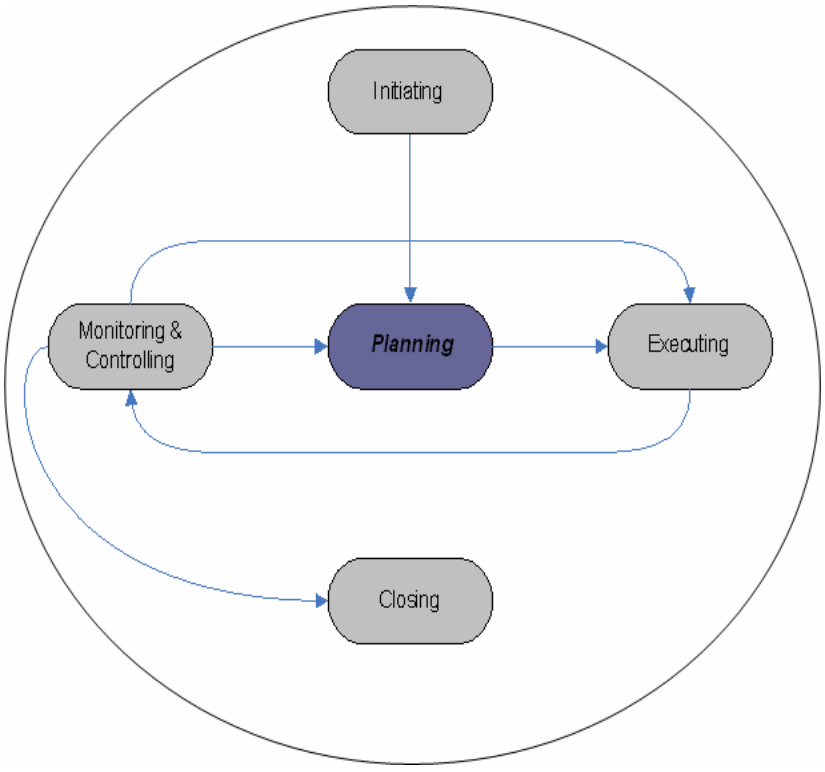
3.1 Project Planning Overview

The Project Planning Phase follows the Project Initiation Phase and is considered to be the most important phase in project management. Time spent up front identifying the proper needs and structure for organizing and managing projects saves countless hours of confusion and rework in the Execution and Control Phases of the project.

The following figure depicts at what point in the Project Management Phases this section of the methodology will be discussed.

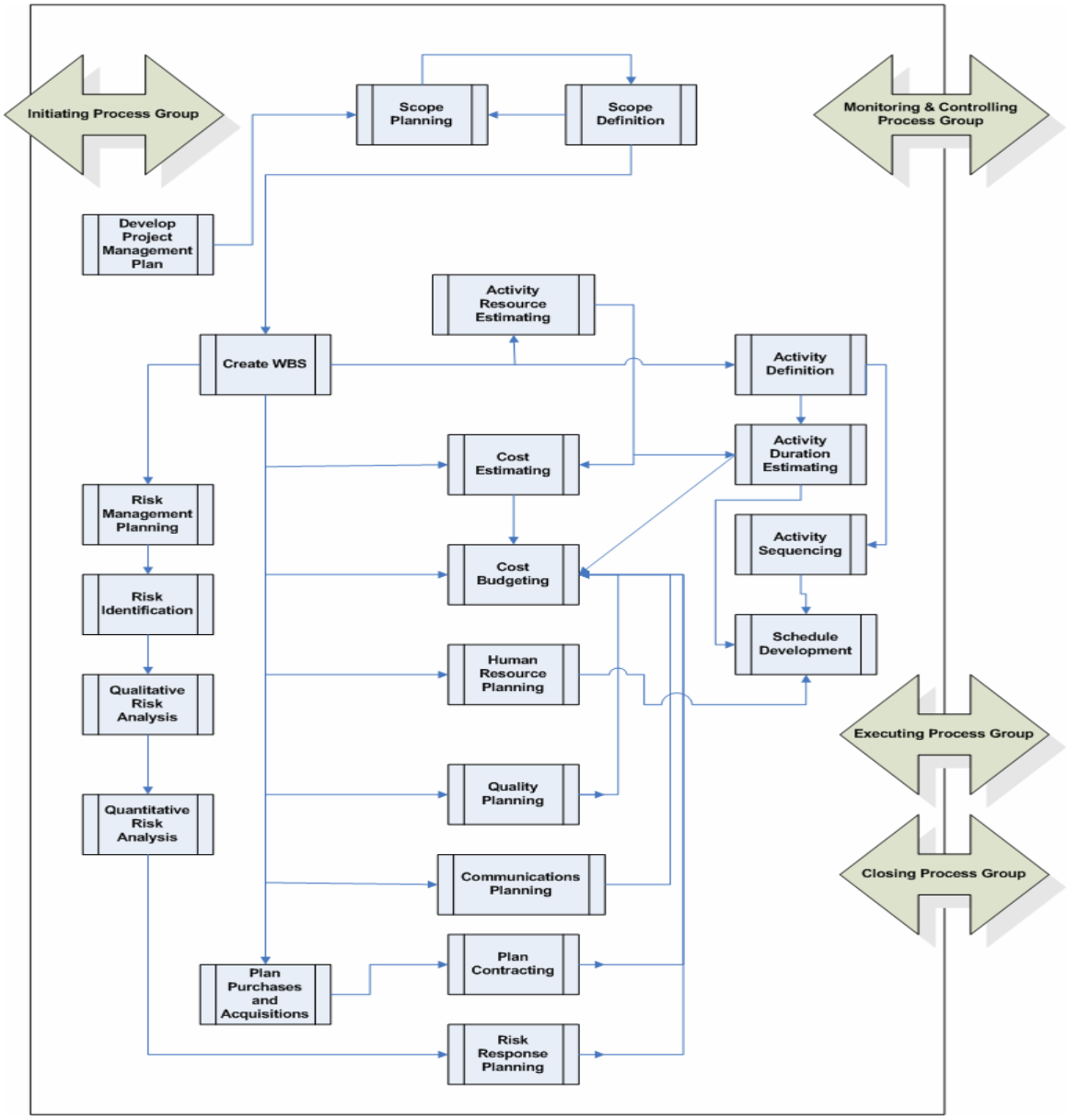
Project Management Planning Phase
Figure 3.1.1



The purpose of this phase in the Project Management Process is to establish business requirements, to establish precise cost and schedule of the project (including a list of deliverables and delivery dates), to establish the work organization, and to obtain management approval.

Relationships of the Planning processes described in this section of the methodology are depicted in Figure 3.1.2.

Planning Phase Processes
Figure 3.1.2



The Intent of Project Planning

Without planning, a project success will be difficult, if not impossible. Team members would have limited understanding of expectations, activities may not be properly defined, and resource requirements may not be completely understood. Even if the project is finished, no one may have defined the conditions for success. Project Planning points out the needs for several specialized areas of concentration when determining the needs for a project. Planning will involve identifying and documenting scope, tasks, schedules, risks, quality, disaster recovery, and staffing needs. The identification process should continue until as many of the areas as possible of the chartered project have been addressed.

The Importance of Project Planning

Inadequate and incomplete Project Planning is the downfall of many high profile and important projects. An adequate planning process and Project Plan will assure that resources and team members will be identified to ensure that the project will be successful.

Project Planning Roles & Responsibilities

Everyone on the project team and in most cases several stakeholders will play a part in the input to planning a project. The responsibilities for Project Planning are summarized below:

- Project Managers are responsible for developing a Project Plan for a specific project. The Project Manager is responsible for ensuring that the overall planning requirements are fulfilled. This includes delegation of responsibility for specific plan documentation and sign- off for approval at the end of the Planning Phase.

- Functional/organizational management is responsible for ensuring that there are adequate resources assigned to a project. This includes both managerial and product development assignments. Management is a full time job for most projects – it is not an activity well suited to being performed in small part by many staff members.

- Key stakeholders play an integral part in the planning of a project. They should have representative input and approval in the Project Plan and associated documents before Project Execution takes place.

3.2 The Planning Process & the Project Plan

Project Planning is not a single activity or task. It is a process that takes time and attention. Remember that the project is not the product/process deliverable itself, but rather all of the activities, documents, and pieces that go into producing the product or process.

Similarly, the intent of the Project Management Methodology in its entirety is to create a project management process that is repeatable and stable. This process includes people with many different backgrounds and from various functional areas. The process is created to ensure the flow of the planning efforts from beginning to end in such a way that all of the necessary areas affecting the project process (or created by it) are considered.

Project Planning defines the project activities that will be performed, end products that will be produced and describes how all of these activities will be accomplished. The purpose of Project Planning is to define each major task, estimate the time and resources required, and provide a framework for management review and control. The Project Planning activities include defining:

- Specific work to be performed and goals that define the project
- Specific objectives, deliverables and success factors to meet the project goals
- Estimates to be documented for planning, tracking, and controlling the project
- Commitments that are planned, documented, and agreed to by affected groups
- Project alternatives, assumptions, and constraints

- Creation of baseline plans from which the project will be managed

Steps in the Planning Process

The planning process consists of the following basic tasks:

- Define the approach used to solve the problem.
- Define and sequence the tasks to be performed and identify all deliverables associated with the project.
- Define the dependency relations between tasks.
- Estimate the resources required to perform each task.
- Schedule all tasks to be performed.
- Define a budget for performing the tasks.
- Define the functional area(s) used to execute the project.
- Estimate each task's duration.
- Identify the known risks in executing the project.
- Define the process used for ensuring quality.
- Define the process used for disaster recovery planning.
- Define the process used for specifying and controlling requirements.

Completion of these steps is necessary to establish the Project Plan. Typically, several iterations of the planning process are performed before a plan is actually completed.

The Project Plan represents the basic tool for successfully executing a project.

The Project Plan

"A Project Plan is a formal, approved document that is used to guide both project execution and project control," - PMI.

The Project Plan forms the basis for all management efforts associated with the project. It is a record of plans that is expected to change over time.

The assigned Project Manager creates the Project Plan. It should be as accurate and complete as possible without being several volumes in length. The Project Plan documents the pertinent information associated with the project; it is not a verbose textual document. The Project Plan should cover the following topics at a minimum:

- General Project Information (Points of Contact, phone numbers, etc.)
- Project Summary
- Project Scope Statement
- Work Breakdown Structure
- Organizational Breakdown Structure
- Cost Benefit Analysis
- Resource Plan
- Project Schedule
- Risk Plan
- Procurement Plan

- Quality Plan
- Communications Plan
- Configuration Management Plan
- Disaster Recovery Planning Approach
- Project Budget Estimate
- Project Planning Transition Checklist

The State of Arkansas Executive Chief Information Officer has published a statement on Best Practices for Managing State Information Technology Projects. This statement provides a guideline as to which of these areas should be addressed, based on the size of the project. A template that will assist with determining the magnitude of the project and identifying which topics to address can be found in the appendix.

These are areas discussed in detail in other sub-sections within the Project Planning section of the methodology.

Format of the Project Plan

A format template for a Project Plan is provided in the Appendix. The template itself is presented in an abbreviated form. The actual template and particular sections, once filled in with project data, will be longer than appears in the blank template.

Also, it is suggested that all areas of the Project Planning Phase be reviewed in detail before the actual Project Plan is created. In fact, the review and subsequent documents/plans created from the review may be summarized within the Project Plan or in some cases be attached to the Project Plan. It is imperative that all areas required in the Project Plan be addressed. As mentioned, the Project Plan is a repository of records that summarizes

the general processes and plans which highlight the detailed processes within the project methodology.

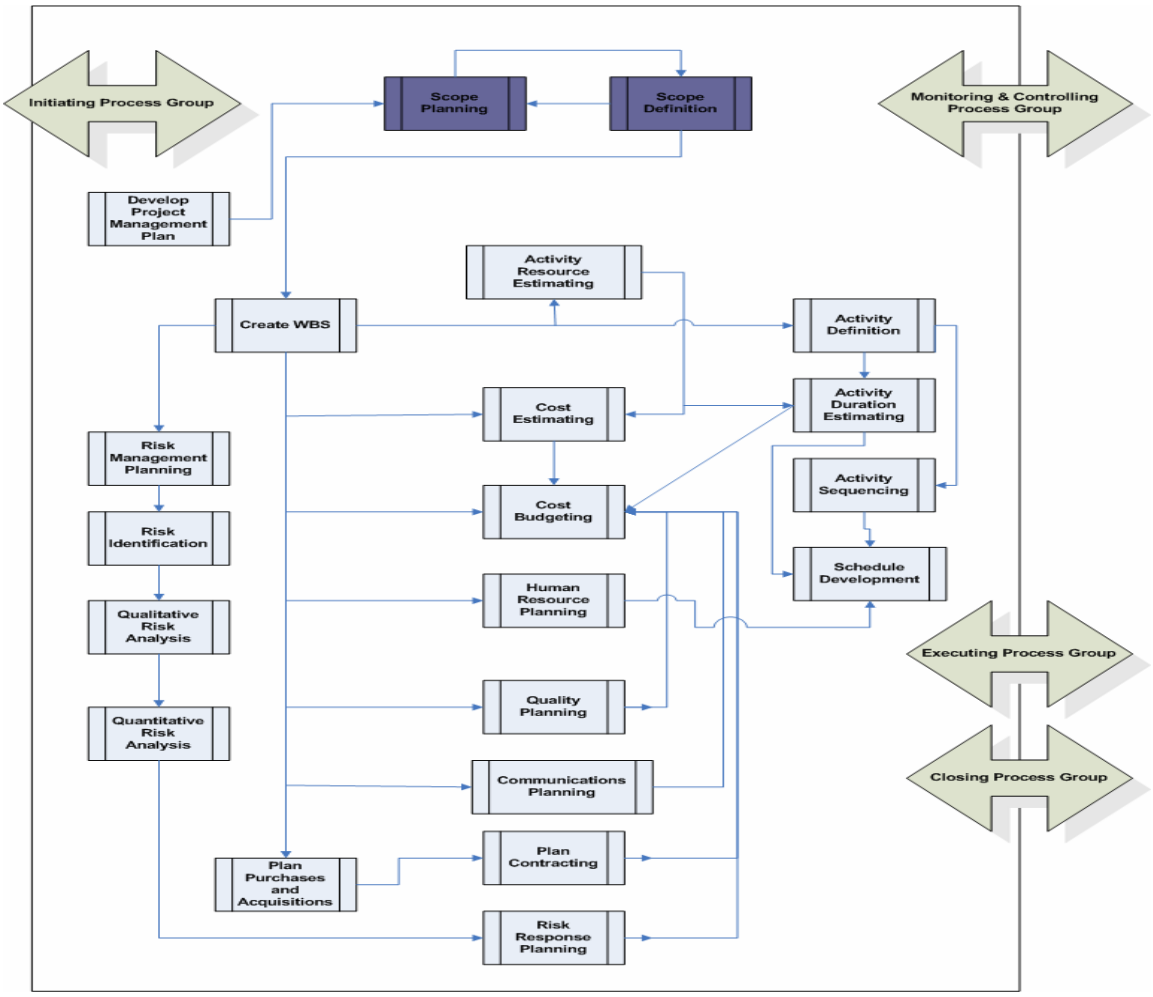
The information associated with the plan evolves as the project moves through its various stages and is to be updated as new information develops about the project. This, of course, will require revision to the Project Plan itself. As previously stated, the Project Plan is a dynamic document that is expected to go through many changes during the life of the project.

3.3 Scope Planning

"Scope Planning is the process of progressively elaborating and documenting the project work (project scope) that produces the product of the project," - PMI.

Scope Planning looks at project scope from the viewpoint of the user. It describes what will be delivered to the users, where it will be delivered, and how it will be delivered. Project scope describes what is included in the project or project phase, and equally important, what will be excluded, such as functions that will not be automated or customers that will not be served. The outputs of scope planning are the Scope Statement and Scope Management Plan, with the supporting detail.

Scope Planning Processes
Figure 3.1.2



The 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. The Scope Statement should focus on what will be delivered to the users and be written in "user language" rather than "technical language." The Scope Statement includes not only the statement of "what is the scope," but also the business rationale behind it. Sometimes the best way to communicate project scope is to describe what is excluded rather than what is included. This is very useful in the management of stakeholder expectations. The Scope Statement is a very important part of a project funding request.

The Scope Statement should include:

- ***Project Description*** – A brief description of the project.

- ***Project Justification*** – The business need that the project will address. The project justification provides the basis for evaluating future tradeoffs.

- ***Project Product*** – A brief summary of the product description.

- ***Phase Description*** – A summary of the next phase(s) that is (are) the subject of this planning activity. The plan being developed may be for a single project phase, such as requirements analysis, or may be for multiple phases, such as design, development, and implementation combined.

- ***Major Deliverables*** – A description of major deliverables including the final product(s) and the hardware, software and documentation required to produce the final product(s). Deliverables are those items that must be delivered to complete the project or project phase, and must be formally accepted by the key stakeholders. The deliverables may include things such as requirements and design documents, hardware and software installations, test plans, training plans, and user and technical support manuals. For each deliverable there should be:

- A description of the deliverable
- The approach to be used to develop/acquire the deliverable
- Completion criteria
- Disaster Recovery Approach

- ***Functional Scope*** – High-level business process flow charts supported by process descriptions, show clearly the boundaries of business processes/ functions that are included and those that are excluded from the scope of the project.

- ***Organization/Stakeholder Scope*** – What Organizations/ Stakeholders will be affected and how, exclusions can be very important.

- ***Technical Scope*** – What technologies will be utilized, the ones deliberately excluded, and why.

- ***Geographical Scope*** – Which sites will or will not be impacted and in what way.

- ***Costs/Benefits Summary*** – What are the expected or unexpected costs and benefits? Are these used to aid in the project justification?

- ***Assumptions and Constraints*** – Assumptions may relate to issues such as:
  - Readiness of the organization to accept and implement changes to their business processes.
  - The availability of key resources whether staff, space, or equipment.
  - The performance and reliability of a new technology being used.

Constraints may be financial, legal, deadline, technical, or political.

- ***Risk Factors*** – Identify potential risks such as, use

of leading edge technologies, lack of required skills, lukewarm management support, etc., and a qualitative assessment of the potential impact on project success in terms of quality, schedule, and cost.

Scope Management Plan

Project Scope Management can be just as important to Scope Planning as the ScopeStatement itself. This effort describes how the project scope will be managed and how scope changes will be integrated into the project. It is a simple statement that discusses the likelihood of scope change within the project and how any changes will be identified.

The efforts of Scope Management should integrate well with the Configuration Management Plan created later in the planning process. A Scope Management Plan may be formal or informal, highly detailed or broadly framed, based on the needs of the project.

Commitment and Approval

Once the Scope Statement has been developed, the next step for the project team is to review it with the project sponsor and stakeholders for their approval. This is the time to ensure there are no misunderstandings between the team and the stakeholders that could result in changes to the project scope after the work has begun. To ensure that the scope statement is completed correctly and in its entirety, the Scope Statement should be signed by the key stakeholders.

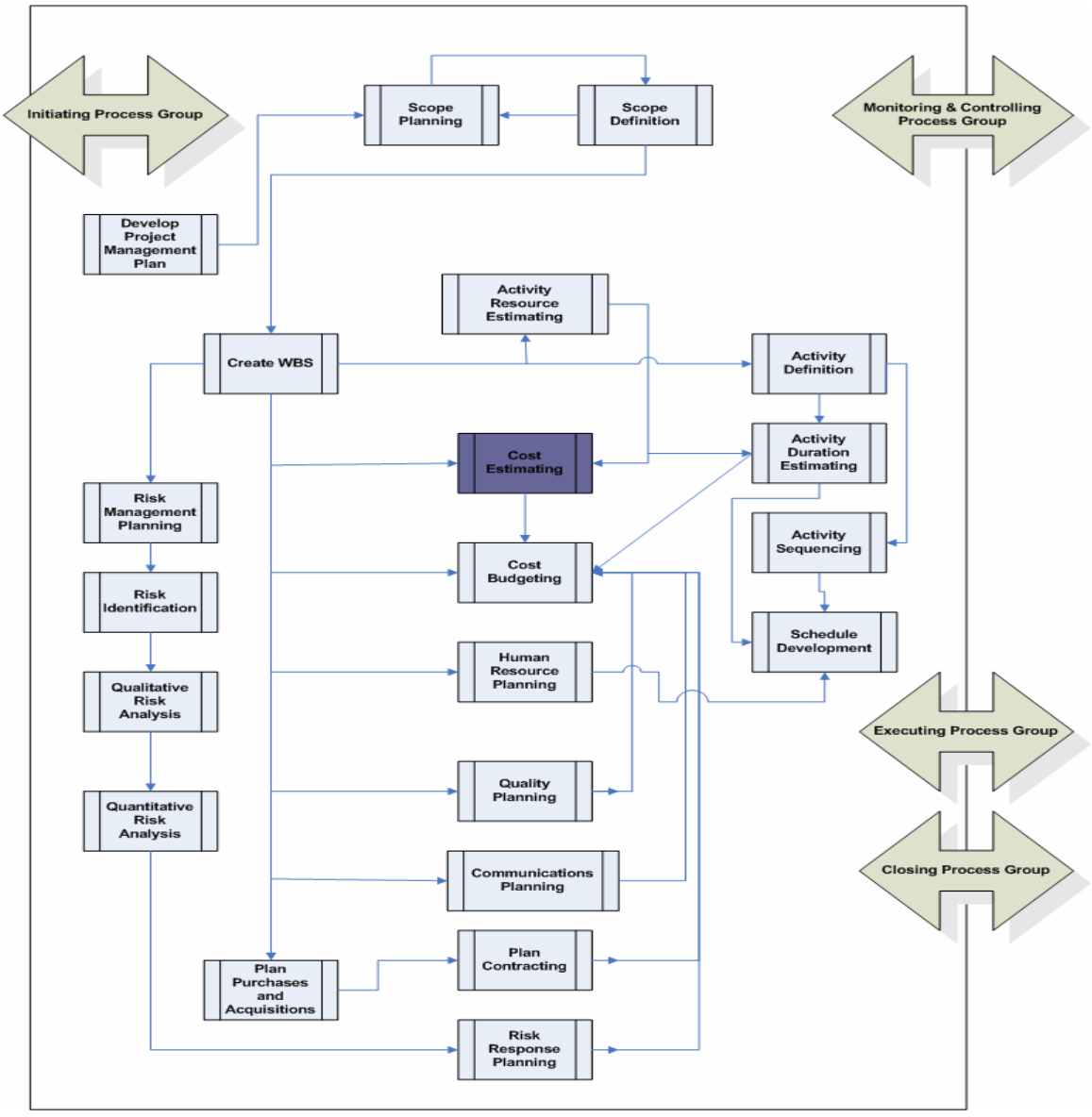
Scope Statements for IT Projects

Scope planning for an Information Technology project is no different than any other project. There is no need to have the level of detail in a Scope Statement that a formal Requirements Document includes. While the Information Technology Project Scope Statement makes reference to technology issues (such as the technology to be used) it is not intended to be a technical document. The audience of the Information Technology Project Scope Statement is interested in what will be achieved, rather than what the technical requirements will be to carry out the project.

3.4 Cost Analysis

A Cost Analysis provides the information to make a balanced decision about the cost, benefits, or value, of various economic choices. Cost Analysis can provide estimates of costs and benefits before a choice is implemented, improve understanding of a project in determining what levels of intervention are most cost-effective, and reveal unexpected costs. Cost Analysis provides the basis for making sound business decisions.

Scope Planning Processes
Figure 3.4.1



Two Types of Cost Analysis

- ***Cost-Effectiveness Analysis*** – Assumes that a certain benefit or outcome is desired, and there are several alternative ways to achieve it. The basic question asked is, "Which of these alternatives is the cheapest or most efficient way to get this benefit?" It is a comparative analysis.

- ***Cost-Benefit Analysis*** – The basic questions asked are, "Do the economic benefits of the product outweigh the economic costs," and "Is it worth doing at all?" Cost Benefit Analysis can include the total cost of benefits divided by the total cost or total costs minus the total value of the benefits.

Cost Analysis Content

The amount of detail and information included in a Cost Analysis will depend on the size and complexity of the individual project. Large and small projects should cover the same subjects, but a smaller project may be more consolidated. Don't spend more time and money on the analysis than the project is worth. It should be a tool to help organize information so economical decisions can be made. In addition to the information on the Cost Analysis document, some typical appendices to a Cost Analysis might include:

- Detailed cost estimates for individual alternatives, including the basis for estimating each Work Breakdown Structure element

- A Work Breakdown Structure outline and a dictionary that defines what is in each cost element

- Detailed schedules that can later be used to manage the project

- Specific references to support the estimating methodology

- A glossary that defines abbreviations and terms used in the analysis

Steps in Conducting a Cost Analysis

Using this approach as a framework for developing a Cost Analysis will help evaluate the status quo/alternative (as-is/to-be) processes, define the objectives more thoroughly, and address the alternatives consistently. Although the general outline should always be followed, the amount of detail used during each step will vary depending on the size and complexity of the individual project.

Step 1: Define the Project

This step is the most critical. It forms the foundation for the rest of the effort. It includes identifying the problem to be solved, objectives of the mission or function, and alternatives that will satisfy the customer's needs while staying within environmental factors such as assumptions and constraints. It also includes defining the Work Breakdown Structure deliverables to be assessed, costs, assumptions, and ground rules for the status quo and alternatives models.

The Work Breakdown Structure becomes the outline for the rest of the work to be done. The Work Breakdown Structure will be updated on a regular basis as the analysis progresses. The Work Breakdown Structure is also the basis for the majority of the information that goes in the various parts of the Cost Analysis Report Sections 1 (Project Overview and Background) and 2 (Discussion of Alternatives). A Work Breakdown Structure should be used for both the As-Is model and the To-Be model. This is important to insure there is a common basis when comparing alternatives and that all relevant issues have been included.

The Cost Analysis should always include a complete list of assumptions and ground rules along with supporting rationale, guidance, and references. The important criteria are that they are reasonable and based on historical data, economic forecasts, or planned changes in processes or operations. Examples of general categories include:

- ***General and Programmatic*** - Information in these areas should reflect approved decisions, budgets, and schedules that will influence how the costs and benefits are calculated. Examples in this area might

include legislative direction, laws, actual budgets, approved strategic plans, etc. Programmatic assumptions might include implementation plans, goals and measures, availability of resources, policy decisions, etc. It is often difficult to distinguish between these two areas, so it is usually better to address them together. The important thing is to get them written down so reviewers understand the project's content and any constraints on the project, especially those that are externally imposed.

- ***Technical and Functional*** – In the technical area, these assumptions will reflect agreement on representative technical architecture, capability, disaster recovery, and support, such as how Personal Computers (PCs) are used and maintained, and what the standards are for office software, etc. The functional area reflects the concept of operations for day-to-day work, processes, procedures, and other basic information needed to estimate reasonable costs and benefits.

- ***Cost Estimating*** – Typically include items like a standard work year for a full-time equivalent, wage/salary rates, the discount rate used for present value calculations, catalog pricing, economic life for items being estimated, disposal values, inflation indices, etc.

Step 2: Research the Cost Elements

This step includes researching the cost elements that make up the Work Breakdown Structure, collecting appropriate cost driver data, analyzing and validating the data, deciding on an estimating methodology, and then costing all the elements. The results will be the basis for Section 3 of the Cost Analysis report (Life Cycle & Benefits).

Estimating and Analyzing Costs

The purpose of cost estimating is to translate specific physical resources into costs. The process of identifying development, acquisition, and operating costs and benefits is necessary, even if the formulas and cost elements are not well defined. When values for a task cannot be finitely determined, a methodology may be used to estimate an approximate value. Depending on the size of the project, its

complexity, and how far along in the development cycle it is, a combination of techniques will probably be used to estimate the total costs and benefits. Specific techniques that may be used to estimate costs include:

- ***Parametric Method*** – This technique uses a statistical relationship between historical data and other variables (e.g., square footage in construction, lines of code in software development) to calculate an estimate. This approach is generally used early in the lifecycle as the primary method to support reviews because only limited definition is available.

- ***Analogous Method*** – Also called top-down uses the actual cost of a previous, similar project as the basis for estimating the cost of the current project. Analogous estimating is a form of expert judgment and is generally less costly than other techniques, but less accurate.

- ***Bottom-up Method*** – This technique uses a detailed approach where the project is decomposed into discrete activities and the labor, material, and other resource units (for example, hours for labor) are quantified based on known factors so that costs can be applied to them. This approach is generally applied later in the project.

Estimating and Analyzing Benefits

Potential benefits include quantifiable savings and cost avoidances as well as non-quantifiable benefits. The task of developing and validating benefit estimates as part of a Cost Analysis involves quantifying project data, resources, and opportunity costs and benefits, and then aggregating these by alternative. To ensure that all the benefits have been identified, someone should make up an initial list. Then use Delphi techniques (request expert opinions) to complete the list. Categorize the benefits as quantifiable or non-quantifiable, and then group them within these categories to define the type of benefit being derived (availability, functionality, maintainability, productivity, etc.).

Next, estimate quantifiable savings and cost avoidances using the same techniques outlined for determining costs. Equally important to decision makers will be the

assessment of non- quantifiable benefits such as improved management information, versatility, and flexibility. Although dollar savings cannot always be determined for these types of improvements, they can be compared through standard statistical scoring or weighting techniques.

Step 3: Identify Major Cost Drivers

Once the basic estimating is done, there is a need to identify the principal functional, technical, and schedule cost drivers and their potential sensitivity to changes in assumptions or project decisions. After identifying these Work Breakdown Structure elements and the variables associated with them, test their stability and see how much they can change before the information to support the conclusions would yield a different result.

Step 4: Analyze Risk And Sensitivity

Sensitivity analysis determines the degree to which costs and benefits are sensitive to changes in factors such as hardware configuration or length of service life. Risk and uncertainty analyses are similar except that risk analysis deals with a measurable probability distribution and uncertainty does not. Because most decisions and cost estimates support these elements of uncertainty, the analyses should be accompanied by an assessment of risk and uncertainty, especially for the major cost drivers. The elements should also be organized in a way to identify, quantify, and measure the potential costs associated with risk. Some common techniques include:

- ***Contingency Analysis*** – This is an evaluation of a set of conditions to determine the technical, financial, or business risks. This type of analysis identifies how alternatives might be affected by potential changes in criteria for evaluation alternatives, ground rules, or general environmental changes.

- ***Risk and Uncertainty Analysis*** – Risk analysis is generally defined as the consequences of uncontrollable random events from a known probability distribution (e.g., rolling dice). For uncertainty analysis, the probability distribution is

unknown. This situation is often referred to as unknown unknowns (UNK UNKs). These instances can be associated with Work Breakdown Structure elements and then probabilities can be assessed to derive point estimates for schedule, technical, and cost risks.

- ***Sensitivity Analysis*** – While this analysis can use some of the same statistical techniques as risk and uncertainty analysis, it is generally used to assess how much a key project parameter or major cost driver must move before a different decision would be made. That is, it assesses how sensitive to change the ranking of alternatives is based on varying individual cost drivers.

- ***Parametric Analysis*** – This technique is employed to test cost-estimating results and projections and mathematical relationships used to estimate a project's elements. Use curve-fitting techniques to develop the estimating relationships and then use statistical analyses to validate usage and fit. Finally, analyze the significance of the curve fit and its relevance to estimating the project's elements to ensure (1) the relationships being used do not fall outside the bounds of the data; and (2) no anomalies are in the data that should have been adjusted prior to fitting the selected curve.

Step 5: Analyze Alternatives

In addition to comparing total costs and benefits among alternatives, other techniques are usually needed to understand which choice is really the best. Depending on the size and complexity of the project, some common procedures to compare alternatives include:

- ***Present Value Analysis*** – Once costs and benefits are estimated and the major cost drivers are identified and assessed for risks and sensitivity, the results need to be time-phased and compared in constant (base year), current (then year), and present value dollars. Current dollars reflect inflation. The present value analysis is done to show the discounted cash flow of the various alternatives' investment streams using an expected investment

percent return. Where the life cycles are of unequal length, use uniform, annual, present-value costs to compare alternatives. This technique of discounting expected costs allows the results of alternatives to be compared despite different expenditure patterns.

- ***Return on Investment*** – This is simply looking at the return (benefits) for the amount of investing (cost) in development and implementation (nonrecurring costs). This is also generally looked at in terms of present value dollars. The rate of return is the discount rate at which the present value of the savings is equal to the present value of the investment cost through the remaining life cycle of the project being evaluated.

- ***Break-Even Point Analysis*** – This is looking at how long it takes to recover the investment. The break-even point is the point, say number of years into the future, at which the cumulative savings become positive. This metric is often used when there is a desire to recover investment costs quickly or generate economic or political benefits quickly.

Step 6: Present the Results

The depth and formality of cost-benefit analysis should be consistent with the complexity and potential cost of the project. The analyst must exercise judgment and use his/her knowledge of the environment, budgets, and the project to decide how much effort is invested in documenting the results. The emphasis should always be on the quality of analysis rather than the quantity of analysis. Aim for a concise, clearly written Cost Analysis so that reviewers and senior management can easily follow the analysis and understand what the key cost drivers are and how they impact the analysis. A Cost Analysis Report template is provided in the Appendix to use as a guideline in presenting a summary of the analysis and recommendations.

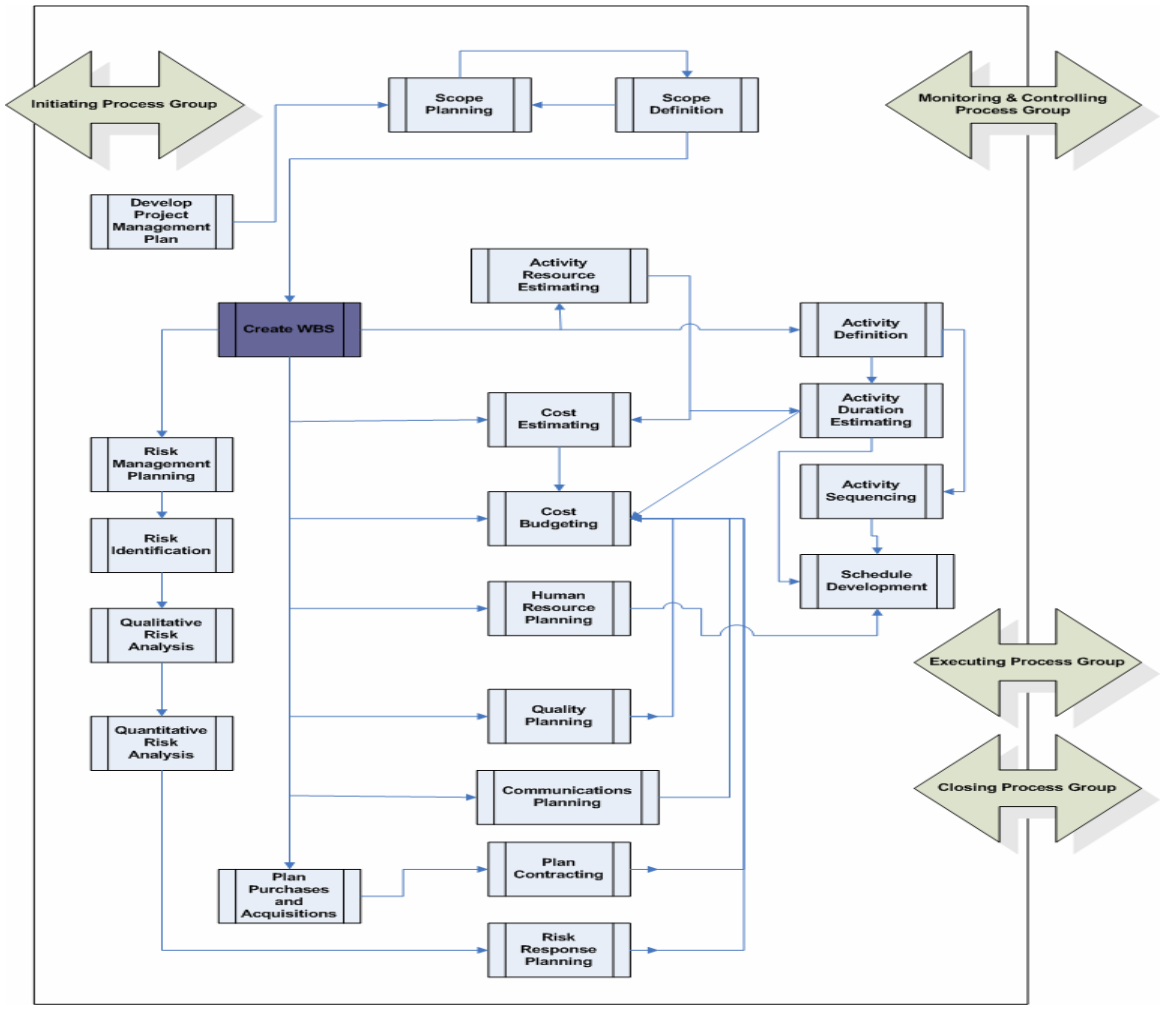
Cost Analysis for IT Projects

The Cost Analysis is one of the areas where Information Technology projects differ slightly from other projects, but the intention and result remain constant. The technical side of the analysis considers the trade-off of applying one technical approach to another. There are usually several technology options available to all projects. The rate at which technology is changing and improving has a dramatic impact on the cost and reasonability of using selected technologies. Therefore, the Project Manager must be aware of the cost implications of comparing one technology to another when performing a Cost Analysis.

3.5 Work Breakdown Structure

The Work Breakdown Structure (WBS) decomposes the entire project into a logical structure of tasks and activities that are tied to deliverables and to assigned responsibilities. The elements of the scope are decomposed to a level that provides a clear understanding of what is to be delivered for purposes of planning, controlling and managing project scope. In its entirety, a Work Breakdown Structure represents the total scope of a project. A Work Breakdown Structure is neither a schedule nor an organizational representation of the project; instead it defines what is to be delivered. This is the one planning tool that must be used to ensure project success on any sized project.

Work Breakdown Structure Processes
Figure 3.5.1



Work Breakdown Structure Development

- ***High-Level Development*** - The first level of the break down is generally a functional breakdown. The functional WBS is developed to depict the associated project deliverables. The characteristics of the WBS depend upon the nature of the project and how the Project Manager wants to plan and manage the work.

- ***Assign High-Level Responsibility*** - Once the high-level elements of the Work Breakdown Structure are defined the organization's functional area is responsible to deliver the overall elements of scope are assigned responsibility. This will ensure there is a management focus to decompose the high-level elements into discrete products and services and thus complete the task of defining the entire scope of the project.

- ***Decompose the WBS*** - The Work Breakdown Structure is decomposed into discrete products and services to be delivered on the project. Higher-level elements represent groupings of products and services to be delivered. Decomposition identifies discrete products and services. Elements can be decomposed in the following way:

    - A discrete product or service is identified.

    - Responsibility to deliver is assigned to one individual or functional area.

    - Scope is clearly understood.

    - Cost can be reasonably estimated.

    - The element is manageable.

    - Higher risk or more critical elements are decomposed to a lower level.

- ***Assign Element Responsibility*** - After the Work Breakdown Structure is decomposed to its lowest level, the Functional Resource Manager or Team Lead assigns the responsibility for each element to a resource. Assignment at the higher level ensures that management is responsible for all project scope.

Individuals assigned to the lower-level elements are responsible for planning, controlling, and delivering the product.

- ***Create the WBS Dictionary*** - The purpose of the WBS dictionary is to clearly describe what scope is to be delivered within each element so that the functional area responsible for delivery can accept it, plan it, and manage the delivery. The WBS dictionary also provides boundaries and hand-offs between functional areas responsible for delivery.

- ***Review and Approve WBS*** - All personnel who are assigned responsibility should accept the responsibility to deliver the scope of each element. Any project stake holders, not having a direct responsibility, should also review the WBS. The review and approval will assure commitment to the project.

- ***Baseline the WBS*** - Once defined and accepted by project stakeholders the Work Breakdown Structure is baselined and put under change control. Changes to scope are controlled through a defined process and the Work Breakdown Structure provides a vehicle to cap ture, assess, review, and implement change.

Coding Scheme

A Work Breakdown Structure, due to its hierarchical nature, requires that a parent-child relationship be established and captured for automated reporting through the structure. To achieve the parent-child relationship, a coding scheme may be developed and assigned to elements. The simpler the coding scheme the better. The codes should not be assigned until the Work Breakdown Structure is somewhat stable and not being constantly changed. This will eliminate the use of complex schemes and the need to reassign codes because of changes in the Work Breakdown Structure.

As shown in the simplified coding scheme example below, a Work Breakdown Structure is also a family tree of related deliverables that make up an entire project.

Project XYZ Work Breakdown Structure

1.0 Sample Project:
1.01 Project Management
1.02 Communications
1.03 Documentation
1.04 Hardware
1.05 Software
1.06 Systems Engineering
1.07 Facilities
1.08 Training
1.09 Disaster Recovery

The Work Breakdown Structure now becomes the common basis for defining all of a project's major deliverable components.

Work Breakdown Structure Format

The Work Breakdown Structure is simple in its intent but can be elaborate in its presentation. The Work Breakdown Structure may be presented in various formats:

- A simple bulletized list of activities.
- Graphical representation.
- Detailed spreadsheet list of tasks and subtasks depending on the size of the project.

A spreadsheet format can be seen in 3.5.2. A graphical representation can be seen in Figure 3.5.3.

Automation

Because the Work Breakdown Structure represents all project scope and is coded using a hierarchical structure, automated databases and project management tools can enhance its ability to assist management in understanding project status. The Work Breakdown Structure should be placed in an environment where tools can be used to manage the resulting project information. Project Management Systems can not only aid development of the Work Breakdown Structure, but also aids with organizational Breakdown Structure, Resource Assignments, Task List, and other project documents.

Work Breakdown Structure for IT Projects

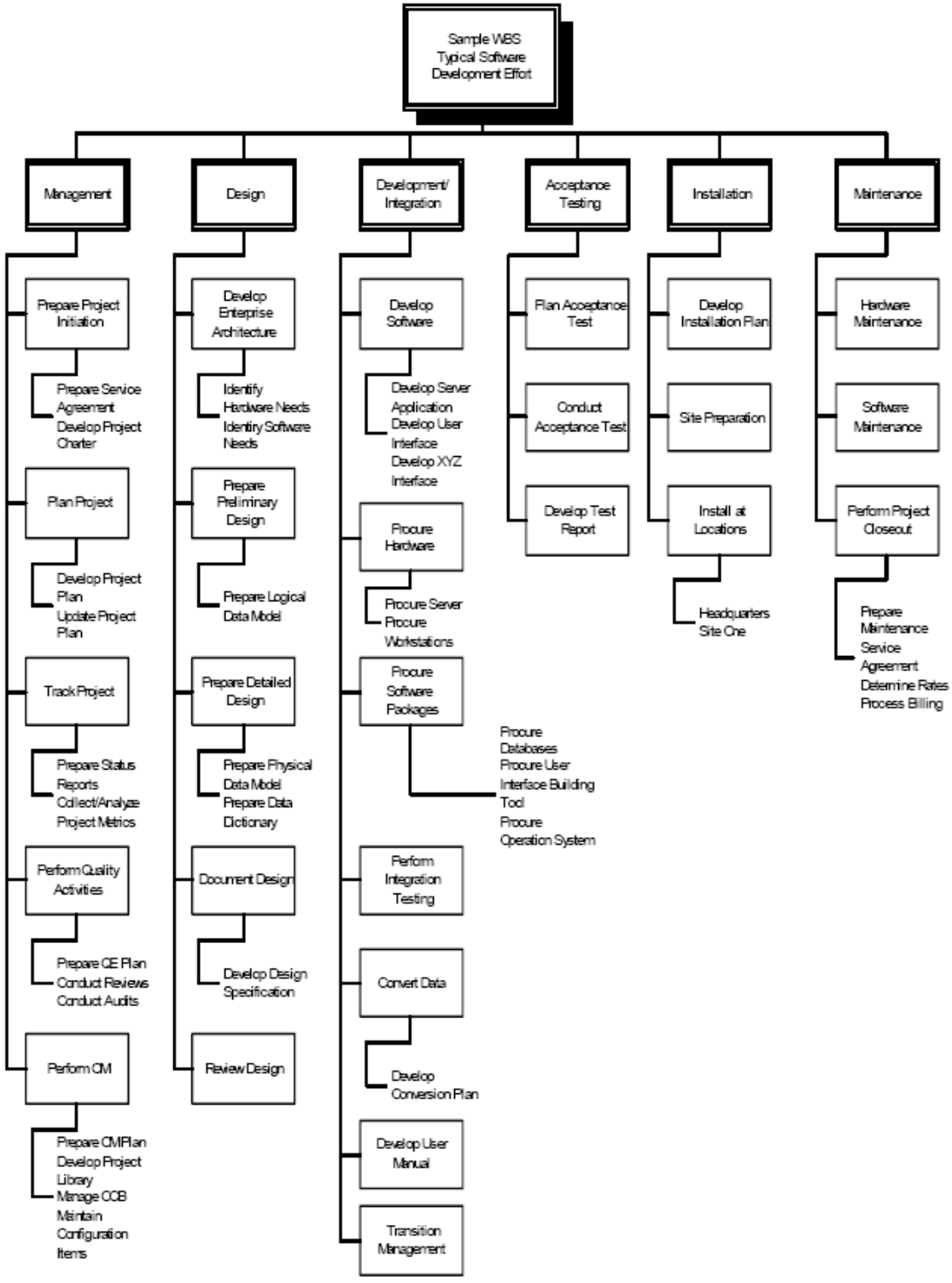
Information Technology projects typically have a life of their own and are different from the normal Work Breakdown Structure because they will call on specialized skills required in the System Development Life Cycle. A good idea to keep in mind during the development of the Work Breakdown Structure is to identify the major phases of the System Development Life Cycle as they apply to the project and identify what must be done to achieve completion of those phases.

Sample Work Breakdown Structure
(A Typical Development Effort)
Figure 3.5.2

WBS Element	Name	Responsibility	Dictionary Description	Cost	Phase
1.0		Management			
1.1	Prepare Project Initiation	PM/Customer Service	Prepare initial documents		Initiation
1.1.1	Prepare Service Agreement				
1.1.2	Develop Project Charter				
1.2	Plan Project	Project Manager	Prepare baseline plan	$3,000.00	Plan
1.2.1	Develop Project Plan				
1.2.2	Update Project Plan				
1.3	Track Project	Project Manager			Execute
1.3.1	Prepare Status Reports				
1.3.2	Collect/Analyze Project Metrics				
1.4	Perform Quality Activities	Quality Engineering	Define quality activities	$12,000.00	Execute
1.4.1	Prepare QE Plan				
1.4.2	Conduct Reviews				
1.4.3	Conduct Audits				
1.5	Perform CM	Configuration Mangement	Detail CM Plan	$17,000	Control
1.5.1	Prepare CM Plan				
1.5.2	Develop Project Library				
1.5.3	Manage CCB				
1.5.4	Maintain Configuration Items				
2.0		Design			
2.1	Develop Enterprise Architecture	SE/Data Integration	Design Architecture		Plan
2.1.1	Identify Hardware Needs				
2.1.2	Identify Software Needs				
2.2	Prepare Preliminary Design	DE/Data Integration	Establish design model	$3,000.00	Plan
2.2.1	Prepare Logical Data Model				
2.3	Prepare Detailed Design	Database Engineering	Detail design model	$12,000	Plan
2.3.1	Prepare Physical Data Model				

2.3.2	Prepare Data Dictionary				
2.4	Document Design	AE(SSE)	Record design model	$5,000.00	Execute
2.4.1	Develop Design Specification				
2.5	Review Design	Project Manager	Evaluate design model	$12,000.00	
3.0	Development/Integration				
3.1	Develop Software	AE(SE)	Outline Software	$12,000.00	Execute
3.1.1	Develop Server Application				
3.1.2	Develop User Interface				
3.1.3	Develop XYZ Interface				
3.2	Procure Hardware	Systems Engineering/Fiscal	Design Hardware	$5,000.00	Execute
3.2.1	Procure Server				
3.2.2	Procure Workstations				
3.3	Procure Software Packages	Systems Engineering, Fiscal	Detail software package	$12,000.00	Execute
3.3.1	Procure Databases				
3.3.2	Procure User Interface Building Tool				
3.3.3	Procure Operation System				
3.4	Perform Integration Testing	AE(SE)	Create/execute test plan	$12,000.00	Execute
3.5	Convert Data	Database Engineering	Convert Information	$20,000.00	Execute
3.5.1	Develop Conversion Plan				
3.6	Develop User Manual	Administrative Support	Develop work manual	$3,000.00	Execute
3.7	Transition Management	Project Manager			Execute
4.0	Acceptance Testing				
4.1	Plan Acceptance Test	AE(SSE)	Design acceptance plan	$1,000.00	Execute
4.2	Conduct Acceptance Test	Customer	Conduct test	$5,000.00	Execute
4.3	Develop Test Report	AE(SSE)	Create test report	$3,000.00	Execute
5.0	Installation				
5.1	Develop Installation Plan	Project Manager	Create installation plan	$3,000.00	Plan
5.2	Site Preparation	Customer	Prepare delivery site	$5,000.00	Execute
5.3	Install at Locations	Configuration Management	Install system at site(s)	$3,000.00	Execute
5.3.1	Headquarters				
5.3.2	Site One				
6.0	Maintenance				
6.1	Hardware Maintenance	Operations	Conduct Maintenance		Closeout
6.2	Software Maintenance	AE(SE)		$20,000.00	Closeout
6.2.1	Disaster Recovery Plan & Test				
6.3	Perform Project Closeout	PM/Customer Service/Fiscal			Closeout
6.3.1	Prepare Maintenance Service Agreement				
6.3.2	Determine Rates				
6.3.3	Process Billing				

Figure 3.5.3


Sample WBS
Typical Software
Development Effort
Management
Design
Development/
Integration
Acceptance
Testing
Installation
Maintenance
Prepare Project
Initiation
Prepare Service
Agreement
Develop Project
Charter
Plan Project
Develop Project
Plan
Update Project
Plan
Track Project
Prepare Status
Reports
Collect/Analyze
Project Metrics
Perform Quality
Activities
Prepare QE Plan
Conduct Reviews
Conduct Audits
Perform CM
Prepare CM Plan
Develop Project
Library
Manage CCB
Maintain
Configuration
Items
Develop
Enterprise
Architecture
Identify
Hardware Needs
Identify Software
Needs
Prepare
Preliminary
Design
Prepare Logical
Data Model
Prepare Detailed
Design
Prepare Physical
Data Model
Prepare Data
Dictionary
Document Design
Develop Design
Specification
Review Design
Develop
Software
Develop Server
Application
Develop User
Interface
Develop XYZ
Interface
Procure
Hardware
Procure Server
Procure
Workstations
Procure
Software
Packages
Procure
Databases
Procure User
Interface Building
Tool
Procure
Operation System
Perform
Integration
Testing
Convert Data
Develop
Conversion Plan
Develop User
Manual
Transition
Management
Plan Acceptance
Test
Conduct
Acceptance Test
Develop Test
Report
Develop
Installation Plan
Site Preparation
Install at
Locations
Headquarters
Site One
Hardware
Maintenance
Software
Maintenance
Perform Project
Closeout
Prepare
Maintenance
Service
Agreement
Determine Rates
Process Billing

3.6 Organizational Breakdown Structure

An Organizational Breakdown Structure (OBS) is a specific type of organization chart that shows which organizational units are responsible for which work packages. The Organizational Breakdown Structure is usually used with a Work Breakdown Structure to ensure all elements (scope) of a project are assigned to and controlled by a responsible organizational unit. The Organizational Breakdown Structure should be coded in a hierarchical (parent-child) manner so aggregations from lower organizational elements to successively higher ones can be achieved. Project information can then be related to the Organizational Breakdown Structure so that information can be understood functionally. The parent-child relationship allows for information to be aggregated to the parent until the highest-level element summarizes the information of its children. The Organizational Breakdown Structure can be used to roll up a variety of management information, such as scope, cost, schedule, risk, issues and so on.

Organizational Breakdown Structure Development

Creating the Organizational Breakdown Structure is a rather straightforward development process. The Organizational Breakdown Structure is the tool that is used to show which work elements in the Work Breakdown Structure are assigned to which organizational units.

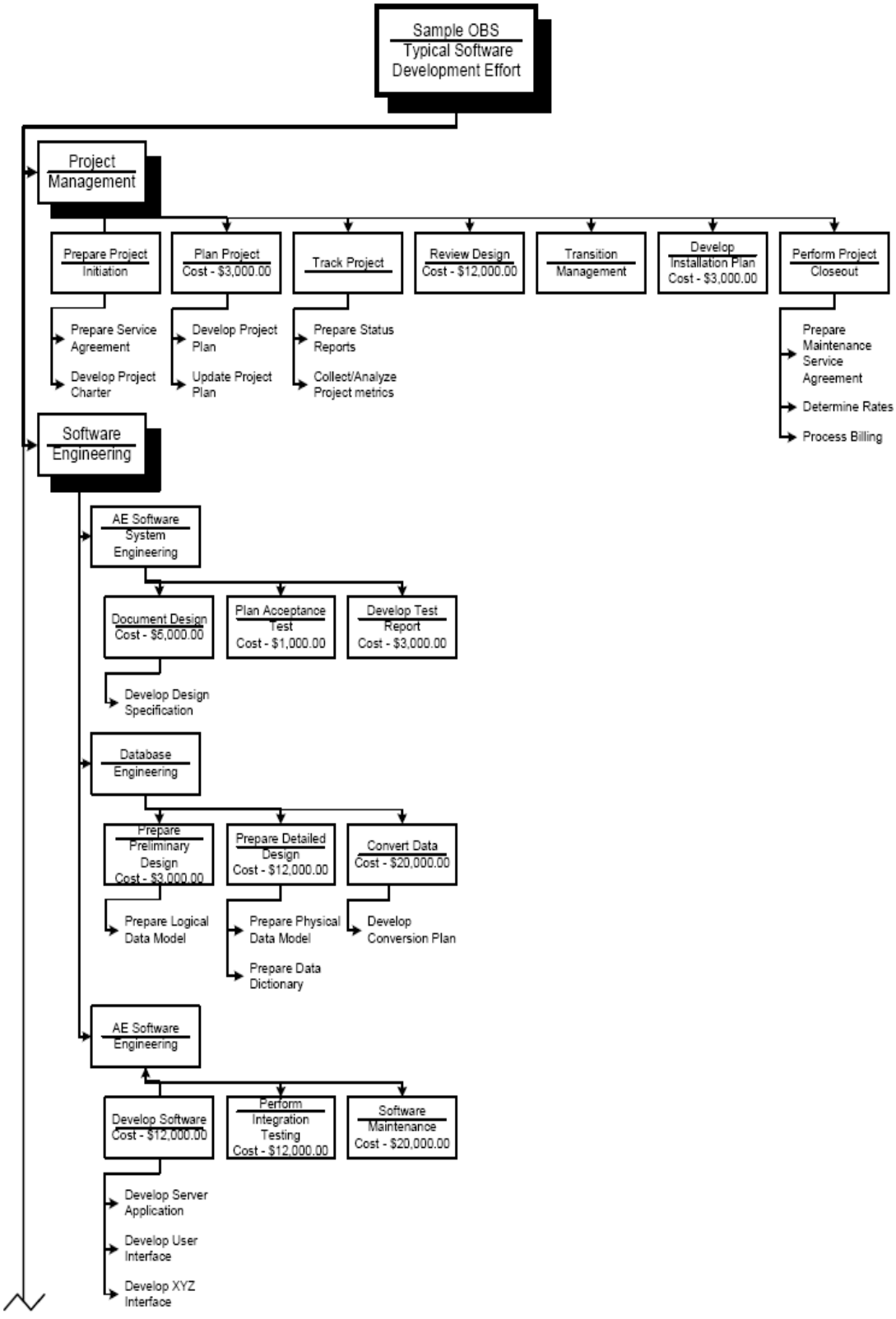
Create a blank ‘tree’ type diagram that looks similar to the Work Breakdown Structure, in order to prepare to assign responsibility for work packages. The Work Breakdown Structure with all the elements of the WBS listed, including the responsible areas, is a good place to retrieve needed information.

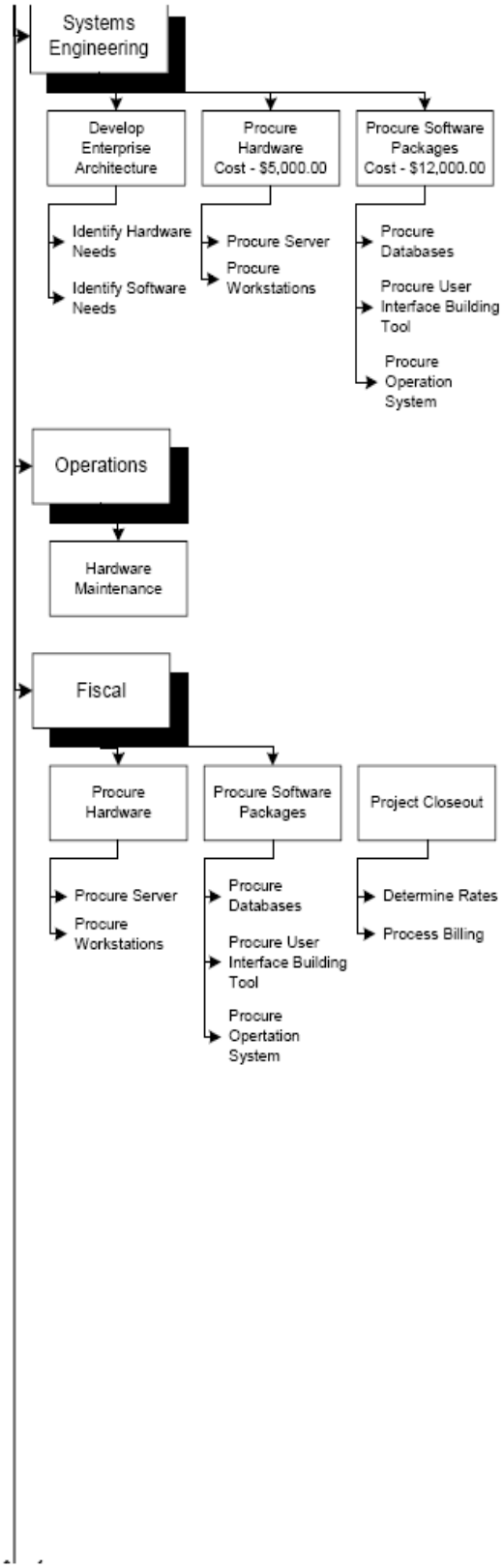
Confirm that the work package to be assigned has been approved and that there is adequate definition to explain the function that needs to be carried out. Be sure the number of resources, the type of resources, the duration of each resource, and the time in the project that the resources will be required is taken into consideration. Attention should be given to the level of involvement of each resource (e.g.,

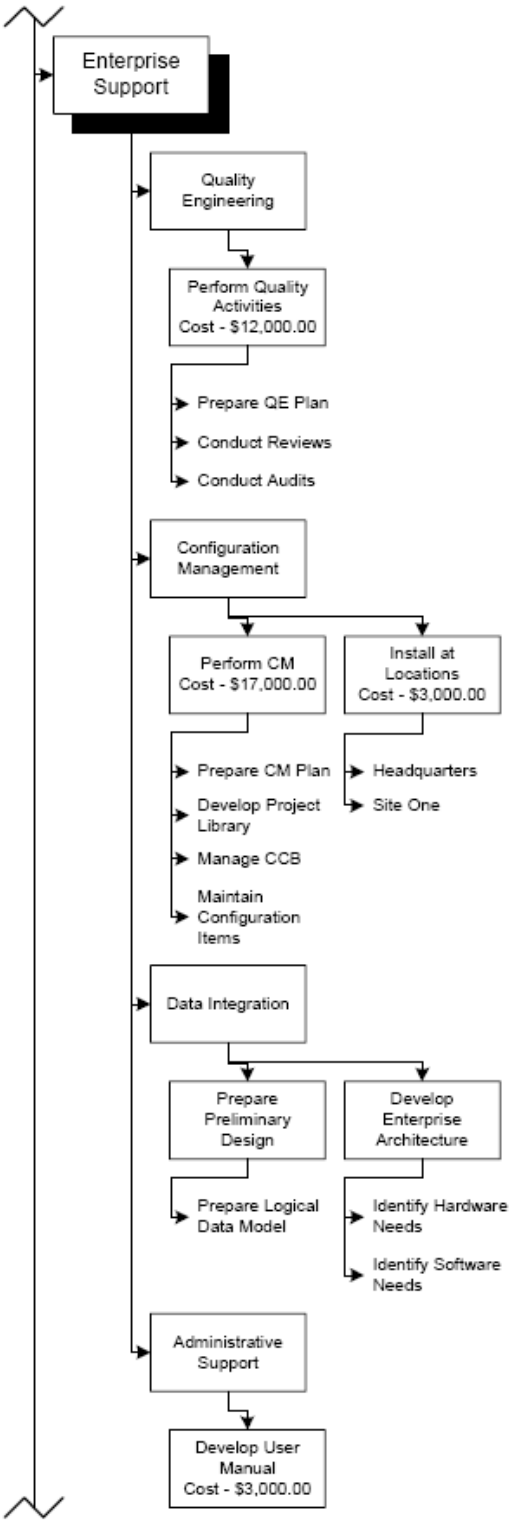
some resources are needed to do the work, some resources are needed for inspection, some resources are needed for approval, and some may be needed for review).

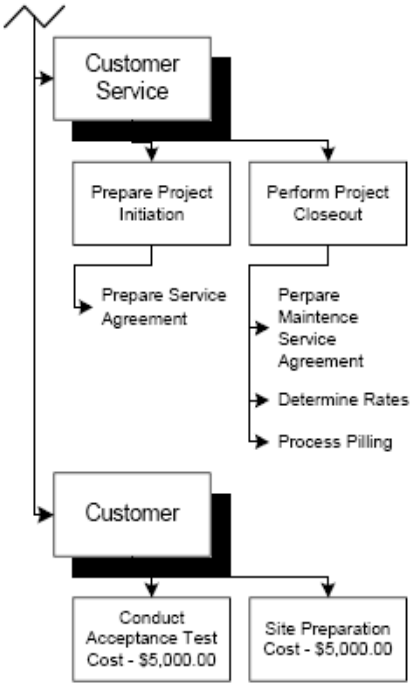
When completed, the Organizational Breakdown Structure will be the tool that provides a means for all project team members to view their responsibilities and agree upon their assignments (see Figure 3.6.2).

Figure 3.6.2
Sample OBS




Systems Engineering
Develop Enterprise Architecture
Procure Hardware Cost - $5,000.00
Procure Software Packages Cost - $12,000.00
Identify Hardware Needs
Identify Software Needs
Procure Server
Procure Workstations
Procure Databases
Procure User Interface Building Tool
Procure Operation System
Operations
Hardware Maintenance
Fiscal
Procure Hardware
Procure Software Packages
Project Closeout
Procure Server
Procure Workstations
Procure Databases
Procure User Interface Building Tool
Procure Opertation System
Determine Rates
Process Billing

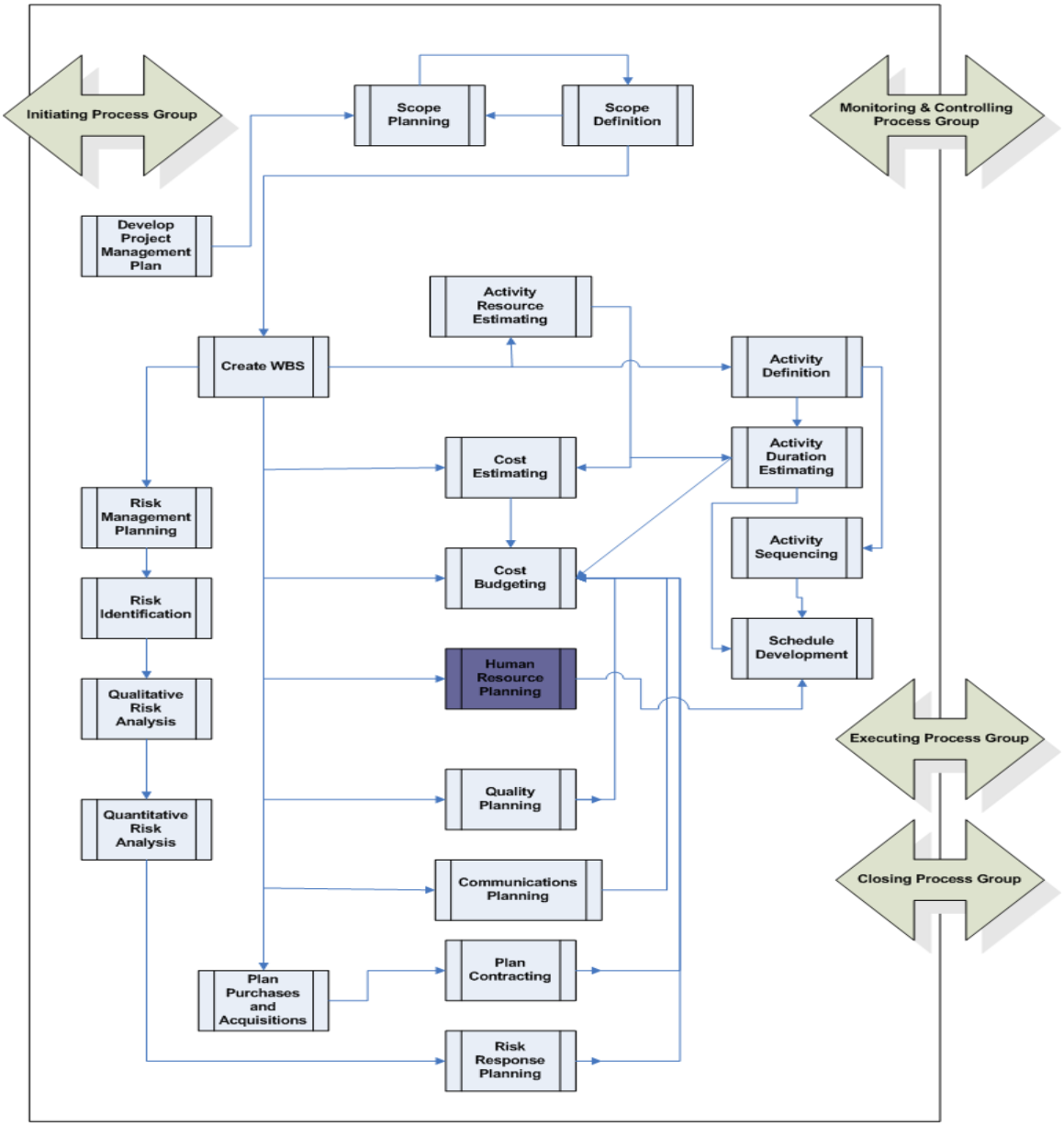

Enterprise Support
Quality Engineering
Perform Quality Activities Cost - $12,000.00
Prepare QE Plan
Conduct Reviews
Conduct Audits
Configuration Management
Perform CM Cost - $17,000.00
Install at Locations Cost - $3,000.00
Prepare CM Plan
Develop Project Library
Manage CCB
Maintain Configuration Items
Headquarters
Site One
Data Integration
Prepare Preliminary Design
Develop Enterprise Architecture
Prepare Logical Data Model
Identify Hardware Needs
Identify Software Needs
Administrative Support
Develop User Manual Cost - $3,000.00


Customer Service
Prepare Project Initiation
Perform Project Closeout
Prepare Service Agreement
Perpare Maintence Service Agreement
Determine Rates
Process Pilling
Customer
Conduct Acceptance Test Cost - $5,000.00
Site Preparation Cost - $5,000.00

3.7 Resource Planning

Resource planning is comprised of establishing a team that possesses the skills required to perform the work (Labor Resources), as well as scheduling the tools, equipment, and processes (Non-Labor Resources) that enable the staff to complete the project.

Figure 3.7.1
Resource Planning Process



Labor Resources

Determining Required Skills

Finding available staff with the skills required to perform a task is critical to project success. It is helpful in the planning process to develop a list of skills required, first for execution of the project, and then for execution of each task. This skills list may then be used to determine the type of personnel required for the task. The Project Manager works with the Functional Managers and assesses the skills of the available people for the project. The Project Manager's job is to determine the risks associate with the available skills and to build a plan that realistically accounts for those skills.

Determining the Size of the Project Team

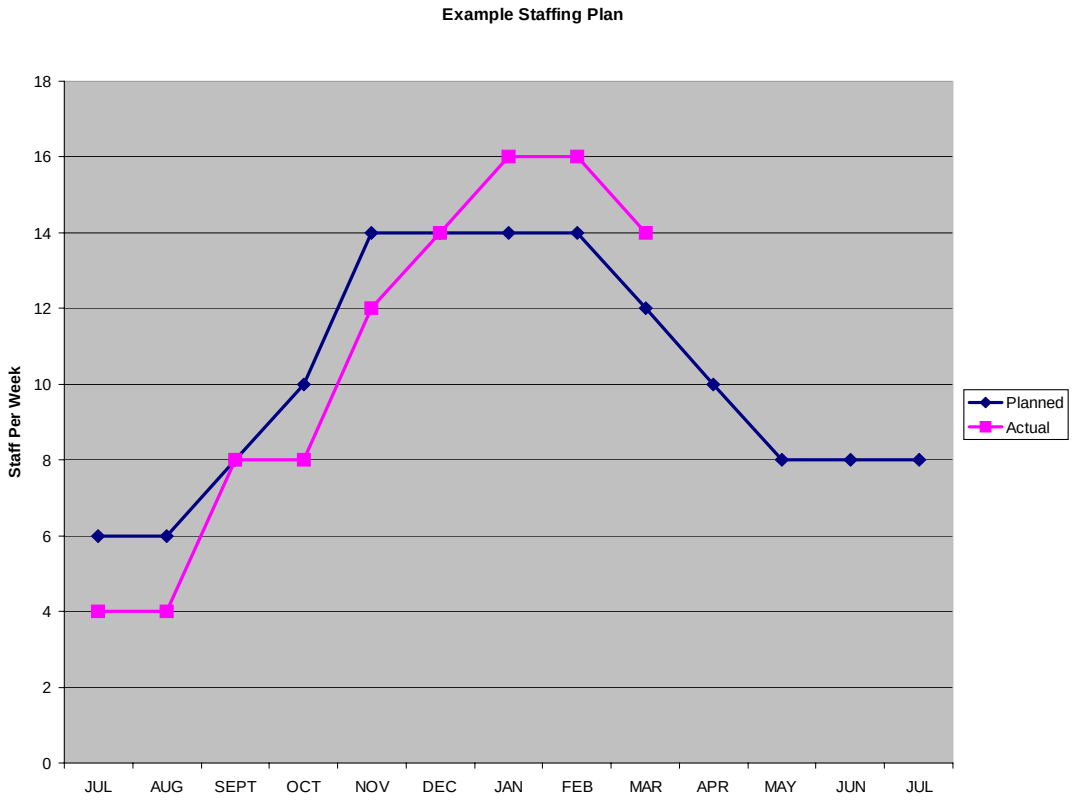
The optimal size of the project team is driven by two principal factors. One is the total number of tasks to be performed, the other is the effort needed to perform the tasks.

In developing the schedule and asking for resource assignment, the Project Manager determines the optimal mix of staff to activities. Doubling resources does not necessarily double productivity. For example, 365 engineers could not complete in a day a project estimated at one person per year. At some point, people begin to get in each other's way. The significance of the project duration, as well as each major activity's duration, need to be clearly understood and documented as part of the scheduling process.

Define Resource Profiles

A staffing plan needs to be developed for every project. The staffing plan identifies when staff is brought onto and removed from the project team. For small projects, this may be simply stated as assigning three full time people to the project throughout its six-month duration. For large projects, the problem is more complex, and the creation of a detailed plan is a requirement. A chart similar to 3.7.2 is useful in the Project Plan for large projects.

Figure 3.7.2
Example Staffing Plan



Team Development

An important aspect of Resource Planning that is often overlooked is the need for team development. This is often times looked at as an Execution Phase issue; however, if thought about early enough in the planning of the project the issue can be dealt with during the Planning Phase. Team Development revolves around activities that are directed to bring together the cohesiveness of a team and get a better understanding of their strengths and weaknesses.

The benefits of team development include improvement in project performance, improvements in agency skill areas, improvement in team interaction and behaviors and a feeling of team satisfaction. The following are examples of team development tools and techniques:

Team Building Activities – Management and individual actions taken specifically and primarily to improve team performance.

Many actions such as involving non-management level team members in the planning process, or establishing ground rules for surfacing and dealing with conflict may enhance team performance as a secondary effect. Team building activities can be work related meetings or they can be fun extracurricular activities.

- ***Reward and Recognition*** – Recognition systems can be as small and informal as peer recognition at a team meeting or as large as a formal recognition and reward in front of the agency and customers. Effective recognition systems must make the link between project performance and the reward clear, explicit, and achievable. Keep in mind; however, that the recognition systems must fit within the policy guideline and framework of the agency and attention should be paid to the cultural difference among recipients.

- ***Collocation*** – This involves placing all, or almost all, of the most active project team members in the same physical location to enhance their ability to perform as a team. On some projects, collocation may not be an option; where it is not viable, an alternative may be scheduling frequent face-to-face meetings to encourage interaction. Collocation fosters increased communication and often quick problem solving.

- ***Training*** – This can be both formal (taking classes in particular skill areas) and informal (receiving feedback from managers and team members). Project team members benefit professionally from learning new skills and that benefit is returned to the project in the form of increased productivity and better products. Training is an element that should be considered early based on the skill needs of the project team and funds should be allocated for training purposes.

Non-Labor Resources

All project teams require the tools necessary to successfully perform the tasks assigned.

In scheduling resources, the Project Manager must ensure that both people and necessary equipment to support those people are available simultaneously. Assuring the availability of equipment at critical points in the project is key in planning a successful project. Efficiency and morale are negatively affected by non-availability of equipment needed to perform a task.

Additional Criteria

Document Assumptions

Documenting the assumptions made in resource allocation is critical to the later success of the project. Without clear documentation of these assumptions, later changes in staffing are very difficult and risky.

If, for example, a key person with a specialized technical skill was assumed in the plan, that assumption must be documented. Then, if that resource is unavailable to perform the task, the Project Manager can address the risk and make necessary decisions. Without documentation of the assumption the plan is open to serious risk without the Project Manager realizing it.

Document Risks

Risks are inherently involved with scheduling resources. Sound resource planning makes allowances for dealing with risks in one or more of the following ways:

- Add time to those tasks where resources are known to be a problem.
- Add time to the schedule if staff is not familiar with new technology being used.
- Where a skill shortage is identified, add time and resources for staff acquisition and training. By recognizing resource shortfalls and providing necessary training, a Project Manager mitigates some level of risk.

Review Schedule and Resources Continually

Despite a Project Manager's best efforts, project schedules and resource allocations have to be reviewed and adjusted continually as the project progresses and circumstances change. Early detection of problems will hopefully allow timely resource or schedule changes without affecting the overall project schedule and cost.

If a change in the master schedule or the overall project cost is required, this must be processed using a formal change control with appropriate management and stakeholder approvals.

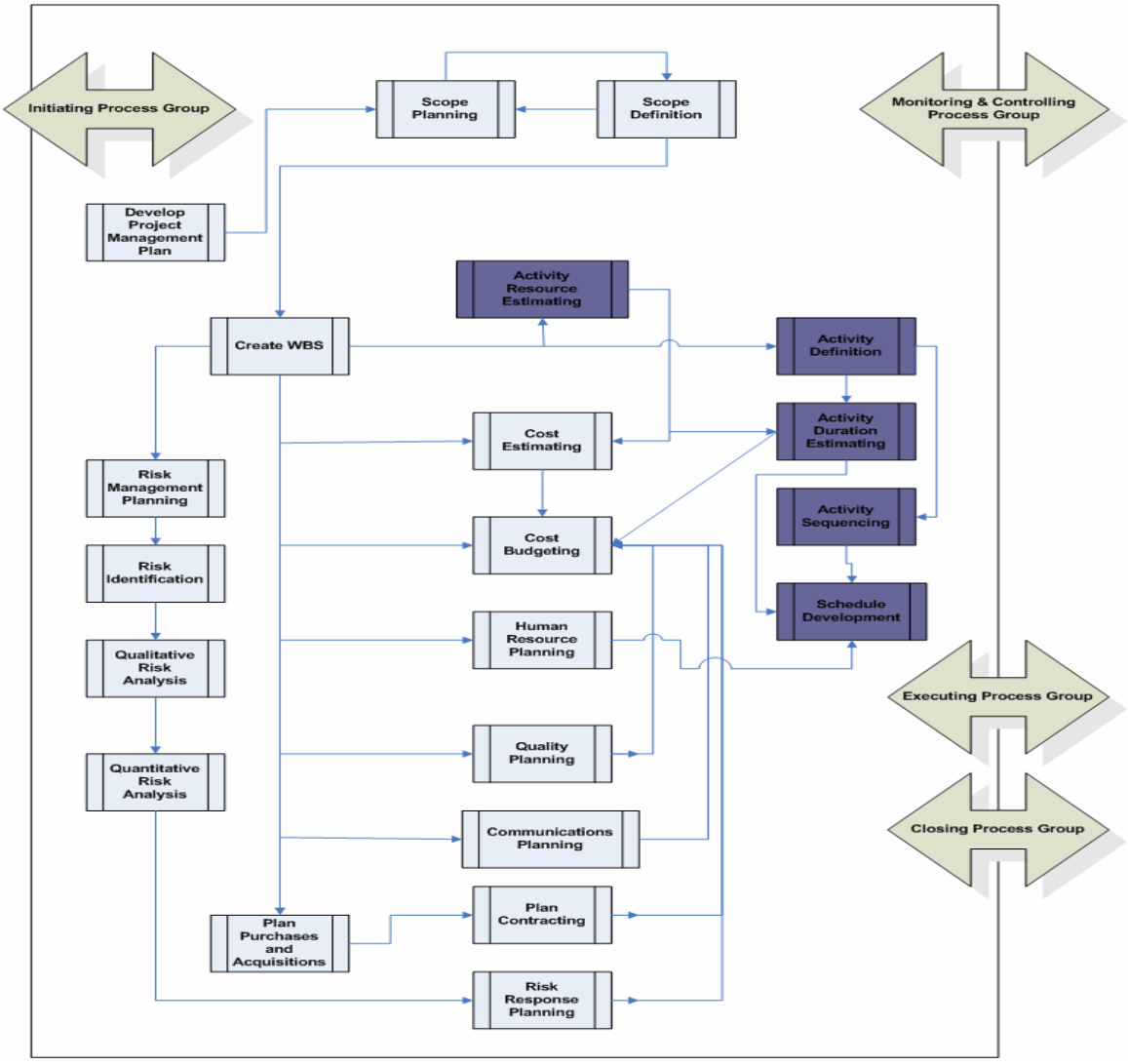
Resource Planning for IT Projects

Skills and resources within an Information Technology project are very important, and the Work Breakdown Structure created by the Project Manager goes a long way towards pinpointing the necessary skills needed on high technology projects. With the vast array of technology applications and varying levels of knowledge in such areas, knowing what skill sets and resources will be needed ahead of time will be critical information for project success. For instance, if a Project Manager knows that on a particular task a Senior Programmer will be needed for five days to code a module, it is critical to point this out to the functional manager responsible for the needed Senior Programmer and make sure that the programmer will be available during the specified time within the project. Project Managers have the responsibility to request specific skill sets and schedule their availability.

3.8 Project Schedule Development

The project schedule provides a graphical representation of predicted tasks, milestones, dependencies, resource requirements, task duration, and deadlines. The project's master schedule interrelates all tasks on a common time scale. The project schedule should be detailed enough to show each Work Breakdown Structure task to be performed, the name of the person responsible for completing the task, the start and end date of each task, and the expected duration of the task. Like the development of each of the project plan components, developing a schedule is an iterative process.

Figure 3.8.1
Project Schedule Development Process



Once completed and approved by the appropriate stakeholders, the schedule will be used to manage the project and will be known as the baseline schedule. During the life of the project, actual progress is frequently compared with the baseline schedule. This allows for evaluation of execution activities. The accuracy of the planning process can also be assessed.

Project Management Software

Project Management software is widely used to assist with schedule development. These tools automate the calculations of mathematical analysis and resource leveling and thus allow for rapid consideration of many schedule alternatives. They are also widely used to print or display the outputs of schedule development.

The Department of Information Systems has selected the Microsoft Project Management Package as its scheduling tool of choice. It is suggested that all Project Managers and project team members who will be working with project schedules take the time to become trained and familiar with the Microsoft Project Management Package and the features the software offers.

Project Schedule Display

Schedule display refers to the summation of schedule information presented to various levels of management. Detailed schedules may contain hundreds or thousands of tasks and milestones; displaying these to the executive level would not be productive, as upper management frequently requires summarized information that highlights potential or real problems. Once the problems are highlighted, upper management may proceed to lower levels of detail to understand the impact on the project and determine corrective action. Schedule display is controlled by individual sign-on for Project Management Software. The authority assigned in the user id for Project Management Software determines the level of information that is made available to the user. The following table identifies typical schedule displays and the intended audience.

Levels of Schedule Display

Schedule Name	Intended Audience	Comments
Executive	o Executive o Management o Agency CIO o Board of Directors o Oversight Committee o Executive Customers	Recipents are stakeholders, but do not have direct involvement or control of the project. The executive schedule usually depicts high-level milestones information only.
Master	o Project Manager o Senior Customer	Displays key milestones and high-level, summarized activities or phases of the project. Usually contains the executive schedule's information and a logical grouping of information from intermediated schedules. Also referred to as an integrated program schedule.
Functional	o Functional Manager	Depicts schedule information based on the responsibility of a functional group.
Detail	o Functional Manager o Team Leader o Individual Team o Members	The lowest-level schedule used to control the day-to-day activities of team members.

Schedule Owners

Identifying the owners or individuals responsible for developing all or part of the project's schedule is essential to ensuring that good schedules are developed and maintained. It is recommended that a Work Breakdown Structure and Organizational Breakdown Structure be used as the basis for schedule development because the Work Breakdown Structure identifies scope and the Organizational Breakdown Structure identifies the functional area to deliver it. From each functional area the Team Lead or other designee will become the schedule owner for the area.

Project Scheduling Process

Identify Major Milestones

The completion of an important action is denoted as a mile-

stone. Milestones are important events that happen at a point in time and have no duration. For example, deliverables are often represented as milestones, while efforts to produce the deliverable are referred to as tasks. While milestones are unique to each project, some typical project milestones are:

- Requirements Approval
- End-of-Phase Review
- Prototype Approval
- Approval of Design
- Hardware and/or Software Installation and Tested
- Approval of Disaster Recovery Approach
- Unit Test Completed
- Integration Test Completed and Approved
- Acceptance Test Completed and Approved
- System Acceptance by User
- Production Implementation

A milestone can occur at the end of a work package in the Work Breakdown Structure and serve as a measurable item in the baseline plan. Major project milestones should be included on the master schedule.

Sequence the Activities

To create the project schedule, the precedence relationships among activities must be defined. One way to determine the precedence of activities is to ask the question, "what other activities must (or should) finish before this activity can start?"

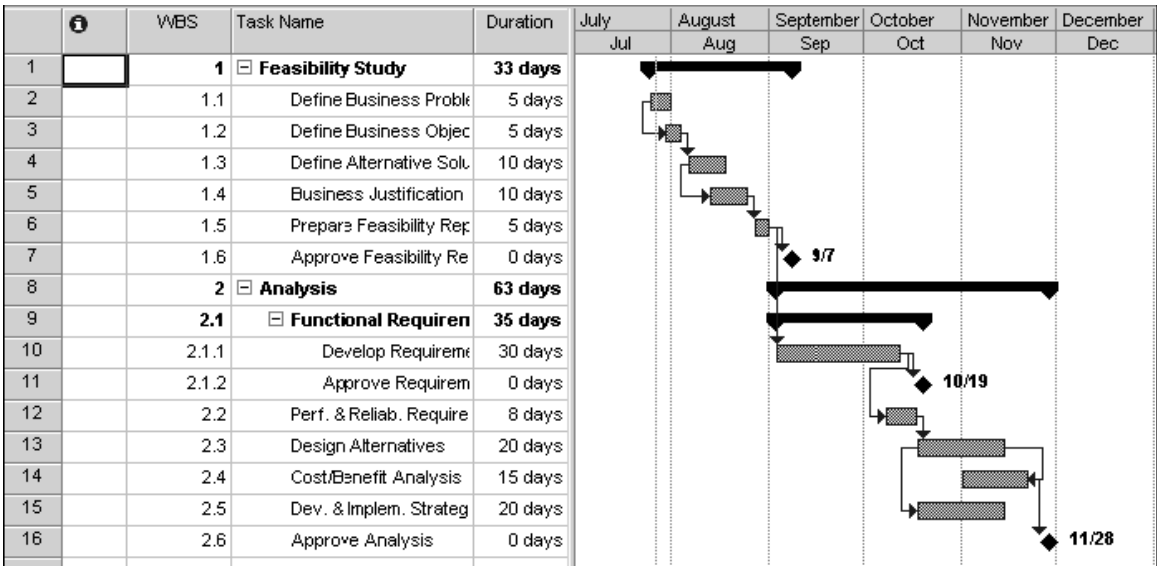
Two basic kinds of logical dependencies need to be considered when sequencing project activities:

- ***Mandatory dependencies*** - those which are inherent in the nature of the work being done. For example, requirements definition comes before design that come before programming. However, all requirements need not be completed before design can start, and not all design must be completed before some programming can start. Therefore, task dependencies must be defined at a more detailed level.

- ***Discretionary dependencies*** - those that are defined voluntarily by the Project Manager in order to, for example, support the use of best practices, limit parallelism and complexity in the project plan, or take into account the known resource limitations. An example of a resource driven dependency is when you have only one person with a particular skill available, which results in doing tasks in series when, with more skilled staff, the tasks could be done in parallel.

The Gantt Chart in Figure 3.8.2 and the spreadsheet in Figure 3.8.3 are two ways of developing and showing project task dependencies.

Figure 3.8.2
Gantt Chart



Gantt Chart with Task Dependencies

In Figure 3.8.3 several types of task dependencies are illustrated.

- Finish-to-Start: It is the most commonly used in schedule development. In this dependency, the "from" activity must finish before the "to" activity can start. For example, Define Alternate Solutions, WBS item 1.3, can't start until Define Business Objectives, WBS item 1.2, is finished.

- A variation of this is "Finish-to-Start with a delay." The Feasibility Report, WBS item 1.6, will be approved 5 days after the report has been completed. Approval is shown as a milestone rather than as a 5-day task because no project resources are used in this process. It is just a time delay.

- Another variation is "Finish-to-Start with overlap." Performance and Reliability Requirements, WBS item 2.2, can start a week before Develop (functional) Requirements, WBS item 2.1.1, has finished; which says the tasks will overlap by a week.

- Start-to-Start (with or without delay or overlap): The "from" activity must start before the "to" activity can start. The Define Business Objectives WBS item 1.2 can start 3 days after Define Business Problem, WBS 1.1, has started.

- Finish-to-Finish (with or without delay or overlap): The "from" activity must finish before the "to" activity can finish. The Cost Benefit Analysis, WBS item 2.4, cannot finish until five days after Design Alternatives, WBS item 2.3, has finished.

- Start-to-Finish: the "from" activity must start before the "to" activity can finish.

The task dependencies can be shown in Figure 3.8.3 using Project Management Software Task Sheet format.

Figure 3.8.3
Task Dependencies Spreadsheet

	WBS	Task Name	Duration	Start	Finish	Predecessors
1	**1**	**Feasibility Study**	**33 days**	**Wed 7/25/01**	**Fri 9/7/01**	
2	´.1	Define Business Problem	5 days	Wed 7/25/01	Tue 7/31/01	
3	´.2	Define Business Objectives	5 days	Mon 7/30/01	Fri 8/3/01	2SS+3 days
4	´.3	Define Alternative Solutions	10 days	Mon 8/6/01	Fri 8/17/01	3
5	´.4	Business Justification	10 days	Mon 8/13/01	Fri 8/24/01	4SS+5 days
6	´.5	Prepare Feasibility Report	5 days	Mon 8/27/01	Fri 8/31/01	5
7	´.6	Approve Feasibility Report	0 days	Fri 9/7/01	Fri 9/7/01	6FS+5 days
8	**2**	**Analysis**	**63 days**	**Mon 9/3/01**	**Wed 11/28/01**	
9	**2.1**	**Functional Requirements**	**35 days**	**Mon 9/3/01**	**Fri 10/19/01**	
10	2.´.1	Develop Requirements	30 days	Mon 9/3/01	Fri 10/12/01	6
11	2.´.2	Approve Requirements	0 days	Fri 10/19/01	Fri 10/19/01	10FS+5 days
12	2.2	Perf. & Reliab. Requirements	8 days	Mon 10/8/01	Wed 10/17/01	10FS-5 days
13	2.3	Design Alternatives	20 days	Thu 10/18/01	Wed 11/14/01	12
14	2.4	Cost/Benefit Analysis	15 days	Thu 11/1/01	Wed 11/21/01	13FF+5 days
15	2.5	Dev. & Implem. Strategies	20 days	Thu 10/18/01	Wed 11/14/01	13SS
16	2.6	Approve Analysis	0 days	Wed 11/28/01	Wed 11/28/01	14FS+5 days

Task Dependencies Spreadsheet

The logical sequencing of activities by defining task dependencies requires a lot of judgment because it has a major impact on the project schedule. As the project plan evolves, the Project Manager may have to add, delete, or change dependencies in order to meet the project schedule objectives. Understanding the relationships among the tasks and clearly defining the task priorities is an effective tool to help resolve many scheduling and/or resource conflicts.

Estimate Task Durations

Estimating task duration is one of the most challenging aspects of project planning. It is also a key to later cost estimation. This is a refined process that occurs throughout the planning process, as it is directly affected by results of staffing and costing activities.

Accurate task duration estimates are defined in order to stabilize customer relations and maintain team morale as a necessary planning tool. With defined task durations, the

team knows what to expect and what is expected of them. Task duration is rarely overestimated, but is frequently underestimated. Inaccurate estimates can result in an increase in the "frenzy level" of a project. The frenzy escalates as sponsors scramble for more money, and/or the technical staff scramble to complete a project in an unrealistic timeframe. Often, the end result is cutting corners, excessive overtime, and a dissatisfied customer.

The estimation process is complex because activity duration is affected by numerous variables that must be dealt with concurrently in the Planning Phase. Some of these variables include staff availability, the skill level of the person assigned to the task, unexpected events, efficiency of work time, and mistakes and misunderstandings during the execution of the project.

When estimating the duration of a task, reality is a major factor. The knowledgeable scheduler takes into account absenteeism, holidays, meetings, discussions, and interaction among the staff. No one is 100% productive every hour of the workday. If a scheduled task assumes 100% productivity, the schedule rapidly falls apart. A successful schedule builds these types of factors into the duration estimates.

There are several techniques that support task duration estimation. The most common technique is based on the historical experience of a similar scope of work performed by the estimator. Collected and archived historical project data is used successfully by many organizations to achieve quality performance on project deliveries.

Historical records greatly support both the duration and the cost estimations that are so important in the Planning Phase. Data based on staff skills is far more valuable than generalized "industry" estimates. If historical data does not exist, seek the advice of experts and others who have completed similar tasks. When historical data or experts are not available, use a technique of getting estimates from multiple sources, comparing results and estimating the duration based upon multiple inputs. The nature of this method is predicated on finding good sources for providing the estimates.

The duration of tasks (for example, year, month, week, day, or hour) should be consistent with the amount of detail tracked and risk.

Often tasks are so detailed they become a checklist of items. In a complex lengthy project, checklists and schedules should be separated to ensure the management benefits of each are achieved.

Define Priorities

Clearly defining the task priorities helps to resolve any scheduling and/or resource conflicts. Understanding the priorities and relationships of the tasks assists in resolving difficult scheduling conflicts.

Define the Critical Path

The critical path is the longest path through a project. It determines the earliest possible completion of the work. The critical path is carefully managed because if these tasks slip, then entire project is delayed. A key to project planning is to keep as many tasks as possible off the critical path in order to provide management flexibility throughout the project. The schedule determines the critical path and the Project Manager remains aware of its importance throughout the implementation of the project.

Document Assumptions

Documentation of the assumptions made in developing the project schedule is critical to the later success of the project. Without clear documentation of these assumptions, later changes to the schedule are very difficult and risky. If, for example, a schedule was shortened because it was assumed that a highly skilled person would be performing the work, that assumption should be documented. Then, if a less skilled person is actually assigned to perform the task, the Project Manager can recognize the risk and make necessary changes and decisions. Without documentation of the assumption, the schedule could be later placed in serious risk without the Project Manager realizing it.

Identify the Risks

Scheduling with limited resources has inherent risks. Good scheduling makes allowances for risks in one or more of the following ways:

- Where significant schedule risks are identified, add an additional Work Breakdown Structure task for risk management/risk reduction, where financial reserves can be set aside to deal with potentially delayed schedules.

- Add additional time to those tasks where risks are inherent. There is no rule of thumb for this multiplier; it depends on the degree of risk and overall importance of the schedule to the project.

- Add a percentage time multiplier for the schedule for particular individuals, especially if new technology is being used or if the person providing the estimate is extremely optimistic. Technical staff often underestimate the time required to do any particular tasks.

Review the Schedule

The development of a schedule requires input from more than one person. No one person possesses all the knowledge of understanding of all the factors that affect schedules in every aspect of a project. A schedule review also facilititates buy-in to the schedule. Buy-in to the schedule by the people who will actually perform the work is critical to success. Participation in scheduling gives staff a stake in the outcome of the project. On the other hand, imposed schedules often create frustration leading to frenzy and inevitable schedule slippage.

Once the initial draft of the schedule is complete, the team should perform a schedule review. The activity or task descriptions and the schedule should be reviewed by the people named to do the work who did not participate in the initial estimates, and by independent experts. Task description and task duration should be reviewed for completeness, accuracy, and realism.

Schedule Baselines

A baseline is a set of agreed upon data used for comparison. Therefore a schedule baseline represents a set of schedule data used as a reference point to compare the current schedule performance against the reference point. The comparison allows for corrective action to ensure that the project remains on track. The baseline may be formal or informal. Although the process to create a schedule

baseline is the same regardless of the formality, the baseline's intended use is different. A formal baseline is used to communicate externally and manage internally. An informal baseline is not communicated externally and provides a point of reference used internally by project team members.

The process to establish a schedule baseline consists of determining what data should be baselined, ensuring the data has been established and recorded, and saving the data for future comparison.

Baselines may be created for a variety of reasons. The following provides examples of the type of baselines that may be established for a project.

- ***Original*** – Once a project schedule is established, reviewed, and approved, it can be baselined as the original schedule baseline. The original baseline should never be changed and should always represent the project schedule as it was first envisioned.

- ***Revised*** – A revised baseline may be established to capture the project schedule based on an approved change in the project. In essence, the original schedule baseline may no longer provide a realistic means to compare future schedule performance, so a new revised baseline is created.

Schedule Development for IT Projects

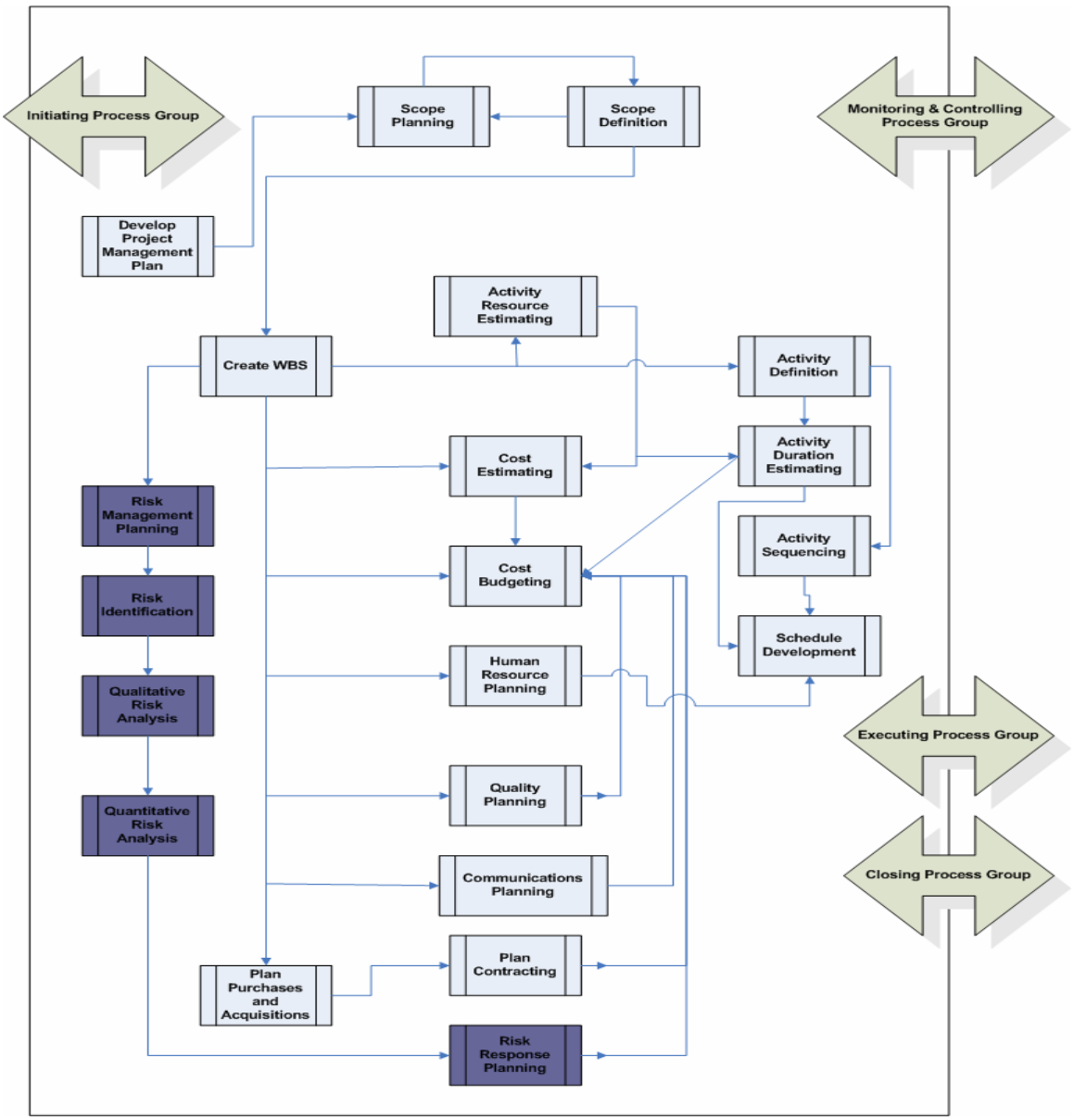
Technology programs are especially time sensitive. Special skill sets that are needed within the project may only be available at certain times. It is also important to note that outputs from a particular segment of an Information Technology project are often the inputs to other sections or deliverables of the Information Technology project. Information Technology projects may have many different dependencies and relationships that may not be obvious to the Project Manager. Therefore, it is important that the functional manager involve the technical team when attempting to determine the project task durations.

Keep in mind while planning a project and developing a schedule certain concessions and considerations must be incorporated for the technical problems that may occur. Technical problems and requirement changes are common inputs to Information Technology project risk. Different elements of risk such as the use of new or unproven technology, hardware or software delivery schedules, and the changing cost of technology can all have dramatic impact on an Information Technology project as well.

3.9 Risk Management Planning

A risk is any factor that may potentially interfere with successful completion of the project. A risk is not a problem – a problem has already occurred; a risk is the recognition that a problem or opportunity might occur. By recognizing potential problems, the Project Manager can attempt to avoid a problem through proper actions.

Figure 3.9.1
Risk Management Planning Process



Risk Management Process

The procedure that the team will use to manage project risks is defined in the Planning Phase, documented in the Project Management Plan, and then executed throughout the Execution, Monitor, and Control Phases of the project. Risk management deals with the following risk phases:

- Risk identification
- Risk qualification and quantification
- Risk response development
- Risk motitoring and response control

The Risk Management Plan documents the procedures used to manage risk throughout the project. In addition to documenting the results of the risk identification and analysis phases, it must cover who is responsible for managing various areas of risk, how risks will be tracked throughout the project, how contingency plans will be implemented, and how project reserves will be allocated to handle risk.

Project risks are identified and carefully managed throughout the life of the project. It is particularly important in the Planning Phase to document risks and identify reserves that have been applied to the risks.

Risk Indentification

Who Identifies Risk

Risk identification is the responsibility of all members of the project team. The Project Manager is responsible for tracking risks and for developing contingency plans that address the risks identified by the team. Sometimes a risk identification brainstorming session can help in the initial identification process. Such meetings help team members understand various perspectives and can help the team better understand the big picture.

When to do Risk Identification

Risk identification is a recurring event. The risk identification process begins in the Project Initiation Phase, where initial risk areas are identified. During the Planning

Phase, risks and mitigation measures are identified and documented. During the resource allocation, scheduling, and budgeting processes, associated reserve planning is also documented. Risk identification, management, and resolution continue after Project Initiation throughout the life of the project. New risks develop as the project matures and external and internal situations change.

When probability of a risk increases, or when a risk becomes a reality and the Project Manager must deal with a real problem, replanning occurs. At this point, the Project Manager and project team develop strategies that assess the impact of the problem. This replanning results in budget, schedule, or resource changes for completion of the project.

How to Identify Risk

Risk can be identified through a variety of means.

- Risk is inherent in any new project and this often times is because the product or process being created is completely new. In situations such as this it is wise to look at the product descriptions and specifications to determine if there are any areas that have the potential for risk.

- Reviewing documents such as the Work Breakdown Structure, budget estimates, staffing plans, etc. may bring to light areas of risks that were not immediately apparent at the time of creation.

- Talking to people who have been on similar projects or looking through historical project files should give the Project Manager an indication of where risk may lie.

- Creating a Risk Breakdown Structure (RBS) that lists the catagories and sub-catagories within which risks may arise for a typical project.

Documenting Risk

Risks are documented so that contingency measures can be taken to mitigate their effects. Again, risks to both the internal and external aspects of the project should be tracked. Internal risks are those items the project team can directly control (e.g. staffing), and external risks are those events that happen outside the direct influence of the

project team (e.g. legislative action).

As stated before, risk identification begins early in the Planning Phase of the project. A Risk Plan is started during the Planning Phase. Then, as scheduling, budgeting, and resource planning occur, the plan is updated to reflect further risks identified throughout the Planning Phase.

Just prior to Project Execution, the Risk Management Plan should be reviewed again and any new risks added to it. As the project progresses, members of the team identify new risk areas that are added to the Risk Management Plan. Also during the Project Control Phase, risks identified earlier may be removed.

Risk Qualification & Quantification

Once risks have been identified, they need to be qualified to the extent that is practical. The first issue is the probability of occurrence. This involves assigning a percentage of probabilty the risk will occur. There is little value in identifying risks that have a very low probability of occurring unless the potential impact is so large that it overshadows the low probability.

The second aspect is quantification of the potential impact on quality, schedule, and cost. This can be done at an order of magnitude level. Some events may set a project back 1-2 months, others 1-2 years with, for example, 10% or 100% cost overruns.

The result of risk quantification is an overall assessment of project risk and the establishment of schedule and cost contingencies for the project.

Contingency Planning

Contingency plans are developed as a result of risks being identified. Contingency plans are pre-defined action plans that can be implemented if identified risks actually occur. If a risk event actually occurs, the contingency plan must be implemented and reserves must be allocated.

To properly implement a plan, a reserve is usually required where dollars and/or time are held by the Project Manager to apply to the execution of a contingency plan. Without maintaining a reserve, the Project Manager is forced to go

back for additional time or dollars for every risk as it becomes a problem. It is far more desirable to maintain a level of reserve where problems can be dealt with from within the original budget and schedule of the project. There are some situations where nothing can realistically be done to prevent or deal with a risk. In this case, the project must be managed in such a way that the probability of the event occurring is minimized. If the event does occur, the Project Manager must re-plan the project and include the effect of the risk event.

Risk Mitigation

Risk mitigation involves preventive actions to reduce the probability of occurrence of risk events and/or minimize their impact.

Common Risk Factors

Some of the common risk areas are shown below along with questions that you may ask yourself when trying to identify and quantify project risks. You will see questions that overlap categories because risks are often inter-related. The list is not intended to be an exhaustive list of questions, but rather something to stimulate thought.

1. Project Scope and Complexity:

    - Is the project scope well understood and supported by all the stakeholders?
    - Is the project scope well understood by the project team?
    - Are requirements complete and well documented?
    - Is the project scope expected to be stable, or are there external forces that may force changes over time?
    - Is the project duration so long that requirements are likely to change due to changes in the environment and the organization?
    - How complex is the project considering factors such as technology, complexity of the business

process, numbers of user organizations, geographical sites, and interfaces with other systems?

1. Technology:

   - Does the project depend on new unproven technology?
   - Are there successful implementation sites that can be visited?
   - Is the project team experienced in the technologies that will be utilized?
   - Is hardware delivery on the critical path, and is planned delivery time normal or tight?
   - Do hardware/software vendors have reliable performance records and responsive support?

2. Staffing:

   - Have all the stakeholders committed adequate resources to the project?
   - Is there a risk of key resources being pulled off for other projects perceived as higher priority by their functional manager?
   - Is project success highly dependent on one or two key people with specialized skills?
   - How many key members of the project team have successfully completed a similar project, or will this be a new experience for the whole team?

3. Cost Estimates:

   - Are time and cost estimates based on well documented history?
   - Do the estimators have experience on similar projects utilizing similar technologies?
   - Is the WBS and are the task definition statements complete, well documented and well understood?

5. Organization and Culture:

    - How ready is the client or user organization to accept and implement changes in the business processes and job content and classifications?

    - Is there an adequate communications plan to keep stakeholders at all levels informed and involved?

    - Is there a risk of organizational changes that may impact the project and the management support of the project?

    - Are there significant differences among the objectives of the stakeholders that could generate difficulties later in the project?

    - Is there strong commitment and support by management for this project?

6. Project Management and Organization:

    - What is the level of project management experience of the project manager and team leaders?
    -
    - Is there a good process in place for user input and involvement?

    - Is the project team physically in the same location with the customer, or in a remote location?

7. Schedule and Budget:

    - Is there an externally imposed tight deadline or budget limitation that significantly increases the risk of quality problems, schedule slippage or cost over-runs?

    - Is the project fully funded, or dependent on future funding for completion? If it is not fully funded, what is the chance that future funding may not come through?

Typical Risk Mitigation Actions and Contingency Measures

- Establish schedule and cost reserves to cover a reasonable level of risk event occurrences.
- Document all planning assumptions and communicate them to the stakeholders.
- Break the project into smaller, more manageable phases and work packages.
- Ensure that all the resources are provided.
- Assign and train backups for the key skilled positions.
- Divide staff into teams and assign team leaders.
- Impose tight change control.
- Establish a Quality Assurance process.
- Insist on formal signoffs of all key deliverables.
- Dedicate management resources.
- Establish several key management checkpoints at which overall project status and risks will be reviewed and necessary management decisions will be made.
- Establish final authority of Project Manager.
- Provide accurate and concise project status reports, identifying all management issues and symptoms of potential risks becoming realities.
- Ensure a high level of user involvement and communication with users.
- Use proven hardware for development if possible.
- Design an alternate (contingent) solution strategy.

Risk Reviews

Risk management requires continuous monitoring of risks. Updating the status of the risk events can best be done concurrently with the analysis of plan variances for project status reporting. Usually a plan variance will impact the probability of a risk event occurring, or the variance may be caused by the occurrence of a risk event. Risk reviews should be a regular part of any Project Status Meeting.

Risk Management Plan

The Risk Management Plan should be a living document that is customized for each individual project. The plan should be updated throughout the project planning and control processes. The Project Manager, with the support of the project team, uses the plan to evaluate each risk event. The Risk Management Plan can be maintained using a risk management software package or by using the Risk Management Plan template found in the appendix. Either method should address these elements:

Impact Level	Percent of Project Planned Value (BCWS)
1	Less than 10%
2	10% to 35%
3	36% to 50%
4	51% to 75%
5	Greater than 75%

- ***Risk Description*** – A brief description of the identified risk.

- ***Probability –*** The chance of the event taking place. Use a decimal value from 1 to 99. 1% = very low, 99% = very high.

- ***Impact*** – The level of impact the event would have on the project. Use a value from 1 to 5 based on the impact table.

- ***Exposure*** – The Probability multiplied by the Impact. 01 = very low, 4.99 = very high.

- ***Current Status*** – The current action that is being taken for the risk management. *Execute Contingency, Mitigate, Transfer, or Watch*.

- ***Affected Phase*** – The Development Phases or WBS elements that are affected by this risk.

- ***Impact Timeframe*** – The earliest and latest dates of a time frame over which the risk could occur.

- ***Risk Area*** – The type of risk: *Quality, Cost, Schedule.*

- ***Critical Path*** – Does this risk affect the critical path?

- ***Section*** – Sections of the department that are affected by this risk.

- ***Control*** – Is the control of the risk *Internal* or *External* to the organization?

- ***Responsible Person*** – The person responsible for managing this risk.

- ***Date Identified*** – The date the risk was first identified.

- ***Contingency Plan*** – Resolve what steps will be taken if the risk event actually occurs.

- ***Mitigation Plan*** – Determine what steps will be taken to prevent a risk event from occurring.

- ***Historical Events*** – Listing of project events concerning this risk.

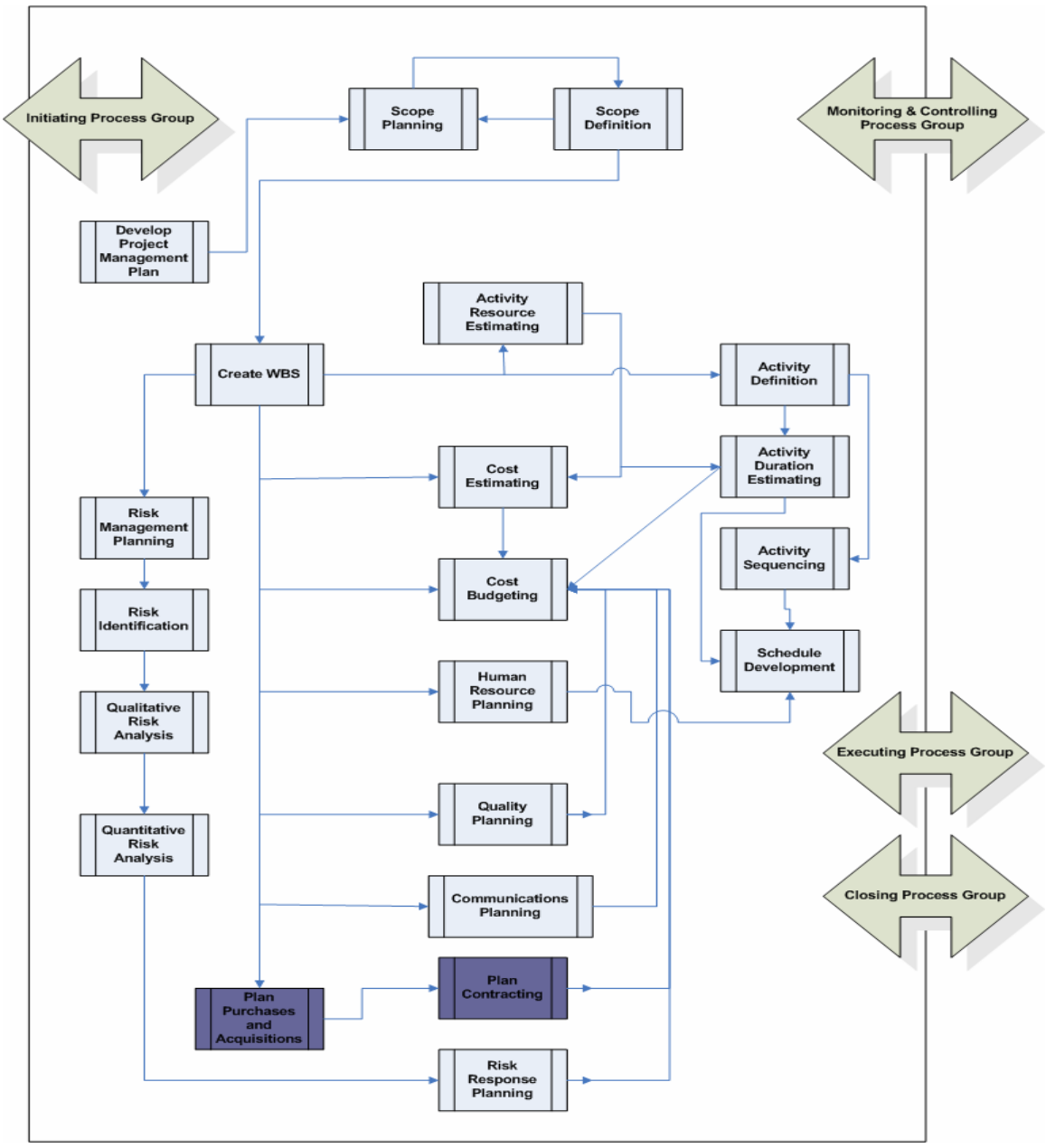
3.10 Procurement Planning

Procurement Planning is the process in which the Project Manager identifies those needs of the project which can be met by purchasing products or services from outside the agency. Procurement Planning should answer the following major questions:

- What should be purchased?
- What is available in the market now or is expected to be available in the required timeframe?
- What are the appropriate requirements for the Purchased item?
- What is the right timeframe and procurement strategy for this purchase?
- What is the appropriate solicitation procedure?
- Who are the most viable potential vendors and what are the key source selection criteria?
- What is the total cost, not just price, of the purchase?
- Is disaster adequate and affordable?

Identification of the items to be purchased should be accomplished in the early stages of the project.

Figure 3.10.1
Procurement Planning Process



What to Procure

Many times the agency is unable to create or supply all of the products necessary to complete a project internally. In those circumstances it is necessary to go outside the agency and purchase the product or service from an external source or enter into a contract with an outside vendor to perform a service or develop the product for the agency. Whatever

choice is made, there is a considerable amount of forethought and planning that needs to go into such a decision. The Project Manager and the project team must look at the needs of the project to determine what special consideration needs to be given to the project. Simple questions need to be answered such as:

- How does this product serve the needs of the project and the agency as a whole?
- Does the product or something similar already exist somewhere else within the agency?
- Is there a service provider available in the market place for this product?
- Does the agency have the means (staff, money, contract, etc.) to produce or to acquire the product?

To answer these questions the project team must take the time to do an extensive investigation into the need and impact of procuring a new product or service.

When to Procure (Decision Tools)

Decision tools are helpful in making decisions regarding procurement within the agency. Decision tools within Procurement Planning are not necessarily tools in the automated sense but specific processes designed to facilitate decision making.

Make or Buy Analysis

This is a simple method to determine the cost effectiveness of creating a product in house as compared to the cost to "buy" the product or have it produced outside the agency. All costs, both direct and indirect, should be considered when performing a make or buy analysis. The costs should then be compared to each other with consideration given to any compelling argument on either side by the project team. Consideration should also be given to the potential of leasing versus purchasing items. Many of the decisions will be based on the length of need for the item or service as well as the overall cost.

Expert Judgment
This process uses the expertise of people from within and outside the agency that have knowledge or training in the area in question to determine what steps should be taken. These people review the needs and the costs and deliver their opinion for consideration in the procurement decision.

How to Procure (Contract Types)

If a decision is made to purchase an item or service from outside the agency then another important decision is made to determine what type of contract should be used. The following are some common contract types:

Fixed Price/Lump Sum Contract
This is a contract that involves paying a fixed, agreed upon price for a well defined product or service. Special consideration must be given to these contracts to ensure that the product is well defined to reduce risk to both the agency and the contractor.

Cost Reimbursement Contract
This contract type refers to a reimbursement to the contractor for actual cost of producing the product or service. Costs within the contract are classified as direct (salaries to staff of the contractor) and indirect (salaries of corporate executive for the contractor). Indirect costs are normally based on a percentage of direct costs.

Unit Price Contract
The contractor is paid a preset amount for each unit ($10 per widget produced) or unit of service ($50 per hour of service) that is produced. The contract equals the total value of all the units produced.

Time and Material Contracts
T&M contracts are a hybrid type of contractual arrangement that contains both cost-reimbursable and fixed-price type arrangements. These types of contracts resemble cost-reimbursable type arrangements in that they are open ended. The full value of the agreement and the exact quantity of items to be delivered are not defined at the time of the contract award. Thus, T&M contracts can grow in contract value as if they were cost-reimbursable type arrangements. Conversely, T&M arrangements can also be fixed price arrangements.

How Much to Procure

This question can only be answered according to the needs of the project itself. However, serious consideration must be put forth to consider questions such as:

- Will there be a need beyond the immediate project for this product?
- How much of the budget has been allocated for this product?
- Is the need for the item clearly defined enough for the agency to know exactly how much of the product will be needed?

Underestimating or overestimating the cost or quantity of an item can have a huge impact on the financial success or failure of a project. Caution should be taken when entering into any contract without clearly defined needs and objectives.

Solicitation Planning

Solicitation planning refers to the process and documentation that is needed to support obtaining bids/proposals from prospective contractors for services needed within the project. State government solicitation is subject to stringent contracting laws and follows a formalized and well documented process for solicitation. The Project Manager and the project team should work with the area of the agency that handles solicitation, when solicitation is needed on their project.

Do not forget that each project is a unique undertaking and; therefore, will require distinctly different procurement documents in reference to the actual technical and specified project needs. Project Managers and their teams should be involved in the creation of these detailed requirements and specifications in bid or proposal information. The Project Manager should take responsibility to ensure that the documentation generated within the solicitation planning process accurately reflects the needs, goals and objectives of the project. The Project Manager should also be involved with the creation of the evaluation criteria for potential bidders and ensure that the criteria are clear and understandable.

Procurement Plan

In most cases there is a pre-defined documentation process for all contracts and outside procurements. Therefore, it may be unnecessary for some projects to create an original or independent Project Procurement Plan for the individual project. Simple reference to agency policy on procurement and contracting should be sufficient when referenced within the Project Plan. It is still wise to provide a summary of this plan as an attachment to the Project Plan itself. However, keep in mind that there may be times in which peculiar circumstances arise within a project that may need to address specific contraction issues. In these cases it will be important to have a pre-defined Procurement Plan.

The Procurement Plan is the management tool that defines the process for the Project Manager to make decisions about the purchasing of products or services throughout the life of the project (from planning through closeout). This plan should include the answers to all major questions listed at the beginning of the chapter. In addition, this plan should also address contractual issues such as the proposed type of contract and the contract management strategy. The Procurement Planning template, found in the Appendix, presents a list of the major sections and a brief description of the major items that may be included in each of the sections. This is a general format. Obviously, some purchases may have issues that are not represented here, and some of the items listed here may not apply to all purchases.

3.11 Quality Planning

Quality Management includes *"all activities of the overall management functions that determine the quality policy, objectives, and responsibilities and implements them by means such as quality planning, quality assurance, quality control, and quality improvement, within the quality system," PMBOK®.*

Figure 3.11.1 depicts a high-level quality project management process.

Figure 3.11.1
Quality Project Management Process

The purpose of using quality management is assuring that the project will satisfy the objectives for which it was undertaken. Quality management may also improve products and services or achieve cost reductions throughout the project. This requires broadening the scope of the quality concept to a "systems" approach. Many advocates of quality management will say that quality is an attitude or way of life that transforms the culture of an organization to one that emphasizes continuous quality improvement. Because the three processes interact with each other, as well as other processes within project management, quality management must be regarded as a system.

"Quality Planning involves identifying which quality standards are relevant to the project and determining how to satisfy them," PMBOK®.

The activities within the Quality Planning process basically translate existing quality policy and standards into a Quality Plan through a variety of tools and techniques.

Quality Assurance is applying the planned, systematic quality activiteis to ensure that the project employs all processes needed to meet requirements. The overall project performance is evaluated on a regular basis to provide confidence that the project will satisfy the relevant quality

standards. A quality survey is one tool used to assure quality standards and customer requirements are met.

Quality Control involves monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance. The seven basic tools used in quality control are: Cause and Effect Diagrams, Control Charts, Flowcharting, Histogram, Pareto Chart, Run Chart, and Scatter Diagram.

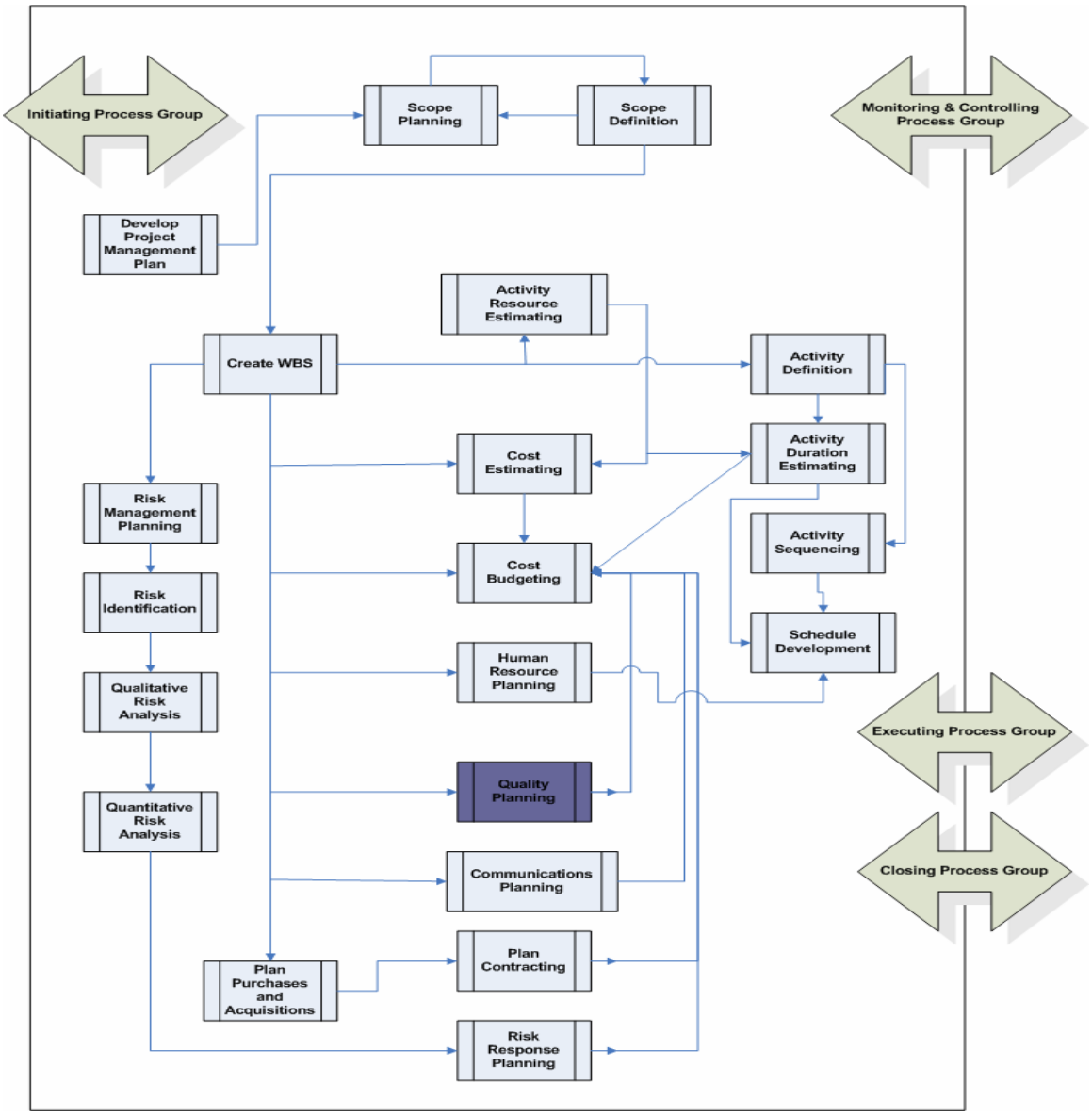
These three processes, when interacting in such manner intent upon practicing quality management principles, form a definition referenced by the Project Management Institute (PMI):

> *"Quality is the totality of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs."*
>
> - International Organization for Standardization 1993.

Successful quality processes always strive to see quality through the eyes of the customer. The customer is the ultimate judge of the quality of the product they receive. They will typically judge a project by whether or not their requirements are met. To ensure delivery of a quality product, each phase of the project should ensure that requirements are addressed.

It is important to include a process that validates that the currently defined requirements will be satisfactory to the customer. It is counterproductive to develop a system that meets a documented requirement if you and the customer know that the requirement has changed. The change management process helps to control the number of such changes, but quality processes must be in place in order to make changes when they are necessary.

Figure 3.11.2
Quality Planning Process



Quality Tools and Techniques

There are four basic techniques used in Quality Management: benefit/cost analysis, benchmarking, flowcharting, and design of experiments. Other quality planning tools that may be used to better define the situation and help plan effective quality management activies are: brainstorming, affinity diagrams, force field analysis, nominal group techniques, matrix diagrams, and prioritization matrices

Benefit/Cost Analysis

Benefit/cost analysis involves estimating tangible and intangible costs and benefits 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.

The quality planning process must consider benefit/cost trade- offs.

"The primary benefit of meeting quality requirements is less rework, leading to higher productivity, lower costs, and increased stakeholder satisfaction. The primary cost of meeting quality requirements is the expense associated with project quality management activities; therefore, it is important for the benefits to outweigh the costs." PMBOK®.

Benchmarking

By using the benchmarking method, the Quality Engineer and project team compare both actual and planned practices of the current project against other similar projects performed in the past. As long as the two projects have comparable processes with measurable results, the Quality Engineer will be able to take a step towards determining the quality success of a project by comparing the two.

Flowcharting

Flowcharts are diagrams that graphically show how different elements of a system fit together in order to understand the logical flow of data or processes. Examples of flowcharts include:

- ***Cause & Effect Fishbone or Ishikawa Diagrams*** – these illustrate how various causes and sub-causes create to or relate to process problems.

- ***System or Process Flowcharts*** – show how various elements of systems interrelate.

Design of Experiments

Design of experiments is an analytical technique which helps identify which variables have the most influence on the overall outcome. In example, senior engineers will cost more than junior engineers, but can also be expected to complete the assigned work in less time. An appropriately

designed “experiment” (in this case, computing project costs and durations for various combinations of senior and junior engineers) will often allow determination of an optimal solution from a relatively limited number of cases.

Responsibility for Quality

Every project member needs to buy-in to the responsibility for producing a quality product. Through ownership of the agency’s quality policy or the individual project’s quality policy, the individual team members become the most effective way to implement quality into products efficiently and completely. A quality policy cannot rely on “adding” quality at the end of a process; it must be built into the work of each individual on the team. It is far more cost effective to have team members add quality into their day-to-day jobs than to have a quality engineer find a problem after a process has been completed.

For most projects areas of responsibility usually fall somewhere along these lines:

Customers	**Set the requirements**
Senior Management	**Set the tone**
Project Manager/Functional Managers/Quality Engineer	**Selects and implements the standards**
Quality Engineer	**Monitor Compliance**
Suppliers/Vendors	**Meet the standards**
Subcontractors	**Meet the standards**
Project Staff	**Meet the standards**

Quality Plan

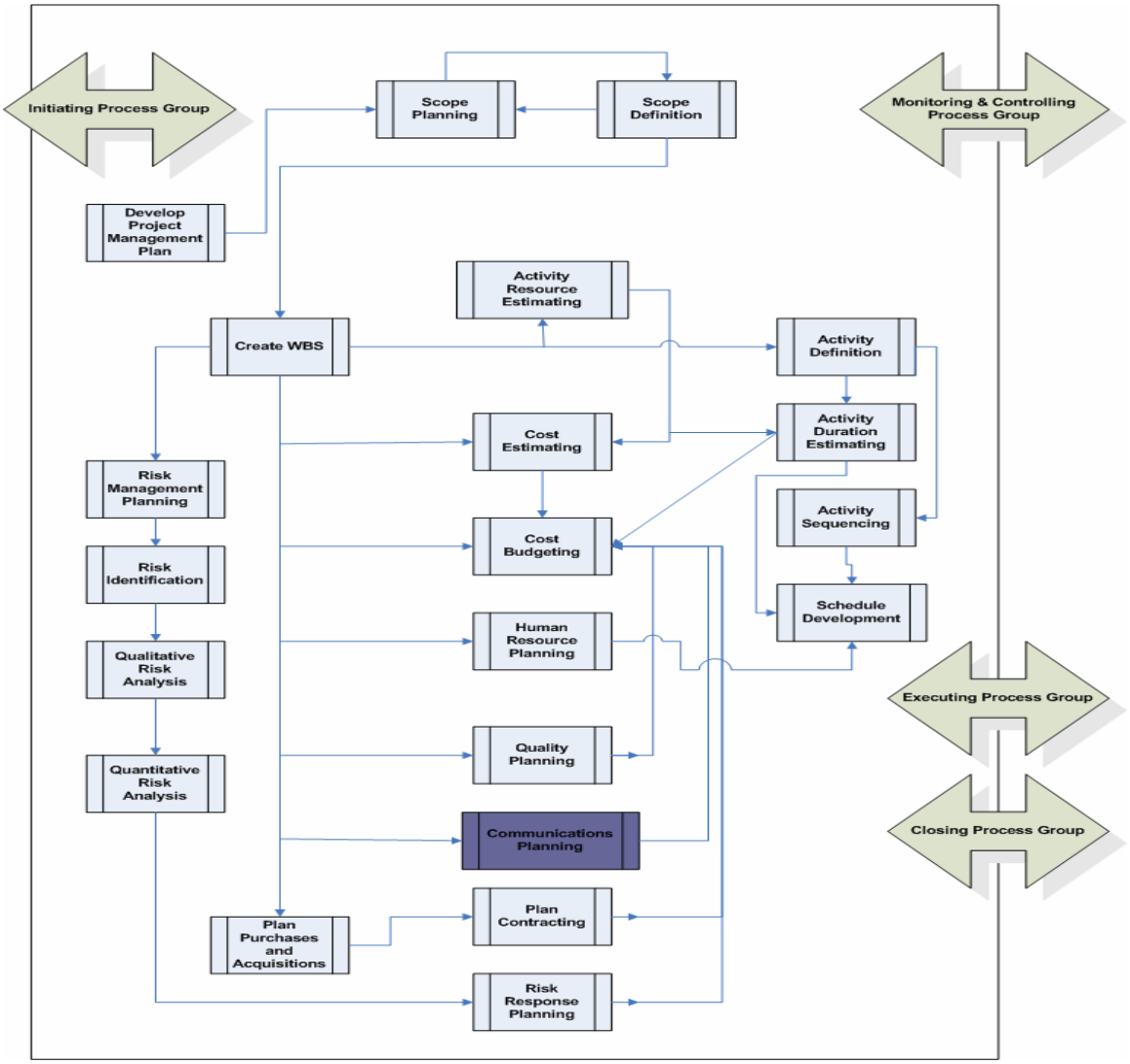
The project's Quality Plan is a sub-element of the Project Plan. It is developed by the Quality Engineer with inputs and review from the Project Manager and Project Team Members.

The quality manaement plan should include efforts at the front end of a project to ensure that the earlier deccisions, such as concepts, designs and tests, are accurate. These efforts should be performed through an independent peer review and not include individuals that worked on the material being reviewed. The Quality Plan should describe how the quality policy will be implemented and describe the project quality system which can include the organizational structure, responsibilities, procedures, processes, and resources needed to implement quality management. The plan must address quality control, quality assurance, and quality improvement for the project.

3.12 Communications Planning

Project Communications Management is the Knowledge Area that employees the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval and ultimate disposition of project information. Communications planning is the first key process in this area that plans and documents how communication flows and how stakeholder requirements will be properly managed.

Figure 3.12.1
Communications Planning Process



Communication planning involves determining the information needs of project stakeholders, as well as which people need what information, when it will be needed, and how they will get it. Communication is the cornerstone of how work gets done among different parties within a project. Communications planning is a process that overlays all other parts of project planning as well as the other phases because it is the way in which we transfer what needs to be done, how it will be done, when it needs to be done, and by whom it will be done.

Communications Planning Process

The Communications Management Plan is contained in, or is a subsidiary plan of, the overall Project Management Plan. It often entails creation of additional deliverables that require tasks, time and effort included in the work breakdown structure, project schedule and project budget. The majority of Communications Planning is done as part of the earliest project phases. However, the results of this planning process are reviewed regularly through the project management life cycle and revised as needed.

Communications Information Requirements

Developing a Communications Plan involves understanding who within the agency or project organization will need what information and their relationship to the project. The number of team members involved with the project, their reporting structure and their location are also considerations when making decisions on how best to handle project information.

To begin developing a communications infrastructure, there is considerable data that needs to be known and understood. What information is required by people throughout the project is often dictated by the organizational structure of the agency. Information that is disseminated should contribute to project success and/or highlight possible areas of communication failure.

Other data is also needed to assist the Project Manager in the creation of the Communications Plan. This data will help the Project Manager develop the infrastructure for

creation and dissemination of information. Information needs include:

- How quickly will people need the project information?
- How often will they need information?
- What is the most convenient form of media for all team members/stakeholders (electronic, paper, etc)?
- Are there already communications systems in place that can be taken advantage of?
- How long will people be involved with the project and need to receive information?
- Where will information be stored and how can people access it?

Communication Plan

After collecting information on the number and needs of the stakeholders involved with the project, it is the Project Manager's responsibility to draft a Communications Management Plan that will outline how communication and information will be distributed, updated, and stored.

Information Distribution - This section of the plan will provide a description on how project information will flow throughout the agency, what stakeholders and team members will need, and what particular areas of information each person needs; as well as how the information is distributed and when the information is needed.

Information Collected and Updated - This section of the plan discusses how the Project Manager will collect information from certain project areas and how often updated information will be expected to be reported. It should also discuss what action should be taken if important information needs to be updated between project information collection cycles.

Information Storage and Access - This section of the plan will give project members an idea where physical project

information will be kept within the agency as well as where electronic media might be stored for project team access.

Performance Reporting

There are various types of performance reports that may be requested within a project. These reports provide information on how resources within the project are being utilized. The most common type of report is the Project Status Report.

These reports cover multiple areas including scope, budget, schedule, risk, procurement, and quality. In order to produce status reports, the project team members must be aware of their project responsibilities and monitor them closely.

Project Status Reports

Individual Status Reports

Individual Status Reports tend to differ from project to project. Each Project Manager likes to see the performance reports in a certain format that is useful to them. This is an area; however, that should be included within the Communications Plan. The Project Manager should start with a standard status reporting template to meet the project reporting needs. The Project Manager should discuss the expectations for filling them out (including detail and frequency). When possible, the Project Manager should use the standard electronic form and adjust the form as necessary within the project management software tool. The electronic form should be used for individual status unless a particular situation might not permit it.

The Individual Status Reports should be prepared by the project team detailing activities, accomplishments, milestones, identified issues, and problems. Some level of recovery plans should be prepared for activities that are not on schedule and corrective action plans prepared for anticipated problems. Individual project task time reporting should be a part of the status report or preferably recorded through the use the project management software tool.

Project Status Reports

A standard requirement of all projects is to provide Project Status Reports to executive management, project sponsors, and other project stakeholders. This typically is either

weekly, bi-weekly, monthly, or at major project phase/milestone completion.

The information shared in the Project Status Report should be in a consistent format throughout the project and should follow the format provided in the Project Status Report template. A general rule of thumb is that the detail should be kept to a minimum. If more detail is needed to clarify issues, then this should be provided as supplementary data.

Manage Stakeholder Outputs

Along with status reports and project requirements documents are the following key documents and processes to be addressed in the Communications Management Plan: Issue Logs, Change Requests, Correction Action Items, and Lessons Learned. As stakeholder requirements are identified and resolved, these documents will address the concerns and record how each are addressed and closed.

Communications Planning for IT Projects

A number of technical disciplines may need to be involved with developing and executing a successful Information Technology project. Often times staff members that harbor needed technical skills come from different functional areas from within the department. This can lead to a large amount of communication that must take place between the Project Manager and the functional managers to obtain the skills needed and to ensure communication channels are open across functional areas. A solid Communications Plan can help outline this process.

In addition the scope of the Communications Plan reaches much further than the team that is working on the project itself. There are several stakeholders, including the customers, agency management, vendors, contractors, and other agencies that need to be considered when vital project status updates or information needs to be disseminated. The Communications Plan for the Information Technology project needs to take all of the stakeholders, such as those listed above and possibly more, into account. Each stakeholder has different information needs and the frequency at which they receive them will be different as well.

3.13 Configuration Management Planning

Meaningful Configuration Management requires an effective and well defined Configuration Management effort. Configuration Management functions include:

- Defining who will be responsible for and have authority over Configuration Management.
- Setting the Configuration Management standards, procedures, and guidelines for the full project team to follow.
- Defining tools, resources, and facilities to be used for Configuration Management.

These functions should be addressed in the Configuration Management Plan which is a sub-element of the Project Plan. A Configuration Management Plan should be developed for all projects.

Terminology

For the purposes of this document, the following terms apply to Configuration Management:

Configuration Management
Configuration Management is the technical and administrative application of configuration control. It includes the following functions:

- Identify and document the functional and physical characteristics of Control Items.
- Audit the Control Items to verify conformance to specifications, interface control documents and other contract requirements.
- Control changes to Control Items and their related documentation.
- Record and report information needed to manage Control Items effectively, including the status of proposed changes and the implementation status of approved changes.

Control Item

Control Item is a project element that is considered a unit for the purpose of Configuration Management. In discussion of general project management this may include such things as the product design, the project plan, and other associated documents.

Configuration Control

Configuration Control is the systematic evaluation, coordination, approval or disapproval and dissemination of proposed changes and implementation of all approved changes in the configuration of any item after formal establishment of its configuration Baseline.

Tasks During the Planning Phase

During the Planning Phase, the Project Manager and the Configuration Management Section Manager identify the person or persons responsible for project Configuration Management and define the procedure for performing Configuration Management. During the Planning Phase, the project team also identifies the control items. The goal is to:

- Explicitly assign Configuration Management's authority and responsibility for the project.
- Ensure that Configuration Management is implemented throughout the project by setting standards, procedures, and guidelines that are produced and distributed to the full project team.
- Ensure that project management has a repository for storing configuration items and associated Configuration Management records.
- Ensure that Quality Assurance reviews the baselines and Configuration Management activities on a regular basis.

Relationship of Quality and Configuration Management

Many of the issues related to Configuration Management are similar to the issues related to developing a project's quality system. In fact, in software development projects,

many of the tasks for Quality and Configuration Management overlap. For this reason, a clear definition needs to be established, even at the Planning Phase, as to who will play what role. Because of this strong relationship, many projects have pointers between the various Quality and Configuration Management plans to avoid redundancy.

Authority & Responsibility

Every project includes some level of development or integration activity that requires Configuration Management. Projects need to include at least a manual configuration control process for storing, retrieving, and changing project requirement documents and management documents. The responsibility for Configuration Management is assigned and clearly shown in the Configuration Management Plan subsection of the Project Plan.

The Configuration Management Plan should define the authority and responsibility for the Configuration Control Board. The Configuration Control Board is a representative subteam of the Project Team. The Configuration Control Board members are appointed by the Project Manager and the Quality Engineer for each project. The Configuration Control Board performs these activities:

- Authorizes the establishment of project baselines and the identification of configuration items.
- Represents the interests of the Project Manager and all groups who may be affected by changes to the project baselines.
- Reviews and authorizes changes to baselines.

Configuration Elements

During the early stages of project planning, the project team, the person responsible for Configuration Management and the Project Manager define the elements placed under configuration control. The list of control items is not standard. The best place to start is with the activity list and Work Breakdown Structure. Typically, all major milestones and deliverables are controlled. The actual project documents and products created are also controlled.

For example, the Configuration Management team might want to control the Project Plan (schedules, budgets, and contracts), support function plans, and correspondence and other documents necessary to recreate a project.

Configuration Management Procedures

Procedures and tools are necessary to ensure successful implementation of a Configuration Management process. In the Planning Phase, fully defined configuration procedures are not necessary. In the Control Phase, the location of these detailed procedures and the definition of the process for enforcement are defined.

The plan also contains information on how the detailed procedures will be developed and specifies that these procedures are in place by project start-up. Some key processes to be addressed in the procedures include:

- How do managers and project team members request and retrieve configuration control items?
- What are the numbering, sequencing, and data processes to be used?
- Does the project contain sensitive or security driven data; if so, will the Configuration Management meet the control requirements for this data? Where is the location of controlled items, and how does the project team get access to them?
- What items will be placed under automated control and what items will be manually controlled?
- Under what circumstances does a formal Configuration Control Board meet and what sort of authorization needs to occur (verbal or written)?

The plan may also include diagrams and flow charts to describe procedures for submitting change requests and for reporting problems.

Configuration Management
Repository and Storage

It is important to ensure that the project has a repository for storing controlled configuration items and associated Configuration Management records. This information should also be reasonably available to members of the project team and project stakeholders as necessary.

The Configuration Management environment includes the resources necessary for the implementation of the configuration plan. This includes the following configuration control tools:

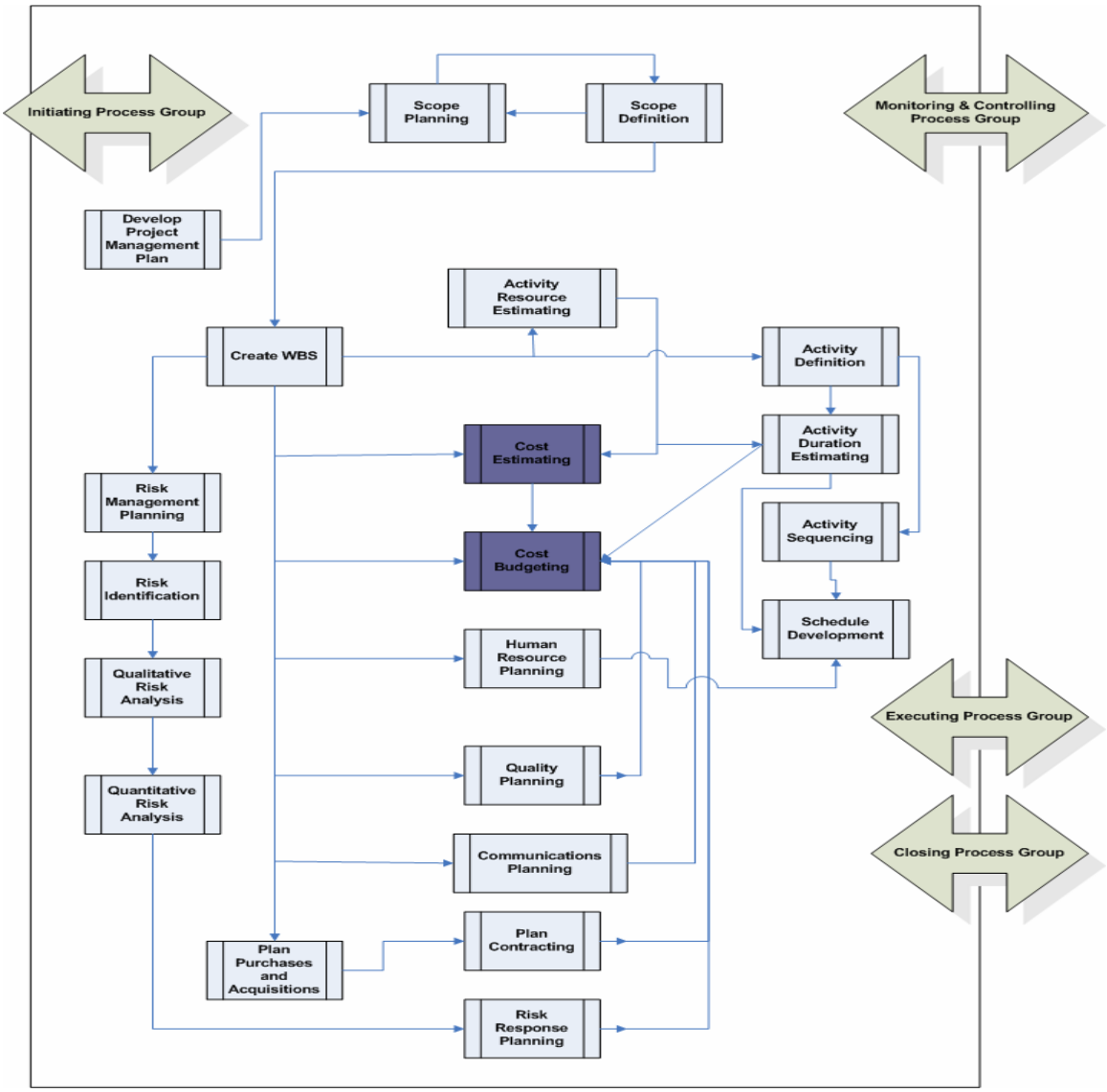
- Automatic version control and change control tools.
- Monitoring, reviewing and registration of support utilities.
- ***Storage facilities*** - a safe repository for all approved configuration items.

Configuration Management is one area in which many automated tools exists.

3.14 Project Budget Planning

Paralleling the Project Schedule Development is Project Budget Planning. At the initial stages of project planning, budgeting is the determination of costs associated with the defined activities. The steps associated with budgeting are highly dependent upon both the estimated lengths of tasks and the resources assigned to the project.

Figure 3.14.1
Project Budgeting Process



Initial budgetary estimates can often be based on availability of funds or may be dictated by legislation. This parameter may or may not coincide with the actual funds needed to perform the project. For this reason, budget estimates are refined in the Planning Phase until they are baselined at the beginning of the Project Execution Phase. Appropriations and Funding for an agency are affected by project budgets and should be considered when doing project budget estimates. Budgeting serves as a control mechanism where actual costs can be compared with and measured to the budget. The budget is often a fairly set parameter in the execution of the project. When project costs begin to escalate, the Project Manager should revisit the Project Plan to determine whether scope, budget, or schedule needs adjusting.

Identify Cost Factors

To develop the budget, the applicable cost factors associated with project tasks are identified. The development of costs for each task should be simple and direct and consist of labor, material, education, and other direct costs. Cost of performing a task is directly related to the personnel assigned to the task, the duration of the task, and the cost of any non-labor items required by the task.

Budget estimates are developed by the Project Manager and the project team. Inputs are obtained from the people responsible for performing the work efforts. This provides the expertise required to make the estimate and provides buy-in and accountability during the actual performance of the task.

Information provided by the team members helps to identify people and labor categories required to perform the work. The cost of the labor is multiplied by the number of hours required to complete the task. Determining how long the task performance takes is the single most difficult part of deriving a cost estimate. The labor costs should factor in vacation time, sick leave, breaks, meetings, and other day-to-day activities. Non- labor charges include such items as

material costs, travel, cost of capital (if leasing equipment), and equipment costs. Not including these factors jeopardizes both scheduling and cost estimates.

Create Cost Model

Labor and non-labor cost information can be entered into a Project Management Software tool or a spreadsheet, depending upon the complexity of the project. A Project Estimate Summary worksheet, which builds in the rates of the DIS Resource Pool, is an appropriate model for costing and can be useful if completed prior to entering information into the project management tool.

Costs should be assigned to the lowest level Work Breakdown Structure task. These costs are then combined to determine a sub-task cost. In turn, these are combined to determine the overall task cost, which can be summed to find the total project cost. An IT Project Budget Estimate sample can be found in the Appendix.

Perform Risk Analysis

Identifying and quantifying project risk is inherently involved with budget development for any project. Good budget practices make allowances for dealing with risk in one or more of the following ways:

- Where significant budgetary risks are identified and another Work Breakdown Structure task for risk management/risk reduction is included or where financial reserves can be set aside to deal with potential budget problems.

- Budget for those tasks where risks are inherent. There is no rule of thumb for this multiplier; it depends on the degree of risk and the overall importance of the task to the project.

- Add a percentage multiplier to the budget where there are risks, especially if new technology is being used or if the person providing the estimate is

extremely optimistic. Also, technical staff frequently underestimate the effort required to do any particular task. This could result in serious budget problems during implementation.

Document Assumptions

As with developing a project schedule, documenting assumptions made while developing the project budget is critical to the success of the project. Without clear documentation of these assumptions, tracking the budget is very difficult and risky.

If, for example, a budget assumed that the material would be acquired at one price rate and only a substantially higher cost material was available to perform the task; there would be a budget problem. If the assumption is not documented, the Project Manager may inadvertently increase project costs unknowingly and may unwittingly jeopardize chances for the project's success.

Review the Cost Estimates

Development of project budgets typically requires more than one person. Rarely does a single individual have the knowledge and understanding of all the factors affecting every aspect of a project. A good process is to have the same people that review the activity list and schedule review the budget.

Upon completion of a draft budget, meet with the project team and determine if the work descriptions, schedule and associated budgets are complete and accurate. Determine if there is a common understanding of what it costs to do the tasks. Get independent estimates. Where there are significant differences, determine the reasons and either redefine the work packages, schedule, and budgets or review and reiterate the estimates.

It is extremely important to get buy-in on the budget from the people who will actually perform the work. Participation results in having a stake in the project's success and fosters accountability. Imposing budgets on staff without a buy-in may result in slippage.

Cost Management Plan

The Cost Management Plan should describe how cost variances will be managed. Variance controls may be different from project to project. Permitted variances may be dependent on such factors as:

- Project phase
- Length of phase
- Length of project
- Type of estimate
- Accuracy of estimate

For many projects, variances are permitted to change over the duration of the project. The variance control level should be established and approved by the project stakeholders.

Variance Analysis

The goal of variance analysis is to develop actions that should be taken to correct the problem within the original budget or to justify a new estimate. Five questions should be addressed during variance analysis:

- What is the problem causing the variance?
- What is the impact on time, cost, and performance?
- What is the impact on other efforts, if any?
- What corrective action is planned or underway?

- What are the expected results of the corrective action?

Variance Analysis Information

In order to calculate variances you must define the three basic variances for budgeting and actual costs for work scheduled and performed.

- Planned Value (PV) is the budgeted amount of cost for work scheduled to be accomplished plus the amount or level of effort or apportioned effort to be accomplished in a given time period.

- Earned Value (EV) is the budgeted amount of cost for completed work, plus budgeted for level of effort or apportioned effort activity completed within a given time period.

- Actual Cost (AC) is the amount reported as actually expended in completing the work accomplished within a given time period.

These costs can then be applied to any level of the work breakdown structure (program, project, task, subtask, work package) for work that is completed or anticipated. Using these definitions, the following variance measures can be obtained:

- ***Cost Variance (CV)*** – the difference in what was budgeted to perform the work (EV) and what was actually spent (AC), money based.

    - CV = EV – AC

- ***Cost Performance Index (CPI)*** – a number representing the ratio of budgeted costs to actual costs.
    - CPI = EV / AC
    - CPI >1 indicates underbudget; CPI< 1 indicates overbudget.
- ***Schedule Variance (SV)*** – the difference in what was budgeted to perform the work (EV) and the amount we scheduled to perform the work (PV), time based.
    - SV = EV - PV
- ***Schedule Performance Index (SPI)*** – a number representing the ratio of work performed to work scheduled.
    - SPI = EV / PV
    - SPI>1 indicates ahead of schedule; SPI<1 indicates behind schedule.

3.15 Project Planning Transition Checklist

In order to transition from the Planning Phase to the Execution Phase of the project it is important to make sure that all of the necessary plans and documents that are pertinent to the particular project in question have been completed. This sub-section discusses the process of insuring that the activities have been finished, reviewed, and signed off so that the project may move into the Execution Phase.

Usefulness of Project Checklists

A good way to ensure that all start-up tasks are completed prior to actually starting the project is to develop a transition checklist. The checklist can be developed and then used by others to ensure that the tasks necessary to baseline the project are completed.

A Project Planning Transition Checklist becomes a way for the Project Manager to organize and communicate tasks that should be completed prior to starting the project. For large projects, some of the start-up tasks could take as long as some of the initial planning steps.

Beyond serving as a communication document, use of the Transition Checklist can also trigger completion of tasks that the project team might overlook. The checklist is a combination of an action list and a tool to verify that necessary steps have been completed. The Transition Checklist should be organized according to the major areas of concern that will determine the project's success. The development and use of a Transition Checklist also provides the project team with the tools to ensure that all information has been reviewed and approved.

Project Planning Transition Checklist Creation

The Project Manager owns the Project Planning Transition Checklist, although in most projects, the full team provides input.

Format of a Project Planning Transition Checklist

The format of the Project Planning Transition Checklist can be whatever the project team defines, but it usually resembles more of an outline than a dissertation. It could be a single line item with space provided for the person to complete the checklist with the current status of an item. Sample answers might be:

- Y = Item has been addressed and is completed.
- N = Item has not been addressed, and needs to be in order to complete the process.
- N/A = Item has not been addressed and is not related to this project.
- P = Item has been addressed and some issue resolution is needed to complete the item or annotate is as “N/A”.

If the item status information is modified, then the person responsible for the Transition Checklist should ensure that the information is given to the full project team for use. Each item on the Transition Checklist should also have an area for comments and should note plans to resolve “N” or “P” entries. The project team can choose to put this checklist under Configuration Management or in the Project File Folder so that it may be shared. The format can be modified to the requirements of a particular project. A sample checklist can be found on the following pages.

Project Planning Transition Checklist Sample

Project Name: ***Date:***

Agency: ***Modification Dates:***

Prepared by:

	Item	Status	Comments/Plan to Resolve
1	Scope Management		
1.1	Is the project statement - scope, defininition and objectives - the same as agreed to in the project initiation process and/or the vendor contract?		
1.2	Has the Project Scope Statement been reviewed as part of the baseline process?		
1.3	Is there a baseline plan against which to measure progress?		
1.4	Is the organization structure appropriate for the project's size and complexity?		
2	Resource Management		
2.1	Is the plan for project resources adequate?		
2.2	Is the project organization documented and on file?		
2.3	Is the plan for the organization of the project resources adequate?		
2.4	Is the Project Manager qualified and experienced in Project Management?		
2.5	Is the Project Sponsor function identified and defined?		
2.6	Is there an identified role of a technical leader (i.e. Project Lead, Team Lead, and System Architect)?		
2.7	Are there backup strategies for key members of the project?		
2.8	Have roles and responsibilities of the team been documented and clearly communicated to the team, customer, and stakeholders?		
2.9	Were key project stakeholders brought in to the Project Plan?		

2.10	Were potential customers involved early in the planning process?		
3	Schedule Development		
3.1	Is the original project schedule realistic?		
3.2	Has the format for tracking and monitoring schedules been defined?		
4	Risk Management		
4.1	Will the project risks being managed be according to the project's risk management process?		
4.2	Will the Risk Plan be updated on a regular and frequent basis?		
4.3	Will the Risk Status be reported to management on a regular and frequent basis?		
4.4	Will the risk documents be filed?		
4.5	Will there be documented contingency plans for the top 5 - 10 risks?		
4.6	Will the Preventive Plans for the top 5 risks be identified, included in the Project Plan, and implemented?		
5	Issue Management		
5.1	Is an Issue Management Process documented and filed?		
5.2	Is this process communicated to the customer and team member?		
5.3	Will an issue form be in use?		
5.4	Will all project issues be unconditionally tracked through the issue resoution process?		
5.5	Will all tasks resulting from issues be entered into the Project Plan and tracked through the plan?		
5.6	Are there processes for unresolved issues to be escalated and resolved within a resasonable timeframe?		
6	Project Procurement		
6.1	If there are any vendors, have they signed off on the Project Plan?		
7	Communications Management		
7.1	Is there an information system for the project?		
7.2	Are the various types of reports, their contents, requency, and audience defined and communicated to the project		

	team?		
7.3	Are the input requirements from the team members clearly documented and communicated?		
7.4	Have the reports to be produced, distributed, and filed been defined?		
7.5	Have the various meetings, the purpose, the context, frequency, and participants been defined and communicated?		
7.6	What are the defined meeting materials?		
7.7	Are the meetings set up to have assigned note takers that will add actions/issues to the issue list?		
8	Quality Management		
8.1	Is the quality function identified and assigned?		
8.2	Are there adequate project control systems?		
8.3	Is there a Quality Plan documented and filed?		
8.4	Are the quality functions and related roles and responsibilities clearly defined?		
8.5	Is there completion/verification criteria defined for each task producing an output?		
8.6	Is there a process (test plans, inspections, reviews) defined for veryifying outputs for each task?		
8.7	Will tasks be marked “complete” only after Quality Surveys have been successfully completed?		
8.8	Will there be a formal process for submitting, logging, tracking, and reporting items undergoing quality review throughout the submit- test-rework-resubmit-retest cycle?		
8.9	Will statistics related to quality be collected, trends analyzed, and problems addressed as issues?		
8.10	Will the quality related information be reported regularly as part of the Status Reporting mechanisms?		
8.11	Has a method and process for requirement tracking been developed?		

9	Configuration Management		
9.1	Is the plan under configuration management?		
9.2	Is there a Change Control Board?		
9.3	Have the Configuration Management functions been assigned?		
9.4	Will there be a Change Control Process in place?		
9.5	Is the Change Control Process documented and on file?		
9.6	Will this process be communicated to the customer and project team?		
9.7	Will there be a change request form in use?		
9.8	Will all project deliverable and software configuration management be changed only through thte change control process?		
9.9	Will all change requests be unconditionally tracked through this process?		
9.10	Will all change requests and current status be logged?		
9.11	Will all tasks resulting from approved changes be entered into the Project Plan and tracked through the plan?		
9.12	Will new change requests be acknolwedged in a timely manner?		
10	Project Budgeting		
10.1	Is the original project budget realistic?		
10.2	Has the format for tracking and monitoring costs been defined?		