CHAPTER 5

# PROJECT SCOPE MANAGEMENT 范围

## LEARNING OBJECTIVES

**After reading this chapter, you will be able to:**

- Understand the importance of good project scope management
- Describe the process of planning scope management
- Discuss methods for collecting and documenting requirements to meet stakeholder needs and expectations
- Explain the scope definition process and describe the contents of a project scope statement
- Discuss the process for creating a work breakdown structure using the analogy, top-down, bottom-up, and mind-mapping approaches
- Explain the importance of validating scope and how it relates to defining and controlling scope
- Understand the importance of controlling scope and approaches for preventing scope-related problems on information technology (IT) projects
- Describe how software can assist in project scope management

## OPENING CASE

Kim Nguyen was leading a meeting to create the work breakdown structure (WBS) for her company's IT upgrade project. This project was necessary because of several high-priority, Internet-based applications the company was developing. The IT upgrade project involved creating and implementing a plan to make all employees' IT assets meet new corporate standards within nine months. These standards specified the minimum requirements for each desktop or laptop computer, including the type of processor, amount of memory, hard disk size, type of network connection, security features, and software. Kim knew that to perform the upgrades, the project team would first have to create a detailed inventory of all the current hardware, networks, and software in the entire company of 2,000 employees.

Kim had worked with other stakeholders to develop a project charter and initial scope statement. The project charter included rough cost and schedule estimates for the project and signatures of key stakeholders; the initial scope statement provided a start in defining the hardware, software, and network requirements as well as other information related to the project scope. Kim called a meeting with her project team and other stakeholders to further define the scope of the project. She wanted to get everyone's ideas on what the project involved, who would do what, and how they could avoid scope creep. The company's new CEO, Walter Schmidt, was known for keeping a close eye on major projects. The company had started using a new project management information system that let everyone know the status of projects at a detailed and high level. Kim knew that a good WBS was the foundation for scope, time, and cost performance, but she had never led a team in creating one or allocating costs based on a WBS. Where should she begin?

## 5.1 WHAT IS PROJECT SCOPE MANAGEMENT?

Many of the factors associated with project success, such as user involvement, clear business objectives, and optimized scope, are elements of project scope management.

A critically important and difficult aspect of project management is defining the scope of a project. **Scope** refers to *all* the work involved in creating the products of the project and the processes used to create them. Recall from Chapter 2 that a **deliverable** is a product created as part of a project. Deliverables can be product-related, such as a piece of hardware or software, or process-related, such as a planning document or meeting minutes. Project stakeholders must agree what the products of the project are and, to some extent, how they should be produced to define all of the deliverables.

**Project scope management** includes the processes involved in defining and controlling what work is or is not included in a project. It ensures that the project team and stakeholders have the same understanding of what products the project will produce and what processes the project team will use to produce them. Six main processes are involved in project scope management:

1. *Planning scope management* involves determining how the project's scope and requirements will be managed. The project team works with appropriate stakeholders to create a scope management plan and requirements management plan.
2. *Collecting requirements* involves defining and documenting the features and functions of the products as well as the processes used for creating them. The project team creates requirements documentation and a requirements traceability matrix as outputs of the requirements collection process.

3. *Defining scope* involves reviewing the scope management plan, project charter, requirements documents, and organizational process assets to create a scope statement, adding more information as requirements are developed and change requests are approved. Outputs of scope definition are the project scope statement and updates to project documents.
4. *Creating the WBS* involves subdividing the major project deliverables into smaller, more manageable components. Outputs include a scope baseline (which includes a WBS and a WBS dictionary) and updates to project documents.
5. *Validating scope* involves formalizing acceptance of the project deliverables. Key project stakeholders, such as the customer and sponsor for the project, inspect and then formally accept the deliverables during this process. If the deliverables are not acceptable, the customer or sponsor usually requests changes. The outputs of this process are accepted deliverables, change requests, work performance information, and updates to project documents.
6. *Controlling scope* involves controlling changes to project scope throughout the life of the project—a challenge on many IT projects. Scope changes often influence the team's ability to meet project time and cost goals, so project managers must carefully weigh the costs and benefits of scope changes. The outputs of this process are work performance information, change requests, and updates to the project management plan, project documents, and organizational process assets.

Figure 5-1 summarizes these processes and outputs and shows when they occur in a typical project.

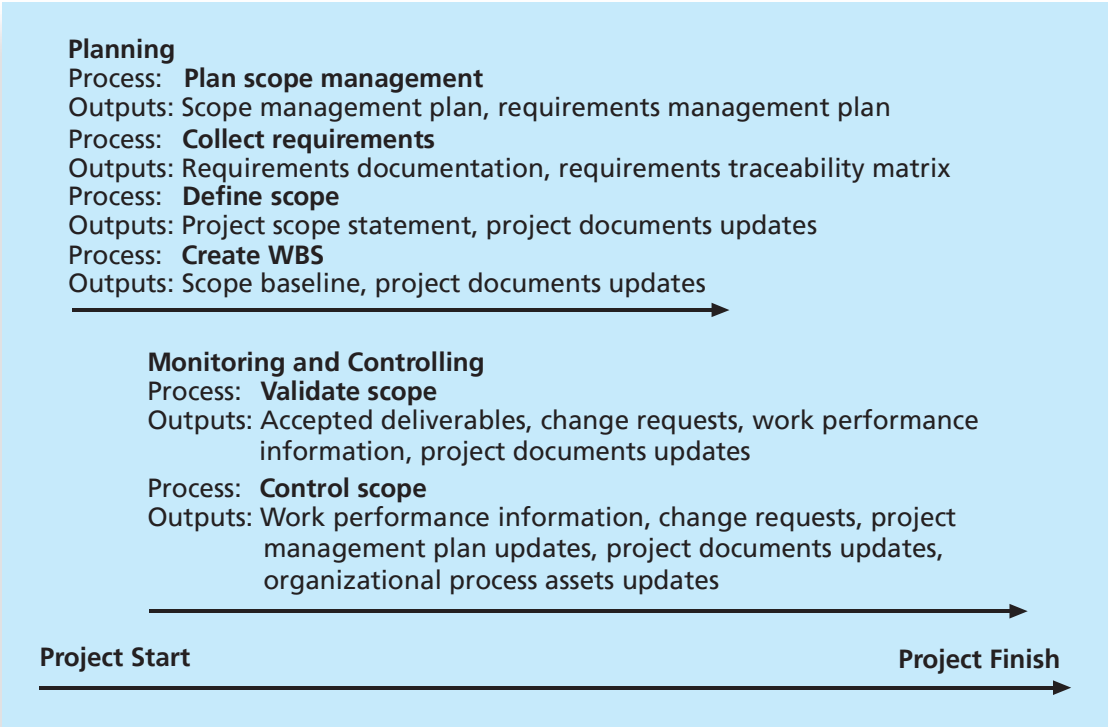





**FIGURE 5-1** Project scope management summary

## 5.2 PLANNING SCOPE MANAGEMENT

The first step in project scope management is planning how the scope will be managed throughout the life of the project. After reviewing the project management plan, project charter, enterprise environmental factors, and organizational process assets, the project team uses expert judgment and meetings to develop two important outputs: the scope management plan and the requirements management plan.



The scope management plan is a subsidiary part of the project management plan, as described in Chapter 4, Project Integration Management. It can be informal and broad or formal and detailed, based on the needs of the project. In fact, small projects may not need a written scope management plan, but large projects or highly technical projects often benefit from one. In general, a scope management plan includes the following information:

- *How to prepare a detailed project scope statement*: For example, are there templates or guidelines to follow? How much detail is needed to describe each deliverable?
- *How to create a WBS*: It is often difficult to create a good WBS. This section of the scope management plan would provide suggestions, samples, and resources for creating a WBS.
- *How to maintain and approve the WBS*: The initial WBS often changes, and project team members disagree on what should be included. The scope management plan describes guidelines for maintaining the WBS and getting approval for it.
- *How to obtain formal acceptance of the completed project deliverables*: It is extremely important to understand the process for obtaining formal acceptance of completed deliverables, especially for projects in which payments are based on formal acceptance.
- *How to control requests for changes to the project scope*: This process is related to performing integrated change control, as described in Chapter 4. Organizations often have guidelines for submitting, evaluating, and approving changes to scope, and this section of the scope management plan would specify how to handle change requests for the project.

Another important output of planning scope management is the requirements management plan. Before you learn about the contents of this document, it is important to understand what requirements are. The 1990 IEEE Standard Glossary of Software Engineering Terminology defines a requirement as follows:

> "1. A condition or capability needed by a user to solve a problem or achieve an objective.
> 2. A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document.
> 3. A documented representation of a condition or capability as in 1 or 2."[1]

The *PMBOK® Guide, Fifth Edition*, describes **requirements** as "conditions or capabilities that must be met by the project or present in the product, service, or result to satisfy an agreement or other formally imposed specification." It further explains that requirements "include the quantified and documented needs and expectations of the sponsor,

customer, and other stakeholders. These requirements need to be elicited, analyzed, and recorded in enough detail to be included in the scope baseline and be measured once project execution begins."

For example, the chapter's opening case describes a project for upgrading IT assets to meet corporate standards. These standards specify the minimum requirements for each laptop, such as the type of processor, amount of memory, and hard disk size. The documented requirements for this project, therefore, might state that all laptops include an Intel processor, at least 16 GB of memory, and a 2-TB hard drive.



For some IT projects, it is helpful to divide requirements development into categories called *elicitation*, *analysis*, *specification*, and *validation*. These categories include all the activities involved in gathering, evaluating, and documenting requirements for a software or software-containing product. It is also important to use an iterative approach to defining requirements because they are often unclear early in a project.

The **requirements management plan** documents how project requirements will be analyzed, documented, and managed. A requirements management plan can include the following information:

- How to plan, track, and report requirements activities
- How to perform configuration management activities
- How to prioritize requirements
- How to use product metrics
- How to trace and capture attributes of requirements

## WHAT WENT RIGHT?

Several studies cite how difficult it is to manage requirements. Finding qualified people—business analysts—to do the job is equally difficult. The U.S. Bureau of Labor Statistics has projected the number of jobs for business analysts to increase 19 percent by 2022.[2] A 2014 PMI survey found that only 49 percent of respondents had the resources in place to do requirements management properly and 53 percent failed to use a formal process to validate requirements.[3]

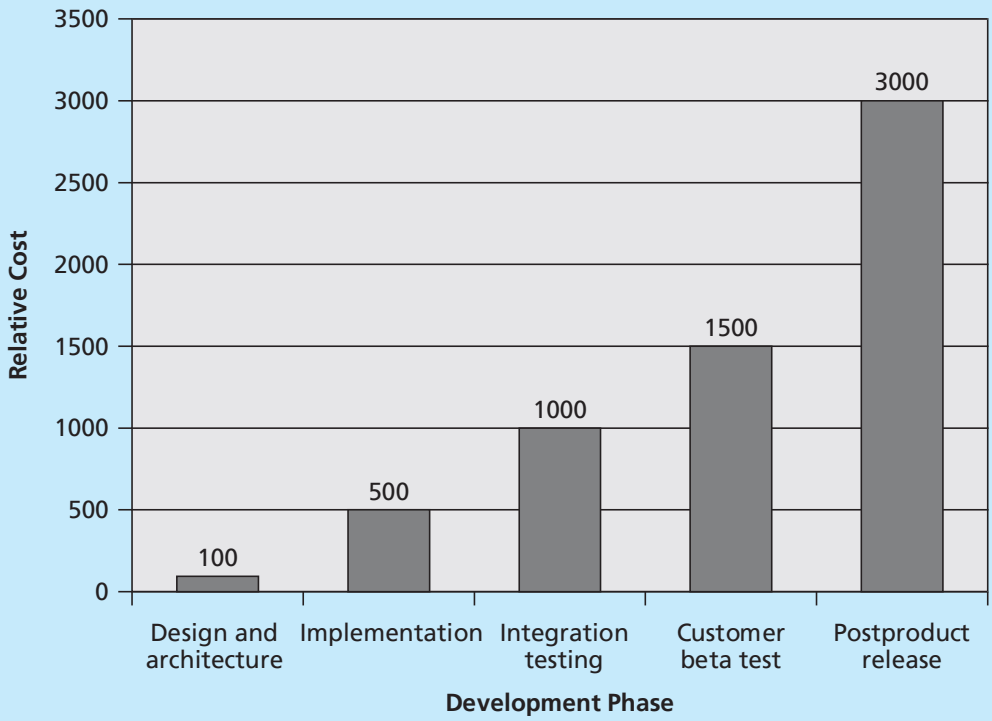
Fortunately, several organizations have recognized this need and have developed training and certification programs for business analysts.

- The International Institute of Business Analysis (IIBA)® issues both the Certified Business Analysis Professional (CBAP®) and Certification of Competency in Business Analysis (CCBA®) certifications. This organization had about 28,000 members by the end of 2014 and recently published the third edition of the *Guide to Business Analysis Body of Knowledge* (*BABOK® Guide*).
- The International Requirements Engineering Board (IREB) provides certification as a Certified Professional for Requirements Engineering (CPRE). Over 19,000 people in 55 countries held this certification by the end of 2014.
- PMI began offering a new certification as a PMI Professional in Business Analysis (PMI-PBA)® in 2014.
- Several colleges and universities are offering majors and minors in business or data analytics at the undergraduate and graduate levels.

## 5.3 COLLECTING REQUIREMENTS

The second step in project scope management is often the most difficult: collecting requirements. A major consequence of not defining requirements well is rework, which can consume up to half of project costs, especially for software development projects. As illustrated in Figure 5-2, it costs much more (up to 30 times more) to correct a software defect in later development phases than to fix it in the requirements phase. Everyone can cite examples in all types of industries of how important it is to understand requirements as early as possible. For example, if you are designing a house, it is much cheaper to decide where windows and walls will be on paper or a computer screen than after the entire house is framed. New processes and technologies are making it easier to define and implement requirements, but it is still one of the most challenging aspects of project scope management.






*Source:* IBM Software Group, "Minimizing code defects to improve software quality and lower development costs," Rational Software (October 2008).

**FIGURE 5-2** Relative cost to correct a software defect

## BEST PRACTICE

Google continues to be among the most admired companies in the world, well-known for being a great place to work and for being innovative in developing new products. James Whittaker, former engineering director at Google, responsible for testing Chrome, maps, and Google web apps, wrote a book with co-authors Jason Arbon and Jeff Carollo (also former Google employees) called *How Google Tests Software*. Whittaker also worked for Microsoft and as a professor and is one of the best-known names in testing software.

In *How Google Tests Software*, the authors explain that Google used to be like other large companies: testing was not part of the mainstream, and people who did it were underappreciated and overworked. It took Google a long time to develop the people, processes, and technologies it uses today to develop software. A key part of success at Google was changing the culture. Google has fewer dedicated testers than most of its competitors have on a single product team. How is that possible? The authors explain that quality rests on the shoulders of those writing the code. The employees at Google do things the best, fastest way possible for them, knowing that coders are responsible for the quality of their own work. They don't rely on testers to ensure quality.

It is also interesting to note that Google does not believe in fads or buzzwords. In an interview, InfoQ asked the authors how Google's approach fits into the wider Agile community. Their response: "Google doesn't try to be part of the Agile community. We don't use the terminology of scrums or bother with scrum masters and the like. We have crafted our own process of moving fast. It's a very Agile process that doesn't get bogged down with someone else's idea of what it means to be Agile. When you have to stop and define what it means to be Agile and argue what flavor of Agile you are, you just stopped being Agile."[4]

Part of the difficulty is that people often do not have a good process for collecting and documenting project requirements.

There are several ways to collect requirements. Interviewing stakeholders one on one is often very effective, although it can be expensive and time-consuming. Holding focus groups and facilitated workshops, and using group creativity and decision-making techniques to collect requirements, are normally faster and less expensive than one-on-one interviews. Questionnaires and surveys can be efficient ways to collect requirements as long as key stakeholders provide honest and thorough information. Observation can also be a good technique for collecting requirements, especially for projects that involve improving work processes and procedures. For software development projects, prototyping and document analysis are common techniques for collecting requirements, as are context diagrams, which help to clarify the interfaces and boundaries of a project or process. On agile software development projects, the product owner creates the prioritized product backlog for each sprint, as shown in Chapter 3. **Benchmarking**, or generating ideas by comparing specific project practices or product characteristics to those of other projects or products inside or outside the performing organization, can also be used to collect requirements.

Even though there are many ways to collect requirements, people who work on software projects in particular have considerable difficulty defining and managing requirements. A 2011 study revealed some interesting statistics:

- Eighty-eight percent of the software projects involved enhancing existing products instead of creating new ones.

- Eighty-six percent of respondents said that customer satisfaction was the most important metric for measuring the success of development projects, 82 percent said that feedback from customers and partners was the main source of product ideas and requirements, and 73 percent said the most important challenge for their teams was gaining a clear understanding of what customers wanted, followed by documenting and managing requirements.
- Seventy-five percent of respondents were managing projects with at least 100 requirements; 20 percent were managing projects with over 1,000 requirements.
- Seventy percent of respondents spent at least 10 percent of their time managing changes to requirements; 30 percent spent more than 25 percent of their time on such changes.
- The majority of software development teams used a hybrid methodology, 26 percent used waterfall or modified waterfall techniques, and 19 percent used agile techniques.
- Eighty-three percent of software development teams still use Microsoft Office applications such as Word and Excel as their main tools to communicate requirements.
- The respondents listed "requirements collaboration and management software" and "requirements modeling and visualization" as the top two software tools on their wish list, followed by test management and project management.[5]

The project's size, complexity, importance, and other factors affect how much effort is spent on collecting requirements. For example, a team working on a project to upgrade the entire corporate accounting system for a multibillion-dollar company with more than 50 locations should spend a fair amount of time collecting requirements. On the other hand, a project to upgrade the hardware and software for a small accounting firm with only five employees would need a much smaller effort. In any case, it is important for a project team to decide how it will collect and manage requirements. It is crucial to gather inputs from key stakeholders and align the scope with business strategy, as described in Chapter 4.

Just as a project team can collect requirements in several ways, there are several ways to document the requirements. Project teams should first review the project charter because it includes high-level requirements for the project, and they should refer to the scope and requirements management plans. They should also review the stakeholder register and stakeholder management plan to ensure that all key stakeholders have a say in determining requirements. The format for documenting stakeholder requirements can range from a listing of all requirements on a single piece of paper to a room full of notebooks. People who have worked on complex projects, such as building a new airplane, know that the requirements documentation for a plane can weigh more than the plane itself! Requirements documents are often generated by software and include text, images, diagrams, videos, and other media. Requirements are often broken down into different categories such as functional requirements, service requirements, performance requirements, quality requirements, and training requirements.

**TABLE 5-1** Sample entry in a requirements traceability matrix

| Requirement No. | Name | Category | Source | Status |
|---|---|---|---|---|
| R32 | Laptop memory | Hardware | Project charter and corporate laptop specifications | Complete. Laptops ordered meet requirement by having 16 GB of memory. |





In addition to preparing requirements documentation as an output of collecting requirements, project teams often create a requirements traceability matrix. A **requirements traceability matrix (RTM)** is a table that lists requirements, their various attributes, and the status of the requirements to ensure that all are addressed. Table 5-1 provides an example of an RTM entry for the IT upgrade project described in the chapter's opening case. An RTM can have many variations. For example, software requirements are often documented in an RTM that cross-references each requirement with related ones and lists specific tests to verify that they are met. Remember that the main purpose of an RTM is to maintain the linkage from the source of each requirement through its decomposition to implementation and validation. Search the Internet for more detailed examples of an RTM.

## 5.4 DEFINING SCOPE

The next step in project scope management is to provide a detailed definition of the work required for the project. Good scope definition is very important to project success because it helps improve the accuracy of time, cost, and resource estimates, it defines a baseline for performance measurement and project control, and it aids in communicating clear work responsibilities. The main tools and techniques used in defining scope include expert judgment, product analysis, alternatives generation, and facilitated workshops. For example, a facilitator could have users, developers, and salespeople join a face-to-face meeting or virtual meeting to exchange ideas about developing a new product. The main outputs of scope definition are the project scope statement and project documents updates.

Key inputs for preparing the project scope statement include the project charter, scope management plan, requirements documentation, and organizational process assets such as policies and procedures related to scope statements, as well as project files and lessons learned from previous, similar projects. Table 5-2 shows the project charter for the IT upgrade project described in the opening case. Notice how information from the project charter provides a basis for further defining the project scope. The charter describes the high-level scope, time, and cost goals for the project objectives and success criteria, a general approach to accomplishing the project's goals, and the main roles and responsibilities of important project stakeholders.

Although contents vary, **project scope statements** should include at least a product scope description, product user acceptance criteria, and detailed information on all project deliverables. It is also helpful to document other scope-related information, such as the project boundaries, constraints, and assumptions. The project scope statement should also

**TABLE 5-2** Sample project charter

**Project Title:** Information Technology (IT) Upgrade Project

**Project Start Date:** March 4 **Projected Finish Date:** December 4

**Key Schedule Milestones:**

- Inventory update completed April 15
- Hardware and software acquired August 1
- Installation completed October 1
- Testing completed November 15



**Budget Information:** Budgeted $1,000,000 for hardware and software costs and $500,000 for labor costs.

**Project Manager:** Kim Nguyen, (310) 555–2784, knguyen@course.com

**Project Objectives:** Upgrade hardware and software for all employees (approximately 2,000) within nine months based on new corporate standards. See attached sheet describing the new standards. Upgrades may affect servers as well as associated network hardware and software.

**Main Project Success Criteria:** The hardware, software, and network upgrades must meet all written specifications, be thoroughly tested, and be completed in nine months. Employee work disruptions will be minimal.

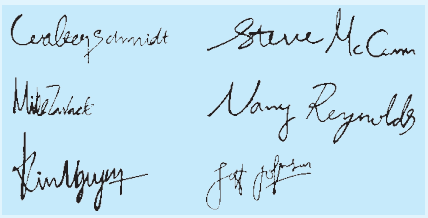
**Approach:**

- Update the IT inventory database to determine upgrade needs
- Develop detailed cost estimate for project and report to CIO
- Issue a request for quote to obtain hardware and software
- Use internal staff as much as possible for planning, analysis, and installation

ROLES AND RESPONSIBILITIES

| Name | Role | Responsibility |
|---|---|---|
| Walter Schmidt | CEO | Project sponsor, monitor project |
| Mike Zwack | CIO | Monitor project, provide staff |
| Kim Nguyen | Project Manager | Plan and execute project |
| Jeff Johnson | Director of IT Operations | Mentor Kim |
| Nancy Reynolds | VP, Human Resources | Provide staff, issue memo to all employees about project |
| Steve McCann | Director of Purchasing | Assist in purchasing hardware and software |

Sign-off: (Signatures of all the above stakeholders)



**Comments:** (Handwritten or typed comments from above stakeholders, if applicable)

"This project must be done within 10 months at the absolute latest." Mike Zwack, CIO

"We are assuming that adequate staff will be available and committed to supporting this project. Some work must be done after hours to avoid work disruptions, and overtime will be provided." Jeff Johnson and Kim Nguyen, IT department

reference supporting documents, such as product specifications that will affect what products are created or purchased, or corporate policies, which might affect how products or services are produced. Many IT projects require detailed functional and design specifications for developing software, which also should be referenced in the detailed scope statement.

As time progresses, the scope of a project should become more clear and specific. For example, the project charter for the IT upgrade project in Table 5-2 includes a short statement about the servers and other computers and software that the project may affect. Table 5-3 provides an example of how the scope becomes progressively more detailed in scope statements labeled Version 1 and Version 2.

Notice in Table 5-3 that the project scope statements often refer to related documents, which can be product specifications, product brochures, or other plans. As more information becomes available and decisions are made related to project scope, such as specific products that will be purchased or changes that have been approved, the project team should update the project scope statement. The team might name different iterations of the scope statement Version 1, Version 2, and so on. These updates may also require changes to other project documents. For example, if the company must purchase servers from a supplier it has never worked with before, the procurement management plan should include information on working with that new supplier.

An up-to-date project scope statement is an important document for developing and confirming a common understanding of the project scope. It describes in detail the work to be accomplished on the project and is an important tool for ensuring customer satisfaction and preventing scope creep, as described later in this chapter.

Recall from Chapter 1 the importance of addressing the triple constraint of project management—meeting scope, time, and cost goals for a project. Time and cost goals are normally straightforward. For example, the time goal for the IT upgrade project is nine months, and the cost goal is $1.5 million. It is much more difficult to describe, agree upon, and meet the scope goal of many projects.

**TABLE 5-3** Further defining project scope

| |
|---|
| **Project Charter:** |
| Upgrades may affect servers … (listed under Project Objectives) |
| **Project Scope Statement, Version 1:** |
| Servers: If additional servers are required to support this project, they must be compatible with existing servers. If it is more economical to enhance existing servers, a detailed description of enhancements must be submitted to the CIO for approval. See current server specifications provided in Attachment 6. The CEO must approve a detailed plan describing the servers and their location at least two weeks before installation. |
| **Project Scope Statement, Version 2:** |
| Servers: This project will require purchasing 10 new servers to support web, network, database, application, and printing functions. Virtualization will be used to maximize efficiency. Detailed descriptions of the servers are provided in a product brochure in Attachment 8, along with a plan describing where they will be located. |

## MEDIA SNAPSHOT

Inaccurate requirements gathering continues to be one of the main causes of project failure. Organizations lack the resources and maturity in requirements management, which comes at a price. The authors of the 2014 PMI in-depth report on requirements management state that "For every dollar spent on projects and programs, 5.1 percent is wasted due to poor requirements management. Put in more striking terms, this amounts to US$51 million wasted for every US$1billion spent. That's a lot of potential value falling through the cracks in the project-driven world."[6]

The report provides the following survey results:

- Forty-seven percent of organizations report that inaccurate requirements management is the primary cause of projects not meeting their original goals and business objectives.
- Over half of organizations report not having adequate resources to perform requirements management well.
- Only 24 percent of organizations report doing well in recognizing and developing skills needed for effective management of requirements.
- Only 46 percent of organizations report using a formal process to ensure unbiased requirements validation for projects.

The report concludes by suggesting that organizations need to develop people, processes, and culture to improve requirements management.

## 5.5 CREATING THE WORK BREAKDOWN STRUCTURE

After collecting requirements and defining scope, the next step in project scope management is to create a work breakdown structure. A **work breakdown structure (WBS)** is a deliverable-oriented grouping of the work involved in a project that defines its total scope. Because most projects involve many people and many different deliverables, it is important to organize and divide the work into logical parts based on how the work will be performed. The WBS is a foundation document in project management because it provides the basis for planning and managing project schedules, costs, resources, and changes. Because the WBS defines the total scope of the project, some project management experts believe that work should not be done on a project if it is not included in the WBS. Therefore, it is crucial to develop a complete WBS.

The project scope management plan, scope statement, requirements documentation, enterprise environmental factors, and organizational process assets are the primary inputs for creating a WBS. The main tool or technique is **decomposition**—that is, subdividing project deliverables into smaller pieces. The outputs of the process of creating the WBS are the scope baseline and project documents updates. The **scope baseline** includes the approved project scope statement and its associated WBS and WBS dictionary.

What does a WBS look like? A WBS is often depicted as a task-oriented tree of activities, similar to an organizational chart. A project team often organizes the WBS around project products, project phases, or the project management process groups. Many people like to create a WBS in chart form first to help them visualize the whole project and all of

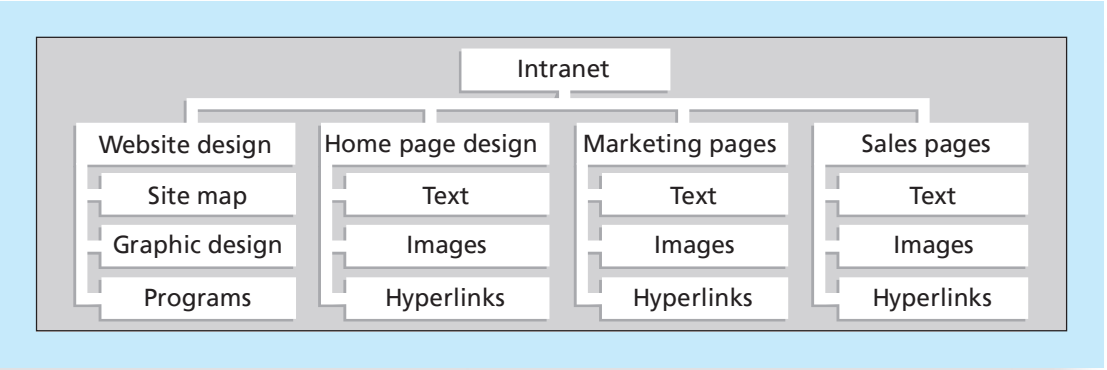





**FIGURE 5-3** Sample intranet WBS organized by product

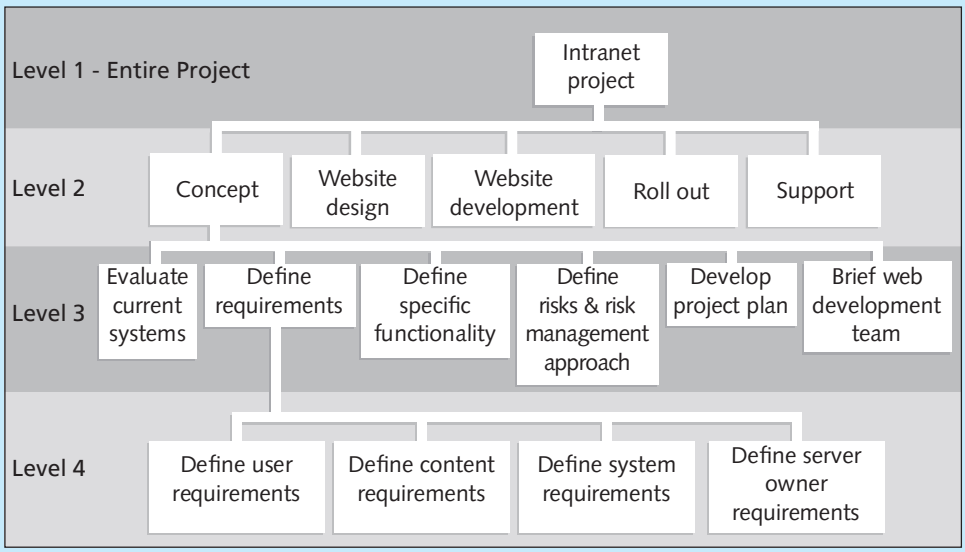
its main parts. Figure 5-3 shows a WBS for an intranet project. Notice that product areas provide the basis for its organization. In this case, there are main boxes or groupings on the WBS for developing the website design, the home page for the intranet, the marketing department's pages, and the sales department's pages.

In contrast, a WBS for the same intranet project can be organized around project phases, as shown in Figure 5-4.[7] Notice that project phases of concept, website design, website development, rollout, and support provide the basis for its organization.

Also note the levels in Figure 5-4. The name of the entire project is in the top box, called Level 1, and the main groupings for the work are listed in the second tier of boxes, called Level 2. This level numbering is based on the Project Management Institute's *Practice Standard for Work Breakdown Structures, Second Edition* (2006). Each of the boxes can be broken down into subsequent tiers of boxes to show the hierarchy of the work. Many people and project management software tools use the term *task* to describe each level of work in the WBS, although PMI does not use that term. For example, in Figure 5-4 the following items can be referred to as tasks: the Level 2 item called "Concept," the Level 3 item called "Define requirements," and the Level 4 item called "Define user requirements." Tasks that are decomposed into smaller tasks are called summary tasks.

Figure 5-4 shows a sample WBS in both chart and tabular form. Notice that both of these formats show the same information. Many documents, such as contracts, use the tabular format. Project management software also uses this format. The WBS becomes the contents of the Task Name column in Microsoft Project, and the hierarchy or level of tasks is shown by indenting and numbering tasks within the software. The numbering shown in the tabular form is based on the *Practice Standard for Work Breakdown Structures*, *Second Edition*. The automatic numbering feature in Microsoft Project 2013 uses this standard, but not all software does. Be sure to check with your organization to see which numbering scheme it prefers to use for work breakdown structures. To avoid confusion, it is important to decide on a numbering scheme and then use it when referring to WBS items.

Chart form →




**Tabular form with PMI numbering**

1.1 Concept
- 1.1.1 Evaluate current systems
- 1.1.2 Define requirements
  - 1.1.2.1 Define user requirements
  - 1.1.2.2 Define content requirements
  - 1.1.2.3 Define system requirements
  - 1.1.2.4 Define server owner requirements
- 1.1.3 Define specific functionality
- 1.1.4 Define risks and risk management approach
- 1.1.5 Develop project plan
- 1.1.6 Brief web development team

1.2 Website design
1.3 Website development
1.4 Roll out
1.5 Support



**FIGURE 5-4** Sample intranet WBS organized by phase in chart and tabular form

Also determine how you will name WBS items. Some organizations use only nouns to focus on describing deliverables. For example, instead of Define requirements, the WBS would say Requirements definition. Remember that the main purpose of the WBS is to define all of the work required to complete a project, so focus on that while following your organization's structural guidelines.

In Figure 5-4, the lowest level of the WBS is Level 4. A **work package** is a task at the lowest level of the WBS. In Figure 5-4, tasks 1.2.1, 1.2.2, 1.2.3, and 1.2.4 (based on the numbering on the left) are work packages. The other tasks would be broken down further. However, some tasks can remain at Level 2 or 3 in the WBS. Others might be broken down to Level 5 or 6, depending on the complexity of the work.

A work package also represents the level of work that the project manager monitors and controls. You can think of work packages in terms of accountability and reporting. If a project has a relatively short time frame and requires weekly progress reports, a work package might represent work completed in one week or less. If a project has a very long time frame and requires quarterly progress reports, a work package might represent work completed in one month or more. A work package might also be the procurement of a specific product or products, such as an item or items purchased from an outside source. A work package should be defined at the proper level so the project manager can clearly establish an estimate of the effort needed to complete it, estimate the cost of all required resources, and evaluate the quality of the results when the work package is finished.

When using project management software, estimates of work time should be entered only at the work package level. The rest of the WBS items are just groupings or summary tasks for the work packages. The software automatically calculates duration estimates for various WBS levels based on data entered for each work package and the WBS hierarchy.

Figure 5-5 shows the phase-oriented intranet WBS, using the Microsoft Project numbering scheme from Figure 5-4, in the form of a Gantt chart created in Project 2013. You can see from this figure that the WBS is the basis for project schedules. Notice that the WBS is in the left part of the figure in the Task Name column. The resulting schedule is in the right part of the figure. You will learn more about Gantt charts in Chapter 6, Project Time Management.

The example WBSs shown here are simplified so that they are somewhat easy to understand and construct. *Nevertheless, it is very difficult to create a good WBS*. To create a good WBS, you must understand the project and its scope and incorporate the needs and knowledge of the stakeholders. The project manager and the project team must decide as a group how to organize the work and how many levels to include in the WBS.

While many project managers have found that they should focus on doing the top levels well before becoming bogged down in more detailed levels, it is also true that more accurate estimates of scope, time, and cost are obtained when the project is defined appropriately and in sufficient detail. Operating at too high a level increases project risk.

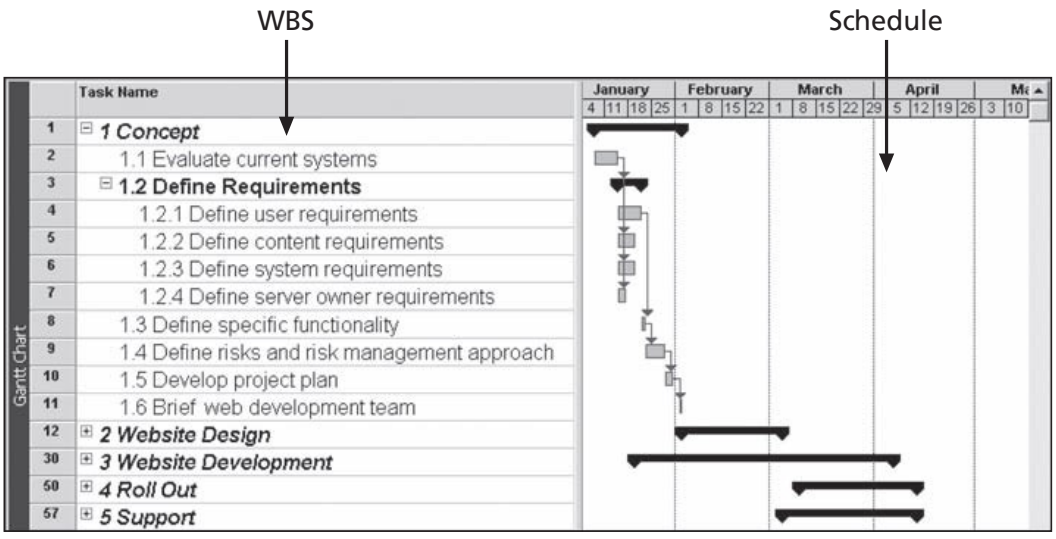



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**FIGURE 5-5** Intranet Gantt chart in Microsoft Project

The act of defining the WBS is meant to offset that risk by considering the project's details in advance of their execution.

Many people confuse tasks on a WBS with specifications. Tasks on a WBS represent work that needs to be done to complete the project. For example, if you are creating a WBS to redesign a kitchen, you might have Level 2 categories called design, purchasing, flooring, walls, cabinets, and appliances. Under flooring, you might have tasks to remove the old flooring, install the new flooring, and install the trim. You would not have tasks like "12 ft. by 14 ft. of light oak" or "flooring must be durable"; these are specifications.

Another concern when creating a WBS is how to organize it to provide the basis for the project schedule. You should focus on what work needs to be done and how it will be done, not when it will be done. In other words, the tasks do not have to be developed as a sequential list of steps. If you want some time-based flow for the work, you can create a WBS using the project management process groups of initiating, planning, executing, monitoring and controlling, and closing as Level 2 in the WBS. By doing this, not only does the project team follow good project management practice, the WBS tasks can also be mapped more easily against time. For example, Figure 5-6 shows a WBS and Gantt chart for the intranet project, organized by the five project management process groups. Tasks under initiating include selecting a project manager, forming the project team, and developing the project charter. Tasks under planning include developing a scope statement, creating a WBS, and developing and refining other plans, which would be broken down in more detail for a real project. The tasks of concept, website design, website development, and rollout, which were WBS Level 2 items in Figure 5-4, now become WBS Level 3 items under executing. The executing tasks vary the most from project to project, but many of the tasks under the other project management process groups would be similar for all projects. If you do not use the project management process groups in the WBS, you can have a Level 2 category called "project management" to make sure you account for all tasks

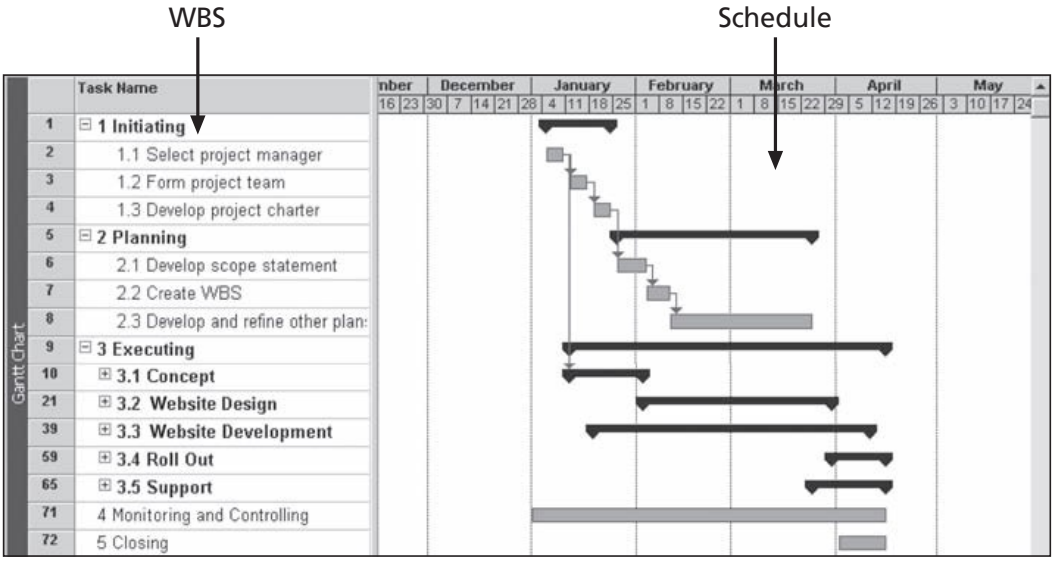


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**FIGURE 5-6** Intranet project Gantt chart organized by project management process groups

**TABLE 5-4** Executing Tasks for JWD Consulting's WBS

| |
|---|
| 3.0 Executing |
| 3.1 Survey |
| 3.2 User inputs |
| 3.3 Intranet site content |
| 3.3.1 Templates and tools |
| 3.3.2 Articles |
| 3.3.3 Links |
| 3.3.4 Ask the Expert |
| 3.3.5 User requests |
| 3.4 Intranet site design |
| 3.5 Intranet site construction |
| 3.6 Site testing |
| 3.7 Site promotion |
| 3.8 Site rollout |
| 3.9 Project benefits measurement |



related to managing the project. Remember that all work should be included in the WBS, including project management.

Some project teams like to list every deliverable they need to produce and then use those as the basis for creating all or part of their WBS. In Chapter 3, JWD Consulting used the project management process groups for the Level 2 items in its WBS for the project management intranet site project. Then in breaking down the executing task, the project team focused on the product deliverables it had to produce. Table 5-4 shows the categories the team used for that part of the WBS. Recall that the scope statement should list and describe all of the deliverables required for the project. It is very important to ensure consistency between the project charter, scope statement, WBS, and Gantt chart to define the scope of the project accurately.

It is also very important to involve the entire project team and the customer in creating and reviewing the WBS. *People who will do the work should help to plan the work* by creating the WBS. Having group meetings to develop a WBS helps everyone understand *what* work must be done for the entire project and *how* it should be done, given the people involved. It also helps to identify where coordination between different work packages will be required.

## 5.5a Approaches to Developing Work Breakdown Structures

You can use several approaches to develop a work breakdown structure:

- Using guidelines
- The analogy approach
- The top-down approach
- The bottom-up approach
- The mind-mapping approach

## Using Guidelines

If guidelines exist for developing a WBS, it is very important to follow them. Some organizations—the U.S. Department of Defense (DOD), for example—prescribe the form and content for WBSs for particular projects. Many DOD projects require contractors to prepare their proposals based on the DOD-provided WBS. These proposals must include cost estimates for each task in the WBS at a detailed and summary level. The cost for the entire project must be calculated by summing the costs of all of the lower-level WBS tasks. When DOD personnel evaluate cost proposals, they must compare the contractors' costs with the DOD's estimates. A large variation in costs for a certain WBS task often indicates confusion as to what work must be done.



Consider a large automation project for the U.S. Air Force. In the mid-1980s, the Air Force developed a request for proposals for the Local On-Line Network System (LONS) to automate 15 Air Force Systems Command bases. This $250 million project involved providing the hardware and developing software for sharing documents such as contracts, specifications, and requests for proposals. The Air Force proposal guidelines included a WBS that contractors were required to follow in preparing their cost proposals. Level 2 WBS items included hardware, software development, training, and project management. The hardware item was composed of several Level 3 items, such as servers, workstations, printers, and network hardware. Air Force personnel reviewed the contractors' cost proposals against their internal cost estimate, which was also based on this WBS. Having a prescribed WBS helped contractors to prepare their cost proposals and helped the Air Force to evaluate them.

Many organizations provide guidelines and templates for developing WBSs, as well as examples of WBSs from past projects. Microsoft Project 2013 comes with several templates, and more are available on Microsoft's website and other sites. At the request of many of its members, PMI developed a WBS *Practice Standard* to provide guidance for developing and applying the WBS to project management. The *Practice Standard* includes sample WBSs for a wide variety of projects in various industries, including projects for web design, telecom, service industry outsourcing, and software implementation.

Project managers and their teams should review appropriate information to develop their unique project WBSs more efficiently. For example, Kim Nguyen and key team members from the opening case should review their company's WBS guidelines, templates, and other related information before and during the team meetings to create their WBS.

## The Analogy Approach

Another method for constructing a WBS is the analogy approach. In the **analogy approach**, you use a similar project's WBS as a starting point. For example, Kim Nguyen from the opening case might learn that one of her organization's suppliers did a similar IT upgrade project last year. She could ask them to share their WBS for that project to provide a starting point for her own project.

McDonnell Aircraft Company, now part of Boeing, provides an example of using an analogy approach when creating WBSs. McDonnell Aircraft Company designed and manufactured several different fighter aircraft. When creating a WBS for a new aircraft design, it started by using 74 predefined subsystems for building fighter aircraft based on past experience. There was a Level 2 WBS item for the airframe that was composed of Level 3 items such as a forward fuselage, center fuselage, aft fuselage, and wings. This generic, product-oriented WBS provided a starting point for defining the scope of new aircraft projects and developing cost estimates for new aircraft designs.

Some organizations keep a repository of WBSs and other project documentation on file to assist people working on projects. Project 2013 and many other software tools include sample files to assist users in creating a WBS and Gantt chart. Viewing examples of WBSs from similar projects allows you to understand different ways to create a WBS.

### The Top-Down and Bottom-Up Approaches



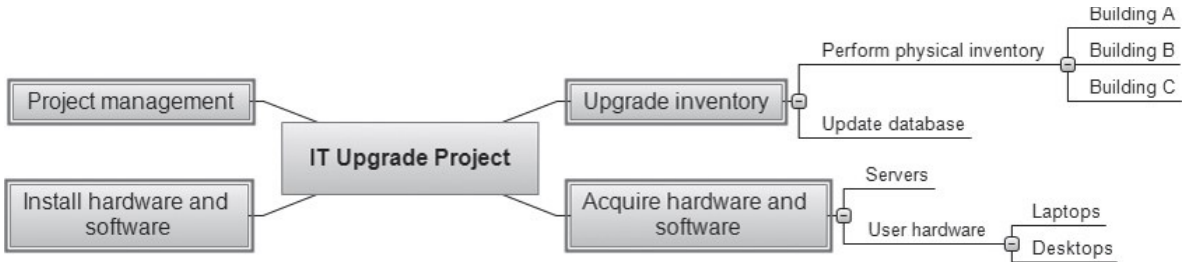
Two other methods of creating WBSs are the top-down and bottom-up approaches. Most project managers consider the top-down approach of WBS construction to be conventional.

To use the **top-down approach**, start with the largest items of the project and break them into subordinate items. This process involves refining the work into greater and greater levels of detail. For example, Figure 5-4 shows how work was broken down to Level 4 for part of the intranet project. After finishing the process, all resources should be assigned at the work package level. The top-down approach is best suited to project managers who have vast technical insight and a big-picture perspective.

In the **bottom-up approach**, team members first identify as many specific tasks related to the project as possible. They then aggregate the specific tasks and organize them into summary activities, or higher levels in the WBS. For example, a group of people might be responsible for creating a WBS to develop an e-commerce application. Instead of looking for guidelines on how to create a WBS or viewing WBSs from similar projects, they could begin by listing detailed tasks they think they would need to perform in order to create the application. After listing these detailed tasks, they would group the tasks into categories. Then they would group these categories into higher-level categories. Some people have found that writing all possible tasks as notes and then placing them on a wall helps the team see all the work required for the project and develop logical groupings for performing the work. For example, a business analyst on the project team might know that it had to define user requirements and content requirements for the e-commerce application. These tasks might be part of the requirements documents the team would have to create as one of the project deliverables. A hardware specialist might know that the team had to define system requirements and server requirements, which would also be part of a requirements document. As a group, they might decide to put all four of these tasks under a higher-level item called "define requirements" that would result in the delivery of a requirements document. Later, they might realize that defining requirements should fall under a broader category of concept design for the e-commerce application, along with other groups of tasks related to the concept design. The bottom-up approach can be very time-consuming, but it can also be a very effective way to create a WBS. Project managers often use the bottom-up approach for projects that represent entirely new systems or approaches to doing a job, or to help create buy-in and synergy with a project team.

### Mind Mapping

Some project managers like to use mind mapping to help develop WBSs. As described in Chapter 4 during the discussion of SWOT analysis, mind mapping is a technique that uses branches radiating from a core idea to structure thoughts and ideas. Instead of writing down tasks in a list or immediately trying to create a structure for tasks, mind mapping allows people to write and even draw pictures of ideas in a nonlinear format. This more visual, less structured approach to defining and then grouping tasks can unlock creativity among individuals and increase participation and morale among teams.[8]






Source: MatchWare's MindView 4 Business Edition

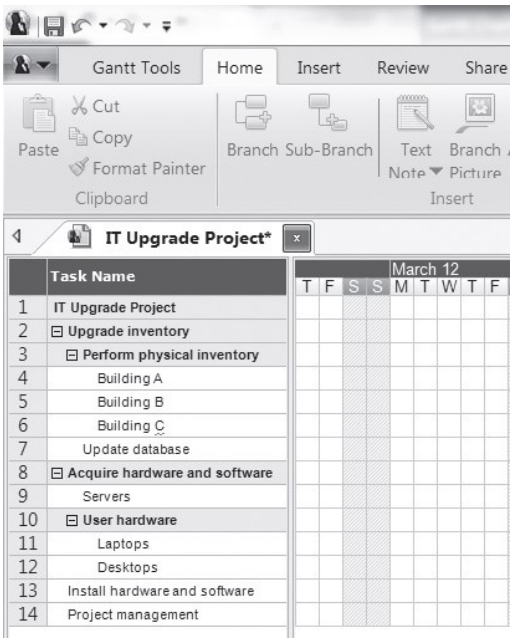
**FIGURE 5-7** Sample mind-mapping technique for creating a WBS

Figure 5-7 shows a diagram that uses mind mapping to create a WBS for the IT upgrade project. The rectangle near the center represents the entire project. Each of the four main branches radiating from the center represents the main tasks or Level 2 items for the WBS. Different people at the meeting who are creating this mind map might have different roles in the project, which could help in deciding the tasks and WBS structure. For example, Kim would want to focus on all of the project management tasks, and she might also know that they will be tracked in a separate budget category. People who are familiar with acquiring or installing hardware and software might focus on that work, and so on. Branching off from the main task called "Upgrade inventory" are two subtasks, "Perform physical inventory" and "Update database." Branching off from the "Perform physical inventory" subtask are three further subdivisions labeled Building A, Building B, and Building C. The team would continue to add branches and items until they exhausted ideas for what work needs to be performed.

After discovering WBS items and their structure using the mind-mapping technique, you could then translate the information into chart or tabular form, as described earlier. A feature of MindView 4.0 Business Edition software is that you can click a single icon to convert a mind map into a Gantt chart. The mind map provides the task list based on the WBS. MindView also lets you enter information about tasks, such as dependencies and durations, to generate a complete Gantt chart. You can also export your mind map into Microsoft Project. The WBS is entered in the Task List column, and the structure is created automatically based on the mind map. Figure 5-8 shows the resulting Gantt charts for the IT upgrade project both in MindView 4.0 and Project 2013. See Appendix A for more information on using Project 2013.

Mind mapping can be used for developing WBSs using the top-down or bottom-up approach. For example, you could conduct mind mapping for an entire project by listing the project in the center of a document, adding the main categories on branches radiating from the center, and then adding branches for appropriate subcategories. You could also develop a separate mind-mapping diagram for each deliverable and then merge them to create one large diagram for the entire project. You can also add items anywhere on a mind-mapping document without following a strict top-down or bottom-up approach. After the mind-mapping documents are complete, you can convert them into a chart or tabular WBS form.

MindView 4.0 Gantt Chart




Source: MatchWare's MindView 4 Business Edition

Project 2013 Gantt Chart

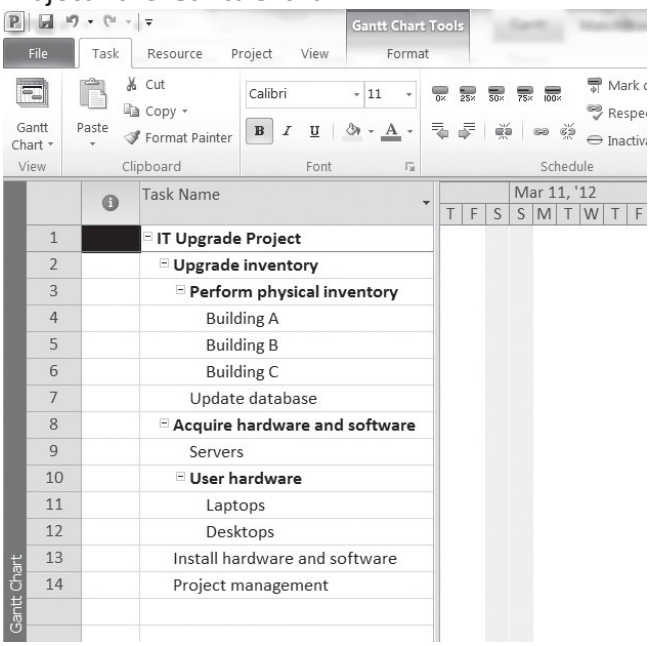



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**FIGURE 5-8** Gantt charts with WBS generated from a mind map

## 5.5b The WBS Dictionary

Many of the items listed on the sample WBSs are rather vague. What exactly does "Update database" mean, for example? The person responsible for this task might think that it does not need to be broken down any further, which could be fine. However, the task should be described in more detail so everyone has the same understanding of what it involves. What if someone else has to perform the task? What would you tell that team member to do? What will it cost to complete the task? More detailed information is needed to answer these and other questions.

A **WBS dictionary** is a document that provides detailed information about each WBS item. The term *dictionary* should not be confused with defining terms or acronyms in this case; such definitions belong in a glossary that would be included elsewhere in the project documentation. Instead, the WBS dictionary is a definition of the work involved in the task—a clarification that makes the summary description in the WBS easier to understand in terms of the approach taken to complete the work.

The format of the WBS dictionary can vary based on project needs. It might be appropriate to have a short paragraph describing each work package. For a more complex project, an entire page or more might be needed for each of the work package descriptions. Some projects might require that each WBS item describe the responsible organization, resource requirements, estimated costs, dependencies with other activities, and other information. Project teams often review WBS dictionary entries from similar tasks to get a better idea of how to create their entries.

**TABLE 5-5** Sample WBS dictionary entry

| WBS Dictionary Entry March 20 |
|---|
| **Project Title:** Information Technology (IT) Upgrade Project |
| **WBS Item Number:** 2.2 |
| **WBS Item Name:** Update Database |
| **Description:** The IT department maintains an online database of hardware and software on the corporate intranet. We need to make sure that we know exactly what hardware and software employees are currently using and if they have any unique needs before we decide what to order for the upgrade. This task will involve reviewing information from the current database, producing reports that list each department's employees and location, and updating the data after performing the physical inventory and receiving inputs from department managers. Our project sponsor will send a notice to all department managers to communicate the importance of this project and this particular task. In addition to general hardware and software upgrades, the project sponsors will ask the department managers to provide information for any unique requirements they might have that could affect the upgrades. This task also includes updating the inventory data for network hardware and software. After updating the inventory database, we will send an e-mail to each department manager to verify the information and make changes online as needed. Department managers will be responsible for ensuring that their people are available and cooperative during the physical inventory. Completing this task is dependent on WBS Item Number 2.1, Perform Physical Inventory, and must precede WBS Item Number 3.0, Acquire Hardware and Software. |





In the IT upgrade project described in the opening case, Kim should work with her team and sponsor to determine the level of detail needed in the WBS dictionary. They should also decide where this information will be entered and how it will be updated. Kim and her team decided to enter all of the WBS dictionary information into their enterprise project management system, following departmental guidelines. Table 5-5 is an example of one entry.

The approved project scope statement and its associated WBS and WBS dictionary form the scope baseline. Performance in meeting project scope goals is based on this scope baseline.

## 5.5c Advice for Creating a WBS and WBS Dictionary

As stated previously, creating a good WBS is no easy task and usually requires several iterations. Often, it is best to use a combination of approaches to create a project's WBS. Some basic principles, however, apply to creating any good WBS and its WBS dictionary.

- A unit of work should appear in only one place in the WBS.
- The work content of a WBS item is the sum of the WBS items below it.
- A WBS item is the responsibility of only one person, even though many people might be working on it.
- The WBS must be consistent with the way work actually will be performed; it should serve the project team first, and serve other purposes only if practical.
- Project team members should be involved in developing the WBS to ensure consistency and buy-in.

- Each WBS item must be documented in a WBS dictionary to ensure accurate understanding of the scope of work included and not included in that item.
- The WBS must be a flexible tool to accommodate inevitable changes while properly maintaining control of the work content in the project according to the scope statement.[9]



## 5.6 VALIDATING SCOPE

It is difficult to create a good project scope statement and WBS for a project. It is even more difficult, especially on IT projects, to verify the project scope and minimize scope changes. Some project teams know from the start that the scope is very unclear and that they must work closely with the project customer to design and produce various deliverables. In this case, the project team must develop a process for scope validation that meets unique project needs. Careful procedures must be developed to ensure that customers are getting what they want and that the project team has enough time and money to produce the desired products and services.

Even when the project scope is fairly well defined, many IT projects suffer from **scope creep**—the tendency for project scope to keep getting bigger and bigger. There are many horror stories about IT projects failing due to problems such as scope creep, including a few classic examples in the following What Went Wrong? feature. For this reason, it is very important to verify the project scope with users throughout the life of the project and develop a process for controlling scope changes.

Scope creep can also be a good thing, if managed well. Later in this chapter, you can see how Northwest Airlines encouraged scope changes on its ResNet project and managed them well.

### WHAT WENT WRONG?

A project scope that is too broad and grandiose can cause severe problems. Scope creep and an overemphasis on technology for technology's sake resulted in the bankruptcy of a large pharmaceutical firm, Texas-based FoxMeyer Drug. In 1994, the CIO was pushing for a $65 million system to manage the company's critical operations. He did not believe in keeping things simple, however. The company spent nearly $10 million on state-of-the-art hardware and software and contracted the management of the project to a prestigious (and expensive) consulting firm. The project included building an $18 million robotic warehouse, which looked like something out of a science fiction movie, according to insiders. The scope of the project kept getting bigger and more impractical. The elaborate warehouse was not ready on time, and the new system generated erroneous orders that cost FoxMeyer Drug more than $15 million in unrecovered excess shipments. In July 1996, the company took a $34 million charge for its fourth fiscal quarter, and by August of that year, FoxMeyer Drug filed for bankruptcy.[10]

Another classic example of scope creep comes from McDonald's Restaurants. In 2001, the fast-food chain initiated a project to create an intranet that would connect its headquarters with all of its restaurants and provide detailed operational information

*continued*

in real time. For example, headquarters would know if sales were slowing or if the grill temperature was correct in every single store—all 30,000 of them in more than 120 countries. McDonald's would not divulge detailed information, but they admitted that the project was too large in scale and scope. After spending $170 million on consultants and initial implementation planning, McDonald's realized that the project was too much to handle and terminated it.[11]

Another major scope problem on IT projects is a lack of user involvement. A prime example occurred in the late 1980s at Northrop Grumman, which specializes in defense electronics, IT, advanced aircraft, shipbuilding, and space technology. An IT project team there became convinced that it should automate the review and approval process of government proposals. The team implemented a powerful workflow system to manage the whole process. Unfortunately, the end users of the system were aerospace engineers who preferred to work in a more casual, ad hoc fashion. They dubbed the system "Naziware" and refused to use it. This example illustrates an IT project that wasted millions of dollars developing a system that was not in touch with the way end users did their work.[12]

Failing to follow good project management processes and use off-the-shelf software also results in scope problems. 21st Century Insurance Group in Woodland Hills, California, paid Computer Sciences Corporation $100 million to develop a system for managing business applications, including managing insurance policies, billing, claims, and customer service. After five years, the system was still in development and supported less than 2 percent of the company's business. Joshua Greenbaum, an analyst at Enterprise Applications Consulting, called the project a "huge disaster" and questioned the insurance company's ability "to manage a process that is pretty well known these days. … I'm surprised that there wasn't some way to build what they needed using off-the-shelf components and lower their risk."[13]

**Scope validation** involves formal acceptance of the completed project deliverables. This acceptance is often achieved by a customer inspection and then sign-off on key deliverables. To receive formal acceptance of the project scope, the project team must develop clear documentation of the project's products and procedures to evaluate whether they were completed correctly and satisfactorily. Recall from Chapter 4 that configuration management specialists identify and document the functional and physical characteristics of the project's products, record and report the changes, and audit the products to verify conformance to requirements. To minimize scope changes, it is crucial to do a good job of configuration management and validating project scope.

The scope management plan, scope baseline, requirements documentation, requirements traceability matrix, validated deliverables, and work performance data are the main inputs for scope validation. The main tools for performing scope validation are inspection and group decision-making techniques. The customer, sponsor, or user inspects the work after it is delivered and decides if it meets requirements. The main outputs of scope validation are accepted deliverables, change requests, work performance information, and project documents updates. For example, suppose that Kim's team members deliver upgraded computers to users as part of the IT upgrade project. Several users might complain because the computers did not include special keyboards they need for medical reasons. Appropriate people would review this change request and take appropriate corrective action, such as getting sponsor approval for purchasing the special keyboards.

### GLOBAL ISSUES

Many countries have had difficulties controlling the scope of large projects, especially those that involve advanced technologies and many different users. For example, the state government of Victoria, Australia, introduced a public transportation smart card, called myki, in 2010. Public Transport Victoria's description of the card included the following information: "Many cities around the world have public transport smart cards. myki has been designed to fit our State's unique needs. myki users enjoy an integrated ticketing system that works across the state on trains, trams and buses."[14]

Unfortunately, there were many problems in developing and implementing the smart cards. The $1.35 billion system became valid on all forms of Melbourne public transportation in July 2010, three years and five months after it was meant to replace the Metcard. Users' initial reactions to the myki smart card were mixed, with several reports of myki readers not working on trams. Many skeptics said they would wait until problems were fixed before trying the new system.[15] Many articles described problems with the myki card, revealing obvious difficulty in validating the scope of this high-visibility project. The Public Transport Users Association (PTUA) compiled a long list of problems with the new card and suggested that people stick to using the old card for a while. Clearly, the new system did not meet user requirements and had major flaws. In January 2012, over 18 months after the myki rollout, 70 percent of users still used the old Metcard. The government decided to keep myki in June 2011 after estimating that it would cost taxpayers more than $1 billion to scrap the troubled system. The Metcard was planned to be phased out for good by the end of 2012. PTUA president Daniel Bowen was not certain that the transition would go smoothly. "To a certain extent it makes sense to bring people across (to myki) because you can't have two systems running at the same time forever. … Once you get the majority of people using myki though, they'd better make sure it's humming, otherwise there could be chaos."[16] Myki continued to make headlines in 2015, but not in a good way. "Two years after myki became the only ticket in town, frustrated commuters say the system is still riddled with issues."[17]

## 5.7 CONTROLLING SCOPE

As you learned in Chapter 4 when you studied integrated change control, change is inevitable on projects, especially changes to the scope of IT projects. Scope control involves managing changes to the project scope while keeping project goals and business strategy in mind. Users often are not sure how they want screens to look or what functionality they will need to improve business performance. Developers are not exactly sure how to interpret user requirements, and they also have to deal with constantly changing technologies.

The goal of scope control is to influence the factors that cause scope changes, to ensure that changes are processed according to procedures developed as part of integrated change control, and to manage changes when they occur. You cannot do a good job of controlling scope if you do not first do a good job of collecting requirements, defining scope, and validating scope. How can you prevent scope creep when you have not agreed

on the work to be performed and your sponsor has not validated that the proposed work is acceptable? You also need to develop a process for soliciting and monitoring changes to project scope. Stakeholders should be encouraged to suggest changes that will benefit the overall project and discouraged from suggesting unnecessary changes.

The project management plan, requirements documentation, requirements traceability matrix, work performance data, and organizational process assets are the main inputs to scope control. An important tool for performing scope control is variance analysis. **Variance** is the difference between planned and actual performance. For example, if a supplier was supposed to deliver five special keyboards and you received only four, the variance would be one keyboard. The outputs of scope control include work performance information, change requests, project management plan updates, project documents updates, and organizational process assets updates.



Table 1-2 in Chapter 1 lists the top 10 factors that help IT projects succeed. Four of these 10 factors are related to scope validation and control: user involvement, executive support, clear business objectives, and optimizing scope. To avoid project failures, therefore, it is crucial for IT project managers and their teams to improve user input and executive support and reduce incomplete and changing requirements.

The following sections provide more suggestions for improving scope management on IT projects.

## 5.7a Suggestions for Improving User Input

Lack of user input leads to problems with managing scope creep and controlling change. How can you manage this important issue? The following suggestions can help a project team improve user input:

- Develop a good project selection process for IT projects. Insist that all projects have a sponsor from the user organization. The sponsor should not work in the IT department, nor should the sponsor be the project manager. Project information, including the project charter, project management plan, project scope statement, WBS, and WBS dictionary, should be easily available in the organization. Making basic project information available will help avoid duplication of effort and ensure that the most important projects are the ones on which people are working.
- Have users on the project team. Some organizations require project managers to come from the business area of the project instead of the IT group. Some organizations assign co-project managers to IT projects, one from IT and one from the main business group. Users should be assigned full-time to large IT projects and part-time to smaller projects. A key success factor in Northwest Airlines' ResNet project was training reservation agents—the users—how to write programming code for their new reservation system. (See the companion website for this text to read the entire case study for the ResNet project.) Because the sales agents had intimate knowledge of the business, they provided excellent input and actually created most of the software.
- Have regular meetings with defined agendas. The idea of meeting regularly sounds obvious, but many IT projects fail because the project team members do not have regular interaction with users. They assume that they understand what users need without getting direct feedback. To encourage this interaction, users should sign off on key deliverables presented at meetings.

- Deliver something to project users and sponsors on a regular basis. If the delivered product is hardware or software, make sure it works first.
- Do not promise to deliver what the team cannot deliver in a particular time frame. Make sure the project schedule allows enough time to produce the deliverables.
- Locate users with the developers. People often get to know each other better by being in close proximity. If the users cannot be physically moved to be near developers during the entire project, they should set aside certain days to work in the same location.

## 5.7b Suggestions for Reducing Incomplete and Changing Requirements

Some requirement changes are expected on IT projects, but many projects have too many changes to their requirements, especially during later stages of the project life cycle when it is more difficult to implement changes. The following suggestions can help improve the requirements process:

- Develop and follow a requirements management process that includes procedures for determining initial requirements.
- Employ techniques such as prototyping, use case modeling, and Joint Application Design to understand user requirements thoroughly. **Prototyping** involves developing a working replica of the system or some aspect of the system. These working replicas may be throwaways or an incremental component of the deliverable system. Prototyping is an effective tool for gaining an understanding of requirements, determining the feasibility of requirements, and resolving user interface uncertainties. **Use case modeling** is a process for identifying and modeling business events, who initiated them, and how the system should respond to them. It is an effective tool for understanding requirements of information systems. **Joint Application Design (JAD)** uses highly organized and intensive workshops to bring together project stakeholders—the sponsor, users, business analysts, programmers, and so on—to jointly define and design information systems. These techniques also help users become more active in defining system requirements. Consult a systems analysis and design text for details on these techniques.
- Put all requirements in writing and keep them current and readily available. Several tools are available to automate this function. For example, a type of software called a requirements management tool aids in capturing and maintaining requirements information, provides immediate access to the information, and assists in establishing necessary relationships between requirements and information created by other tools.
- Create a requirements management database for documenting and controlling requirements. Computer Aided Software Engineering (CASE) tools or other technologies can assist in maintaining a repository for project data. A CASE tool's database can also be used to document and control requirements.
- Provide adequate testing to verify that the project's products perform as expected. Conduct testing throughout the project life cycle. Chapter 8, Project Quality Management, includes more information on testing.

- Use a process for reviewing requested requirements changes from a systems perspective. For example, ensure that project scope changes include associated cost and schedule changes. Require approval via signatures of appropriate stakeholders. It is crucial for the project manager to lead the team in its focus on achieving approved scope goals and not getting sidetracked into doing additional work. For example, in his book *Alpha Project Managers*, Andy Crowe tried to uncover what the best or "alpha" project managers do differently from other project managers. One of these alpha project managers explained how he learned an important lesson about scope control:

  > Toward the end of some projects I've worked on, the managers made their teams work these really long hours. After the second or third time this happened, I just assumed that this was the way things worked. Then I got to work with a manager who planned everything out really well and ran the team at a good pace the whole time, and we kept on schedule. When the customer found out that things were on schedule, he kept trying to increase the scope, but we had a good manager this time, and she wouldn't let him do it without adjusting the baselines. That was the first time I was on a project that finished everything on time and on budget, and I was amazed at how easy she made it look.[18]

- Emphasize completion dates. For example, a project manager at Farmland Industries, Inc. in Kansas City, Missouri, kept her 15-month, $7 million integrated supply-chain project on track by setting the project deadline. She said, "May 1 was the drop-dead date, and everything else was backed into it. Users would come to us and say they wanted something, and we'd ask them what they wanted to give up to get it. Sticking to the date is how we managed scope creep."[19]
- Allocate resources specifically for handling change requests. For example, Peeter Kivestu and his ResNet team at Northwest Airlines knew that users would request enhancements to the reservations system they were developing. They provided a special function key on the ResNet screen for users to submit their requests, and the project included three full-time programmers to handle these requests. Users made over 11,000 enhancement requests. The managers who sponsored the four main software applications had to prioritize the software enhancement requests and decide as a group what changes to approve. The three programmers then implemented as many items as they could, in priority order, given the time they had. Although they only implemented 38 percent of the requested enhancements, they were the most important ones, and the users were very satisfied with the system and process.

## 5.8 USING SOFTWARE TO ASSIST IN PROJECT SCOPE MANAGEMENT

Project managers and their teams can use several types of software to assist in project scope management. As shown in several of the figures and tables in this chapter, you can use word-processing software to create scope-related documents, and most people

use spreadsheet or presentation software to develop various charts, graphs, and matrixes related to scope management. Mind-mapping software can be useful in developing a WBS. Project stakeholders also transmit project scope management information using various types of communication software such as e-mail and assorted web-based applications.

Project management software helps you develop a WBS, which serves as a basis for creating Gantt charts, assigning resources, allocating costs, and performing other tasks. You can also use the templates that come with various project management software products to help you create a WBS for your project. (See the section on project scope management in Appendix A for detailed information on using Project 2013, and see the companion website for information on templates related to project scope management.)

You can also use many types of specialized software to assist in project scope management. Many IT projects use special software for requirements management, prototyping, modeling, and other scope-related work. Because scope is such a crucial part of project management, many software products are available to assist in managing project scope. For example, Gartner estimates that the market for requirements definition and management tools was $280 million in 2014 and growing over 3 percent annually. New tools focus on improving collaboration and speed to better address mass market needs.[20]

Project scope management is very important, especially on IT projects. After selecting projects, organizations must plan scope management, collect the requirements and define the scope of the work, break down the work into manageable pieces, validate the scope with project stakeholders, and manage changes to project scope. Using the basic project management concepts, tools, and techniques discussed in this chapter can help you manage project scope successfully.

## CASE WRAP-UP

Kim Nguyen reviewed guidelines for creating WBSs that were provided by her company and other sources. She had a meeting with the three team leaders for her project to get their input on how to proceed. They reviewed several sample documents and decided to have major groupings for their project based on updating the inventory database, acquiring the necessary hardware and software, installing the hardware and software, and performing project management. After they decided on a basic approach, Kim led a meeting with the entire project team of 12 people, with some attending virtually. She reviewed the project charter and stakeholder register, described the basic approach they would use to collect requirements and define the project scope, and reviewed sample WBSs. Kim opened the floor for questions, which she answered confidently. She then let each team leader work with his or her people to start writing the detailed scope statement and their sections of the WBS and WBS dictionary. Everyone participated in the meeting, sharing their expertise and openly asking questions. Kim could see that the project was off to a good start.