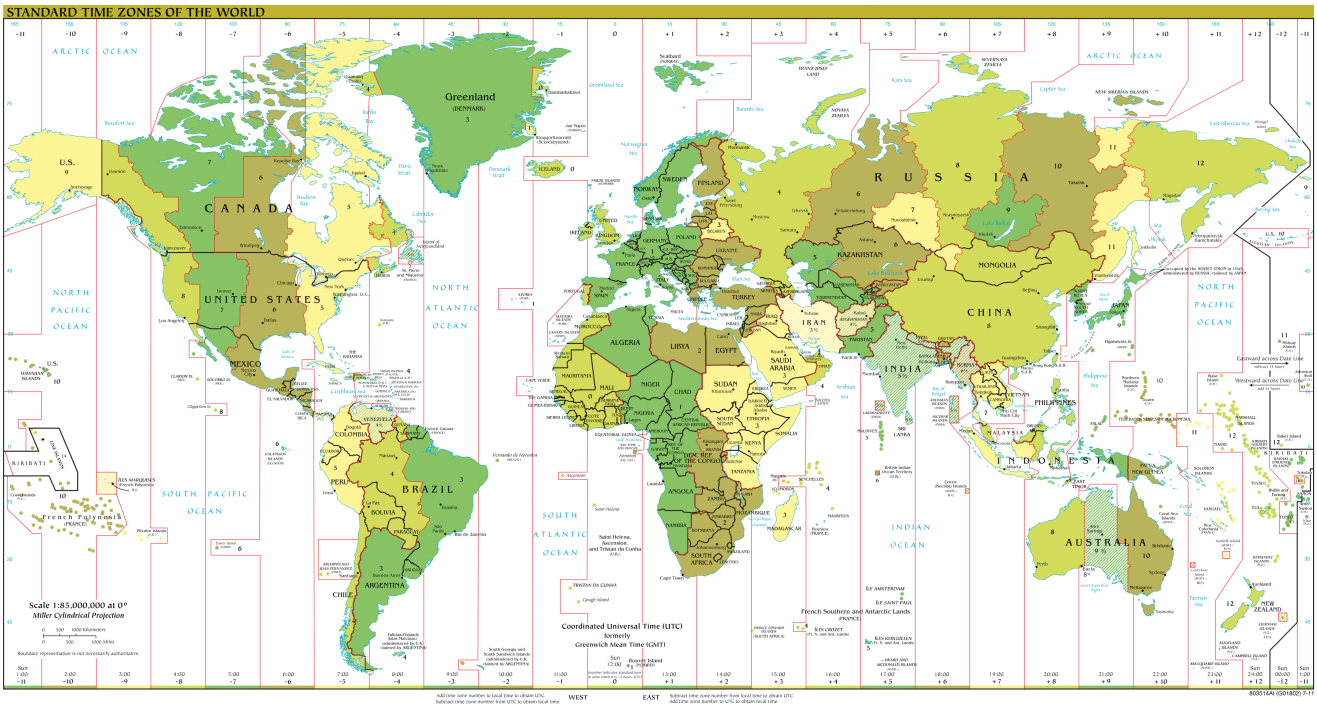

Figure 15.1: World Time Zones.

Time zones (Figure 15.1[1]) are calculated in reference to the time zone of the Royal Observatory in Greenwich, England. The time at that location is Greenwich Mean Time (GMT). More recent references designate it as Coordinated Universal Time (UTC) instead of GMT. The time zones advance from Greenwich in an easterly direction. However, at the international dateline (about the midpoint around the world from Greenwich), you subtract the time zone from GMT. To prevent confusion between a.m. and p.m., times are often given using a 24-hour clock. For example, midnight is indicated as 00:00, noon is 12:00 and 1 p.m. is 13:00.

1. Standard time zones of the world by TimeZonesBoy http://commons.wikimedia.org/wiki/File:Standard_time_zones_of_the_world.png under the Public Domain

Example: Conference Call between Toronto and Paris

A project manager for a software development project in Toronto is five time zones west of the reference zone, so the time is given as UTC–5 (or GMT–5). If it is noon in the reference zone, it is 7 a.m. (five hours earlier) in Toronto. The manager would like to contact a project team member in Paris, France. Paris is one time zone east of the reference zone (UTC+1 or GMT+1). If it is noon (12:00) in the reference zone, it is 1 p.m. (13:00) in Paris. This means that there is a six-hour difference between Toronto and Paris. If the project manager waits until after lunch to place the call (1 p.m. in Toronto), it will be too late in the day in Paris (7 p.m.) to reach someone.

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.

Mail and Package Delivery

Many companies prefer that final contracts are personally signed by an authorized representative of each party to the agreement. If several signatures are required, this can take weeks to get all the signatures if the contracts are transferred by a postal service. If this process is holding up the start of the project, you can use an overnight delivery service to minimize the time spent transferring the documents.

Fax

Fax machines have been around a long time and enjoy a high level of trust for transmitting documents accurately. Although it might seem archaic to still use fax transmissions, in many countries a fax of a signed contract is legal, but a computer-scanned image is not.

Email

Electronic mail (email) is widely used to coordinate projects and to communicate between team members. It has several valuable characteristics for project management:

- Information can be sent to a list of team members.
- Messages can be saved to document the process in case of a misunderstanding or miscommunication.
- Files can be attached and distributed.

Project Blog

A blog is an online journal that can be private, shared by invitation, or made available to the world. Some project managers keep a journal in which they summarize the day’s challenges and triumphs and the

decisions they made. They return to this journal at a later date to review their decision-making process after the results of those decisions are known to see if they can learn from their mistakes. Many decisions in project management are made with incomplete knowledge, and reflecting on previous decisions to develop this decision-making skill is important to growth as a project manager.

Really Simple Syndication (RSS)

Some projects are directly affected by external factors such as political elections, economic trends, corporate mergers, technological or scientific breakthroughs, or weather. To keep informed about these factors, you can subscribe to online news sources. A technology that facilitates this process is Really Simple Syndication (RSS). Web pages with RSS news feeds have labeled links.

If the user clicks on the RSS feed, news from the website is automatically sent to the user's news reader, such as Google Reader. The news reader can be set to filter the news for key words to limit the stories to those that are relevant to the project.

Assessing New Communication Technologies

New technologies for communicating electronically appear with increasing frequency. Using a new technology that is unfamiliar to the team increases the technology complexity, which can cause delays and increase costs. To decide if a new technology should be included in a communications plan, seek answers to the following questions (Business Dictionary):

- Does the new communication technology provide a competitive advantage for the project by reducing cost, saving time, or preventing mistakes?
- Does the project team have the expertise to learn the new technology quickly?
- Does the company offer support such as a help desk and equipment service for new communication technology?
- What is the cost of training and implementation in terms of time as well as money?

Communication Plan Template

So how do you create a communication plan?

1. Identify your stakeholders (to whom)
2. Identify stakeholder expectations (why)
3. Identify communication necessary to satisfy stakeholder expectations and keep them informed (what)
4. Identify time-frame and/or frequency of communication messages (when)
5. Identify how the message will be communicated (the stakeholder's preferred method) (how)
6. Identify who will communication each message (who)
7. Document items – templates, formats, or documents the project must use for communicating.

Figure 15.2 shows a communication plan template.[2]shows a communication plan template.

Figure 1
Communication plan template

Communications Plan	
Project Name:	Beginning Date:
Project Manager:	Completion Date:
Plan Owner:	
Planning	
Project objective and key message points (high level): • • •	
Stakeholders – target audience (list) • • •	

Outline				
Timeline (date)	**Team Member (responsible for communication)**	**Target (audience)**	**Tool (medium for communication delivery)**	**Messag Points**

Figure 15.2 Communications Plan Template

RACI Chart

RACI analysis is a communication tool which describes the tasks and roles that stakeholders take in delivering a project or operating process:

R – Responsibility (“I get it done”)

A – Accountability (“The buck stops here”)

C – Consulted (“I want to be part of the decisions)

I – Informed (“I want to know”)

Example – Responsible, Accountable, Consult and Inform chart (RACI Matrix)

2. (http://inte5160.wikispaces.com/Communication+Plans) used under CC-BY-SA license (http://creativecommons.org/licenses/by-sa/3.0/)

Activity Description	Roles					
	Sponsor	Project Authority	Project Manager	Team Member 1	Team Member 2	Team Member 3
1	A	I	I	R	I	R
2	I	A	R	I	R	I
3		C	A	I	R	I
4	A	I	I	R	I	R

R: Responsible, A: Accountable, C: Consulted, I: Informed

Key Takeaways

- Project communication is a key success factor.
- Communication throughout the project includes within the team and with others outside the team.
- The communications planning process concerns defining the types of information you will deliver (Communication Requirement Analysis), who will receive it, the format for communicating it, and the timing of its release and distribution.
- A good communication plan includes:
- What needs to be communicated?
- Who needs to be communicated with?
- What methods will be used?
- What frequency?
- Who within the project will be responsible?
- Modern communication technologies make it possible to assemble project teams from anywhere in the world.
- Consider a variety of synchronous and asynchronous options:
- Synchronous Options – Face to face, international–(remember the time zones), Conference call, Video link, Computer-assisted video conference, IM; texting
- Asynchronous Options- Courier, mail, E-mail, Fax, Project Blog, RSS, Social media.
- Consider cultural issues when planning and carrying out project communication.
- Remember communication is a two-way process, not always “broadcast!”
- RACI analysis is a communication tool which describes the tasks and roles that stakeholders take in delivering a project or operating process:

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Chapter 8: Project Completion

Learning Objectives

- Discuss the value of the project completion phase.
- Evaluate a finished project.
- Write end of project reports.
- Document project work for future learning.

Every project needs to end and that's what project completion is all about in the last phase of the project life cycle. The whole point of the project is to deliver what you promised. By delivering everything you said you would, you make sure that all stakeholders are satisfied and all acceptance criteria have been met. Once that happens, your project can end.

Project completion is often the most neglected phase of the project life cycle. Once the project is over, it's easy to pack things up, throw some files in a drawer, and start moving right into the initiation phase of the next project. Hold on. You're not done yet.

The key activities in project completion are gathering project records; disseminating information to formalize acceptance of the product, service, or project; and performing project closure. As the project manager, you will need to review project documents to make certain they are up-to-date. For example, perhaps some scope change requests were implemented that changed some of the characteristics of the final product. The project information you are collecting during this phase should reflect the characteristics and specifications of the final product. Don't forget to update your resource assignments as well. Some team members will have come and gone over the course of the project. You need to double-check that all the resources and their roles and responsibilities are noted.

Once the project outcomes are documented, you'll request formal acceptance from the stakeholders or customer. They're interested in knowing if the product or service of the project meets the objectives the project set out to accomplish. If your documentation is up-to-date, you'll have the project results at hand to share with them.

Contract Closure

Contracts come to a close just as projects come to a close. Contract closure is concerned with completing and settling the terms of the contracts let for the project. It supports the project completion process because the contract closure process determines if the work described in the contracts was completed accurately and satisfactorily. Keep in mind that not all projects are performed under contract so not

all projects require the contract closure process. Obviously, this process applies only to those phases, deliverables, or portions of the project that were performed under contract.

Contract closure updates the project records, detailing the final results of the work on the project. Contracts may have specific terms or conditions for completion. You should be aware of these terms or conditions so that project completion isn't held up because you missed an important detail. If you are administering the contract yourself, be sure to ask your procurement department if there are any special conditions that you should be aware of so that your project team doesn't inadvertently delay contract project closure.

One of the purposes of the contract closure process is to provide formal notice to the seller, usually in written form, that the deliverables are acceptable and satisfactory or have been rejected. If the product or service does not meet the expectations, the vendor will need to correct the problems before you issue a formal acceptance notice. Before the contract is closed, any minor items that need to be repaired or completed are placed on a *punch list*, which is a list of all the items found by the client or team or manager that still remain to be done. Hopefully, quality audits have been performed during the course of the project, and the vendor was given the opportunity to make corrections earlier in the process than the closing phase. It's not a good idea to wait until the very end of the project and then spring all the problems and issues on the vendor at once. It's much more efficient to discuss problems with your vendor as the project progresses because it provides the opportunity for correction when the problems occur.

The project team will then work on all of the items on the punch list, building a small schedule to complete the remaining work. If the number of items on the punch list is too large or the amount of work is significant, the project team continues to work on the project. Once the punch list becomes smaller, the project manager begins closing down the project, maintaining only enough staff and equipment to support the team that is working on the punch list.

If the product or service does meet the project's expectations and is acceptable, formal written notice to the seller is required, indicating that the contract is complete. This is the formal acceptance and closure of the contract. It's your responsibility as the project manager to document the formal acceptance of the contract. Many times the provisions for formalizing acceptance and closing the contract are spelled out in the contract itself.

If you have a procurement department handling the contract administration, they will expect you to inform them when the contract is complete and will in turn follow the formal procedures to let the seller know the contract is complete. However, you will still note the contract completion in your copy of the project records.

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.

Post-Project Evaluations

Before the team is dissolved and begins to focus on the next project, a review is conducted to capture the lessons that can be learned from this project, often called a **lessons-learned meeting** or document. The team explores what went well and captures the processes to understand why they went well. The team asks if the process is transferable to other projects. The team also explores what did not go well and what people learned from the experience. The process is not to find blame, but to learn.

Quality management is a process of continual improvement that includes learning from past projects and making changes to improve the next project. This process is documented as evidence that quality management practices are in use. Some organizations have formal processes for changing work processes and integrating the lessons learned from the project so other projects can benefit. Some organizations are less formal in the approach and expect individuals to learn from the experience and take the experience to their next project and share what they learned with others in an informal way. Whatever type of approach is used, the following elements should be evaluated and the results summarized in reports for external and internal use.

Trust and Alignment Effectiveness

The project leadership reviews the effect of trust—or lack of trust—on the project and the effectiveness of alignment meetings at building trust. The team determines which problems might have been foreseen and mitigated and which ones could not have been reasonably predicted. What were the cues that were missed by the team that indicated a problem was emerging? What could the team have done to better predict and prevent trust issues?

Schedule and Budget Management

The original schedule of activities and the network diagram are compared to the actual schedule of events. Events that caused changes to the schedule are reviewed to see how the use of contingency reserves and float mitigated the disruption caused by those events. The original estimates of contingency

time are reviewed to determine if they were adequate and if the estimates of duration and float were accurate. These activities are necessary for the project team to develop expertise in estimating schedule elements in future projects—they are not used to place blame.

A review of budget estimates for the cost of work scheduled is compared to the actual costs. If the estimates are frequently different from the actual costs, the choice of estimating method is reviewed.

Risk Mitigation

After the project is finished, the estimates of risk can be reviewed and compared to the events that actually took place. Did events occur that were unforeseen? What cues existed that may have allowed the team to predict these events? Was the project contingency sufficient to cover unforeseen risks? Even if nothing went wrong on this project, it is not proof that risk mitigation was a waste of money, but it is useful to compare the cost of avoiding risk versus the cost of unexpected events to understand how much it cost to avoid risk.

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.

Customer Satisfaction

Relationships with the client are reviewed and decisions about including the client in project decisions and alignment meetings are discussed. The client is given the opportunity to express satisfaction and identify areas in which project communication and other factors could be improved. Often a senior manager from the organization interviews the client to develop feedback on the project team performance.

A general report that provides an overview of the project is created to provide stakeholders with a summary of the project. The report includes the original goals and objectives and statements that show how the project met those goals and objectives. Performance on the schedule and budget are summarized and an assessment of client satisfaction is provided. A version of this report can be provided to the client as a stakeholder and as another means for deriving feedback.

Senior Management

The report to senior management contains all the information provided to the stakeholders in a short executive summary. The report identifies practices and processes that could be improved or lessons that were learned that could be useful on future projects.

Types of Closing Reports

Capturing lessons learned from a project experienced should be part of every close down operation. Project participants should convene to identify what went right and what went wrong. They should make a list of their successes, their mistakes, their unjustified assumptions, and the things that could have been done better. This should be stored with the rest of the other documents.

As stated earlier every project is different and depending of the complexities and project requirements four types closing reports may be produced for different purposes:

Project Evaluation and Review Report: Prepared by the core project team. Purpose is to compare results to commitment, to identify lessons learned, to refined project management processes.

Audit Report: A project audit is a more formal final review of a project by a group outside the project team. This is a special type of evaluation. It involves a thorough examination of the management of the project, its methodology and procedures, its records, properties, inventories, budgets, expenditures, progress.

Final Report: The final report is not another evaluation report though the audit and evaluation reports may have a role in it. It is prepared by the project manager (reflections) and should contain the following 5 areas of discussions: Project performance, administrative management performance, project organizational structure, project management techniques and team work.

Post Implementation Audit: Post-Implementation Audit is scheduled if appropriate in 6-12months. It involves an evaluation of the project goals and activities as measured against project plans.

Archiving of Document

The documents associated with the project must be stored in a safe location where they can be retrieved for future reference. Signed contracts or other documents that might be used in tax reviews or lawsuits must be stored. Organizations will have legal document storage and retrieval policies that apply to project documents and must be followed. Some project documents can be stored electronically.

Care should be taken to store documents in a form that can be recovered easily. If the documents are stored electronically, standard naming conventions should be used so documents can be sorted and grouped by name. If documents are stored in paper form, the expiration date of the documents should be determined so they can be destroyed at some point in the future. The following are documents that are typically archived:

Key Takeaways

- Evaluate project performance on the basis of chartered objectives or deliverables and adherence to schedule and cost.

- Project documentation creates a record for future learning.
- Complete end of project reports.
- Different types of project reports and depends on the complexities of the project and requirements.
- Project evaluation and review report
- Final repot
- Audit report
- Post implementation report
- The documents associated with the project must be stored in a safe location where they can be retrieved for future reference.
- Use a closedown meeting to make the formal end of the project, to celebrate successes, to recounts lessons and to thank the team.

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Project Planning Remix Mapping Plan

Project Planning	Remixed from NSCC Project Management
Chapter 1	Chapter 1: Project Management Overview – NSCC Project Management
Chapter 2	Chapter 2: The Project Life Cycle (Phases) – NSCC Project Management
Chapter 3	Chapter 3: Framework for Project Management – NSCC Project Management
Chapter 4	Chapter 6: Project Initiation – NSCC Project Management
Chapter 5	Chapter 8: Scope Planning – NSCC Project Management
Chapter 6	Chapter 9: Project Schedule Planning – NSCC Project Management
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NSCC Edition

- New title and cover.
- Style changes. Header tagging revised to meet accessibility requirements.

Appendix 1: Project Management PowerPoints

Chapter 1 [PPT]

Chapter 2 [PPT]

Chapter 3 [PPT]

Chapter 4 [PPT]

Chapter 5 [PPT]

Chapter 6 [PPT]

Chapter 7 [PPT]

Chapter 8 [PPT]

Chapter 9 [PPT]

Chapter 10 [PPT]

Chapter 11 [PPT]

Chapter 12 [PPT]

Chapter 13 [PPT]

Chapter 14 [PPT]

Chapter 15 [PPT]

Chapter 16 [PPT]

Chapter 17 [PPT]

Chapter 18 [PPT]

Celebration [PPT]

Appendix 2: Chapter Questions

Chapter 1: Project Management Overview

1. Everyone has been involved in projects. What is the largest project you have been involved in? (You do not have to have been the project manager, but could have played another role.)
    1. Write one sentence that describes the objective of the project.
    2. Describe specifically how this project meets the definition of a project used in this textbook. (How is it unique? What were the time constraints? If it is over, how did you know it was over? If it is ongoing, how will you know when it is over?
    3. What was your role? Were you the project manager, a volunteer, some other role? If you were not the project manager, who was?
    4. Was the project part of a larger portfolio or program of projects?
    5. Who else was involved?
    6. What was the budget?
    7. Did you anticipate any risks at the outset? Did the project experience any outside forces that caused a change in either the objectives or the approach to achieving those objectives?
2. In what ways can the following activities be seen as projects? In what ways do they resemble ongoing, routine business activities? Feel free to add assumptions and details to describe how the activity might be a project in one context and routine in another.
    1. Reading the chapter before attending a university lecture.
    2. Taking the bus to work each day.
    3. Piloting an aircraft between Vancouver and Fiji.
    4. Teaching a course for the first time; teaching the same course every semester.

Chapter 2: The Project Life Cycle (Phases)

1. Go online and search for project life cycle models. Identify at least two that are different from the PMI model, and compare and contrast the phases. Be sure to cite your sources.
2. How does the application of a phased approach to project management vary in different

industries? Do you think that the phases work the same in construction as they do in event management or software development?

Chapter 5: Stakeholder Management

1. Identify a major public infrastructure project that is either underway, complete, or proposed in your region. This could be a bridge, road, building, or something of that nature. For the project you have identified, think of as many stakeholders and stakeholder groups as you can. Create a three-column table. In column 1, list the stakeholders. In column 2, list what each stakeholder wants to get from the project. In column 3, list the influence each stakeholder has over the project.
2. How can the stakeholders change over the course of a project? Give examples of changes in who the stakeholders are, and also in how their interests or influence over the project might change throughout the term of the project.

Chapter 4: Project Initiation

1. Software project decision point.
    1. You need to determine an interest rate to use—select an interest rate and explain why you think this number should be used. Use it in your calculations in item 1.2.
    2. Given the information below on options 1 and 2, carry out three forms of analysis: breakeven, ROI, and NPV.
    3. Make a recommendation on which way to proceed, based on the TCO for each option.

- Option 1: Purchase the FunSoft package: Cost $200,000 for software and $85,000 for hardware in year one; with $50,000 to customize it and a $40,000 annual licensing fee for the life of the contract. There will be an annual saving of $61,000 due to the layoff of a clerk.
- Option 2: Purchase the SoftComm package, which will operate on the vendor's hardware: Cost $250,000 for a five-year license, payable half up front and half during the first year of implementation. The maintenance contract, at $75,000 a year, includes all currently identified modifications to the software for the first three years. The clerk's hours will be cut by half, for a saving of $25,000 a year.

In both cases, sales are expected to increase from the current $1 million a year, by 10% per year each year (over each year's previous year's sales) after full implementation.

Assume a five-year life for the software.

Chapter 5: Scope Planning

1. A project to put on a major international sporting competition has the following major deliverables: Sports Venues, Athlete Accommodation, Volunteer Organization, Security, Events, and Publicity (which has already been broken down into pre-event publicity and post-event publicity.) Prepare a WBS for any single major deliverable on the list. Remember the 100 percent rule, and number your objectives.

Chapter 6: Project Schedule Planning

Your team has been asked to test and document enhancements to a web application that allows buyers to purchase custom-printed canvas shoes. The tasks and dependencies are as follows:

- Create a testing plan

Once the testing plan is ready, your team can:

- Test the user interfaces
- Test the database
- Test the network
- Write the documentation first draft

When the user interface tests are complete, you can:

- Perform user testing—enlist some users to test the user interface

When the database and network testing are complete, you can:

- Perform integration testing—network with the database

When the user testing of the user interface and the database testing are complete, you can:

- Perform integration testing—database, network, and user interface

When all integration testing and user testing are complete, you can:

- Perform system testing

Then you can:

- Review and revise documentation

After all other tasks are complete, you can:

- Obtain management approval

Duration estimates for the tasks:

a. 3 days
b. 10 days
c. 6 days
d. 7 days
e. 20 days
f. 5 days
g. 3 days
h. 2 days
i. 8 days
j. 4 days
k. 5 days

1. Create a network diagram and a Gantt chart for the project tasks. Ask your instructor if you are permitted to use software such as Microsoft Project to help you prepare your diagrams.
    1. What is the planned duration for the testing project?
    2. What is the critical path for the testing project?
    3. For each task NOT on the critical path, calculate the amount of slack available.
    4. If the user testing of the user interface takes 15 days, what will the impact be on the project duration?
2. Go online and find at least two sites with definitions of fast tracking and crashing a project schedule.
    1. Prepare proper reference citations for the sites you located, using APA style.
    2. In your own words, write definitions for project fast tracking and project crashing.
    3. Consider the plan you prepared for the software system testing project in question 1 above. If you were informed by management that you must reduce the planned duration of the project by five days, describe how you, as a project manager, could crash or fast track this project. Be specific in identifying exactly what could be changed in the project plan for each option.
    4. (continuation of question 2.3) If the request to speed up the project occurs after day 25 of the original schedule, what is the only option available?
3. Go online and research the difference between total slack and free slack.
    1. Prepare proper reference citations for the sites you located, using APA style.
    2. Write definitions of total slack and free slack in your own words.

3. Why would the distinction between different forms of slack be important to a project manager?

Appendix 3: Chapter Audio Files

- Chapter 1
- Chapter 2
- Chapter 3
- Chapter 4
- Chapter 5
- Chapter 6
- Chapter 7
- Chapter 8
- Chapter 9
- Chapter 10
- Chapter 11 (Part 1)
- Chapter 11 (Part 2)
- Chapter 12
- Chapter 13
- Chapter 14

- Chapter 15

- Chapter 16

Long Descriptions

Figure 5.2 The stakeholder analysis template has six fields plus a table to be filled out. The lines ask for: the project scope, key messages, communication goals, communication teams, project team, and other stakeholders. Then, there is a table with seven columns where you can track the communication plan. The column headers of this table are: communication date, deliverable, audience, message, action item or FYI (info?), plans, and status.