October 2000

Dear Professional Colleague,

Reference: Exposure Draft for Project Management Institute Practice Standard for Work Breakdown Structures

A Guide to the Project Management Body of Knowledge (*PMBOK® Guide*) has received widespread acclaim and serves as a reference for anyone interested in project management by focusing on knowledge and practices applicable to most projects most of the time. In fact, the *PMBOK® Guide* has become the de facto global standard for project management. And, its acceptance as an official project management standard is evidenced by its adoption by the American National Standards Institute as an American National Standard on 21 September 1999 and its prior adoption by The Institute of Electrical and Electronic Engineers (IEEE) as a project management standard for its profession.

Earlier this year in accord with the PMI Project Management Standards Setting Policy and Procedures, you reviewed and commented on an updated version of the *PMBOK® Guide* as an Exposure Draft. Comments and suggestions you made were reviewed by the update project team and used to improve the update which is currently in the publishing cycle.

PMI® volunteers have also been working on companion documents that would expand on the inputs, tools and techniques and outputs in the *PMBOK® Guide*. The first of those companion documents is now ready as an Exposure Draft. PMI volunteers, under the project leadership of Kim Colenso, PMP, have stepped forward once again to aid the profession by preparing the *Project Management Institute Practice Standard for Work Breakdown Structures*.

In accord with the PMI Project Management Standards Setting Policy and Procedures, the *Project Management Institute Practice Standard for Work Breakdown Structures* is available at this web site as an Exposure Draft for your review and comment. Your thorough review of the entire document, and your submission of any recommended additions, deletions, or corrections are encouraged. Please submit your comments by following the procedures and using the forms also available on this web site. Any suggestion(s) that you submit regarding this Exposure Draft will be reviewed carefully, and then you will be informed of the resultant decision.

Your support for PMI and the profession is appreciated.

With best professional regards,

Kim Colenso, PMP
Project Manager,
Project Management Institute
Practice Standard for Work Breakdown Structures

Steve Fahrenkrog, PMP
PMI Standards Manager

Project Management Institute Practice Standard for Work Breakdown Structures

Exposure Draft Version

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PROJECT MANAGEMENT INSTITUTE

Published by: Project Management Institute, Inc.
Four Campus Boulevard
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Phone: 610-356-4600 or Visit our website: www.pmi.org

The paper used in this book complies with the Permanent Paper Standard issued by the National Information Standards Organization (Z39.48—1984).

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Contents

Foreword

This *Practice Standard* provides guidance useful in the initial generation, further development, and application of Work Breakdown Structures (WBSs). The target audience for this standard includes project managers, contract personnel, and others who participate in the technical, schedule, financial, quality, and risk management of projects. In using this *Practice Standard*, it must be recognized that because projects vary, so may the resulting WBSs. Certain principles, however, may be considered universal. This document addresses those principles.

The *Practice Standard for Work Breakdown Structures* is consistent with the current release of *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide* 1996) except for the glossary, which has been updated to be consistent with the upcoming *PMBOK® Guide* 2000. The Work Breakdown Structure Practice Standard project team will update the rest of this practice standard to be consistent with the *PMBOK® Guide* 2000 while addressing comments from the exposure draft process. This practice standard will remain linked to future releases of the *PMBOK® Guide*. The Work Breakdown Structure Practice Standard project team has included additional information derived from generally accepted project management sources. The intent of the PMI Project Management Standards Program is to update the *Practice Standard for Work Breakdown Structures* periodically. Your comments are both requested and welcome. The *Practice Standard* presents guidelines for defining, developing, and maintaining WBSs during the initiating, planning, executing, controlling, and closing phases of a project. It is organized as follows:

Introduction	Introduces to the WBS concept.
What Is a WBS?	Defines the WBS and its characteristics.
Why Use a WBS?	Defines the benefits derived from using WBSs.

How to Create a WBS	Documents the steps required for building WBSs and presents guidelines for determining if the WBS is sufficient for subsequent planning and control.
Glossary	Provides clarification of key terms that exist in our profession, including those that have subtle or variable meanings depending on the organization and industry.
Appendices	Provides documented industry examples for use as guides. Each appendix represents an approach tailored to a specific purpose, application, or industry. Examples are in different stages of completion, and represent the evolutionary development of a WBS. None of the examples should be taken as the only *right* WBS for that type of project.

Preface

Evolution of the PMI *Practice Standard for Work Breakdown Structures*

During the development and subsequent publication by the Project Management Institute (PMI®) of *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, it was recognized that project management practitioners and other stakeholders would be aided by more in-depth treatment of the listed inputs, tools and techniques, and outputs. Consequently, in early 1998, the PMI Standards Committee asked for volunteers to develop the first such *practice standard* specifically on Work Breakdown Structures (WBSs). George Belev, a member of the PMI Standards Committee, was selected as the project manager. A volunteer team was assembled and during the year worked through a number of drafts and revision cycles.

In early 1999, the PMI Project Management Standards Program Team, successor to the PMI Standards Committee, reviewed the draft and recommended the completion of the document. At that point in time, George relinquished his project manager role in order to participate more fully on the PMI Project Management Standards Program Team as a member of the PMI Project Management Standards Program Member Advisory Group. George solicited a new project manager from among the other volunteers on the WBS Practice Standard Project Team.

In late spring 1999, Kim Colenso was approved as the new WBS Practice Standard Project Manager. The PMI Project Management Standards Program Team recommended that he form a new team to make minor modifications to the current draft, and add some example Work Breakdown Structures. The hope was that the WBS Practice Standard could go as an Exposure Draft to the PMI membership and other affected parties by the summer of 2000, and a final document could be published as a PMI Standard in 2001.

A team was assembled during the summer and fall of 1999 through solicitation of participation from the PMI Specific Interest Groups and other volunteer sources. During this period, a controversy developed

within the project team on whether or not an *activity* was or should be part of the WBS. Through further discussion among the project team and among the PMI Project Management Standards Program Member Advisory Group, the issue was resolved. An article describing the outcome was published in *PM Network* in April 2000. The project team implemented a formal change-control procedure to guide and control the evolution of the draft. This procedure required all proposed changes to be documented and approved by the project team. As a result of this process, the following events occurred:

- The specific working draft supplied to the new project team from the PMI Project Management Standards Program Team was judged to be unsatisfactory by the project team due to its structure. With the approval of the PMI Project Management Standards Program Team, that draft was replaced with an earlier one. The November 1998 draft was chosen, and all further changes were applied to that one.
- Over forty formal change requests were submitted and approved by the project team between October 1999 and April 2000. Another six were disapproved, as the arguments were deemed unpersuasive.
- Twelve examples of WBSs were approved and incorporated into the draft. They are included in the Appendices D through N of this document.

The resultant draft was submitted to the PMI Project Management Standards Program Team in May 2000 for consideration as an Exposure Draft to be circulated among PMI membership and other affected parties. Following approval by the PMI Project Management Standards Program Team, the proposed Exposure Draft was submitted for formal review to six other knowledge experts. The project team evaluated the comments from these six reviewers and the PMI Project Management Standards Program Team. A final draft was submitted to the PMI Project Management Standards Program Team and approved for the Exposure Draft.

Chapter 1 Introduction

Successful project management utilizes effective planning techniques to define the project objectives in sufficient detail to support effective management of the project. The Work Breakdown Structure (WBS) is the foundation for defining the project's work as it relates to the objectives and establishes a structure for managing the work to its completion. The WBS defines:

- the project's work in terms of activities that create deliverables
- the project's life-cycle process, in terms of process steps appropriate to that project and organization

and is the basis for establishing:

- all the effort/cost to be expended to create the deliverables and supporting processes
- the assigned responsibility for accomplishing and coordinating the work.

As a definition for use within this *Practice Standard for Work Breakdown Structures*, a project can be internally focused, externally focused, or both—while deliverables for these projects can take the form of products and/or services. Moreover, internally focused projects may produce deliverables as inputs to steps found later in the project, other individuals, or organizations within a company. Externally focused projects typically produce outputs and deliverables to people or organizations outside the company, such as customers or project sponsors. Many projects produce both internally and externally focused deliverables. A WBS is routinely prepared in all cases.

A WBS is considered a viable next step during the project initiation phase—when core scope information and key personnel assignments have been established. Beginning WBS development with limited scope data may lead to subsequent rework of the WBS, as additional information comes to light later in the project.

This *Practice Standard* provides insight into WBS development and application. Additionally, the *Practice Standard* has been prepared as a guide and should be used accordingly. It is expected that use of the principles found in this standard will improve the quality and usefulness of the WBS.

1.1 OBJECTIVE

This *Practice Standard's* primary objective is to provide a common ground for understanding the benefits and concepts of the WBS, and to present an improved application of the WBS as a project management tool. The intent is to encourage the consistent development of this tool, and as a result improve the planning and control of projects.

Chapter 2 What Is a Work Breakdown Structure?

2.1 COMMON USAGE OF TERMS

The following commonly used words have generally accepted meaning:

Work Sustained physical or mental effort to overcome obstacles and achieve an objective or result; a specific task, duty, function, or assignment often being a part or phase of some larger activity; something produced or accomplished by effort, exertion, or exercise of skill.

Breakdown To divide into parts or categories, to separate into simpler substances: to undergo decomposition.

Structure Something arranged in a definite pattern of organization.

These definitions imply that a Work Breakdown Structure (WBS) has the following characteristics:

- It is representative of work as an activity, and this work has a tangible result.
- It is arranged in a hierarchical structure.
- It has an objective or tangible result, which is referred to as a deliverable.

2.2 OVERVIEW

The WBS is the basis for dividing the project level scope into manageable, definable packages of work that balance the control needs of management with an appropriate and effective level of project data. The WBS defines the work in terms of the project life cycle, and defines the hierarchy of deliverables that will be created in order to achieve the

project objectives. The WBS can assist the project manager in developing a clear vision of the end product of the project and of the overall process by which it will be created.

The WBS provides the mechanism to translate project objectives into a supporting hierarchy of deliverables to be provided by the project. The WBS can be further partitioned (and deliverables subdivided) into finer divisions to aid in communication with stakeholders, and clearly identify accountability to the level of detail required for managing and controlling the project.

The WBS provides the mechanism to translate the project's objectives into deliverables to be provided by the project and the efforts needed to complete those deliveries. It defines the project in terms of hierarchically related product-oriented elements. Each element provides logical summary points for assessing performance accomplishments and for measuring cost and schedule performance. The WBS can then be further subdivided into supporting deliverables with finer divisions of effort to aid in understanding and provide clarity of action for those required to complete the project objectives. Whenever work is structured, easily identifiable, and clearly within the capabilities of individuals, there will be a high degree of confidence that the objectives associated with that work can—and will—be achieved.

2.2.1 WBS Overview: Deliverables

A deliverable as defined in the *PMBOK® Guide* is:

> Any measurable, tangible, verifiable outcome, result or item that must be produced to complete a project or part of a 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 (*PMBOK® Guide* 1996).

As an integral concept in the definition of a WBS, it is important to understand the broad context of a deliverable and how a WBS can be used in that broad context. In addition, the WBS provides the foundation for subsequently integrating the work package details and deliverables with all other aspects of project initiating, planning, controlling, executing, and closing

2.2.2 WBS Overview: Communications

The WBS facilitates communication of information regarding project progress and performance between the project manager and stakeholders throughout the life of the project. Project stakeholders include all who directly participate or have an interest in the outcome of the project, and include but are not limited to:

- Project Manager
- Project Team Members
- Customers
- Suppliers
- Management
- Regulators
- The Public/Community
- Sponsors and Owners.

2.2.3 WBS Overview: Design

A well-developed 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 and instrumental to the success of the project.

The WBS:

- 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 that the project participants and project customers can understand.
- Supports documenting the accountability and responsibility for the various deliverables by having the WBS elements related to the Organizational Breakdown Structure (OBS) through the Responsibility Assignment Matrix (RAM).

The WBS provides a structure for organizing the scope and subsequent information of the project's progress, periodic status, and projected performance for which a project manager is responsible. The WBS also supports tracking problems to their root causes to assist the project manager in identifying and implementing changes necessary to assure desired performance.

2.2.4 WBS Overview: Reporting

The WBS can provide different perspectives of the project status. For example, by:

- Life Cycle Phase
- Deliverable
- Work Package
- All of the above compared to past similarly structured projects
- All of the above relative to cost, schedule, risk, scope, and quality perspectives.

2.2.5 WBS Overview: Management

The WBS supports effective management in several ways during the life of a project. It:

- Separates the deliverable into its component parts (This ensures that the project schedule matches the approved project scope and is targeted to fulfill the overall objectives of the project.)
- Supports planning and the assignment of responsibilities
- Supports tracking the status of resource allocations, cost estimates, expenditures, and performance
- Supports the decomposition into simpler components, providing one of the primary methods for handling complex projects
- Assists in determining resource requirements (i.e., skills, characteristics, and so on).

2.2.6 WBS Overview: Organizational

The WBS provides the ability to relate the work defined to responsible 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.

2.2.7 WBS Overview: Levels

While in some application areas the WBS has frequently consisted of a three-level hierarchy describing the entire effort to be accomplished by the primary organization, that number may not be appropriate for all situations. 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. The WBS is intended to provide a clear statement of the technical objectives and the deliverables of the work to be performed. The elements should represent identifiable work products (e.g., equipment, data, and services) encompassing the work to be performed by all parties. The WBS includes all work done by the primary organization, as well as contracted organizations.

2.3 SUMMARY

In summary, the WBS:

- Defines the hierarchy of deliverables
- Includes all work effort required to achieve an end objective or deliverable(s)

- Is developed by dividing the deliverables into identifiable and measurable elements
- Provides the framework for all deliverables across the project life cycle
- Provides a vehicle for integrating and assessing technical, schedule, and cost performance.

The WBS provides a framework for specifying performance objectives by defining the project in terms of hierarchically related deliverables and the work processes required for their completion. Each WBS element represents a logical summary point for evaluating and measuring accomplishment, as well as cost and schedule performance associated with attaining the project objectives.

Chapter 3 Why Use a Work Breakdown Structure?

The *PMBOK® Guide* lists the Work Breakdown Structure (WBS) as the output of project scope definition (*PMBOK® Guide* 1996, 54). It defines project scope management as: "the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully (47)." Based on this definition, the WBS has two goals:

1. To ensure that the project includes all the work needed
2. To ensure that the project includes no unnecessary work.

Both of these goals are of great concern to the project manager. If necessary work is omitted, the project will be delayed and may experience cost overruns. If unnecessary work is performed, the customer's money will be wasted. If the WBS does not meet either of these two goals, the project may fail.

Figure 3-5 of the *PMBOK® Guide* (reproduced in part and modified here) illustrates how the entire project plan pivots on the WBS. The WBS is the primary input to four core processes and one facilitating process:

1. Activity Definition
2. Resource Planning
3. Cost Estimating
4. Cost Budgeting
5. Risk Identification.

As Figure 3-5 of the *PMBOK® Guide* illustrates, the entire project plan builds on these processes. This makes the WBS the foundation of:

- *The Entire Project Plan*—The WBS provides the basis for integrated scope, cost, schedule, and risk planning. It also provides the means for utilizing project management software to its full capability.
- *Performance Reporting*—The WBS organizes monitoring processes, as well as the cost and schedule performance metrics associated with the work.

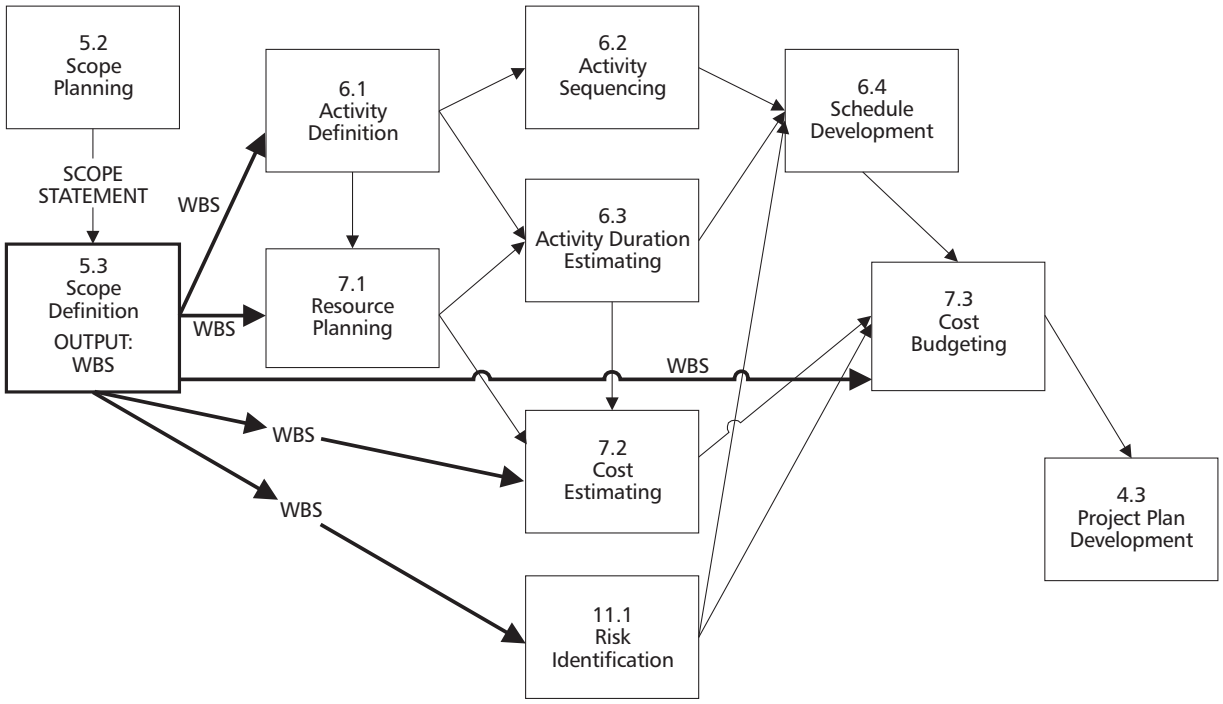


Figure 3.5 with WBS Interactions (*PMBOK® Guide* 1996)

- *Overall Change Control*—The WBS provides for the identification of suitable management control points that are utilized to facilitate communication and control scope, quality, technical soundness, schedule, and cost performance.
- *Product Scope Management*—The WBS development process facilitates conceptualization and definition of product details.

Successful project management depends on the project manager's ability to effectively direct the project team by specifying the work contents of the project in terms of its deliverables. Through the WBS, work is structured and directly related to the schedule, and the resources are allocated and tracked.

Chapter 4 How to Create a Work Breakdown Structure

The Work Breakdown Structure (WBS) can be created new, or it can reuse components from other Work Breakdown Structures. When reusing existing components, WBS elements may be drawn from previous similar projects or from standard project templates that the organization has determined support accepted best practices.

The following sections in this chapter are presented as guides for use during the development of a WBS, and contain a number of topics for consideration: 4.1 contains Basic Assumptions or Factors; 4.2 includes Project Challenges for consideration; 4.3.1 is an aid for determining Appropriate Level of Detail; 4.4 discusses WBS Life-Cycle Considerations; 4.5.1 addresses Risk Assessment; and 4.6.1 is a guide for use when considering Resource Planning. The sections can be used as checklists for the development and refinement of the WBS.

4.1 FACTORS TO BE CONSIDERED

In developing a WBS, the following basic assumptions should be considered:

- Each element in the WBS should represent a single tangible deliverable.
- Each element of the WBS should represent an aggregation of all subordinate elements listed immediately below it.
- The deliverables should be logically subdivided to the level that represents how they will be obtained (designed, purchased, subcontracted, fabricated). The partitioning of deliverables from higher levels within the WBS to lower levels must be logically related.
- Deliverable components must be unique and distinct from their peer components, and should be subdivided to the level of detail needed to successfully plan and manage the work related to obtaining or creating them.

- The WBS development process should provide a vehicle for flexibility, particularly when the scope of the project effort may 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.
- Each entry in the WBS representing subcontracted or externally committed deliverables should directly correspond to matching entries in the subcontractor's WBS.
- All deliverables are explicitly included in the WBS.
- All significant reporting elements (e.g., review meetings, monthly reports, test reports, and so on) are included and identified in the WBS.
- All activities should be compatible with organizational and accounting structures.
- Deliverables should be clearly defined to eliminate duplication of effort within WBS elements, across organizations, or between individuals responsible for completing the work.
- Deliverables should be limited in size and defined for effective control—but not so small as to make cost of control excessive.

4.2 CHALLENGES TO BE CONSIDERED

Challenges associated with developing Work Breakdown Structures include:

- Developing a WBS that defines a logical relationship between all the elements of the project. This is generally clarified through the use of a dependency network.
- Balancing the project definition aspects of the WBS with the data collecting and reporting requirements. (Remember that the primary purpose of the WBS is to define the project's scope.) 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 may require unrealistic levels of maintenance and reporting.
- Preventing the omission of WBS development and proceeding directly to the network diagram (such as a Gantt chart, CPM Schedule, or Precedence Diagram). This may lead to unforeseen and unexpected difficulty, including project delay.
- Avoiding the creation of WBS entries that define only process-stage or organizational-focused activities. WBS entries that are not deliver-

able focused may lead to project cost overrun and/or failure, as they are difficult to estimate and track progress against.
- Defining WBS entries representing opening and closing elements such as planning, assembly, and shakedown.
- Identifying and detailing all key project deliverables (e.g., regulatory permits, packaging, distribution, or marketing).
- Defining all work assigned to stakeholders.
- Ensuring against the inclusion of WBS elements that define overlapping responsibilities for the creation of a deliverable(s).
- Developing a WBS with too much or not enough detail.
- Identifying key project management deliverables such as process management, services and provisioning, information/communication, administrative documentation, training, and software. These should be defined as level-of-effort activities where they do not generate a discrete deliverable.

4.3 DETERMINING APPROPRIATE WBS LEVEL OF DETAIL

The WBS development process has been described as proceeding to successive levels of increasing detail until a level is reached that provides the needed insight for effective management. This can be summarized in the checklist in Section 4.3.1, which provides guidance for determining the need for further decomposition of the work. If the answers to most of the items in the checklist are positive, then further decomposition should be considered. The greater the number of positive answers to the questions in Section 4.3.1, the stronger the justification for further division of some or all of the WBS.

4.3.1 Determining Appropriate WBS Level of Detail

Should the WBS be decomposed further?
- Is there a need to improve the accuracy of the cost and duration estimates of the WBS element?
- Is more than one individual or group responsible for the WBS element? While there may be a variety of resources assigned to a WBS element, there should be one individual assigned overall responsibility for the deliverable created during the WBS element activity.
- Does the work element content include more than one type of work process or more than one deliverable?
- Is there a need to precisely know the timing of work processes internal to the work element?

- Is there a need to define separately the cost of work processes or deliverables internal to the work element?
- Are there dependencies between internal work-element deliverables and other external work elements?
- Are there significant time gaps in the execution of the work processes internal to the work element?
- Do resource requirements change over time within a work element?
- Do prerequisites differ among internal deliverables within the work element?
- Are there clear, objective criteria for measuring progress for the work element?
- Are there acceptance criteria applicable before the completion of the entire work element?
- Are there specific risks that require focused attention to a portion of the work element, requiring further division to separate them?
- Can a portion of the work to be performed within the work element be scheduled as a unit?
- Is the work element understood clearly and completely to the satisfaction of the Planner, the Doer(s), and the Customer?

As identified earlier, the level of the detail in a WBS is a function of the size and a balance between complexity, risk, and the project manager's need for control. The level of detail also may vary during the evolution of a project.

Short-duration projects may lend themselves to decomposition to appropriate levels of detail at the outset, while projects of longer duration and higher complexity may preclude decomposition of all deliverables until further in the future. Again, this may mean that on any given project, some portions of the WBS may have different levels of decomposition. This is especially true when doing a *rolling plan*, where the plan is detailed for the immediately upcoming work only, and work far in the future is defined at a high level until later in the project life cycle.

4.4 WBS LIFE-CYCLE CONSIDERATIONS

Decomposition of complex requirements into simpler components provides one of the primary methods for handling complex projects. WBS development is the technique for accomplishing this decomposition. In structuring the WBS, one must look to the future and determine how the work will be accomplished and managed. The WBS should reflect this structure. In addition to strict end-product identification, the WBS may also reflect level-of-effort functions such as project management

activities and life-cycle timing (project phases). These elements should only be used, however, as necessary to organize the work tasks. Remember that each of the lowest-level WBS elements should reflect work with specific tangible deliverables.

4.5 THE RELATIONSHIP BETWEEN PROJECT RISK AND THE WBS

For projects with highly related risk factors, a more detailed WBS is strongly suggested. The risk events—events that might have a detrimental impact on the project—are evaluated to identify and characterize specific risks.

Project risk is related to the likelihood of events positively or adversely affecting project objectives, including key elements such as technical design, quality, cost, and schedule. The WBS decomposition approach may assist in risk identification and mitigation. For instance, projects that require permits and approvals from regulatory authorities can be high risk. Since risk can impact several WBS elements, it would be prudent for the project manager to perform impact analyses against all WBS elements, thus isolating the risks, providing for individual treatment, and permitting more effective focus for risk management.

The first step in this technique is to review the WBS elements to the level being considered and segment them into risk events. This review should consider the critical areas (design and engineering, technology, logistics, and so on) and elements that may help to describe risk events. Using information from a variety of sources such as program plans, prior risk assessments, expert interviews, and the like, the risk events are examined to identify specific risks in each critical area. They are then analyzed to determine probability of occurrence, severity of consequence (impact), and interdependency.

The risks associated with an effort may also define the level of detail necessary. Additional detail in high-risk areas provides for better assumption definition, as well as for improved cost estimates and time assessment. This forced structuring provides an opportunity to define the assumptions and expectations at a controllable level.

A method for incorporating risk planning directly into the WBS is defining contingency activities as successors to the risk-impacted activities. The duration of the contingency activities are set to compensate for the degree of uncertainty and potential impact of the risk event. As an example, a permit-contingency activity could be created as a successor to the permit-application activity. The duration of the permit-application

activity is set to the normal time period expected for a permit application, and the duration of the contingency activity is set to reflect the probability and impact of the risk of delay.

4.5.1 The Relationship between Project Risk and the WBS

The following questions should be addressed for each WBS element when considering project risk:

- Is the technology changing faster than the project can be accomplished?
- Are the deliverables completely and clearly defined?
- Will the quality of the work be evaluated through testing and inspection?
- What is the likelihood of change?
- Have manpower, facilities capability, availability of internal resources, and potential suppliers been checked?
- Is extensive subcontracting expected?
- Is management committed to the project, and will it provide the support needed?
- Are requirements defined and approved?
- Has a formal change process been defined and implemented?
- Have the metrics been defined for how the deliverables will be measured for success?
- Have the resource requirements been identified for the development of the project deliverables?
- Have the risks of buy-in, public relations, management approval, team understanding, and so on been identified?

4.6 THE RELATIONSHIP BETWEEN RESOURCE PLANNING AND MANAGEMENT AND THE WBS

The WBS is decomposed to the level necessary to plan and manage. Normally this will be at least one level below the reporting requirements—one that allows for the effective planning, control, and performance measurement of discrete activities with uniquely identifiable resources.

Although full resource identification will come later in the planning process, it can be useful to understand in general how that will be done, and ensure that the level of detail in your WBS will support those efforts.

4.6.1 Resource Planning and Management

In order to prepare for adequate resource planning against the WBS, consider the following when examining the level of detail in your WBS:

- Is all the work planned to the degree of detail necessary to make and keep commitments?
- Is there an ability to establish and manage individual work assignments with the reporting structure indicated by this WBS?
- Can work assignments be established from a progressive expansion of the WBS? Has it been validated top-down as well as bottom-up?
- How will work generally be assigned and controlled?
- Will individual work assignments have the ability to be reconciled to the formal scheduling system?
- How will budgets be established?
- Will it be possible to relate budget to these proposed increments of work?
- Are the basic increments of work being measured of reasonable size (i.e., the level of detail in the WBS is appropriate for effective planning and control)?
- Is it a logical aggregation of individual work tasks (i.e., is the work defined by the WBS grouped in a logical manner)?
- Is more than one organization involved (indicating the need to validate the WBS with others before doing detailed resource planning)?
- How will the status of work in process be determined?

4.7 PREPARING A WBS

The WBS evolves through iterative consideration of the project's purpose and objectives, functional/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 be developed.

The following steps describe the general process for developing a WBS:

- The *first step* is to identify the final products of the project—what must be delivered to achieve project success. It is always a good idea to review the high-level project scope documents for guidance.
- The *second step* is to identify the major deliverables necessary to meet the final products. Often these major deliverables are predecessor deliverables that are needed to build what has been committed to, but that in themselves do not satisfy a business need (i.e., a design specification).

- The *third step* is to incorporate additional levels of work detail appropriate for management insight and integrated control. These elements normally tie to clear and discrete identification of stand-alone deliverable products.
- The *fourth step* is to review and refine the WBS until project stakeholders agree that project planning can be successfully completed and that managing, monitoring, and control will successfully produce the desired outcomes.

4.8 CLOSING SUGGESTIONS

Once a WBS is completed, detailed technical objectives can be defined and specified work activities can be assigned to organizational resources. This interrelationship among the specification requirements, the WBS, the statement of work, resource plans, and the master and detailed schedules provide specific information relative to the relationship between cost, schedule, and performance.

The WBS can assist the project manager in developing a clear vision of the end product of the project and of the overall project by which it will be created. With this in mind, the following should stimulate thought when developing a WBS to handle and manage the project:

- Think through the entire project. (Look at dividing high-level deliverables.)
- Think deliverables. (What is to be provided/what is required?)
- Think with the end in mind. (How will this element contribute to the finished deliverable?)

Do you have the vision of the final product in your mind? What are its constituent parts? How do the pieces work together? What needs to be done? These thoughts are intended to provide a clear statement of what is the product of the project—and to answer the question, "How do you eat an elephant?" Answer: "One bite at a time!" The WBS is the technique for dividing "the elephant" into bite-sized pieces. Once the WBS is developed, it is important that the management involved in the project know "how things are going" as they are going. In this regard:

- Think performance measurements. (What are the gates, intermediate milestones?)
- Think metrics. (How will you measure? Know it when you see it? How does the customer define success?)
- When will you know that you are done?

It is suggested that project management activities foster measurement of work accomplishment as opposed to goal achievement by providing

an integrated view across programmatic elements. Proper linking between WBS and associated cost and schedule is critical if integrated analysis between cost, schedule, and performance is to be accomplished. In doing so, the project manager should keep the following in mind:

- Cost and schedule impacts can only be determined if there is a clear link between performance parameters and budgeted work packages via the WBS. This activity is accomplished in order to obtain a "performance budget baseline" or the budget associated with the work packages that are responsible for a particular performance parameter's developmental success.
- All work in the WBS must be estimated, resourced, scheduled, budgeted, and controlled. The WBS has two parts: the structure and the element definition. It is the mechanism that divides and organizes the work scope into units of work such that each unit can be estimated, resourced, scheduled, budgeted, and controlled while progress is reported.
- Where there is a clear link between performance parameters and budgeted work packages via the WBS, the linkage should be made at a high level within the WBS. All work packages can be associated with the performance parameters.
- The identification and tracking of performance metrics in a disciplined and systematic fashion provide significant early warning of potential problems and their nature.

Chapter 5 Glossary

Activity: An element of work performed during the course of a project. An activity normally has an expected duration, an expected cost, and expected resource requirements. Activities can be subdivided into tasks.

Customer: The individual or group that has requested, that is the recipient, or who is paying for the deliverable(s). This could be an internal department, someone in management, an external organization, and so on.

Decomposition: Decomposition involves subdividing the major project deliverables into smaller, more manageable components until the deliverables are defined in sufficient detail to support future project activities (planning, executing, controlling, and closing).

Deliverable: Any measurable, tangible, verifiable outcome, result, or item that must be produced to complete a project or part of a 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.

Organizational Breakdown Structure (OBS): A depiction of the project organization arranged so as to relate **work packages** to organizational units.

Phase: See **Project Phase**.

Project Phase: A collection of logically related project activities, usually culminating in the completion of a major **deliverable**.

Responsibility Assignment Matrix (RAM): A structure that relates the project organization structure to the **Work Breakdown Structure** to help ensure that each element of the project's scope of work is assigned to a responsible individual.

Risk Event: A discrete occurrence that may affect the project for better or worse.

Scope: The sum of the products and services to be provided as a project.

Scope Change: Any change to the project scope. A scope change almost always requires an adjustment to the project cost or schedule.

Stakeholder: Individuals and organizations who are involved in or who may be affected by project activities.

Statement of Work (SOW): A narrative description of products or services to be supplied under contract.

Task: A generic term for work that is not included in the **Work Breakdown Structure**, but potentially could be a further decomposition of work by the individuals responsible for that work. Also, lowest level of effort on a project.

Work Breakdown Structure (WBS): A deliverable-oriented grouping of project elements that organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of the project work.

Work Breakdown Structure Dictionary: A document that describes each **WBS** element, including scope, deliverable(s), specification, schedule, resource requirements, and so on.

Work Breakdown Structure Element: An entry in the **WBS** that can be at any level.

Work Package: A deliverable at the lowest level of the **WBS**, when that deliverable may be assigned to another project manager to plan and execute. This may be accomplished through the use of a subproject where the work package may be further decomposed into activities.

Chapter 6 References

PMI Standards Committee. 1996. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. Upper Darby, PA: Project Management Institute, pp. 47, 54.

Youker, Robert. 1990. A New Look at Work Breakdown Structure (WBS). PMI Seminars/Symposium, Calgary, Alberta, Canada.

Appendix A The Project Management Institute Standards-Setting Process

The PMI Standards-Setting Process was established initially as Institute policy by a vote of the Project Management Institute (PMI) Board of Directors at its October 1993 meeting. In March 1998, the PMI Board of Directors approved modifications to the process. Then in March 1999, it was modified again to make it consistent with the concurrent change in PMI governance procedures, approved by the PMI Executive Director, and provided to the PMI Board of Directors.

A.1 PMI Standards Documents

PMI Standards Documents are those developed or published by PMI that describe generally accepted practices of project management, specifically:

- *A Guide to the Project Management Body of Knowledge* (*PMBOK® Guide*)
- Project Management Body of Knowledge Handbooks.

Additional documents may be added to this list by the PMI Standards Manager, subject to the advice and consent of the PMI Project Management Standards Program Member Advisory Group and the PMI Executive Director. Standards Documents may be original works published by PMI, or they may be publications of other organizations or individuals.

Standards Documents will be developed in accordance with the Code of Good Practice for Standardization developed by the International Organization for Standardization (ISO) and the standards development guidelines established by the American National Standards Institute.

A.2 Development of Original Works

Standards Documents that are original works developed by PMI, or revisions of such documents, will be handled as follows:

- Prospective developer(s) will submit a proposal to the PMI Standards Manager. The Manager may also request such proposals. The Manager will submit all received proposals to the PMI Standards Program

Member Advisory Group who, with the Manager, will decide whether to accept or reject each proposal.

- The Manager will inform the prospective developer(s) as to the decision and the rationale for the decision. If an approved proposal requires funding in excess of that budgeted for standards development, the Manager will submit the proposal to the PMI Executive Director for funding.
- For all approved and funded proposals, the Manager will support the developer's efforts so as to maximize the probability that the end product will be accepted. Developer(s) will be required to sign the PMI Volunteer Assignment of Copyright.
- When the proposed material has been completed to the satisfaction of the developer(s), the developer(s) will submit the material to the PMI Standards Manager. The PMI Standards Program Member Advisory Group, with the Manager, will review the proposed material and decide whether to initiate further review by knowledgeable individuals or request additional work by the developer(s).
- The Manager will appoint, subject to review and approval by the PMI Standards Program Member Advisory Group, at least three knowledgeable individuals to review and comment on the material. Based on comments received, the Member Advisory Group will decide whether to accept the material as an *Exposure Draft*.
- The PMI Standards Manager will develop a plan for obtaining appropriate public review for each *Exposure Draft*. The plan will include a) a review period of not less than one month and not more than six months, b) announcement of the availability of the *Exposure Draft* for review in the *PM Network* (and/or any other similarly appropriate publication media), and c) cost of review copies. The PMI Standards Program Member Advisory Group must approve the Manager's plan for public review. Each *Exposure Draft* will include a notice asking for comments to be sent to the PMI Standards Manager at the PMI Headquarters and noting the length of and expiration date for the review period.
- *Exposure Drafts* will be published under the aegis of the PMI Publishing Division and must meet the standards of that group regarding typography and style.
- During the review period, the Manager will solicit the formal input of the Managers of other PMI Programs (e.g., Certification, Education, Components, and Publishing) that may be affected by the future publication of the material as a PMI Standard.
- At the conclusion of the review period, the PMI Standards Manager will review comments received with the PMI Standards Program

Member Advisory Group and will work with the developer(s) and others as needed to incorporate appropriate comments. If the comments are major, the PMI Standards Program Member Advisory Group may elect to repeat the *Exposure Draft* review process.

- When the PMI Standards Manager and the PMI Standards Program Member Advisory Group have approved a proposed PMI Standards Document, the Manager will promptly submit the document to the PMI Executive Director for final review and approval. The PMI Executive Director will verify compliance with procedures and ensure that member input was sufficient. PMI Executive Director will a) approve the document as submitted; b) reject the document; or c) request additional review, and will provide explanatory comments in support of the chosen option.

A.3 Adoption of NonOriginal Works as Standards

Standards Documents that are the work of other organizations or individuals will be handled as follows:

- Any person or organization may submit a request to the PMI Standards Manager to consider a non-PMI publication as a PMI Standard. The Manager will submit all proposals received to the PMI Standards Program Member Advisory Group who, with the Manager, will decide whether to accept or reject each proposal. If accepted, the Manager will appoint, subject to review and approval by the PMI Standards Program Member Advisory Group, at least three knowledgeable individuals to review and comment on the material.
- During the review period, the Manager will solicit the formal input of the Managers of other PMI Programs (e.g., Certification, Education, Components, and Publishing) that may be affected by the future publication of the material as a PMI Standard.
- Based on comments received, the Member Advisory Group, with the Manager, will decide whether to a) accept the proposal as written as a PMI Standard, b) accept the proposal with modifications and/or an addendum as a PMI Standard, c) seek further review and comment on the proposal (that is, additional reviewers and/or issuance as an *Exposure Draft*), or d) reject the proposal. The Manager will inform the submitter as to the decision and the rationale for the decision.
- When the PMI Standards Manager and the PMI Standards Program Member Advisory Group have approved a proposed PMI Standards Document, the Manager will promptly submit the document to the PMI Executive Director for final review and approval. The Manager will prepare a proposal for the PMI Executive Director for consideration of a prospective relationship with the owner(s) of the material.

- The PMI Executive Director will verify compliance with procedures and will ensure that member input was sufficient. The PMI Executive Director will a) approve the document as submitted; b) reject the document; or c) request additional review, and will provide explanatory comments in support of the chosen option.

Appendix B Guidelines for a PMI Practice Standard

- Each practice standard provides guidelines on the mechanics (e.g., *nuts and bolts*, basics, fundamentals, step-by-step usage guide, how it operates, how to do it) of some significant process (input, tool, technique, or output) that is relevant to a project manager.
- A practice standard does not necessarily mirror the life-cycle phases of many projects. But, an individual practice standard may be applicable to the completion of one or more phases within a project.
- A practice standard does not necessarily mirror the knowledge areas within *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, although an individual practice standard will provide sufficient detail and background for one or more of the inputs, tools and techniques, and/or outputs. Therefore, practice standards are not required to use the name of any knowledge area. However, to establish a firm relationship to the *PMBOK® Guide*, where applicable or practicable, the practice standard section or clause shall reference the relevant *PMBOK® Guide* section or clause.
- Each practice standard should include information on *what* the significant process is and does, *why* it is significant, *how* to perform it, *when* it should be performed and, if necessary for further clarification, *who* should perform it.
- Each practice standard should include information that is accepted and applicable for most projects most of the time within the project management community. Processes that are generally restricted or applicable to one industry, country, or companion profession (i.e., an application area) may be included as an appendix for informational purpose, rather than part of the practice standard. With strong support and evidence, an application area specific process may be considered as an *extension* practice standard in the same manner as extensions to the *PMBOK® Guide* are considered.

- Each practice standard will benefit from the inclusion of examples and templates. It is best when an example or template includes a discussion of its strengths and weaknesses. A background description may be necessary to put this discussion in the appropriate context. The examples should be aligned with the relevant information in the standard or its appendix and placed in close proximity to that information.
- Each practice standard will be written in the same general style and format.
- Each practice standard project will assess the need to align with or reference other practice standards.
- Each practice standard will be consistent with the *PMBOK® Guide.*
- Each practice standard is intended to be more prescriptive than the *PMBOK® Guide.*

Appendix C Contributors and Reviewers

1998 Project Team

Contributors

- George Belev, Knolls Atomic Power Laboratory, WBS Practice Standard Project Manager
- Ed Kilner, PMP, Project Solutions Unlimited
- Kim Colenso, PMP, Blue Cross Blue Shield of Colorado

Reviewers

- William R. Duncan, PMP, Duncan • Nevision, PMI Director of Standards

1999/2000 Project Team

Contributors

- Kim Colenso, Artemis Management Systems, WBS Practice Standard Project Manager
- Ron Stein, ARCADIS, Environmental Management WBS Example Team Leader
- Nigel Blampied, California Department of Transportation
- Wayne Stottler, Kepner-Tregoe
- Ben Voivedich
- Ed Smith, Sun Microsystems, Inc.
- Eric S. Norman, Getronics Inc.
- Robert Youker, World Bank, Retired
- Mikkel Hansen, Texaco Upstream Technology, OGP WBS Example Team Leader
- Nathan Lewis, Eli Lilly and Company, Pharmaceutical WBS Example Team Leader

- Dr. Jann Nielsen, Eli Lilly and Company (contributed to WBS example)
- Dr. Jim McDonough, Eli Lilly and Company (contributed to WBS example)

Reviewers

- Allan Mikoff, Project Management Resources, WBS Example Review Team Leader
- Kim-Mei Lim, Unisys Msc Sdn Bhd
- John Schlicter, The Weather Channel
- Jim Peters, SoftwareMatters.com, Inc.
- Rick Trites, Human Resources Development Canada
- Carl Wetzel, Shell Services International, Inc
- Wesley Sturgis
- Janet Murray, USAA Federal Savings Bank
- Stephen Mattera, Nokia
- Margery Cruise, Cruise 8 Associates
- Monica Rousset, American General Life
- John Waterbury, Fleet Bank
- James W. Parcels, Commonwealth of Pennsylvania
- Darrel G. Hubbard, MACTEC, Inc.
- E. N. Friesen, Seagull Consulting
- Linda Salac, State of Nebraska Health & Human Services
- Wayne Abba
- Neil F. Albert, GRC International, MCR Federal, Inc.

PMI '99 Standards Session Volunteers

The following individuals worked in a team setting during the PMI '99 Standards Program Open Working Session to create example Work Breakdown Structures. These were used as delivered by the team members or as the basis for several of the examples that appear in this document.

- Robert Trafton, Merant
- Eric S. Norman, Getronics Inc.
- Connie Inman, Encore Development
- Dean A. Hoffer, Fermi National Accelerator Laboratory
- Scott Freauf, PMSI - Project Mentors
- Warren Nogaki, JPL/Caltech
- Margery J. Cruise, SPMgroup Ltd.
- Darrell Hubbard, MACTEC, Inc.
- James W. Parcels, Commonwealth of Pennsylvania
- Dr. Al Zeitoun, International Institute for Learning, Inc.
- Craig Garvin, IT Corporation

- Ed Smith, Sun Microsystems, Inc.
- Bradford Nelson, Lockheed Martin Federal Systems

PMI Research Program Member Advisory Group

- George Belev, Knolls Atomic Power Laboratory
- Cindy Berg, PMP, Medtronic Micro-Rel
- Sergio Coronado Arrechedera, MicroStrategy
- Judy A. Doll, PMP, G. D. Searle, Inc.
- J. Brian Hobbs, PMP, University of Quebec at Montreal
- David Hotchkiss, PMP, Nexgenix

Selected Reviewers of Pre-Exposure Draft

These volunteers provided specific evaluations and comments on the pre-exposure draft. The project team and the PMI Standards Program Team considered their input in the development of the *Exposure Draft*.

- William Bahnmaier, US DoD Defense Systems Management College
- Don Campbell, Horne Engineering Services
- Scott Campbell, PMP, DMR Consulting
- Fred Manzer, PMP, Welkin Associates
- Regina Santarcangelo, PMP, SoftKey, Inc.
- Max Smith, Compaq Computer Corporation

PMI Standards Program Headquarters Staff

- Steven Fahrenkrog, PMP, PMI Standards Manager
- Eva Goldman, PMI Technical Research & Standards Associate
- Iesha Turner-Brown, PMI Standards Associate

PMI Publishing Division Production Staff

- John McHugh, PMI Interim Publisher
- Dewey Messer, PMI Design and Production Manager
- Michelle Owen, PMI Graphic Designer
- Toni Knott, PMI Editor, Book Division
- Lisa Fisher, PMI Assistant Editor

Appendix D Oil, Gas, and Petrochemical (OGP) WBS Example

Production Platform Example

This is an example of a Work Breakdown Structure (WBS), from the owner's point of view, for the detailed design, fabrication, and installation of an offshore production platform. As the detailed engineering, fabrication, and installation are distinct phases of the work, these are placed at level 1 of the WBS. This fits with the progression of the work, but also with the contracting strategy; i.e., you may have different contractors for engineering, for fabrication, and so on.

1.0 PROJECT MANAGEMENT

- ***1.1 Project Management***
  - 1.1.1 Project Direction and Procedures
  - 1.1.2 Project Planning & Scheduling and Cost
  - 1.1.3 Progress Reports, Monthly Reports, etc.
- ***1.2 Project Control***
  - 1.2.1 Document Control
  - 1.2.2 Interface Control

2.0 DETAILED ENGINEERING

- ***2.1 General***
  - 2.1.1 Audit by and Contractor's Acceptance of Preliminary Engineering
  - 2.1.2 Design Basis and Specifications
  - 2.1.3 Calculations and Engineering Data Books
  - 2.1.4 Summary Reports
  - 2.1.5 Platform Equipment Manuals

*2.2 **Jacket***

2.2.1 Structural Engineering & Drafting

- Jacket In-Service Analyses
- Jacket Pre-Service Analyses
- Jacket Design Details
- Jacket Cathodic Protection
- Jacket Weights and Material Takeoffs
- Jacket Approved for Construction Drawings
- Jacket Detailed Engineering and Design Report

2.2.2 Mechanical Engineering & Drafting

- Flood & Vent System
- Grouting System

*2.3 **Piling***

2.3.1 Structural Engineering & Drafting

- Piling In-Service Analyses
- Piling Pre-Service Analyses
- Piling Design Details
- Piling Weights and Material Takeoffs
- Piling Approved for Construction Drawings
- Piling Detailed Engineering and Design Report

*2.4 **Topsides***

2.4.1 Structural Engineering & Drafting

- Deck In-Service Analyses
- Deck Pre-Service Analyses
- Deck Design Details
- Deck Weights and Material Takeoffs
- Deck Approved for Construction Drawings
- Deck Detailed Engineering and Design Report

2.4.2 Mechanical/Process Engineering & Drafting

- Process Simulation/Calculations
- Equipment Design/Sizing
- Pipe Stress Analysis
- Hazard Analysis
- Specifications, Data Sheets, and Request for Quotations
- Vendor Data Reviews
- Weight, Material Takeoffs, Bill of Materials
- Approved for Construction Drawings for:
  - Process Flow Diagrams/Utility Flow Diagrams
  - Mechanical Flow Diagrams/Piping & Instrument Drawings
  - Equipment Layouts/Arrangements/Skid Layouts
  - Piping Supports
  - Piping General Arrangements, Elevations, and Isometrics
  - Other Approved for Construction Drawings
- Data Books, Equipment Manuals, Engineering and Design Report

2.4.3 Electrical Engineering & Drafting
- Electrical Engineering and Design
- Electrical Specifications, Data Sheets, and Request for Quotations
- Electrical Load Study/List
- Vendor Data Reviews
- Weight, Material Takeoffs, Bill of Materials
- Approved for Construction Drawings for:
  - Area Classifications
  - Electrical Symbol Legend
  - Electrical One-Line Drawings
  - Schematics/Schedule/Plans
  - Buildings and Equipment Layouts
  - Electrical Arrangement and Cable Tray Routing
  - Electrical Installation Details
  - Other AFC Drawings
- Data Books, Equipment Manuals, Engineering and Design Report

2.4.4 Instrument Engineering & Drafting
- Instrument Engineering & Design
- Fire & Safety Engineering & Design
- Relief Systems Sizing Calculations
- Instrument Specification, Data Sheets, and Request for Quotations
- Instrument Index
- Vendor Data Reviews
- Weight, Material Takeoffs, Bill of Materials
- AFC Drawings for:
  - SAFE Charts/PSFD's
  - Control Panels
  - PLC System
  - Tubing Tray Routing
  - Loop Diagrams
  - Instrument Installation Details
  - Fire & Safety
  - Pressure Relief Systems
  - Other AFC Drawings
- Data Books, Equipment Manuals, Engineering and Design Reports

3.0 PROCUREMENT

3.1 General

Procurement Procedures
Expediting & Inspection Procedures

3.2 Jacket
- 3.2.1 Owner Furnished Equipment (OFE)
- 3.2.2 Contractor Furnished Reimbursable Equipment (CFRE)
- 3.2.3 All Other Contractor Supplied Equipment
- 3.2.4 Bulk Materials—Contractor Supplied
  - Structural
  - Anodes

3.3 Piling
- 3.3.1 Bulk Materials—Contractor Supplied
  - Structural

3.4 Topsides
- 3.4.1 Owner Furnished Equipment (OFE)
  - Rotating Equipment
  - Pressure Vessels
  - Electrical Generation
  - etc.
- 3.4.2 Contractor Furnished Reimbursable Equipment (CFRE)
  - Rotating Equipment
  - Pressure Vessels
  - Other CFRE
- 3.4.3 All Other Contractor Supplied Equipment
- 3.4.4 Bulk Materials—Contractor Supplied
  - Structural
  - Piping, Valves, & Fittings
  - Electrical
  - Instrument
  - etc.

4.0 FABRICATION

4.1 General
- 4.1.1 Safety Manual and Plan
- 4.1.2 Yard and Work-Force Mobilization
- 4.1.3 Qualification of Welding Procedures and Welders
  - Structural
  - Piping
- 4.1.4 Shop Drawings
  - Structural
  - Piping Isometrics
  - Piping Spools
- 4.1.5 Receipt of Materials
- 4.1.6 QA/QC, NDT, and Dimensional Control
- 4.1.7 Weight Control Reports
- 4.1.8 As-Built Drawings and Certification Dossier

*4.2 **Jacket***

4.2.1 Frames
- Frame 1
- Frame 2
- Frame A
- Frame B

4.2.2 Horizontal Levels
- Level 1 (EL +10')
- Level 2
- Level 3
- Level 4

4.2.3 Appurtenances
- Disposal Pile
- Caissons
- Risers
- Boat Landing
- Corrosion Protection
- Stairs, Walkways, and Landings
- Installation Aids

4.2.4 Loadout & Seafasten

*4.3 **Piling***

4.3.1 Pile A1
4.3.2 Pile A2
4.3.3 Pile B1
4.3.4 Pile B2
4.3.5 Loadout & Seafasten

*4.4 **Topsides***

4.4.1 Main Deck
- Plate Girders
- Deck Panels
- Tertiary Steel

4.4.2 Cellar Deck
- Plate Girders
- Deck Panels
- Tertiary Steel

4.4.3 Sub-Cellar Deck
4.4.4 Legs
4.4.5 Bracing
4.4.6 Equipment Installation
4.4.7 Interconnect Piping
4.4.8 Electrical
4.4.9 Instrumentation

- 4.4.10 Precommissioning
- 4.4.11 Appurtenances
  - Flare Boom
  - Stairs, Walkways, & Landings
  - Installation Aids
- 4.4.12 Loadout & Seafasten

5.0 TRANSPORTATION

- ***5.1 General***
  - 5.1.1 Safety Manual and Plan
  - 5.1.2 Seafastening Drawings
  - 5.1.3 Marine Warranty Surveyor Review and Approval
- ***5.2 Jacket***
- ***5.3 Piling***
- ***5.4 Topsides***

6.0 INSTALLATION, HOOKUP, AND COMMISSIONING

- ***6.1 General***
  - 6.1.1 Safety Manual and Plan
  - 6.1.2 Installation Procedures and Drawings
  - 6.1.3 Qualification of Welding Procedures and Welders
    - Structural
    - Piping
  - 6.1.4 As-Installed Drawings
  - 6.1.5 Mobilization
  - 6.1.6 Demobilization
- ***6.2 Jacket***
- ***6.3 Piling***
- ***6.4 Topsides***
  - 6.4.1 Hookup
  - 6.4.2 Commissioning
  - 6.4.3 Startup

This WBS example is illustrative only and is intended to provide guidance to the reader. No claim of completeness is made—for any specific project, the example may be complete or incomplete. As expressed previously in the *PMBOK® Guide*, "the project management team is always responsible for determining what is appropriate for any given project."

Appendix E Environmental Management WBS Example

Example Environmental Project WBS to Conduct a Bio-Venting Test for the Remediation of Hydrocarbon Impacted Soils

1.0 SYSTEM DESIGN
- *1.1 Initial Design*
- *1.2 Client Meeting*
- *1.3 Draft Design*
- *1.4 Client & Regulatory Agency Meeting*
- *1.5 Final Design*

2.0 SYSTEM INSTALLATION
- *2.1 Facility Planning Meeting*
- *2.2 Well Installation*
- *2.3 Electrical Power Drop Installation*
- *2.4 Blower and Piping Installation*

3.0 SOIL PERMEABILITY TEST
- *3.1 System Operation Check*
- *3.2 Soil Permeability Test*
- *3.3 Test Report*

4.0 INITIAL IN SITU RESPIRATION TEST
- *4.1 In Situ Respiration Test*
- *4.2 Test Report*

5.0 LONG-TERM BIO-VENTING TEST

- *5.1 Ambient Air Monitoring*
- *5.2 Operation, Maintenance, and Monitoring*
- *5.3 Three-Month In Situ Respiration Test*
- *5.4 Test Report*
- *5.5 6 month In Situ Respiration Test*
- *5.6 Test Report*

6.0 CONFIRMATION SAMPLING

- *6.1 Soil Boring and Sampling*
- *6.2 Data Validation*

7.0 REPORT PREPARATION

- *7.1 Pre-Draft Report*
- *7.2 Client Meeting*
- *7.3 Draft Report*
- *7.4 Client & Regulatory Agency Meeting*
- *7.5 Final Report*

8.0 PROJECT MANAGEMENT

- *8.1 Project Plan Development*
- *8.2 Project Plan Execution*
- *8.3 Overall Change Control*

This WBS example is illustrative only and is intended to provide guidance to the reader. No claim of completeness is made—for any specific project, the example may be complete or incomplete. As expressed previously in the *PMBOK® Guide*, "the project management team is always responsible for determining what is appropriate for any given project."

Appendix F Process Improvement Project Example WBS

This WBS example is used with permission of the California Department of Transportation.

This is an example of a WBS for a process improvement project. It is divided into three phases:

1. Research to determine the best solution to the problem. This research includes the recommendation of a solution, or solutions, to the sponsor.

2. Implementation of the approved solution(s). If there is more than one approved solution, then the "Phase 2" WBS would be repeated for each solution.

3. Evaluation to determine if the solution works. This leads back to further research and continuous process improvement.

1.0 PHASE 1: RESEARCH AND RECOMMENDATIONS

- ***1.1 Phase 1: Charter***
- ***1.2 Project Management Plans for Phase 1***
  - 1.2.1 Scope Management Plan
  - 1.2.2 Cost and Schedule Management Plan
  - 1.2.3 Quality Management Plan
  - 1.2.4 Human Resources Management Plan
  - 1.2.5 Communication Management Plan
  - 1.2.6 Risk Management Plan
  - 1.2.7 Procurement Management Plan
- ***1.3 Research***
  - 1.3.1 Documentation of the "State of the Art"
    - 1.3.1.1 Document Search
    - 1.3.1.2 Consultation with Experts
    - 1.3.1.3 Benchmarking
    - 1.3.1.4 Product and Software Review

1.3.2 Documentation of the Current State in the Subject Organization
1.3.2.1 Interviews
1.3.2.2 Surveys
1.3.2.3 Statistical Analysis
1.3.2.4 Flow Charts of Current Processes

1.4 ***Identification of Improvement Needs***
1.4.1 Determination of Desired State (Vision Statement)
1.4.2 Gap Analysis
1.4.3 Most Likely Solutions
1.4.3.1 Brainstorming
1.4.3.2 Statistical Analysis
1.4.3.3 Flow Charts of Desired Processes

1.5 ***Recommendations***
1.5.1 Recommendation 1
1.5.1.1 Draft Charter
1.5.1.2 Estimated Cost
1.5.2 Recommendation 2
1.5.2.1 Draft Charter
1.5.2.2 Estimated Cost
1.5.3 Recommendation n
1.5.3.1 Draft Charter
1.5.3.2 Estimated Cost

2.0 PHASE 2: IMPLEMENTATION OF APPROVED RECOMMENDATION X
(this portion of the WBS is repeated for each approved recommendation)

2.1 ***Recommendation x Charter***
(approved and amended version of the draft from 1.5)

2.2 ***Project management plans for Phase 2***
(seven plans, as for Phase 1)

2.3 ***Process Documentation***
2.3.1 Draft process (policy, handbook, manual chapter, etc.)
2.3.2 Review
2.3.3 Revision (2.3.2 and 2.3.3 are iterative—repeat until there is consensus)
2.3.4 Publication
2.3.4.1 Hardcopy
2.3.4.2 Internet or Intranet
2.3.4.3 Other

2.4 Tools (software, etc.)
- 2.4.1 Design
- 2.4.2 Build
- 2.4.3 Test
- 2.4.4 Revision (2.4.3 and 2.4.4 are iterative—repeat until the product meets its goals)
- 2.4.5 Implementation

2.5 Training
- 2.5.1 Instructors
  - 2.5.1.1 Hiring
  - 2.5.1.2 Training ("Train the Trainers")
- 2.5.2 Development
  - 2.5.2.1 Draft Training Materials
  - 2.5.2.2 Review and Pilot
  - 2.5.2.3 Revision (2.5.2.2 and 2.5.2.3 are iterative—repeat until the class meets its goals)
- 2.5.3 Delivery

3.0 PHASE 3: EVALUATION

3.1 Project Management Plans for Phase 3 (seven plans, as for Phase 1)

3.2 Documentation of the New State in the Subject Organization
- 3.2.1 Interviews
- 3.2.2 Surveys
- 3.2.3 Statistical Analysis
- 3.2.4 Flow Charts of New Processes

3.3 Identification of Deficiencies
- 3.3.1 Flow Charts of desired processes (from 1.4.3.3)
- 3.3.2 Gap Analysis

3.4 Recommendations for New Projects
- 3.4.1 Recommendation 1
  - 3.4.1.1 Draft Charter
  - 3.4.1.2 Estimated Cost
- 3.4.2 Recommendation 2
  - 3.4.2.1 Draft Charter
  - 3.4.2.2 Estimated Cost
- 3.4.3 Recommendation n
  - 3.4.3.1 Draft Charter
  - 3.4.3.2 Estimated Cost

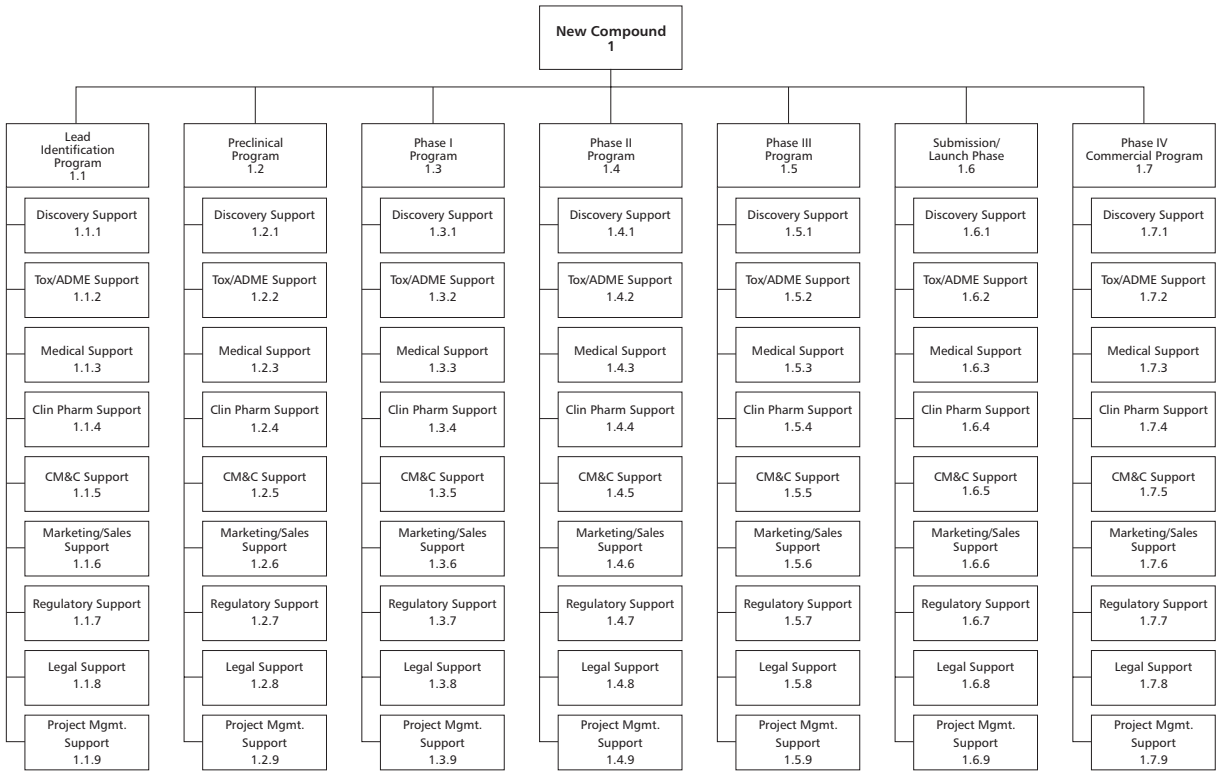
This WBS example is illustrative only and is intended to provide guidance to the reader. No claim of completeness is made—for any specific project, the example may be complete or incomplete. As expressed previously in the *PMBOK® Guide*, "the project management team is always responsible for determining what is appropriate for any given project."

Appendix G Pharmaceutical WBS Example

The following example represents an example of a Work Breakdown Structure (WBS) for a pharmaceutical development project. It is not intended to represent the only feasible WBS for this type of project. There are numerous variations and approaches that a project manager can take to develop the WBS for the project. In this example, level one of the WBS represents the new compound. Level 2 illustrates the various phases of pharmaceutical development. Level 3 represents the functional area work packages per each phase of pharmaceutical development. Level 4 represents standard sub-work packages for each of the functional areas. For consistency sake, these sub-work packages have used "carried forward" for each phase of the pharmaceutical development. In reality, many of these sub-work packages are specific to a given phase of development. They were carried forward to illustrate a consistent level of detail for this example.

It is recommended that the project manager develop the WBS to a level of detail that is appropriate for him/her and his/her team. For example, if a new project is a line extension of an existing project, it is likely that the project manager may choose to not include any aspect of lead identification in the WBS. Additionally, the project manager may want to illustrate geographic elements in the WBS that would necessitate a modification to what is depicted here.

The graphical depiction of the WBS covers the first three levels of the WBS. The tabular depiction of the WBS covers the four levels. The project manager may choose to add levels to the WBS to adequately detail the work packages for the project team.



Pharmaceutical Work Breakdown Structure Example

New Compound	**1**
Lead Identification Program	**1.1**
Discovery Support	*1.1.1*
Hypothesis Generation	1.1.1.1
Assay Screening	1.1.1.2
Lead Optimization	1.1.1.3
Other Discovery Support	1.1.1.4
Tox/ADME Support	*1.1.2*
Non-GLP Animal Studies	1.1.2.1
Bioanalytical Assay Development	1.1.2.2
ADME Evaluations	1.1.2.3
Acute Toxicological Studies	1.1.2.4
Sub-Chronic Toxicological Studies	1.1.2.5
Chronic Toxicological Studies	1.1.2.6
Other Tox/ADME Support	1.1.2.7

Medical Support	*1.1.3*
Pharmacokinetic/Pharmacodynamic Study(ies)	1.1.3.1
Dose Ranging Study(ies)	1.1.3.2
Multiple Dose Safety Study(ies)	1.1.3.3
Multiple Dose Efficacy Study(ies)	1.1.3.4
Pivotal Registration Study(ies)	1.1.3.5
Other Clinical Study(ies)	1.1.3.6
Clinical Pharmacology Support	*1.1.4*
Pharmacokinetic Study(ies)	1.1.4.1
Drug Interaction Study(ies)	1.1.4.2
Renal Effect Study(ies)	1.1.4.3
Hepatic Effect Study(ies)	1.1.4.4
Bioequivalency Study(ies)	1.1.4.5
Other Clinical Pharmacology Study(ies)	1.1.4.6
CM&C Support	*1.1.5*
Active Pharmaceutical Ingredient Development Program	1.1.5.1
New Drug Product Development Program	1.1.5.2
Clinical Trial Supply Program	1.1.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.1.5.4
New Drug Product Tech Transfer/Validation/ Launch Program	1.1.5.5
Other CM&C Support	1.1.5.6
Marketing/Sales Support	*1.1.6*
Market Research Program	1.1.6.1
Branding Program	1.1.6.2
Pricing Program	1.1.6.3
Sales Development Program	1.1.6.4
Other Marketing/Sales Support	1.1.6.5
Regulatory Support	*1.1.7*
Preclinical Package	1.1.7.1
Clinical Package	1.1.7.2
Clinical Pharmacology Package	1.1.7.3
CM&C Package	1.1.7.4
Promotional Materials Package	1.1.7.5
Other Regulatory Support	1.1.7.6
Legal Support	*1.1.8*
Publications	1.1.8.1
Patents/Intellectual Property	1.1.8.2
Trademarks	1.1.8.3
Other Legal Support	1.1.8.4

Project Management Support	*1.1.9*
Compound Project Management	1.1.9.1
Preclinical Project Management	1.1.9.2
Clinical Project Management	1.1.9.3
CM&C Project Management	1.1.9.4
Other Project Management Support	1.1.9.5
Preclinical Program	**1.2**
Discovery Support	*1.2.1*
Hypothesis Generation	1.2.1.1
Assay Screening	1.2.1.2
Lead Optimization	1.2.1.3
Other Discovery Support	1.2.1.4
Tox/ADME Support	*1.2.2*
Non-GLP Animal Studies	1.2.2.1
Bioanalytical Assay Development	1.2.2.2
ADME Evaluations	1.2.2.3
Acute Toxicological Studies	1.2.2.4
Sub-Chronic Toxicological Studies	1.2.2.5
Chronic Toxicological Studies	1.2.2.6
Other Tox/ADME Support	1.2.2.7
Medical Support	*1.2.3*
Pharmacokinetic/Pharmacodynamic Study(ies)	1.2.3.1
Dose Ranging Study(ies)	1.2.3.2
Multiple Dose Safety Study(ies)	1.2.3.3
Multiple Dose Efficacy Study(ies)	1.2.3.4
Pivotal Registration Study(ies)	1.2.3.5
Other Clinical Study(ies)	1.2.3.6
Clinical Pharmacology Support	*1.2.4*
Pharmacokinetic Study(ies)	1.2.4.1
Drug Interaction Study(ies)	1.2.4.2
Renal Effect Study(ies)	1.2.4.3
Hepatic Effect Study(ies)	1.2.4.4
Bioequivalency Study(ies)	1.2.4.5
Other Clinical Pharmacology Study(ies)	1.2.4.6
CM&C Support	*1.2.5*
Active Pharmaceutical Ingredient Development Program	1.2.5.1
New Drug Product Development Program	1.2.5.2
Clinical Trial Supply Program	1.2.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.2.5.4

New Drug Product Tech Transfer/Validation/ Launch Program	1.2.5.5
Other CM&C Support	1.2.5.6
Marketing/Sales Support	*1.2.6*
Market Research Program	1.2.6.1
Branding Program	1.2.6.2
Pricing Program	1.2.6.3
Sales Development Program	1.2.6.4
Other Marketing/Sales Support	1.2.6.5
Regulatory Support	*1.2.7*
Preclinical Package	1.2.7.1
Clinical Package	1.2.7.2
Clinical Pharmacology Package	1.2.7.3
CM&C Package	1.2.7.4
Promotional Materials Package	1.2.7.5
Other Regulatory Support	1.2.7.6
Legal Support	*1.2.8*
Publications	1.2.8.1
Patents/Intellectual Property	1.2.8.2
Trademarks	1.2.8.3
Other Legal Support	1.2.8.4
Project Management Support	*1.2.9*
Compound Project Management	1.2.9.1
Preclinical Project Management	1.2.9.2
Clinical Project Management	1.2.9.3
CM&C Project Management	1.2.9.4
Other Project Management Support	1.2.9.5
Phase I Program	**1.3**
Discovery Support	*1.3.1*
Hypothesis Generation	1.3.1.1
Assay Screening	1.3.1.2
Lead Optimization	1.3.1.3
Other Discovery Support	1.3.1.4
Tox/ADME Support	*1.3.2*
Non-GLP Animal Studies	1.3.2.1
Bioanalytical Assay Development	1.3.2.2
ADME Evaluations	1.3.2.3
Acute Toxicological Studies	1.3.2.4
Sub-Chronic Toxicological Studies	1.3.2.5
Chronic Toxicological Studies	1.3.2.6
Other Tox/ADME Support	1.3.2.7

Medical Support	*1.3.3*
Pharmacokinetic/harmacodynamic Study(ies)	1.3.3.1
Dose Ranging Study(ies)	1.3.3.2
Multiple Dose Safety Study(ies)	1.3.3.3
Multiple Dose Efficacy Study(ies)	1.3.3.4
Pivotal Registration Study(ies)	1.3.3.5
Other Clinical Study(ies)	1.3.3.6
Clinical Pharmacology Support	*1.3.4*
Pharmacokinetic Study(ies)	1.3.4.1
Drug Interaction Study(ies)	1.3.4.2
Renal Effect Study(ies)	1.3.4.3
Hepatic Effect Study(ies)	1.3.4.4
Bioequivalency Study(ies)	1.3.4.5
Other Clinical Pharmacology Study(ies)	1.3.4.6
CM&C Support	*1.3.5*
Active Pharmaceutical Ingredient Development Program	1.3.5.1
New Drug Product Development Program	1.3.5.2
Clinical Trial Supply Program	1.3.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.3.5.4
New Drug Product Tech Transfer/Validation/ Launch Program	1.3.5.5
Other CM&C Support	1.3.5.6
Marketing/Sales Support	*1.3.6*
Market Research Program	1.3.6.1
Branding Program	1.3.6.2
Pricing Program	1.3.6.3
Sales Development Program	1.3.6.4
Other Marketing/Sales Support	1.3.6.5
Regulatory Support	*1.3.7*
Preclinical Package	1.3.7.1
Clinical Package	1.3.7.2
Clinical Pharmacology Package	1.3.7.3
CM&C Package	1.3.7.4
Promotional Materials Package	1.3.7.5
Other Regulatory Support	1.3.7.6
Legal Support	*1.3.8*
Publications	1.3.8.1
Patents/Intellectual Property	1.3.8.2
Trademarks	1.3.8.3
Other Legal Support	1.3.8.4

Project Management Support	*1.3.9*
Compound Project Management	1.3.9.1
Preclinical Project Management	1.3.9.2
Clinical Project Management	1.3.9.3
CM&C Project Management	1.3.9.4
Other Project Management Support	1.3.9.5
Phase II Program	**1.4**
Discovery Support	*1.4.1*
Hypothesis Generation	1.4.1.1
Assay Screening	1.4.1.2
Lead Optimization	1.4.1.3
Other Discovery Support	1.4.1.4
Tox/ADME Support	*1.4.2*
Non-GLP Animal Studies	1.4.2.1
Bioanalytical Assay Development	1.4.2.2
ADME Evaluations	1.4.2.3
Acute Toxicological Studies	1.4.2.4
Sub-Chronic Toxicological Studies	1.4.2.5
Chronic Toxicological Studies	1.4.2.6
Other Tox/ADME Support	1.4.2.7
Medical Support	*1.4.3*
Pharmacokinetic /Pharmacodynamic Study(ies)	1.4.3.1
Dose Ranging Study(ies)	1.4.3.2
Multiple Dose Safety Study(ies)	1.4.3.3
Multiple Dose Efficacy Study(ies)	1.4.3.4
Pivotal Registration Study(ies)	1.4.3.5
Other Clinical Study(ies)	1.4.3.6
Clinical Pharmacology Support	*1.4.4*
Pharmacokinetic Study(ies)	1.4.4.1
Drug Interaction Study(ies)	1.4.4.2
Renal Effect Study(ies)	1.4.4.3
Hepatic Effect Study(ies)	1.4.4.4
Bioequivalency Study(ies)	1.4.4.5
Other Clinical Pharmacology Study(ies)	1.4.4.6
CM&C Support	*1.4.5*
Active Pharmaceutical Ingredient Development Program	1.4.5.1
New Drug Product Development Program	1.4.5.2
Clinical Trial Supply Program	1.4.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.4.5.4

New Drug Product Tech Transfer/Validation/ Launch Program	1.4.5.5
Other CM&C Support	1.4.5.6
Marketing / Sales Support	*1.4.6*
Market Research Program	1.4.6.1
Branding Program	1.4.6.2
Pricing Program	1.4.6.3
Sales Development Program	1.4.6.4
Other Marketing / Sales Support	1.4.6.5
Regulatory Support	*1.4.7*
Preclinical Package	1.4.7.1
Clinical Package	1.4.7.2
Clinical Pharmacology Package	1.4.7.3
CM&C Package	1.4.7.4
Promotional Materials Package	1.4.7.5
Other Regulatory Support	1.4.7.6
Legal Support	*1.4.8*
Publications	1.4.8.1
Patents / Intellectual Property	1.4.8.2
Trademarks	1.4.8.3
Other Legal Support	1.4.8.4
Project Management Support	*1.4.9*
Compound Project Management	1.4.9.1
Preclinical Project Management	1.4.9.2
Clinical Project Management	1.4.9.3
CM&C Project Management	1.4.9.4
Other Project Management Support	1.4.9.5
Phase III Program	**1.5**
Discovery Support	*1.5.1*
Hypothesis Generation	1.5.1.1
Assay Screening	1.5.1.2
Lead Optimization	1.5.1.3
Other Discovery Support	1.5.1.4
Tox/ADME Support	*1.5.2*
Non-GLP Animal Studies	1.5.2.1
Bioanalytical Assay Development	1.5.2.2
ADME Evaluations	1.5.2.3
Acute Toxicological Studies	1.5.2.4
Sub-chronic Toxicological Studies	1.5.2.5
Chronic Toxicological Studies	1.5.2.6
Other Tox/ADME Support	1.5.2.7

Medical Support	*1.5.3*
Pharmacokinetic /Pharmacodynamic Study(ies)	1.5.3.1
Dose Ranging Study(ies)	1.5.3.2
Multiple Dose Safety Study(ies)	1.5.3.3
Multiple Dose Efficacy Study(ies)	1.5.3.4
Pivotal Registration Study(ies)	1.5.3.5
Other Clinical Study(ies)	1.5.3.6
Clinical Pharmacology Support	*1.5.4*
Pharmacokinetic Study(ies)	1.5.4.1
Drug Interaction Study(ies)	1.5.4.2
Renal Effect Study(ies)	1.5.4.3
Hepatic Effect Study(ies)	1.5.4.4
Bioequivalency Study(ies)	1.5.4.5
Other Clinical Pharmacology Study(ies)	1.5.4.6
CM&C Support	*1.5.5*
Active Pharmaceutical Ingredient Development Program	1.5.5.1
New Drug Product Development Program	1.5.5.2
Clinical Trial Supply Program	1.5.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.5.5.4
New Drug Product Tech Transfer/Validation/ Launch Program	1.5.5.5
Other CM&C Support	1.5.5.6
Marketing/Sales Support	*1.5.6*
Market Research Program	1.5.6.1
Branding Program	1.5.6.2
Pricing Program	1.5.6.3
Sales Development Program	1.5.6.4
Other Marketing/Sales Support	1.5.6.5
Regulatory Support	*1.5.7*
Preclinical Package	1.5.7.1
Clinical Package	1.5.7.2
Clinical Pharmacology Package	1.5.7.3
CM&C Package	1.5.7.4
Promotional Materials Package	1.5.7.5
Other Regulatory Support	1.5.7.6
Legal Support	*1.5.8*
Publications	1.5.8.1
Patents/Intellectual Property	1.5.8.2
Trademarks	1.5.8.3
Other Legal Support	1.5.8.4

Project Management Support	*1.5.9*
Compound Project Management	1.5.9.1
Preclinical Project Management	1.5.9.2
Clinical Project Management	1.5.9.3
CM&C Project Management	1.5.9.4
Other Project Management Support	1.5.9.5
Submission/Launch Phase	**1.6**
Discovery Support	*1.6.1*
Hypothesis Generation	1.6.1.1
Assay Screening	1.6.1.2
Lead Optimization	1.6.1.3
Other Discovery Support	1.6.1.4
Tox/ADME Support	*1.6.2*
Non-GLP Animal Studies	1.6.2.1
Bioanalytical Assay Development	1.6.2.2
ADME Evaluations	1.6.2.3
Acute Toxicological Studies	1.6.2.4
Sub-Chronic Toxicological Studies	1.6.2.5
Chronic Toxicological Studies	1.6.2.6
Other Tox/ADME Support	1.6.2.7
Medical Support	*1.6.3*
Pharmacokinetic/Pharmacodynamic Study(ies)	1.6.3.1
Dose Ranging Study(ies)	1.6.3.2
Multiple Dose Safety Study(ies)	1.6.3.3
Multiple Dose Efficacy Study(ies)	1.6.3.4
Pivotal Registration Study(ies)	1.6.3.5
Other Clinical Study(ies)	1.6.3.6
Clinical Pharmacology Support	*1.6.4*
Pharmacokinetic Study(ies)	1.6.4.1
Drug Interaction Study(ies)	1.6.4.2
Renal Effect Study(ies)	1.6.4.3
Hepatic Effect Study(ies)	1.6.4.4
Bioequivalency Study(ies)	1.6.4.5
Other Clinical Pharmacology Study(ies)	1.6.4.6
CM&C Support	*1.6.5*
Active Pharmaceutical Ingredient Development Program	1.6.5.1
New Drug Product Development Program	1.6.5.2
Clinical Trial Supply Program	1.6.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.6.5.4

New Drug Product Tech Transfer/Validation/ Launch Program	1.6.5.5
Other CM&C Support	1.6.5.6
Marketing/Sales Support	*1.6.6*
Market Research Program	1.6.6.1
Branding Program	1.6.6.2
Pricing Program	1.6.6.3
Sales Development Program	1.6.6.4
Other Marketing/Sales Support	1.6.6.5
Regulatory Support	*1.6.7*
Preclinical Package	1.6.7.1
Clinical Package	1.6.7.2
Clinical Pharmacology Package	1.6.7.3
CM&C Package	1.6.7.4
Promotional Materials Package	1.6.7.5
Other Regulatory Support	1.6.7.6
Legal Support	*1.6.8*
Publications	1.6.8.1
Patents/Intellectual Property	1.6.8.2
Trademarks	1.6.8.3
Other Legal Support	1.6.8.4
Project Management Support	*1.6.9*
Compound Project Management	1.6.9.1
Preclinical Project Management	1.6.9.2
Clinical Project Management	1.6.9.3
CM&C Project Management	1.6.9.4
Other Project Management Support	1.6.9.5
Phase IV/Commercialization Program	**1.7**
Discovery Support	*1.7.1*
Hypothesis Generation	1.7.1.1
Assay Screening	1.7.1.2
Lead Optimization	1.7.1.3
Other Discovery Support	1.7.1.4
Tox/ADME Support	*1.7.2*
Non-GLP Animal Studies	1.7.2.1
Bioanalytical Assay Development	1.7.2.2
ADME Evaluations	1.7.2.3
Acute Toxicological Studies	1.7.2.4
Sub-Chronic Toxicological Studies	1.7.2.5
Chronic Toxicological Studies	1.7.2.6
Other Tox/ADME Support	1.7.2.7

Medical Support	*1.7.3*
Pharmacokinetic/Pharmacodynamic Study(ies)	1.7.3.1
Dose Ranging Study(ies)	1.7.3.2
Multiple Dose Safety Study(ies)	1.7.3.3
Multiple Dose Efficacy Study(ies)	1.7.3.4
Pivotal Registration Study(ies)	1.7.3.5
Other Clinical Study(ies)	1.7.3.6
Clinical Pharmacology Support	*1.7.4*
Pharmacokinetic Study(ies)	1.7.4.1
Drug Interaction Study(ies)	1.7.4.2
Renal Effect Study(ies)	1.7.4.3
Hepatic Effect Study(ies)	1.7.4.4
Bioequivalency Study(ies)	1.7.4.5
Other Clinical Pharmacology Study(ies)	1.7.4.6
CM&C Support	*1.7.5*
Active Pharmaceutical Ingredient Development Program	1.7.5.1
New Drug Product Development Program	1.7.5.2
Clinical Trial Supply Program	1.7.5.3
Active Pharmaceutical Ingredient Tech Transfer/ Validation/Launch Program	1.7.5.4
New Drug Product Tech Transfer/Validation/ Launch Program	1.7.5.5
Other CM&C Support	1.7.5.6
Marketing/Sales Support	*1.7.6*
Market Research Program	1.7.6.1
Branding Program	1.7.6.2
Pricing Program	1.7.6.3
Sales Development Program	1.7.6.4
Other Marketing/Sales Support	1.7.6.5
Regulatory Support	*1.7.7*
Preclinical Package	1.7.7.1
Clinical Package	1.7.7.2
Clinical Pharmacology Package	1.7.7.3
CM&C Package	1.7.7.4
Promotional Materials Package	1.7.7.5
Other Regulatory Support	1.7.7.6
Legal Support	*1.7.8*
Publications	1.7.8.1
Patents/Intellectual Property	1.7.8.2
Trademarks	1.7.8.3
Other Legal Support	1.7.8.4

Project Management Support	*1.7.9*
Compound Project Management	1.7.9.1
Preclinical Project Management	1.7.9.2
Clinical Project Management	1.7.9.3
CM&C Project Management	1.7.9.4
Other Project Management Support	1.7.9.5

This WBS example is illustrative only and is intended to provide guidance to the reader. No claim of completeness is made—for any specific project, the example may be complete or incomplete. As expressed previously in the *PMBOK® Guide*, "the project management team is always responsible for determining what is appropriate for any given project."

Appendix H Construction Project WBS Examples

PMI Project Management Standards Open Working Session volunteers at PMI's '99 Seminars & Symposium created these two construction WBS examples. They are examples of engineering-oriented Work Breakdowns Structures (WBSs), rather than contractor-oriented WBSs, as the orientation is on the design of systems rather than on the startup and commissioning of systems. Communication between the engineering team and the construction/commissioning team needs to be very good to minimize problems during construction. In practice there can be problems when Engineers do design based on "Systems," while the Crafts/Trades (Contractors) do their work by location and sequence. A viable approach could be one where an engineering-oriented WBS may be appropriate for the project and the customer, but would likely need the sequencing of work to be handled by dependency relationships.

However, it should be noted that whether the WBS has a process focus, a systems focus, a structure focus, or some other focus, the sequence of work is not the primary objective. The issue is whether the work required to complete the desired outcome and meet the project objectives has been captured in enough detail to identify resources, assign responsibility, and set sequence.

Process Plant Construction Project Example

1.0 SYSTEM DESIGN

- *1.1 System Engineering*
- *1.2 Site Development*
- *1.3 Civil Structures*
- *1.4 Thermal Systems*
- *1.5 Flow Systems*
- *1.6 Storage Systems*
- *1.7 Electrical Systems*

- *1.8 Mechanical Systems*
- *1.9 Environmental Systems*
- *1.10 Instrumentation & Control Systems*
- *1.11 Auxiliary Systems*

2.0 CONSTRUCTION

- *2.1 Site Development*
- *2.2 Civil Structures*
- *2.3 Thermal Systems*
- *2.4 Flow Systems*
- *2.5 Storage Systems*
- *2.6 Electrical Systems*
- *2.7 Mechanical Systems*
- *2.8 Instrument & Control Systems*
- *2.9 Environmental Systems*
- *2.10 Temporary Structure*
- *2.11 Auxiliary Systems*

3.0 LEGAL & REGULATORY

- *3.1 Licensing (non-government)/Permitting (government)*
- *3.2 Environmental Impact*
- *3.3 Labor Agreements*
- *3.4 Land Acquisition*
- *3.5 Other Legal/Regulatory Requirements*

4.0 PROJECT MANAGEMENT

- *4.1 Project Plan Development*
- *4.2 Status Reports*
- *4.3 Data Management*
- *4.4 Configuration Management*
- *4.5 Meetings (Minutes)*
- *4.6 Contract Administration*

5.0 SYSTEM TEST/STARTUP

Nuclear Construction Project

1.0 INITIATION

2.0 PLANNING

3.0 EXECUTION

- *3.1 Engineering*
  - 3.1.1 Electrical
  - 3.1.2 Mechanical
  - 3.1.3 Civil
  - 3.1.4 I+C
- *3.2 Design Engineering*
  - 3.2.1 Electrical
  - 3.2.2 Mechanical
  - 3.2.3 Civil
  - 3.2.4 I+C
- *3.3 Regulatory*
  - 3.3.1 Legal
    - 3.3.1.1 Permits
    - 3.3.1.2 ...
- *3.4 Outage/Non-Outage Construction*
- *3.5 Commissioning*
  - 3.5.1 Test
  - 3.5.2 Turnover
  - 3.5.3 Startup

Note: PMI Project Management Standards Open Working Session volunteers at PMI's '99 Seminars & Symposium created this WBS example.

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Appendix I Service Industry Outsourcing Example WBS

Service Industry Outsourcing Project

The really unique aspect of this WBS is its inclusion of an RFP process.

1.0 NEEDS ANALYSIS
- *1.1 Determine Need for Service*
- *1.2 Define & Baseline Requirements*
- *1.3 Develop Specifications*
- *1.4 Develop High-Level Statement of Work*

2.0 MARKET ANALYSIS
- *2.1 Determine Internal Capability + Cost*
- *2.2 Identify Qualified Vendors*
- *2.3 Prepare RFI (Information)*
- *2.4 Evaluate RFI Submissions*
- *2.5 Conduct Decision Analysis (includes make/buy)*

3.0 RFP DEVELOPMENT
- *3.1 Develop Solution Criteria*
- *3.2 Finalize Requirements*
- *3.3 Finalize Schedule*
- *3.4 Finalize Budget*

4.0 SOLICITATION
- *4.1 Issue RFQ*
- *4.2 Issue RFP*
- *4.3 Receive Bids*
- *4.4 Evaluate Response*
- *4.5 Qualify Vendors*
- *4.6 Award/Select Vendors*
- *4.7 Issue LOI(s)*

5.0 CONTRACT

5.1 Develop Master Agreement

Negotiate Contract

Finalize Terms & Conditions (use boiler plate)

Finalize Scope/Schedule/Cost

5.2 Develop Contract Orders/Task Orders/CSOWs

5.2.1 Develop Specific Deliverables

5.2.2 Identify Resources

5.2.3 Define SLAs

5.2.4 Define Acceptance Criteria

5.2.5 Define Performance Measures

5.2.6 Issue PO/Task Order

5.3 Execute Agreement/Signed Contract

6.0 SERVICES PERSPECTIVE

6.1 Task Order/Contract Order SOW

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Appendix J Web Design Project WBS Example

Goal: Design an Internet site that sells products within one country.
Assumption: This project is being conducted internally to develop a commerce site to sell the company's own products. The company will create and host the design.

1.0 WEB DESIGN
- *1.1 Web Design Methods*
  - 1.1.1 Evaluate Available Web Design Methods
  - 1.1.2 Select Web Design Method
- *1.2 Web Designer*
  - 1.2.1 Hire Web Designer
  - 1.2.2 Educate Web Designer
- *1.3 Web Site Design*
  - 1.3.1 Consult Web Design Expert
  - 1.3.2 Decide on Web Site Design
- *1.4 Web Site Programs*
  - 1.4.1 Validate Web Site in Conformance to Internal Business Process
  - 1.4.2 Validate Web Site in Conformance to External Requirements
  - 1.4.3 Approve Solution

2.0 HARDWARE
- *2.1 Determine Sizing*
- *2.2 Define Hardware Architecture*
- *2.3 Buy Hardware*
- *2.4 Install Hardware*
- *2.5 Test Hardware*

3.0 SOFTWARE
- *3.1 Obtain and Train Programmers*
- *3.2 Design Programs*
- *3.3 Conduct Program Peer Review*
- *3.4 Prototype Programs*
- *3.5 Order Entry*
  - 3.5.1 Code Order Entry
  - 3.5.2 Test Order Entry

- *3.6 Order Fulfillment*
  - 3.6.1 Code Order Fulfillment
  - 3.6.2 Test Order Fulfillment
- *3.7 Acknowledgment*
  - 3.7.1 Code Acknowledgment
  - 3.7.2 Test Acknowledgment
- *3.8 Invoicing*
- *3.9 Database*
  - 3.9.1 Design Database
  - 3.9.2 Build Database
  - 3.9.3 Cleanse Data
  - 3.9.4 Load Database
- *3.10 Test SQL*

4.0 COMMUNICATION

- *4.1 Choose ISP*
- *4.2 Choose Telecom Vendor*
- *4.3 Define Network Environment*
- *4.4 Select Communication Method to Infrastructure Vendor*
- *4.5 Firewall & Encryption Security*

5.0 INTEGRATION

- *5.1 Install Software Application on Hardware*
- *5.2 Middleware/Application Test*
- *5.3 External Network Test*
- *5.4 Performance System Test*

6.0 LOGISTICS

- *6.1 Order Processing Link*
  - 6.1.1 Invoice Link
  - 6.1.2 Replenishment/Forecast Link
- *6.2 Shipping Link*
- *6.3 Customer Support Link*
- *6.4 Link to Credit Authorization*

Note: PMI Project Management Standards Open Working Session volunteers at PMI's '99 Seminars & Symposium created this WBS example.

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Appendix K Telecom Project WBS Example

Telecom Project

1.0 CONCEPT/FEASIBILITY
- *1.1 Develop Concept/Marketing Plan*
- *1.2 Conduct Market Analysis & Scope*
- *1.3 Conduct Technical Analysis*
- *1.4 Develop Prototype*
- *1.5 Prepare Product Development Plan/Cost/Schedule*

2.0 REQUIREMENTS
- *2.1 Develop End-User Requirements*
- *2.2 Develop Application Requirements*
- *2.3 Develop Infrastructure (Systems) Requirements*
- *2.4 Develop Operations/Maintenance Requirements*
- *2.5 Develop Service Requirements*

3.0 DECISION
- *3.1 Present Prototype*
- *3.2 Present Financial & Schedule*
- *3.3 Present Technical Capabilities*
- *3.4 Obtain Financial Commitment*
- *3.5 Go/No-Go Decision (Milestone)*

4.0 DEVELOPMENT
- *4.1 Develop End-User Systems*
- *4.2 Develop Application*
- *4.3 Develop Infrastructure Systems & Network*
- *4.4 Develop Operations/Maintenance Structure*
- *4.5 Develop Service Plan*

5.0 TEST

- *5.1 Develop Test Plans for Each Aspect/Element*
- *5.2 Conduct Tests*
- *5.3 Validate Results*
- *5.4 Perform Corrective Action (as necessary)*
- *5.5 Conduct Retesting*
- *5.6 Revalidate Results*

6.0 DEPLOY

- *6.1 Conduct Trial in a Non-Penalty Environment*
- *6.2 Conduct First Live Test in First Action Site*
- *6.3 Complete Deployment*

7.0 LIFE CYCLE

- *7.1 Conduct Customer Training & Education*
- *7.2 Perform Turnover to Customer*
- *7.3 Obtain Customer Acceptance*
- *7.4 Perform Support & Maintenance*

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Appendix L Refinery TurnAround WBS Example

This is an example of a Work Breakdown Structure (WBS) for the Turn-Around (T/A) of a refinery. As used on a previous project, Level 4 was treated as the lowest level of the WBS. Work orders and their associated activities rolled up under the Equipment ID (WBS Level 4). Shift status (updated every twelve hours) was reported to upper management at Level 3 for most of the turnaround.

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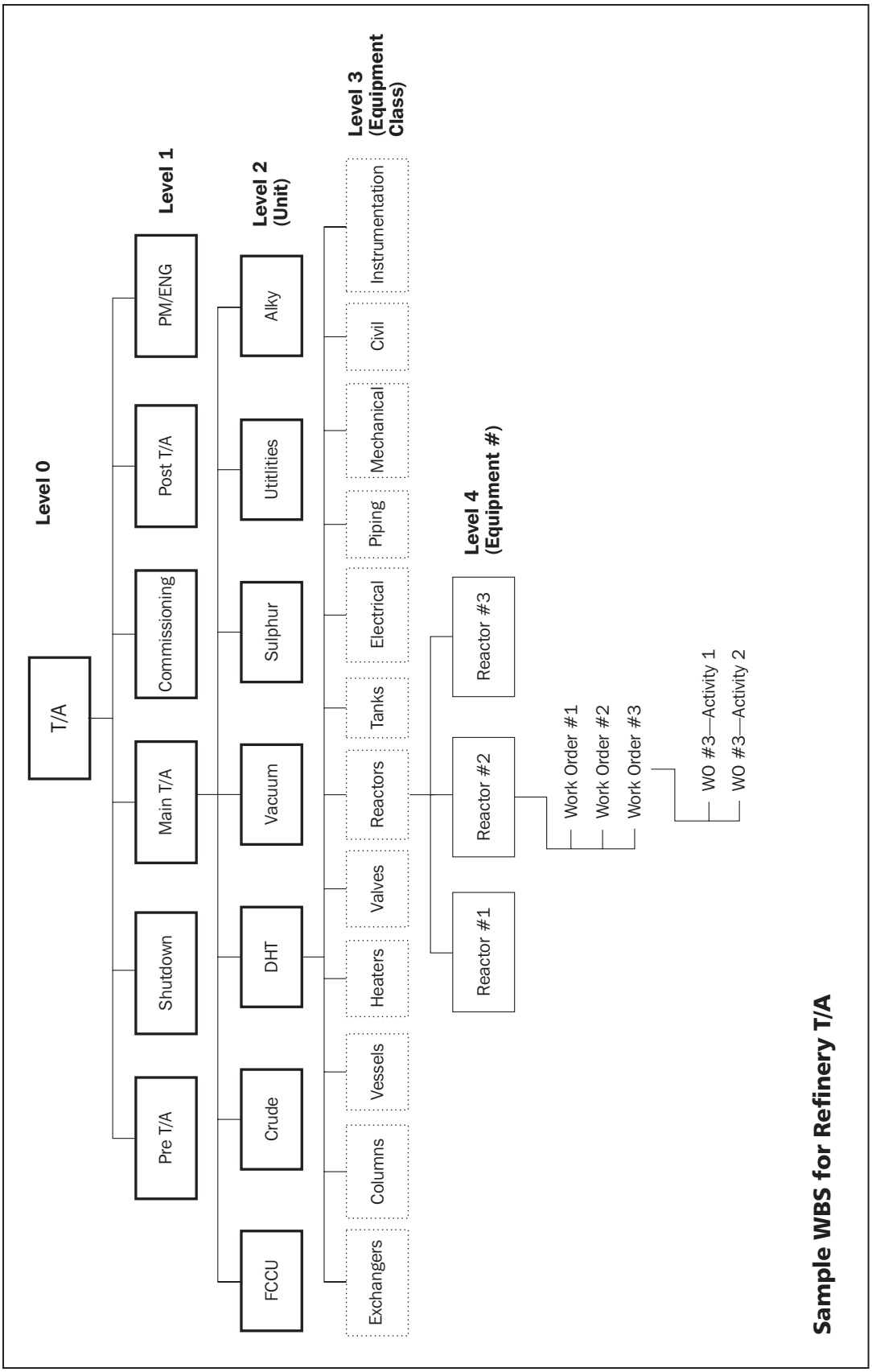

Appendix M Government Design-Bid-Build Project WBS Example

This is an example of a WBS, from the government's point of view, of a Government Design-Bid-Build Construction project. These projects have three key features:

1. Limits on the power of the executive branch of government. Every democratic system has limits of this type. The executive branch is authorized to make decisions within established limits. To proceed beyond those limits, it must obtain permission from representatives of the people. These representatives may be the legislative branch or a commission that acts for the people. Limits of this type are established no matter what system is used to appoint the chief executive. In most cases, the legislative branch appoints the chief executive (1). In some cases, the chief executive is elected directly (2).

2. Real property is obtained by eminent domain. In the private sector, developers need to own the land or have assurance that they can purchase the land before they begin the project. In the government sector, the government may begin the project long before it owns the land.

3. The lowest qualified bidder performs the construction. To ensure a fair competition, the government must prepare detailed plans and specifications before letting the contract.

1.0 PHASE 1: PROSPECTUS

(that which the executive branch can complete without external review or approval)

1.1 Project Management Plans for Phase 1

1.1.1 Scope Management Plan
1.1.2 Cost and Schedule Management Plan
1.1.3 Quality Management Plan
1.1.4 Human Resources Management Plan
1.1.5 Communication Management Plan
1.1.6 Risk Management Plan
1.1.7 Procurement Management Plan

1.2 Description of Customer Needs
1.3 Preliminary Plans of Alternatives
1.4 Estimates for Alternatives
1.5 Cost/Benefit Analysis
1.6 Report

2.0 PHASE 2: SELECTED ALTERNATIVE
(may be combined with Phase 1, depending on the requirements set by the legislative branch)
2.1 Project Management Plans for Phase 2 (seven plans, as for Phase 1)
2.2 Environmental Studies
2.2.1 Biological
2.2.2 Archaeological
2.2.3 Air Quality
2.2.4 Water Quality
2.2.5 Social and Economic
2.3 More Detailed Plans of Alternatives
2.4 Estimates for Alternatives
2.5 Draft Report
2.6 Final Report

3.0 PHASE 3: REAL PROPERTY
3.1 Project Management Plans for Phase 3 (seven plans, as for Phase 1)
3.2 Appraisal
3.3 Acquisition
3.4 Relocation of Occupants
3.5 Demolition
3.6 Relocation of Utilities
3.7 Hazardous Waste Removal
3.8 Environmental Mitigation

4.0 PHASE 4: CONTRACT AWARD DOCUMENTS
4.1 Project Management Plans for Phase 4 (seven plans, as for Phase 1)
4.2 Detailed Plans of Selected Alternative
4.2.1 Civil Plans
4.2.2 Water Supply and Removal Plans
4.2.3 Structural Plans
4.2.4 Furnishing Plans
4.3 Specifications
4.3.1 General Provisions
4.3.2 Special Provisions

4.4 Estimate
4.5 Bid Documents
4.6 Signed Contract

5.0 PHASE 5: PHYSICAL IMPROVEMENT (CONSTRUCTION)
5.1 Project Management Plans for Phase 5 (seven plans, as for Phase 1)
5.2 Civil Work
5.2.1 Earthwork
5.2.2 Pavement
5.3 Water Supply, Drainage, and Sanitation
5.3.1 Drainage
5.3.2 Water Supply
5.3.3 Sanitary Sewers and Purification
5.4 Structural Work
5.4.1 Structures
5.4.2 Electrical
5.4.3 Mechanical
5.5 Furnishings

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Endnotes—Appendix M

1. Examples: The Prime Minister in the United Kingdom, Italy, Sweden, Japan, the Netherlands, Israel, Canada, Australia, New Zealand, India, and so on; the President of South Africa; the Chancellor of Germany; City Managers, County Executives, and School Superintendents in the United States.

2. Examples: The President, Governors, and some Mayors in the United States; the President of France.

Appendix N Software Implementation Project WBS Example

1.0 PROJECT MANAGEMENT

1.1 Planning

1.1.1 Develop Project Charter
1.1.2 Define Scope
1.1.3 Develop Resource Plan
1.1.4 Develop Communication Plan
1.1.5 Develop Risk Plan
1.1.6 Develop Change Control Plan
1.1.7 Develop Quality Plan
1.1.8 Develop Purchase Plan
1.1.9 Develop Cost Plan
1.1.10 Develop Organization Plan
1.1.11 Develop Project Schedule

1.2 Meetings

1.2.1 Conduct Kickoff Meeting
1.2.2 Weekly Status Meeting
1.2.3 Monthly Tactical Meeting
1.2.4 Project Closing Meeting

1.3 Administration

1.3.1 Standards
1.3.1.1 Document Performance Standards
1.3.1.2 Document Reporting Standards
1.3.1.3 Document Naming Conventions
1.3.1.4 Document Housekeeping Standards
1.3.2 Program Office
1.3.2.1 Develop Program Office Charter
1.3.2.2 Assign Program Office Resources

2.0 PRODUCT REQUIREMENTS

2.1 Software Requirements
- 2.1.1 Create Draft Software Requirements
- 2.1.2 Review Draft Software Requirements
- 2.1.3 Update Draft Software Requirements
- 2.1.4 Review Final Software Requirements
- 2.1.5 Software Requirements Approved

2.2 User Documentation
- 2.2.1 Create Draft User Documentation
- 2.2.2 Review Draft User Documentation
- 2.2.3 Update Draft User Documentation
- 2.2.4 Review Final User Documentation
- 2.2.5 User Documentation Approved

2.3 Training Program Materials
- 2.3.1 Create Initial Training Requirements
- 2.3.2 Review & Approve Training Requirements
- 2.3.3 Create Initial Training Materials
- 2.3.4 Review & Approve Training Materials
- 2.3.5 Conduct Trial Course Delivery
- 2.3.6 Update and Finalize Training Materials

2.4 Hardware
- 2.4.1 Create Draft Hardware Requirements
- 2.4.2 Review Draft Hardware Requirements
- 2.4.3 Hardware Requirements Approved

2.5 Implementation & Future Support

3.0 DETAIL SOFTWARE DESIGN

3.1 Create Initial Software Design

3.2 Review Initial Software Design

3.3 Update Initial Software Design

3.4 Review Final Software Design

3.5 Software Design Approved

4.0 SYSTEM CONSTRUCTION

4.1 Configure Software

4.2 Customize User Documentation

4.3 Customize Training Program Materials

4.4 Install Hardware

4.5 Implementation & Future Support

5.0 INTEGRATION & TEST

- *5.1 Software*
- *5.2 User Documentation*
- *5.3 Training Program Materials*
- *5.4 Hardware*
- *5.5 Implementation & Future Support*

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