Chapter 1

Introduction to the *Practice Standard for Work Breakdown Structures*—Second Edition

1.1 Overview

Successful project management relies on thorough planning. This begins by defining the project objectives with sufficiently detailed information. The Work Breakdown Structure (WBS) provides the foundation for defining work as it relates to project objectives. The WBS also establishes the framework for managing the work to its completion. The remaining sections of this chapter are as follows:

1.2 Concept
1.3 Objectives

1.2 Concept

The WBS is used in projects as follows:

- To define the project’s scope of work in terms of deliverables and to further decompose these deliverables into components. Depending upon the decomposition method used, the WBS can also define the project’s life cycle as well as the deliverables appropriate to the project, program, or portfolio. This project scope decomposition balances management’s need for control with representation of an appropriate level of detail in the WBS.
- To provide the project management team with a framework on which to base project status and progress reports.
- To facilitate communication between the project manager and stakeholders throughout the life of the project. The WBS can be used to communicate information regarding the project scope. In combination with additional data, the WBS is the framework for communicating information that includes, but is not limited to, schedule, risk, performance, dependencies, and budget.
- As a key input to other project management processes and deliverables.

The WBS articulates the project scope. It is considered as critical input to other project management processes and deliverables such as activity definitions, project...
schedule network diagrams, project and program schedules, performance reports, risk analysis and response, control tools, or project organization. Moreover, although the WBS is a key input to these project management processes and deliverables, the WBS is not a substitute for any of these on its own.

For the purposes of this Practice Standard for Work Breakdown Structures—Second Edition, a project can be defined as focused internally, externally, or both. Additionally, deliverables for these projects can take the form of products, services, achievement of specific objectives, or attainment of goals.

Internally focused projects can produce deliverables as inputs to other project phases, other individuals, or other organizations within the organization sponsoring the project. Externally focused projects typically produce deliverables for people or organizations outside the organization, such as customers or project sponsors. Many projects produce both internally and externally focused deliverables. Regardless of the focus of the project, a WBS should be prepared in all cases.

Developing a WBS is an essential step during the initial project phases; as soon as the basic scope has been identified, the initial WBS can be created with limited scope information. As additional scope information is developed or made available by more complete analysis of the project work to be performed, the WBS can be updated through the formal change control processes. This updating process is known as "progressive elaboration."

This practice standard provides insight into the WBS, its development and its application. It is expected that use of the principles found in this standard will enable the user to prepare a valuable, high-quality WBS and put it to work in the course of managing a project, program, or portfolio.

1.3 Objectives
The primary objectives of the Practice Standard for Work Breakdown Structures—Second Edition are (1) to provide a common ground for understanding the concepts and benefits of the WBS and (2) to present a standard application of the WBS as a project management tool. The intent is to encourage consistency in applying this tool and, as a result, to improve project planning and control. The Practice Standard for Work Breakdown Structures—Second Edition provides guidance in WBS development, based on the PMBOK® Guide—Third Edition, and is used by other PMI standards.

Finally, although the Practice Standard for Work Breakdown Structures—Second Edition provides guidance in WBS development, it is not intended to be a tutorial on how to create a WBS.
Chapter 2

Defining the WBS

2.1 Overview

A project is made more manageable by breaking it down into individual components that together are known as a Work Breakdown Structure or WBS. Such a structure defines unique work elements that can be arranged and completed in the order defined by the network diagram: sequentially, in parallel, or in the specific order necessary to accomplish project outcomes. It facilitates other project management processes such as estimating, scheduling, resource allocation, risk analysis, and measurement and control of the project. The WBS represents a clear description of the project’s deliverables and scope—the “what” of the project. It is not a description of a process or schedule that defines how or when the deliverables will be produced, but rather is specifically limited to describing and detailing the project’s outcome or scope. As stated in the PMBOK® Guide—Third Edition, “The WBS organizes and defines the total scope of the project. The WBS subdivides the project work into smaller, more manageable pieces of work, with each descending level of the WBS representing an increasingly detailed definition of the project work. The planned work contained in the lowest level WBS components, which are called work packages, can be scheduled, cost estimated, monitored, and controlled.”

This chapter will provide more information regarding WBS terms, concepts, the 100% Rule, and an example of a good WBS in action. The remaining sections of this chapter include:

2.2 Common Usage of Terms
2.3 Concept
2.4 The 100% Rule
2.5 WBS for Construction of a Bicycle
2.6 Representations of the WBS
2.7 Summary

2.2 Common Usage of Terms

A WBS, as defined in the PMBOK® Guide—Third Edition, is: “A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organizes and defines the total scope of the project. Each descending level represents an increasingly
detailed definition of the project work. . .

The following terms help clarify this definition:

**Work.** Sustained physical or mental effort, exertion, or exercise of skill to overcome obstacles and achieve an objective. Commonly used to refer to a specific activity, duty, function, or assignment often being a part or phase of some larger undertaking; something produced or accomplished by effort, exertion, or exercise of skill. In this context, work refers to work products or deliverables that are the result of effort and not to the effort itself.

**Breakdown.** Division into parts or categories; separation into simpler substances; decomposition.

**Structure.** Something arranged in a definite pattern of organization.

These dictionary definitions imply that a WBS has the following characteristics:

- Supports the definition of all work required to achieve an objective, tangible result.
- Is constructed to illustrate and define the hierarchy of deliverables. This hierarchy is organized into “parent-child” relationships.
- Has an objective or tangible result that is referred to as a deliverable. In a sense, the WBS can be thought of as a “deliverable” breakdown structure.

Additionally, as noted above, the WBS is a deliverable-oriented hierarchical decomposition of the work to be executed by the project team. It can thus be defined in the following terms:

**Deliverable.** Any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. Often used more narrowly in reference to an external deliverable, which is a deliverable that is subject to approval by the project sponsor or customer.

**Oriented.** Aligned or positioned with respect to a point or frame of reference; focused toward the concerns and interests of a specific group.

**Hierarchical.** Classified according to various criteria into successive levels or layers.

**Decomposition.** A planning technique that subdivides the project scope and project deliverables into smaller, more manageable components, until the project work associated with accomplishing the project scope and providing the deliverables is defined in sufficient detail to support executing, monitoring, and controlling the work.

These definitions work together to define the overall role of the WBS, that is, to provide a foundation for the development of project schedules, communications, risk management plans, as well as other key project elements.

### 2.2.1 Definition of Terms

The following definitions represent WBS-related terms as defined by the *PMBoK® Guide—Third Edition*. These terms and others listed in the Glossary of this standard facilitate understanding of the integral role the WBS plays in project management practice. Terms are listed here in alphabetical order.
Activity. A component of work performed during the course of a project.

Apportioned Effort. Effort applied to project work that is not readily divisible into discrete efforts for that work, but which is related in direct proportion to measurable discrete work efforts. Contrast with discrete effort.

Control Account. A management control point where scope, budget (resource plans), actual cost, and schedule are integrated and compared to earned value for performance measurement. Control accounts are placed at selected management points (specific components at selected levels) of the work breakdown structure. Each control account may include one or more work packages, but each work package may be associated with only one control account. Each control account is associated with a specific single organizational component in the organizational breakdown structure (OBS). Previously called a cost account. See also work package.

Discrete Effort. Work effort that is separate, distinct, and related to the completion of specific work breakdown structure components and deliverables, and that can be directly planned and measured. Contrast with apportioned effort.

Level of Effort (LOE). Support-type activity (e.g., seller or customer liaison, project cost accounting, project management, etc.), which does not produce definitive end products. It is generally characterized by a uniform rate of work performance over a period of time determined by the activities supported.

Task. A term for work whose meaning and placement within a structured plan for project work varies by the application area, industry, and brand of project management software.

Work Breakdown Structure Component. An entry in the work breakdown structure that can be at any level.

Work Package. A deliverable or project work component at the lowest level of each branch of the work breakdown structure. The work package includes the schedule activities and schedule milestones required to complete the work package deliverable or project work component. See also control account.

The following definition is included to reflect common usage:

WBS Element. Any single work breakdown structure (WBS) component and its associated WBS attributes contained within an individual work breakdown structure.

2.3 Concept

2.3.1 Overview

The WBS assists project leaders, participants, and stakeholders in the development of a clear vision of the end products or outcomes produced by the project. To be more precise, the WBS provides a clear vision of the work of the project. The WBS divides the project scope into hierarchical, manageable, definable packages of work that balance the control needs of management with an appropriate and effective level of detailed project data. The WBS provides the framework for all deliverables across the project life cycle. The various levels of the WBS also provide support for focusing
communication with stakeholders and aid in clearly identifying accountability to a level of detail necessary for effectively managing and controlling the project.

The upper levels of the WBS typically reflect the major deliverable work areas of the project or major phases in the project’s life cycle. These levels also provide logical summary points for assessing team and individual performance, communicating accomplishments, and measuring cost and schedule performance with respect to individual deliverables as well as the overall project.

The content of the upper levels can vary, depending upon the type of project and the industry involved. To avoid confusion and rework, it is often prudent to define the levels of the WBS prior to its construction. The lower WBS elements provide appropriate focus for project management processes such as scope and schedule development, cost estimating and resource allocation, and risk assessment.

Whenever work is logically structured, easily identifiable, and clearly within the capabilities of individuals, project stakeholders can confidently expect that objectives associated with the work can and will be achieved. The use of a WBS helps ensure that the project meets these criteria.

2.3.2 Deliverables

The underlying concept of a deliverable is the core of a WBS. The PMBOK® Guide—Third Edition defines a deliverable as:

Any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. Often used more narrowly in reference to an external deliverable, which is a deliverable that is subject to approval by the project sponsor or customer.

The WBS provides the foundation for integrating the work package and intermediate deliverables with all other aspects of project initiation, planning, execution, monitoring and controlling, and closing.

A deliverable-oriented WBS provides many benefits to the project, including the following:

- Better communication to project sponsors, stakeholders, and team members
- More accurate estimation of tasks, risks, timelines, and costs
- Increased confidence that 100% of the work is identified and included
- A foundation for the control processes within the project.

The deliverable concept and deliverable orientation of the WBS are integral to understanding the proper definition and use of the WBS and the benefits it provides within the larger context of all project management processes.

2.3.3 Design

A well-designed WBS that presents information at the appropriate level of detail and in formats and structures meaningful to those performing the work is an invaluable tool in project management. It provides a graphical representation or textual outline of the project scope. Here are some roles the WBS plays in supporting clarity for project definition:

- Decomposes (or disassembles) the overall project scope into deliverables and supports the definition of the work effort required for effective management
• Clearly and comprehensively defines the scope of the project in terms of deliverables that the project participants and stakeholders can understand
• Supports documentation of the accountability and responsibility for the various deliverables by having a direct relationship among the WBS elements related to the Organizational Breakdown Structure (OBS) identified through the Responsibility Assignment Matrix (RAM)
• Provides a structure for organizing information regarding the project’s progress, periodic status, and projected performance for which a project manager is responsible
• Supports tracking of risks to assist the project manager in identifying and implementing responses necessary to achieve desired outcomes.

2.3.4 Management
The WBS supports effective project management in several ways during the life of a project by:
• Separating project deliverables into component parts to ensure the project plan matches the approved project scope and will fulfill the overall objectives of the project
• Supporting the decomposition of project scope into simpler components, providing one of the primary methods for managing complex projects
• Providing a framework for specifying performance objectives
• Providing the basis for integrating and assessing schedule and cost performance
• Supporting the planning and assignment of responsibilities
• Assisting in determining resource requirements such as technical skills, experience and knowledge
• Facilitating the reporting and analysis of project progress and status data, including resource allocations, cost estimates, expenditures, and performance.

2.3.5 Organizational Perspective
The WBS provides the foundation for assigning work to the appropriate organizational units, subcontractors, or individuals. As the work and organizational responsibilities become more clearly defined, individuals, including subcontractors, are assigned responsibility for accomplishing specific WBS elements within defined budgets and schedules.

2.3.6 WBS Levels
The WBS includes all work to be done by the project leaders, stakeholders, and both internal and external participants, such as team members and subcontractors. The WBS provides a clear statement of the objectives and deliverables of the work to be performed. The depth of a WBS is dependent upon the size and complexity of the project and the level of detail needed to plan and manage it. Most work breakdown structures consist of a multi-level hierarchy describing the entire scope to be accomplished by the performing organization; however, the specific number of levels should be appropriate for effectively managing the project in question.
2.4 The 100% Rule

The 100% rule (Haugan, 2002, p 17) is a core characteristic of the WBS. This rule states that the WBS includes 100% of the work defined by the project scope and captures ALL deliverables—internal, external, and interim—in terms of work to be completed, including project management. The 100% rule is one of the most important principles guiding the development, decomposition and evaluation of the WBS. The rule applies at all levels within the hierarchy: the sum of the work at the “child” level must equal 100% of the work represented by the “parent” and the WBS should not include any work that falls outside the actual scope of the project, that is, it cannot include more than 100% of the work.

It is important to remember that the 100% rule also applies at the activity level. The work represented by the activities in each work package must add up to 100% of the work necessary to complete the work package.

2.5 WBS for Construction of a Bicycle

The scope of a project can be decomposed in multiple ways. Regardless of the manner of decomposition, the sum of the work packages for each different decomposition should add up to the same scope of work. The following sample WBS illustrates key concepts that will be discussed throughout the remaining chapters of this standard.

![Diagram of WBS for Construction of a Bicycle]

Figure 2-1. WBS Bicycle Example
Figure 2-1 is a sample WBS designed to capture the scope of work required to construct a custom bicycle. To keep the graphic simple, this particular WBS does not differentiate among the many types of bicycles that can be built from similar WBS constructs, for example, a road bicycle, mountain bicycle, racing bicycle, or any other bicycle, but assumes that detailed requirements for a specific type of bicycle would be provided as further decompositions of the illustrated WBS elements.

This particular example was selected for its simplicity to enable the reader to focus on the WBS itself, rather than the multitude of alternatives, options, and components required to define a complex, unique, and perhaps esoteric product. The bicycle is a familiar and common product, an example that easily suggests the processes required to produce the end result.

This illustration shows how concepts and guidance described in later chapters work together to produce a completed bicycle that meets the quality, timeliness, features, and functionality requirements of the project sponsor, which in this case is the purchaser.

Specifically, this WBS illustrates the various levels of a WBS, the numbering scheme, naming convention, relationship of parent and child WBS elements, and the representation of each of these characteristics and principles working together to form a complete WBS. This illustration represents one example of the possible decomposition of the testing elements. It is not intended to be comprehensive or definitive.

The bicycle WBS helps to communicate and reinforce some of the concepts presented. The annotated illustration (Figure 2-2) immediately following shows that all

Figure 2-2. Annotated Bicycle Example
WBS elements are not decomposed to the same extent. For example, this hypothetical bicycle WBS does not decompose each Level 2 WBS component further into subelements. While it can be helpful to decompose the entire WBS to the same level for some projects, there are no hard and fast rules dictating that each WBS element is decomposed to the same level. Decomposition is a use-related characteristic that is defined by the context of the project the WBS is developed to support. This concept is presented in detail in Chapter 4, Section 4.2.

Additionally, this example communicates WBS concepts that reflect application in a broad array of industries. The construction of the WBS can remain the same, such as the relationship of the WBS elements, the decomposition level, and the relationship to other WBS elements. The content can be modified to reflect the application of the concept in alternate terms for other industries, projects, or programs. This is illustrated in the decomposed elements that are identified below the Level 2 WBS element for Integration (1.6). In Figure 2-2, elements 1.6.4.1–1.6.4.3 are called Component Test, Product Test and Customer Test, respectively. In the next example, Figure 2-3, these

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**Figure 2-3.** WBS Example

same elements are entitled Unit Test, System Test, and Acceptance Test, showing how the concept of testing is represented in various ways using basic WBS elements.

Finally, throughout the standard, the bicycle WBS is repeatedly used as a reference point to clarify and illustrate concepts. To illuminate the concept being discussed, parts of the WBS are extracted, elements are singled out, or sets of decomposed elements are highlighted by placing dotted lines around them. For clarity, these WBS elements are frequently shown in a number of different representations.
2.6 Representations of the WBS

The WBS can be represented in a variety of ways including graphical, textual, or tabular views. Regardless of the representation used, the WBS enables the project team to predict and forecast costs, schedules, resource requirements, and allocations more accurately. Two common methods are the hierarchy diagram and the outline or tabular view as shown in Figure 2-4.

![Hierarchy Diagram]

1 Bicycle

1.6 Integration
  1.6.1 Concept
  1.6.2 Design
  1.6.3 Assembly
  1.6.4 Testing
    1.6.4.1 Component Test
    1.6.4.2 Product Test
    1.6.4.3 Customer Test

Figure 2-4. WBS Representations Comparison

2.7 Summary

In summary, the WBS:
- Defines the hierarchy of deliverables
- Supports the definition of all work required to achieve an end objective or deliverable(s)
- Provides a graphical representation or textual outline of the project scope
• Provides the framework for all deliverables across the project life cycle
• Provides a vehicle for integrating and assessing schedule and cost performance
• Facilitates assignment of resources
• Facilitates the reporting and analysis of progress and status data
• Provides a framework for specifying performance objectives.
Chapter 3

Importance of the WBS

3.1 Overview

A WBS can not alone ensure project success, but consider that the WBS does the following:

- Defines all the work of the project, and only the work of the project, thereby clarifying the project scope
- Reflects the input from all team members to ensure buy-in
- Provides the baseline for subsequent change control
- Is a primary input to other project management processes—for example, resource planning, cost estimating, schedule development, and risk identification
- Provides the framework for project control, performance monitoring, and the foundation for communication with all stakeholders
- Ensures the work of the project correlates appropriately with the Responsibility Assignment Matrix (RAM) and the Organizational Breakdown Structure (OBS)
- Is referenced in other PMI standards, for example, the PMBOK® Guide—Third Edition and Practice Standard for Earned Value Management (EVM), as an essential planning deliverable supporting key project management functions.

Experienced project managers know that there are many things that can go wrong in projects regardless of how successful the project managers are in the planning and execution of their work. Project failures, however, can often be traced back to a poorly developed or nonexistent WBS.

A poorly constructed WBS can result, among other things, in the following project stumbling blocks and adverse project outcomes:

- Incomplete project definition leading to ongoing project extensions
- Unclear work assignments, goals, objectives, or deliverables
- Scope creep or unmanageable, frequently changing scope
- Budget overrun
- Missed deadlines on scheduled deliverables, or timeline slippage
- Unusable new product or feature
- Failure to deliver on some elements of project scope.

The remainder of this chapter highlights in more detail the important role the WBS plays in project and program management planning:
3.2 Integration with Project Management Processes

The WBS is created in the Create WBS Planning Process (PMBOK® Guide—Third Edition). The WBS also plays an integral role in other project management processes. Typical (though not exhaustive) examples are shown in Table 3-1. References in Table 3-1 are to sections in the PMBOK® Guide—Third Edition.

<table>
<thead>
<tr>
<th>Process Group</th>
<th>Importance of WBS in Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiating</td>
<td>• Develop Preliminary Project Scope Statement (Section 4.2)</td>
</tr>
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<td></td>
<td>o Historical WBS elements can contribute in determining the scope and viability of projects.</td>
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<tr>
<td>Planning</td>
<td>• Scope Planning (Section 5.1)</td>
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<td></td>
<td>o The Scope Planning process documents how the WBS will be created and defined.</td>
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<td></td>
<td>• Scope Definition (Section 5.2)</td>
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<td></td>
<td>o The WBS further defines the entire scope of the project.</td>
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<td></td>
<td>• Activity Definition (Section 6.1)</td>
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<td></td>
<td>o The WBS is an input source to this process, and is a key component of a project plan.</td>
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<td></td>
<td>• Cost Estimating (Section 7.1)</td>
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<td></td>
<td>o The WBS is an input to this process.</td>
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<td></td>
<td>• Cost Budgeting (Section 7.2)</td>
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<td></td>
<td>o The WBS is an input to this process.</td>
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<td></td>
<td>• The WBS identifies project deliverables to which costs will be allocated.</td>
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<td></td>
<td>• Human Resource Planning (Section 9.1)</td>
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<td></td>
<td>o The WBS is an input source to this process, and is a key component of a project plan.</td>
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<td></td>
<td>• Risk Identification (Section 11.2)</td>
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<td></td>
<td>o The WBS identifies project deliverables that must be evaluated for risk events.</td>
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<td></td>
<td>• Risk Response Planning (Section 11.4)</td>
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<td></td>
<td>o The WBS might be updated to include work and deliverables required for risk management.</td>
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<tr>
<td>Executing</td>
<td>• Plan Purchases and Acquisitions (Section 12.1)</td>
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<td></td>
<td>o The WBS is an input to this process.</td>
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<tr>
<td>Monitoring and Controlling</td>
<td>• Information Distribution (Section 10.2)</td>
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<td></td>
<td>o The WBS provides the basis for developing the communications plan and the level of granularity at which project information can be distributed.</td>
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<td>o The WBS helps determine what level of project detail is appropriate to communicate to different stakeholder groups.</td>
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<td>• Scope Verification (Section 5.4)</td>
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<td>o The WBS facilitates the process of formally accepting completed deliverables.</td>
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<td></td>
<td>• Scope Control (Section 5.5)</td>
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<td></td>
<td>o The WBS is an input source to this process, which is a key component of a project plan.</td>
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<td></td>
<td>o It is important to adjust the WBS if project scope is changed so that future changes will be based on an updated, agreed-upon project baseline.</td>
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<td>o A WBS enhances the project manager’s ability to assess the impact of scope changes.</td>
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<td>• Cost Control (Section 7.3)</td>
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<td></td>
<td>o The creation of the WBS reveals the best point in the hierarchy of deliverables at which to implement cost control.</td>
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</table>

Table 3-1. Project Management Processes
3.3 Relationship to Other Tools

3.3.1 Project Management Tools

The purpose of the WBS, as a project management tool, is to organize the scope of a project. WBS definition for programs and portfolios can use similar techniques to organize scope. There are many project management tools that use the WBS or its components as input (see Section 5.3 of PMBOK® Guide—Third Edition).

1. Project Charter.

The WBS takes the project charter as its starting point. The highest level element in the WBS should represent the project’s overall end-point product(s), service(s), or outcomes as described in the project charter. If the project’s major products cannot be described during the creation of the WBS, then the project management team should examine the charter to determine if it has been sufficiently defined.

2. Project Scope Statement.

The scope statement for the project is intended to clearly and succinctly describe what the project is and is not intended to accomplish. The high-level elements in the WBS should match, word-for-word, the nouns used to describe the outcomes of the project in the scope statement. If the project management team has difficulty identifying the objects in the scope statement and applying them to the high-level WBS elements, the team should carefully examine the scope statement to determine if it sufficiently captures all project outcomes and deliverables. The WBS Dictionary can also be used to further document and clarify each deliverable (see 3.3.1.6).

3. Program and Portfolio WBS.

The WBS can be used to define scope for projects, programs, and portfolios. For example, program offices are typically established to share tools, techniques, methodologies, and resources in managing one or more collections of related projects as program(s). The project WBS must illustrate a clear understanding of the relationship among highly decomposed work packages within individual projects and program (or higher order) scope definitions. If strategic changes are made, the impact on projects, resources, and budgets can be easily calculated, assuming the project WBS has been constructed correctly in consideration of these higher order factors.

4. RBS.

The Resource Breakdown Structure (RBS) describes the project’s resource organization and can be used in conjunction with the WBS to define work package assignments. The link between work packages and the RBS can be used to verify that all members of the project team have been appropriately assigned work packages, and that all work packages have owners.

5. OBS.

The Organizational Breakdown Structure (OBS) is loosely related to the WBS. The OBS depicts the organization hierarchy, allowing the project’s work packages to be related to the performing organizational units. This tool reinforces the guideline that each work package should have a single point of responsibility.
The OBS can be a useful tool for project managers in that it clearly demonstrates the hierarchy of people or groups, whereas the WBS is strictly organized by deliverables.

.6 WBS Dictionary:
The WBS dictionary is a key document that accompanies the WBS and carries critical project information. The WBS dictionary defines, details, and clarifies the various elements of the WBS to ensure that each component of the WBS is accurately articulated and can be communicated to anyone referencing the WBS. The development of the WBS dictionary often uncovers ambiguity or other errors in the WBS itself, and results in revisions to the WBS. The WBS dictionary contains information about each element of the WBS, including a detailed description of the work, deliverables, activities, and milestones associated with each element. The WBS dictionary might also include an indication of the type and number of resources required and contract control information, such as a charge number or other similar data. Often, a WBS dictionary will include traceability matrices linking the WBS to other scope control documents such as statements of work or requirements documents.

.7 Project Schedule Network Diagram:
The network diagram is a sequential arrangement of the work defined by the WBS, and is essential to uncovering project dependencies and risks. The activities within the WBS work packages are arranged to show precedence and order. Developing the network diagram often uncovers problems in the WBS, such as incomplete decomposition, the assignment of too much work in an element, or the assignment of more than one person for an individual WBS element, thus resulting in needed revisions.

.8 Project Schedule:
The various elements of the WBS are used as starting points for defining the activities included in the project schedule. Implied dependencies can be recorded in the WBS Dictionary, and the activities as described in the WBS Dictionary are then included as detail in the schedule.

3.3.2 Interrelationships Among Project Management Tools
Because of interrelationships among the WBS and other project management tools, it is important to note that any change in the WBS requires an associated change in the related tools.

Such interrelationships among the WBS and other Project Management processes are described throughout the PMBOK® Guide—Third Edition. As an example of these interdependencies, consider the relationship between the WBS and the activity list used for the project schedule as described in Section 6.1.2 of the PMBOK® Guide—Third Edition (Activity Definition: Tools and Techniques). Specifically, item 6.1.2.1 (Decomposition) reads:

"The technique of decomposition, as it is applied to activity definition, involves subdividing the project work packages into smaller, more manageable components called schedule activities. The Activity Definition process defines the final outputs as schedule activities rather than as deliverables, as is done in the Create WBS process (Section 5.3)."
"The activity list, WBS, and WBS dictionary can be developed either sequentially or concurrently, with the WBS and WBS dictionary being the basis for development of the final activity list. Each work package within the WBS is decomposed into the schedule activities required to produce the work package deliverables. This activity definition is often performed by the project team members responsible for the work package."

Section 6.2 of the PMBOK® Guide (Activity Sequencing) further states:

"Activity sequencing involves identifying and documenting the logical precedence relationships among schedule activities. Schedule activities can be logically sequenced with proper precedence relationships, as well as leads and lags to support later development of a realistic and achievable schedule."

This discussion briefly describes how many project management tools are interrelated, all based upon the foundation of the WBS. The Work Breakdown Structure plays a pivotal role in project and program management in each of the process groups: Initiating, Planning, Executing, Monitoring & Controlling and Closing for which it ensures a consistent definition of the scope of the work to be undertaken.

3.3.3 WBS Development Tools

There are a number of project management tools that can be used to assist a project manager with the development of a WBS. These tools include outlines and organization charts, fishbone and brainstorming techniques, and top down and bottom up development strategies. There are many WBS templates available, and corporate standards can be referenced or copied for quick-starting WBS development. When using generic or corporate WBS templates, it will be important to ensure that the template chosen for the project closely matches the project type (such as a Construction WBS template, an IT Software Development WBS template, a commercial product WBS template, etc.) and is used as a guide or basic structure that is then customized to fit the needs of the specific project being planned. (More information about these tools can be found in Chapter 5 of this standard.)

There are many benefits to using tools to develop a WBS. For example, tools often promote consistency and repeatability in the development of a WBS, especially enterprise productivity tools. WBS tools can also promote and enforce the principles of the WBS standard and can significantly reduce the development effort, simplifying the WBS process, and even promoting reusable WBS products.

3.4 WBS Integration and Use by Other Standards

Scope management is integral to other PMI standards. These include but are not limited to: the PMBOK® Guide—Third Edition; Practice Standard for Earned Value Management (EVM), and Organizational Project Management Maturity Model (OPM3®). The development of a quality WBS is critical to the successful execution of project management processes, as described in the PMBOK® Guide—Third Edition, as well as in the other aforementioned standards.

Standards that take advantage of the WBS typically fall into one of two categories. The first category focuses on using the content output of the WBS as an input. PMI’s Practice Standard for Earned Value Management (EVM) and upcoming Practice Standard for Scheduling fall into this category. Since the content output from a WBS is
predictable and well understood, such standards can build upon or leverage the Practice Standard for Work Breakdown Structures—Second Edition.

Other standards incorporate the WBS (as defined by this practice standard) as the preferred tool to develop the scope definition for their role. For example, the PMBOK® Guide—Third Edition uses the Practice Standard for Work Breakdown Structures—Second Edition to develop the project scope, and OPM3® identifies the WBS as a tool that can be used to develop a program WBS. These standards recognize the Practice Standard for Work Breakdown Structures—Second Edition as representing good practice.

The WBS is developed to define carefully what is in the project scope and, by implication, what is out of scope. The Practice Standard for Scheduling (currently in development) is based, in part, on an assumption that a high-quality WBS has been developed using good practice, correctly defining project scope. When the project schedule is developed, each high-level (summary) task must correspond to a WBS element. If an activity or task does not have a relationship to a work package within the WBS, then either the WBS does not fully encompass the project scope, or the activity or task is unnecessary.

EVM is a management methodology for integrating scope, schedule, and resources, and for objectively measuring project performance and progress. The data used in EVM are dependent upon WBS elements having been developed using good practice. If WBS elements are not well defined, are too large in scope, are too lengthy in duration, or are in some other manner not appropriately decomposed or developed, it will be difficult to measure the project’s earned value. The Practice Standard for Earned Value Management relies upon a high-quality WBS as a key input.

The PMBOK® Guide—Third Edition, PMI’s project management standard, discusses project management practice as a whole. A core element of project management is scope management, and the PMBOK® Guide discusses the benefits of using the WBS as a technique to manage and control a project’s scope.

The Standard for Program Management describes how collections of related projects are best managed. This standard assumes that the WBS for each relevant project is developed according to good practice and accurately describes the scope for the project.

The Standard for Portfolio Management describes how collections of projects or programs are best managed. This standard assumes that the WBS for each relevant project/program is developed according to good practice and accurately describes the scope for the project.

PMI’s OPM3® is an example of a maturity model that can be used to measure and detail an organization’s maturity level, as well as provide a clear path to higher levels of maturity. The WBS is important to OPM3®, since OPM3® relies on the benefits of processes aimed at scope management. This standard relies on the development of a quality WBS as a foundation for effective project management.

### 3.5 Summary

The WBS is an important tool used in the planning and execution of a successful project. Many project cost, schedule, and quality failures can be traced directly to flaws in the development of the project’s WBS. It is less likely that a project will be successful without the existence of a quality WBS. In contrast, developing and applying a high-quality WBS will significantly increase the likelihood of successful project completion. Chapter 4 will provide insight into the characteristics and components that make up a high-quality WBS.
Chapter 4

Defining WBS Quality

4.1 Overview

What is a quality WBS? The *PMBOK* Guide—Third Edition (Chapter 8) considers quality to involve the “degree to which a set of inherent characteristics fulfills requirements.” This includes the ideas of conformance to requirements and fitness for use; that is, the ability to satisfy the purpose for which the item (in this case, a WBS) was intended. (See Chapter 3 of this *WBS Practice Standard* for the uses, purpose, and importance of the WBS.) To state that a particular WBS is of high quality, one must agree that the WBS has been created so that it satisfies the purpose for which it was created.

There are two basic principles that govern the quality of a WBS. This chapter will describe these principles and identify the characteristics of a high-quality WBS that flows from each principle. It will illustrate the negative effects of a poorly constructed WBS and it will provide tools for project managers to use in evaluating any specific WBS that is being developed. The remaining sections of this chapter are as follows:

4.2 WBS Quality Principle 1
4.3 WBS Quality Principle 2
4.4 Annotated Example of a High-Quality WBS
4.5 Problem Diagnostic Checklist
4.6 Summary

4.2 WBS Quality Principle 1

A quality WBS is a WBS constructed in such a way that it satisfies all of the requirements for its use in a project.

There are two sub-principles that pertain to satisfying requirements for use of a WBS. These describe core characteristics of every WBS and use-related characteristics that describe a particular WBS based on its individual setting and use.

4.2.1 WBS Quality Sub-Principle 1—Core Characteristics

There is a set of core characteristics that must be present in every WBS, as these characteristics enable the WBS to satisfy project needs that are present in every project.
With respect to core characteristics, a WBS either has them or it does not, and, as such, these characteristics represent the minimum set of specific attributes a WBS must contain. When evaluating or developing a WBS, the absence or presence of these core characteristics will dictate whether or not it is a quality WBS. A WBS with the following core quality characteristics can be said to have core quality:

- Is a deliverable-oriented grouping of project elements
- Defines the scope of the project
- Clarifies the work and communicates project scope to all stakeholders
- Contains 100% of the work defined by the scope
- Captures internal, external, and interim deliverables in terms of work to be completed, including project management
- Is constructed so that each level of decomposition contains 100% of the work in the parent level
- Contains work packages that clearly support the identification of the tasks that must be performed in order to deliver the work package
- Provides a graphical, textual, or tabular breakdown of the project scope
- Contains elements that are defined using nouns and adjectives—not verbs
- Arranges all major and minor deliverables in a hierarchical structure
- Employs a coding scheme for each element that clearly identifies its hierarchical nature when viewed in any format such as a chart or outline
- Has at least two levels with at least one level of decomposition
- Is created by those who will be performing the work
- Is constructed with technical input from knowledgeable subject matter experts (SMEs) and other project stakeholders, such as financial and business managers
- Iteratively evolves along with the progressive elaboration of project scope, up to the point the scope has been baselined
- Is updated in accordance with project change control, thereby allowing for continual improvement, after the project scope has been baselined.

4.2.2 WBS Quality Sub-Principle 2—Use-Related Characteristics

There is an additional set of use-related characteristics that may vary from one WBS to another. These characteristics enable the WBS to be used for purposes that are unique to a specific project, industry or environment, or are applied in a particular way to individual projects.

With respect to use-related characteristics, the quality of a WBS depends on how well the specific content and type of WBS elements meet all the needs for which the WBS has been developed. This statement implies that the more project needs are met by the WBS, the higher its quality. A high-quality WBS is constructed so that it can be used to meet all project requirements, even if a given project does not take advantage of all of the characteristics present.

Use-related characteristics support the application of WBS practice in situational contexts. These can include, and are not limited to the following:

- Achieves a sufficient level of decomposition. A WBS is broken down to a level of detail sufficient for managing the work. The appropriate level of detail to enable effective management can differ from organization to organization or project to project.
  - The depth of the WBS correlates with the size and complexity of the project and the level of detail needed to plan and manage it.
  - All deliverables are limited in size and definition for effective control. However, they should neither be so small that the cost of control is excessive, nor should
they be so large that the item is unmanageable or the associated risks cannot be identified.

- **Provides sufficient detail for communicating all work.** A WBS facilitates conceptualization and definition of the product, service, or result (deliverable) details. But the degree of WBS detail necessary for conceptualization of project detail can vary. For example, existing modules can be satisfactorily described by a product number, while to-be-designed components might need to be described in greater detail. To ensure clarity of communication regarding the intent of any WBS element, an entry detailing specific information about the WBS element should be placed in the WBS Dictionary. This will minimize misunderstanding of the WBS and, in turn, the project scope.

- **Is appropriate for tracking, as required by the specific project or organization.** Some projects or organizations can require highly detailed performance reporting at the work package level, while others might require only summary level reporting at a WBS rollup level.
  - The WBS has logical summary points that assist in tracking the evaluation of performance accomplishments, resource allocations, costs, and schedule performance.
  - Suitable management control points are identified in the WBS that can be used to facilitate communication and to control scope, quality, and technical soundness.
  - In summary, the WBS provides a feasible mechanism to assess performance and progress.

- **Is appropriate for control activities.** A WBS balances the control needs of management with an effective level of project detail. It provides a good balance between complexity, risk, and the project manager's need for control.
  - Shorter, less complex projects may require only a few performance assessments at higher WBS levels, whereas larger, more complex projects may require many intermediate reviews at the work package level.
  - Elements are detailed enough to meet performance measurements and accountability objectives, thereby facilitating effective planning, monitoring, and control.

- **Can contain specific kinds of WBS elements, as needed for each project.** Some projects might need to include a majority of the following types of WBS elements, while other projects need only one or two:
  - Some project WBSs can include elements for integration, procurement, supply chain management, information/communication, administration, documentation, training, and software development.
  - WBS elements representing subcontracted or externally committed deliverables should directly correspond to matching elements in the subcontractor's WBS.
  - A WBS might include level-of-effort WBS elements.
  - Deliverables from the development life cycle stages, such as planning, analysis, design, assembly, testing, and implementation, can be reflected in the WBS, where appropriate.
  - WBS elements can reflect the deliverables within the product development life cycle, where appropriate, such as in the IT industry.

- **Enables assignment of accountability at the appropriate level.** Some projects or organizations can require assignment of accountability at a very detailed, work package level, while others might be satisfied with accountability assigned at a summary rollup level.
  - Each WBS element can be assigned to an accountable individual, subcontractor, or organizational unit.
The WBS can serve as the mechanism for documenting the accountability and responsibility for the various deliverables by having a direct relationship among the WBS elements related to the Organizational Breakdown Structure (OBS) identified through the Responsibility Assignment Matrix (RAM).

- WBS elements clearly identify accountability to the level of detail required for managing and controlling the project.
- Has a succinct, clear, and logically organized structure to meet project management and oversight requirements. The logic of the hierarchical decomposition of a project can vary in response to a variety of project and organizational factors.
- The WBS decomposition level balances the project definition with data collecting and reporting requirements.
- WBS elements are compatible with relevant organizational and accounting structures.

4.3 WBS Quality Principle 2

WBS quality characteristics apply at all levels of scope definition.

There is no conceptual difference between a project WBS, a program WBS, and a portfolio WBS. A high-quality WBS developed at any of these broader levels possess precisely the same characteristics and attributes as a high-quality WBS developed at the individual project level. These differ only in the breadth of the content and scope.

4.4 Annotated Example of a High-Quality WBS

This WBS example is based on a hypothetical organization that builds bicycles to an individual customer's specifications. The annotations refer to specific characteristics of a high-quality WBS. Figure 4-1 illustrates a simplified WBS as it pertains to a sample project. The project is the design and building of a bicycle and is an example of a WBS to encompass the work for this sample project.

4.4.1 Level 1

This level comprises the full scope of work necessary to produce the bicycle. It includes all direct and indirect work. Level 1 is the overall product, always a single WBS element. In this example, the top level is represented by both a name and a WBS identifier to differentiate it from other WBSs in a program or portfolio of which it is a member. This may not always be the case. If the project stands alone, the top level or Level 1 identifier may not be required. When the top level identifier is not included, numbering for the remaining WBS levels will also change accordingly.

4.4.2 Level 2

This is the first level of decomposition. This level is the high-level breakdown of the major areas in the scope of work. It holds the basic components of the product, along with integration and project management. The frame set is basically the parts you sit on, steer with, and to which you attach wheels and other parts. The crank set includes the pedals, bearings, crank arms, and sprocket. The braking system includes the brake pads and related mechanisms for the wheels, cables, and levers. The shifting system
includes the front and rear shift mechanism, cables, and levers. This level is numbered as #.#—for example, frame set is 1.1.

4.4.3 Level 3
This level decomposes each major area from Level 2 into its constituent parts. It is important to note that the 100% Rule is always adhered to in the development of a WBS. This level would tend to start targeting specific, tangible deliverables of the project effort. Here, integration is decomposed into interim deliverables based on the project life cycle chosen for this project. This level is numbered as #.#.#—for example, rear wheel is 1.3.2.

4.4.4 Level 4
In the same manner, each exclusive area in Level 3 would be decomposed further, if applicable. Again, the complexity of the work will drive the depth and number of levels of the WBS decomposition. Note that testing is further decomposed into three elements: component test is pre-assembly testing; product test is quality control and
4.5 Problem Diagnostic Checklist

The following are representative examples of major project problems resulting from key WBS defects.

- There are frequently missed deadlines and an extended schedule
  - Have all major and minor deliverables been included? Failure to include all deliverables within the initial WBS can increase project schedules when missed deliverables are identified.
  - Have deliverables been defined specifically enough to allow for appropriate work packages to be developed?
  - Does the WBS facilitate the use of earned value management techniques?

- Project is over budget
  - Does the WBS provide logical summary points for assessing accomplishments, as well as for measuring costs and schedule performance?
  - Does the WBS facilitate the use of Earned Value Management techniques?

- Individuals are unable to use the new product or feature
  - Are deliverables decomposed into smaller, more specific deliverables? For example, a deliverable of training might not be decomposed thoroughly enough to cover all of the people who need training to use the new product, process, or service.
  - Are the WBS elements deliverable-focused?
  - Were appropriate assembly or integration deliverables and testing activities present?
  - Were training and implementation deliverables defined?

- The project scope has changed and is unmanageable
  - Has a WBS been created for the project?
  - Does the WBS decompose the overall project scope into deliverables?
  - Does the WBS provide a level of flexibility for change?
  - Has the WBS been updated when necessary changes are approved by the change control process?
  - Has the WBS been placed under change control?

- The project has become an ongoing project with no end in sight
  - Has a maintenance plan been developed for post implementation if needed?
  - Does the project have a specific end point?
  - Does the WBS include a closeout phase or plan?
  - Is the endeavor actually a project or is it an ongoing operation?

- Project team members are confused about their individual responsibilities
  - Do the WBS elements define overlapping responsibilities for the creation of a deliverable?
  - Is the information within the WBS at the appropriate level of detail, and in formats and structures meaningful to those performing the work? If so, were clear communication processes and decision authorities agreed upon beforehand?
  - Do the WBS elements reflect work with specific, tangible deliverables?
  - Have all key stakeholders, including subject matter experts, contributed to the creation and validation of the WBS?
• Some planned work does not get done
  ○ Has all required work been included in the WBS?
  ○ Are the WBS elements deliverable-focused?
  ○ Has the WBS organized around deliverables rather than process steps?
  ○ Was decomposition completed before dependencies and durations were defined?

4.6 Summary

There are several characteristics that need to be present to produce a quality WBS deliverable. For a WBS to be considered as high quality, it should conform to its original requirements and be fit for use by the project. More simply stated, it should satisfy the purpose for which it was originally intended.

In summary, a high-quality WBS:
• Is constructed in a consistent fashion, varying only in its level of focus based upon its intended use
• Satisfies the needs of the project
• Contains all of the key elements necessary to represent the full scope of work
• Is usable by project managers with a broad base of experience to manage the varying degrees of scope, budget, schedule, and risk
• Avoids the common pitfalls associated with WBS construction.
Chapter 5

Considerations While Creating a WBS

5.1 Overview

There are many ways to create a Work Breakdown Structure (WBS). It can be developed entirely as a new document, can reuse components from existing WBSs, can be based on a template, or can follow pre-defined WBS standards. When reusing existing components, WBS elements can be drawn from similar projects or from standard project templates that the organization has determined support accepted good practices.

This chapter discusses the methods used to create a WBS, as well as some considerations that should be taken into account during WBS development. The sections of this chapter are presented as guides for use during the WBS development process, while some sections can be used as checklists for the development and refinement of the WBS. The remaining sections of this chapter are as follows:

5.2 Preparing a WBS
5.3 General Factors to be Considered
5.4 Essential Judgments
5.5 Evaluating WBS Quality
5.6 WBS Usage Continuum
5.7 WBS for Program and Portfolio Management
5.8 Summary

All project, program, or portfolio requirements need to be considered during development of the WBS. A critical factor for success at any level is the creation of a high-quality Work Breakdown Structure.

5.2 Preparing a WBS

The WBS evolves through an iterative consideration of the project’s purpose and objectives (both business and technical), functional and performance design criteria, project scope, technical performance requirements, and other technical attributes. A high-level WBS can often be developed early in the conceptual stage of the project. Once the project is defined and specifications are prepared, a more detailed WBS can then be developed. It should be customized to the specific needs and requirements
of the project. All non-required work and deliverables should be listed and removed so the WBS represents only the project’s scope. The end result is a WBS that represents the complete list of deliverables for the project. A number of authors have provided useful guidance on preparing a WBS (Haugan, 2002; Pritchard, 1998; Uytteewaal, 2005).

The WBS can assist the project manager and stakeholders in communicating a clear vision of the end product(s) of the project, and of the overall process by which those products will be created. It helps communicate the work to be accomplished as well as the interim and end-point deliverables to be completed. With this in mind, the following list of questions should stimulate thought when developing a WBS to manage a project:

- Is the project charter defined and issued?
- Is the project scope statement defined and issued?
- Have the project manager and the team formulated a vision of the final product(s), services, or results?
- Have personnel who will do the work been assigned to develop the WBS?
- What are the project’s component parts?
- How do the pieces work together?
- What needs to be done?
- Have the project’s intended business objectives been defined? What is required to achieve the business value?
- Has the entire project been thought through? Have the high-level deliverables been progressively decomposed?
- Have all deliverables, both interim and final, been identified? What is to be provided? What is required?
- Has the relationship of each component to the end product been defined? How will this component contribute to the finished deliverables?
- Has the process for production of the deliverables been defined? What methods will be employed? What special processes will be needed? What are the quality requirements? What kinds of inspections need to be done?
- Have the activities that are needed to support the deliverables been identified, including those that directly or indirectly facilitate their creation?
- Has technical input from knowledgeable Subject Matter Experts (SMEs) been obtained, and is that technical input communicated to and validated by other key SMEs assigned to the project?
- Does the project require any external sources to contribute to the project and have they been identified?
- Has all work associated with risk management been identified? Have risks associated with project assumptions been identified?

These thoughts and questions are intended to help the project manager develop a clear statement of what the product(s) of the project are. They should be iteratively reviewed until all questions have been completely addressed and all information is known—to the extent possible. Once completed, all of the work packages (i.e., the lowest-level WBS elements) should together comprise the complete list of deliverables for the project. They depict the project’s scope.

5.2.1 Preparation Methods

A number of methods and tools can be employed to create a WBS including outlines, organization charts, fishbone diagrams, brainstorming techniques, and top-down and
bottom-up development strategies. WBS templates, as well as corporate guidelines or standards can be referenced or copied for quick-starting WBS development.

There are many benefits to using tools to develop a WBS. For example, tools often promote consistency and repeatability in the development of a WBS, especially if it is an enterprise productivity tool. WBS tools can also promote and enforce the principles of the organization's WBS guidelines or standards, and can significantly reduce the development effort, simplify the WBS process, and even promote reuse of WBS elements.

Some of the more popular methods employed to create a WBS include a top-down approach, a bottom-up approach, the use of organization-specific WBS guidelines or standards, and the use of WBS templates. The choice of appropriate method should be based on the specific project objectives, requirements, assumptions, and constraints. Table 5-1 highlights some advantages and challenges of the aforementioned methods.

<table>
<thead>
<tr>
<th>WBS Creation Method</th>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top-Down</td>
<td>• Structures project conveniently for status reporting</td>
<td>• Requires constant attention that no work packages are overlooked</td>
</tr>
<tr>
<td></td>
<td>• Helps ensure projects are logically structured</td>
<td>• WBS needs to be elaborated to sufficiently detailed level to permit management oversight and control</td>
</tr>
<tr>
<td></td>
<td>• Is valuable when brainstorming/discovering project deliverables</td>
<td></td>
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<tr>
<td></td>
<td>• Can accommodate additional deliverables as they are uncovered</td>
<td></td>
</tr>
<tr>
<td>Bottom-Up</td>
<td>• Starts with all deliverables and works backwards into a project</td>
<td>• Identifying all deliverables before producing the WBS</td>
</tr>
<tr>
<td></td>
<td>• Confirms that all work packages are included</td>
<td>• Making sure work packages are logically grouped</td>
</tr>
<tr>
<td>WBS Standards</td>
<td>• Formats are predefined</td>
<td>• Can lose focus on big picture</td>
</tr>
<tr>
<td></td>
<td>• Enhances cross-project WBS consistency</td>
<td></td>
</tr>
<tr>
<td>WBS Templates</td>
<td>• Provides a starting point for WBS creation</td>
<td>• Making a project fit the standard</td>
</tr>
<tr>
<td></td>
<td>• May help determine appropriate level of detail required</td>
<td>• Can lead to inclusion of unnecessary deliverables or failure to include project-specific deliverables</td>
</tr>
<tr>
<td></td>
<td>• Enhances cross-project WBS consistency</td>
<td>• Not all projects fit into a highly structured set of WBS standards</td>
</tr>
</tbody>
</table>

Table 5-1. WBS Creation Methods

1 Top-Down
The following steps describe the general top-down process for developing a WBS:
• Step 1. Identify the final products of the project—what must be delivered to achieve project success. A thorough review of high-level project scope documents (such as Statement of Work and Technical Requirements) is recommended to ensure consistency between the WBS and the project requirements.
• Step 2. Define the project's major deliverables, which are often interim deliverables necessary for the project, but which in themselves do not satisfy a business need (such as a design specification).
Step 3. Decompose major deliverables to a level of detail appropriate for management and integrated control. These WBS elements are normally tied to clear and discrete identification of stand-alone deliverable products. The sum of the elements at each level should represent 100% of the work in the element above it, as noted in the 100% Rule. Each work package of the WBS should contain only one deliverable.

Step 4. Review and refine the WBS until project stakeholders agree that project planning can be successfully completed, and that execution and control will successfully produce the desired deliverables and results.

2 Bottom-Up
The following steps describe the general bottom-up process for developing a WBS:

Step 1. Identify all of the deliverables (or work packages) involved in the project. If participants propose activities, then the associated deliverables, but not the activities, should be included (i.e., translate suggested activities into associated deliverables). This will encompass the entire output of the effort. Each work package should contain only one deliverable.

Step 2. Logically group related work packages (or deliverables) together.

Step 3. Aggregate deliverables to the next level, for instance, the parent level. The sum of the elements at each level should represent 100% of the work below it, as noted in the 100% Rule.

Step 4. Once a given group of related tasks has been aggregated to a parent, analyze the subset again to ensure that all of the work has been encompassed.

Step 5. Repeat until all subelements have been aggregated to a single parent representing the project. Ensure that the completed structure includes all of the project scope.

Step 6. Review and refine the WBS until project stakeholders agree that project planning can be successfully completed, and that execution and control will successfully produce the desired deliverables and results.

3 WBS (Organizational) Standards
An organizational WBS standard is a set of principles for constructing a WBS and might include a format, numbering scheme, naming convention, or required elements. WBS standards are common in many organizations with a high level of project management maturity. These standards help ensure consistency and completeness in WBSs throughout the organization. Examples of WBS standards include the following:

- Project management must be a Level 2 WBS element
- Graphical and textual WBS views must be developed and maintained.

4 WBS Templates
A WBS template is a sample WBS, with hierarchical elements filled in to some level of detail, or a generic WBS "container" that is customized (i.e., filled) with project-specific information. An organization can have templates for different types of projects and different life cycles.

The use of WBS standards and WBS templates helps promote consistency through reuse of WBSs or WBS components. When reusing existing components, be sure to customize the WBS to the specific needs and requirements of the project. Any non-required work or deliverables should be removed so that the WBS is aligned with the project scope. In addition, the questions defined in
Section 5.2 should again be iteratively reviewed for these two methods. The use of standards and templates in the creation of WBSs helps promote quality assurance through the application of successfully applied WBS good practices.

The use of WBS standards and WBS templates differs from top-down and bottom-up methodology in that top-down and bottom-up are methods of creating new WBSs, while standards and templates involve the reuse of existing WBS materials.

**5.2.2 Guidance in Choosing a Method for Preparing a WBS**

In developing a WBS, the project management team needs to decide first which development method to use. The choice between a top-down or a bottom-up approach is somewhat personal, and can depend on the habits and thinking styles of the project team, as well as on organizational practices. Aside from those considerations, some guidelines and explanations for which approach might be more appropriate are as follows:

1. **Top-Down**
   
   Use the top-down approach in these situations:
   - The project manager and project management team have little to no experience in developing Work Breakdown Structures. Top-down development allows for progressive understanding and elaboration of the WBS.
   - The nature of the project's products or services is not well understood. The development of a WBS jointly with all stakeholders using the top-down approach is useful in gaining understanding and consensus when the scope and nature of the project is unclear.
   - The nature of the project life cycle is not familiar or well known. Top-down development of the WBS more easily uncovers life cycle issues and characteristics.
   - No appropriate WBS templates are available. When developing a WBS from scratch, it is far easier to start with the overall project deliverable, such as building a bicycle, and then iteratively determine subelements.

2. **Bottom-Up**
   
   Use the bottom-up approach in these situations:
   - The nature of the project's products or services is well understood. For example, if the organization has developed very similar products or services on previous projects, the project team might already have a very good understanding of all interim deliverables required for the new project.
   - The nature of the project life cycle is well known. If the organization always uses the same project life cycle, the interim deliverables for that life cycle are well known and can be used to begin bottom-up WBS development.
   - Appropriate WBS templates are available. If the organization has WBSs from projects with similar products or services, and these can be reused, a bottom-up approach enhances the team's ability to customize the WBS template.

3. **WBS Standards and Templates**
   
   In general, if WBS standards or WBS templates are available, they should be used, with the caveats expressed in Figure 5-1. There are plenty of sample WBSs available in the literature, but the choice to use sample WBSs as templates must be made carefully. The organization can have WBS templates for very similar
projects, and the use of these templates is highly encouraged. However, if the project significantly differs from other projects in the organization, and no template seems to apply, develop the WBS from scratch with a top-down approach.

4 Iterations

Construction of the WBS is an iterative process and may rely on more than one method to produce the final high quality WBS. For example, a WBS template and the top-down approach may be used initially to determine the overall structure of the WBS, while it might be more appropriate to use the bottom-up method to verify that all the elements are present to achieve a particular deliverable.

Regardless of what method is chosen to prepare the WBS, the resulting WBS must have all the core characteristics of a high-quality WBS. The WBS must describe 100% of the work on the project, must be oriented toward deliverables rather than activities, and must be hierarchically arranged. For additional details on WBS quality principles, please see Chapter 4, and specifically Section 4.2 for a discussion of WBS core quality characteristics.

5.3 General Factors to Be Considered

In developing a WBS, the following basic tenets should be considered:
- Each WBS element represents a single tangible or intangible deliverable.
- Deliverables include both final and interim deliverables that are required to create the final results.
- Deliverables include intangible items, such as information/communication, integration, administration, training, process management, and procurement.
- All deliverables are explicitly included in the WBS.
- Deliverables are unique and distinct.
- All significant reporting mechanisms, such as review meetings, monthly reports and test reports are included and identified in the WBS.
- Clearly defining the project deliverables, so that each is unique, ensures there will be no duplication in the outcomes of the project or of the work performed to produce the end-products.
- Accountability for each work package can be assigned to a single project team member or subcontractor. If this is not possible, then reconsider whether or not the work package can be further decomposed.
- Each element in the WBS representing subcontracted or externally committed deliverables directly corresponds to matching elements in the subcontractor’s WBS.
- The deliverables are logically decomposed to the level that represents how they will be produced and managed (e.g., designed, purchased, subcontracted, or fabricated).
- All WBS elements are compatible with organizational and accounting structures.

The following basic guidelines should be considered when organizing WBS elements into the WBS hierarchy:
- Each WBS element belongs to only one parent WBS element.
- The set of child elements into which a parent element is decomposed includes all of the work contained in the parent, such that the 100% Rule applies.
• A coding scheme is used for WBS elements that clearly represents the hierarchical structure when viewed in text format.
• All “legs” of the WBS need not be to the same depth. Some areas of the WBS will need to show more detail than others.
• There is no need to have all work packages at the same level. The WBS development process should:
  • Be iterative
  • Be reviewed and revised as the rest of the project planning process progresses
  • Provide a vehicle for flexibility, particularly when the scope of the project effort might change.

A well-managed project, however, will incorporate a rigorous change control process to document and manage scope changes. When work scope changes do take place, the WBS must be updated. Any change in the WBS requires an associated change in related project management tools, such as the WBS Dictionary, network diagram, and schedule.

5.3.1 Project Management Knowledge Area Considerations

In the iterative WBS development process, the following guidelines and questions should be considered as they relate to each Project Management Knowledge Area in the PMBOK® Guide—Third Edition:

.1 Project Integration Management
  • Include work in the WBS for the integration of components. Place the WBS element for component integration at the same level as the components being integrated.
  • Include work in the WBS for the necessary communications and meetings required for effective integration management.
  • Is the work defined by the WBS grouped in a logical manner? Have all reporting and control mechanisms been addressed?

.2 Project Scope Management
  • WBS development is critical to scope management. Revisit the WBS often and expect to iterate WBS development.
  • Are requirements defined and approved?
  • Is there a statement of work, a set of contract requirements, or other documented requirements? Be sure that each WBS element can be traced to these requirements. Include only those activities that are considered in scope and can be traced to contractual or other requirements.
  • As the WBS is defined, keep a list of activities and efforts that are considered to be out of scope. Confirm scope with stakeholders often by reviewing the WBS and the out of scope list.
  • Are all deliverables explicitly identified in the WBS?
  • Will horizon or rolling wave planning be applied to develop or further decompose the scope progressively over time?
  • Have historical data, risk registries, checklists, and lessons learned been consulted to ensure identification of all work?
3 Project Time Management
- Deliverables should be decomposed to the level of detail needed to estimate the effort required to obtain or create them.
- How will the status of work in progress be determined?

4 Project Cost Management
- Deliverables should be limited in size and definition for effective control—not so small as to make cost of control excessive, and not so large as to make the item unmanageable or the risk unacceptable.
- How will budgets be established?
- Will it be possible to relate the budget to the proposed work assignments?
- Is the level of detail in the WBS appropriate for effective planning and control?

5 Project Quality Management
- Will the quality of the work be evaluated through efforts such as testing and inspection?
- Are there quality requirements for the project? If so, be sure to include WBS elements to document the periodic review of quality requirements, quality management activities, quality audits, and quality reviews.
- Are there requirements to show compliance with ANSI, ISO or other standards? If so, include WBS elements for outside auditing of the project for compliance.
- Are there quality requirements defined for the deliverables outlined in the WBS?
- Have metrics been defined for how the deliverables will be measured?

6 Project Human Resource Management
- Ensure that each WBS element has a single point of accountability. If a WBS element might involve more than one accountable person, consider decomposing the WBS element.
- Is all the work planned to a degree of detail necessary to make and keep commitments?
- Ensure that the reporting structure indicated by this WBS supports establishing and managing individual work assignments.
- Can work assignments be established from a progressive expansion of the WBS?
- How will work generally be assigned and controlled?
- Will it be possible to reconcile individual work assignments to the formal scheduling system?
- Is more than one organization involved, requiring validation of the WBS with others before doing detailed resource planning?

7 Project Communications Management
- Have all communication needs been accounted for?
- Are there long distance, Regional, National and International communications required?
- Are there any special deliverables required for international communications, such as translations and other country-specific requirements?
- Are there special communication needs for any deliverables outlined in the WBS?
Project Risk Management

- For areas of the WBS that are considered high-risk, consider decomposing the WBS to a more detailed level. This will allow better definition of assumptions and expectations, and will allow for more accurate planning, thus reducing risk.
- Are the deliverables completely and clearly defined?
- What is the likelihood of change?
- Is the technology changing faster than the project can be accomplished?
- Have manpower, facilities capability, availability of internal resources, and potential suppliers been checked?
- Has a formal change process been defined and implemented?
- Have metrics been defined for how the deliverables will be measured?
- Have resource requirements been identified for development of the project deliverables?
- Have other risks been identified, including stakeholder buy-in, public relations, management approval, team understanding, and project opposition?
- Has both an internal and external communication plan been defined and implemented?
- Are third-party dependencies understood and monitored for change?
- Have alternate suppliers of required products, supplies, or expertise been identified?
- Have historical data, risk registries, checklists, and lessons learned been consulted to ensure identification of all risks?
- Has risk management and contingency work been included?

Project Procurement Management

- Is extensive subcontracting expected?
- Is there a WBS element for each procured deliverable?
- Are intangible deliverables required for managing the procurement process?
- Will procurement be managed by the project team or by an existing procurement organization?

5.4 Essential Judgments

Effective application of use-related characteristics relies on experience and judgment. This section examines that concept in a bit more detail. Factors that can vary from one project or application to another, depending upon the purpose for which the WBS is intended, include, but are not limited to, the level of detail needed in the decomposition of the deliverables, the selection of the type of WBS element to be included, and structuring the logic of the decomposition.

5.4.1 Determining Appropriate WBS Level of Detail

The WBS development process has been described as proceeding to successive levels of increasing detail, culminating in a level of detail that captures all elements of the scope of the project. This process also provides needed insight for clear communications and effective project management. The level of detail in a WBS is a function of the size of the project, and reflects a balance between complexity, risk, and the project manager's need for control. The level of detail can also vary during the evolution of a project. A top-down and bottom-up analysis of the WBS can clarify whether the WBS is both complete and defined at the proper level of detail.
Short-duration projects can lend themselves to decomposition to a high degree (extensive level) of detail at the outset, while projects of longer duration and higher complexity can preclude decomposition of all deliverables until more is known about the project. Again, this means that on any given project, some portions of the WBS can have different levels of decomposition. This is especially true when doing rolling wave planning, where the plan is detailed only for the immediately upcoming work, and work far in the future is defined at a high level until later in the project life cycle.

When proceeding to successive levels of increasing detail, the 100% rule must still apply. This rule states that the children nodes of a parent node must make up 100% of the work of that parent node. Additionally, not all legs of the WBS must be symmetrical in terms of the number of levels developed. There is no need to decompose all legs of the WBS if the need is only present in one area.

Should the WBS be decomposed further? The following questions provide guidance for determining the need for further decomposition of the WBS. If the answer to any of these questions is yes, then further decomposition should be considered. The greater the number of positive answers, the stronger the justification for further division of some or all of the WBS.

1. **Scope and Work Package Detail**
   - Are clear, objective criteria missing for measuring the progress for the WBS element?
   - Does the WBS element contain more than one deliverable?
   - Do prerequisites differ among internal deliverables within the WBS element?
   - Can a portion of the work to be performed within the WBS element be scheduled as a unit?
   - Are there acceptance criteria applicable before completion of the entire WBS element?
   - Is the WBS element clearly and completely understood to the satisfaction of the project manager, project team members, and other stakeholders—including the customer?
   - Are there relationships between internal WBS element deliverables and other external WBS elements?
   - Is there a stakeholder interested in analyzing status and performance of only a portion of the work covered by the WBS element?
   - Can progress of the work be assessed as needed?

2. **Resources and Risks**
   - Can the work element be assigned to a single accountable individual? While there might be a variety of resources assigned to a given WBS element, there should ultimately be only one individual accountable for delivery of the work package.
   - Are there specific risks that require focused attention to a portion of the WBS element?
   - Can actionable risks be identified for each WBS element?

3. **Costs and Timing**
   - Are there significant time gaps in the execution of the work processes internal to the WBS element?
   - Is there a need to improve the accuracy of the cost and duration estimates of the WBS element?
   - Is there a need to separately define the cost of work processes or deliverables internal to the WBS element?
   - Is there a need to precisely know and report the timing of deliverables internal to the WBS element?
5.4.2 Selection of the Type of WBS Element to be Included

A WBS organizes and defines the total work scope of the project. Not every WBS, however, needs to include all types of work. Rather, the kinds of work included in a WBS should be dictated by the scope and nature of the project for which the WBS is being developed. Some examples of this are presented here:

- Some projects require certain types of WBS elements that are not necessary for other projects. For example, in a project that involves production of several different components that need to be assembled into a finished product, it would be necessary to include an integration or assembly WBS element so that the assembly work can be identified, resourced, tracked, and reported. In contrast, a project to develop a business process might not require such an assembly element.

- All projects require a project management WBS element at Level 2, in order to ensure that the work of planning, tracking, and reporting is adequately captured and managed. A particular organization, however, might require use of a standardized WBS template that does not include certain kinds of project management WBS elements (for example, administration, documentation, or reporting elements) because the need for these is adequately addressed by other business processes established by that organization. In such cases, these elements would not be required.

- Quality assurance is applicable to all projects. Some organizations could have requirements for compliance with specific quality standards. In such cases, the WBS must include elements, such as documentation and audits, to account for compliance with the specified procedures.

5.4.3 Structuring the Logic of the Decomposition

An essential feature of a WBS is that it clearly and comprehensively defines the scope of the project work through decomposition of deliverables into a hierarchy of simpler components, thereby providing one of the primary methods for managing complex projects. The way that the project manager decomposes the project (i.e., the logic used for decomposing the work) can vary depending on the needs and requirements of the performing organization and the use to which the WBS will be put. This is illustrated by the following examples:

- One organization might be structured along very strict functional lines, with few business processes that facilitate communication among the separate subunits. In such a case, it can make sense to structure the decomposition in terms of the work and sub-deliverables that each function independently contributes. In contrast, in a projectized organization without functional divisions, the same deliverable might more effectively be decomposed into a hierarchy of subassemblies.

- Where new product development proceeds in sequential stage-like phases with later work contingent on the outcome of earlier work, it would make sense to organize the WBS in terms of the product development life cycle, rather than in terms of physical components of the product.

- A food-service enterprise with regional offices might find it particularly valuable to structure the WBS for a program to create a new chain of restaurants as a series of geographic subprojects, while a centralized enterprise that sub-contracts, for instance, building development, food sourcing, or marketing, would find it more useful to decompose the new restaurant program in terms of sub-systems.

In all cases, it is important that the WBS remain deliverable-oriented, rather than process-oriented, and explicitly contain all intermediate deliverables.
5.5 Evaluating WBS Quality

There are several points that are considered essential when creating a WBS. As detailed in Chapter 4, there is a set of core characteristics that every WBS must have, which enable it to satisfy project needs. Failure to address these considerations can lead to failure of the project, because there would be a high risk of not identifying all of the required work.

5.5.1 Core Characteristics

- The WBS structure is not based on timing or sequence dependencies among components. Timing, sequencing, and dependencies are project schedule concerns.
- The WBS is not structured strictly by process or organization.
- The WBS defines the logical relationships among all the components of the project.
- All WBS elements are deliverable-oriented.
- Project activities are not listed, as these are components of the project schedule, not the WBS.
- All element names are nouns. Verbs are not used to identify WBS elements.
- The WBS includes only sufficient and necessary deliverables. All deliverables are necessary components of the project's product, service, or end result, and are defined in the project's scope.
- All project deliverables including regulatory permits, packaging, distribution, or marketing, as well as preliminary, interim, internal, external, or final deliverables, are identified and detailed.
- There are no WBS elements with overlapping responsibilities. Each WBS element must have one person who is clearly accountable for its completion.

Also, as discussed in Chapter 4, there is an additional set of use-related characteristics that might vary from one WBS to another. These characteristics enable the use of the WBS for purposes that can be unique to a specific project, industry, or environment, or are applied in a particular way on individual projects. With respect to use-related characteristics, the quality of the WBS depends on how well the specific content and type of WBS elements meet the use for which the WBS was intended.

5.5.2 Use-Related Characteristics

- Identify key project management (non product) work such as:
  - Initiation, planning, executing, monitoring and controlling, and closing
  - Process management
  - Services and provisioning
  - Information/communication
  - Administrative documentation, training, and software.
  These should be defined as level-of-effort WBS elements in those cases where they can be interim deliverables, do not themselves generate discrete deliverables, and might not be included in the delivery of the final product.
- Include cross-project WBS elements, such as those representing opening and closing stages, for example, planning, assembly, integration, and testing.
- Balance the project definition aspects of the WBS with the data collecting and reporting requirements. The primary purpose of the WBS is to define the project's scope through the decomposition of deliverables.
- Decompose the WBS to the appropriate level of detail by achieving a balance between project complexity, risk, and the project manager's need for monitoring and control.
- Do not decompose the WBS too far. Each WBS is a tool designed to assist the project manager with decomposition of the project only to the levels necessary to meet
the needs of the project, the nature of the work, and the confidence of the team. Excessive WBS levels can require unrealistic levels of maintenance and reporting.

- Do not omit WBS development, such as Gantt chart, CPM schedule or precedence diagram before proceeding to the network diagram. Omitting the development and refinement of the WBS can lead to unforeseen and unexpected difficulty, including project delays, cost over-runs, or outright project failure.

5.6 WBS Usage Continuum

The ability of a WBS to meet the needs of a project is directly related to the level of project management competency available within the project management team.

An experienced project management team will be able to identify a greater range of stated and implied project needs that the WBS can address. A more experienced project management team will ensure the WBS is employed in a greater variety of project roles, and will use the WBS in more efficient and sophisticated ways than will a novice or inexperienced project management team. A WBS can be of high quality even if it is not being used to its full capacity by the project management team.

The project management team’s development and use of the WBS as an effective planning and control tool represents its position on the WBS usage continuum. In other words, once the project management team begins using a WBS within the project context, their ability to make the WBS play an important defining and controlling role for scope, budget, and risk follows a growth continuum similar to that of any other project management methodology or tool. The following is an experience continuum for WBS development and use:

- Develop a WBS that contains all Core Characteristics
- Develop a WBS that contains all Core Characteristics
- Develop a WBS that contains all Core Characteristics
- Identify & include some user-related attributes
- Identify & include all required user-related characteristics
- Apply the WBS effectively to project schedule development and resource assignment
- Apply the WBS effectively to project schedule development and resource assignment
- Apply project estimating techniques in developing the WBS
- Apply project estimating techniques to develop & manage the project using the WBS
- Apply the WBS effectively to Change Control Planning and Execution, Quality Planning and Control, Risk Planning and Management, Cost and Budget Planning and Control, etc.

Figure 5-1. WBS Usage Continuum
5.7 WBS for Program and Portfolio Management

According to the *PMBOK® Guide*—Third Edition, projects, programs and portfolios are defined as follows:

**Project.** A temporary endeavor undertaken to create a unique product, service, or result.

**Program.** A group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually. Programs may include elements of related work outside of the scope of the discrete projects in the program.

**Portfolio.** A collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related.

Work Breakdown Structures are useful not only for projects, but for programs and portfolios as well. Use of the WBS at these levels is a growing practice. There is no conceptual difference among a project WBS, a program WBS, or a portfolio WBS. A high-quality WBS developed at any of these broader levels possesses precisely the same characteristics and attributes as a high-quality WBS developed at the individual project level. These differ only in the breadth of the content (scope).

All of the principals defined in Section 4 that apply to a project WBS also apply to a program or portfolio WBS. Great care should be taken, however, when working with WBSs beyond the program level. The difficulty in verifying that all work and deliverables are defined increases significantly as the scope increases.

5.8 Summary

This chapter has shown that there are many ways in which a WBS can be created. It can be developed as an entirely new document, can reuse components from existing WBSs, can be based on a template, or can follow predefined WBS standards. Regardless of the method used to construct it, the WBS evolves through an iterative consideration of the project’s scope, including the project’s purpose and objectives (both business and technical), functional and performance design criteria, technical performance requirements, and other technical attributes.

This chapter has presented several guidelines and checklists to assist in the preparation of a WBS. All other Project Management Knowledge Areas (such as Project Time Management, Project Cost Management, and Project Quality Management) are highly dependent upon the resulting WBS. In the end, a high-quality WBS provides a strong foundation upon which to build a successful project.