

Chapter 1

Background and Key Concepts

“If you don’t know where you’re going, any road will take you there”

Anon

CHAPTER OVERVIEW

This chapter is placed up front not only because it is Chapter 1, but also because we wanted to provide background information for you before beginning the process of developing Work Breakdown Structures. This chapter introduces key concepts about the WBS that are discussed in much more detail later in the book, along with historic information about the emergence and evolution of the WBS over a number of decades. We also introduce the House metaphor.

The house what? The **House metaphor**. For our purposes, we will use the term metaphor here to mean a symbol or example that will represent how this concept can be applied in practice—although the example itself is fictitious. Actually, the House metaphor is a tool or rather, a section of a WBS from the construction of a house that we have developed for use throughout the book to help us illustrate our intended meaning—when words alone aren’t enough to clarify and communicate key points or concepts. Following is an outline view of the House metaphor we will use, in one form or another, throughout the remainder of the text.

This metaphor is an important tool to cover at the beginning of the book because we will use it to describe, discuss and illuminate concepts throughout the text. We will use the House metaphor to illustrate examples, to provide a common, practical application of a topic or concept, and as a starting point for detailed examination of related topics.

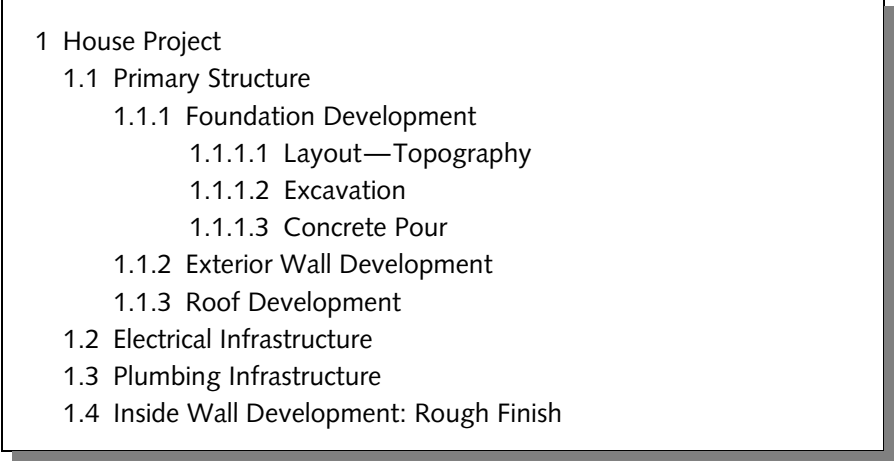
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 1.1 --> 1.1.1[1.1.1 Foundation Development]
 1.1 --> 1.1.2[1.1.2 Exterior Wall Development]
 1.1 --> 1.1.3[1.1.3 Roof Development]
 1.1.1 --> 1.1.1.1[1.1.1.1 Layout—Topography]
 1.1.1 --> 1.1.1.2[1.1.1.2 Excavation]
 1.1.1 --> 1.1.1.3[1.1.1.3 Concrete Pour]
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- 1 House Project
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    - 1.3 Plumbing Infrastructure
    - 1.4 Inside Wall Development: Rough Finish

Exhibit 1.1 House Metaphor—Outline Example

At the highest level, this chapter will contain the following:

- A general description of the Work Breakdown Structure and its role in project management
- WBS background and history
- Key terms and definitions
- The House Metaphor

## WORK BREAKDOWN STRUCTURES

Let us begin . . .

Work Breakdown Structures were first used by the U.S. Department of Defense for the development of missile systems as far back as the mid-1960s, and they have been a fundamental component of the Project Management lexicon for nearly as long. The concept of the WBS and the practices around its use were initially developed by the U.S. Department of Defense (DoD) and National Aeronautics and Space Administration (NASA) for the purpose of planning and controlling large acquisition projects whose objective was development and delivery of weapons or space systems (Cleland, *Air University Review*, 1964, p. 14). These projects often involved many industrial contractors each with responsibility for separate components of the system and were managed by a central administrative office, either within a governmental agency or within one of the contracting firms which served as prime contractor. In

this environment, the WBS was used to “...ensure that the total project is fully planned and that all derivative plans contribute directly to the desired objectives” (NASA, 1962).

The point is, that if true, and we assert right here that the statement is true, then the statement raises a question: “If the WBS is a fundamental building block for most projects, most of the time, then why are there so many conflicting viewpoints and approaches to development and use of Work Breakdown Structures?”

The answer to that question is somewhat elusive, and is one of the driving factors for writing this book. In the sections and chapters that follow we will examine various approaches to WBS development and will present a number of concepts, attributes, challenges and ultimately, recommendations for your consideration and use.

## DEFINING WORK BREAKDOWN STRUCTURES

The *PMBOK® Guide*—Third Edition, defines a **Work Breakdown Structure** as “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 WBS is decomposed into Work Packages. **Work Packages** are defined in two different ways in the *PMBOK® Guide*—Third Edition. In the text, Work Packages are said to be the “lowest level in the WBS, and is the point at which the cost and schedule can be reliably estimated. The level of detail for Work Packages will vary with the size and complexity of the project. The **deliverable orientation** of the hierarchy includes both internal and external deliverables” (*PMBOK® Guide*—Third Edition, pp. 112, 114). Later in this chapter we provide the Work Package glossary definition for you.

There are a number of important concepts presented in this definition for the WBS. Of particular interest is the concept of deliverable orientation. The inclusion of these words is a key change from the definitions for the WBS in earlier editions of the *PMBOK® Guide* and reflects the expanded role the WBS performs in projects today. These changes are highlighted in Table 1.1.

Today, the WBS is understood to be more than an organization of the work of the project. The current definition, with the inclusion of the

Table 1.1 WBS Definition—Changes by Version

| <b>The Project Management Body of Knowledge (PMBOK®) (1987)</b> | <b>A Guide to the Project Management Body of Knowledge (PMBOK® Guide) (1996)</b>                                                                                                                                                                             | <b>A Guide to the Project Management Body of Knowledge (PMBOK® Guide—Second Edition) (2000)</b>                                                                                                                                                              | <b>A Guide to the Project Management Body of Knowledge (PMBOK® Guide—Third Edition) (2004)</b>                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A task-oriented 'family tree' of activities.                    | A deliverable-oriented grouping of project elements which organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services. | A deliverable-oriented grouping of project elements which organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services. | 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 WBS is decomposed into work packages. The deliverable orientation of the hierarchy includes both internal and external deliverables. |

(**Sources:** Project Management Institute, *The Project Management Body of Knowledge (PMBOK®)*. PMI. Newtown Square: PA. 1987.; Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. PMI. Newtown Square: PA. 1996.; Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK® Guide—Second Edition)* PMI. Newtown Square: PA. 2000.; Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK® Guide—Third Edition)* PMI. Newtown Square: PA. 2004.)

deliverable orientation wording, indicates that the process of developing the WBS includes the definition and articulation of specific outcomes of the project—the end products and results. By doing so, it becomes a reference point for all future project activities.

This critically important concept will be expanded later in the book, but we want to point to this definition as a departure point for our writing

as well as a point of reference for you. Deliverable orientation is one of the Core Characteristics for the WBS, which we will discuss in Chapter 2. It is a fundamental attribute that will allow your WBS to be more than “shelfware” for your project, and will enable it to perform a critical role as a baseline document for communication of scope and outcomes during the initial phases of your project. In later phases, the WBS performs an active role as a basis for other key executing and monitoring and controlling activities. With these thoughts in mind, we can now take a broader look across the project management horizon to examine current trends and to establish context for our discussion.

There are additional reasons for preferring a deliverable orientation for WBS construction over task/activity or process orientations. With process and task-oriented Work Breakdown Structures, the deliverables or outcomes described by the WBS are the project processes themselves, rather than the project’s products or outcomes. When this is the case, the project team spends a great deal of energy on refinement and execution of the project’s processes, which can ultimately become models of care and efficiency—but that do not necessarily produce the desired outcomes for the project because the focus has been on the process of producing outcomes, not the outcomes themselves.

Additionally, task/activity WBS construction is truly a contradictory concept from the outset. As we will examine later, tasks and activities are truly part of the project scheduling process and have no place in the WBS to begin with. Later, in Chapter 7, we will discuss the creation of the Project Schedule and will explain that tasks, activities and milestones are outcomes of the decomposition of the WBS that extends beyond the Work Package level, (the lowest level of decomposition of the WBS) and yields elements that are carried forward into the project schedule. So from our perspective, developing a WBS based around tasks and activities is simply a contradiction in terms. To us, and to those who wish to develop high-quality Work Breakdown Structures that focus attention on outcomes and deliverables, this truly cannot be useful.

## IMPORTANCE OF THE WBS

Everyday practice is revealing with increasing regularity that creation of a WBS to define the scope of the project will help ensure delivery of the project’s objectives and outcomes. There are numerous writings that

point to the WBS as the beginning step for defining the project and insist that the more clearly the scope of the project is articulated before the actual work begins, the more likely the success of the project. Here are a few examples from recognized, reliable Project Management sources:

- John L. Homer and Paul D. Gunn “The intelligent structure of work breakdowns is a precursor to effective project management.” (Homer and Gunn, 1995, p. 84).
- Dr. Harold Kerzner: “The WBS provides the framework on which costs, time, and schedule/performance can be compared against the budget for each level of the WBS” (Kerzner 1997, p. 791).
- Carl L. Pritchard: “The WBS serves as the framework for project plan development. Much like the frame of a house, it supports all basic components as they are developed and built” (Pritchard 1998, p. 2).
- Dr. Gregory T. Haugan: “The WBS is the key tool used to assist the project manager in defining the work to be performed to meet the objectives of a project” (Haugan, 2002, p. 15).
- The *PMBOK® Guide*—Third Edition stresses the importance of the WBS in the Planning Process Group, which begins with three essential steps—Scope Planning (3.2.2.2), Scope Definition (3.2.2.3) and Work Breakdown Structure Development (3.2.2.4). (*PMBOK® Guide*—Third Edition).

Experienced Project Managers know there are many things that can go wrong in projects regardless of how successfully they plan and execute their work. Component or full-project failures, when they do occur, can often be traced to a poorly developed or nonexistent WBS.

A poorly constructed WBS can result in negative project outcomes including ongoing, repeated project re-plans and extensions, unclear work assignments for project participants, scope creep, and its sister, unmanageable, frequently changing scope, as well as budget overruns, missed deadlines and ultimately unusable new products or delivered features that do not satisfy the customer nor the objectives for which the project was initiated.

### WBS LESSON LEARNED: A BRIEF ILLUSTRATION

Why is this the case? How can all of these problems be linked to the completeness or quality of the WBS? To answer this question, let us

take a brief look at what typically happens following missed deliverables or project component failures. Once it becomes obvious something will be missed by the project team—the delivery date, key features or functionality, or perhaps the budget, the dust settles.

Shortly afterward (and exactly how long “shortly” is can vary quite a bit) the project leader and functional managers stop looking for someone to blame and cooler heads prevail. Quite often someone emerges (most likely an executive or Project Sponsor) and asks to see the “project’s documentation.” At this point the Project Manager scrambles to produce the project plan, project schedule, risk plan and register, change request log and the WBS for the project—if it exists. In a very short time, this person, who hasn’t been close to the project on a day-to-day level, “down in the trenches” with the project team, will undoubtedly pull out a single project document and point to specific wording that describes precisely what should have been delivered by the project team, and when. That document is often the Scope Statement, the project’s Charter or its contracts and agreements.

Having found the desired scope statements and agreements, the project executive or sponsor will call a series of meetings with the appropriate responsible parties, and will ask some very pointed questions about the reasons the project didn’t result in the outcomes specified in the foundational documents—and will immediately begin negotiations to get what he/she intended to have delivered, delivered. Most notably, the project executive or sponsor may, at this point commit to ensuring the delivery will happen by taking a much more active role in the day-to-day activities of the project. This is *not* the most desirable outcome for a Project Manager wishing to be the master of his or her own project destiny.

Examining this scenario a little more closely, we can find the root cause. The sponsor/executive wants to take a more active role in ensuring the project has a higher likelihood of reaching its desired objectives because he or she believes that key project information, vital to making decisions about the project’s outcomes didn’t reach the decision maker(s). Clearly, this was a communications problem from the beginning. It truly doesn’t matter whether the Project Manager believes the project communications were effective or not. The sponsor/executive believes they were not, and is taking an active role as a result. Key deliverables were missed—and there had been plenty of opportunity to surface the issues relating to the absent scope elements.

So what can the Project Manager do to learn from this experience? Beyond learning how to manage the pain of embarrassment and lead the recovery process following the missed deliverable(s), the Project Manager should look carefully at root causes. So now would be a good time for the Project Manager to ask him or herself, “What is (frequently) the cause for this scenario?” The answer is fairly straightforward: poor communication and validation of changes to the approved scope, schedule, and feature/functionality.

When this occurs, the Project Manager very quickly realizes that the obvious solution to the problem exists within the project’s documentation.

Had the project’s WBS clearly articulated the project deliverables (internal, interim and endpoint) and outcomes, at each critical interval along the way to delivery, the Project Manager could have validated progress against the stated scope—represented by the WBS. When challenges to scope and schedule were presented to the sponsor and/or other stakeholders, using the Change Management process for the project, these could be balanced against the documented, agreed-upon scope and feature/functionality described by the WBS and explained by the project plan. In the absence of clear WBS deliverables and outcomes, these discussions are considerably more elusive and difficult.

For the Project Manager, it’s a lesson learned. For this discussion, the scenario becomes a template for defining critical success factors for scope management and communication. Those factors include a clearly articulated WBS, a scope management and scope control process (Change Management), and an effective communications process that will enable the Project Manager to articulate agreed-upon deliverables and the decisions that affect the schedule for completion of those deliverables.

It is essential for the Project Manager to find tools that will help communicate the frequency and impact of changes that follow the initiating and planning phases of the project—when the WBS is finalized and approved. If the WBS for the project was constructed so that it clearly defined the deliverables and outcomes for the project—including those that are transitional or temporary (interim) in nature, prepared for internal organizations as well as the end customer, then the Project Manager has at his or her fingertips a highly valuable tool. The WBS becomes the static document that can be referenced in an unemotional manner.

To avoid these project pitfalls, the WBS is used as a foundational building block for the initiating, planning, executing, and monitoring



and controlling processes and is central to the management of projects as they are described in the *PMBOK® Guide*—Third Edition. Typical examples of the contribution the WBS makes to other processes are described and elaborated in the *Practice Standard for Work Breakdown Structures*—Second Edition.

To explain, there are many project management tools and techniques that use the WBS or its components as input (*PMBOK® Guide*—Third Edition, Chapter 5, Section 5.3). For example, the WBS utilizes the **Project Charter** as its starting point. The high-level elements in the WBS should match, as closely as possible, the nouns used to describe the outcomes of the project in the **Project Scope Statement**. In addition, 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 **WBS Dictionary** defines, details, and clarifies the various elements of the WBS.

Transitioning from the WBS to the Project Schedule is discussed in Chapter 7 and takes a number of references from the chapter on Project Time Management of the *PMBOK® Guide*—Third Edition. **Activity Definition**, the starting point for project schedule development relies on the WBS for the decomposition process, beginning at the lowest level of the WBS—the Work Package, to produce relevant project tasks, activities and milestones. Activity Sequencing describes and illustrates the logical relationships between these tasks, activities and milestones and shows the dependencies and precedence for each, orienting them in a Project Schedule Network Diagram.

Whether you choose Arrow Diagram Method (ADM), where the activities are shown on arrows that link nodes of the network diagram (Activity On Arrow), or the Precedence Diagram Method (PDM) where the nodes represent the project's activities while the arrows depict dependencies between them (Activity On Node), the starting point for this process is the WBS, where the scope of the project has been carefully decomposed to the Work Package level.

The WBS is also used as a starting point for **Scope Management** and is integral to other Project Management processes, and as a result, the standards that define these processes explicitly or implicitly rely on the WBS. Standards that take advantage of the WBS either use the WBS as an input (e.g., PMI's *Practice Standard for Earned Value Management (EVM)* and the *Practice Standard for Scheduling* or incorporate the WBS as the preferred tool to develop the scope definition (e.g., the *PMBOK®*

*Guide*—Third Edition, *OPM3*®). Beyond this, other practices recognized world-wide frequently reference the WBS as the starting point for scope. These practices include Prince2, (Projects in Controlled Environments), CMMI (Capability Maturity Model Integration) and RUP, the (Rational Unified Process).

## WBS CONCEPTS

As we noted at the beginning of this chapter, the 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 WBS is decomposed into work packages.”

With this definition, it is clear the WBS provides an unambiguous statement of the objectives and deliverables of the work performed. It represents an explicit description of the project’s scope, deliverables and outcomes—the “what” of the project. The WBS is not a description of the processes followed to perform the project . . . nor does it address the schedule that defines how or when the deliverables will be produced. Rather, the WBS is specifically limited to describing and detailing the project’s outcomes or scope. The WBS is a foundational project management component, and as such is a critical input to other project management processes and deliverables such as activity definitions, project network diagrams, project and program schedules, performance reports, risk analysis and response, control tools or project organization.

## DESCRIBING THE WBS

The upper levels of the WBS typically reflect the major deliverable work areas of the project, decomposed into logical groupings of work. The content of the upper levels can vary, depending on the type of project and industry involved. The lower WBS elements provide appropriate detail and focus for support of project management processes, such as schedule development, cost estimating, resource allocation, and risk assessment. The lowest-level WBS components are called, as we’ve discussed earlier, Work Packages. The glossary definition for Work Package is, “A deliverable or project work component at the lowest level 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” (*PMBOK® Guide—Third Edition*, p. 380). These Work Packages define and contain the work to be performed and tracked. These can be later used as input to the scheduling process to support the elaboration of tasks, activities, resources and milestones which can be cost estimated, scheduled, monitored, and controlled.

Here are a few of the key characteristics of high-quality Work Breakdown Structures (*Practice Standard for Work Breakdown Structures—Second Edition*):

- A central attribute of the WBS is that it is “deliverable oriented” (Berg and Colenso (2000)). 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.” In this context, *oriented* means aligned or positioned with respect to deliverables (i.e., focused on deliverables).
- An additional key attribute of the WBS is that it is a “. . . hierarchical decomposition of the work . . .” Decomposition is “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 deliverables is defined in sufficient detail to support executing, monitoring, and controlling the work” (*PMBOK® Guide—Third Edition*, p. 358). This decomposition (or subdivision) clearly and comprehensively defines the scope of the project in terms of individual subdeliverables that the project participants can easily understand. The specific number of levels defined and elaborated for a specific project should be appropriate for effectively managing the work in question.
- The 100% Rule (Haugan, 2002, p. 17) is one of the most important principles guiding the development, decomposition, and evaluation of the WBS. This rule states that the WBS includes 100% of the work defined by the project scope and, by doing so, captures *all* deliverables—internal, external and interim—in terms of work to be completed, including project management. 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”. 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.

## THE HOUSE METAPHOR—A CONSISTENT EXAMPLE

Throughout the book, and from this point forward, we will be discussing the use of the WBS in the execution of projects. We will show how the WBS is designed and created during the Initiating and Planning phases, and we will describe and illuminate the ways in which the WBS is used as a basis for decision making throughout the remainder of the project, during project Executing, Monitoring and Controlling, and Closing.

With this in mind, we have developed a small example—a fictitious project WBS that we will refer to when we want to explain a concept or describe the application of a theory. This example—our House Construction WBS, is intentionally sparse and not precisely correct. We are using it as a metaphor for other, more complete Work Breakdown Structures.

Here, the House Metaphor will allow us to communicate key concepts and help articulate our dialog with you. When it becomes necessary, and to reinforce concepts we present in later chapters, we will use other WBS examples that are fully elaborated and complete. But when we do that, we will be reinforcing concepts we have presented previously, or showing how more than one concept is linked together in a larger WBS example.

As we begin, however, we'll have to ask you to join us in “suspending the disbelief” about the accuracy and design of the House Metaphor. If you are familiar with home construction or work in the construction industry, it is likely you will find plenty of reasons to challenge our example. In fact, if you are familiar with the development of Work Breakdown Structures, you will also likely find lots of opportunity to dissect the House Metaphor. For you to find value in the book, we want you to accept the House Metaphor as valid and agree to accept it as the example it is for describing concepts.

The House Metaphor in its most simple construction—the outline view is shown in Exhibit 1.2.

You will see this example many times throughout the book. We will use it in its complete form, we'll take excerpts from it, we'll represent it in other ways and we'll show you how this example relates to other project management processes by elaborating various parts of the House Metaphor. Whatever the case, we'll use this example as a thread, or series of breadcrumbs we will leave for you so you can always find the path through the book. Look for the House Metaphor, and just like that, you'll be back on the right track.

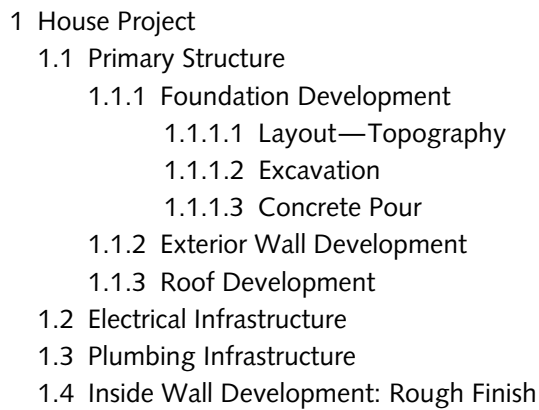
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Exhibit 1.2 House Metaphor—Outline Example

## CHAPTER SUMMARY

This chapter presents key topics regarding the history of the WBS and its application in projects, from early use and development with the U.S. Department of Defense and NASA (National Aeronautics and Space Administration) to the current application of Work Breakdown Structures in projects today.

Most importantly, this chapter introduces a number of fundamental truths about Work Breakdown Structures, including the significant evolution of the definition itself. This striking evolution shows how thinking about the WBS has progressed and advanced over the past forty years, from what was then a simple statement about its attributes . . .

- A “task-oriented family tree of activities”  
to what is now recognized internationally as the latest thinking about it’s utility and function,
- “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 WBS is decomposed into work packages. The deliverable orientation of the hierarchy includes both internal and external deliverables.”

This detailed and fully elaborated definition reflects the care that has been taken over the past four decades to explain and document the true function and role the WBS performs as a foundational building block for projects and programs.

Basic concepts, essential to understanding and effectively applying Work Breakdown Structures are presented in this chapter. First, we explain how each descending level of the WBS is accomplished through a process of decomposition to reach the lowest level of the WBS, the Work Package. We additionally introduce the 100% Rule guidance provided from a highly regarded authority on Work Breakdown Structures from the U.S. military. This concept along with a host of others is briefly discussed in this chapter. In later chapters, each of the concepts is elaborated in greater detail.

Finally, this chapter introduces a new concept and a few breadcrumbs to aid in the journey through WBS principles and practice. This series of breadcrumbs starts with the House Metaphor a fictitious example the authors have developed to establish a common path and theme throughout the book from Initiating and Planning through Executing, Monitoring and Controlling and finally Closing. The concepts presented throughout the book utilize this metaphor and rely on its simplicity to help guide the reader through a typical project lifecycle starting in this chapter and progressing through Chapter 10.

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**CHAPTER QUESTIONS**

1. According to current PMI standards, Work Breakdown Structures are:
  - a. Task-oriented
  - b. Process-oriented
  - c. Deliverable-oriented
  - d. Time-oriented
2. The elements at lowest level of the WBS are called \_\_\_\_\_.
  - a. Control Accounts
  - b. Work Packages
  - c. WBS deliverables
  - d. Lowest-level WBS elements
3. The \_\_\_\_\_ is utilized as the starting point for creating a WBS.
  - a. Preliminary Project Scope Statement
  - b. Product Scope Description
  - c. Final Product Scope Statement
  - d. Project Charter
4. Which of the following are key characteristics of high-quality Work Breakdown Structures? (Select all that apply.)
  - a. Task-oriented
  - b. Deliverable-oriented
  - c. Hierarchical
  - d. Includes only the end products, services or results of the project
  - e. Completely applies the 100% Rule
5. Who initially developed Work Breakdown Structures?
  - a. U.S. Department of Defense and NASA
  - b. Builders of the great pyramids of Egypt
  - c. Architects of the Roman Coliseum
  - d. Russian Space Agency