5

Scope Management

Chapter Outline

Chapter Objectives

After completing this chapter, you should be able to:

1. Understand the importance of scope management for project success.
2. Understand the significance of developing a scope statement.
3. Construct a Work Breakdown Structure for a project.
4. Develop a Responsibility Assignment Matrix for a project.
5. Describe the roles of changes and configuration management in assessing project scope.

PROJECT MANAGEMENT BODY OF KNOWLEDGE CORE CONCEPTS COVERED IN THIS CHAPTER

1. Develop Project Charter (PMBoK sec. 4.1)
2. Plan Scope Management (PMBoK sec. 5.1)

3. Collect Requirements (PMBoK sec. 5.2)
4. Define Scope (PMBoK sec. 5.3)
5. Create WBS (PMBoK sec. 5.4)
6. Validate Scope (PMBoK sec. 5.5)
7. Control Scope (PMBoK sec. 5.6)

PROJECT PROFILE

Case—"We look like fools."—Oregon's Failed Rollout of Its Obamacare Web Site

Controversy has surrounded the Affordable Care Act (ACA), ever since it was proposed and passed through Congress without a single Republican vote. After two years of heated debate, the Act was signed into law by President Obama in 2010. Since then, the ACA, more commonly referred to as "Obamacare," has been held up as a symbol of looming disaster and liberal overreach by its critics, while defenders argue that it represents a genuine effort to bring health care options to millions of Americans who could not afford coverage. Following its authorization and having survived numerous court challenges, parties on both sides of the debate waited for its effects to be felt as the federal and state health care exchanges came online, with a scheduled starting date of October 1, 2013. However, prior to the rollout, numerous warning signs were in evidence, from the late selection of prime contractors to develop the Web sites, to failed dress rehearsals, when the website crashed or could not be accessed. On October 1, the Obamacare exchanges and signup Web site (www.healthcare.gov) failed spectacularly, with thousands of those attempting to sign up unable to access the system, frustratingly long waits to complete the registration, and innumerable crashes that required citizens to start the process over and over again. Records show that nationwide, only *six* people were able to register for health care coverage on day 1. So poorly did the system work in some states that, months after the rollout, a mere handful of people were able to sign up online. The government had to create phone-in centers as an alternative method for registering for Obamacare. In fact, the initial history of Obamacare has given its critics plenty of ammunition with which to assail the administration and its dreadful management of the Obamacare exchange rollout.

Nowhere has this process been a more abject failure than in the state of Oregon. Oregon had attempted to develop its own Web site, Cover Oregon (as one of 14 states that opted to set up their own health care exchanges), since 2011. However, what started off as a popular and widely supported measure has turned into one of the worst examples of IT system implementation failure. Journalistic investigations have uncovered a series of missteps that included the perfect storm of politics, poor planning, poor technological design, and contractors that were not up to the herculean task of setting up a health exchange. In the end, not one Oregonian was able to sign up through the exchange. Customers that ended up completing the task did so via paper enrollment. At the beginning of June 2014, Oregon announced that the 80,000 people who signed up for private insurance will have to reenroll in November via the federal exchange. The federal government will handle Oregon's exchange as the state considers whether or not to overhaul its system, which it hopes would be ready in 2015. The state estimates that it lost over $250 million on its Cover Oregon Web site.

At the start of the project, Oregon selected Oracle as its primary contractor and hired the consulting firm Maximus to provide quality-control assessments. From its very first report, Maximus foretold nearly all of the major problems that would eventually doom Cover Oregon's Web site to a catastrophic launch.

A Brief Timeline of Failure:

November 2011: With the clock ticking toward a launch deadline in two years, the project was already raising a number of red flags. Oracle had indicated its concern with the state's decision to support an outdated software package and the project's budget was looking questionable. On top of that, the consulting auditors termed the delivery date "functionally impossible," as it was established seemingly without any regard for technical estimates. At this point, the project was already $3 million over budget, the majority of the tasks were well behind schedule, and 75% of the project's staff had not yet been hired.

July 2012: By this point, over half the original budget has been spent (over $7 million) but the consultants label the Web site as technically poor. After several iterations of the software, the IT team has major concerns about the network's security. Worse, the project managers for different teams have developed their own schedules and development roadmap, all without consulting each other or trying to integrate their efforts. The result is redundancies in performing some tasks and completely ignoring others. The consultants have begun to criticize the working relationships among the senior staff, warning that conflict and communication problems are only going to get worse.

September 2012: With a little more than a year to the start-up, Cover Oregon is in trouble. The consultants offer a number of suggestions for getting the project back on track, including narrowing the scope, and begin developing contingency plans in case more problems emerge as the deadline nears. Because the project is not being tracked and controlled like a normal undertaking, it is difficult to identify the most pressing problems in order to devote more

(continued)

resources and level of effort to fixing the serious gaps. Finally, the Web site is going through multiple changes, updates, and modifications and they are being signed off on without a formal review of the overall system.

December 2012: Cover Oregon administrators brief a legislative oversight committee about their progress. So far, staff members have identified a total of 108 risks to the project. Meanwhile, the state's contract with Oracle comes under review because the company is billing by the hour, rather than on the basis of completed work. Using this formulation, there is not much incentive for Oracle to finish the work quickly.

May 2013: By this point, a critical milestone was to be met; that is, the handoff of the project Web site from the web developer organization to the insurance group, Cover Oregon. The two groups had been working simultaneously on parallel efforts for months now, so the handoff was expected to happen seamlessly. It didn't; in fact, it was a disaster. The technical pieces of the Web site did not work and the site proved to be nearly impenetrable for users. This was the first clear evidence that the project was in serious problems from a technical perspective and coupled with ongoing cost and schedule overruns, highlighted the clear threat the project was facing.

June 2013: June was supposed to be the point when systems testing showed that the project was fully operational. In fact, Cover Oregon personnel have finally come to the conclusion that not only will the site not be ready on time, but the only question left to answer is: just how bad will it be? More staff members are added to try and push as many features into the system as possible in time for the October 1 deadline. Meanwhile, Cover Oregon's director, Rocky King, is already trying to protect his reputation by explaining the project's problems in terms of its size and shortened timeframe to completion.

September 2013: Seemingly out of nowhere, Rocky King delivered an upbeat project status presentation stating: "Bottom Line: We Are on Track to Launch." In spite of the positive tone, no one associated with the project had any illusions about its real state. For example, Oracle's efforts have been increasingly criticized to the point where Oregon was forced to hire a second consultant, Deloitte, to help with the site. Over the course of one week in September, 780 software tests were supposed to be run. In fact, they only managed to run 74 tests during this critical period leading up to the launch. Even worse, *every single test failed*. Even the relentlessly upbeat King recognizes the signs of imminent disaster.

October 2013: The rollout has come and the site fails spectacularly. No one can access the system and in its inaugural version, Cover Oregon does not sign up a single resident. The finger pointing has begun and the state is threatening legal action against Oracle to recover some of its money.

January 2014: Citing medical reasons, Rocky King resigns from his position as Director of Cover Oregon. He had been on medical leave since December and his resignation is the second for a high-profile individual associated with the project, following the earlier resignation of Carolyn Lawson, Chief Information Officer for the Oregon Health Authority.

After spending nearly a quarter of a billion dollars on its health care exchange site, Oregon was left with such a poorly developed and technically flawed exchange that it was forced to spend additional millions hiring temporary workers to sign up subscribers with a paper-based system. Left with the choice between hiring a new contractor and starting from scratch or opting for the federal Web site, Cover Oregon announced its intention of letting the federal government take over the system. This debacle is an example of poor project coordination and communication among key stakeholders, coupled with the risks of overpromising a new system, trying to coordinate massive systems to a fixed deadline, and failing to understand the complexities they were trying to address. While memory of specific elements of the Cover Oregon disaster may fade over time, its lessons deserve to be brought up every time a project of this sort is contemplated.[1]

INTRODUCTION

The **project scope** is everything about a project—work content as well as expected outcomes. Project scope consists of naming all activities to be performed, the resources consumed, and the end products that result, including quality standards.[2] Scope includes a project's goals, constraints, and limitations. **Scope management** is the function of controlling a project in terms of its goals and objectives through the processes of conceptual development, full definition, execution, and termination. It provides the foundation upon which all project work is based and is, therefore, the culmination of predevelopment planning. The process of scope management consists of several distinct activities, all based on creating a systematic set of plans for the upcoming project.

Emmitt Smith, former All-Pro running back for the Dallas Cowboys and member of the Pro Football Hall of Fame, attributes his remarkable success to his commitment to developing and working toward a series of personal goals. He likes to tell the story of his high school days and

how they affected his future success. When Smith was a student at Escambia High in Pensacola, Florida, his football coach used to say, "It's a dream until you write it down. Then it's a goal."

For successful projects, comprehensive planning can make all the difference. Until a detailed set of specifications is enumerated and recorded and a control plan is developed, a project is just a dream. In the most general sense, project planning seeks to define what needs to be done, by whom, and by what date, in order to fulfill assigned responsibility.[3] Projects evolve onto an operational level, where they can begin to be developed, only after systematic planning—scope management—has occurred. The six main activities are (1) conceptual development, (2) the scope statement, (3) work authorization, (4) scope reporting, (5) control systems, and (6) project closeout.[4] Each of these steps is key to comprehensive planning and project development (see Table 5.1).

This chapter will detail the key components of project scope management. The goal of scope management is maximum efficiency through the formation and execution of plans or systems that leave as little as possible to chance.

TABLE 5.1 Elements in Project Scope Management

1. Conceptual Development
Problem statement
Requirements gathering
Information gathering
Constraints
Alternative analysis
Project objectives
Business case
Statement of Work
Project charter
2. Scope Statement
Goal criteria
Management plan
Work Breakdown Structure
Scope baseline
Responsibility Assignment Matrix
3. Work Authorization
Contractual requirements
Valid consideration
Contracted terms
4. Scope Reporting
Cost, schedule, technical performance status
S curves
Earned value
Variance or exception reports
5. Control Systems
Configuration control
Design control
Trend monitoring
Document control
Acquisition control
Specification control
6. Project Closeout
Historical records
Postproject analysis
Financial closeout

5.1 CONCEPTUAL DEVELOPMENT

Conceptual development is the process that addresses project objectives by finding the best ways to meet them.[5] To create an accurate sense of conceptual development for a project, the project management team must collect data and develop several pieces of information. Key steps in information development are:

- ***Problem or need statement:*** Scope management for a project begins with a statement of goals: why there is a need in search of a solution, what the underlying problem is, and what the project intends to do. For example, consider the following need statement from a fictitious county:

  > *A 2014 report from the Maryland State Department of Health showed that the township of Freefield ranked among the worst in the state over a five-year average for infant mortality, low birth weight and premature births, late entry into prenatal care, unmarried parents, teen pregnancies, and poverty. A Clarion County health care focus group report identified patterns of poor communication between county families and doctors. There is a need for information gathering and dissemination on childbirth education opportunities, support service availability, preparation for new babies, and postpartum depression. The focus group indicated that the Freefield Public Library could be an important center for collecting this information and directing new parents to resources and materials. To adequately meet this need, the library proposes a grant program to fund expanding their collections and programs in addition to linking the library with local primary care health providers and Freefield Memorial Hospital to serve expectant and postpartum mothers and their children.*

- ***Requirements gathering:*** Requirements are the demands, needs, and specifications for a product (project outcome) as outlined by project stakeholders. It is the list of customer needs. Once a problem has been articulated (where we are now), the next step is to determine—in the words of the customer—where we wish to be. There can be many different types of requirements that an organization collects from a potential customer, including (1) product-related requirements—what features they desire the project to possess, (2) quality requirements—the absolute minimum expectations for overall project quality, and (3) performance requirements—the expectations for how well the project performs or the standards it maintains. For example, in gathering requirements for a new automobile development project, Porsche might interview current and former owners of its high-performance cars to determine the expected levels of quality, price, and performance that customers expect.

  It is critical that during requirements gathering the project team does not overtly or unintentionally substitute their own interpretations for those of the customer. In other words, many project organizations, such as the IT industry, consider themselves the experts on what new software can do and the ways in which a customer would be expected to use it. In overestimating their own role in requirements gathering, these organizations run the very real risk of creating systems that they imagine customers must have when, in reality, they are either not useful or are so overdesigned that customers only use them to the most limited degree. To guard against this situation, we discuss the critical nature of hearing the "voice of the customer" in requirements gathering in Chapter 11.
- ***Information gathering:*** Research to gather all relevant data for the project is the next step. A project can be effectively initiated only when the project manager has a clear understanding of the current state of affairs—specific target dates, alternative supplier options, degree of top management support for the project, and so forth. At any step along the way, project managers should take care that they have not limited their information search. Continuing the above example, suppose that as part of our information gathering, we identify five prospective funding sources in the Maryland Department of Health that would be good sources to access for grants. Further, our information search informs us that these grants are competitive and must be submitted by the end of the current calendar year, we can count on support from local political figures including our state representative and county commissioner, and so forth. All this information must be factored into the program proposal and used to shape it.

- ***Constraints:*** In light of the goal statement, project managers must understand any restrictions that may affect project development. Time constraints, budget shrinkages, and client demands can all become serious constraints on project development. Referring back to the health grant example, some important constraints that could affect our ability to develop the grant application in time could be the need to find a medical professional to serve as the grant's principal author, concern with statewide budgets and a withdrawal of support for community initiatives such as this one, and the need for a knowledgeable person within the library willing to serve as the primary collector of the prenatal and postnatal health care information.
- ***Alternative analysis:*** Problems usually offer alternative methods for solution. In project management, alternative analysis consists of first clearly understanding the nature of the problem statement and then working to generate alternative solutions. This process serves two functions: It provides the team with a clearer understanding of the project's characteristics, and it offers a choice of approaches for addressing how the project should be undertaken. It may be, as a result of alternative analysis, that an innovative or novel project development alternative suggests itself. Alternative analysis prevents a firm from initiating a project without first conducting sufficient screening for more efficient or effective options.
- ***Project objectives:*** Conceptual development concludes with a clear statement of the final objectives for the project in terms of outputs, required resources, and timing. All steps in the conceptual development process work together as a system to ultimately affect the outcome. When each step is well done, the project objectives will logically follow from the analysis. In our health care example above, final objectives might include specific expectations, such as receiving a $100,000 grant to support collection services, printing costs, and holding information sessions and seminars with health care providers. These seminars would begin within a 90-day window from the administration of the grant. Library collections and subscriptions would be enhanced in this area by 25%. In this way, the problem or need statement is the catalyst that triggers a series of cascading steps from motive for the project through to its intended effects.
- ***Business case:*** The **business case** is the organization's justification for committing to the project. Whenever a company intends to commit capital or its resources to a project, it should be clearly in support of a demonstrable business need. For example, it would make little sense for an IT organization like Google to develop a residential construction project unless a clear link could be made between the project and Google's strategic goals and business activities. The project business case should (1) demonstrate the business need for a given project, (2) confirm the project is feasible before expending significant funding, (3) consider the strategic internal and external forces affecting the project (refer to the TOWS matrix discussion from Chapter 2), (4) assess and compare the costs (both monetary and nonmonetary) of choosing the project over other courses of action, and (5) provide time estimates for when we expect to be spending investment money on the project.

  The business case is usually a carefully prepared document that highlights financial commitments, justification for undertaking the project, costs of doing the project, and more importantly, *risks from not doing the project*. For example, in the Maryland county example, we could build a business case that argued that because of the systemic problems with infant mortality in Fairfield Township, it is imperative not to delay action on this grant opportunity because failure to act will continue to result in higher levels of infant health problems in the county. A strong business case explores all feasible approaches to a given problem and enables business owners to select the option that best serves the organization. In short, the business case is the company's (or project sponsor's) best argument for undertaking a project.

Conceptual development begins with the process of reducing the project's overall complexity to a more basic level. Project managers must set the stage for their projects as completely as possible by forming problem statements in which goals and objectives are clearly stated and easily understood by all team members.

Many projects that are initiated with less than a clear understanding of the problem the project seeks to address far exceed their initial budgets and schedules. At base level, this problem is due to the vague understanding among team members as to exactly what the project is attempting to accomplish. For example, a recent information technology project was developed with the

vague goal of "improving billing and record-keeping operations" in a large insurance firm. The IT department interpreted that goal to develop a project that provided a complex solution requiring multiple interactive screens, costly user retraining, and the generation of voluminous reports. In fact, the organization simply wanted a streamlined link between the billing function and end-of-month reporting. Because the problem was articulated vaguely, the IT department created an expensive system that was unnecessarily complex. In reality, the optimal project solution begins with creating a reasonable and complete problem statement to establish the nature of the project, its purpose, and a set of concrete goals.

A complete understanding of the problem must be generated so that the projects themselves will be successful in serving the purpose for which they were created. A key part of the problem statement is the analysis of multiple alternatives. Locking in "one best" approach for solving a problem too early in a project can lead to failure downstream.

Also, to be effective, problem statements should be kept simple and based on clearly understood needs in search of solutions. For example, a clear project goal such as "improve the processing speed of the computer by 20%" is much better than a goal that charges a project team to "significantly increase the performance of the computer." A set of simple goals provides a reference point that the team can revisit when the inevitable problems occur over the course of project development. On the other hand, project goals that are vague or excessively optimistic—such as "improve corporate profitability while maintaining quality and efficiency of resources"—may sound good, but do not provide clear reference points for problem solving.

The Statement of Work

The impetus to begin a project is often the result of a statement of work. The **Statement of Work (SOW)** is a detailed narrative description of the work required for a project.[6] Useful SOWs contain information on the key objectives for the project, a brief and general description of the work to be performed, expected project outcomes, and any funding or schedule constraints. Typically, in the case of the latter, it is difficult to present schedule requirements past some "gross" level that may only include starting and ending dates, as well as any major milestones.

An SOW can be highly descriptive, as in the case of a U.S. Department of Defense Request for Proposal (RFP) for a new Army field communication device that is "no greater than 15 inches long by 15 inches wide by 9 inches deep, can weigh no more than 12 pounds, has a transmitting and receiving range of 60 miles, must remain functional after being fully immersed in water for 30 minutes, and can sustain damage from being dropped at heights up to 25 feet." On the other hand, an SOW can be relatively general, merely specifying final performance requirements without detailed specifics. The purpose of the SOW is to give the project organization and the project manager specific guidance on both work requirements as well as the types of end results sought once the project is completed.

A Statement of Work is an important component of conceptual development, as it identifies a need within the firm or an opportunity from an outside source, for example, the commercial market. Some elements in an effective SOW include:

1. ***Introduction and background***—a brief history of the organization or introduction to the root needs that identified the need to initiate a project. Part of the introduction should be a problem statement.
2. ***Technical description of the project***—an analysis, in clear terms, of the envisioned technical capabilities of the project or technical challenges the project is intended to resolve.
3. ***Time line and milestones***—a discussion of the anticipated time frame to completion and key project deliverables (outcomes).

A useful Statement of Work should clearly detail the expectations of the project client, the problems the project is intended to correct or address, and the work required to complete the project.

For example, the U.S. Federal Geographic Data Committee recently developed an SOW for purchasing commercial services from government or private industry as an independent contractor. The Statement of Work contained the following components:

1. ***Background***—describes the project in very general terms; discusses why the project is being pursued and how it relates to other projects. It includes, as necessary, a summary of statutory authority or applicable regulations and copies of background materials in addenda or references

2. ***Objectives***—provide a concise overview of the project and how the results or end products will be used.
3. ***Scope***—covers the general scope of work the contractor will be performing.
4. ***Tasks or requirements***—describe detailed work and management requirements, and also spell out more precisely what is expected of the contractor in the performance of the work.
5. ***Selection criteria***—identify objective standards of acceptable performance to be provided by the contractor.
6. ***Deliverables or delivery schedule***—describes what the contractor shall provide; identifies the contractor's responsibilities; and identifies any specialized expertise and services, training, and documentation that is needed. In addition, it clearly states the deliverables required, the schedule for delivery, the quantities, and to whom they should be delivered. Finally, it describes the delivery schedule in calendar days from the date of the award.
7. ***Security***—states the appropriate security requirement, if necessary, for the work to be done.
8. ***Place of performance***—specifies whether the work is to be performed at the government site or the contractor's site.
9. ***Period of performance***—specifies the performance period for completion of the contracted project.

Notice how the Statement of Work moves from the general to the specific, first articulating the project's background, including a brief history of the reasons the project is needed, and then identifying the component tasks before moving to a more detailed discussion of each task objective and the approach necessary to accomplish it.[7]

A more detailed example of a generic statement of work is shown in Table 5.2. The SOW covers the critical elements in a project proposal, including description, deliverables, resource requirements, risks, expected outcomes, estimated time and cost constraints, and other pending issues. Table 5.2 can serve as a standard template for the construction of a reasonably detailed SOW for most projects.

The Statement of Work is important because it typically serves as the summary of the conceptual development phase of the project plan. Once armed with the SOW, the project manager can begin moving from the general to the more specific, identifying the steps necessary to adequately respond to the detailed SOW.

The Project Charter

After a comprehensive SOW has been developed, many organizations establish a project charter. The **project charter** is defined as a document issued by the project initiator or sponsor that formally sanctions the existence of the project and authorizes the project manager to begin applying organizational resources to project activities.[8] In effect, a charter is created once the project supporters have done the needed "homework" to verify that there is a business case for the project, that they fully understand the elements of the project (as demonstrated through the SOW), and have applied more company-specific information for the project as it begins. The project charter demonstrates formal company approval of the project and that can only occur when all necessary information during conceptual development has been satisfied. For some organizations, the formal signoff of the SOW constitutes the project charter, while other organizations require that a separate document be created. An example of a project charter is shown in Appendix 5.1 at the end of the chapter.

PROJECT PROFILE

Statements of Work: Then and Now

Modern weapon systems have traditionally contained many more specifications and greater detailed SOWs than those of the past. Contrast the Army Signal Corps' SOW for the Wright Brothers' heavier-than-air flying machine in 1908 to the Air Force's SOW for the Joint Strike Fighter, originally approved in 2001. The requirements in the 1908 SOW—for example, that the plane be easily taken apart for transport in Army wagons and be capable of being reassembled in an hour—and other contract conditions were specified on one page. The requirements section in the 2001 SOW for the Air Force Joint Strike Fighter is nearly 100 pages long with more than 300 paragraphs of requirements. Today's SOWs are much more complex and require greater attention to detail, perhaps because the products are so much more complex, the equipment and materials are technically challenging, and legal requirements need much greater specification.[9]

TABLE 5.2 Elements in a Comprehensive Statement of Work

Date Submitted	
Revision Number	
Project Name	
Project Identification Number	
SOW Prepared by:	

1. Description and Scope

a. Summary of work requested
b. Background
c. Description of major elements (deliverables) of the completed project
d. Expected benefits
e. Items not covered in scope
f. Priorities assigned to each element in the project

2. Approach

a. Major milestones/key events anticipated

Date	Milestone/Event

b. Special standards or methodologies to be observed
c. Impact on existing systems or projects
d. Assumptions critical to the project
e. Plans for status report updates
f. Procedures for changes of scope or work effort

3. Resource Requirements

a. Detailed plan/rationale for resource needs and assignments

Person	Role and Rationale

b. Other material resource needs (hardware, software, materials, money, etc.)
c. Expected commitments from other departments in support
d. Concerns or alternatives related to staffing plan

4. Risks and Concerns

a. Environmental risks
b. Client expectation risks
c. Competitive risks
d. Risks in project development (technical)
e. Project constraints
f. Overall risk assessment
g. Risk mitigation or abatement strategies

TABLE 5.2 Continued

5. Acceptance Criteria
   a. Detailed acceptance process and criteria
   b. Testing/qualification approach
   c. Termination of project

6. Estimated Time and Costs
   a. Estimated time to complete project work
   b. Estimated costs to complete project work
   c. Anticipated ongoing costs

7. Outstanding Issues

5.2 THE SCOPE STATEMENT

The **scope statement**, the heart of scope management, reflects a project team's best efforts at creating the documentation and approval of all important project parameters prior to proceeding to the development phase.[10] Key steps in the scope statement process include:

- ***Establishing the project goal criteria.*** Goal criteria include cost, schedule, performance and deliverables, and key review and approval "gates" with important project stakeholders (particularly the clients). **Deliverables** are formally defined as "any measurable, tangible, verifiable outcome, result, or item that must be produced to complete a project or part of a project." The goal criteria serve as the key project constraints and targets around which the project team must labor.
- ***Developing the management plan for the project.*** The management plan consists of the organizational structure for the project team, the policies and procedures under which team members will be expected to operate, their appropriate job descriptions, and a well-understood reporting structure for each member of the team. The management plan is essentially the project's bureaucratic step that creates control systems to ensure that all team members know their roles, their responsibilities, and professional relationships.
- ***Establishing a Work Breakdown Structure.*** One of the most vital planning mechanisms, the **Work Breakdown Structure (WBS)**, divides the project into its component substeps in order to begin establishing critical interrelationships among activities. Until a project has gone through WBS, it is impossible to determine the relationships among the various activities (which steps must precede others, which steps are independent of previous tasks, and so on). As we will see, accurate scheduling can begin only with an accurate and meaningful Work Breakdown Structure.
- ***Creating a scope baseline.*** The **scope baseline** is a document that provides a summary description of each component of the project's goal, including basic budget and schedule information for each activity. Creation of the scope baseline is the final step in the process of systematically laying out all pre-work information, in which each subroutine of the project has been identified and given its control parameters of cost and schedule.

The Work Breakdown Structure

When we are first given a project to complete, the task can seem very intimidating. How do we start? Where should we first direct our efforts? One of the best ways to begin is to recognize that any project is just a collection of a number of discrete steps, or activities, that together add up to the overall deliverable. There is no magic formula; projects get completed one step at a time, activity by activity.

According to the Project Management Body of Knowledge (PMBoK), a Work Breakdown Structure (WBS) is "a deliverable-oriented grouping of project elements which organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services." To rephrase this PMBoK definition, the Work Breakdown Structure is a process that sets a project's scope by breaking down its overall mission into a cohesive set of synchronous, increasingly specific tasks.[11] The result is a comprehensive document reflecting this careful work.

The WBS delineates the individual building blocks that will construct the project. Visualize the WBS by imagining it as a method for breaking a project up into "bite-sized" pieces, each representing a step necessary to complete the overall project plan. It can be challenging at the project's start to envision all the elements or component tasks needed to realize the project's success, but the effort to "drill down" into the various activities at the task level actually can reinforce the overall picture of the project.

Consider the simple case of a student team working together on a term paper and final presentation for a college seminar. One of the first steps in the process of completing the assignment consists of breaking the project down into a series of tasks, each of which can be allocated to a member or members of the student team. The overall project consisting of specific products—a final paper and presentation—becomes easier to manage by reducing it to a series of simpler levels, such as:

Task One: Refine topic
Task Two: Assign library research responsibilities
Task Three: Develop preliminary outline for paper and presentation
Task Four: Assign team member to begin putting presentation together
Task Five: Begin producing drafts of paper
Task Six: Proofread and correct drafts
Task Seven: Refine class presentation
Task Eight: Turn in paper and make classroom presentation

A WBS could go much further in defining a project's steps; this example is intended only to give you a sense of the logic employed to reduce an overall project to a series of meaningful action steps. You will see, in subsequent chapters, that those same action steps are later evaluated in order to estimate the amount of time necessary to complete them.

The logic of WBS is shown visually in Figure 5.1. Rather than giving a starting date and an end goal, the diagram provides a string of checkpoints along the way. These checkpoints address the specific steps in the project that naturally lead from the start to the logical conclusion. The WBS allows you to see both the trees and the forest, so you can recognize on many levels what it will take to create the completed project.

Purposes of the Work Breakdown Structure

The WBS serves six main purposes:[12]

1. ***It echoes project objectives.*** Given the mission of the project, a WBS identifies the main work activities that will be necessary to accomplish this goal or set of goals. What gets mentioned in the WBS is what gets done on the project.

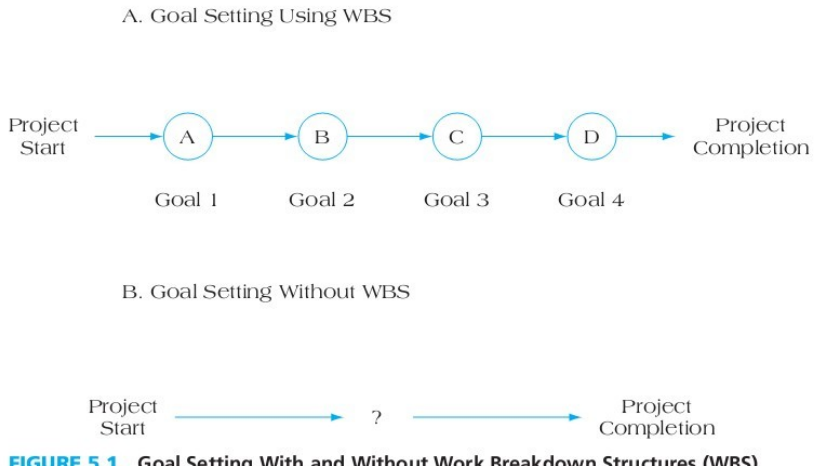


FIGURE 5.1 Goal Setting With and Without Work Breakdown Structures (WBS)

2. ***It is the organization chart for the project.*** Organization charts typically provide a way to understand the structure of the firm (who reports to whom, how communication flows evolve, who has responsibility for which department, and so forth). A WBS offers a similar logical structure for a project, identifying the key elements (tasks) that need attention, the various subtasks, and the logical flow from activity to activity.
3. ***It creates the logic for tracking costs, schedule, and performance specifications for each element in the project.*** All project activities identified in the WBS can be assigned their own budgets and performance expectations. This is the first step in establishing a comprehensive method for project control.
4. ***It may be used to communicate project status.*** Once tasks have been identified and responsibilities for achieving the task goals are set, you can determine which tasks are on track, which are critical and pending, and who is responsible for their status.
5. ***It may be used to improve overall project communication.*** The WBS not only dictates how to break the project into identifiable pieces, but it also shows how those pieces fit together in the overall scheme of development. As a result, team members become aware of how their component fits into the project, who is responsible for providing upstream work to them, and how their activities will affect later work. This structure improves motivation for communication within the project team, as members wish to make activity transitions as smooth as possible.
6. ***It demonstrates how the project will be controlled.*** The general structure of the project demonstrates the key focus that project control will take on. For example, is the project based on creating a deliverable (new product) or improving a process or service (functional efficiency) within the firm? Either way, the WBS gives logic to the control approach and the most appropriate control methods.

Let's illustrate the WBS with a simplified example. Consider the case of a large, urban hospital that has made the decision to introduce an organizationwide information technology (IT) system for billing, accounts receivable, patient record keeping, personnel supervision, and the medical process control. The first step in launching this large installation project is to identify the important elements in introducing the technology. Here is a basic approach to identifying the deliverables in a project to install a new information system for an organization (see Figure 5.2).

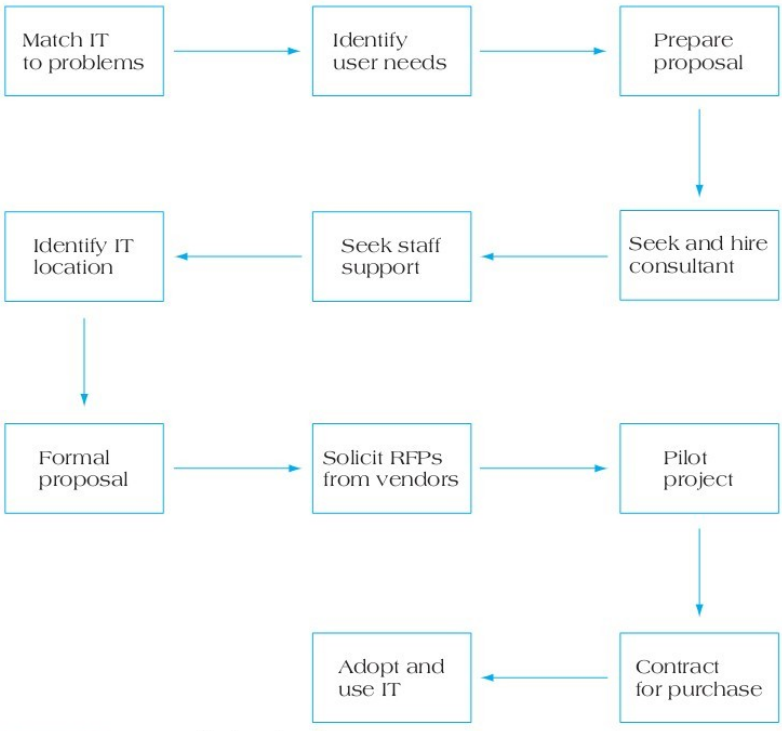


FIGURE 5.2 IT Installation Flowchart

1. Match IT to organizational tasks and problems.
2. Identify IT user needs.
3. Prepare an informal proposal to top management (or other decision makers) for IT acquisition.
4. Seek and hire an IT consultant.
5. Seek staff and departmental support for the IT.
6. Identify the most appropriate location within the organization for the IT hardware to be located.
7. Prepare a formal proposal for IT introduction.
8. Undertake a request for proposals (RFPs) from IT vendors.
9. Conduct a pilot project (or series of pilot projects using different IT options).
10. Enter a contract for purchase.
11. Adopt and use IT technology.

For simplicity's sake, Figure 5.2 identifies only the first-level tasks involved in completing this project. Clearly, each of the 11 steps in the flowchart in Figure 5.2 has various supporting subtasks associated with it. For example, step 2, identifying IT user needs, might have three subtasks:

1. Interview potential users.
2. Develop presentation of IT benefits.
3. Gain user "buy-in" to the proposed system.

Figure 5.3 illustrates a partial WBS, showing a few of the tasks and subtasks. The logic across all identified tasks that need to be accomplished for the project is similar.

We do not stop here but continue to flesh out the WBS with additional information. Figure 5.4 depicts a more complete WBS to demonstrate the logic of breaking the project up into its component pieces. The 1.0 level shown in Figure 5.4 identifies the overall project. Underneath this level are the major deliverables (e.g., 1.2, 1.3, etc.) that support the completion of the project. Underneath these deliverables are the various "work packages" that must be completed to conclude the project deliverables.

Work packages are defined as WBS elements of the project that are isolated for assignment to "work centers" for accomplishment.[13] Just as atoms are the smallest, indivisible unit of matter in physics, work packages are the smallest, indivisible components of a WBS. That is, work packages are the lowest level in the WBS, composed of short-duration tasks that have a defined beginning and end, are assigned costs, and consume some resources. For example, in the 1.2 level of identifying IT user needs (a deliverable), we need to perform three supporting activities: (1) interviewing potential users, (2) developing a presentation of IT benefits, and (3) gaining user "buy-in" to the system. This next level down (1.2.1, 1.2.2, etc.) represents the work packages that are necessary to complete the deliverable.

Sometimes confusion arises as to the distinction made between "work package" and "task," as they relate to projects and the development of the WBS. In truth, for many organizations, the

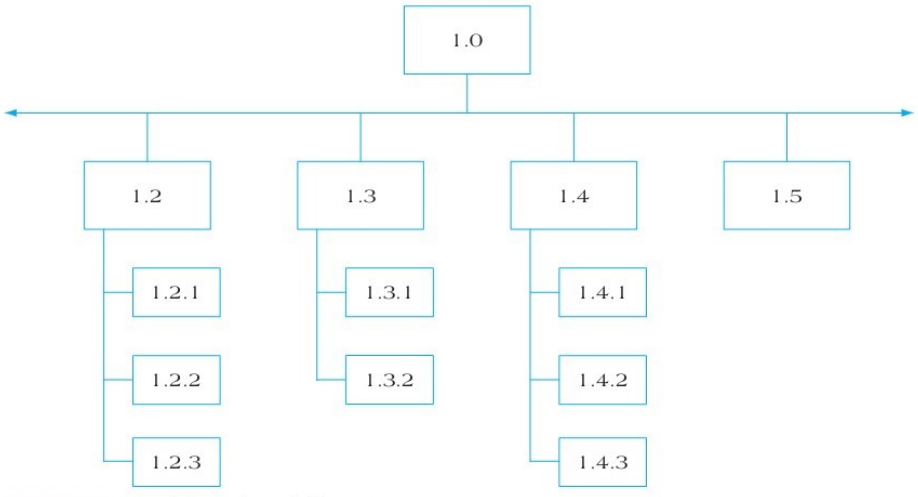


FIGURE 5.3 Partial Work Breakdown Structure

Breakdown	Description	WBS	Code
IT Installation Project			**1.0**
Deliverable 1	**Match IT to organizational tasks and problems**		**1.1**
WP 1	Conduct problem analysis	1.1.1	
WP 2	Develop information on IT technology	1.1.2	
Deliverable 2	**Identify IT user needs**		**1.2**
WP 1	Interview potential users	1.2.1	
WP 2	Develop presentation of IT benefits	1.2.2	
WP 3	Gain user "buy-in" to system	1.2.3	
Deliverable 3	**Prepare informal proposal**		**1.3**
WP 1	Develop cost/benefit information	1.3.1	
WP 2	Gain top management support	1.3.2	
Deliverable 4	**Seek and hire IT consultant**		**1.4**
WP 1	Delegate members as search committee	1.4.1	
WP 2	Develop selection criteria	1.4.2	
WP 3	Interview and select consultant	1.4.3	
Deliverable 5	**Seek staff and departmental support for IT**		**1.5**
Deliverable 6	**Identify the appropriate location for IT**		**1.6**
WP 1	Consult with physical plant engineers	1.6.1	
WP 2	Identify possible alternative sites	1.6.2	
WP 3	Secure site approval	1.6.3	
Deliverable 7	**Prepare a formal proposal for IT introduction**		**1.7**
Deliverable 8	**Solicit RFPs from vendors**		**1.8**
WP 1	Develop criteria for decision	1.8.1	
WP 2	Contact appropriate vendors	1.8.2	
WP 3	Select winner(s) and inform losers	1.8.3	
Deliverable 9	**Conduct a pilot project (or series of projects)**		**1.9**
Deliverable 10	**Enter a contract for purchase**		**1.10**
Deliverable 11	**Adopt and use IT technology**		**1.11**
WP 1	Initiate employee training sessions	1.11.1	
WP 2	Develop monitoring system for technical problems	1.11.2	

FIGURE 5.4 **Example of a Project WBS**

difference between the terms and their meanings is actually quite small; often they are used interchangeably by the project management organization. The key is to be consistent in applying the terminology, so that it means the same thing within different parts of the organization, in regard to both technical and managerial resources.

Overall, for a generic project, the logic of hierarchy for WBS follows this form:

Level	WBS Term	Description
Level 1 (Highest)	Project	The overall project under development
Level 2	Deliverable	The major project components
Level 3	Subdeliverable	Supporting deliverables
Level 4 (Lowest)	Work package	Individual project activities

Figure 5.4 provides an example of how project activities are broken down and identified at both the deliverable and the work package levels, as well as a brief description of each of these activities. The WBS in that figure also shows a numeric code assigned to each activity. A company's accounting function assigns **WBS codes** to each activity to allocate costs more precisely, to track the activities that are over or under budget, and to maintain financial control of the development process.

Sometimes it is necessary to differentiate between a subdeliverable, as identified in the hierarchical breakdown above, and work packages that are used to support and complete the subdeliverables. Typically, we think of subdeliverables as "rolled-up" summaries of the outcomes of two or more work packages. Unlike work packages, subdeliverables do not have a duration of their own, do not consume resources, and do not have direct assignable costs. Any resources or costs attached to a subdeliverable are simply the summary of all the work packages that support it.

Most organizations require that each deliverable (and usually each of the tasks or work packages contained within) come with descriptive documentation that supports the goals of the project and can be examined as a basis for allowing approval and scheduling resource commitments. Figure 5.5 is a sample page from a task description document, intended to support

Project Task Description Form

Task Identification

Project Name: IT Installation Project Code: IS02 Project Manager: Williams

WP Name: Delegate members as search committee

WP Code: 1.4.1 WP Owner: Susan Wilson

Deliverables: Assignment of personnel to IT vendor search committee

Revision no.: 3 Date: 10/22/12 Previous revision: 2 (on file)

Resources Required

Labor		Other Resources		
Type	Labor Days	Type	Quantity	Cost
Systems manager	5	Software A	1	$15,000
Senior programmer	3	Facility	N/A	
Hardware technician	2	Equipment	1	$500
Procurement manager	3	Other	N/A	
Systems engineer	5			

Required prerequisites: Deliverables 1.1, 1.2, and 1.3 (on file)

Acceptance tests: None required

Number of working days required to complete task: 5

Possible risk events, which may impair the successful completion of the task: _____

TO BE COMPLETED AFTER SCHEDULING THE PROJECT:

Earliest start on the task: 1/15/13 Earliest finish on the task: 2/15/13

Review meeting according to milestones:

Name of milestone	**Deliverables**	**Meeting date**	**Participants**
Identify IT user needs	IT work requirements	8/31/12	Wilson, Boyd, Shaw
_____	_____	_____	_____
_____	_____	_____	_____

Design approval of the task:

Task Owner: Sue Wilson Signature: _____ Date: _____

Customer contact: Stu Barnes Signature: _____ Date: _____

Project Manager: Bob Williams Signature: _____ Date: _____

FIGURE 5.5 **Project Task Description**

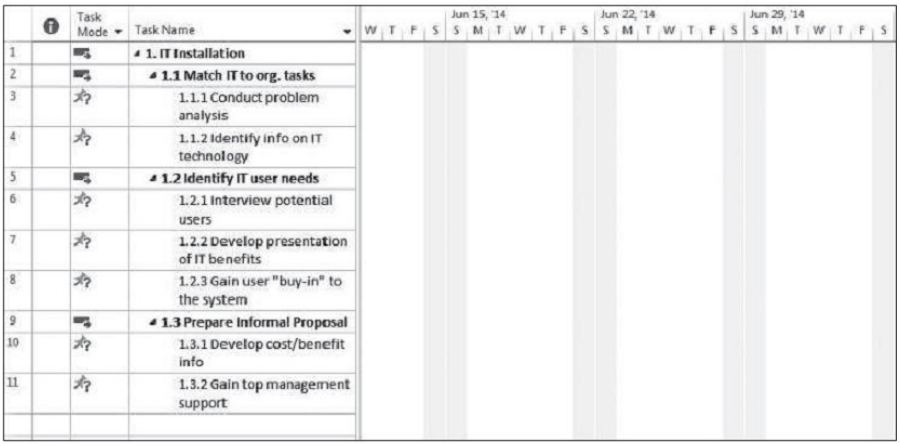


FIGURE 5.6 **Sample WBS Development Using MS Project 2013**

Source: MS Project 2013 by Microsoft Corporation.

the project WBS outlined in Figure 5.4. Using work package 1.4.1, "Delegate members as search committee," a comprehensive control document can be prepared. When a supporting document functions as a project control device throughout the project's development, it is not prepared in advance and is no longer used once that project step has been completed; in other words, it is a dynamic document. This document also specifies project review meetings for the particular work package as the project moves forward; the task description document must be completed, filed, and revisited as often as necessary to ensure that all relevant information is available.

MS Project allows us to create a WBS for a project. As we input each project task, we can assign a WBS code to it by using the WBS option under the Project heading. Figure 5.6 gives a sample screen shot of some of the activities identified in the hospital IT project example. Note that we have created a partial WBS for the IT project by using the MS Project WBS option, which also allows us to distinguish between "Project Level" headings, "Deliverable" headings, and "Work Package" headings.

The Organization Breakdown Structure

An additional benefit of creating a comprehensive WBS for a project is the ability to organize the work needed to be performed into **cost control accounts** that are assignable to various units engaged in performing project activities within the company. The outcome of organizing this material is the **Organization Breakdown Structure (OBS)**. In short, the OBS allows companies to define the work to be accomplished and assign it to the owners of the work packages.[14] The budgets for these activities are then directly assigned to the departmental accounts responsible for the project work.

Suppose, for example, that our IT project example required the committed resources of three departments—information technology, procurement, and human resources. We want to make certain that the various work packages and their costs are correctly assigned to the person and department responsible for their completion in order to ensure that our cost control for the project can remain accurate and up-to-date. Figure 5.7 shows a visual example of the intersection of our partial WBS with an OBS for our IT installation project. The three departments within the organization are shown horizontally and the work packages underneath one of the deliverables are shown vertically. Notice that only some of the boxes used to illustrate the intersection are affected, suggesting that for some work packages multiple departments may be involved, each with its own cost accounts, while for other work packages there may be only one direct owner.

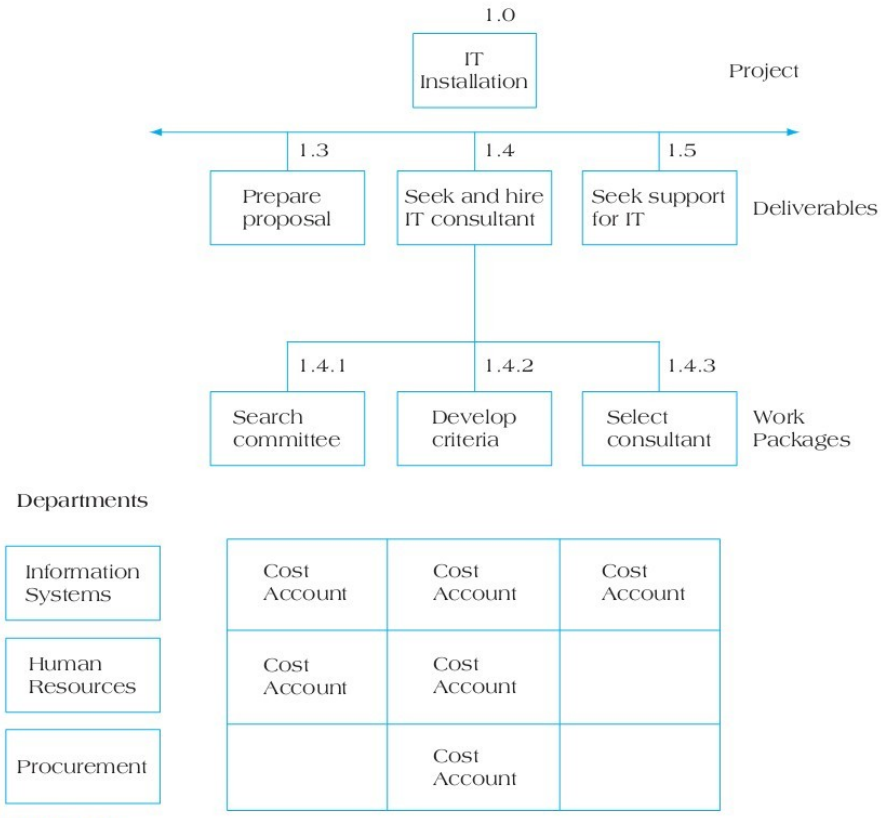


FIGURE 5.7 The Intersection of the WBS and OBS

The benefit of using an OBS is that it allows for better initial linking of project activities and their budgets, either at a departmental level or, even more directly, on an individual-by-individual basis, as shown in Figure 5.8. In this case, the direct cost for each work package is assigned to a specific individual responsible for its completion. Figure 5.9 reconfigures the OBS to show the cost account rollups that can be done for each department responsible for a specific work package or project deliverable.

In managing projects, the main point to keep in mind about the scope statement is the need to spend adequate up-front time preparing schedules and budgets based on accurate and reasonable estimation. This estimation can be adequately performed only if project managers have worked through the WBS and project goals statements thoroughly. There are fewer surefire ways to create an atmosphere for project failure than to do a cursory and incomplete WBS. When steps are left out, ignored, or underestimated during the WBS phase, they are then underbudgeted or underestimated in scheduling. The result is a project that will almost certainly have sliding schedules, rapidly inflating budgets, and confusion during the development phase. Much of this chaos can be avoided if the project manager spends enough time with her scope statement to ensure that there are no missing elements.

The Responsibility Assignment Matrix

To identify team personnel who will be directly responsible for each task in the project's development, a **Responsibility Assignment Matrix (RAM)** is developed. (The RAM is sometimes referred to as a *linear responsibility chart*.) Although it is considered a separate document, the RAM is often developed in conjunction with the WBS for a project. Figure 5.10 illustrates a Responsibility Assignment Matrix for this chapter's example project. Note that the matrix lists

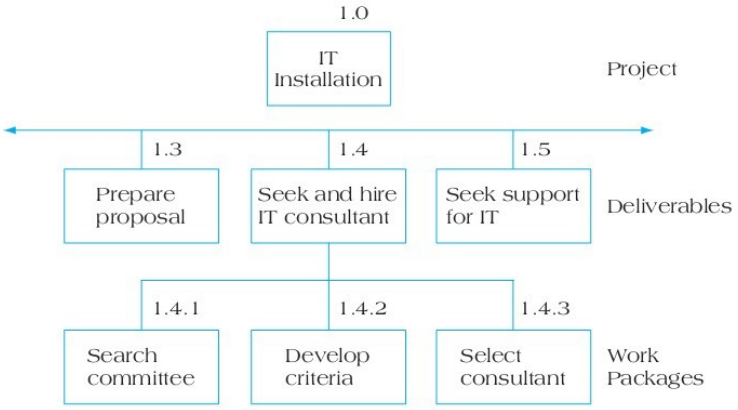
WBS Code	Budget	Responsibility
1.0	$700,000	Bob Williams, IT Manager
1.1	5,000	Sharon Thomas
1.1.1	2,500	Sharon Thomas
1.1.2	2,500	Dave Barr
1.2	2,750	David LaCouture
1.2.1	1,000	David LaCouture
1.2.2	1,000	Kent Salfi
1.2.3	750	Ken Garrett
1.3	2,000	James Montgomery
1.3.1	2,000	James Montgomery
1.3.2	-0-	Bob Williams
1.4	2,500	Susan Wilson
1.4.1	-0-	Susan Wilson
1.4.2	1,500	Susan Wilson
1.4.3	1,000	Cynthia Thibodeau
1.5	-0-	Ralph Spence
1.6	1,500	Terry Kaplan
1.6.1	-0-	Kandra Ayotte
1.6.2	750	Terry Kaplan
1.6.3	750	Kandra Ayotte
1.7	2,000	Bob Williams
1.8	250	Beth Deppe
1.8.1	-0-	Kent Salfi
1.8.2	250	James Montgomery
1.8.3	-0-	Bob Williams
1.9	30,000	Debbie Morford
1.10	600,000	Bob Williams
1.11	54,000	David LaCouture
1.11.1	30,000	David LaCouture
1.11.2	24,000	Kandra Ayotte

FIGURE 5.8 **Cost and Personnel Assignments**

not only the member of the project team responsible for each activity, but also the other significant members of the team at each stage, organized according to how that activity requires their support. The RAM identifies where each person can go for task support, who should be notified of the task completion status at each stage, and any sign-off requirements. This tool provides a clear linkage among all project team members and combats the danger of a potential communication vacuum in which project team members perform their own tasks without updating others on the project team.

5.3 WORK AUTHORIZATION

This stage in scope management naturally follows the two previous steps. Once the scope definition, planning documents, management plans, and other contractual documents have been prepared and approved, the **work authorization** step gives the formal "go ahead" to commence with the project. Many times work authorization consists of the formal sign-off on all project



Departments

Information Systems	$0	$500	$1,000
Human Resources	$0	$500	
Procurement		$500	
Totals	$0	$1,500	$1,000

FIGURE 5.9 **Cost Account Rollup Using OBS**

Deliverable	Task & Code	Bob IT	David IT	Susan HR	Beth Procurement	James Engineering	Terry Legal
		Lead Project Personnel					
Match IT to Org. Tasks—1.1	Problem Analysis –1.1.1	○	■			☆	□
	Develop info on IT technology –1.1.2	☆	○	■			
Identify IT user needs—1.2	Interview potential users –1.2.1	□		○	☆		
	Develop presentation –1.2.2	○	☆			■	
	Gain user "buy-in" –1.2.3			☆	■	○	
Prepare proposal—1.3	Develop cost/ benefit info –1.3.1	□			○		☆

○ Responsible ☆ Support
■ Notification □ Approval

FIGURE 5.10 **Responsibility Assignment Matrix**

PROJECT PROFILE

Defining a Project Work Package

Remember these seven important points about defining a project work package:[15]

1. The work package typically forms the lowest level in the WBS. Although some projects may employ the term *subtask,* the majority leave *work package–level* activities as the most basic WBS step.
2. A work package has a deliverable result. Each work package should have its own outcome. One work package does not summarize or modify another. Together, work packages identify all the work that must be contributed to complete the project.
3. A work package has one owner assigned—a project team member who will be most responsible for that package's completion. Although other team members can provide support as needed, only one person should be directly answerable for the work package.
4. A work package may be considered by its owner as a project in itself. If we adopt the notion that all work packages, because they are of finite length and budget and have a specific deliverable, can be considered miniature projects, each package owner can view his activities as a microproject.
5. A work package may include several milestones. A **milestone** is defined as a significant event in the project. Depending on the size and complexity of a project work package, it may contain a number of significant checkpoints or milestones that determine its progress toward completion.
6. A work package should fit organizational procedures and culture. Tasks undertaken to support project outcomes should be in accord with the overall cultural norms of the project organization. Performing a work package should never lead a team member to violate company policy (either codified or implicit); that is, assigned activities must pass both relevant legal standards for ethical behavior and also adhere to the accepted behaviors and procedures of the organization.
7. The optimal size of a work package may be expressed in terms of labor hours, calendar time, cost, report period, and risks. All work packages should be capable of being tracked, meaning that they must be structured to allow the project manager to monitor their progress. Progress is usually a measurable concept, delineated by metrics such as time and cost.

In developing a project's RAM, managers must consider the relationships between the project team and the rest of the organization as well as those within the project team. Within an organization and without it, actions of department heads and external functional managers can affect how members of a project team perform their jobs. Thus, a detailed RAM can help project managers negotiate with functional managers for resources, particularly through detailing the necessity of including various team members on the project.

Working through a RAM allows the project manager to determine how best to team people for maximum efficiency. In developing the document, a project manager has a natural opportunity to assess team members' strengths, weaknesses, work commitments, and availability. Many firms spend a significant amount of money developing and using software to accurately track project activities, but not nearly as many devote time to tracking the ongoing interaction among project team members. A RAM allows project managers to establish a method for coordinating the work activities of team members, realizing the efficiencies that take place as all team members provide support, notification, and approval for each other's project responsibilities.

plans, including detailed specifications for project delivery. In cases of projects developed for external clients, work authorization typically addresses contractual obligations; for internal clients, it means establishing an audit trail by linking all budget and resource requirements to the formal cost accounting system of the organization. Numerous components of contractual obligations between project organizations and clients can exist, but most contractual documentation possesses some key identifiable features:[16]

- ***Contractual requirements.*** All projects are promised in terms of the specific functionality, or performance criteria, they will meet. This raises the questions: What is the definition accepted by both parties of "specific performance"? Are the terms of performance clearly understood and identified by both parties?
- ***Valid consideration.*** What items are voluntarily promised in exchange for a reciprocal commitment by another party? Does the work authorization contract make clear the commitments agreed to by both parties?

- ***Contracted terms.*** What are excusable delays, allowable costs, and statements of liquidated damages in the case of nonperformance? What are the criteria for inspection? Who has responsibility for correction of defects? What steps are necessary to resolve disputes? Contracted terms typically have clear legal meanings that encourage both parties to communicate efficiently.

A number of contractual arrangements can serve to codify the relationship between a project organization and a customer. It is beyond the purview of this chapter to explore the various forms of contracts and legal recourse in great detail, but some standard contractual arrangements should be considered when managing the project scope. From the perspective of the project organization, the most common contracts range from *lump-sum* or **turnkey contracts**, in which the project organization assumes all responsibility for successful performance, to **cost-plus contracts**, which fix the company's profit for a project in advance. We will discuss the latter first.

Sometimes it is nearly impossible to determine the likely cost for a project in advance. For example, the sheer technical challenges involved in putting a man on the moon, drilling a tunnel under the English Channel, or developing the Strategic Defense Initiative make the process of estimating project costs extremely difficult. In these cases, it is common for project companies to enter into a cost-plus contract that guarantees them a certain profit, regardless of the cost overruns that may occur during the project development. Cost-plus contracts can be abused; in fact, there have been notorious examples of huge overruns in governmental contracts because the lack of oversight resulted in systematic abuses. However, cost-plus contracts can minimize the risk that a company would incur if it were to undertake a highly technical project with the potential for uncertain outcomes, provided that both parties understand the terms of the agreement, the project organization acts with due diligence, and there is a final audit of the project books.

At the opposite extreme are lump-sum (sometimes referred to as turnkey) contracts in which the contractor is required to perform all work at an initially negotiated price. Lump-sum contracting works best when the parameters of the project are clearly understood by both sides (e.g., a residential construction project) and the attendant costs of the project can be estimated with some level of sophistication. In lump-sum contracts, initial cost estimation is critical; if the original estimate is too low and the contractor encounters unforeseen problems, the project's profit may be reduced or even disappear. The advantage of the lump-sum contract to the customer is that the selected project contractor has accepted the majority of the risk in the project. On the other hand, because cost estimation is so crucial, it is common for initial estimates in lump-sum contracts to be quite high, requiring negotiation and rebidding between the contractors and the customer.

The key point about work authorization is grounded in the nature of stated terms for project development. The manager must draw up contracts that clearly stipulate the work agreed to, the nature of the project development process, steps to resolve disputes, and clearly identified criteria for successfully completing the project. This specificity can be especially important when dealing with external stakeholders, including suppliers and clients. Precisely worded work authorization terminology can provide important assistance for project development downstream. On the other hand, ambiguously stated terms or incorrectly placed milestones may actually provoke the opposite results: disagreements, negotiations, and potentially legal action—all guaranteed to slow project development down to a crawl and add tremendous costs to the back end of "completed" projects.

5.4 SCOPE REPORTING

At the project's kickoff, the project team and key clients should make decisions about the need for project updates: How many will be required, and how frequently? **Scope reporting** fulfills this function by determining the types of information that will be regularly reported, who will receive copies of this information, and how this information will be acquired and disseminated.

What types of information are available and what may be appropriately reported? Clearly, a wide variety of forms of project reports can be tracked and itemized. Although the concept will be

developed in more detail in subsequent chapters, among the types of project parameter information that are most commonly included in these reports are:[17]

- Cost status: updates on budget performance
  - S curves: graphical displays of costs (including labor hours and other costs) against project schedule
  - Earned value: reporting project status in terms of both cost and time (the budgeted value of work performed regardless of actual costs incurred)
  - Variance or exception reports: documenting any slippages in time, performance, or cost against planned measures
- Schedule status: updates on schedule adherence
- Technical performance status: updates on technical challenges and solutions

Solid communication between all concerned parties on a project is one of the most important aspects of effective scope reporting. It is necessary to avoid the temptation to limit project status information to only a handful of individuals. Often using the excuse of "need to know," many project teams keep the status of their project secretive, even past the point when it has run into serious trouble (see "Project Management Research in Brief" box). Project managers should consider who would benefit from receiving regular project updates and plan their reporting structure appropriately. Some stakeholders who could be included in regular project status reporting are:

- Members of the project team
- Project clients
- Top management
- Other groups within the organization affected by the project
- Any external stakeholders who have an interest in project development, such as suppliers and contractors

All of these groups have a stake in the development of the project or will be affected by the implementation process. Limiting information may seem to be efficient or save time in the short run, but it can fuel possible misunderstandings, rumors, and organizational resistance to the project in the long run.

BOX 5.1

Project Management Research in Brief

Information Technology (IT) Project "Death Marches": What Is Happening Here?

Every year, billions of dollars are spent on thousands of information technology (IT) projects worldwide. With the huge emphasis on IT products and advances in software and hardware systems, it is no surprise that interest in this field is exploding. Under the circumstances, we would naturally expect that, given the importance of IT projects in both our corporate and everyday lives, we are doing a reasonably good job of implementing these critical projects, right? Unfortunately, the answer is a clear "no." In fact, IT projects have a terrible track record for delivery, as numerous studies show. How bad? The average IT project is likely to be 6 to 12 months *behind* schedule and 50% to 100% *over* budget. Of course, the numbers vary with the size of the project, but the results still suggest that companies should expect their IT projects to lead to wasted effort, enormous delays, burnout, and many lost weekends while laboring for success with the cards stacked the other way.

What we are referring to here are "death march" projects. The death march project is typically one in which the project is set up for failure through the demands or expectations that the company places on it, leaving the expectation that project team will pull off a miracle. The term *death march* invokes images of team members wearily trudging along mile after mile, with no end or possibility of successful conclusion in sight. Death march projects are defined as projects "whose parameters exceed the norm by at least 50%." In practical terms, that can mean:

- The schedule has been compressed to less than half the amount estimated by a rational estimating process (e.g., the schedule suggests it should take one year to complete the project, but top management shrinks the schedule to six months).

(*continued*)

- The project team staffing has been reduced to half the number that normally would be assigned to a project of this size and scope (e.g., a project manager needing 10 resources assigned is instead given only 5).
- The budget and other necessary resources are cut in half (e.g., as a result of downsizing and other cost-cutting exercises in the company, everyone is expected to "do more with less"; or competitive bidding to win the contract was so intense that when the smoke cleared, the company that won the project did so at such a cut-rate price it cannot possibly hire enough people to make it work).

The result of any or all of these starting conditions is a virtual guarantee that the project will fail. The prevalence of death march projects begs the question: Why are death march projects so common and why do they continue to occur? According to the research, there are a number of reasons:

1. Politics—the project may be the result of a power struggle between two ambitious senior executives, or it may have been set up to fail as a form of revenge upon some manager. In these cases, the project manager just gets caught in the blast zone.
2. Naïve promises made by marketing executives or inexperienced project managers—inexperience can result in all sorts of promises made, including those that are impossible to fulfill. In order to impress the boss, a new project manager may promise more than he can deliver. Marketing managers who are concerned with sales and how to improve them may think, "what's a little exaggerated promise if it closes the deal?"
3. Naïve optimism of youth—a technical hotshot who is ambitious and feeling particularly cocky one day may make exaggerated promises that quickly result in the project team getting in over its head. Optimism is no substitute for careful planning.
4. The "start-up" mentality of fledgling entrepreneurial companies—start-up firms come loaded with energy, enthusiasm, and an aggressive, get-it-going attitude. When that mentality translates into projects, however, problems can occur. Entrepreneurial approaches to managing projects may ignore critical planning and detailed advance preparation that no experienced project manager would sacrifice.
5. The "Marine Corps" mentality: Real programmers don't need sleep—this attitude emphasizes bravado as a substitute for evaluation. The hyperoptimistic schedule or budget is not an accident; it is a deliberate manifestation of this aggressive attitude: If you can't handle it, you don't belong here.
6. Intense competition caused by globalization—the appearance of new, international competitors often comes as a rude awakening when it is first experienced. Many firms respond with radical moves that push for rapid technical advances or "catching up" behaviors, resulting in numerous new death march projects.
7. Intense competition caused by the appearance of new technologies—as new opportunities emerge through new technologies, some firms jump into them eagerly, without first understanding their capacities, scalability for larger projects, and limitations. The result is an endless game of exploiting "opportunities" without fully comprehending them or the learning curve for using new technologies.
8. Intense pressure caused by unexpected government regulations—government-mandated death march projects occur through a failure of top management to anticipate new regulations or mandates or, worse, to recognize that they are coming but put off any efforts to comply with them until deadlines have already been set. New pollution or carbon-energy controls laws, for example, may lead to huge projects with looming deadlines because the company put off until the last minute any efforts to self-regulate.
9. Unexpected and/or unplanned crises—any number of crises can be anticipated with sufficient advance planning. Examples of crises that can severely affect project delivery are the loss of key project team personnel midway through the project's development or the bankruptcy of a key supplier. Some crises, of course, are unpredictable by definition, but all too often the crisis that destroys all of the work to date on a project is one that could have been anticipated with a little foresight. The long road back from these disasters will lead to many death marches.

Death march projects are not limited to the IT industry. Indeed, as we consider the list of reasons why death marches occur, we can see similar effects in numerous projects across different industries. The end result is typically the same: massively wasted efforts spent on projects that have been set up to fail by the very conditions under which they are expected to operate. The implications are clear: To avoid setting the stage for future death march projects, we need to start with the end in mind and ask, are the goals and conditions (budget, personnel assigned, and schedule) conducive to project success, or are we just sowing the seeds of inevitable disaster?[18]

5.5 CONTROL SYSTEMS

A question we might ask is: "How does a project become one year late?" The answer is: "One day at a time." When we are not paying close attention to a project's development, anything can (and usually does) happen. Project control is a key element in scope management. **Control systems** are vital to ensure that any changes to the project baseline are conducted in a systematic and thorough manner. Project managers can use a number of project control systems to track the status of their projects, including:[19]

- ***Configuration control*** includes procedures that monitor emerging project scope against the original baseline scope. Is the project following its initial goals, or are they being allowed to drift as status changes or new circumstances alter the original project intent?
- ***Design control*** relates to systems for monitoring the project's scope, schedule, and costs during the design stage. Chrysler developed Platform Design Teams (PDTs), composed of members from functional departments, to ensure that new automobile designs could be immediately evaluated by experts in engineering, production, and marketing. It found that this instantaneous feedback eliminated the time that had been lost when designs were deemed unworkable by the engineering organization at some later point in the car's development.
- ***Trend monitoring*** is the process of tracking the estimated costs, schedules, and resources needed against those planned. Trend monitoring shows significant deviations from norms for any of these important project metrics.
- ***Document control*** ensures that important documentation is compiled and disseminated in an orderly and timely fashion. Document control is a way of making sure that anything contractual or legal is documented and distributed. For example, document control would ensure that the minutes of a building committee's deliberations concerning a new construction project are reproduced and forwarded to appropriate oversight groups.
- ***Acquisition control*** monitors systems used to acquire necessary project equipment, materials, or services needed for project development and implementation.
- ***Specification control*** ensures that project specifications are prepared clearly, communicated to all concerned parties, and changed only with proper authorization.

One of the most important pieces of advice for project managers and teams is to establish and maintain a reasonable level of control (including clear lines of authority) *at the start of a project.* Perhaps surprisingly, *reasonable* here means avoiding the urge to overdevelop and overcontrol projects. Project managers' ability to manage day-to-day activities can be hindered by having to handle excessive control system reports—there can simply be too much paperwork. On the other hand, it is equally important not to devalue control systems as taking up too much time. Knowing the right project control systems to use and how often to employ them can eliminate much of the guesswork when dealing with project delays or cost overruns. For example, a recent large office building project brought together a project team composed of groups and contractors relating to the architectural design; the heating, ventilation, and air conditioning (HVAC); the electrical and plumbing work; concrete and steel construction; and facilities management. During meetings early in the project, the combined construction project team agreed to a clear scope for the project and a streamlined control and reporting process that had trend monitoring, configuration, and specification control as the key elements in the project review cycle. Because several of the independent contractors had a long history of working together and had built a level of mutual trust, they reasoned that the barest minimum control processes would be preferable. In this example, the team sought a balance in project control processes between the twin errors of excessive and nonexistent control.

Configuration Management

The Project Management Body of Knowledge (PMBoK) defines *configuration management* as "a system of procedures that monitors emerging project scope against the scope baseline. It requires documentation and management approval on any change to the baseline." A **baseline** is defined as the project's scope fixed at a specific point in time—for example, the project's scheduled start date. The baseline, therefore, is viewed as the project's *configuration.* Remember that the scope baseline is simply a summary description of the project's original content and end product, including budget and time constraint data. As a result, in simple terms, **configuration management** relates to the fact that projects usually consist of component parts, all contributing to the project's functionality.

These parts must be individually developed and ultimately assembled, or configured, to produce the final product or service. The role of designing, making, and assembling these components belongs to configuration management. However, because this process often requires several iterations, adjustments, and corrections to get the project right, in practical terms, *configuration management is the systematic management and control of project change.*[20]

The management of project changes is most effectively accomplished at the beginning of the project when plans and project scope are first articulated. Why would you want to begin managing change at the point where you are carefully defining a project? The answer is that the need to make significant project changes is usually an acknowledged part of the planning process. Some changes are made as the result of carefully acknowledged need; others emerge almost by accident during the project's development. For example, we may discover at some point during the project's execution that certain technical specifications we designed into the original prototype may not work under specific conditions (e.g., high altitudes, humid conditions), requiring us to make midcourse alterations to the project's required functionality.

Configuration management works toward formalizing the change process as much as possible as early in the project's life as possible, rather than leaving needed downstream changes to be made in an uncoordinated manner. The need to make project changes or specification adjustments, it has been suggested, comes about for one of several reasons:[21]

- ***Initial planning errors, either technological or human.*** Many projects involve technological risks. It is often impossible to accurately account for all potential problems or technological roadblocks. For example, the U.S. Navy and Marine Corps' drive to create a vertical takeoff, propeller-driven aircraft, the Osprey, resulted in a series of unexpected technical problems, including some tragic accidents during prototype testing. Initial engineering did not predict (and perhaps could not have predicted) the problems that would emerge with this new technology. Hence, many projects require midcourse changes to technical specifications as they encounter problems that are not solvable with existing resources or other unexpected difficulties. Planning errors also may be due to human mistake or lack of full knowledge of the development process. In the case of nontechnical causes for change, reconfiguration may be a simple adjustment to the original plans to accommodate new project realities.
- ***Additional knowledge of project or environmental conditions.*** The project team or a key stakeholder, such as the client, may enter into a project only to discover that specific features of the project or the business, economic, or natural environment require midcourse changes to the scope. For example, the technical design of a deep-water oil-drilling rig may have to be significantly modified upon discovery of the nature of water currents or storm characteristics, underwater terrain formations, or other unanticipated environmental features.
- ***Uncontrollable mandates.*** In some circumstances, events occur outside the control of the project team and must be factored into the project as it moves forward. For example, a governmental mandate for passenger safety established by the European Union in 2001 forced Boeing Corporation to redesign exit features on its new 777 aircraft, temporarily delaying the project's introduction and sale to foreign airlines.
- ***Client requests.*** The situation in which a project's clients, as the project evolves, attempt to address new needs with significant alterations is a very common phenomenon. In software development, for example, a client taking the role of potential user might list several complaints, requests, new features, reworked features, and so on when first exposed to a planned software upgrade. Often IT projects run excessively behind schedule as users continue to bring forward lists of new requirements or change requests.

Configuration management can probably be traced to the change control techniques initiated by the U.S. defense community in the 1950s. Defense contractors routinely changed the configuration of various weapon systems at the request of governmental groups, especially the armed forces. In making these changes, however, little of the process would be documented or traceable; hence, when new weapon systems were introduced, the armed forces found them hard to service and maintain. Poor record keeping led to poor channels of communication to relevant contractors when problems or modification requests arose. As a result, the Defense Department routinely found it necessary to reissue general change request orders that delayed its ability to gain timely performance corrections. In the middle of the decade after much frustration (and expense), the

Step	Action
1. Configuration identification	1. Develop a breakdown of the project to the necessary level of definition. 2. Identify the specifications of the components of the breakdown and of the total project.
2. Configuration reviews	Meet with all the project stakeholders to agree to the current project definition.
3. Configuration control	1. If agreement is achieved, repeat the first three steps, developing the breakdown and specification further, until the project is defined. 2. If agreement is not reached, either: • Cycle back to the configuration as agreed at a previous review and repeat steps 1, 2, and 3 until agreement is achieved; or • Change the specification last obtained by a process change control to match what people think it should be.
4. Status accounting	Memory of the current configurations, and all previous ones, must be maintained so that if agreement is not reached at some point, the team can cycle back to a previous configuration and restart from there. Also, memory of the configuration of all prototypes must be maintained.

FIGURE 5.11 Four Stages of Configuration Management

Source: © Turner, R. (2000), "Managing scope-configuration and work methods," in Turner, R. (Ed.), *Gower Handbook of Project Management,* 3rd ed. Aldershot, UK: Gower.

Defense Department finally issued an order mandating that all organizations supplying systems to the government demonstrate a comprehensive change control and documentation process.[22]

Figure 5.11 presents the four stages in configuration management, including the tasks to be performed at each of the configuration management steps.[23]

5.6 PROJECT CLOSEOUT

Effective scope management also includes appropriate planning for a project's termination. Although the process of effective project termination will be covered in great detail in Chapter 14, it is useful to reflect on the fact that even when planning for a project, we should be planning for the project's conclusion. The **project closeout** step requires project managers to consider the types of records and reports they and their clients will require at the completion of the project.[24] The earlier in the scope development process that these decisions are made, the more useful the information collected over the project's development can be. Closeout information can be important (1) in the case of contractual disputes after the project has been completed, since the more thorough the project records, the less likely it is that the organization will be held liable for alleged violations; (2) as a useful training tool for postproject analysis of either successes or failures; and (3) to facilitate project auditing tasks by showing the flow of expenses in and out of various project accounts.

Closeout documentation a project leader may decide to track includes the following:

- ***Historical records,*** or project documentation that can be used to predict trends, analyze feasibility, and highlight problem areas for similar future projects
- ***Postproject analysis,*** which follows a formal reporting structure, including analysis and documentation of the project's performance in terms of cost, schedule adherence, and technical specification performance
- ***Financial closeout,*** or the accounting analysis of how funds were dispersed on the project

One of the most important lessons for successful project managers is to "start with the end in mind." Clear goals at the beginning of a project make clear what the project's completion will require. Project closeout requires managers to consider a priori the types and amounts of information to continually collect during project development, relying on a sound project tracking and

filing system. That way, when the project is in its closeout, time is not wasted scrambling for old project records and other information that is needed but missing.

A project's goals are just a dream until they are written down. Until the project's plans are laid out, its purposes specified, its constraints considered, and its results anticipated, a project is nothing more than an organization's hope for success. Scope management is the systematic process of turning these dreams into reality by formally developing project goals. Like a lighthouse, a thorough scope document illuminates the way toward project completion even while the team may be tossed on the waves of numerous crises and concerns. As long as the light continues to shine, as long as the project manager works to develop and maintain the various elements of project scope, the likelihood of passage to successful project completion is strong.

Summary

1. **Understand the importance of scope management for project success.** This chapter examined the role of project scope management as an important planning technique. Project scope management is the detailed development of the project plan to specify the work content and outcomes of the project, the activities that must be performed, the resources consumed, and the quality standards to be maintained. The six steps in creating a project scope management procedure are conceptual development, the scope statement, work authorization, scope reporting, control systems, and project closeout.

   Conceptual development is the process of choosing the best method for achieving the project's goals. The project's conceptual development allows the project manager to begin the process of transitioning from the project as a dream to the project as a specific goal or set of objectives. Problem statements, information gathering, identified constraints, alternatives analyses, and final project objectives are all created during the conceptual development.

   The scope statement is a comprehensive definition of all parameters necessary for the project to succeed. A number of elements factor into effective scope statement development, but perhaps most key is the Work Breakdown Structure (WBS). The work breakdown process gives the project team the ability to create a hierarchy of activities-based priorities, creating work packages, tasks, and subtasks as building blocks for completing the overall project. When this is coupled with a clear Responsibility Assignment Matrix (RAM), the project manager and team are able to begin moving beyond the project as a concept and tackle the project as a set of identified activities, with responsible personnel assigned to them.

   Work authorization, the third element in project scope management, refers to the process of sanctioning all project work. This step may involve formulating contractual obligations with vendors, suppliers, and clients.

   Project scope reporting refers to any control systems and documentation that will be used to assess the project's overall status. Examples of scope reporting include the creation of control documents and budget and schedule tracking.

   Control systems, including configuration management, refer to the processes put in place to track the ongoing status of the project, compare actual with baseline projections, and offer corrective measures for bringing the project back on track.

   Finally, the project closeout phase represents the project team's best determination as to the information and transition materials necessary to ensure a smooth transfer of the project to its intended clients.
2. **Understand the significance of developing a scope statement.** The project scope statement reflects the project team's best efforts to create the documentation and approval for all important project parameters prior to beginning the development phase. This statement is an opportunity to clearly "nail down" the elements of the project and what it is intended to accomplish, as well as to identify the project's critical features. The elements in the scope statement include (1) establishing the goal criteria—defining what will demonstrate project success and what the decision gates are for evaluating deliverables; (2) developing the management plan for the project—determining the structure for the project team, key rules and procedures that will be maintained, and the control systems to monitor effort; (3) establishing the Work Breakdown Structure (WBS)—dividing the project into component substeps in order to establish the critical interrelationships among project activities; and (4) creating a scope baseline—providing a summary description of each component of the project's goal, including budget and schedule information for each activity.
3. **Construct a Work Breakdown Structure for a project.** The Work Breakdown Structure (WBS) is a process that sets a project's scope by breaking down its overall mission into a cohesive set of synchronous, increasingly specific tasks. Defined as a "deliverable-oriented grouping of

project elements which organizes and defines the total scope of the project," the WBS is the most important organizing tool project teams have in preparing their tasks.

The WBS serves six main purposes: (1) it echoes project objectives; (2) it is the organization chart for the project; (3) it creates the logic for tracking costs, schedule, and performance specifications for each element in the project; (4) it may be used to communicate project status; (5) it may be used to improve overall project communication; and (6) it demonstrates how the project will be controlled. The logic of the WBS is to subdivide project deliverables into increasingly more specific sublevels to identify all significant activities. The common terminology is to first identify the overall project, then the major deliverables for that project, and finally the work packages that must be accomplished to complete each deliverable.

Closely related to the WBS is the Organization Breakdown Structure (OBS), which allows companies to define the work to be accomplished and assign it to the owners of the work packages. The budgets for these activities are then directly assigned to the departmental accounts responsible for the project work.

4. **Develop a Responsibility Assignment Matrix for a project.** The Responsibility Assignment Matrix (RAM), sometimes referred to as a linear responsibility chart, identifies project team personnel who are directly responsible for each task in the project's development. The RAM identifies where responsible team members can go for task support, who should next be notified of the task completion status, and any sign-off requirements. The goal of the RAM is to facilitate communication between project team personnel to minimize transition disruptions as the project moves toward completion. An additional benefit of the RAM is to make the coordination between project managers and functional department heads easier as they work to make best use of personnel who may be assigned to the project for only temporary periods.
5. **Describe the roles of changes and configuration management in assessing project scope.** Significant project changes occur for a number of reasons, including (1) initial planning errors, either technological or human; (2) additional knowledge of project or environmental conditions; (3) uncontrollable mandates; and (4) client requests.

The four stages of configuration management are (1) configuration identification—breaking down the project and identifying the specifications of its components; (2) configuration reviews—meeting with stakeholders to agree to project definition; (3) configuration control—following agreement with stakeholders, developing the breakdown and specifications further; and (4) status accounting—maintaining memory of all current and previous configurations for reference.

Key Terms

Baseline *(p. 167)*
Business case *(p. 149)*
Conceptual development *(p. 148)*
Configuration management *(p. 167)*
Control systems *(p. 167)*
Cost control accounts *(p. 159)*
Cost-plus contracts *(p. 164)*
Deliverables *(p. 153)*
Milestone *(p. 163)*
Organization Breakdown Structure (OBS) *(p. 159)*
Project charter *(p. 151)*
Project closeout *(p. 169)*
Project scope *(p. 146)*
Requirements gathering *(p. 148)*
Responsibility Assignment Matrix (RAM) *(p. 160)*
Scope baseline *(p. 153)*
Scope management *(p. 146)*
Scope reporting *(p. 164)*
Scope statement *(p. 153)*
Statement of Work (SOW) *(p. 150)*
Turnkey contracts *(p. 164)*
WBS codes *(p. 158)*
Work authorization *(p. 161)*
Work Breakdown Structure (WBS) *(p. 153)*
Work packages *(p. 156)*

Discussion Questions

5.1 What are the principal benefits of developing a comprehensive project scope analysis?
5.2 What are the key characteristics of a work package?
5.3 Create a Work Breakdown Structure for a term paper project or another school-related project you are working on. What are the steps in the WBS? Can you identify any substeps for each step?
5.4 What are the benefits of developing a Responsibility Assignment Matrix (RAM) for a project?
5.5 Develop an argument for scope reporting mechanisms. At a minimum, what types of reports do you consider necessary for document control of a project? Why?
5.6 What is the chief purpose of configuration management? In your opinion, why has it become increasingly popular in recent years as a part of the project management process?
5.7 What is the logic behind developing a plan for project closeout prior to even beginning the project?