PROJECT SCOPE MANAGEMENT

5

Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully [1]. It is primarily concerned with defining and controlling what is or is not included in the project. Figure 5–1 provides an overview of the major project scope management processes:

5.1 Initiation—committing the organization to begin the next phase of the project.
5.2 Scope Planning—developing a written scope statement as the basis for future project decisions.
5.3 Scope Definition—subdividing the major project deliverables into smaller, more manageable components.
5.4 Scope Verification—formalizing acceptance of the project scope.
5.5 Scope Change Control—controlling changes to project scope.

These processes interact with each other and with the processes in the other knowledge areas as well. Each process may involve effort from one or more individuals or groups of individuals based on the needs of the project. Each process generally occurs at least once in every project phase.

Although the processes are presented here as discrete elements with well-defined interfaces, in practice they may overlap and interact in ways not detailed here. Process interactions are discussed in detail in Chapter 3.

In the project context, the term "scope" may refer to:

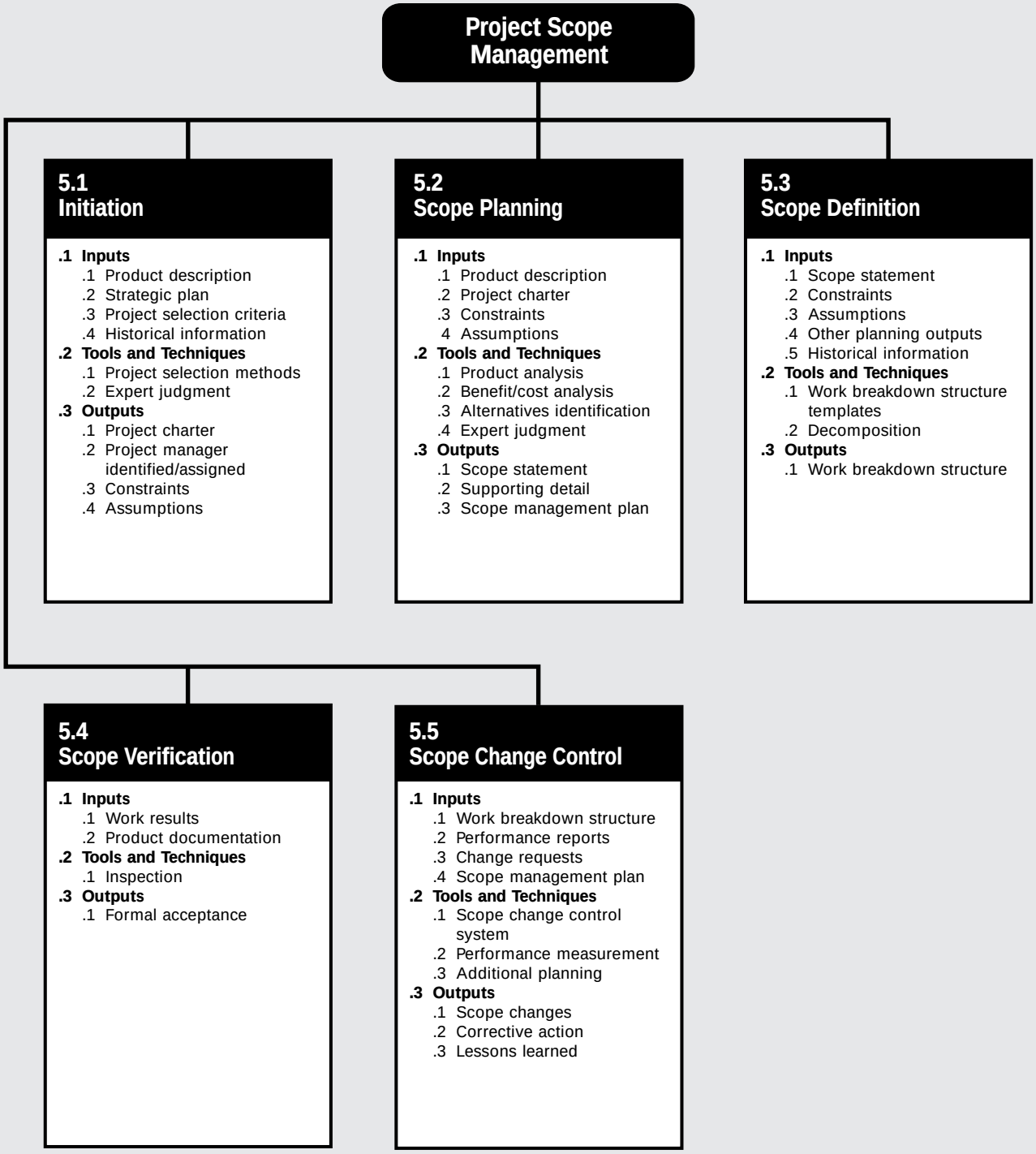
- Product scope—the features and functions that are to be included in a product or service.
- Project scope—the work that must be done in order to deliver a product with the specified features and functions.

The processes, tools and techniques used to manage *project* scope are the focus of this chapter. The processes, tools, and techniques used to manage *product* scope vary by application area and are usually defined as part of the project life cycle (the project life cycle is discussed in Section 2.1).

A project consists of a single product, but that product may include subsidiary elements, each with their own separate but interdependent product scopes. For example, a new telephone system would generally include four subsidiary elements—hardware, software, training, and implementation.

Completion of the *product* scope is measured against the requirements while completion of the *project* scope is measured against the plan. Both types of scope management must be well integrated to ensure that the work of the project will result in delivery of the specified product.

Figure 5–1. Project Scope Management Overview

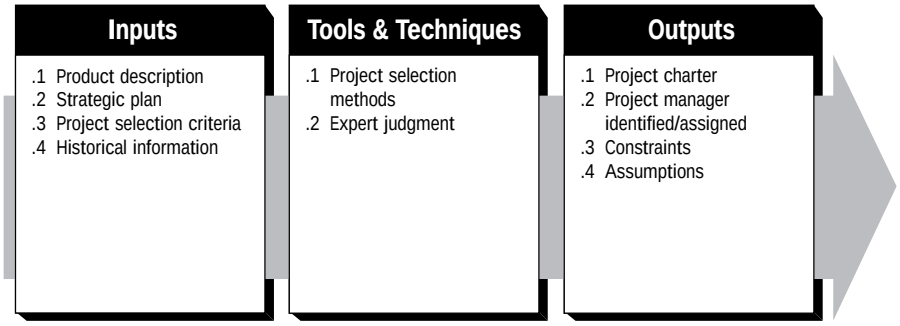


5.1 INITIATION

Initiation is the process of formally recognizing that a new project exists or that an existing project should continue into its next phase (see Section 2.1 for a more detailed discussion of project phases). This formal initiation links the project to the ongoing work of the performing organization. In some organizations, a project is not formally initiated until after completion of a feasibility study, a preliminary plan, or some other equivalent form of analysis which was itself separately initiated. Some types of projects, especially internal service projects and new product development projects, are initiated informally and some limited amount of work is done in order to secure the approvals needed for formal initiation. Projects are typically authorized as a result of one or more of the following:

- A market demand (e.g., an oil company authorizes a project to build a new refinery in response to chronic gasoline shortages).
- A business need (e.g., a training company authorizes a project to create a new course in order to increase its revenues).
- A customer request (e.g., an electric utility authorizes a project to build a new substation to serve a new industrial park).
- A technological advance (e.g., an electronics firm authorizes a new project to develop a video game player after the introduction of the video cassette recorder).
- A legal requirement (e.g., a paint manufacturer authorizes a project to establish guidelines for the handling of toxic materials).

These stimuli may also be called problems, opportunities, or business requirements. The central theme of all these terms is that management generally must make a decision about how to respond.



5.1.1 Inputs to Initiation

.1 Product description. The product description documents the characteristics of the product or service that the project was undertaken to create. The product description will generally have less detail in early phases and more detail in later ones as the product characteristics are progressively elaborated.

The product description should also document the relationship between the product or service being created and the business need or other stimulus that gave rise to the project (see list above). While the form and substance of the product description will vary, it should always be detailed enough to support later project planning.

Many projects involve one organization (the seller) doing work under contract to another (the buyer). In such circumstances, the initial product description is usually provided by the buyer. If the buyer's work is itself a project, the buyer's product description is a statement of work as described in Section 12.1.3.2.

.2 Strategic plan. All projects should be supportive of the performing organization's strategic goals—the strategic plan of the performing organization should be considered as a factor in project selection decisions.

.3 *Project selection criteria.* Project selection criteria are typically defined in terms of the product of the project and can cover the full range of possible management concerns (financial return, market share, public perceptions, etc.).

.4 *Historical information.* Historical information about both the results of previous project selection decisions and previous project performance should be considered to the extent it is available. When initiation involves approval for the next phase of a project, information about the results of previous phases is often critical.

5.1.2 Tools and Techniques for Initiation

.1 *Project selection methods.* Project selection methods generally fall into one of two broad categories [2]:

- Benefit measurement methods—comparative approaches, scoring models, benefit contribution, or economic models.
- Constrained optimization methods—mathematical models using linear, nonlinear, dynamic, integer, and multi-objective programming algorithms.

These methods are often referred to as *decision models.* Decision models include generalized techniques (decision trees, forced choice, and others) as well as specialized ones (Analytic Hierarchy Process, Logical Framework Analysis, and others). Applying complex project selection criteria in a sophisticated model is often treated as a separate project phase.

.2 *Expert judgment.* Expert judgment will often be required to assess the inputs to this process. Such expertise may be provided by any group or individual with specialized knowledge or training and is available from many sources including:

- Other units within the performing organization.
- Consultants.
- Professional and technical associations.
- Industry groups.

5.1.3 Outputs from Initiation

.1 *Project charter.* A project charter is a document that formally recognizes the existence of a project. It should include, either directly or by reference to other documents:

- The business need that the project was undertaken to address.
- The product description (described in Section 5.1.1.1).

The project charter should be issued by a manager external to the project and at a level appropriate to the needs of the project. It provides the project manager with the authority to apply organizational resources to project activities.

When a project is performed under contract, the signed contract will generally serve as the project charter for the seller.

.2 *Project manager identified/assigned.* In general, the project manager should be identified and assigned as early in the project as is feasible. The project manager should always be assigned prior to the start of project plan execution (described in Section 4.2) and preferably before much project planning has been done (the project planning processes are described in Section 3.3.2).

.3 *Constraints.* Constraints are factors that will limit the project management team's options. For example, a predefined budget is a constraint that is highly likely to limit the team's options regarding scope, staffing, and schedule.

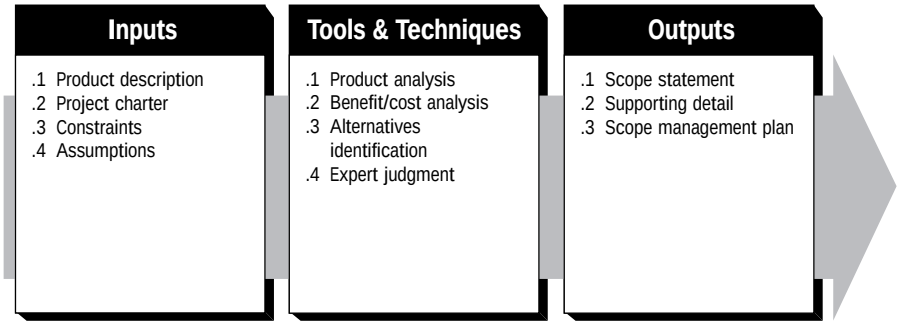
When a project is performed under contract, contractual provisions will generally be constraints.

.4 *Assumptions.* Assumptions are factors that, for planning purposes, will be considered to be true, real, or certain. For example, if the date that a key person will become available is uncertain, the team may assume a specific start date. Assumptions generally involve a degree of risk. They may be identified here or they may be an output of risk identification (described in Section 11.1).

5.2 SCOPE PLANNING

Scope planning is the process of developing a written scope statement as the basis for future project decisions including, in particular, the criteria used to determine if the project or phase has been completed successfully. A written scope statement is necessary for both projects and subprojects. For example, an engineering firm contracted to design a petroleum processing plant must have a scope statement defining the boundaries of its work on the design subproject. The scope statement forms the basis for an agreement between the project team and the project customer by identifying both the project objectives and the major project deliverables.

If all the elements of the scope statement are already available (e.g., a request for proposal may identify the major deliverables, the project charter may define the project objectives), this process may involve little more than physically creating the written document.



5.2.1 Inputs to Scope Planning

.1 *Product description.* The product description is discussed in Section 5.1.1.1.

.2 *Project charter.* The project charter is described in Section 5.1.3.1.

.3 *Constraints.* Constraints are described in Section 5.1.3.3.

.4 *Assumptions.* Assumptions are described in Section 5.1.3.4.

5.2.2 Tools and Techniques for Scope Planning

.1 *Product analysis.* Product analysis involves developing a better understanding of the product of the project. It includes techniques such as systems engineering, value engineering, value analysis, function analysis, and quality function deployment.

.2 *Benefit/cost analysis.* Benefit/cost analysis involves estimating tangible and intangible costs (outlays) and benefits (returns) of various project alternatives, and then using financial measures such as return on investment or payback period to assess the relative desirability of the identified alternatives.

.3 *Alternatives identification.* This is a catchall term for any technique used to generate different approaches to the project. There are a variety of general management techniques often used here, the most common of which are brainstorming and lateral thinking.

.4 *Expert judgment.* Expert judgment is described in Section 5.1.2.2.

5.2.3 Outputs from Scope Planning

.1 *Scope statement.* The scope statement provides a documented basis for making future project decisions and for confirming or developing common understanding of project scope among the stakeholders. As the project progresses, the scope statement may need to be revised or refined to reflect changes to the scope of the project. The scope statement should include, either directly or by reference to other documents:

- Project justification—the business need that the project was undertaken to address. The project justification provides the basis for evaluating future trade-offs.
- Project product—a brief summary of the product description (the product description is discussed in Section 5.1.1.1).
- Project deliverables—a list of the summary level sub-products whose full and satisfactory delivery marks completion of the project. For example, the major deliverables for a software development project might include the working computer code, a user manual, and an interactive tutorial. When known, exclusions should be identified, but anything not explicitly included is implicitly excluded.
- Project objectives—the quantifiable criteria that must be met for the project to be considered successful. Project objectives must include, at least, cost, schedule, and quality measures. Project objectives should have an attribute (e.g., cost), a yardstick (e.g., U.S. dollars), and an absolute or relative value (e.g., less than 1.5 million). Unquantified objectives (e.g., "customer satisfaction") entail high risk.

In some application areas, project deliverables are called project objectives while project objectives are called critical success factors.

.2 *Supporting detail.* Supporting detail for the scope statement should be documented and organized as needed to facilitate its use by other project management processes. Supporting detail should always include documentation of all identified assumptions and constraints. The amount of additional detail varies by application area.

.3 *Scope management plan.* This document describes how project scope will be managed and how scope changes will be integrated into the project. It should also include an assessment of the expected stability of the project scope (i.e., how likely is it to change, how frequently, and by how much). The scope management plan should also include a clear description of how scope changes will be identified and classified (this is particularly difficult—and therefore absolutely essential—when the product characteristics are still being elaborated).

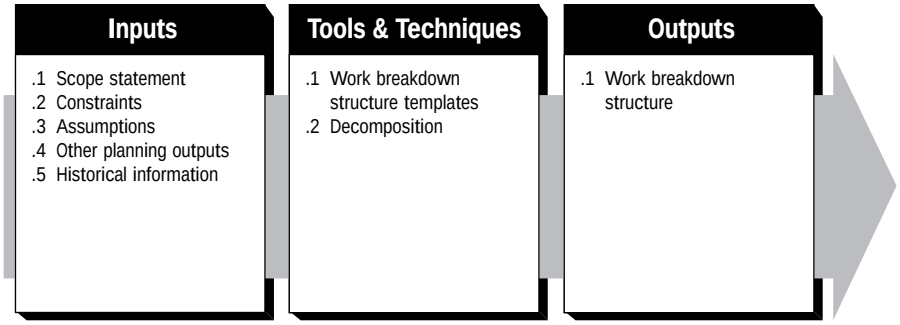
A scope management plan may be formal or informal, highly detailed or broadly framed based on the needs of the project. It is a subsidiary element of the overall project plan (described in Section 4.1.3.1).

5.3 SCOPE DEFINITION

Scope definition involves subdividing the major project deliverables (as identified in the scope statement) into smaller, more manageable components in order to:

- Improve the accuracy of cost, time, and resource estimates.
- Define a baseline for performance measurement and control.
- Facilitate clear responsibility assignments.

Proper scope definition is critical to project success. "When there is poor scope definition, final project costs can be expected to be higher because of the inevitable changes which disrupt project rhythm, cause rework, increase project time, and lower the productivity and morale of the workforce" [3].



5.3.1 Inputs to Scope Definition

.1 Scope statement. The scope statement is described in Section 5.2.3.1.

.2 Constraints. Constraints are described in Section 5.1.3.3. When a project is done under contract, the constraints defined by contractual provisions are often important considerations during scope definition.

.3 Assumptions. Assumptions are described in Section 5.1.3.4.

.4 Other planning outputs. The outputs of the processes in other knowledge areas should be reviewed for possible impact on project scope definition.

.5 Historical information. Historical information about previous projects should be considered during scope definition. Information about errors and omissions on previous projects should be especially useful.

5.3.2 Tools and Techniques for Scope Definition

.1 Work breakdown structure templates. A work breakdown structure (WBS, described in Section 5.3.3.1) from a previous project can often be used as a template for a new project. Although each project is unique, WBSs can often be "reused" since most projects will resemble another project to some extent. For example, most projects within a given organization will have the same or similar project life cycles and will thus have the same or similar deliverables required from each phase.

Many application areas have standard or semi-standard WBSs that can be used as templates. For example, the U.S. Department of Defense has defined standard WBSs for Defense Materiel Items. A portion of one of these templates is shown as Figure 5–2.

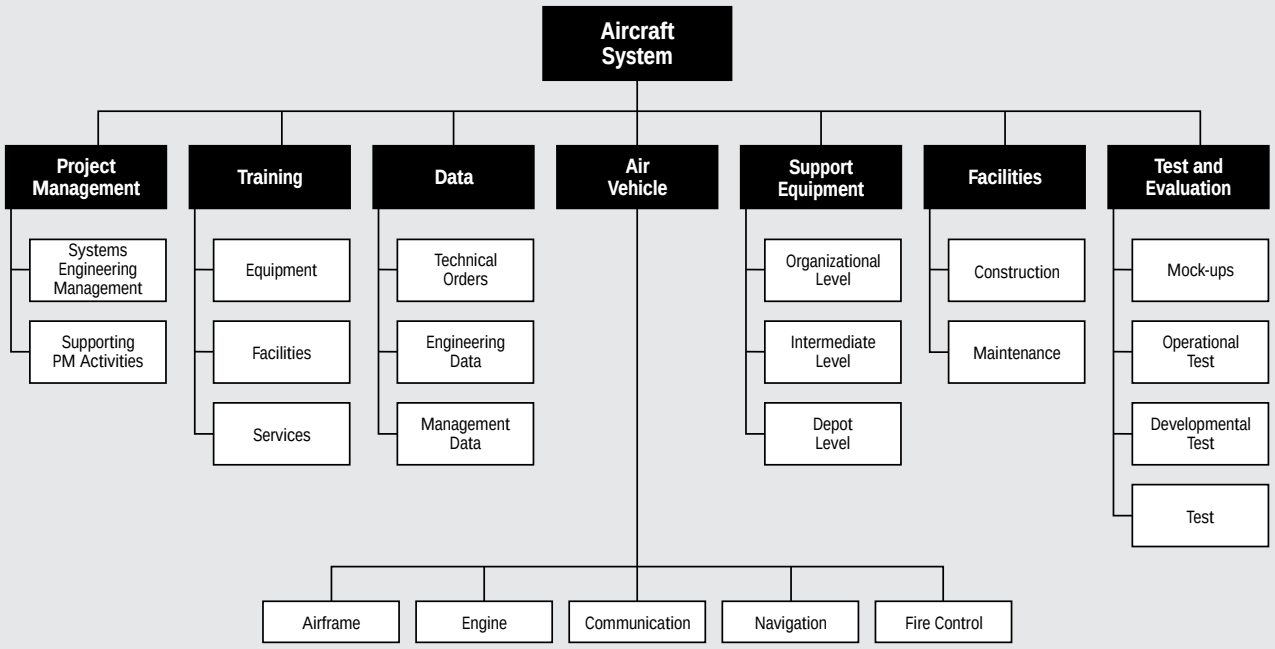
.2 Decomposition. Decomposition involves subdividing the major project deliverables into smaller, more manageable components until the deliverables are defined in sufficient detail to support future project activities (planning, executing, controlling, and closing). Decomposition involves the following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

(1) Identify the major elements of the project. In general, the major elements will be the project deliverables and project management. However, the major elements should always be defined in terms of how the project will actually be managed. For example:

- The phases of the project life cycle may be used as the first level of decomposition with the project deliverables repeated at the second level, as illustrated in Figure 5–3.
- The organizing principle within each branch of the WBS may vary, as illustrated in Figure 5–4.

(2) Decide if adequate cost and duration estimates can be developed at this level of detail for each element. The meaning of *adequate* may change over the course of the project—decomposition of a deliverable that will be produced far in the future may not be possible. For each element, proceed to Step 4 if there is adequate detail and to Step 3 if there is not—this means that different elements may have differing levels of decomposition.

Figure 5–2. Sample Work Breakdown Structure for Defense Materiel Items



This WBS is illustrative only. It is not intended to represent the full project scope of any specific project, nor to imply that this is the only way to organize a WBS on this type of project.

(3) Identify constituent elements of the deliverable. Constituent elements should be described in terms of tangible, verifiable results in order to facilitate performance measurement. As with the major elements, the constituent elements should be defined in terms of how the work of the project will actually be accomplished. Tangible, verifiable results can include services as well as products (e.g., *status reporting* could be described as *weekly status reports*; for a manufactured item, constituent elements might include several individual components plus *final assembly*). Repeat Step 2 on each constituent element.

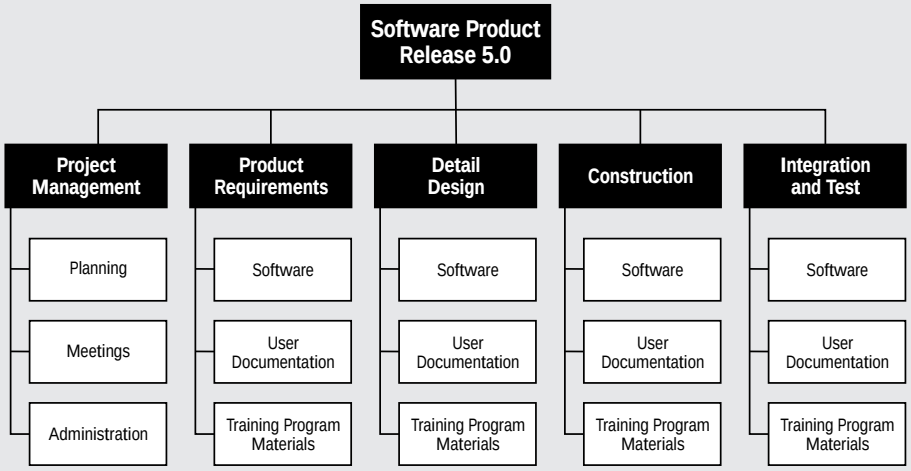
(4) Verify the correctness of the decomposition:

- Are the lower-level items both necessary and sufficient for completion of the item decomposed? If not, the constituent elements must be modified (added to, deleted from, or redefined).
- Is each item clearly and completely defined? If not, the descriptions must be revised or expanded.
- Can each item be appropriately scheduled? Budgeted? Assigned to a specific organizational unit (e.g., department, team, or person) who will accept responsibility for satisfactory completion of the item? If not, revisions are needed to provide adequate management control.

5.3.3 Outputs from Scope Definition

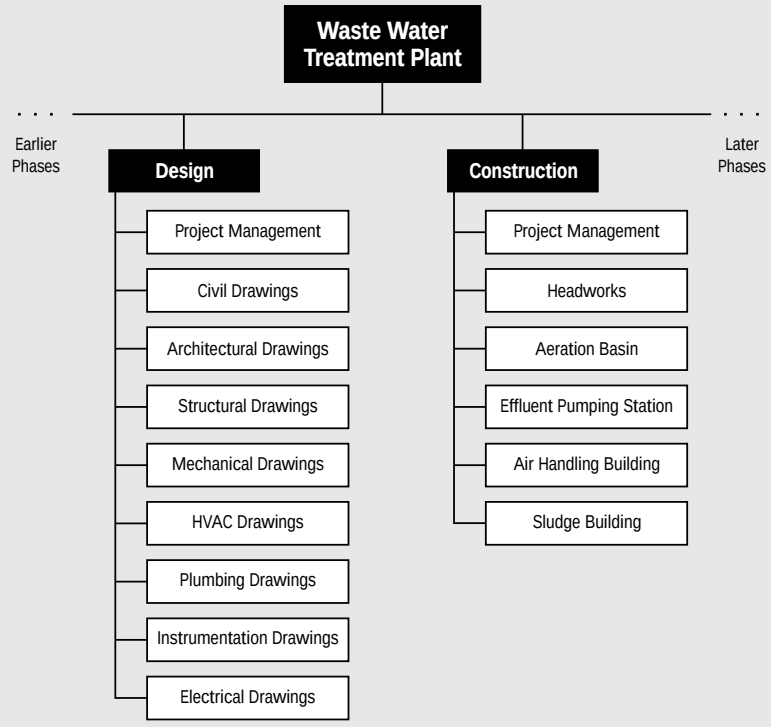
.1 *Work breakdown structure.* A work breakdown structure is a deliverable-oriented grouping of project elements that organizes and defines the total scope of the project: work not in the WBS is outside the scope of the project. As with the scope statement, the WBS is often used to develop or confirm a common understanding of project scope. Each descending level represents an increasingly detailed description of the project elements. Section 5.3.2.2 describes the most common approach

Figure 5–3. Sample Work Breakdown Structure Organized by Phase



This WBS is illustrative only. It is not intended to represent the full project scope of any specific project, nor to imply that this is the only way to organize a WBS on this type of project.

Figure 5–4. Sample Work Breakdown Structure for Waste Water Treatment Plant



This WBS is illustrative only. It is not intended to represent the full project scope of any specific project, nor to imply that this is the only way to organize a WBS on this type of project.

for developing a WBS. A WBS is normally presented in chart form as illustrated in Figures 5–2, 5–3, and 5–4; however, the WBS should not be confused with the method of presentation—drawing an unstructured activity list in chart form does not make it a WBS.

Each item in the WBS is generally assigned a unique identifier; these identifiers are often known collectively as the *code of accounts*. The items at the lowest level of the WBS are often referred to as *work packages*. These work packages may be further decomposed as described in Section 6.1, Activity Definition.

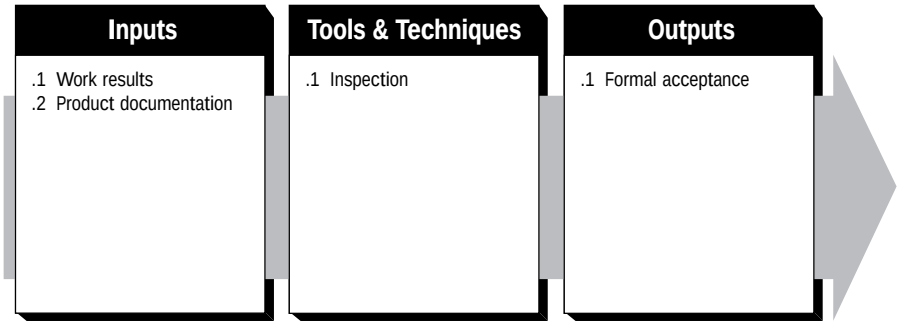
Work element descriptions are often collected in a *WBS dictionary*. A WBS dictionary will typically include work package descriptions as well as other planning information such as schedule dates, cost budgets, and staff assignments.

The WBS should not be confused with other kinds of "breakdown" structures used to present project information. Other structures commonly used in some application areas include:

- Contractual WBS (CWBS), which is used to define the level of reporting that the seller will provide the buyer. The CWBS generally includes less detail than the WBS used by the seller to manage the seller's work.
- Organizational breakdown structure (OBS), which is used to show which work elements have been assigned to which organizational units.
- Resource breakdown structure (RBS), which is a variation of the OBS and is typically used when work elements are assigned to individuals.
- Bill of materials (BOM), which presents a hierarchical view of the physical assemblies, subassemblies, and components needed to fabricate a manufactured product.
- Project breakdown structure (PBS), which is fundamentally the same as a properly done WBS. The term PBS is widely used in application areas where the term WBS is incorrectly used to refer to a BOM.

5.4 SCOPE VERIFICATION

Scope verification is the process of formalizing acceptance of the project scope by the stakeholders (sponsor, client, customer, etc.). It requires reviewing work products and results to ensure that all were completed correctly and satisfactorily. If the project is terminated early, the scope verification process should establish and document the level and extent of completion. Scope verification differs from quality control (described in Section 8.3) in that it is primarily concerned with *acceptance* of the work results while quality control is primarily concerned with the *correctness* of the work results.



5.4.1 Inputs to Scope Verification

.1 Work results. Work results—which deliverables have been fully or partially completed, what costs have been incurred or committed, etc.—are an output of project plan execution (discussed in Section 4.2).

.2 Product documentation. Documents produced to describe the project's products must be available for review. The terms used to describe this documentation (plans, specifications, technical documentation, drawings, etc.) vary by application area.

5.4.2 Tools and Techniques for Scope Verification

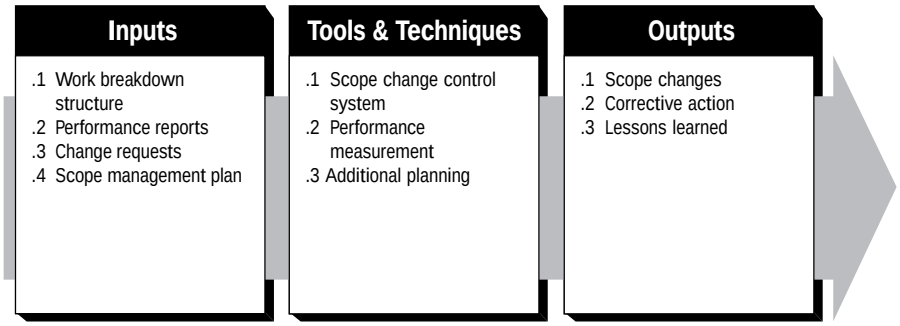
.1 Inspection. Inspection includes activities such as measuring, examining, and testing undertaken to determine whether results conform to requirements. Inspections are variously called reviews, product reviews, audits, and walk-throughs; in some application areas, these different terms have narrow and specific meanings.

5.4.3 Outputs from Scope Verification

.1 Formal acceptance. Documentation that the client or sponsor has accepted the product of the project or phase must be prepared and distributed. Such acceptance may be conditional, especially at the end of a phase.

5.5 SCOPE CHANGE CONTROL

Scope change control is concerned with (a) influencing the factors which create scope changes to ensure that changes are beneficial, (b) determining that a scope change has occurred, and (c) managing the actual changes when and if they occur. Scope change control must be thoroughly integrated with the other control processes (time control, cost control, quality control, and others as discussed in Section 4.3).



5.5.1 Inputs to Scope Change Control

.1 Work breakdown structure. The WBS is described in Section 5.3.3.1. It defines the project's scope baseline.

.2 Performance reports. Performance reports discussed in Section 10.3.3.1 provide information on scope performance such as which interim products have been completed and which have not. Performance reports may also alert the project team to issues which may cause problems in the future.

.3 Change requests. Change requests may occur in many forms—oral or written, direct or indirect, externally or internally initiated, and legally mandated or optional. Changes may require expanding the scope or may allow shrinking it. Most change requests are the result of:

- An external event (e.g., a change in a government regulation).
- An error or omission in defining the scope of the product (e.g., failure to include a required feature in the design of a telecommunications system).
- An error or omission in defining the scope of the project (e.g., using a bill of materials instead of a work breakdown structure).
- A value-adding change (e.g., an environmental remediation project is able to reduce costs by taking advantage of technology that was not available when the scope was originally defined).

.4 Scope management plan. The scope management plan is described in Section 5.2.3.3.

5.5.2 Tools and Techniques for Scope Change Control

.1 *Scope change control system.* A scope change control system defines the procedures by which the project scope may be changed. It includes the paperwork, tracking systems, and approval levels necessary for authorizing changes. The scope change control system should be integrated with the overall change control system described in Section 4.3 and, in particular, with any system or systems in place to control *product* scope. When the project is done under contract, the scope change control system must also comply with all relevant contractual provisions.

.2 *Performance measurement.* Performance measurement techniques, described in Section 10.3.2, help to assess the magnitude of any variations which do occur. An important part of scope change control is to determine what is causing the variance and to decide if the variance requires corrective action.

.3 *Additional planning.* Few projects run exactly according to plan. Prospective scope changes may require modifications to the WBS or analysis of alternative approaches.

5.5.3 Outputs from Scope Change Control

.1 *Scope changes.* A scope change is any modification to the agreed-upon project scope as defined by the approved WBS. Scope changes often require adjustments to cost, time, quality, or other project objectives.

Scope changes are fed back through the planning process, technical and planning documents are updated as needed, and stakeholders are notified as appropriate.

.2 *Corrective action.* Corrective action is anything done to bring expected future project performance into line with the project plan.

.3 *Lessons learned.* The causes of variances, the reasoning behind the corrective action chosen, and other types of lessons learned from scope change control should be documented so that this information becomes part of the historical database for both this project and other projects of the performing organization.