

Welcome to PMP Exam Preparation

Introduction

The Project Management Framework

Session Objective

- Understand the growing need for better project management
- Explain what a project is, provide examples of projects, list various attributes of projects, and describe the triple constraint of projects
- Describe project management and discuss key elements of the project management framework, including project stakeholders, the project management knowledge areas, common tools and techniques, and project success
- Discuss the relationship between project, program, and portfolio management and the contributions they each make to enterprise success
- Understand the role of the project manager by describing what project managers do, what skills they need, and what the career field is like for information technology project managers
- Describe the project management profession, including its history, the role of professional organizations like the Project Management Institute, the importance of certification and ethics, and the advancement of project management software

Introduction



Trying to manage a project without project management is like trying to play a football game without a game plan.

K. Tate

Advantages of Using Formal Project Management

- Better control of financial, physical, and human resources
- Improved customer relations
- Shorter development times
- Lower costs
- Higher quality and increased reliability
- Higher profit margins
- Improved productivity
- Better internal coordination
- Higher worker morale (less stress)

1.1 What is a Project ?

- *A Project is a temporary endeavor undertaken to create a unique, product, service, or result.*
 - ❖ Temporary endeavor with a beginning and an end.
 - ❖ Creates unique product, service or result.
 - ❖ Is Progressively Elaborated.
 - ✓ Distinguishing characteristics of each unique project will be progressively detailed as the project is better understood.

Project Attributes

- A project:
 - ❖ Has a unique purpose
 - ❖ Is temporary
 - ❖ Is developed using progressive elaboration
 - ❖ Requires resources, often from various areas
 - ❖ Should have a primary customer or sponsor
 - ✓ The **project sponsor** usually provides the direction and funding for the project
 - ❖ Involves uncertainty

1.2 Project vs. Operational Work

| | |
|---|--|
| Projects <ul style="list-style-type: none">• To attain its objectives and terminate• Create own character, organization, and goals• Catalyst for change• Unique product or services• Heterogeneous teams• Start and end date | Operations <ul style="list-style-type: none">• To sustain the business• Semi permanent charter, organization, and goals• Maintain status quo• Standard product or services• Homogeneous teams• Ongoing |
| Examples <ul style="list-style-type: none">• Producing a News letter• Writing and publishing a book• Implementing a LAN• Hiring a sales man• Arrange for a conference• Opening for a new shop• Producing the annual report | Examples <ul style="list-style-type: none">• Responding to customers requests• Writing a letter to a Prospect• Hooking up a Printer to a computer• Meeting with an employee• Attending a conference• Opening the shop• Writing a progress update memo |

1.3 Projects and Strategic Planning

- Projects are means of organizing activities that cannot be addressed within the organizations normal operational limits.
- Projects are typically authorized as a result of one or more of the following strategic considerations:
 - ❖ A Market Demand & Organizational Need
 - ❖ A Customer Request
 - ❖ A Technological Advancement
 - ❖ A Legal Requirement
 - ❖ Ecological Impacts
 - ❖ Social need

1.4 What is Project Management?

- The application of knowledge, skills, tools and technique to project activities to meet project requirements
- Project Management is accomplished through the application and integration of the processes such as
 - ❖ Initiating
 - ❖ Planning
 - ❖ Executing
 - ❖ Monitoring and Controlling
 - ❖ Closing

Managing Project

- The Project Manager is the person responsible for accomplishing the project objectives.
- Managing a project includes:
 - ❖ Identifying requirements.
 - ❖ Establishing clear and achievable objectives.
 - ❖ Balancing the competing demand of quality, scope, time and cost.
 - ❖ Adapting the specifications, plans, and approach to the different concerns and expectations of the various stakeholders.
- Project managers strive to meet the **triple constraint** by balancing project scope, time, and cost goals

Triple Constraints



The Triple Constraint

- Every project is constrained in different ways by its:
 - ❖ *Scope*: What work will be done as part of the project? What unique product, service, or result does the customer or sponsor expect from the project?
 - ❖ *Time*: How long should it take to complete the project? What is the project's schedule?
 - ❖ *Cost*: What should it cost to complete the project? What is the project's budget?
- It is the project manager's duty to balance these three often competing goals.

More on the Triple Constraint

- It may be good enough to hit the target, or range of triple constraint goals, but not the bull's-eye.
- It's important to determine which aspects of the triple constraint are the most important.
- The “quadruple constraint” includes quality as well as scope, time, and cost.

Project Management Knowledge Areas

- Four core knowledge areas lead to specific project objectives.
 - ❖ *Project scope management* involves defining and managing all the work required to complete the project successfully.
 - ❖ *Project time management* includes estimating how long it will take to complete the work, developing an acceptable project schedule, and ensuring timely completion of the project.
 - ❖ *Project cost management* consists of preparing and managing the budget for the project.
 - ❖ *Project quality management* ensures that the project will satisfy the stated or implied needs for which it was undertaken.

Project Management Knowledge Areas (continued)

- ❖ *Project human resource management* is concerned with making effective use of the people involved with the project.
- ❖ *Project communications management* involves generating, collecting, disseminating, and storing project information.
- ❖ *Project risk management* includes identifying, analyzing, and responding to risks related to the project.
- ❖ *Project procurement management* involves acquiring or procuring goods and services for a project from outside the performing organization.
- ❖ *Project Stakeholder Management* involves the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project,

Project Management Tools and Techniques

- Project management tools and techniques assist project managers and their teams in various aspects of project management.
- Note that a tool or technique is more than just a software package.
- Specific tools and techniques include:
 - ❖ Project charters, scope statements, and WBS (scope)
 - ❖ Gantt charts, network diagrams, critical path analyses (time)
 - ❖ Net present value, cost estimates, and earned value management (cost)

Project Success

- There are different ways to define project success:
 - ❖ The project met scope, time, and cost goals.
 - ❖ The project satisfied the customer/sponsor.
 - ❖ The project produced the desired results.

Relationships Among Project Management, Program Management and Portfolio Management

- Program Management
- Portfolio Management
- Projects and Strategic Planning
- Project Management Office

What is a Program?

➤ A **program** is:

- ❖ “a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.”*
- ❖ A **program manager** provides leadership and direction for the project managers heading the projects within the program.

➤ **ADVANTAGES**

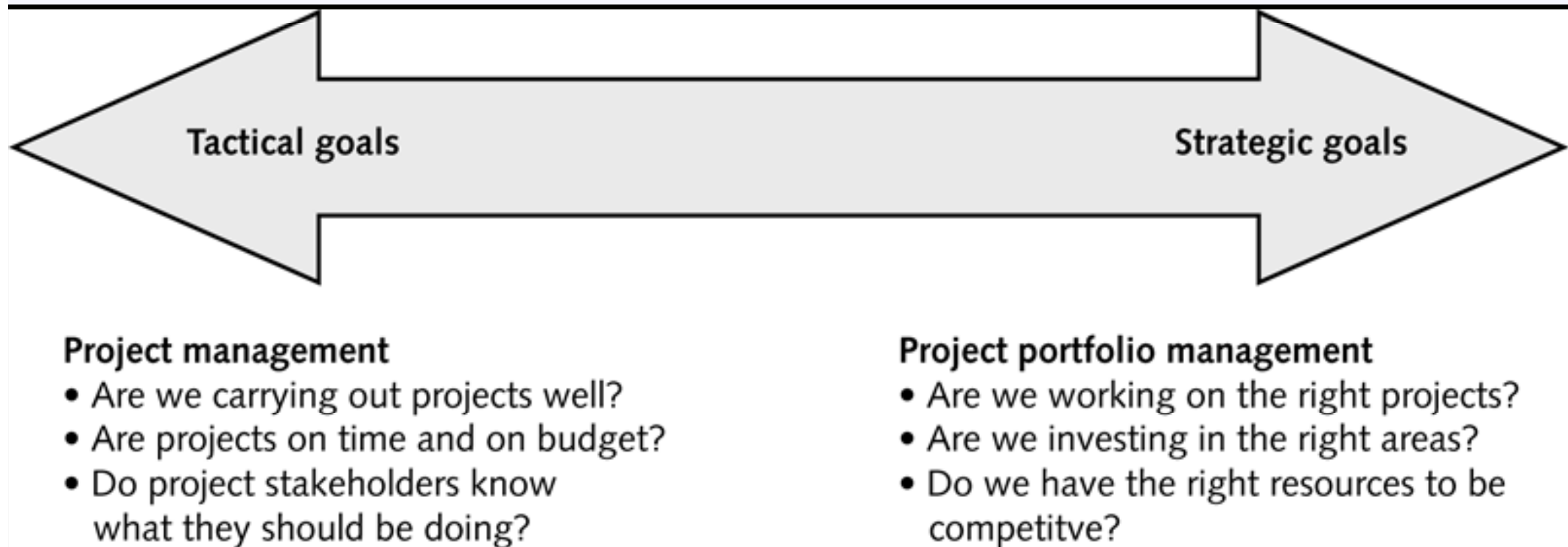
- ❖ Decreased risk
- ❖ Economies of Scale
- ❖ Improved Management

Portfolios and Portfolio Management

- A portfolio is a collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives.
- Portfolio managers help their organizations make wise investment decisions by helping to select and analyze projects from a strategic perspective

The projects or programs in the portfolio may not necessarily be interdependent or directly related.

Project Management Compared to Project Portfolio Management



Comparative Overview of Project, Program , and Portfolio Management

| | Projects | Programs | Portfolios |
|-----------------|--|--|---|
| Scope | Projects have defined objectives. Scope is progressively elaborated throughout the life cycle | Have a larger scope and provide more significant benefits | Portfolios have a business scope that changes with the strategic goals of the org |
| Change | Project managers expect change and implement processes to keep change managed and controlled | The program manager must expect change from inside and outside the program and be prepared to manage it | Portfolio managers continually monitor changes in the broad environment |
| Planning | Project manages progressively elaborate high level information into detailed plans throughout the project life cycle | Program managers develop the overall program plan and create high level plans to guide detailed planning at the end of the component level | Portfolio manages create and maintain necessary processes and communication relative to the aggregate portfolio |

| | Projects | Programs | Portfolios |
|-------------------|---|--|---|
| Management | Project managers manage the project team to meet the project objectives | Program managers manage the program staff and the project managers ; they provide vision and overall leadership | Portfolio managers may manage or coordinate portfolio management staff |
| Success | Success is measured by product and project quality , timelines , budget compliance, and degree of customer satisfaction | Success is measured by the degree to which the program satisfies the needs and benefits for which it was undertaken | Success is measured in terms of aggregate performance of portfolio components |
| Monitoring | Project managers monitor and control the work of producing the products , services , results that the project was undertaken to produce | Program managers monitor the progress of program components to ensure the overall goals , schedules, budget& benefits of the program will be met | Portfolio managers monitor aggregate performance and value indicators |

1.3 Projects and Strategic Planning

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 - ❖ A Technological Advancement
 - ❖ A Legal Requirement

Project Management and Operations Management

- Operations are an organizational function performing ongoing execution of activities that produce the same product or service
- Projects are temporary in nature and can help the organization achieving their goals when they are aligned with the organization's strategy

Role of a Project Manager

- The Project Manager is the person responsible for accomplishing the project objectives.
- Project managers strive to meet the triple constraint by balancing project scope, time, and cost goals
- Depending on the organization structure , a project manager may report to functional manager.
- In other cases project manager may be one of the several project managers who report to a portfolio or program manager that is ultimately responsible for enterprise wide projects . In this type of structure, the project manager works closely with the portfolio or program manager to achieve the project objectives

Role of a Project Manager

- In addition to area specific skills and general management proficiencies required for the project , effective project management requires that the project manager possess the following characteristics :
- **Knowledge** : this refers to what project manager knows about project management
- **Performance** : this refers to what project manager is able to do or accomplish while applying their project management knowledge
- **Personal** : this refers to how project manager behaves when performing the project or related activity . Personal effectiveness encompasses attitudes, core personality characteristics and leadership.

Suggested Skills for Project Managers

Knowledge of the following:

- All nine project management knowledge areas
- The application area, including specific standards and regulations
- The project environment
- General management
- Human relations

Media Snapshot – Good Project Management Skills from *The Apprentice*

- *Leadership and professionalism are crucial.*
- *Know what your sponsor expects from the project, and learn from your mistakes.*
- *Trust your team, and delegate decisions.*
- *Know the business.*
- *Stand up for yourself.*
- *Be a team player.*
- *Don't be overly emotional and stay organized.*
- *Work on projects and for people you believe in.*
- *Think outside of the box.*
- *Some luck is involved in project management, and you should always aim high.*

Importance of Leadership Skills

- Effective project managers provide leadership by example.
- A **leader** focuses on long-term goals and big-picture objectives while inspiring people to reach those goals.
- A **manager** deals with the day-to-day details of meeting specific goals.
- Project managers often take on the role of both leader and manager.

Ten Most Important Skills and Competencies for Project Managers

1. *People skills*
2. *Leadership*
3. *Listening*
4. *Integrity, ethical behavior, consistent*
5. *Strong at building trust*
6. *Verbal communication*
7. *Strong at building teams*
8. *Conflict resolution, conflict management*
9. *Critical thinking, problem solving*
10. *Understands, balances priorities*

Summary

- *A project is a temporary endeavor undertaken to create a unique product, service, or result.*
- *Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements.*
- *A program is a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.*
- *Project portfolio management involves organizing and managing projects and programs as a portfolio of investments that contribute to the entire enterprise's success.*
- *The project management profession continues to grow and mature.*

2.1 The Project Life Cycle

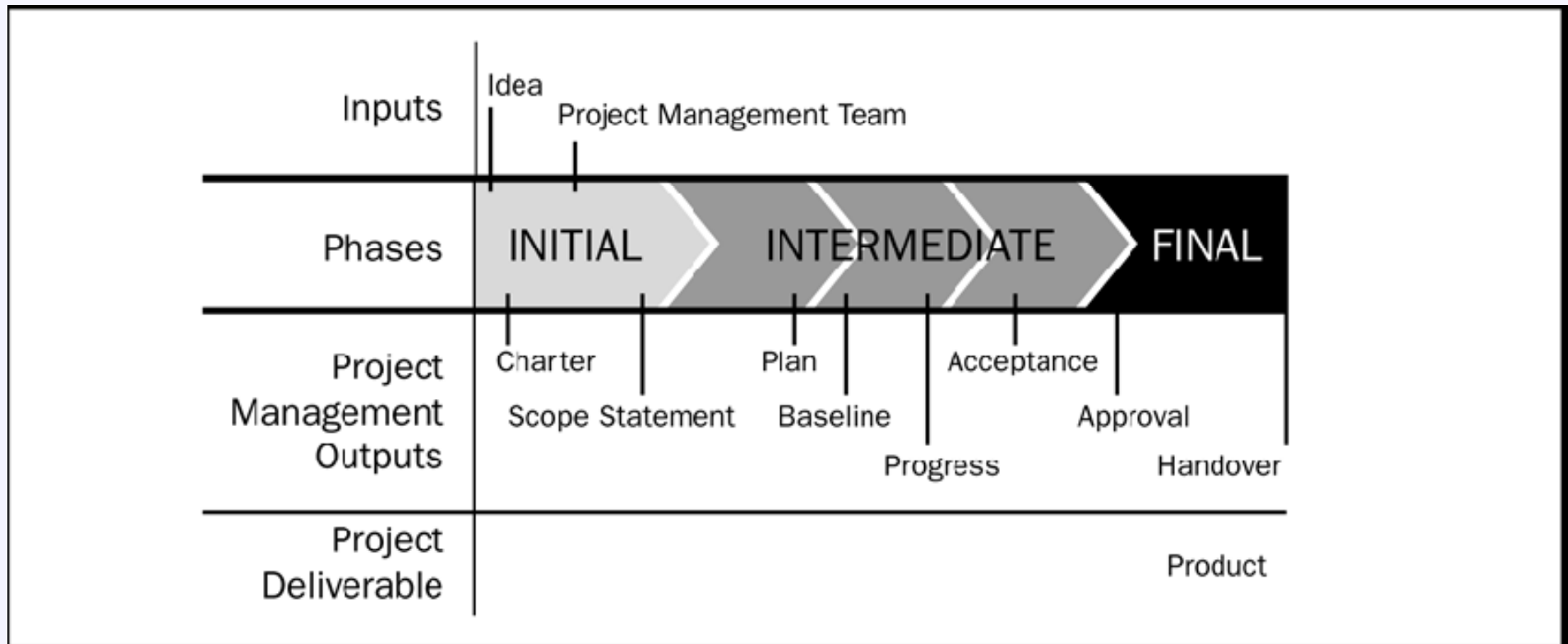
- The project life cycle is the agglomeration of all phases in the project
 - ❖ All projects are divided into phases, and all projects, large or small, have a similar life cycle structure.: Starting the project , organizing and preparing , carrying out the project work and closing the project
 - ❖ At a minimum, project will have a beginning or initiation phase, an intermediate phase or phases, and an ending phase.
 - ✓ Each phase has a defined endpoint

Construction: Feasibility-> Planning -> Design -> Production -> Turnover -> Startup
IT Project: Requirement -> Design -> Program -> Test -> Implement

Project Phases and the Project Life Cycle

- A **project life cycle** is a collection of project phases that defines:
 - ❖ What work will be performed in each phase
 - ❖ What deliverables will be produced and when
 - ❖ Who is involved in each phase
 - ❖ How management will control and approve work produced in each phase
- A **deliverable** is a product or service produced or provided as part of a project

Phases in Project Life Cycle



Handoffs

- Project phases evolve through the life cycle in a series of phases sequences called handoffs, or technical transfers. The end of one phase sequence typically marks the beginning of the next.

The completion of one phase does not automatically signals the beginning of next phase.

Phase Completion

- You will recognize phase completion because each phase has a specific **deliverable**, or multiple deliverables, that marks the end of the phase.

A deliverable is an output that must be produced, reviewed, and approved to bring the phase or project to completion. Deliverable is a tangible, verifiable work product.

A Guide to the PMBOK states that phase ending reviews are also known by a new other names: Phase Exits, Phase Gates, or Kill Points.

More on Project Phases

- In early phases of a project life cycle:
 - ❖ Resource needs are usually lowest
 - ❖ The level of uncertainty (risk) is highest
 - ❖ Project stakeholders have the greatest opportunity to influence the project
- In middle phases of a project life cycle:
 - ❖ The certainty of completing a project improves
 - ❖ More resources are needed
- The final phase of a project life cycle focuses on:
 - ❖ Ensuring that project requirements were met
 - ❖ The sponsor approves completion of the project

Key Stakeholders

| | |
|-------------------------|---|
| Project Manager | Manages the Project |
| Customer | Purchases the product or service |
| User | Uses the product or services |
| Performing Organization | Whose employees are most directly involved in doing the project's work |
| Project team members | Group performing the project's work |
| Project management team | Who are directly involved in the project management activities |
| Sponsor | Provides the financial resources for the project |
| Influencers | Due to an individual's position can influence positively or negatively |
| PMO | It has direct or indirect responsibility for the outcome of the project |

What we do with the Stakeholders ?

- Identify ALL of them
- Determine ALL of their requirements
- Determine their expectations
- Communicate with them
- Manage their influence

2.3 Organizational Influence

- Projects are typically part of an organization that is larger than the project.
- The maturity of the organization with respect to its project management system, culture, style, organizational structure and project management office can also influence the project.
 - ❖ Organizational Systems
 - ❖ Organizational Cultures and Styles
 - ❖ Organizational Structure
 - ❖ Organizational Process Assets

2.3.1 Organizational System

- Project-based organizations are those whose operations consist primarily of projects. These organizational falls into two categories:
 - ❖ Organizations that derive their revenue primarily from performing projects for others under contract - architectural firms, engineering firms, consultants, construction contractors, and government contractors.
 - ❖ Organizations that have adopted management by projects.

Organizational Cultures and Styles

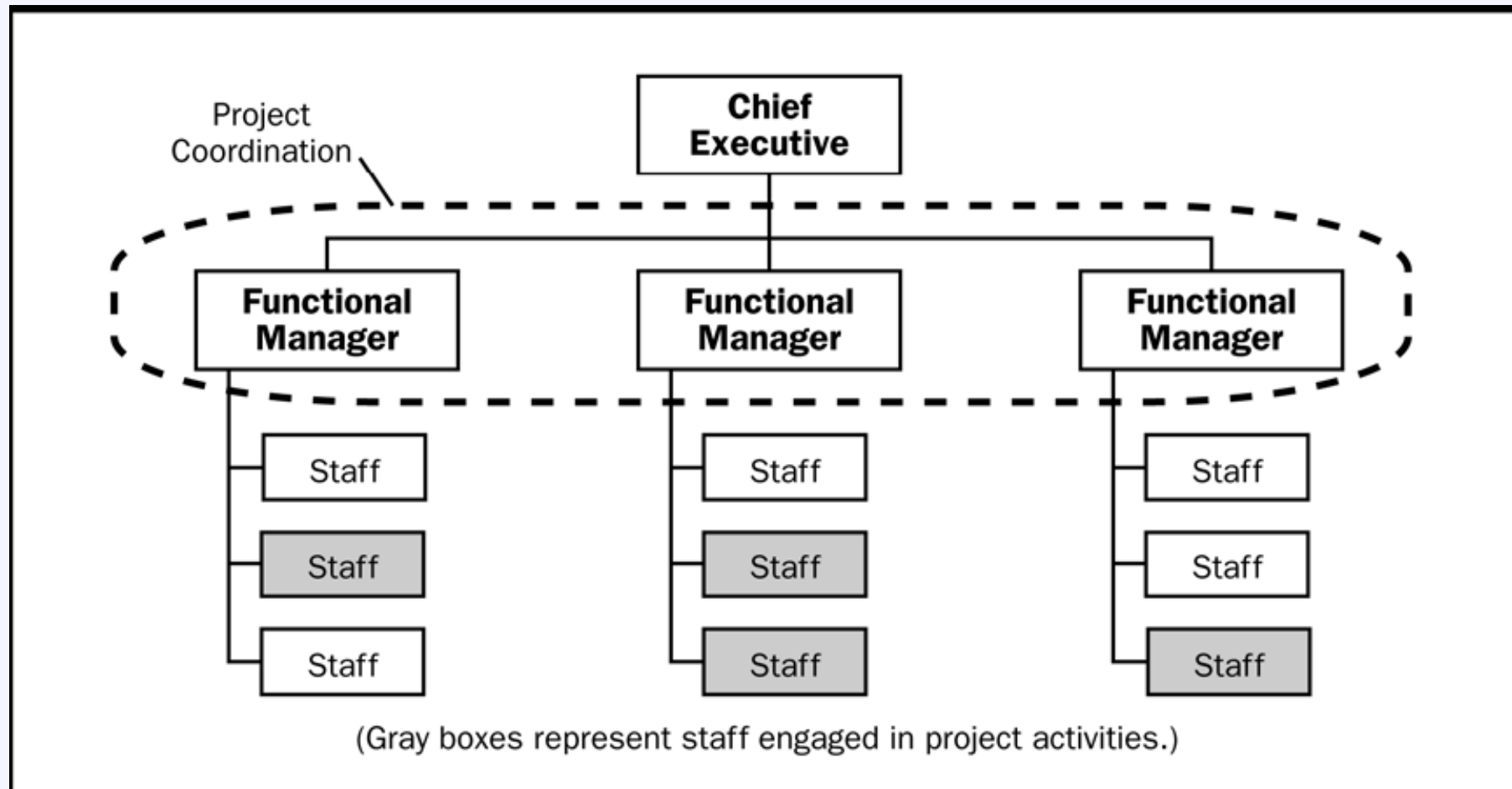
➤ These cultures are reflected in numerous factors:

- ❖ Shared values, norms, beliefs, and expectations
- ❖ Policies and procedures
- ❖ View of authority relationships
- ❖ Work ethics and work hours

Organizational Structure

- The structure of the performing organization often constraints the availability of resources in a spectrum from Functional to Projectized, with a variety of matrix structure in between.

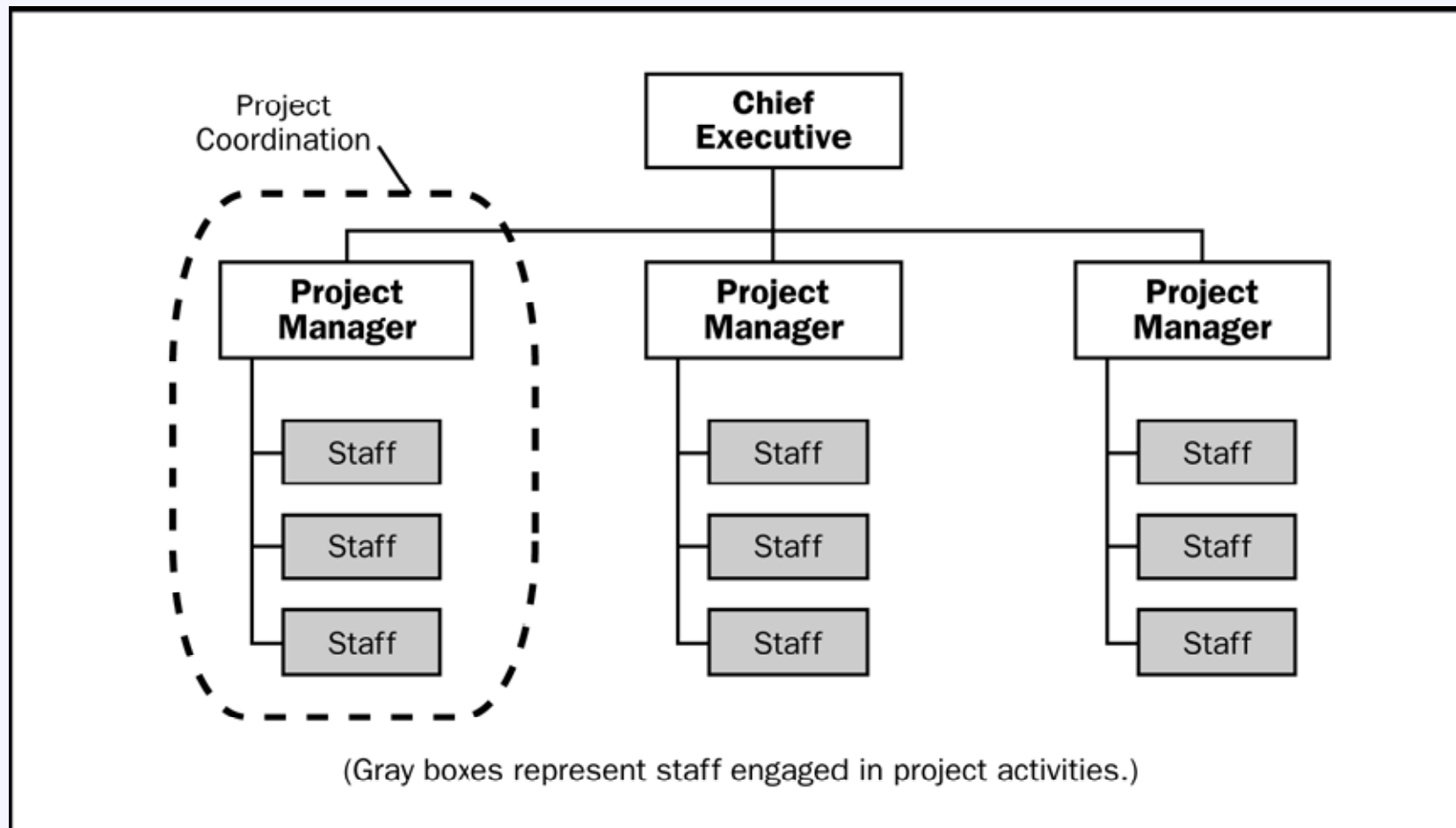
Functional



Functional Organization - Key Points

- The organization is grouped by areas of specialization within different functional areas.
- Projects generally occur within a single department.
- Information required from other department will be routed through departmental heads.
- Team members complete project work in addition to normal department work.

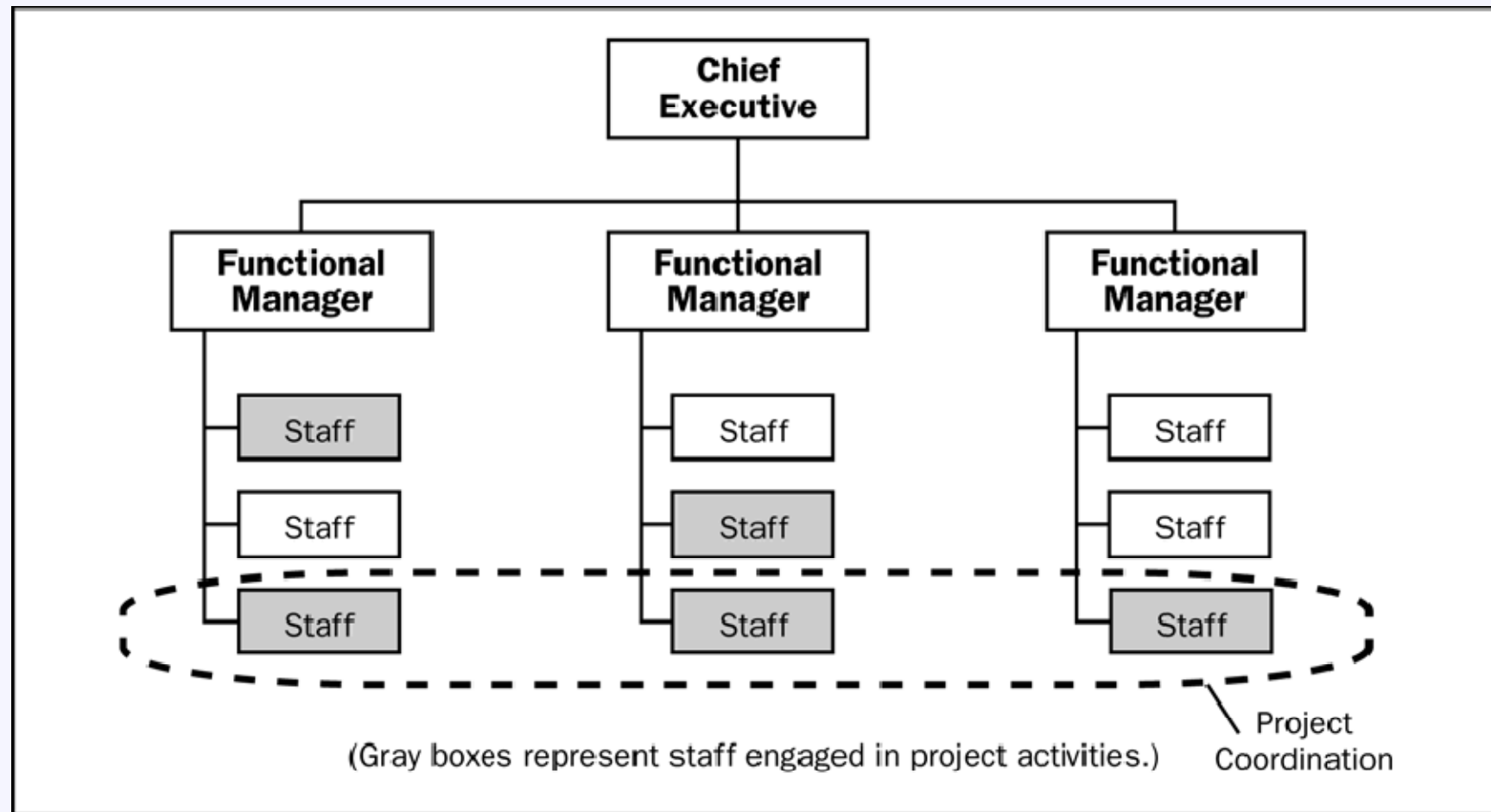
Projectized Organization



Projectized Organization – Key Points

- The entire company is organized by projects.
- The project manager has control of projects.
- Personnel are assigned and report to a project manager.
- Team members complete only project work and when its over they don't have HOME.
- Communication generally occurs only within the project.

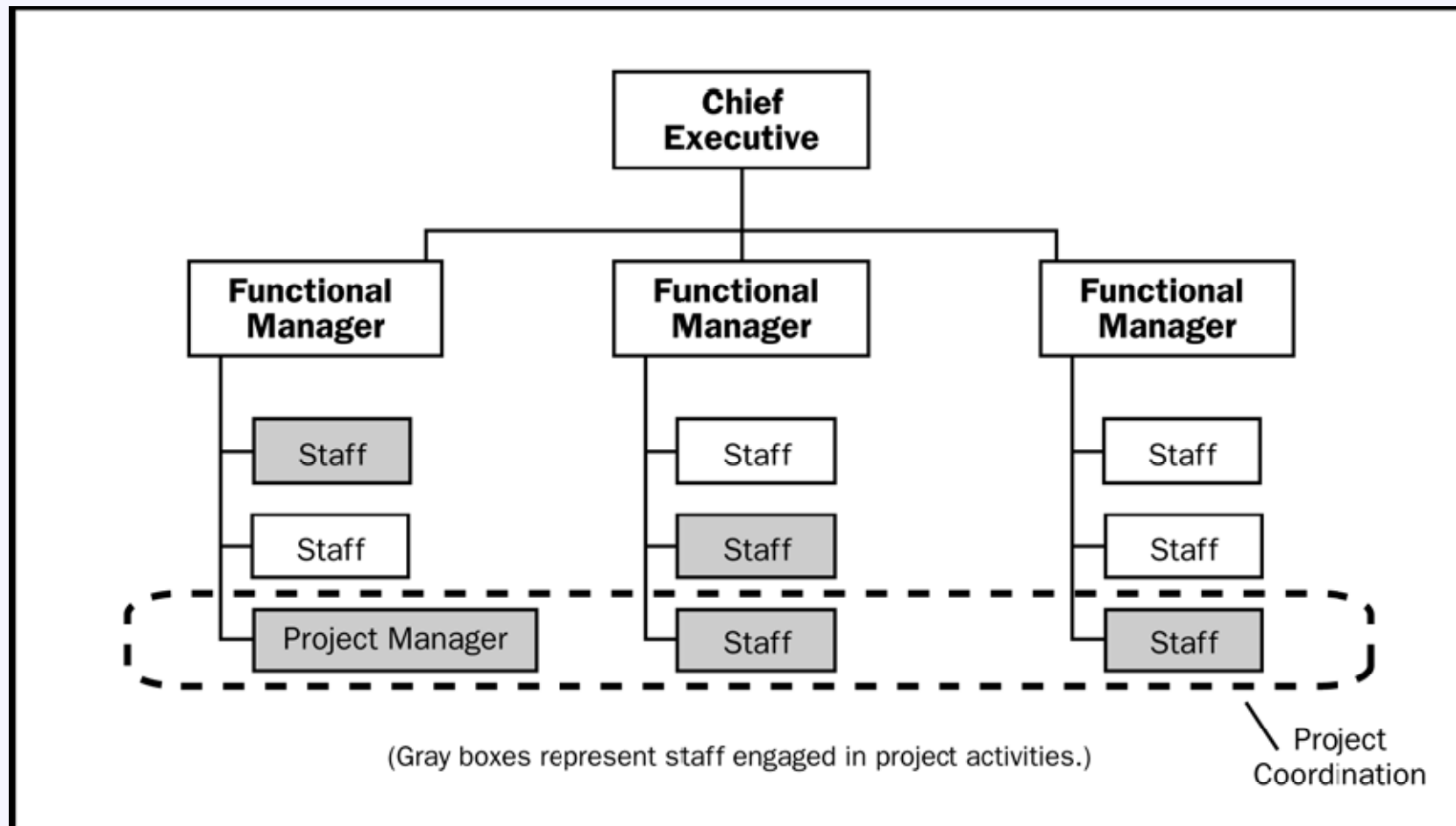
Weak Matrix Organization



Weak Matrix - Key Points

- Two Bosses
- Team members reports to Project Manager and Functional Manager
- Team members do project work in addition to normal departmental work
- Power rests with functional manager
- Project Manager plays a role of:
 - ❖ **Project Expediter:** Cannot take decision. Staff assistant and Communication coordinator.
 - ❖ **Project Coordinator:** Similar to Project Expeditor except has some power to take decision.

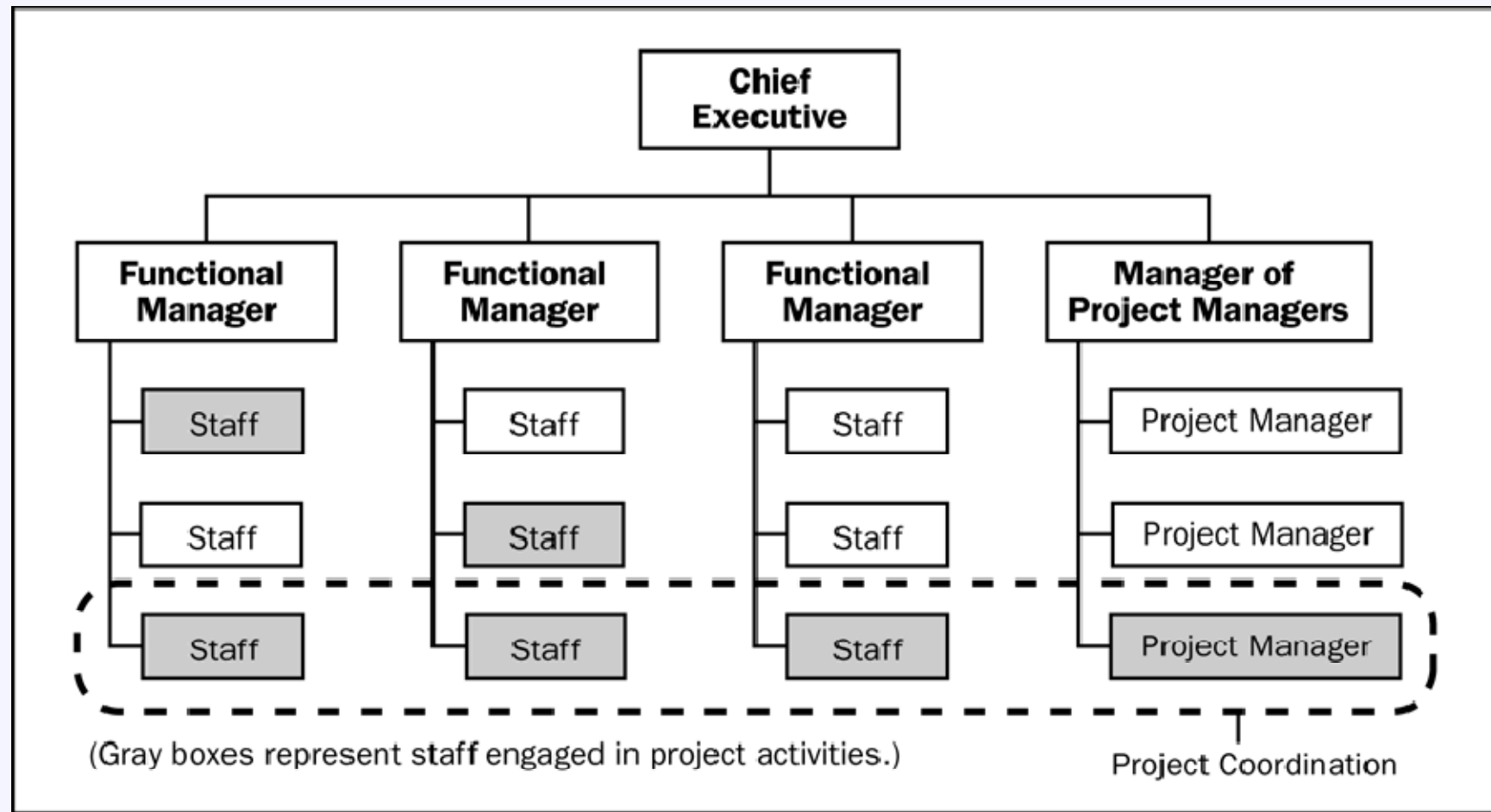
Balanced Matrix Organization



Balanced Matrix Organization - Key Points

- Two Bosses
- Team members reports to Project Manager and Functional Manager
- Team members do project work in addition to normal departmental work
- Power is shared between the functional and project manager

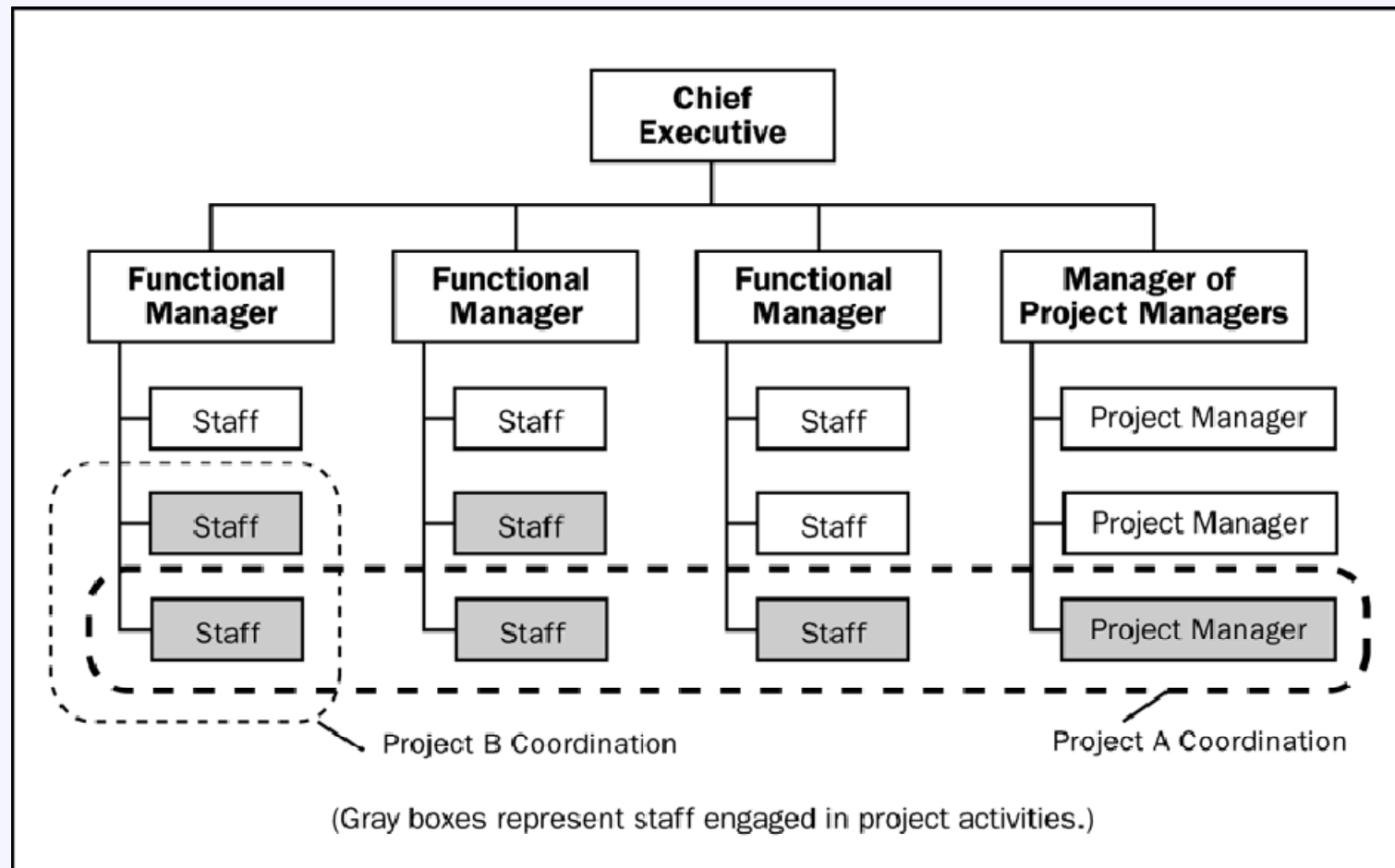
Strong Matrix



Strong Matrix – Key Points

- Power rests with the Project Manager

Composite Organization



Organization Structure influence on Project

| <div> <div>Organization Structure</div> <div>Project Characteristics</div> </div> | Functional | Matrix | | | Projectized |
|---|--------------------|--------------------|-----------------|------------------|----------------------|
| | | Weak Matrix | Balanced Matrix | Strong Matrix | |
| Project Manager's Authority | Little or None | Limited | Low to Moderate | Moderate to High | High to Almost Total |
| Resource Availability | Little or None | Limited | Low to Moderate | Moderate to High | High to Almost Total |
| Who controls the project budget | Functional Manager | Functional Manager | Mixed | Project Manager | Project Manager |
| Project Manager's Role | Part-time | Part-time | Full-time | Full-time | Full-time |
| Project Management Administrative Staff | Part-time | Part-time | Part-time | Full-time | Full-time |

Advantages & Disadvantages

| Functional | |
|---|---|
| Advantages | Disadvantages |
| <ul style="list-style-type: none">➤ Clear career paths in specialization areas➤ Team members report to one supervisor➤ Easier specialist management | <ul style="list-style-type: none">➤ More than one boss for project team members➤ Resource allocation is challenging➤ Potential for conflict between functional and project managers |

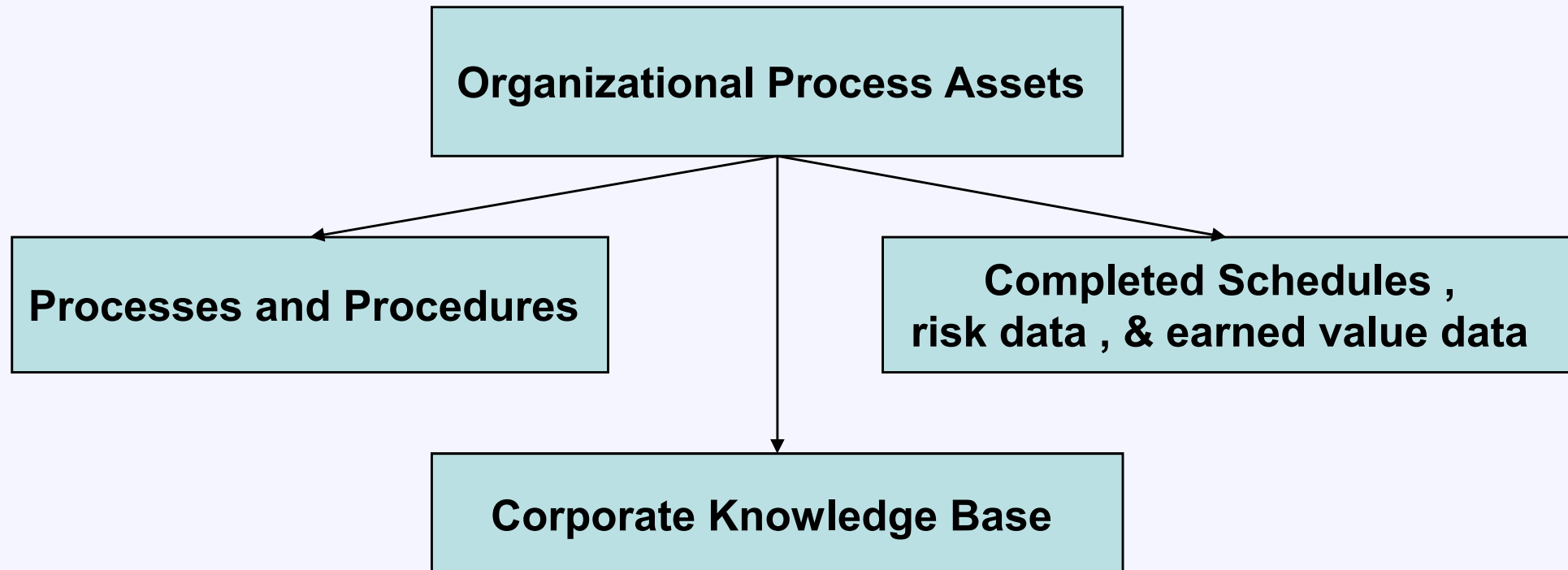
| Matrix | |
|--|---|
| Advantages | Disadvantages |
| <ul style="list-style-type: none">➤ Improved project manager control over resources➤ Project objectives are supported in the organization➤ More support from functional organization | <ul style="list-style-type: none">➤ More than one boss for project team members➤ Resource allocation is challenging➤ Potential for conflict between functional and project managers |

Advantages & Disadvantages (Cont..)

| Projectized | |
|--|---|
| Advantages | Disadvantages |
| <ul style="list-style-type: none">➤ Efficient project organization➤ Project loyalty➤ Simplified communications | <ul style="list-style-type: none">➤ Lack of professionalism in specialization areas➤ No “home” when projects are completed➤ Duplication of facilities and job functions |

Organizational Process Assets

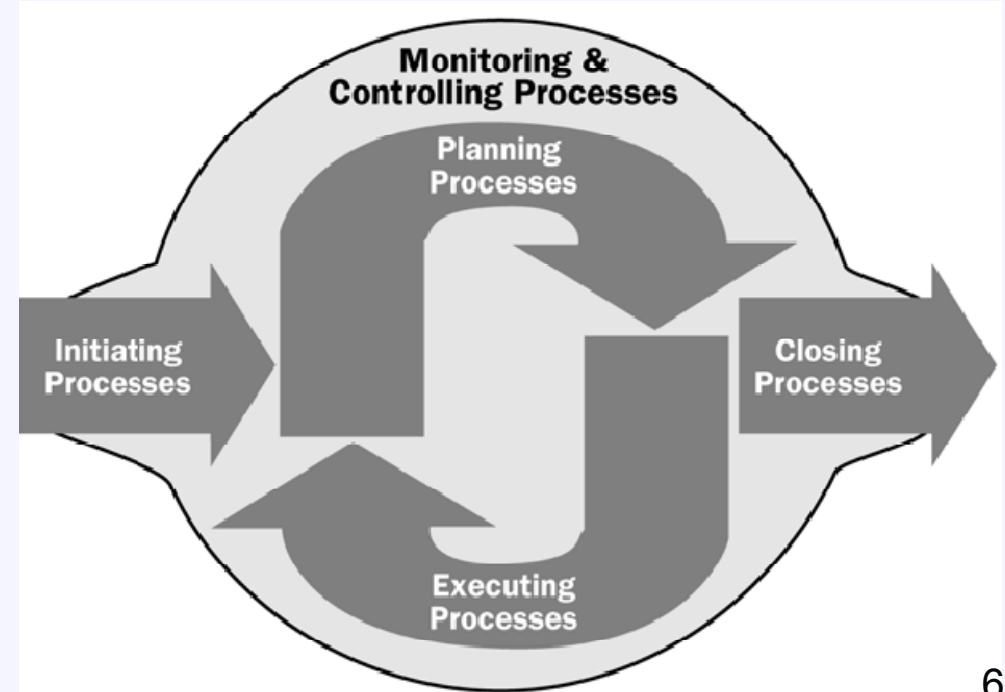
Include any or all process related assets from any or all of the organizations involved in the project that can be used to influence the project's success



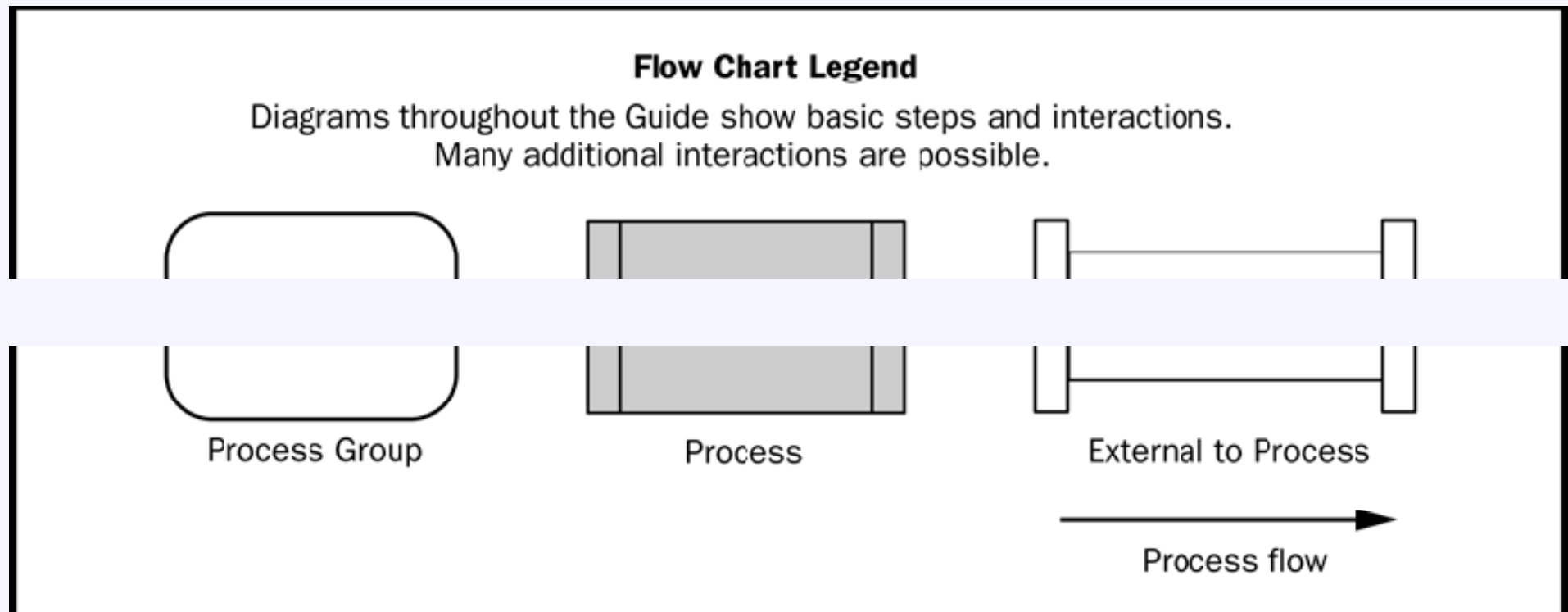
3.2 Project Management Process Groups

- The project life cycle describes what you need to do the work, the project management process describes what you need to do to manage the project. It includes:

- ❖ Initiating
- ❖ Planning
- ❖ Executing
- ❖ Monitoring & Controlling
- ❖ Closing



Symbols for process flow diagrams



Project Management Process Groups

- A **process** is a series of actions directed toward a particular result
- Project management can be viewed as a number of interlinked processes
- The project management process groups include:
 - ❖ Initiating processes
 - ❖ Planning processes
 - ❖ Executing processes
 - ❖ Monitoring and controlling processes
 - ❖ Closing processes

Project Initiation

- Initiating a project includes recognizing and starting a new project or project phase.
- Some organizations use a pre-initiation phase, while others include items such as developing a business case as part of the initiation.
- The main goal is to formally select and start off projects.
- Key outputs include:
 - ❖ Assigning the project manager.
 - ❖ Identifying key stakeholders.
 - ❖ Completing a business case.
 - ❖ Completing a project charter and getting signatures on it.

Project Initiation Documents

- Every organization has its own variations of what documents are required to initiate a project. It's important to identify the project need, stakeholders, and main goals.

Project Planning

- The main purpose of project planning is to guide execution
- Every knowledge area includes planning information
- Key outputs include:
 - ❖ A team contract
 - ❖ A project scope statement
 - ❖ A work breakdown structure (WBS)
 - ❖ A project schedule, in the form of a Gantt chart with all dependencies and resources entered
 - ❖ A list of prioritized risks (part of a risk register)

Project Executing

- Usually takes the most time and resources to perform project execution
- Project managers must use their leadership skills to handle the many challenges that occur during project execution
- Many project sponsors and customers focus on deliverables related to providing the products, services, or results desired from the project
- A milestone report can help focus on completing major milestones

Project Monitoring and Controlling

- Involves measuring progress toward project objectives, monitoring deviation from the plan, and taking correction actions
- Affects all other process groups and occurs during all phases of the project life cycle
- Outputs include performance reports, requested changes, and updates to various plans

Project Closing

- Involves gaining stakeholder and customer acceptance of the final products and services
- Even if projects are not completed, they should be closed out to learn from the past
- Outputs include project archives and lessons learned, part of organizational process assets
- Most projects also include a final report and presentation to the sponsor/senior management

Summary

- The five project management process groups are initiating, planning, executing, monitoring and controlling, and closing
- You can map the main activities of each process group to the nine knowledge areas
- Some organizations develop their own information technology project management methodologies

Project Integration Management

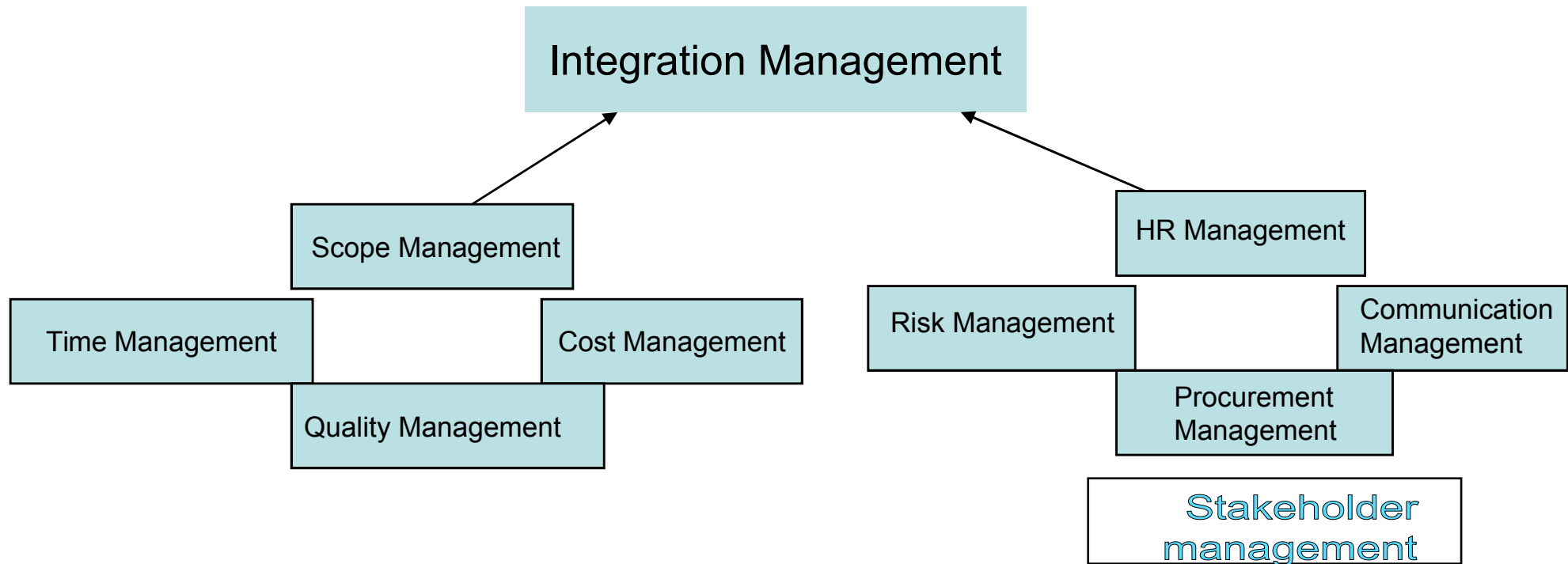
The Key to Overall Project Success: Good Project Integration Management

- Project managers must coordinate all of the other knowledge areas throughout a project's life cycle
- Many new project managers have trouble looking at the “big picture” and want to focus on too many details

Basics

- Project Integration Management knowledge area includes the processes and activities need to identify, define, combine, unify and coordinate the various processes and project management activities within the Project Management Process Groups.
- It is very important for:
 - ❖ Project Completion
 - ❖ Successfully meeting customer & stakeholder requirements
 - ❖ Managing Expectations

Project Integration Management Processes



Project Integration Management Processes

- 4.1 Develop Project Charter
- 4.2 Develop Project Management Plan
- 4.3 Direct and Manage Project Execution
- 4.4 Monitor and Control Project Work
- 4.5 Perform Integrated Change control
- 4.6 Close Project or Phase

4.1 Develop Project Charter

- A Project charter is the document that formally authorizes a project.
- It gives the authority to Project Manager to apply organizational resources to project activities.
- A Project Manager is identified and assigned as early as in the project as is feasible.
- The Project Manager should always be assigned prior to the start of planning, and preferably while the project charter is being developed.

Benefits of Project Charter

- Formally recognizes the existence of the project. (This means that a project does not exist without a project charter.)
- Gives the project manager authority to spend money and commit corporate resources.
- Provides the high-level requirements for the project.
- Links the project to the ongoing work of the organization.
- The Project Charter is also:
 - ❖ Issued by a sponsor, not the project manager
 - ❖ Created in the initiating process group
 - ❖ Broad enough so it does not NEED to change as the project changes

4.1 Develop Project Charter (Integration) [Initiating]

| Inputs | Tools & Techniques | Outputs |
|---|---|--|
| <ol style="list-style-type: none"> 1. Project statement of work 2. Business Case 3. Contract (when applicable) 4. Enterprise environmental factors 5. Organizational process assets | <ol style="list-style-type: none"> 1. Expert judgement | <ol style="list-style-type: none"> 1. Project charter |

4.1 Develop Project Charter: Inputs

Business Case :

- The business case or similar document provides the necessary information from a business standpoint to determine whether or not the project is worth the required investment .
- Typically the business need and the cost – benefit analyses are contained in the business case to justify the project .
- The requesting organization or the customer , in the case of external projects , may write the business case . The business case is created as a result of one or more of the following :

***Market demand
Request***

Organizational Need

Customer

***Technological advance
Impacts***

Legal Requirement

Ecological

Social Need

4.1 Develop Project Charter: Inputs

➤ Project Statement of Work

- ❖ The statement of work (SOW) is a narrative description of products or service to be supplied by the project.
- ❖ For internal projects, the project initiator or sponsor provides the statement of work based on business needs, product, or service requirements.
- ❖ For external projects, the statement of work can be received from the customer as part of the bid document. (request for proposal, request for information, request for bid, as part of a contract)
- ❖ Describes the customer/sponsor needs, product scope and how the project fits into their strategic plan.

4.1 Develop Project Charter: Inputs

➤ Contract (When Applicable)

- ❖ A contract from the customers acquiring organization is an input if the project is being done for an external customer.
- ❖ A contract is an input to this process , if the project is being done for an external customer

4.1 Develop Project Charter: Inputs

➤ Enterprise Environmental Factor

- ❖ Organizational or company culture and structure
- ❖ Governmental or industry standards
- ❖ Infrastructure
- ❖ Existing Human Resources
- ❖ Personnel Administration
- ❖ Company work authorization system
- ❖ Marketplace conditions
- ❖ Stakeholder risk tolerances
- ❖ Commercial databases
- ❖ Project Management Information Systems

4.1 Develop Project Charter: Inputs

➤ Organizational Process Assets

- ❖ Organizational process assets refers to the organization's policies, guidelines, procedures, plans, approaches, or standards for conducting work, including project work.
- ❖ Organizational process assets also includes the information the organization has learned on previous projects (including how to store and retrieve that information). (Historical Information and lessons learned knowledge base) and templates etc

4.1 Develop Project Charter: Tools & Techniques

Expert Judgment

- The concept behind expert judgment is to rely on individuals, or groups of people, who have training, specialized knowledge, or skills in the areas you're assessing and is available from various sources , including :
 1. **Other units within the organization**
 2. **Consultants**
 3. **Stakeholders, including customers and sponsors**
 4. **Professional and technical associations**
 5. **Industry groups**
 6. **Subject matter experts**
 7. **PMO**
- Such judgment and expertise is applied to any technical and management details during this process

4.1 Develop Project Charter: Outputs

➤ Project Charter

The project charter documents the business needs ,current understanding of the customer's needs , and the new product , service , or result that it is intended to satisfy , such as :

1. Project purpose or justification
2. Measurable project objectives and related success criteria
3. High-level requirements
4. High-level project description
5. High-level risks
6. Summary milestone schedule
7. Summary budget
8. Project approval requirements
9. Assigned project manager, responsibility and authority level
10. Name and authority of the sponsor or other person(s) authorizing the project charter

Project Charter Contents

- Key details in Project Charter includes but not limited to:
 - ❖ Project Title & Description
 - ❖ Project Manager Assigned and Authority Level
 - ❖ Business Need
 - ❖ Project Justification
 - ❖ Resources Pre-assigned
 - ❖ Stakeholders
 - ❖ Stakeholders Requirements as Known
 - ❖ Product Description/Deliverables
 - ❖ Constraints and Assumptions
 - ❖ Project Sponsor Approval

Sample Project Charter

Project Charter July 16, 2007

Project Title: Just-In-Time Training Project

Project Start Date: July 1, 2007

Projected Finish Date: June 30, 2008

Budget Information: The firm has allocated \$1,000,000 for this project. Approximately half of these costs will be for internal labor, whereas the other half will be for outsourced labor and training programs.

Project Manager: Kristin Maur, (610) 752-4896, kristin_maur@globalconstruction.com

Project Objectives: Develop a new training program that provides just-in-time training to employees on key topics, including supplier management, negotiating skills, project management, and software applications (spreadsheets and Web development). Reduce the training cost per employee by 10 percent, or \$100 per employee per year. Develop an approach for measuring productivity improvements from this approach to training on an annual basis.

Approach:

- Terminate all internal training courses except the Six Sigma training after new courses are developed.
- Communicate to all employees the plans to improve internal training and let them know that tuition reimbursement will continue as is.
- Work closely with internal managers and employees to determine the best approaches for providing training in supplier management, negotiating skills, project management, and software applications.
- Research existing training, and work with outside experts to develop several alternatives for providing each training topic.
- Develop and implement new training.
- Take advantage of new training approaches and technologies, and encourage employees to take some training during nonworking hours.
- Encourage experts within the company to mentor other workers on current job duties.
- Determine a way to measure the effectiveness of the training and its impact on productivity on an annual basis.

Sample Project Charter (continued)

| Roles and Responsibilities: | | | |
|---|---------------------------|------------------------------|--------------------------------------|
| <i>Name and Signature</i> | <i>Role</i> | <i>Position</i> | <i>Contact Information</i> |
| Mike Sundby <i>Mike Sundby</i> | Project champion | VP of HR | mike_sundby@globalconstruction.com |
| Lucy Camarena <i>Lucy Camarena</i> | Project sponsor | Training director | lucy_camarena@globalconstruction.com |
| Kristin Maur <i>Kristin Maur</i> | Project manager | Project manager | kristin_maur@globalconstruction.com |
| Julia Portman <i>Julia Portman</i> | Steering committee member | VP of IT | julia_portman@globalconstruction.com |
| Tim Nelson <i>Tim Nelson</i> | Steering committee member | Supplier management director | tim_nelson@globalconstruction.com |
| Mohamed Abdul <i>Mohamed Abdul</i> | Team member | Senior programmer/analyst | mohamed_abdul@globalconstruction.com |
| Kim Johnson <i>Kim Johnson</i> | Team member | Curriculum designer | kim_johnson@globalconstruction.com |
| Etc. | | | |
| Comments: (Handwritten or typed comments from above stakeholders, if applicable) "I am concerned about people's reactions to totally changing most training classes. I also hate to terminate some contracts with local training firms we've used for several years. We should try to get some of them involved in this project." Lucy "I want to review all of the information related to providing the supplier management training. We need to make something available quickly." Tim | | | |

4.2 Develop Project Management Plan

- The Develop Project Management Plan process includes the actions necessary to define, integrate, and coordinate all subsidiary plans into a project management plan.
- The Develop Project Management Plan process brings all these subsidiary plans together, along with the outputs of the Planning group processes, into one document called the *project management plan*.
- The project management plan defines how the project is executed, monitored and controlled, and closed.

4.2 Develop Project Management Plan (Integration) [Planning]

| Inputs | Tools & Techniques | Outputs |
|--|---|--|
| <ol style="list-style-type: none">1. Project Charter2. Outputs from Planning Processes3. Enterprise environmental factors4. Organizational process assets | <ol style="list-style-type: none">1. Expert judgement | <ol style="list-style-type: none">1. Project management plan |

Develop Project Management Plan: Inputs

1. Project Charter
2. Outputs from Planning Processes
3. Enterprise Environmental Factors
4. Organizational Process Assets

4.2 Develop Project Management Plan: Inputs

Outputs from Planning Processes :

1. Outputs from many of the planning processes described in chapters 5 through 12 are integrated to create the project management plan .
2. Any baselines and subsidiary management plans that are an output from the other planning processes are inputs to this process .
3. In addition , updates to these documents can necessitate updates to the project management plan

4.2 Develop Project Management Plan: Inputs

Organizational Process Assets

Include , but not limited to :

1. Standardized Guidelines , work instructions, proposal evaluation criteria, performance measurement criteria
2. Project management plan template
3. Change control procedures : including the steps by which official company standards ,policies ,plans and procedures , or any project documents will be modified and how any changes will be approved and validated
4. Project files from past projects , historical information and lessons learned knowledge base
5. Configuration management knowledge base containing the versions and baselines of all official company standards , policies , procedures and any project documents

4.2 Develop Project Management Plan: Tools & Techniques

Expert Judgment Is utilized to :

- Tailor the process to meet the project needs
- Develop technical and management details to be included in the project management plan
- Determine resources and skill levels needed to perform the project work
- Define the level of configuration management to apply on the project, and
- Determine which project documents will be subject to the formal change control process

4.2 Develop Project Management Plan: Output

1. Project Management Plan

- The project management plan documents the collection of outputs of the planning processes of the Planning Process Group and includes:
 - ❖ Processes you'll use to perform the project
 - ❖ Degrees of execution of each of the processes selected for the project
 - ❖ Tools and techniques to use from each process
 - ❖ Essential inputs and outputs from each of the processes and how they'll be used to manage the project
 - ❖ Dependencies and interactions of the processes used to manage the project
 - ❖ Methods for executing the work of the project to fulfill the objectives

Develop Project Management Plan (cont...)

- ❖ Methods for monitoring and controlling changes
- ❖ Methods to perform configuration management
- ❖ Methods for determining and maintaining the validity of performance baselines
- ❖ Communication needs of the stakeholders and techniques to fulfill those needs
- ❖ Project life cycle
- ❖ Project phases for multi-phased projects
- ❖ Management reviews of issues and pending decisions

Develop Project Management Plan (cont...)

- The project management plan can be either summary level or detailed, and can be composed of one or more subsidiary plans and other components. Each of the subsidiary plans and components is detailed to the extent required by the specific project.
- These subsidiary plans include, but are not limited to:
 - ❖ Project scope management plan
 - ❖ Stakeholder Management
 - ❖ Schedule management plan
 - ❖ Cost management plan
 - ❖ Quality management plan
 - ❖ Process improvement plan
 - ❖ Staffing management plan
 - ❖ Communication management plan
 - ❖ Risk management plan
 - ❖ Procurement management plan

Develop Project Management Plan (cont...)

- These other components include, but are not limited to:
 - ❖ Milestone list
 - ❖ Resource calendar
 - ❖ Schedule baseline
 - ❖ Cost baseline
 - ❖ Quality baseline
 - ❖ Risk register

Note...

- A **project management plan** is a document used to coordinate all project planning documents and help guide a project's execution and control
- Plans created in the other knowledge areas are subsidiary parts of the overall project management plan

Sample Project Management Plan

Project Management Plan Version 1.0 September 17, 2007

Project Name: Just-in-Time Training Project

Introduction/Overview of the Project

Global Construction employs 10,000 full-time employees in ten different counties and fifteen U.S. states. The company spends, on average, \$1,000 per employee for training (not including tuition reimbursement), which is higher than the industry average. By redesigning training, Global Construction can reduce training costs and improve productivity. The main goal of this project is to develop a new training program that provides just-in-time training to employees on key topics, including supplier management, negotiating skills, project management, and software applications.

Project Organization

The basic organization of the project is provided in Figure 4-1. The project sponsor, Lucy Camarena, will have the final say on major decisions, with consultation from the project steering committee and the project champion, Mike Sundby. The project sponsor should have time to thoroughly review important project information and provide timely feedback to the project manager. The project manager in this case reports to the project sponsor, and the team leaders and supplier project managers report to the project manager.

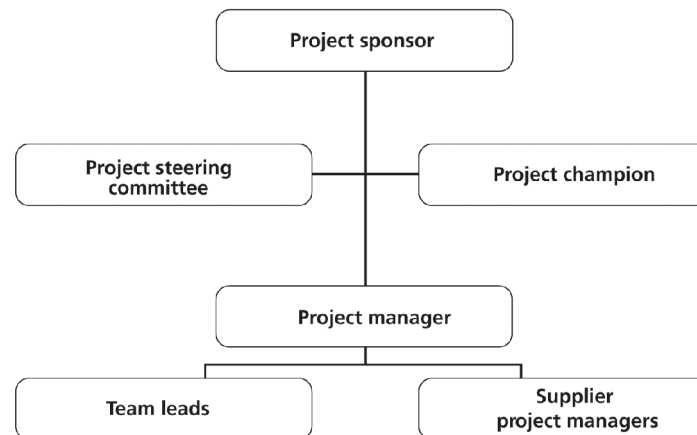


FIGURE 4-1 Project organizational chart

Management and Technical Processes

Management Processes:

1. **Management Review Process:** The project steering committee will meet at least monthly to provide inputs and review progress on this project.
2. **Progress Measurement Process:** The project steering committee will review project progress during project review meetings, and they can also review information as needed by viewing reports on the enterprise project

Sample Project Management Plan (continued)

management software system. Earned value data will be provided for this project and available on a weekly basis in the system. Post-project progress will also be measured to see if the project met its goals. These goals include reducing the training cost per employee by \$100/person/year and receiving positive results from survey participants on the effectiveness of the training.

3. Change Approval Process: See Attachment 1 based on corporate standards.
4. Supplier Management Process: See Attachment 2 based on corporate standards.

Technical Processes:

1. Enterprise Project Management Software: All tasks, costs, resources, issues, and risks will be tracked for this project using our enterprise project management software. Data must be entered on at least a weekly basis to provide timely information.
2. Supplier Evaluation: The project team will coordinate with the purchasing department to follow our standard procedures for selecting and working with suppliers. See Attachment 2 for corporate standards.
3. Productivity Improvement: The project team will work with the finance and quality assurance departments to develop and implement a system to measure improvements in employee productivity that result from this new training program. The finance department will report on this information annually, beginning one year after the first new training course is offered.

Work to Be Performed

Summary: Research, develop or purchase, and implement a new just-in-time training program covering the topics of supplier management, negotiating skills, project management, and software applications, and determine a way to measure the effectiveness of the training and its impact on productivity on an annual basis. See the scope statement, WBS, and other scope documents for further details.

Schedule Information

The entire project will be completed in one year, with a projected completion date of June 30, 2008. See the project schedule and other time management documents for further details.

Budget Information

The total budget for this project is \$1,000,000. Approximately half of these costs will be for internal labor, whereas the other half will be for outsourced labor and training programs. See the cost estimate and cost baseline for further details.

References to Other Project Planning Documents

All current project plans created for this project are provided in Appendix A. Initial documents and revisions are available on the project Web site.

4.3 Direct and Manage Project Execution

- The purpose of the *Direct and Manage Project Execution* process is to carry out the project plan.
- Typical activities of this process:
 - ❖ The work is authorized to begin and activities are performed.
 - ❖ Resources are committed and carry out their assigned activities to create the product or service of the project.
 - ❖ Funds are spent to accomplish project objectives.
 - ❖ Performing project activities, training, selecting sellers, collecting project data, utilizing resources, and so on are all integrated with or a part of this process.

4.3 Direct and Manage Project Execution

- The Direct and Manage Project Execution process requires the project manager and the project team to perform multiple actions to execute the project management plan to accomplish the work defined in the project scope statement. Some of those actions are:
 - ❖ Perform activities to accomplish project objectives
 - ❖ Expend effort and spend funds to accomplish the project objectives
 - ❖ Staff, train, and manage the project team members assigned to the project
 - ❖ Obtain quotations, bids, offers, or proposals as appropriate

4.3 Direct and Manage Project Execution

- Direct and Manage Project Execution also requires implementation of:
 - ❖ Approved corrective actions that will bring anticipated project performance into compliance with the project management plan
 - ❖ Approved preventive actions to reduce the probability of potential negative consequences
 - ❖ Approved defect repair requests to correct product defects found by the quality process.

Note...

- Project execution involves managing and performing the work described in the project management plan
- The majority of time and money is usually spent on execution
- The application area of the project directly affects project execution because the products of the project are produced during execution

4.3 Direct and Manage Project Execution

| Inputs | Tools & Techniques | Outputs |
|---|--|---|
| <ol style="list-style-type: none"> 1. Project management plan 2. Approved corrective actions 3. Approved preventive actions 4. Approved change requests 5. Approved defect repair 6. Validated defect repair 7. Enterprise environmental factors 8. Organizational process assets | <ol style="list-style-type: none"> 1. Expert Judgement 2. Project management information system (PMIS) | <ol style="list-style-type: none"> 1. Deliverables 2. Work performance information 3. Change Requests 4. Project Management Plan updates 5. Project document updates |

4.3 Direct and Manage Project Execution – Tools & Tech

1. Expert Judgment
2. Project Management Information System :

Provides access to an automated tool, such as scheduling software tool, a configuration management system, an information collection and distribution system, or web interfaces to other online automated systems used during the Direct and Manage Project Execution effort .

Develop Project Management Plan: Tools & Techniques

➤ Configuration Management System

- ❖ The configuration management system is a subsystem of the overall project management information system. The system includes the process for:
 - ✓ Submitting proposed changes
 - ✓ Tracking systems for reviewing
 - ✓ Approving proposed changes
 - ✓ Defining approval levels for authorizing changes
 - ✓ Providing a method to validate approved changes

Develop Project Management Plan: Tools & Techniques

➤ Change Control System

- ❖ The change control system is a collection of formal documented procedures that define how project deliverables and documentation are controlled, changed, and approved.
- ❖ The change control system is a subsystem of the configuration management system.
- ❖ There can be a change control system for each knowledge area in project management. These systems are described in the management plan for each knowledge area (project scope management plan, schedule management plan, etc.) and are implemented in integrated change control as part of the overall effort to control change.

Change Control System

- The collected change control system may include:
 - ❖ A change control plan included in the project management plan outlining how changes will be managed
 - ❖ Creation of a change control board to approve all changes
 - ❖ Change control procedure (How, Who)
 - ❖ Performance statistics (e.g., time/system, time/drawing)
 - ❖ Reports (e.g., software output, milestone charts, resource usage)
 - ❖ Change forms
- The project scope management plan may add the following in order to control changes to scope:
 - ❖ Specification reviews
 - ❖ Demonstrations
 - ❖ Testing
 - ❖ Meetings to review scope to identify changes

4.3 Direct and Manage Project Execution - Output

1. Deliverables
2. Work Performance Information
3. Change requests
4. Project Management Plan Updates
5. Project document updates

Work Performance Information

- Information on the status of the project activities being performed to accomplish the project work is routinely collected as part of the project management plan execution.
- This information includes, but is not limited to:
 - ❖ Schedule progress showing status information
 - ❖ Deliverables that have been completed and those not completed
 - ❖ Schedule activities that have started and those that have been finished
 - ❖ Extent to which quality standards are being met
 - ❖ Costs authorized and incurred
 - ❖ Estimates to complete the schedule activities that have started
 - ❖ Percent physically complete of the in-progress schedule activities
 - ❖ Documented lessons learned posted to the lessons learned knowledge base
 - ❖ Resource utilization detail.

Project Management Plan Updates

Include , but are not limited to :

1. Requirements management plan
2. Schedule management plan
3. Cost management plan
4. Quality management plan
5. Human resource management plan
6. Communication management plan
7. Risk management plan
8. Procurement management plan
9. Project Baselines
10. Stakeholder management plan

Project Document Updates

Include , but are not limited to :

1. Requirement documents
2. Project Logs(issue, assumptions, etc)
3. Risk register
4. Stakeholder register

4.4 Monitor and Control Project Work

- The Monitor and Control Project Work process is performed to monitor project processes associated with initiating, planning, executing, and closing.
- Corrective or preventive actions are taken to control the project performance.
- Monitoring includes collecting, measuring, and disseminating performance information, and assessing measurements and trends to effect process improvements.

4.4 Monitor and Control Project Work

- The Monitor and Control Project Work process is concerned with:
 - ❖ Comparing actual project performance against the project management plan
 - ❖ Assessing performance to determine whether any corrective or preventive actions are indicated, and then recommending those actions as necessary
 - ❖ Analyzing, tracking, and monitoring project risks to make sure the risks are identified, their status is reported, and that appropriate risk response plans are being executed
 - ❖ Maintaining an accurate, timely information base concerning the project's product(s) and their associated documentation through project completion
 - ❖ Providing information to support status reporting, progress measurement, and forecasting
 - ❖ Providing forecasts to update current cost and current schedule information
 - ❖ Monitoring implementation of approved changes when and as they occur.

Note...

- Changes are inevitable on most projects, so it's important to develop and follow a process to monitor and control changes
- Monitoring project work includes collecting, measuring, and disseminating performance information
- Two important outputs of monitoring and controlling project work include recommended corrective and preventive actions

4.4 Monitor & Control Project Work (Integration)

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Project management plan 2. Performance reports 3. Enterprise environmental factors 4. Organizational Process assets | <ol style="list-style-type: none"> 1. Expert judgement | <ol style="list-style-type: none"> 1. Change requests 2. Project Management Plan Updates Project Document updates |

4.4 Monitor and Control Project Work - Inputs

1. Project Management Plan
2. Performance Reports : Reports should be prepared by the project team detailing activities , accomplishments , milestones , identified issues and problems . Performance reports can be used to report the key information , but not limited to :
 - Current status
 - Significant accomplishments for the period
 - Scheduled activities
 - Forecasts
 - Issues

4.4 Monitor and Control Project Work – Tools & Tech

1. Expert Judgment

- Is used by the project management team to interpret the information provided by the monitor and control processes.
- The project manager in collaboration with the team, determines the actions required to ensure project performance matches expectations

4.4 Monitor and Control Project Work – Outputs

1. **Change Requests** : Changes include but are not limited to :

- Corrective Action
- Preventive Action
- Defect Repair

2. **Project Management Plan Updates**

3. **Project Document Updates** : include but are not limited to :

- Forecasts
- Performance reports
- Issue Log

4.5 Perform Integrated Change Control

- The integrated change control process is a control function that is done from project initiating through project closing.
- This is where all the recommendations for changes, corrective actions, preventive actions and defect repairs are evaluated across all the knowledge areas and either approved or rejected.
- Changes to any part of the project management plan or the product of the project are handled in the integrated change control process.

Integrated Change Control

- Three main objectives are:
 - ❖ Influencing the factors that create changes to ensure that changes are beneficial
 - ❖ Determining that a change has occurred
 - ❖ Managing actual changes as they occur
- A **baseline** is the approved project management plan plus approved changes

Suggestions for Performing Integrated Change Control

View project management as a process of constant communication and negotiation.

Plan for change.

Establish a formal change control system, including a change control board (CCB).

Use effective configuration management.

Define procedures for making timely decisions on smaller changes.

Use written and oral performance reports to help identify and manage change.

Use project management and other software to help manage and communicate changes.

Focus on leading the project team and meeting overall project goals and expectations.

4.5 Integrated Change Control

- Integrated Change Control, according to *A Guide to the PMBOK*, is primarily concerned with the following:
 - ❖ Influencing the factors that cause change and reaching agreement on their resulting change requests.
 - ✓ Factors that may cause change include project constraints, stakeholder requests, team member recommendations, vendor issues, and many others.
 - ❖ Determining that change is needed or has happened
 - ❖ Managing approved changes
 - ❖ Updating the requirements that impact scope, quality, schedule, and budgets based on approved changes
 - ❖ Documenting requested changes and their impacts

4.5 Integrated Change Control

- Managing changes may involve making changes to the project scope, schedule, or cost baseline, also known as the *performance measurement baseline*.
- The performance measurement baseline is the approved project management plan that describes the work of the project.

Exam Spotlight

Managing changes involves maintaining accurate and reliable performance measurement baselines, coordinating all processes impacted as a result of the change, including revisiting Planning and Executing processes where needed and updating project scope to reflect any changes in product scope.

4.5 Integrated Change Control

➤ Process for Making Changes

1. Prevent the root cause of change
2. Identify change
3. Create a change request (4 Step Change Request Process)
4. Assess the change
5. Look at the impact of the change
6. Perform Integrated Change Control
7. Look for options
8. Change is approved or rejected
9. Adjust the project management plan and baseline
10. Notify stakeholders affected by the change
11. Manage the project to the new project management plan

- ### ➤ UNLESS THE QUESTION SAYS OTHERWISE, if there is a change to the project charter, the sponsor who signed or approved the project charter has to make the final decision. The project manager may provide options.

4.5 Integrated Change Control

➤ Requirement for Change

- ❖ There are two things you should require at the beginning of all projects regarding change.
 - ✓ First, require that all change requests be submitted in writing. This is to clarify the change and make sure no confusion exists regarding what's requested.
 - ✓ Second, all change requests must come through the formal change control system. Make sure no one is allowed to go directly to team members and request changes without the project manager knowing about it.

4.5 Integrated Change Control

➤ Change Control Board

- ❖ The board is given the authority to approve or deny change requests as defined by the organization.
- ❖ The CCB may meet only once a week, once every other week, or even once a month, depending on the project.
- ❖ When emergencies arise, the pre-established procedures allow the project manager to implement the change on the spot.
- ❖ CCB members may include stakeholders, managers, project team members, and others who may not have any connection to the project at hand.
- ❖ Some other names you might see are technical assessment board (TAB), technical review board (TRB), engineering review board (ERB), and change control board (CCB).

4.5 Perform Integrated Change Control

| Inputs | Tools & Techniques | Outputs |
|--|---|---|
| <ol style="list-style-type: none"> 1. Project management plan 2. Work performance information 3. Change requests 4. Enterprise environmental factors 5. Organizational process assets | <ol style="list-style-type: none"> 1. Expert judgement 2. Change Control Meetings | <ol style="list-style-type: none"> 1. Change request status updates 2. Project Management plan updates 3. Project document updates |

4.5 Perform Integrated Change Control – Tools & Techniques

1. Expert Judgment
2. Change Control Meetings :
 - A change control board is responsible for meeting and reviewing the change requests and approving or rejecting those change requests .
 - All change control board decisions are documented and communicated to the stakeholders for information and follow up actions

4.5 Perform Integrated Change Control - Output

1. Change request status updates :
 - Change requests are processed according to the change control system by the project manager or by the assigned team member .
 - Approved change requests will be implemented by the direct and manage project execution process .
 - The status of all the changes , approved or not, will be updated in the change request log as part of the project document updates
2. Project Management Plan Updates
3. Project Document Updates : include the change request log and any documents that are subject to the formal change control process

4.6 Close Project or a Phase

- The Close Project Process involves performing the project closure portion of the project management plan.
- In multi-phase projects, the Close Project process closes out the portion of the project scope and associated activities applicable to a given phase.
- This process includes finalizing all activities completed across all Project Management Process Groups to formally close the project or a project phase, and transfer the completed or cancelled project as appropriate.

4.6 Close Project or a Phase

➤ Project Ending

❖ Projects come to an end for several reasons:

- ✓ They're completed successfully.
- ✓ They're canceled or killed prior to completion.
- ✓ They evolve into ongoing operations and no longer exist as projects.

➤ There are four formal types of project endings you might need to know for the exam:

- ❖ Addition
- ❖ Starvation
- ❖ Integration
- ❖ Extinction

4.6 Close Project or a Phase

1. Addition

- ❖ Projects that evolve into ongoing operations are considered projects that end due to *addition*; in other words, they become their own ongoing business unit.

2. Starvation

- ❖ When resources are cut off from the project or are no longer provided to the project, it's starved prior to completing all the requirements and you're left with an unfinished project on your hands.

4.6 Close Project or a Phase

3. Integration

- ❖ *Integration* occurs when the resources of the project—people, equipment, property, and supplies—are distributed to other areas in the organization or are assigned to other projects.



The difference between starvation and integration is that starvation results in funding or resource cuts while integration results in reassignment or redeployment of the resources.

4. Extinction

- ❖ This is the best kind of project end because *extinction* means the project has been completed and accepted by the stakeholders. As such, it no longer exists because it had a definite ending date, the goals of the project were achieved, and the project was closed out.

4.6 Close Project or a Phase

- The key activity of the *Close Project* process is concerned with gathering project records and disseminating information to formalize acceptance of the product, service, or project as well as to perform project closure.
- The Close Project process is also concerned with analyzing the project management processes to determine their effectiveness and to document lessons learned concerning the project processes.
- And one of the other key functions of the Close Project process is the archiving of all project documents for historical reference.

4.6 Close Project or a Phase

- Every project requires closure. According to *A Guide to the PMBOK*, the completion of each project phase requires project closure as well.

Exam Spotlight

Project closure occurs at the end of each phase of the project in order to properly document project information and keep it safe for future reference. You shouldn't wait until project completion to perform the Close Project process but rather perform it at the end of every phase, no matter if the project phase was completed successfully or was ended for some other reason.

4.6 Close Project or a Phase Integration) [Closing]

| Inputs | Tools & Techniques | Outputs |
|--|---|---|
| <ol style="list-style-type: none"> 1. Project management plan 2. Accepted Deliverables 3. Organizational Process Assets | <ol style="list-style-type: none"> 1. Expert judgement | <ol style="list-style-type: none"> 1. Final product, service, or result 2. Organizational process assets. |

4.6 Close Project or a Phase : Inputs

Accepted Deliverables :

- Those deliverables that have been accepted through the Verify Scope process

Organizational Process Assets :

- Project or phase closure guidelines or requirements (e.g.: project audits ,project evaluations, and transition criteria), and ,
- Historical Information and Lessons Learned Knowledge Base

4.6 Close Project or a Phase : Tools & Techniques

1. Expert Judgment :

- Is applied when performing administrative closure activities .
- These experts ensure that project or phase closure is performed to the appropriate standards

4.6 Close Project or a Phase : Outputs

Final Product, Service, or Result

- ❖ This actually refers to the acceptance of the final product, service, or result and the turnover of the product to the organization.
- ❖ This refers to the transition of the final product, service, or result that the project was authorized to produce
- ❖ This usually requires a formal sign-off .
performed on contract, definitely requires a formal sign-



The final product, service, or result is concerned with obtaining formal acceptance while organizational process assets involves documenting and archiving formal acceptance.

4.6 Close Project or a Phase : Outputs

Organizational Process Assets (Updates)

- ❖ The organizational process assets output is where the formal sign-off of the acceptance of the product is documented, collected, and archived for future reference.
- ❖ Documenting formal acceptance is important because it signals the official closure of the project and it is your proof that the project was completed satisfactorily.
- ❖ Another function of sign-off is that it kicks off the beginning of the warranty period.

4.6 Close Project or a Phase : Outputs

Organizational Process Assets (Updates)

- ❖ Project Files
- ❖ Project or phase closure documents
- ❖ Historical Information

4.6 Close Project or a Phase : Outputs

- Closure will include the development of the index and location of project documentation using the configuration management system.
 - ❖ Formal Acceptance Documentation
 - ❖ Project Files
 - ❖ Project Closure Documents
 - ❖ Historical Information

**Administrative closure focuses on closing the project or project phase.
Contract closure focuses on closing a contract that is part of a project.**

4.6 Close Project or a Phase : General Information

Administrative Closure Procedure

- ❖ Administrative closure procedures involves collecting all the records associated with the project, analyzing the project success (or failure), documenting and gathering lessons learned, and archiving project records.
- ❖ Administrative closure procedures also document the project team members' and stakeholders' roles and responsibilities in performing this process. According to *A Guide to the PMBOK*, this should include the processes and methodologies for defining the following:
 - ✓ Approval requirements of the stakeholders for project deliverables and changes to deliverables.
 - ✓ Assuring and confirming that the project meets the requirements of the stakeholders, customers, and sponsor. Documenting necessary actions to verify that the deliverables have been accepted and exit criteria have been met.
 - ✓ Assuring and confirming that the exit criteria for the project is satisfied.

4.6 Close Project or a Phase : General Information

Contract Closure Procedure

- ❖ This procedure is developed to provide a step-by-step methodology that addresses the terms and conditions of the contracts and any required completion or exit criteria for contract closure.
- ❖ This procedure details the methodology you use to assure that contract exit criteria and contract conditions have been satisfied.

Project Scope Management

Product Scope

➤ *Product scope*

- ❖ The features and functions that are to be included in your products or service or result of the project.
- ❖ Completion is measured against the product requirements.

➤ **Project Scope**

- ❖ The work that must be done to deliver the specified product.
- ❖ Completion is measured against the project management plan.

Project Scope Management

➤ Scope Management means:

- ❖ Processes required to ensure that project includes all the work required, and only the work required, to complete the project.
- ❖ Managing a project scope is primarily concerned with defining and controlling what is and is not included in the project.
- ❖ Scope management defines how the deliverables of project will be verified and accepted.
- ❖ Develop project management plan under integration produces scope management plan which will define how the scope shall be defined, verified and controlled.
- ❖ Uncontrolled scope is called Scope Creep

Project Scope Management Processes

- **Plan Scope Management:** The process of creating a scope management plan that documents how the project scope will be defined, validated, and controlled.
- **Collect Requirements** : the process of defining and documenting stakeholder's needs to meet the project objectives
- **Define Scope** : the process of developing a detailed description of the project and the product
- **Create WBS**: the process of subdividing the project deliverables and the project work into smaller, more manageable components
- **Validate Scope** : the process of formalizing acceptance of the completed project deliverables
- **Control Scope** : the process of monitoring the status of the project and product scope and managing changes to the scope baseline

5.1 Plan Scope Management

Plan Scope management is the process of creating a scope management plan that documents how the project scope will be defined, validated, and controlled. The key benefit of the process is that it provides guidance and direction on how scope will be managed throughout the project.

5.1 Plan Scope Management

| INPUTS | Tools & Techniques | OUTPUT |
|--|--|--|
| <ul style="list-style-type: none">1. Project Management Plan2. Project Charter3. Enterprise Environmental factors4. Organisational Process Assets | <ul style="list-style-type: none">1. Expert Judgements2. Meetings | <ul style="list-style-type: none">1. Scope Management Plan2. Requirements Management Plan |

Plan Scope Management - Tools & Techniques

- 1. Expert Judgement-** Expert judgement refers to input received from knowledgeable and experienced parties. Expertise may be provided by any group or with specialized education, knowledge or training in developing scope management plans.
- 2. Meetings-** Project teams may attend project meetings to develop the scope management plan. Attendees at these meetings may include the project manager, the project sponsor, anyone with responsibility for any scope management processes.

Plan Scope Management - Outputs

- 1. Scope Management Plan-** The scope management is a component of the project or program management plan that describes how the scope will be defined, developed, monitored, controlled and verified.
- 2. Requirements Management Plan-** The requirements management plan is a component of the project management plan that describes how requirements will be analyzed, documented and managed. The Phase -to-Phase relationship strongly influences how requirements are managed.

5.2 Collect Requirements

- Collect requirements is the process of defining and documenting stakeholders' needs to meet the project objectives .
- Requirements include the quantified and documented needs and expectations of the sponsor, customer, and other stakeholders.
- These requirements need to be elicited , analyzed, and recorded in enough detail to be measured once project execution begins .
- Collecting requirements is defining and managing customer expectations . Requirements become the foundation of the WBS. Cost , Schedule, and quality planning are all built upon these requirements .

5.2 Collect Requirements

- The development of requirements begins with an analysis of the information contained in the project charter and the stakeholder register .
- Many organizations categorize requirements into project requirements and product requirements
- Project requirements : business requirements, project management requirements ,delivery requirements etc
- Product requirements : technical,security,performance , etc

5.2 Collect Requirements

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Project charter 2. Stakeholder Register | <ol style="list-style-type: none"> 1. Interviews 2. Focus Groups 3. Facilitated workshops 4. Group creativity techniques 5. Questionnaires and surveys 6. Observations 7. Prototypes | <ol style="list-style-type: none"> 1. Requirements documentation 2. Requirements management plan 3. Requirements traceability matrix |

5.2 Collect Requirements - Inputs

1. Project Charter
2. Stakeholder Register :
 - The stakeholder register is used to identify stakeholders that can provide information on detailed project and product requirements .

5.2 Collect Requirements – Tools & Techniques

1. Interviews :

- Is a formal or informal approach to discover information from stakeholders by talking to them directly
- It is typically performed by asking prepared and spontaneous questions and recording the responses .
- Interviews are often conducted **one –on –one** , but may involve multiple interviewers and/or interviewees.
- Interviewing experienced project participants, stakeholders and subject matter experts can aid in identifying and the defining the features and the functions of the desired project deliverables .

5.2 Collect Requirements – Tools & Techniques

2. Focus Groups :

- Focus groups bring together prequalified stakeholders and the subject matter experts to learn about their expectations and attitudes about a proposed product, service, or result .
- A trained moderator guides the group through an interactive discussion , designed to be more **conversational than a one-on-one interview**

5.2 Collect Requirements – Tools & Techniques

3. Facilitated Workshops :

- Requirements workshops are focused sessions that bring key cross – functional stakeholders together to **define the product requirements** and reconcile stakeholders differences on the same
- Benefit of this technique is that issues can be discovered and resolved more quickly than in individual sessions

5.2 Collect Requirements – Tools & Techniques

4. Group Creativity Techniques :

- **Brainstorming** : a technique used to generate and collect multiple ideas related to the project and product requirements
- **Nominal Group Technique** : enhances brainstorming with a voting process used to rank the most useful ideas for further brainstorming or prioritization (Brainstorming + Voting)

5.2 Collect Requirements – Tools & Techniques

4. Group Creativity Techniques :

- **The Delphi Technique** is an anonymous method to query experts. Delphi technique uses an experienced Facilitator.
- The responses are only available to the facilitator.
- Participants can express ideas or opinions without fear or getting intimidated.

5.2 Collect Requirements – Tools & Techniques

4. Group Creativity Techniques :

- **Idea/mind mapping** : ideas created through individual brainstorming are consolidated into a single map to reflect commonality and differences in understanding , generate new ideas (Brainstorming +Map).
- **Affinity Diagram** : this technique allows large number of ideas to be sorted into groups for review and analysis

5.2 Collect Requirements – Tools & Techniques

5. Group Decision Making Techniques : there are multiple methods of reaching a group decision :

- **Unanimity** : everyone agrees on a single course of action
- **Majority** : support from more than 50% of the members of the group
- **Plurality** : the largest block in a group decides even if a majority is not achieved
- **Dictatorship** : one individual makes the decision for the group

5.2 Collect Requirements – Tools & Techniques

6. Questionnaires and Surveys :

- Questionnaires and surveys are written sets of questions designed to quickly accumulate information from a wide number of respondents .

5.2 Collect Requirements – Tools & Techniques

6. Observations :

- Observations provide a direct way of viewing individuals in their environment and how they perform their jobs or tasks and carry out processes
- It is particularly helpful for detailed processes when the people that use the product have difficulty or are reluctant to articulate their requirements
- Observation (also called “job shadowing”) is usually done externally by the observer viewing the user performing his or her job .
- It can also be done by a “participant observer” who actually performs a process to experience how it is done to uncover hidden requirements

5.2 Collect Requirements – Tools & Techniques

7. Prototypes :

- Is a method of obtaining early feedback on requirements by providing a working model of the expected product before actually building it
- Prototypes support the concept of progressive elaboration because they are used in iterative cycles of mock up creation, user experimentation, feedback generation, and prototype revision.
- When enough feedback cycles have been performed , the requirements obtained from the prototype are sufficiently complete to move to a design or a build phase

5.2 Collect Requirements – Outputs

1. Requirements Documentation :

- Describe how individual requirements meet the business need for the project
- Requirements may start out at a high level and become progressively more detailed as more is known
- Before being baselined, requirements shall be made measurable, traceable, complete and acceptable to the stakeholders.

5.2 Collect Requirements – Outputs

2. Requirements Management Plan :

- Documents how requirements will be analyzed , documented and managed throughout the project.
- The phase to phase relationship strongly influences how requirements are managed.
- Configuration management is often used manage and track changes to deliverable (product, service or result) requirements

5.2 Collect Requirements – Outputs

3. Requirements Traceability Matrix :

- It is a matrix that links requirements to their origin and traces them throughout the project life cycle .
- It provides structure for managing changes to the project scope
- Each requirements origin and its attributes are recorded
- Matrix helps to ensure that requirements approved in requirements documentation are delivered at the end of the project.

5.3 Define Scope

- Define Scope is the process of developing a detailed description of the project and the product (SOW is now elaborated)
- Initial scope, risks, constraints and assumptions documented during project initiation are analyzed for completeness and defined in more detail.

5.3 Define Scope

| Inputs | Tools & Techniques | Outputs |
|---|--|---|
| <ol style="list-style-type: none"> 1. Organizational process assets 2. Project charter 3. Requirements Documentation | <ol style="list-style-type: none"> 1. Product analysis 2. Alternatives identification 3. Expert Judgement 4. Facilitated Workshops | <ol style="list-style-type: none"> 1. Project scope statement 2. Project Document Updates |

5.3 Define Scope – Tools and Techniques

1. Product Analysis

- The purpose of product analysis is to analyze the objectives stated by the customer or sponsor and turn them into real requirements. (Product breakdown, systems analysis, value engineering, requirements analysis and value analysis)

2. Alternative Identification

- ❖ Identifying alternatives is a technique used to generate different approaches to execute and perform the work of the project.
 - ✓ Brainstorming
 - ✓ Lateral Thinking
 - ✓ Pair wise comparison

5.3 Define Scope

- 3. Expert Judgement
- 4. Facilitated Workshops

5.3 Define Scope - Outputs

1. Project Scope Statement

- ❖ Project scope statements describes, in detail (remember SOW), project deliverables and work required to create these deliverables
- ❖ It helps to create a common understanding among stakeholders (avoid scope creep)
- ❖ Project team can perform detailed planning now

5.3 Scope Definition - Outputs

Project scope statement will normally have

- ✓ Product scope description
- ✓ Product acceptance criteria
- ✓ Project deliverables
- ✓ Project exclusions (will define project boundaries)
- ✓ Project constraints
- ✓ Project assumptions

5.3 Scope Definition - Outputs

2. Project Document Updates :

➤ Project documents that may be updated include

1. Stakeholder register
2. Requirements documentation
3. Requirements traceability matrix

5.4 Create WBS

➤ What is Work Breakdown Structure (WBS)

- ❖ The WBS is a deliverables-orientated decomposition of the work to be executed by project team in a project. WBS is not an organization structure of project or product breakdown.
- ❖ ***Work that doesn't fit into the WBS does not fit within the project.***
- ❖ Projects are normally too big to manage and WBS breaks the project works into smaller more manageable components arranged according to deliverables.
- ❖ This is a top down effort, break works from top to down

5.4 Create WBS

➤ More about WBS

- ❖ Each level of WBS is a smaller piece of level above.
- ❖ The top most level of each WBS is the total project itself
- ❖ Work is broken down to the lowest level possible till further division is logically not possible or the work can be confidently estimated and scheduled.
- ❖ WBS represents total work specified in the current approved scope statement and shall be revised if a major scope change occurs.

5.4 Create WBS

| Inputs | Tools & Techniques | Outputs |
|---|--|---|
| <ol style="list-style-type: none"> 1. Organizational process assets 2. Project scope statement 3. Requirements Documentation | <ol style="list-style-type: none"> 1. Decomposition | <ol style="list-style-type: none"> 1. Work breakdown structure (WBS) 2. WBS dictionary 3. Scope baseline 4. Project Documentation Updates |

5.4 Create WBS – Tools & Techniques

1. Decomposition

- This technique involves breaking down the deliverables into smaller, more manageable components of work.
- The idea here is to break down the deliverables to a point where you can easily plan, execute, monitor and control, and close out the project deliverables.
- Each level of WBS is a more detailed definition of the level above it.

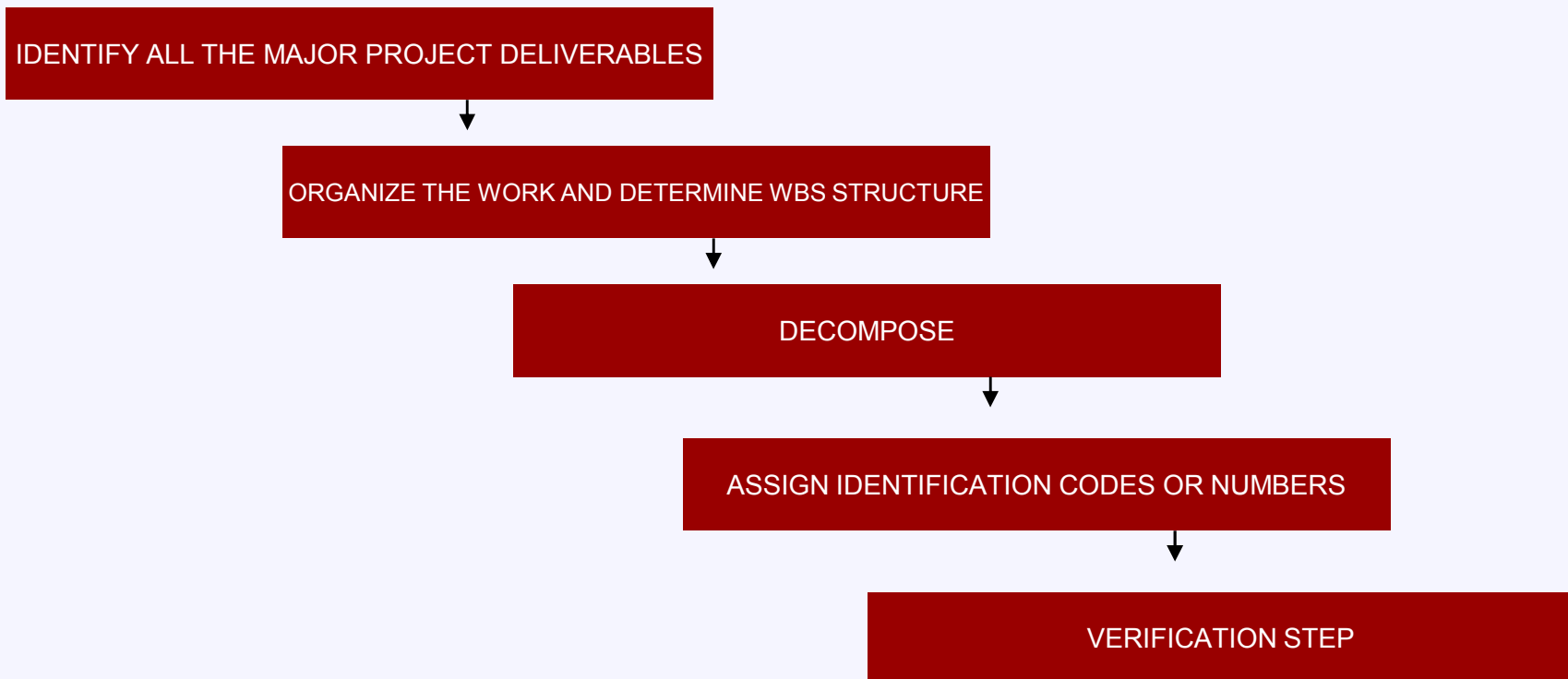
5.4 Create WBS

➤ Merits of Decomposition

- ❖ Improves estimates
- ❖ Better performance measures and controls
- ❖ Baselines to compare against throughout the project or phase
- ❖ Assigning resources and responsibility to work package

5.4 Create WBS

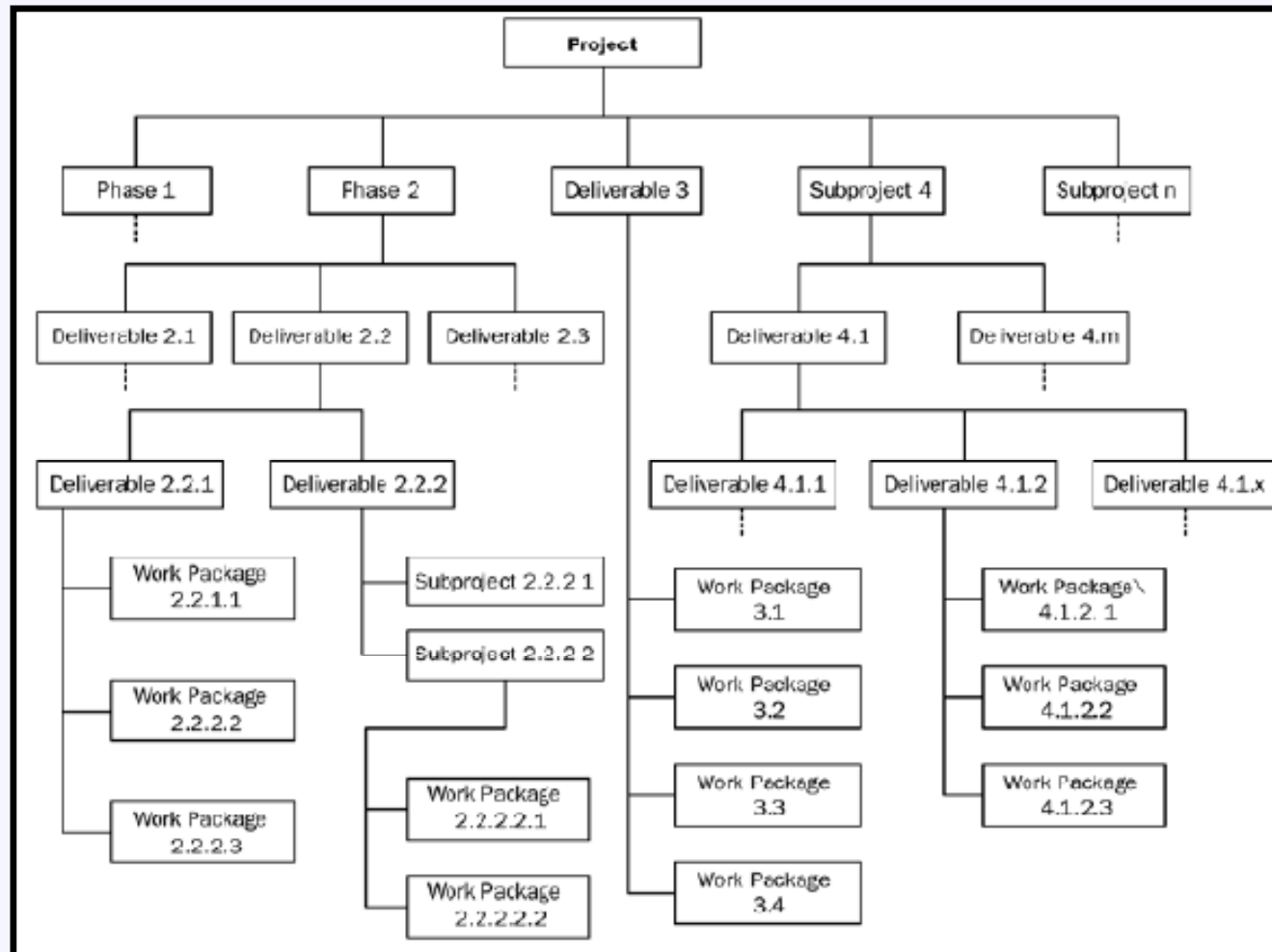
- According to PMBOK, Decomposition is five step process:



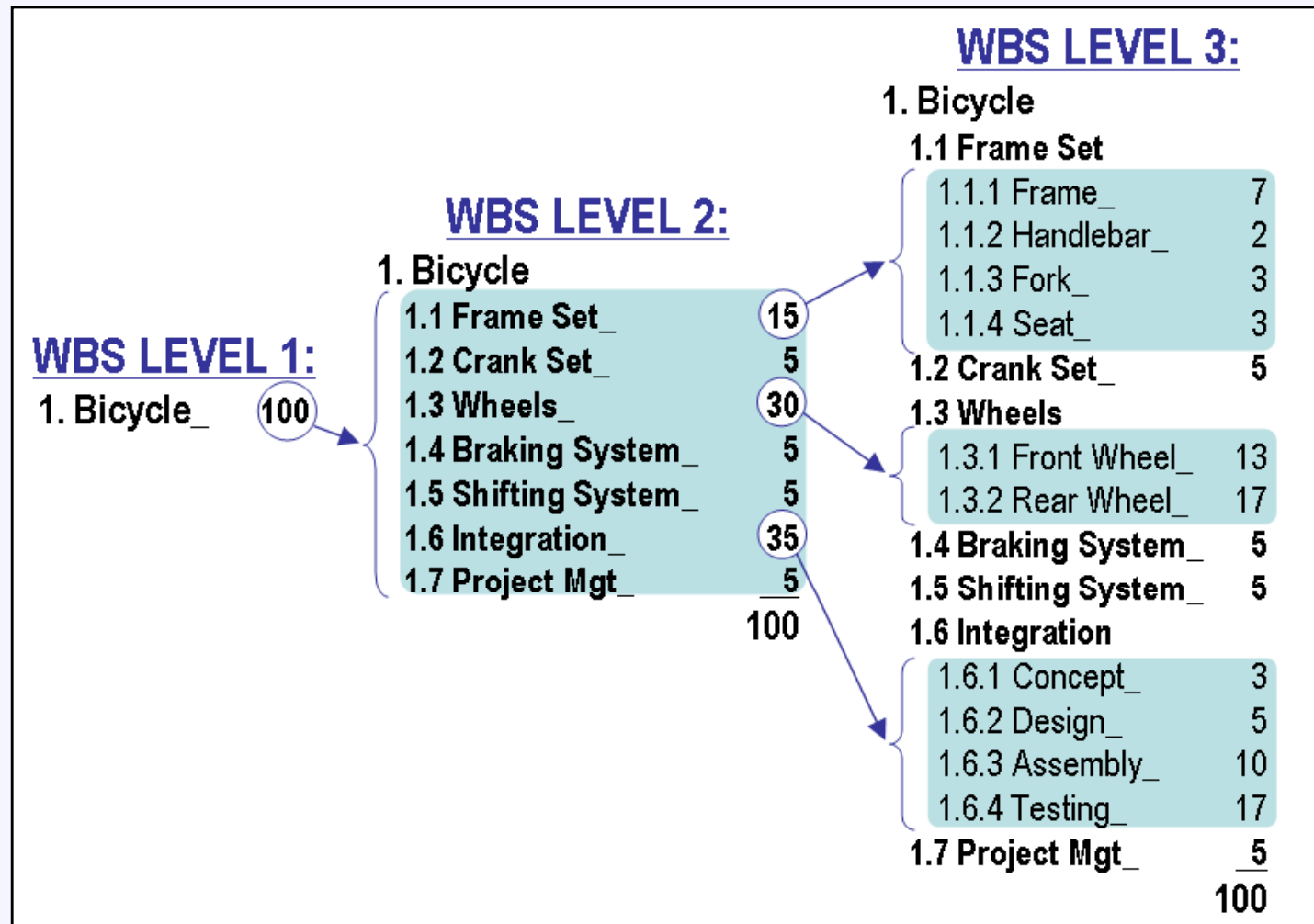
5.4 Create WBS

- According to the A Guide to the PMBOK, there are also several ways you can organize the WBS.
 - ❖ Major deliverables and subprojects
 - ❖ Subproject executed outside the project team
 - ❖ Project phases
 - ❖ Combination approach

5.4 Create WBS



5.4 Create WBS



5.4 Create WBS – Rolling Wave Plan

- Detailed decomposition of work may not be possible for works that will be completed in the future since project team is not fully aware of details of work. Team waits for the more details and only work in the near future is decomposed. This is called Rolling Wave Planning
- Work in the near term is elaborated in more detail than work to performed in the future.

5.4 100% Rule

- Each WBS levels represents a breakdown of WBS level above.
- Lowest level is called work package
- If the lowest levels are rolled up to the higher levels, the total must represents the total work of the project. This is called 100% rule.
- This ensures that no work is left out or extra work is added.

5.4 Create WBS - Outputs

1. Work Breakdown Structure
2. WBS Dictionary
3. Scope Baseline
4. Project Document Updates

5.4 WBS

➤ WBS is

- ❖ WBS represents all product and project works including the project management work decomposed based on deliverables
- ❖ Each descending level of WBS represents increasingly detailed definition of project work.
- ❖ Lowest level of WBS is work package which may again be broken down for scheduling.
- ❖ WBS is completed by establishing control accounts for work packages and a unique identifier from a code of accounts

5.4 Control Accounts

- Each element at each level of the WBS is generally assigned a unique identifier. Unique identifiers are normally taken from organization's code of accounts to track cost by category.
- Each item in WBS need to be estimated, resourced, budgeted and controlled. If management need to measures performance (budget & time), WBS shall be linked to accounting system. Normally control account is placed in WBS for this purpose.
- Control account is placed above work package level in WBS
- Each control account may have more than one work package but one work package shall only be linked to one control account.

5.4 WBS Dictionary

- The WBS dictionary is where work component descriptions are documented.
- WBS dictionary should include the following elements for each component of the WBS.
 - ❖ Code of accounts identifier
 - ❖ Statement of work, which describes the work of the component
 - ❖ Organization responsible for completing the component
 - ❖ List of Schedule Milestones
 - ❖ Associated Schedule Activities
 - ❖ Resources required
 - ❖ Cost estimates
 - ❖ Quality requirements
 - ❖ Acceptance criteria
 - ❖ Technical references

5.4 Scope Baseline

- The scope baseline is defined as the detailed project scope statement, the WBS, and the WBS dictionary.
- From these documents, you'll document schedules, assign resources, and monitor and control the work of the project according to what's described here.

5.4 Project Document Update

- Creation of WBS may update project documents
- Any update has to follow integrative change control processes

5.5 Validate Scope

- Scope Verification is the process of the project customer accepting the project deliverables.
- Scope verification is ensuring that the deliverables is concerned with the acceptance of the work.
- Scope verification is concerned with acceptance of deliverables but Quality control is concerned with meeting the quality requirements specified.
- Quality control is normally performed prior to scope verification but both may be performed in parallel.

5.5 Validate Scope

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Project Management Plan 2. Requirements Documentation 3. Requirements traceability matrix 4. Validated deliverables | <ol style="list-style-type: none"> 1. Inspection | <ol style="list-style-type: none"> 1. Accepted deliverables 2. Change requests 3. Project document updates |

5.5 Validate Scope : Inputs

- **Project Management Plan** : as it contains the scope baseline (Project scope + WBS + WBS Dictionary)
- **Requirements Documentation**
- **Requirements Traceability matrix** : this matrix links requirements to their origin and tracks them throughout the project life cycle.
- **Validated deliverables** : validated deliverables have been completed and checked for correctness by the perform quality control process

5.5 Validate Scope : Tools & Techniques

1. Inspection

- ❖ To complete scope verification, the work must be inspected.
- ❖ This may require measuring, examining, and testing the product to prove it meets customer requirements.
- ❖ Inspection usually involves the project manager and customer inspecting the project work for verification, which in turn results in **acceptance**.
- ❖ Depending on the industry, inspection may also be known as:
 - ✓ Reviews, Product Reviews, Audits & Walkthrough

5.5 Validate Scope : Tools & Techniques

➤ Inspection vs Audit

- ❖ Inspection involves measuring, examining, and testing the product to prove it meets requirements.
- ❖ Audit is normally an independent review (normally third party) to determine whether a process comply with policies and procedures.
- ❖ Inspection need measurements

5.5 Validate Scope : Outputs

1. Accepted Deliverables: This is a formal process that requires signed documentation of the acceptance by the sponsor or customer.
2. Change Requests : those completed deliverables that have not been accepted are documented , along with the reasons for non acceptance . Those deliverables may require a change request for defect repair .
3. Project Document Updates : Project documents that may be updated include any documents that define the product or report status on product completion

5.6 Control Scope

➤ Control Scope :

- ❖ Monitor the status of project and product scope and manages any changes to scope baseline.
- ❖ Is part of integrative change control.
- ❖ Uncontrolled scope changes result in scope creep.

5.6 Control Scope

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Project Management Plan 2. Work performance information 3. Requirements documentation 4. Requirements traceability matrix 5. Organizational process assets | <ol style="list-style-type: none"> 1. Variance analysis | <ol style="list-style-type: none"> 1. Work performance measurements 2. Organizational process assets updates 3. Change requests 4. Project management plan updates 5. Project document updates |

5.6 Control Scope - Inputs

1. Project Management Plan :

It contains the following information that is used to control scope :

- Scope Baseline
- Scope Management Plan
- Change Management Plan : defines the process for managing change on the project
- Configuration Management Plan : defines those items that are configurable, those items that require formal change control, and the process for controlling changes to such items
- Requirements Management Plan

5.6 Control Scope - Inputs

2. Work Performance Information :

Information about the project progress , such as which deliverables have started , their progress and which deliverables have been finished

3. Requirements documentation

4. Requirements traceability matrix

5. Organizational process assets

5.6 Control Scope – Tools & Techniques

1. Variance Analysis :

- Project performance measurements are used to assess the magnitude of variation from the original scope baseline .
- Important aspects of the project scope control include determining the cause and the degree of variance relative to the scope baseline and deciding whether corrective or preventive action is required

5.6 Control Scope - Outputs

1. **Work Performance Measurements :**

- Measurements can include planned vs. actual technical performance or other scope performance measurements .
- This information is documented and communicated to the stakeholders

2. **Change Requests :** change requests to the scope baseline or other components of the project management plan. Change requests can include preventive or corrective actions or defect repairs .

3. **Project Management Plan Updates :**

- Scope Baseline Updates
- Other Baseline Updates

4. **Project Document Updates :** requirements documentation update, requirements traceability matrix updates , etc

Project Time Management



Project Time Management Processes

- Plan Schedule Management
- Define Activities
- Sequence Activities
- Estimate Activity Resources
- Estimate Activity duration
- Develop Schedule
- Control Schedule

In some projects, especially with smaller scope, defining activities, sequencing, estimating activity resources, estimating activity duration and develop schedule are viewed as a single process. However processes from define activities to develop schedule shall be done in sequence.

6.1 Plan Schedule Management

Plan schedule management is the process of establishing the policies, procedures, and documentation for planning, developing, managing, executing and controlling the project schedule. The key benefit of this process is that it provides guidance and direction on how the schedule will be managed throughout the project

6.1 Plan Schedule Management

| Inputs | Tools & Techniques | Outputs |
|---|--|---|
| <ol style="list-style-type: none">1. Project Management Plan2. Project charter3. Enterprise environmental factors | <ol style="list-style-type: none">1. Expert Judgement2. Analytical techniques3. Meetings | <ol style="list-style-type: none">1. Schedule Management Plan |

Plan Schedule Management- Tools & Techniques

1. Expert Judgment

Expert judgment, guided by historical information, provides valuable insight about the environment and information from prior similar projects.

2. Analytical Techniques

The Plan Schedule Management process may involve choosing strategic options to estimate and schedule the project such as: scheduling methodology, scheduling tools and techniques, estimating approaches, formats, and project management software.

3. Meetings

Project teams may hold planning meetings to develop the schedule management plan. Participants at these meetings may include the project manager, the project sponsor, selected project team members, selected stakeholders, anyone with responsibility for schedule planning or execution, and others as needed.

Plan Schedule Management- Output

Schedule Management Plan

A component of the project management plan that establishes the criteria and the activities for developing, monitoring, and controlling the schedule. The schedule management plan may be formal or informal, highly detailed or broadly framed, based upon the needs of the project, and includes appropriate control thresholds.

6.2 Define Activities

| Inputs | Tools & Techniques | Outputs |
|--|--|---|
| <ol style="list-style-type: none">1. Enterprise environmental factors2. Organizational process assets3. Scope Baseline | <ol style="list-style-type: none">1. Decomposition2. Templates3. Rolling WAVE Planning4. Expert Judgement | <ol style="list-style-type: none">1. Activity List2. Activity attributes3. Milestone List |

6.2 Define Activities

- This process involves taking the work packages created in the WBS and breaking them down further in order to reach the activity level.
- Activity level is small enough to estimate, schedule, monitor and manage.
- These activities are then sequenced in the next process; activity sequencing.

6.2 Define Activities

| Inputs | Tools & Techniques | Outputs |
|--|--|---|
| <ol style="list-style-type: none">1. Enterprise environmental factors2. Organizational process assets3. Scope Baseline | <ol style="list-style-type: none">1. Decomposition2. Templates3. Rolling WAVE Planning4. Expert Judgement | <ol style="list-style-type: none">1. Activity List2. Activity attributes3. Milestone List |

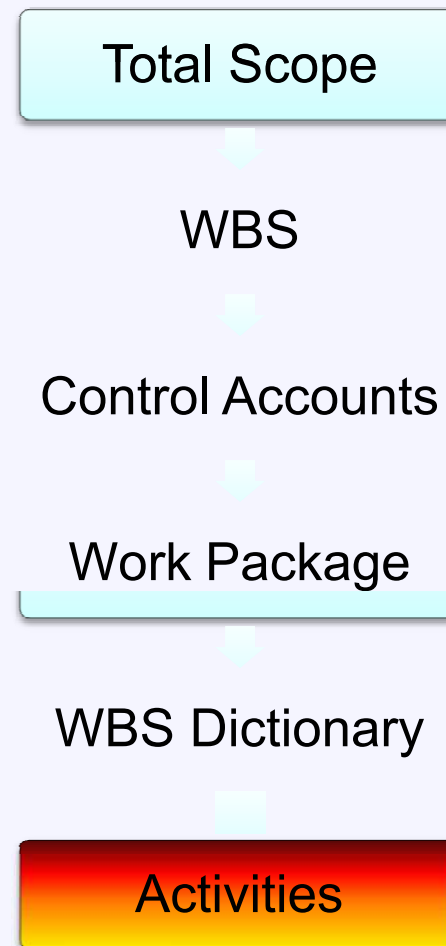
Define Activities – Decomposition

- Decomposition in WBS subdivide total scope of project in to smaller components and decomposition in define activities subdivide work package in to smaller, more manageable components called activities.
- WBS and WBS dictionary are the basis for development of activities.
- WBS, WBS dictionary and activity list can be completed together.

Templates

- Why reinvent the wheel? If similar projects have been completed in the past, rely on the WBS and activity lists from the historical information to serve as a template for the current project.
- Templates can also be used to identify typical schedule milestones.

We now know what to do in a project but yet to determine when to do what



Rolling Wave Planning

- Work that is imminent is planned in detail while work that is way off in the future is planned at a high level.
- As the work in the future approaches more and more details are available enabling team to do further planning.
- This is a form of progressive elaboration.

6.2 Define Activities : Outputs

1. Activity list
2. Activity attributes
3. Milestone list

Activity List

- An **activity list** is a tabulation of activities to be included on a project schedule that includes:
 - ❖ The activity name
 - ❖ An activity identifier or number
 - ❖ A brief description of the activity

Activity Attributes

- **Activity attributes** provide information such as predecessors, successors, logical relationships, leads and lags, resource requirements, constraints, imposed dates, and assumptions related to the activity
- Activity attributes describe the characteristics of the activities and are an extension of the activity list.

Milestone Lists

- Milestones are typically major accomplishments or a significant event of the project and mark the completion of major deliverables or some other key event in the project.

6.3 Sequence Activities

- Activity list prepared are now logically sequenced
- A **dependency** or **relationship** between activities established.
- Dependencies shall be determined in order to use critical path analysis

6.3 Sequence Activities

| Inputs | Tools & Techniques | Outputs |
|---|--|---|
| <ol style="list-style-type: none"> 1. Project scope statement 2. Activity List 3. Activity attributes 4. Milestone list 5. Organizational Process Assets | <ol style="list-style-type: none"> 1. Precedence Diagramming method (PDM) 2. Schedule network templates 3. Dependency determination 4. Applying leads and lags | <ol style="list-style-type: none"> 1. Project schedule network diagrams 2. Project Document Updates |

Precedence Diagramming Method (PDM)

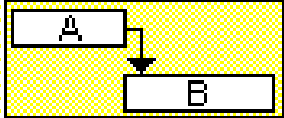
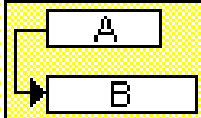
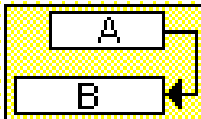
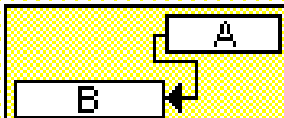
- A network diagram is drawn after preparation of activity list in order to logically arrange activities in sequence and to show dependencies.
- PDM is a method of drawing network diagram
- This is also called Activity on Node (AON)
- Activities are represented by boxes, also called nodes, and arrow between boxes to show logical relationship (and hence name AON)

Task Dependency Types

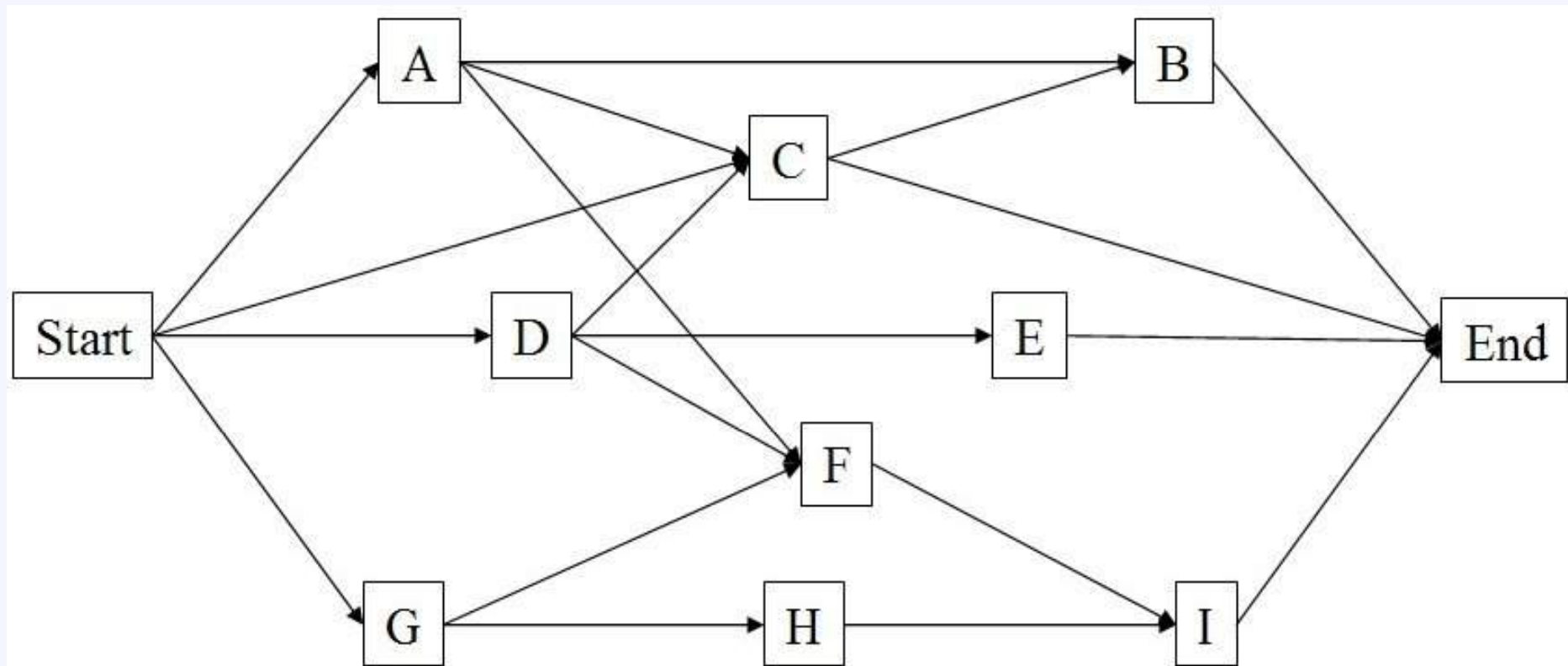
PDM can have four types of dependencies

Task dependencies

The nature of the dependencies between linked tasks. You link tasks by defining a dependency between their finish and start dates. For example, the "Contact caterers" task must finish before the start of the "Determine menus" task. There are four kinds of task dependencies in Microsoft Project.

| Task dependency | Example | Description |
|-----------------------|---|---|
| Finish-to-start (FS) |  | Task (B) cannot start until task (A) finishes. |
| Start-to-start (SS) |  | Task (B) cannot start until task (A) starts. |
| Finish-to-finish (FF) |  | Task (B) cannot finish until task (A) finishes. |
| Start-to-finish (SF) |  | Task (B) cannot finish until task (A) starts. |

A Network Diagram drawn with PDM



Dependency Determination

- Three types of dependencies:
 - ❖ Mandatory dependencies
 - ❖ Discretionary dependencies
 - ❖ External dependencies

Dependency Determination

➤ Mandatory Dependencies:

❖ Mandatory dependencies are those that are contractually required or inherent in the nature of work. This dependency is also called **Hard Logic**.

- ✓ For example, you can't begin building your house until your foundation is in place.
- ✓ Contract says prototype must be approved prior to start work.

Dependency Determination

➤ Discretionary dependencies:

- ❖ These dependencies are the preferred order of activities. It is defined by the project management team based on the knowledge of best practice in each field.
- ❖ These relationship are also known as soft logic, preferred logic, or preferential logic.
- ❖ Discretionary dependencies shall be fully documented since they can create arbitrary total float values and can limit later scheduling options.
- ❖ When fast tracking is applied, normally these dependencies are reviewed or removed.

Dependency Determination

➤ External dependencies

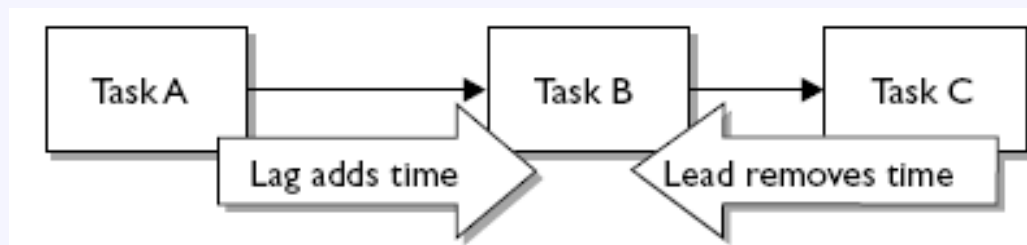
- ❖ As its name implies, these are dependencies outside of the project's control.
- ❖ Example include the delivery of deliverable of another project, or the decision of a committee, lawsuit, or expected new law.

Applying Leads and Lags

- A Lead may be added to start an activity before the predecessor activity is finished. The successor activity may be started prior to completion or predecessor.

Ex: Furniture may be installed 2 weeks prior to completion of painting (Finish to start relationship with 2 weeks lead)

- Lag introduces waiting period between activities. Lag introduces a delay in the successor activity



Schedule Network Templates

- Schedule network diagram from a previous projects or standard templates from PM software may be used to speedup network preparation.
- Network template may include entire project or part of project and templates used for portion of project are also known as sub networks or fragment networks.
- Subnets are very useful if repeated work is involved (identical floors or identical modules in software development)

6.3 Sequence Activities : Outputs

1. Project Schedule Network Diagrams :

- Are schematic displays of the project schedule activities and the logical relationships among them.
- It can be produced manually or by using a project management software

Project Schedule Network Diagrams are not final schedule For the exam, know that, in its pure form, the network diagram shows just dependencies

2. Project Document Updates

6.4 Estimate Activity Resources

- All projects, from the smallest to the largest, require resources.
- The term resources in this case does not mean just people; it means all the physical resources required to complete the project.
 - ❖ People
 - ❖ Equipment
 - ❖ Materials

6.4 Estimate Activity Resources

| Inputs | Tools & Techniques | Outputs |
|---|---|--|
| <ol style="list-style-type: none"> 1. Enterprise environmental factors 2. Organizational process assets 3. Activity list 4. Activity attributes 5. Resource calendar | <ol style="list-style-type: none"> 1. Expert Judgment 2. Alternatives analysis 3. Published estimating data 4. Bottom-up estimating 5. Project Management Software | <ol style="list-style-type: none"> 1. Activity resource requirements 2. Resource breakdown structure (RBS) 3. Project Documents Updates |

6.4 Estimate Activity Resources : Input

Resource Calendar :

- Resource calendar will give Information on which resources are potentially available during planned activity period.
- Resources include people, material and equipment
- A composite resource calendar will include availability, capabilities and skills of human resource.
- Holidays of human resource are normally included in a composite resource calendar.

6.4 Estimate Activity Resources : Tools and Techniques

1. Expert Judgment
2. Alternative Analysis
3. Published Estimating Data
4. Bottom-up Estimating
5. Project Management Software

6.4 Estimate Activity Resources: Tools and Techniques

1. Expert Judgment

2. Alternative Analysis

- ❖ Many activities can be completed in different ways and using various resource allocations. Alternative analysis is used to choose the best way to complete an activity.
- ❖ You can also consider make-or-buy analysis when determining alternatives. Hiring a tower crane may be less costlier than buying in short term perspective but buying may be better for organization in long term.

6.4 Estimate Activity Resources

3. Published estimating data

- ❖ Estimating data may include organizational guidelines, industry rates or estimates, production rates, and so on.

4. Bottom-up Estimating

- ❖ When an activity cannot be estimated with a reasonable degree of confidence, the work within the activity is decomposed into more detail.
- ❖ The resource needs are estimated.
- ❖ These estimates are then aggregated into a total quantity for each of the activities resources.

6.4 Estimate Activity Resources

5. Project Management Software

- ❖ Project Management software can help estimate resource needs and document resource availability. It may also produce an RBS, resource rates, calendars, and availability.

6.4 Estimate Activity Resources : Outputs

1. Activity Resource Requirements

2. Resource Breakdown Structure

- ❖ A **resource breakdown structure** is a hierarchical structure of the identified resources by resource category and resource type .
- ❖ E.g. of resource categories : labor, material, equipment , supplies etc
- ❖ Resource Types can include the skill level, grade level, etc

3. Project Document Updates : documents that may get updated, include, but not limited to :

- ❖ Activity List, activity attributes, resource calendars , etc

6.5 Estimate Activity Durations

- Here the network diagram is updated by estimating duration for each activities.
- The Activity Duration Estimating process attempts to estimate the work effort and number of work periods needed to complete each schedule activity.
- A person or team most familiar with work of the project shall estimate duration to make it more accurate.
- All data and assumptions used for estimation shall be documented for future analysis (remember this, we need this information during risk management process)

6.5 Estimate Activity Durations

| Inputs | Tools & Techniques | Outputs |
|---|--|--|
| <ol style="list-style-type: none"> 1. Enterprise environmental factors 2. Organizational process assets 3. Project scope statement 4. Activity list 5. Activity attributes 6. Activity resource requirements 7. Resource calendars | <ol style="list-style-type: none"> 1. Expert Judgment 2. Analogous Estimating 3. Parametric estimating 4. Three-point estimates 5. Reserve analyses | <ol style="list-style-type: none"> 1. Activity duration estimates 2. Project Documents Updates |

6.5 Estimate Activity Durations : Tools & Techniques

1. Expert Judgment

2. Analogous Estimating

- Analogous estimating uses information from a previous, similar project, such as duration, budget, size and complexity for future project.
- Analogous estimating is also known as top-down estimating and is a form of expert judgment using historical information.
- Analogous estimate is generally less costly and time consuming but generally less accurate.
- This estimate will be more accurate if previous project is similar in nature and not just in appearance.

6.5 Estimate Activity Durations : Tools & Techniques

3. Parametric Estimating

- ❖ Parametric estimate uses a statistical relationship between historical data and other variables.
- ❖ More accurate than analogous estimate
- ❖ Example : A resource will take 20hrs per module and hence 1000 modules will take 50hrs ($50 \times 20 = 1000\text{hrs}$)
- ❖ Estimation is done by multiplying quantity of work by labor hours per unit of work.

6.5 Estimate Activity Durations: Tools & Techniques

4. Three Point Estimates (PERT)

- ❖ A three-point estimate uses average of optimistic, most likely, and pessimistic estimates and hence improving the accuracy.
- ❖ **Most likely estimate (t_M)** – The realistic and most likely estimate
- ❖ **Optimistic estimate (t_O)** is the best case scenario.
- ❖ **Pessimistic estimate (t_P)** assumes the worst case scenario

4. Three-Point Estimates

PERT analysis calculates An Expected $t(E)$ activity duration using a weighted average of three estimates :

$$t(E) = [t_o + 4t_m + t_p]/6$$

- PERT analysis consider estimation uncertainties and risks and hence accuracy of estimate is improved.

PERT

PERT Formulas

- PERT Duration $t(E) = [t_o + 4t_m + t_p]/6$
- Standard Deviation of Activity = $[t_p - t_o]/6$
- Variance of an Activity = $([t_p - t_o]/6)^2$

PERT Calculations

| Activity | O | M | P | PERT | SD | Variance | Range |
|----------|----|----|----|--------|-------|----------|-----------------|
| A | 14 | 27 | 47 | 28.167 | 5.500 | 30.250 | 28.167+/- 5.500 |
| B | 41 | 60 | 89 | 61.667 | 8.000 | 64.000 | 61.667+/-8.000 |
| C | 39 | 44 | 48 | 43.833 | 1.500 | 2.250 | 43.833+/-1.500 |
| D | 29 | 37 | 42 | 36.500 | 2.167 | 4.694 | 36.500+/-2.167 |

If all activities are on critical, then total estimated project duration = sum of PERT values for each activities

Standard Deviation shall not be added. Add variance of each activities and take square root of sum to get standard deviation for total project.

In the example above, range will be 170.167 +/-10.060

6.5 Estimate Activity Durations Tools & Techniques

5. Reserve Analysis

- ❖ *Contingency Reserve time* —also called *buffer* or *time reserves*
- ❖ Reserve is added to account for schedule risk.
- ❖ You might choose to add a percentage of time or a set number of work periods to the activity or the overall schedule.
- ❖ If not done properly can lead to padding
- ❖ Contingency reserve shall be clearly identified and documented for future analysis

6.5 Estimate Activity Durations : Outputs

1. Activity Duration Estimates

- ❖ Activity duration estimates reflect how long each activity will take to complete.

2. Project Document Updates : documents that may be updated include, but not limited to :

- ❖ Activity Attributes : You will update the activity attributes with the duration estimate and the assumptions you used when deriving the estimates.
- ❖ Assumptions made in developing the activity duration estimate such as skill level and availability

6.6 Develop Schedule

- The *Develop Schedule* process is the heart of the Planning process group.
- The creation of the project schedule is iterative. It's rare for a schedule to get created, approved, and implemented without some iterative examination, arrangement, and management input—though on smaller projects it may be possible.

6.6 Develop Schedule

- Schedule Management Plan
 - ❖ *A Guide to the PMBOK* notes that the schedule management plan (a subsidiary of the project management plan) is produced as part of the Develop Project Management Plan process and contains the criteria for formatting, developing, and controlling the project schedule.

6.6 Develop Schedule

- Uses results of the other time management processes to determine the start and end date of the project
- Ultimate goal is to create a realistic project schedule that provides a basis for monitoring project progress for the time dimension of the project

6.5 Develop Schedule

| Inputs | Tools & Techniques | Outputs |
|---|--|--|
| <ol style="list-style-type: none"> 1. Organizational process assets 2. Project scope statement 3. Activity list 4. Activity attributes 5. Project schedule network diagrams 6. Activity resource requirements 7. Resource calendars 8. Activity duration estimates 9. Enterprise environmental factors | <ol style="list-style-type: none"> 1. Schedule network analysis 2. Critical path method 3. Schedule compression 4. What-if scenario analysis 5. Resource levelling 6. Critical chain method 7. Adjusting leads and lags 8. Scheduling Tool | <ol style="list-style-type: none"> 1. Project Schedule 2. Schedule data 3. Schedule baseline 4. Project Document Updates |

Tools & Techniques

1. Schedule Network Analysis.

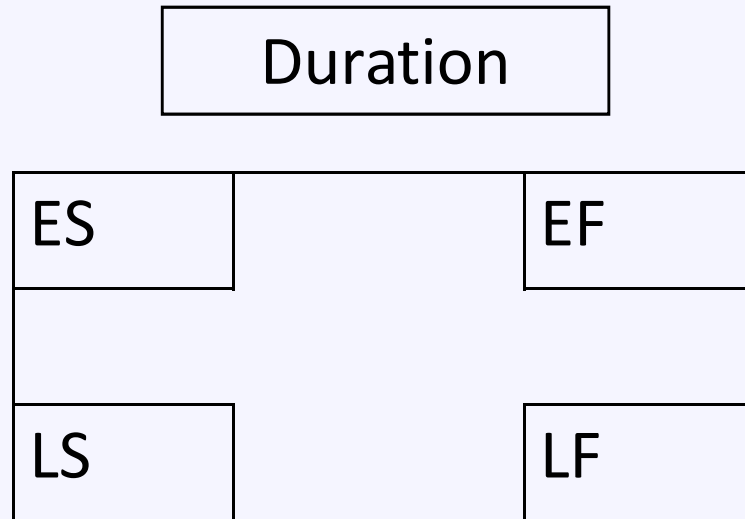
- ❖ Schedule network analysis is a technique that generates the project schedule. It employs a schedule model and various analytical techniques, such as critical path method, critical chain method, what-if analysis, and resource leveling to develop the schedule.

Tools & Techniques

2. Critical Path Method

- ❖ The critical path method is a schedule network analysis technique that is performed using the schedule model.
- ❖ The critical path method calculates the early start and finish dates, and late start and finish dates for all schedule activities

Network Diagram Nodes



ES = Earliest date an activity can be started

EF = Earliest date an activity can be completed

LS = Latest date an activity can start

LF = Latest date an activity can be completed

Floats

- Floats are not same as lead or lag
- Lead or lags are introduced (manually) to correct the sequence while float is calculated in CPM method
- $\text{Float} = \text{LS-ES}$ or LF-EF
- Float for all activities on critical path will be zero
- If lead or lag is introduced to activities
 - Duration of activities may change (Increase or Decrease)
 - Critical path may change. CPM calculation is not affected but total duration of project may alter.
 - Lead reduces the duration and hence negative value and lag increases the duration and have positive value.

Types of Floats (or Slacks)

- **Total Float** – The amount of time an activity can be delayed without delaying the project end date or milestone.
- **Free Float** – The amount of time an activity can be delayed without delaying the early start date of successor activity
- **Project Float** – The amount of time a project can be delayed without delaying an externally imposed project completion date (other than calculated by CPM) by customer. Normally project floats are zero unless CPM calculations shows an earlier completion date than required by customer.

3. Critical Chain Method

- Team members have a tendency to pad activity duration estimates to account for uncertainties. Activity duration extends due to padding.
- According to Parkinson's Law, **“Work expands to time it is given”**
- **“Student Syndrome”** – Many people will start to fully apply themselves to task just the wake of deadline.
- Due to padding, activity expands to the time given and most of the work associated with activity will be done near the deadline.
- Buffer built in to each activity is inefficient and normally lead to extended schedule. Critical chain method removes buffers from activities and manage them separately.
- It is unlikely that all activities will suffer delays (Insurance idea)

3. Critical Chain Analysis

- Remove buffers from individual activities in conventional CPM
- Calculate critical chain using CPM
- Enter resource and recalculate the critical path. Normally critical path alters and now the path is called resource-constrained critical path.
- Now add one buffer at the end of the critical chain to protect the target finish date due to slippage in critical chain. This is called **project buffer**.
- Critical chain normally have non critical paths feeding (or connected) to critical path. In order to protect critical path due to slippage in non critical path, another buffer is placed at the end of non critical path, before it get connected to critical path. This is called **feed buffer**.

3. Critical Chain Analysis

- Project manager now manages the Project Buffers and Feed Buffers instead of floats in traditional CPM
- Trends now can be analyzed from the use of buffers
- Result are more committed and stringent schedule.

4. Resource Leveling

- Critical path is calculated using CPM.
- Resources are loaded to activities based on actual availability or considering conflicts.
- Resource leveling often result a change in originally calculated Critical Path.
- Preference is normally always given to critical path activities and floats available for non critical path is used during leveling.
- This may also result is near critical path to become critical which may increase the risk.

5. What-If Scenario Analysis

- What-if scenario analysis uses different sets of activity assumptions to produce multiple project durations.
 - ❖ For e.g., what would happen if a major deliverable was delayed or the weather prevents you from completing a deliverable on time ?
 - ❖ What-if analysis weighs these questions and their assumptions and determines the feasibility of the project schedule under these conditions.
- Monte Carlo analysis use a range of probable activity durations for each activity, and those ranges are then used to calculate a range of probable duration results for the project itself.
 - ❖ It runs the possible activity durations and schedule projections many times to come up with the schedule projections and their probability, critical path duration estimates, and float time.

6. Adjusting Leads and Lags

- Leads and lags are now adjusted to get a realistic schedule.

7. Schedule Compression

- Schedule compression is the method of shortening the project schedule **without changing the scope**.
- Need for compression occurs if a customer need a date prior to end date shown in original schedule or to bring back a project schedule back to baseline.
 - ❖ Crashing – This approach adds more resources to activities on the critical path to complete the project earlier. Crashing almost always result in increased cost. Many options are considered and the option with maximum compression with minimum cost impact is selected.
 - ❖ Fast Tracking –Critical activities that would normally be done in sequence are allowed to be done in parallel or with some overlap. Fast track may result in rework and increases the risk. Communication requirements increases during fast tracking.

8. Scheduling Tool

- Automated scheduling tools expedite the scheduling process by generating start and finish dates based on the inputs of the activities , network diagrams, resources and activity durations.
- A scheduling tool can be used in conjunction with other project management software applications as well as manual methods

Planning Package

- Scope of work may not be complete while schedule development and team need to wait till further information is available.
- Team need to proceed with schedule development for other work where scope is clear now.
- A planning package is placed now in WBS, below control account, and schedule development is done with approximate estimate.
- Planning package contains known work content but team have no enough details to decompose till activities.

6.7 Develop Schedule : Outputs

➤ The Schedule Development process has 4 outputs:

1. Project schedule
2. Schedule baseline
3. Schedule Data
4. Project Document Updates

6.7 Develop Schedule : Outputs

1. Project Schedule

- ❖ The purpose of the Schedule Development process is to determine the start and finish date for the each of the project activity.
- ❖ The project schedule should be approved and signed off by stakeholders and functional managers.
 - ✓ This assures that they have read the schedule, understand the dates and resource commitments, and will likely cooperate

6.7 Develop Schedule: Outputs

- The schedule can be displayed in a variety of ways:
 - ❖ Project Schedule Network Diagram
 - ❖ Gantt Charts/ Bar Charts
 - ❖ Milestone Charts

6.7 Develop Schedule : Outputs

2. Schedule Baseline

- A schedule baseline is a specific version of the project schedule developed from the schedule network analysis .
- It is accepted and approved by the project management team as the schedule baseline with baseline start dates and baseline finish dates .
- The schedule baseline is a component of the project management plan

3. Schedule Data

- The schedule data refers to documenting the supporting data for the schedule.
- The minimum amount of information in this output includes:
 - ❖ Milestones
 - ❖ Schedule activities and activity attributes
 - ❖ Documenting the assumptions and constraints
 - ✓ Supporting Details
 - Resource Requirements , Alternative Scheduling, Schedule Contingency Reserves

6.7 Develop Schedule : Outputs

4. Project Document Updates :

Documents that might get updated include , but not limited to :

1. Activity Resource Requirements
2. Activity Attributes
3. Calendar
4. Risk Register

6.6 Control Schedule

- Schedule Control is concerned with :
 1. Determining the current status of the project schedule
 2. Influencing the factors that create schedule changes
 3. Determining that the project schedule has changed, and
 4. Managing the actual changes as they occur

6.7 Control Schedule

| Inputs | Tools & Techniques | Outputs |
|--|---|---|
| <ol style="list-style-type: none"> 1. Project Management Plan 2. Project Schedule 3. Work performance Information 4. Organizational Process Assets | <ol style="list-style-type: none"> 1. Performance Reviews 2. Variance analysis 3. Project management software 4. Resource Levelling 5. What-if scenario analysis 6. Adjusting leads and lags 7. Schedule compression 8. Scheduling tool | <ol style="list-style-type: none"> 1. Work Performance measurements 2. Organizational process assets (updates) 3. Change Requests 4. Project Management Plan updates 5. Project Document Updates |

Performance Reviews

- Performance reviews measure , compare, and analyze schedule performance such as actual start and finish dates , percent complete, and the remaining duration for the work in progress .
- If EVT is utilized the SV and the SPI are used to assess the magnitude of schedule variations
- An important part of schedule control is to decide if the schedule variations require corrective actions .

Performance measurement

- Poor performance may result in schedule changes.
- Performance measurements for schedule control include the schedule variance and schedule performance index. Both of these should be used to determine if corrective action is needed to get the schedule back on track.
- We will see about Schedule Performance Index in Cost Management.

Variance Analysis

- Variance analysis is a key factor in monitoring and controlling project time because this technique helps determine variances in schedule start and end dates.
- More details in cost

Project Management Software

- **Project Management Software for scheduling provides the ability to track planned dates vs. actual dates, and to forecast the effects of changes to the project schedule**

6.7 Control Schedule : Tools & Techniques

- Resource Leveling
- What-if scenario analysis
- Adjusting leads and lags
- Scheduling Tool

6.7 Control Schedule : Outputs

- The Schedule Control process has the following outputs:
1. Work Performance Measurements - Calculated Schedule Variance (SV) and Schedule Performance Index (SPI) are documented and communicated with stakeholders
 2. Organizational process asset updates (lessons learned)
 3. Change Requests – Approved schedule baselines shall be only updated through integrative change control. SV & SPI may result in change requests for baseline update.
 4. Project Management Plan Update
 5. Project Document updates – Schedule data

Q & A

- Can there be more than one critical path
- Is this advisable
- Why dummy activities are placed in schedule network
- Can critical path have dummy activity
- Can critical path change
- Do we need to follow change control for critical path change
- Will the network diagram changes if critical path changes
- How much float in critical activities
- What is the difference between project float and path float
- Can there be negative float

Q & A

- Is float & lead/lag same
- A project have too much float, what does that indicate
- Which is the longest path in a schedule
- What is the shortest period which you can complete a project
- What is the difference between schedule compression and resource leveling.
- Team prepares a schedule which will exceed milestone from client. What to do.
- Where the team shall look in first prior to start of estimation.

Project Cost Management



Project Cost Management Processes

- 1. Plan Cost Management**
- 2. Estimate Costs**
- 3. Determine Budget**
- 4. Control Costs**

In some projects, especially with smaller scope, cost estimation and cost budgeting are so tightly linked that they are viewed as a single process.

Quick Facts Cost Management

- Costing is different from Pricing. Costing includes the monetary resource required to complete the project and pricing normally include a profit margin.
- Costing is based on WBS and controlled by Control Accounts
- Costing shall be ideally done by a team who perform the work
- Schedule get affected by funding and project manager shall manage the link with organization
- Padding is not a good practice
- Final schedule can be done only after costing and final costing can only be done after risk since risk management involves budget for handling risk

Cost Management

- **Life Cycle Cost** - Project cost management is primarily concerned with cost needed to complete project activities however project cost management shall consider the effect of project decisions on the subsequent recurring cost of operation, maintenance and support of deliverables. Remember the product life cycle.
- Some decisions on project cost management have direct impact on future recurring cost. Example – Reduction in some features of project may reduce project cost but may make future operations more difficult and hence resulting overall more cost to organizations.
- Some project costing may involve predicting and analyzing the future financial performance of deliverables and may include techniques such as Return on Investments (ROI), Discounted Cash Flow and Investment Pay Back Analysis.

Project Cost Estimating

➤ Types of Cost

➤ Cost can be Direct or Indirect

- ❖ **Direct costs** These costs are attributed directly to the project work and cannot be shared among projects (Wages, Material, Equipment etc).
- ❖ **Indirect costs** Overhead costs that incurred for the benefit of more than one project (Taxes, Training, project management software license, and so on).

Cost can be Direct or Indirect

- ❖ **Variable costs** Costs that vary depending on the amount of work or production (Cost of materials, supplies, wages etc..).
- ❖ **Fixed costs** These costs remain constant throughout the project (Cost of office setup, rentals etc...).

7.1 Plan Cost Management

| Inputs | Tools & Techniques | Outputs |
|--|--|---|
| <ul style="list-style-type: none">1. Project Management Plan2. Project charter3. Enterprise Environmental Factors4. Organizational Process Assets | <ul style="list-style-type: none">1. Expert Judgement2. Meetings3. Analytical Techniques | <ul style="list-style-type: none">1. Cost Management Plan |

Plan Cost Management -Output

Cost Management Plan

The cost management plan is a component of the project management plan and describes how the project costs will be planned, structured, and controlled. The cost management processes and their associated tools and techniques are documented in the cost management plan.

7.2 Estimate Costs

| Inputs | Tools & Techniques | Outputs |
|---|---|--|
| <ol style="list-style-type: none"> 1. Enterprise environmental factors 2. Organizational process assets 3. Scope Baseline 4. Project Schedule 5. Human Resource Plan 6. Risk Register | <ol style="list-style-type: none"> 1. Expert Judgement 2. Analogous estimating 3. Bottom-up estimating 4. Parametric estimating 5. Three Point Estimates 6. Project management estimating software 7. Vendor bid analysis 8. Reserve analysis 9. Cost of quality | <ol style="list-style-type: none"> 1. Activity cost estimates 2. Basis of estimates 3. Project Document Updates |

7.2 Estimate Costs : Tools & Techniques

1. Expert Judgment :

- Expert judgment , guided by historical information , provides valuable insight about the environment and information from previous similar projects .

7.2 Estimate Costs : Tools & Techniques

2. Analogous Estimating

- Analogous estimating relies on historical information to predict the cost of the current project. It is also known as top-down estimating.
- The process of analogous estimating takes the actual cost of a historical project as a basis for the current project.
- Analogous estimating uses historical data and expert judgment.
- Less costlier than other methods, faster but less accurate

7.2 Estimate Costs : Tools & Techniques

3. Parametric Estimating

- ❖ Parametric estimate uses statistical relationship between historical data and other variables
- ❖ Per sq.ft cost of previous project of similar nature was XYZ and hence the new project shall cost XYZ multiplied by new total area.
- ❖ Parametric estimate can be applied to total project or part of project.

7.2 Estimate Costs : Tools & Techniques

4. Bottom-up Estimating

- ❖ Cost estimation starts from bottom level.
- ❖ Each WBS work package is estimated and rolled up to higher level.
- ❖ While this method is more expensive, it is also one of the most accurate.

7.2 Three-Point Estimates (PERT)

5. Three Point Estimates

PERT analysis calculates An Expected $c(E)$ activity cost using a **weighted** average of three estimates :

$$c(E) = [c_o + 4c_m + c_p]/6$$

- PERT analysis consider estimation uncertainties and risks and hence accuracy of estimate is improved.

7.2 Estimate Costs : Tools & Techniques

6. Reserve Analysis

- ❖ Reserves are added to costing to manage risks, cost overruns and error associated with costing.
- ❖ More details about reserve analysis in Risk Management
- ❖ Padding is not a good project management practice.

7.2 Estimate Costs : Tools & Techniques

7. Cost of Quality (COQ)

- ❖ Details about cost of quality in quality knowledge area

7.2 Estimate Costs : Tools & Techniques

7. Project Management Estimating Software

- ❖ Several different computer programs are available that can streamline project work estimates and increase their accuracy. These tools can include project management software, spreadsheet programs, and simulations.

7.2 Estimate Costs : Tools & Techniques

8. Vendor Bid Analysis

- ❖ Sometimes it's just more cost effective to hire someone else to do the work. Other times, the project manager has no choice because the needed skill set doesn't exist within the organization.
- ❖ In either condition, the vendors' bids need to be analyzed to determine which vendor should be selected based on their ability to satisfy the project scope, the expected quality, and the cost of their services.

7.2 Estimate Costs :Outputs

1. Activity Cost Estimates

- ❖ The output of cost estimating is the actual cost estimates of the resources required to complete the project work.
- ❖ Each resource in the project must be accounted for and assigned to a cost category. Categories include the following:
 - ✓ Labor costs
 - ✓ Material costs
 - ✓ Travel costs
 - ✓ Supplies
 - ✓ Hardware costs
 - ✓ Software costs
 - ✓ Special categories (inflation, cost reserve, and so on)

Project Cost Estimating - Estimating Accuracy

- Accuracy of estimate is normally refined during the course of project to reflect additional details as it becomes available.
- **Rough order of magnitude** This estimate is “rough” and is used during the initiating processes and in top-down estimates. The range of variance for the estimate can be from +/- 50%.
- Later the estimate can be refined to a range of +/- 10%
- Refinements and range of accuracy depends on policies of individual organizations.

7.2 Estimate Costs :Outputs

2. Basis of estimates

- ❖ Once the estimates have been completed, supporting detail must be organized and documented to show how the estimates were created.
- ❖ Specifically, the supporting detail includes the following:
 - ✓ **Document basis of estimate (how it was developed)**
 - ✓ **Information on the assumptions and constraints made while developing the cost estimates.**
 - ✓ **Information on the range of variance in the estimate** For example, based on the estimating method used, the project cost may be \$220,000 ± \$15,000.
 - ✓ **Indication of the confidence level of the final estimate**

7.2 Estimate Costs :Outputs

3. Project Document Updates : project documents that may get updated include, but not limited to the risk register

7.3 Determine Budget

- Cost of completing individual activities are now completed.
- During budgeting, the cost of individual activities are compiled to generate a complete time phased budget.
- Cost of individual activities are rolled up to work package level and as the work packages are now part of schedule baseline, this will result in a time phased cost.
- Schedule, estimate and risk analysis shall be complete prior to budgeting
- This cost is now linked to organization accounting system through control accounts placed above work package.

7.3 Determine Budget

| Inputs | Tools & Techniques | Outputs |
|--|---|--|
| <ol style="list-style-type: none"> 1. Activity cost estimates 2. Basis of estimates 3. Scope Baseline 4. Project schedule 5. Resource calendars 6. Contracts 7. Organizational Process Assets | <ol style="list-style-type: none"> 1. Cost aggregation 2. Reserve analysis 3. Expert Judgement 4. Historical Relationships 5. Funding limit reconciliation | <ol style="list-style-type: none"> 1. Cost Performance Baseline 2. Project funding requirements 3. Project Document Updates |

7.3 Determine Budget :Tools & Techniques

1. Cost Aggregation

- ❖ Activity costs are rolled up to work package costs. Work package costs are rolled up to control account costs and finally into project costs.

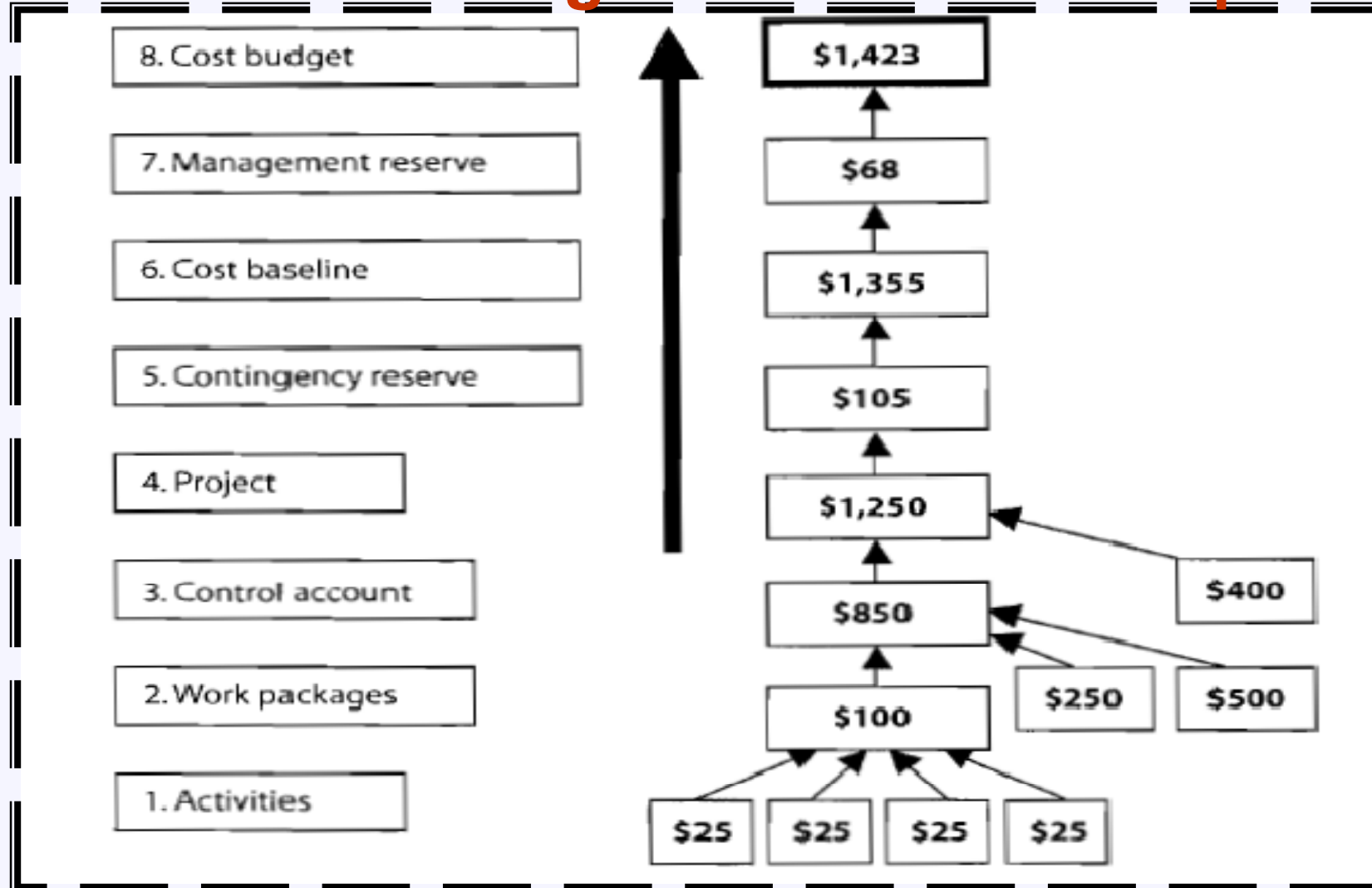
2. Reserve Analysis

- ❖ Budget reserves are kept for both contingency reserve and management reserve.
- ❖ **Contingency Reserves** – Monetary reserves kept for identified but unplanned changes (risks). Project manager will normally have the authority to utilize contingency reserves.
- ❖ Contingency reserves are placed for changes that can result from an identified risk.

7.3 Determine Budget :Tools & Techniques

- **Management reserve** - Budget set aside to cover unforeseen risks or changes to the project. This is the budget kept for unidentified risks.
- Management reserve will not be part of project budget and hence project manager need approval from management for using this reserve.
- The cost baseline will contain the contingency reserve and the cost budget will include the management reserve.
- Management reserves are not part of earned value calculations (since it is not part of cost baseline & measurements are based on baselines)

7.3 Determine Budget :Tools & Techniques



7.3 Determine Budget :Tools & Techniques

3. Expert Judgment

4. Historical Relationships :

- A historical knowledge of previous projects of similar nature can be used for determining budget.
- Parametric or Analogous estimates can be used. This method uses the statistical relationship between historical data and variable (Data multiplied by variable)

7.3 Determine Budget :Tools & Techniques

5. Funding Limit Reconciliation

- ❖ Funding limit reconciliation is an organization's approach to managing cash flow.
- ❖ Budgeting will result in S curve showing time phased cost requirements and project manager shall negotiate fund requirements with organization prior to finalization of cost baseline and schedule.
- ❖ Changes in funding may results in changes to project management plan and schedule
- ❖ An unrealistic budget is project manager's fault
- ❖ Funding normally happens in steps where are expenditure follow S curve.

7.3 Determine Budget : Outputs

1. Cost Performance Baseline

- ❖ A project's cost baseline is an authorized time-phased budget used to measure, monitor and control overall cost performance of the project.
- ❖ Cost baselines forms the shape of an S-curve indicating low spending in the initial stages of project and increasing towards end of the project.

7.3 Determine Budget : Outputs

2. Project Funding Requirements

- ❖ Funding requirements are derived from cost baselines
- ❖ Funding often occurs in incremental rather than continuous
- ❖ Total funds required are cost baseline plus management reserve, if any.

7.3 Determine Budget : Outputs

3. Project Document Updates : documents that may get updated include , but are not limited to :

- ❖ Risk register
- ❖ Cost estimates
- ❖ Project schedule

7.4 Control Costs

- Control cost is the processes of monitoring the status of project based on cost baseline
- Do not confuse control cost with cost control
- Any change in authorized funding shall only be done through integrative change control

7.4 Control Costs

| Inputs | Tools & Techniques | Outputs |
|--|--|--|
| <ol style="list-style-type: none"> 1. Project Management Plan 2. Project funding requirements 3. Work performance information 4. Organizational Process Assets | <ol style="list-style-type: none"> 1. Earned Value Technique 2. Forecasting 3. To- complete performance index 4. Performance reviews 5. Variance Analysis 6. Project Management Software | <ol style="list-style-type: none"> 1. Work Performance data 2. Budget Forecasts 3. Organizational process assets (updates) 4. Change Requests 5. Project management plan (updates) 6. Project Document Updates |

7.4 Control Cost

➤ 1. Earned Value Management

- ❖ Earned value management will indicate status and health of project at any time and can predict possible outcomes.
- ❖ EVM can be used for analysis of cost and schedule baselines
- ❖ Earned Value Management is carried out using the three main inputs
 - Planned Value (**PV**)
 - Earned Value (**EV**)
 - Actual Cost (**AC**)

7.4 Control Cost

➤ Planned Value (PV)

- ❖ Authorized budget assigned to the work to be accomplished on a particular Day
- ❖ It means, value of planned work to be done as on today
- ❖ Work package XX have a 4 stages and each stage will take one week to complete with \$500 estimated cost per stage.

What is the PV on 3rd Week = Total value of planned work to be completed on third week in monetary terms ($500 \times 3 = 1500$)

- ❖ Total Planned Value for project will be approved total budget (Remember – Management reserve is not part of EVM) and is known as Budget at Completion (**BAC**)

7.4 Control Cost

➤ Earned Value(PV)

- ❖ **Estimated** (not actual) value of work actually completed in monetary terms
- ❖ Work package XX have a 4 stages and each stage will take one week to complete with \$500 estimated cost per stage. End of 2nd week 3 stages were completed what is the PV and EV

PV on 2nd Week = Total value of planned work to be completed on second week in monetary terms ($500 \times 2 = 1000$)

EV on 2nd week = Estimated value of work completed ($500 \times 3 = 1500$)

7.4 Control Cost

➤ Actual Cost(AC)

- ❖ **Actual** cost spend to complete the work completed
- ❖ Work package XX have a 4 stages and each stage will take one week to complete with \$500 estimated cost per stage. End of 2nd week 3 stages were completed and contractor has spend 1700. What is the PV, EV & AC

PV on 2nd Week = Total value of planned work to be completed on second week in monetary terms ($500 \times 2 = 1000$)

EV on 2nd week = Estimated value of work completed ($500 \times 3 = 1500$)

AC on 2nd Week = Actual cost spend of work already completed (1700)

7.4 Control Cost

- ❖ Variances from approved baselines (Cost & Schedule) can now be analysed

SV (Schedule Variance) = EV-PV (Difference between estimated value of work completed and estimated value of work planned)

CV (Cost Variance) = EV-AC (Difference between estimated value of work completed and actual cost of work completed)

SPI (Schedule Performance Index) = EV/PV

CPI (Cost Performance Index) = EV/AC

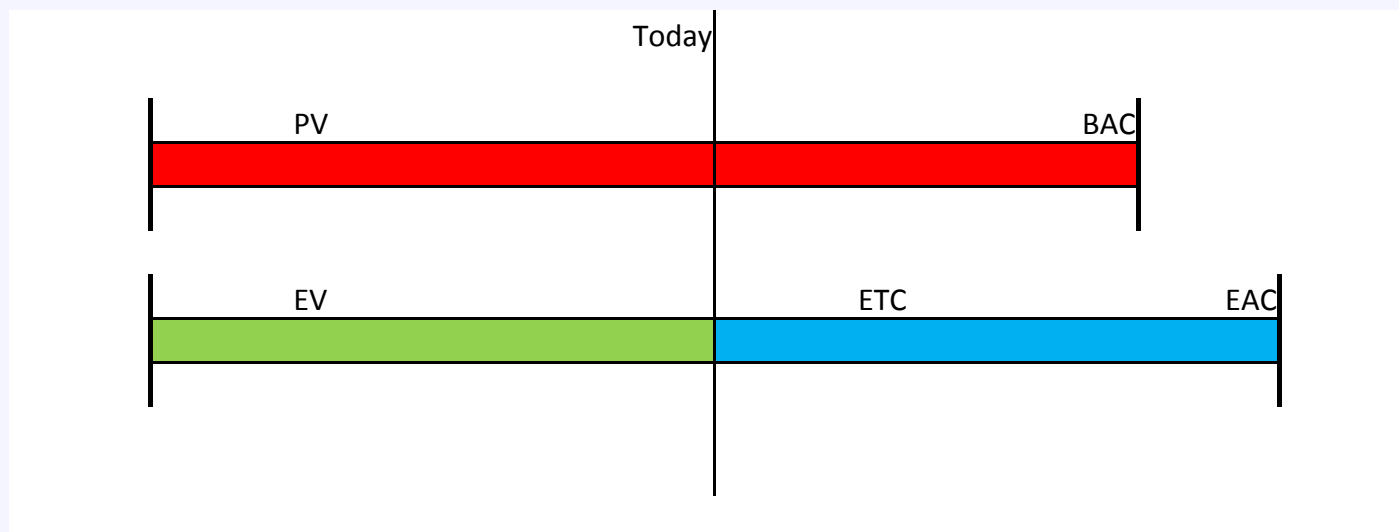
Tips

- EV comes first in all equations.
- For Schedule related equation there is PV and AC for cost related

7.4 Control Cost

➤ 2. Forecasting

- ❖ Using the earned value analysis, team can now forecast the project performance.
- ❖ Estimate at completion (EAC) may differ from Budget at Completion (BAC)
- ❖ Estimate to complete (ETC) is the estimate of remaining work. Now
Estimate at completion = $AC + ETC$.



7.4 Control Cost

➤ EAC can be calculated by

1. There will be no variation for remaining work and will progress as planned before $ETC = BAC - EV$ & that means $EAC = AC + ETC (BAC - EV)$
2. The changes project experience will continue to occur for remaining work.
 $EAC = BAC / CPI$ (Only cost efficiency is considered now)
3. Here team considers that remaining work will be completed at the same efficiency rate considering cost and schedule performance
 $EAC = AC + (ETC / CPI \times SPI)$ & $ETC = BAC - EV$

A variation to this is to weight CPI or SPI at different values as per project managers judgement (to give weight to schedule performance or cost performance as per previous performance). In case of an 70/30 ratio

$$EAC = AC + ((BAC - EV) / 0.7CPI \times 0.3SPI)$$

7.4 Control Cost

4. Team think that original estimate if fundamentally flawed. Team need to prepare new estimate for remaining work. This the best way to forecast but requires management effort and additional expenditure of costing

$$\text{EAC} = \text{AC} + \text{New Estimate for remaining work}$$

7.4 Control Cost

➤ 3. To Complete Performance Index (TCPI)

- ❖ TCPI predicts the efficiency that must be achieved for remaining work to complete the remaining works with available budget
- ❖ $TCPI = \text{Work Remaining} / \text{Funds remaining}$

$$= (\text{Budget At Completion} - \text{Earned Value}) / (\text{BAC} - \text{Actual cost})$$

$$= (\text{BAC} - \text{EV}) / (\text{BAC} - \text{AC})$$

If it is obvious that earlier estimated budget at completion can not be achieved, Project manager develops a forecasted estimate at completion (EAC). Once approved through integrative change control process, EAC will superseded BAC and cost baselines will be revised.

$$\text{Now } TCPI = (\text{BAC} - \text{EV}) / (\text{EAC} - \text{AC})$$

7.4 Control Cost

❖ Now TCPI = Work Remaining/Funds remaining as per forecasted EAC

$$= (\text{Budget At Completion} - \text{Earned Value}) / (\text{EAC} - \text{Actual cost})$$

TCPI (based on original estimate or forecasted budget) will set a new baseline for performance efficiency to be achieved to complete the works with funds remaining.

If CPI falls below TCPI baseline, remaining works will not be completed with available funds. All future works shall be accelerated to bring CPI within TCPI range.

TCPI value >1 means in future, more work must be achieved per every dollar spent in the future compared to actual work achieved previously per dollar.

TCPI value <1 means in future lesser work need to be achieved for every dollar spent compared to past performance

Examples

- A project has the following *Earned value data assessed*: AC: \$ 4,000,000 CV: \$ -500,000 SPI: 1.12 BAC: \$ 9,650,000 What is the Earned value of the project? What is the CPI? What is the TCPI?
- In your project, there have been several changes in the cost and schedule estimates and the original estimating assumptions are no longer valid. What is the Estimate at Complete for your project? BAC = \$ 300,000, AC = \$ 100,000, EV = \$ 150,000, CPI = \$ 1.2, ETC = \$ 120,000

7.4 Control Costs – Outputs

- Work Performance Measurements
- Budget Forecasts
- Organizational process assets (updates
- Change Requests
- Project management plan (updates)
- Project Document Updates

Till Now

- Projects are authorized by project charter
- SOW is issued as a preliminary scope guideline
- Project manager and project management team are appointed now
- Project manager & team decides whether projects need to be divided in to phases.
- Stakeholders are identified
- Project management plan is prepared (determining how to do planning)
- Requirements for the projects are collected
- Scope of the project is created (need iteration)
- Scope is too big to handle. Scope is now decomposed using WBS (based on deliverables)

Till Now

- Scope is decomposed till work package level & Scope baseline is created
- Control accounts are placed in WBS to link the work to accounting system
- Work packages level is further decomposed to activities
- Activities are arranged in a logical sequence by creating network diagram and PDM
- Leads or lags are introduced
- Activity resource is estimated
- Activity duration is estimated
- Critical path is now calculated (forward pass and backward pass)
- Resource levelling is carried out

Till Now

- Schedule compression methods (Crashing or fast tracking) to achieve a milestone or completion date demanded by customer/client
- Critical path is revised
- Schedule baseline is prepared and floats are identified (free float, total float and project float)
- Schedule is signed off by all parties.
- Cost of activities are estimated and rolled up to project level (or reverse).
- Cost is now loaded to activities. PM software now can produce a time based cost for the project (S Curve) and budget is created
- Contingency reserves and Management reserves are added (after risk analysis).

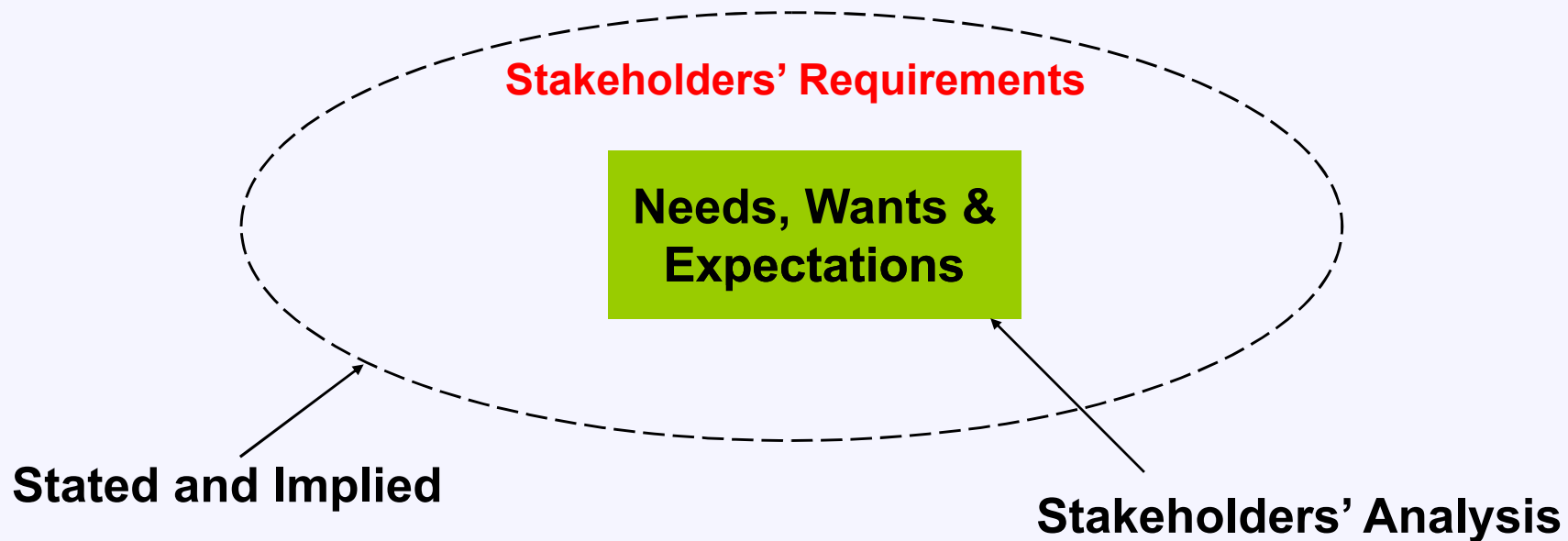
Till Now

- Cost baseline is prepared (except management reserve) and the project can be now monitored with baseline for performance.
- Cost budget is now negotiated with organization to ensure proper funding.
- Iterate from schedule if required
- Remember, Integration and change control is a repeated process from starting to end

Project Quality Management

What is Quality?

“ the degree to which a set of inherent characteristics fulfill **requirements**”



Key Concepts

Quality vs. Grade (degree of functionality)

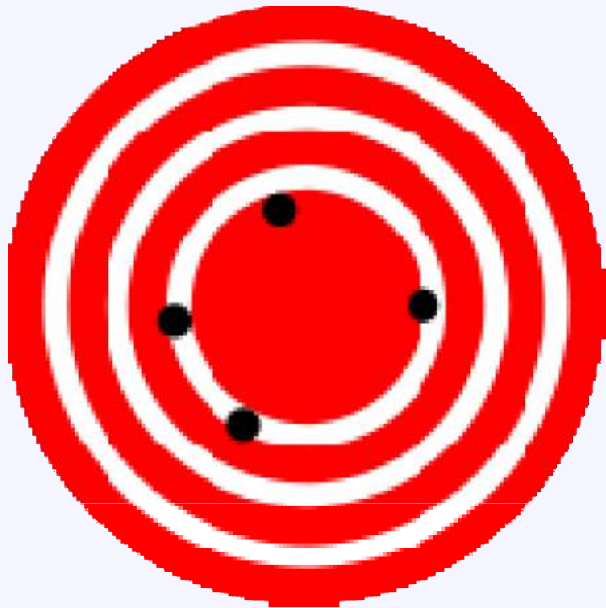
- Grade is a category assigned to products or services having the same functional use but different technical characteristics.
- A camera with lots of functions is high grade and a camera which takes bad pictures is low quality
- Low Quality is always a problem; low grade may not be.

Precision vs. Accuracy

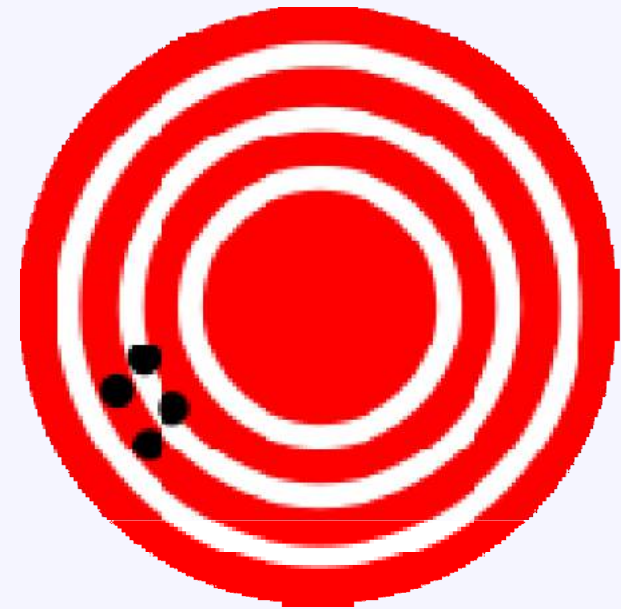
Precision and Accuracy are not equivalent.

- Precision is consistency that the value of repeated measurements are clustered and have little scatter.
- Accuracy is correctness that the measured value is very close to the true value.
- Precise measurements are not necessarily accurate. A Very accurate measurement is not necessarily precise.
- The Project Management Team must determine how much accuracy or precision or both are required.

Precision vs. Accuracy



High accuracy, but low precision



High precision, but low accuracy

Key Concepts

➤ Modern Quality Management Focus

- ❖ Customer Satisfaction – Understanding, evaluating, defining and managing expectations so that customer requirements are met.
- ❖ Conformance to requirements – Ensure that project produces what it was created to produce
- ❖ Fitness for use – The product must satisfy real needs
- ❖ Prevention over inspection – Quality is planned, designed and built in and not inspected in. Inspections generally produce rework, cost and customer complaints.
- ❖ Continuous improvement – Plan-Do-Check-Act cycle (Defined by Shewhart and modified by Deming)
- ❖ Management Responsibility – Management shall provide necessary resources to complete quality activities

Quality Theorists

- ✔ Three people are responsible for rise of the quality management movement & theories behind the cost of quality.
 - ✔ **Philip B. Crosby**
 - ✔ Zero defects practice (Do it right in the first time) (Prevention)
 - ✔ **Joseph M. Juran**
 - ✔ Fitness for use (Stakeholders or customers expectations are met or exceeded.)
 - ✔ **W. Edwards Deming**
 - ✔ 85% of cost of quality is a management problem.
- ✔ Kaizen approach
 - ✔ Quality technique from Japan. (Continuous improvement)
 - ✔ Improve the quality of people first. Then quality of products or service.

Project Quality Management

- The Project Quality Management processes include the following:
 - ❖ Plan Quality Management
 - ❖ Perform Quality Assurance
 - ❖ Control Quality

8.1 Plan Quality Management

- Quality requirements are identified (normally from Stakeholders), quality standards the project work and products shall follow are identified (includes external standards and a plan how the project will comply with these requirements are prepared).
- Plan quality produces a plan (and done prior to start of work)
- Checklists, procedures, manuals etc are prepared here.

8.1 Plan Quality Management

| Inputs | Tools & Techniques | Outputs |
|--|---|---|
| <ol style="list-style-type: none"> 1. Scope Baseline 2. Stakeholder Register Cost performance baseline 3. Schedule baseline 4. Risk Register 5. Enterprise environmental factors 6. Organizational process assets | <ol style="list-style-type: none"> 1. Cost-benefit analysis 2. Cost of quality 3. Control charts 4. Benchmarking 5. Design of experiments 6. Statistical sampling 7. Flowcharting 8. Proprietary quality management methodologies 9. Additional quality planning tools | <ol style="list-style-type: none"> 1. Quality management plan 2. Quality metrics 3. Quality checklists 4. Process improvement plan 5. Project document updates |

8.1 Plan Quality Management : Tools & Techniques

1. Cost Benefits Analysis:

- ❖ Benefit of meeting quality requirements and costs of meeting quality requirements are analyzed.
- The primary benefit of meeting quality requirements is less rework, which means higher productivity, lower costs, and increased stakeholder's satisfaction.
- The primary cost of meeting quality requirements is the expense associated with project quality management activities.

8.1 Plan Quality Management : Tools & Techniques

2. Cost of Quality (COQ):

- Cost of quality refers to all efforts related to quality activities throughout the product life cycle. This include cost of conformance and cost of non conformance.
- For project point of view, Cost of Quality is primarily the Cost associated with doing the activities related to Quality Planning, Quality Assurance, Quality Control and internal failure cost. However for an organization cost of quality may include external failure cost.
- Due to temporary nature of project, organizations may choose to invest in product quality, especially quality improvements, defects prevention and appraisal, to reduce external cost of quality.

Cost of Non-Conformance and Conformance

Cost of Conformance

Prevention Costs

(Build a quality product)

- Training
- Document Processes
- Equipment
- Time to do it right

Appraisal Costs

(Assess the Quality)

- Testing
- Destructive testing loss
- Inspection

Money Spent during the project **to avoid failures**

Cost of Non Conformance

Internal Failure Costs

(Failures found by the project)

- Rework
- Scrap

External Failure Costs

(Failures found by the customer)

- Testing
- Destructive testing loss
- Inspection

Money Spent during and after the project **because of failures**

8.1 Plan Quality Management : Tools & Techniques

3. Control Chart

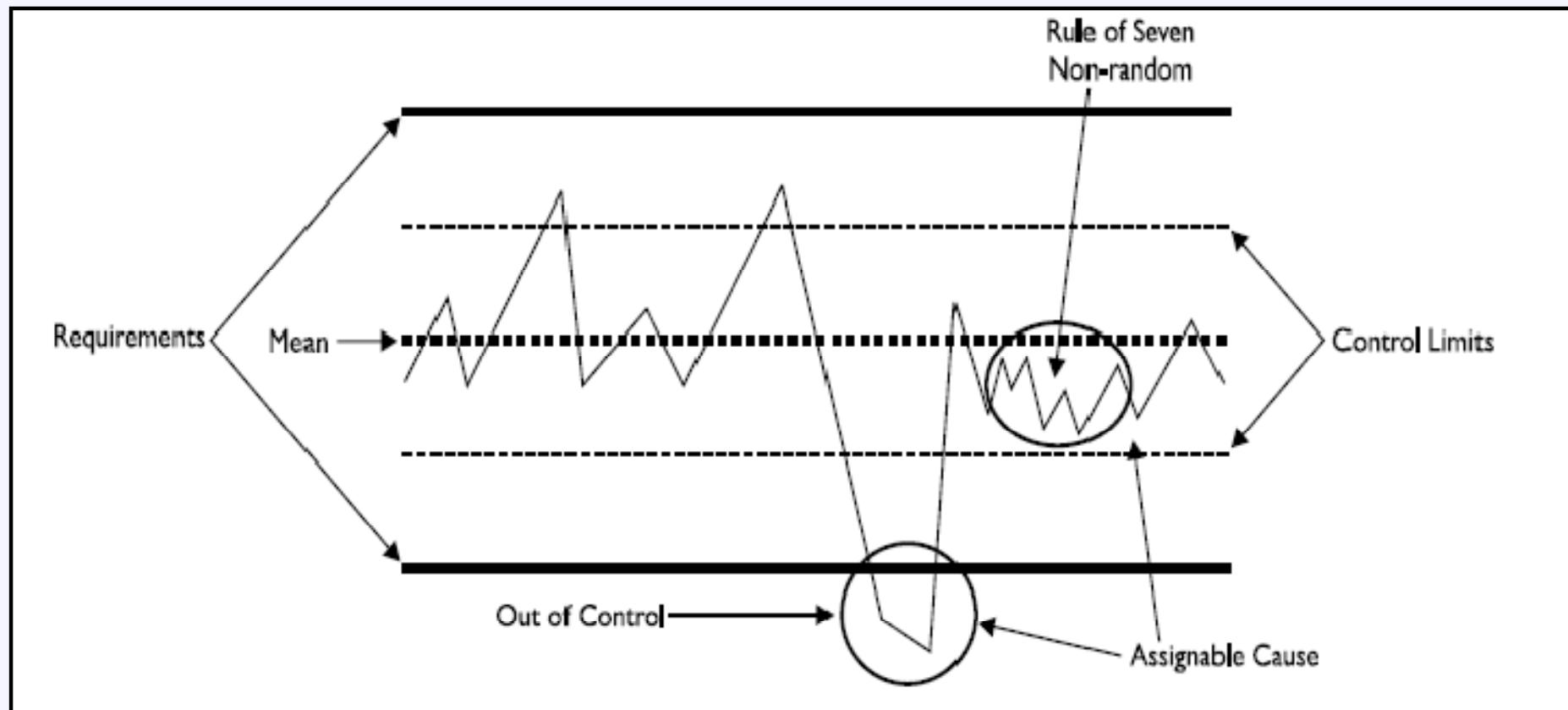
Purpose: It determines whether or not a process is stable or has predictable performance.

- ❖ It is a graphic display of the interaction of the process variables within acceptable limits
- ❖ When a process is outside acceptable limits the process should be adjusted.
- ❖ The upper control limits and lower control limits are usually set at ± 3 sigma (i.e. standard deviation)
- ❖ In project, control chart can be used for monitoring of cost and time.

8.1 Plan Quality Management : Tools & Techniques

- To draw a control chart, upper and lower control limits are identified. Normally control limits are determined by organizations policies
- **Specification limit** – are normally drawn from contract or customer requirement. It may be stringent than control limits
- **Mean** represent the average of control limits or specification limits
- **Out of control** – A process is considered out of control if
 - A data point falls out of control limits
 - Breaks the rule of seven
- **Rule of seven** – Is a rule of thumb or heuristic. A consecutive seven data points one single side of mean is considered out of control, even though the data points are within control limits.
- **Assignable cause / Special Cause Variation** – is a data point that requires investigation (either out of control limits or breaks rule of seven)

8.1 Plan Quality Management : Tools & Techniques



8.1 Plan Quality Management : Tools & Techniques

4. Benchmarking

- It compares actual or planned project practices to those projects to generate ideas for improvement and to provide a basis by which to measure performance.
- These other projects can be within the performing organization or outside of it, and can be within the same or in another application area.

8.1 Plan Quality Management : Tools & Techniques

5. Design of Experiments (DOE)

- It helps identify which variables have the most influence on the overall outcome of a process
- It provides a statistical framework for systematically changing the entire important factors one at a time rather than each at a time.
- Automotive designers use this technique to determine which combination of suspension and tires will produce the most desirable ride characteristics at a reasonable cost.

8.1 Plan Quality Management : Tools & Techniques

6. Statistical Sampling

- ❖ It is used to **choose part of a population of interest for inspection**
- ❖ A sample selected according to statistical calculation is tested / checked rather than all products.
- ❖ Sample frequency and sizes shall be determined during plan quality process.

8.1 Plan Quality Management : Tools & Techniques

7. Flowcharting :

- A flowchart is a graphical representation of a process showing the relationships among the process steps.
- All flow charts will have activities, decision points and order of processing.

8.1 Plan Quality Management : Tools & Techniques

8. Proprietary Quality Management Methodologies :

- These include Six Sigma, Lean Six Sigma, Quality Function Deployment , CMMI, etc
- Recommend further reading

8.1 Plan Quality Management : Tools & Techniques

9. Additional Quality Planning Tools

- Brainstorming
- Affinity diagram
- Force field analysis
- Nominal group techniques
- Matrix diagrams
- Prioritization matrices

8.1 Plan Quality Management : Outputs

1. Quality Management Plan:

- It describes how the project management team will implement the performing organization's quality policy.
- ❖ The quality management plan is a component or a subsidiary plan of the project management plan
- ❖ The quality management plan provides inputs to the overall project management plan and must address quality control (QC), quality assurance (QA) and continuous process improvement for the project.

8.1 Plan Quality Management :Outputs

2. Quality Metrics

- ❖ A metric is an operational definition that describes, in very specific terms, what something is and how the quality control process measures it.
- ❖ A measurement is an actual value and matrices defines the tolerances
- ❖ A product can be accepted with +/- 5% variation
- ❖ Cost can exceed 10% of estimated values.
- ❖ Metrics will define statistical sampling requirements which are used in QA & QC processes

8.1 Plan Quality Management :Outputs

3. Quality Checklists:

- ❖ A checklist is a structured tool to verify that a set of required steps has been performed
- ❖ It may be simple or complex phrased as imperatives (do this) or Interrogatories (Have you done this) in which process you may ask it
- ❖ Quality checklists are used in QC process but prepared here.

8.1 Plan Quality Management :Outputs

4. Process improvement plan:

- It details the step for analyzing processes that will facilitate the identification of waste and non-value added activities and thus increasing customer satisfaction
 - ❖ Process boundaries: start and end of processes, their inputs and outputs, data required, if any and the owners and stakeholders of processes
 - ❖ Process configuration: A flowchart of processes to facilitate analysis with interfaces identified.
 - ❖ Process metrics: Maintain control over status of process
 - ❖ Targets for improved performance: Guides the process improvement activities

8.1 Plan Quality Management :Outputs

5. Project Document Updates :

- Project documents that may get updated include, but are not limited to :
 1. Stakeholder register
 2. Responsibility Assignment Matrix

8.2 Perform Quality Assurance

- Perform Quality assurance is the process of auditing the quality requirements and results from quality control measurements to ensure that appropriate quality standards and operations definitions are met.
- Another goal of quality assurance is continuous quality improvement
- Normally done by a third party

8.2 Perform Quality Assurance

| Inputs | Tools & Techniques | Outputs |
|--|--|---|
| <ol style="list-style-type: none"> 1. Project Management Plan 2. Quality metrics 3. Work performance information 4. Quality control measurements | <ol style="list-style-type: none"> 1. Plan Quality and perform quality control tools and techniques 2. Quality audits 3. Process analysis | <ol style="list-style-type: none"> 1. Organizational process assets (updates) 2. Change requests 3. Project management plan (updates) 4. Project Document Updates |

8.2 Perform Quality Assurance: Tools & Techniques

1. The T & T for quality planning also can be used for QA Activities.
2. Quality Audits: It is structured, **independent review** to determine whether project activities comply with org. & project policies, processes and procedures.
3. Policies and procedures are set in the Quality planning stage and here auditing is carried out to confirm that project quality activities are confirming to this.

8.2 Perform Quality Assurance: Tools & Techniques

3. Process Analysis: : Main goal of quality assurance is continuous quality improvement , hence process analysis is done

- ❖ It follows the steps outlined in the process improvement plan to the identified improvements.
- ❖ It examines problems experienced, constraints experienced, and non- value-added activities identified during process operation.
- ❖ It includes root cause analysis to create preventive action for similar problems.

4. Quality control Tools & Techniques

- ❖ Described later

8.2 Perform Quality Assurance: Outputs

1. Organizational process assets (updates)
2. Change Requests
3. Project Management Plan Updates
4. Project Document Updates :

Documents that might get updated include , but are not limited to :

- Quality audit reports
- Training plans
- Process documentation

8.3 Perform Quality Control

- QC involves monitoring specific project results to determine:
 - ❖ Whether they comply with relevant quality standards
 - ❖ Identifying ways to eliminate causes of unsatisfactory results.
- QC should be performed throughout the project
- Project results include deliverables and PM results, such as cost and schedule performance
- QC is often performed by a quality control Dept.

Some Quality Control Terms

- **Marginal Analysis**

- Optimal quality is reached at the point where the incremental revenue from improvement equals the incremental cost to secure it.

- **Prevention**

- Keeping errors out of the process.

- **Inspection**

- Catching errors when they have occurred.

- **Attribute Sampling**

- Is the color (attribute) blue (acceptable) or red (unacceptable) ?

- **Variable Sampling**

- How blue is it on the blueness scale ?

Some Quality Control Terms

- **Special Causes (Assignable Causes)**
 - Unusual events that probably merit investigation.
- **Random Causes (Common Causes)**
 - Normal process variation – probably doesn't merit investigation.
- **Tolerances**
 - The result is acceptable if it falls within the range specified by the tolerance.
- **Control limits**
 - The process is in control if the result falls within the control limits.

8.3 Control Quality

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Project management plan 2. Quality metrics 3. Quality checklists 4. Organizational process assets 5. Work performance measurements 6. Approved change requests 7. deliverables | <ol style="list-style-type: none"> 1. Cause and effect diagram 2. Control charts 3. Flowcharting 4. Histogram 5. Pareto chart 6. Run chart 7. Scatter diagram 8. Statistical sampling 9. inspection 10. Approved change requests review | <ol style="list-style-type: none"> 1. Quality control measurements 2. Validated changes 3. Organizational process assets (updates) 4. Validated deliverables 5. Project management plan (updates) 6. Change Requests 7. Project Document Updates |

8.3 Control Quality Tools & Techniques

1. Cause and effect diagram
2. Control Charts
3. Flowcharting
4. Histogram
5. Pareto chart
6. Run Chart
7. Scatter Diagram
8. Statistical Sampling
9. Inspection
10. Approved change requests review

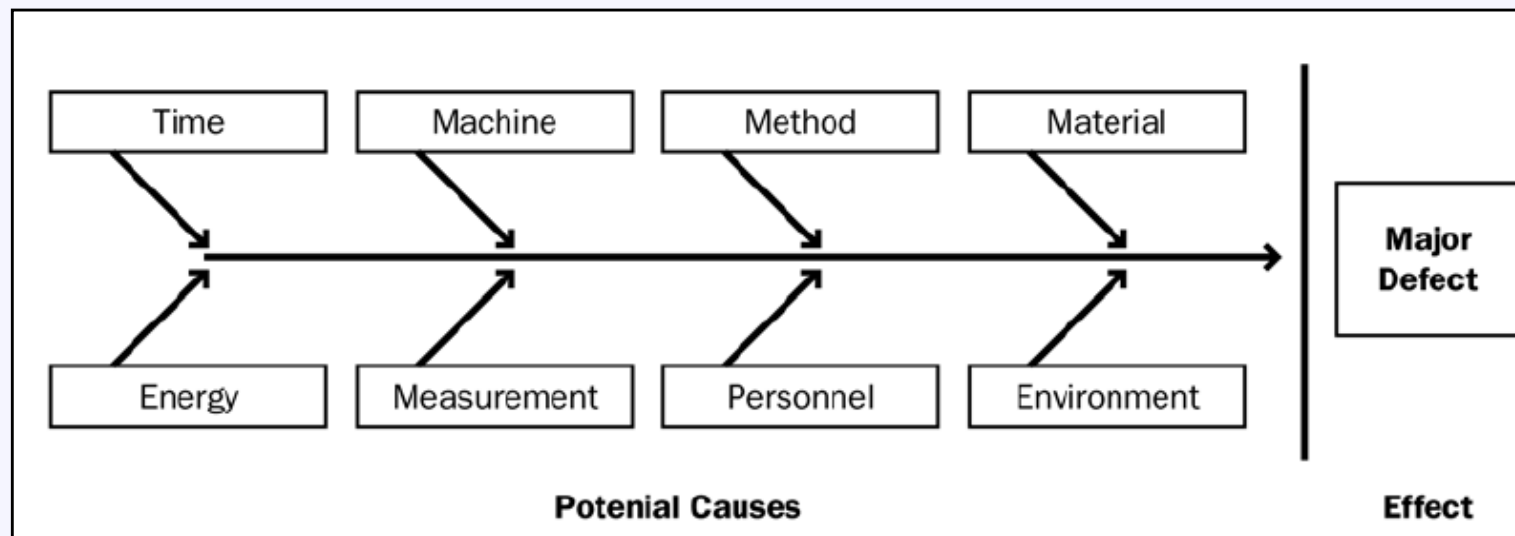
The first seven of these
are known as the Seven Basic
Tools of Quality

8.3 Control Quality Tools & Techniques

1. Cause and Effect Diagram. Also called Ishikawa diagrams or fishbone diagrams.

➤ Purpose

It illustrates how various factors might be linked to potential problems or effects.

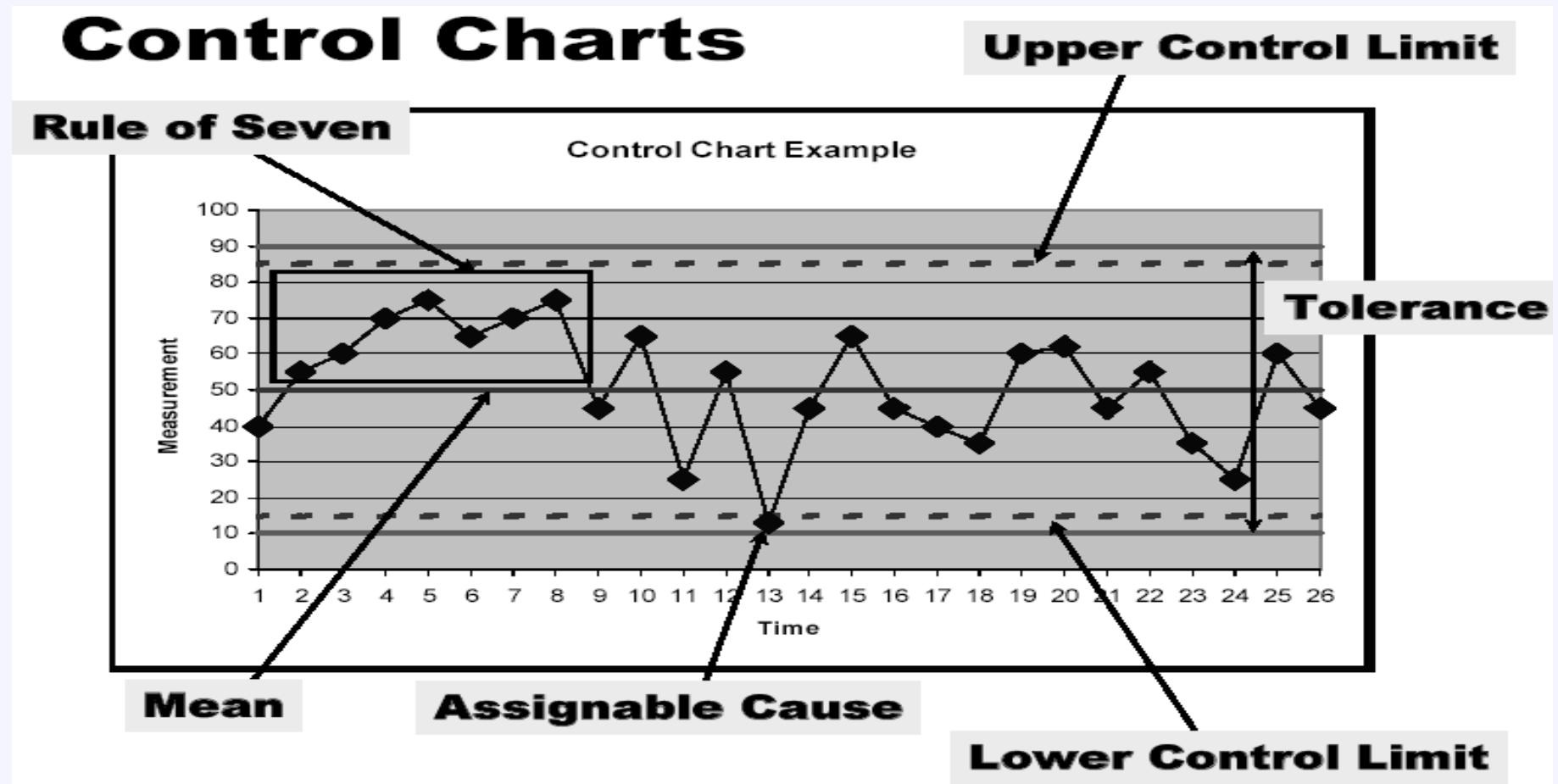


8.3 Control Quality Tools & Techniques

- Control Chart

As described earlier

8.3 Control Quality : Tools & Techniques

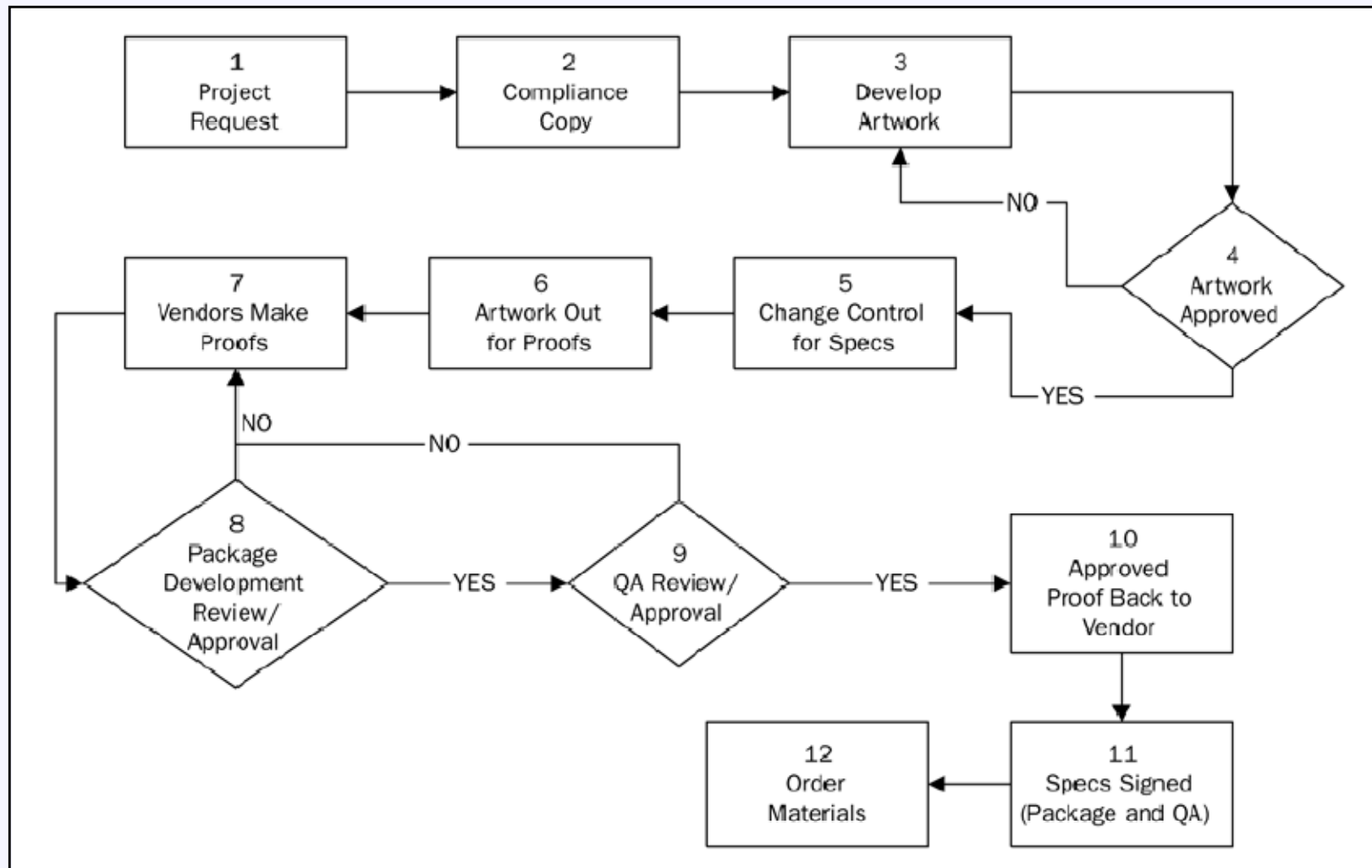


8.3 Control Quality: Tools & Techniques

3. Flowcharting, It helps to analyze how problems occur

- ❖ A flowchart is a graphical representation of a process
- ❖ It shows how various elements of a system interrelated and the order of processing
- ❖ It helps the project team anticipate what and where quality problems might occur.

3. Flowcharting

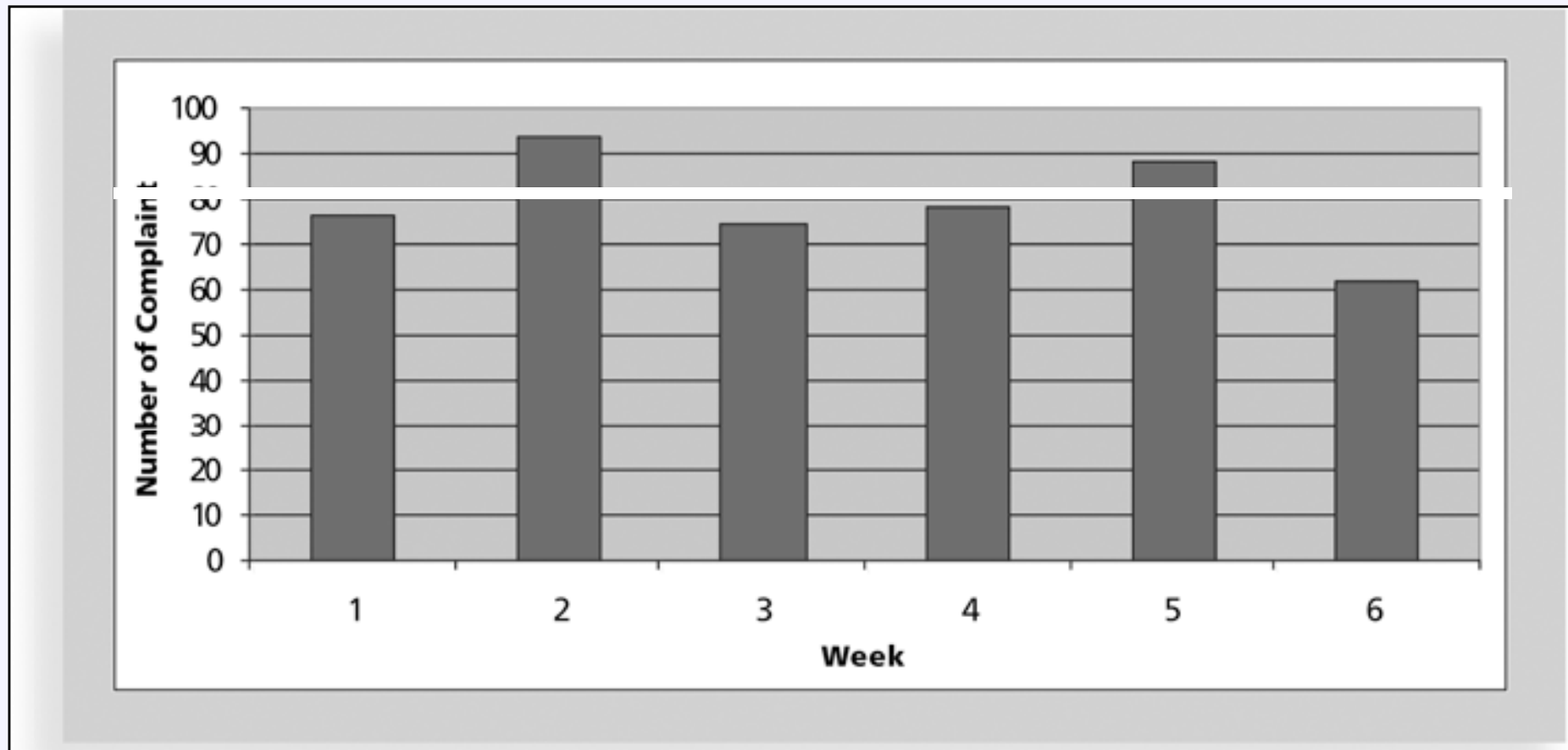


8.3 Control Quality: Tools & Techniques

4. Histogram: it is a bar chart showing the distribution of variables

- ❖ Each column represents an attribute or characteristics of a problem or situation
- ❖ The height of each column represents the relative frequency of the characteristics
- ❖ Histogram helps identify the cause of the problem in a process by the shape and width of the distribution.

Sample Histogram

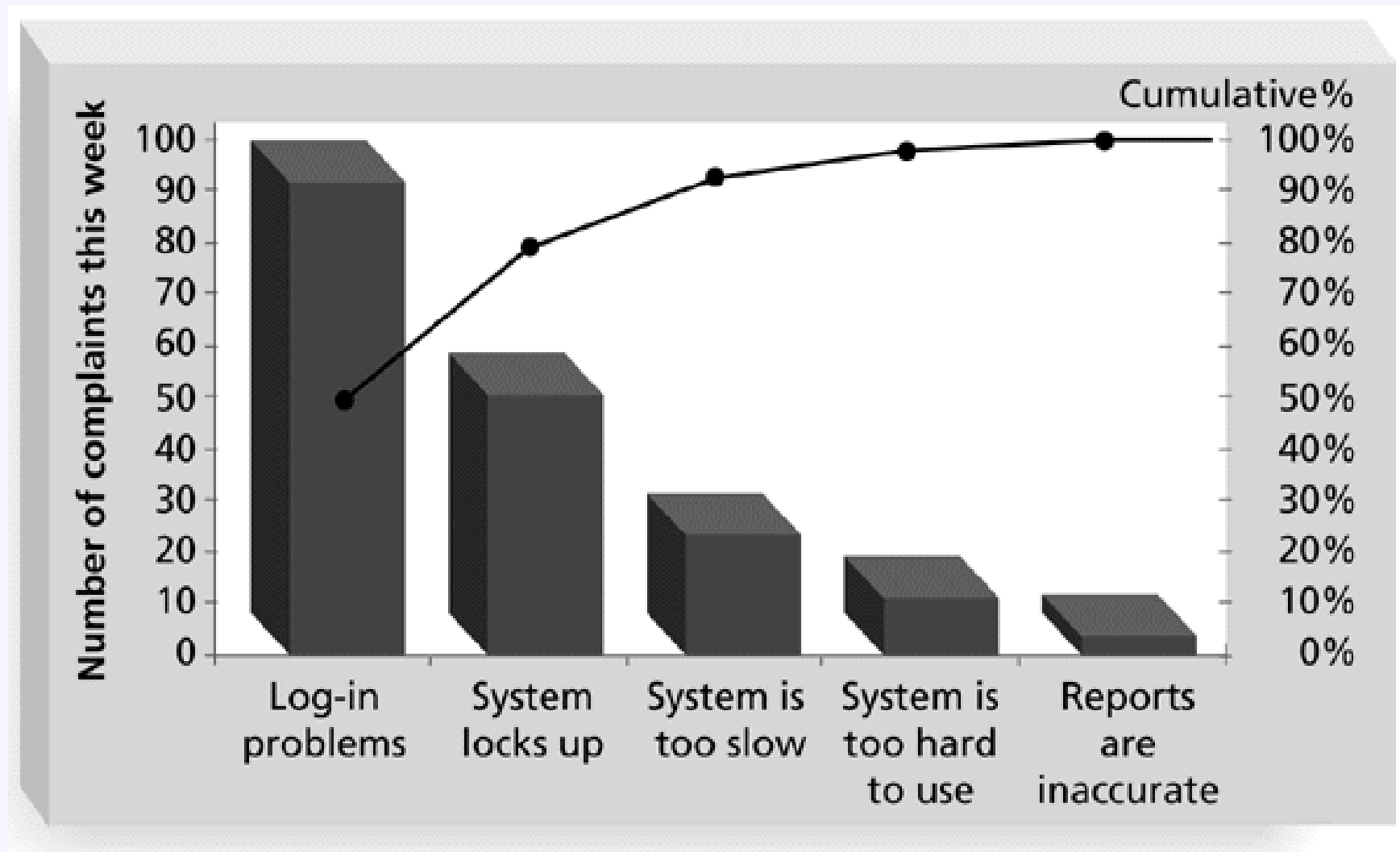


8.3 Control Quality : Tools & Techniques

5. Pareto Chart (80/20 Principles)

- ❖ Pareto chart is a specific type of histogram ordered by frequency of occurrences
- ❖ A Pareto chart can help you identify and prioritize problem areas
- ❖ Pareto analysis is also called the 80-20 rule, meaning that 80 percent of problems are often due to 20 percent of the causes

Sample Pareto Diagram



Pareto diagram

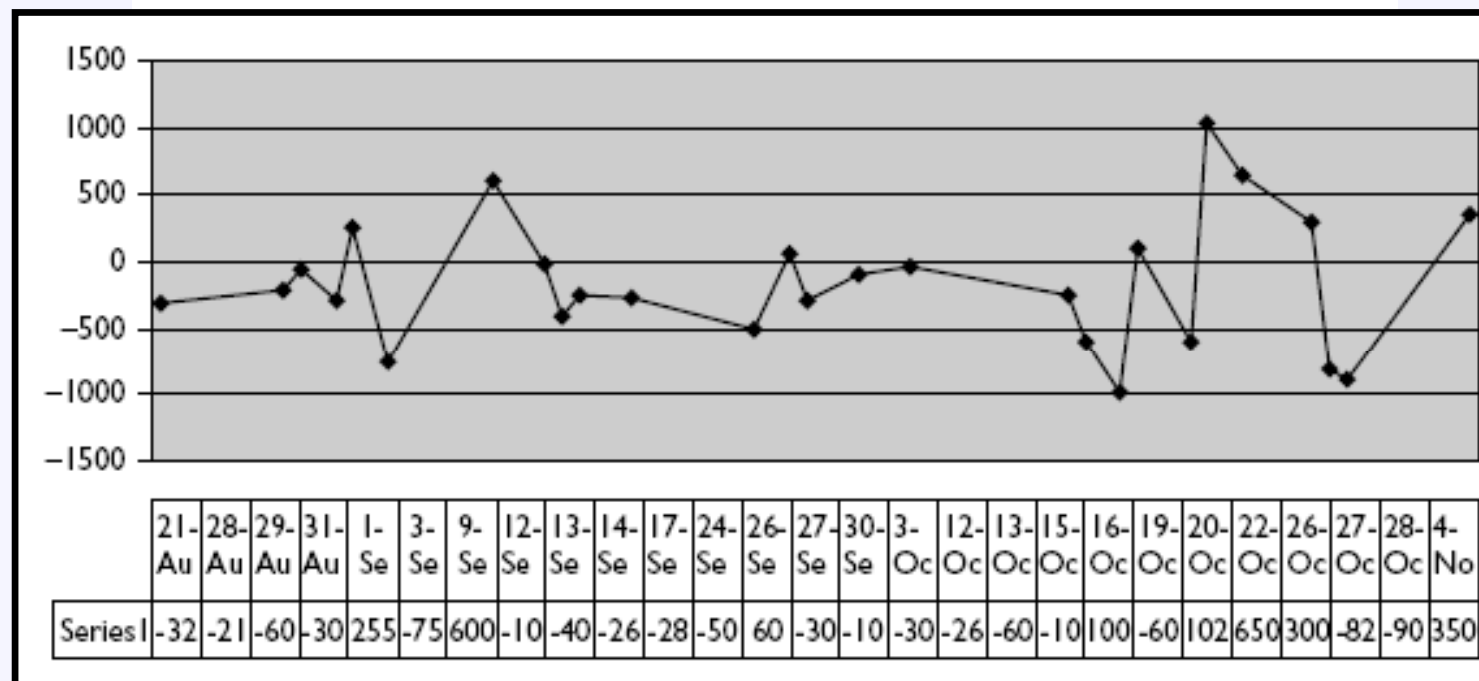
- Pareto diagram rank ordering is used to guide corrective actions
- The project team should take actions to fix the problems that are causing the greatest number of defects first.
- Pareto's Law "80/20 principle": a relatively small number of causes will typically produce a large majority of the problems or defects
- 80 percent of problems are due to 20 percent of the causes.

8.3 Control Quality: Tools & Techniques

6. Run Chart

- It shows the history and pattern of variation.
- It is a line graph that shows data points plotted in the order in which they occur.
- It shows the trends in a process overtime variation overtime or declines or improvement in process overtime.
- Can be used to perform trend analysis to forecast future outcomes based on historical patterns

Run Chart



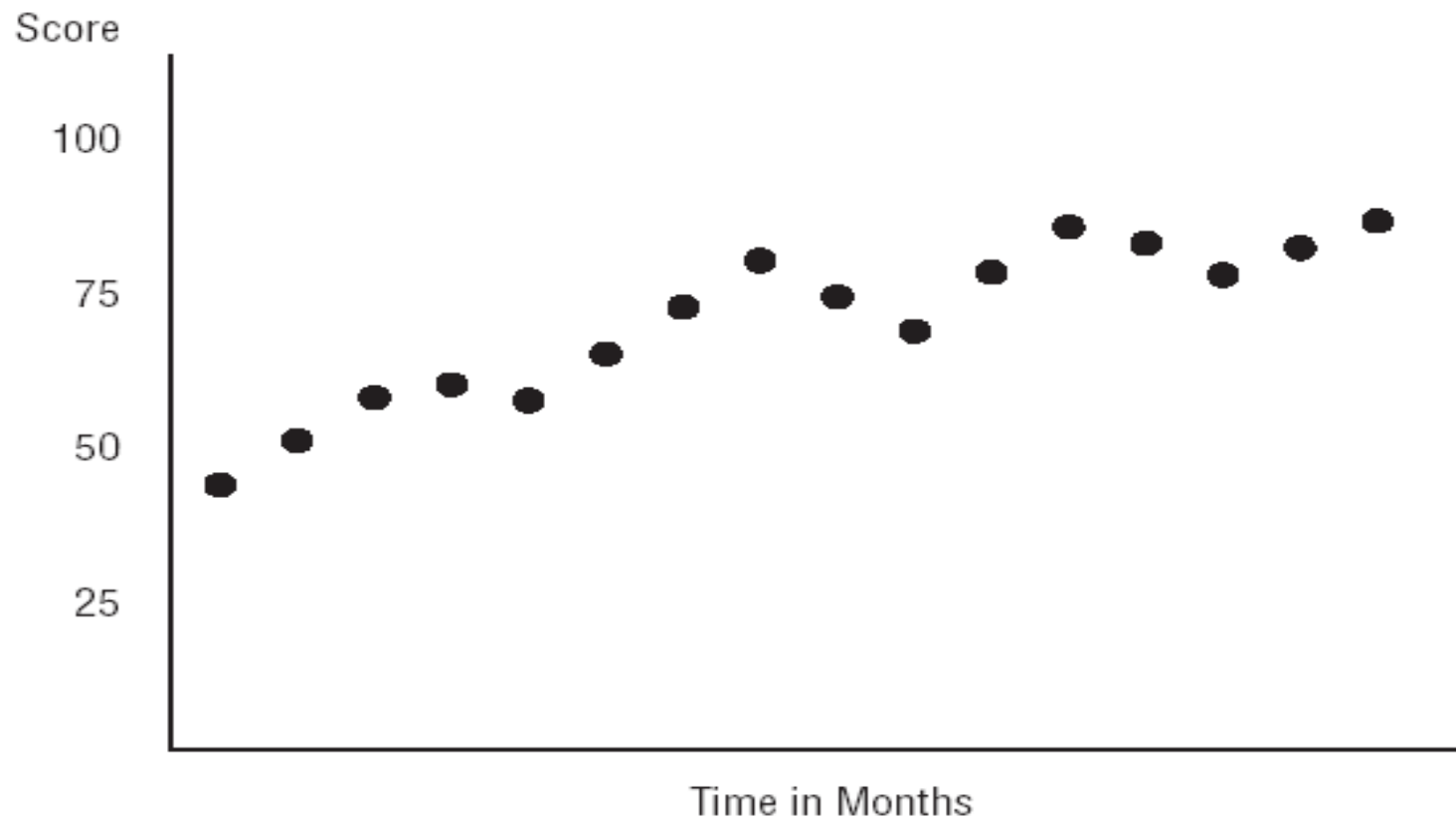
8.3 Control Quality: Tools & Techniques

7. Scatter Diagram

- It allows the Quality team to study and identified the possible relationship between two variables.
- It shows the pattern of relationship between two variables.
- Dependent variables versus independent variables are plotted.
- The closer the points are to a diagonal line the more closely they are related.

8.3 Control Quality: Tools & Techniques

Scatter diagram



8.3 Control Quality: Tools & Techniques

8. Statistical Sampling

- ❖ As described before

8.3 Control Quality: Tools & Techniques

9. Inspection

- ❖ Also called reviews, peer reviews, audits, and walk thorough
- ❖ It is the examination of a work product to determine whether it conforms to standards.
- ❖ Inspection includes measurements
- ❖ Inspections can be conducted at any level i.e. results of a single activity or the final product can be inspected
- ❖ Inspections are also used to validate defect repairs.

8.3 Control Quality: Tools & Techniques

10. Approved Change Requests Review :

- All approved change requests should be reviewed to verify that they were implemented as approved

8.3 Control Quality: Outputs

1. Quality control measurements

- These measurements are the result of the QC activities
- These measurements are fed back to the QA (section 8.2) to reevaluate and analyze the quality standards & processes

8.3 Perform Quality Control: Outputs

2. Validate Changes :

- Any changed or repaired items are inspected and will be either accepted or rejected before notification of the decision is provided .
- Rejected items may require rework

8.3 Control Quality: Outputs

3. Organization process Assets (updates)

- Completed checklist: when checklist are used the completed checklist should become the part of the project's record
- Lessons learned documentation
- Lessons learned e.g. the causes of variances, the reasoning behind the corrective actions chosen... Should be documented so that they become the part of historical database for both this project and the performing organization.

8.3 Control Quality: Outputs

4. Validated Deliverables

- ❖ QC aims to determine the correctness of deliverables
- ❖ The result of the execution quality control process are validated deliverables.

5. Project management plan (updates)

8.3 Control Quality: Outputs

6. Change Requests :

- If the recommended corrective or preventive actions or a defect repair requires a change to the project management plan , a change request should be initiated in accordance with the defined Perform Integrated Change Control process

7. Project Document Updates :

- Project documents that may get updated include, but are not limited to : the quality standards

Project HR Management

Keys to Managing People

- Psychologists and management theorists have devoted much research and thought to the field of managing people at work

- Important areas related to project management include:
 - ❖ Motivation theories
 - ❖ Influence and power
 - ❖ Effectiveness

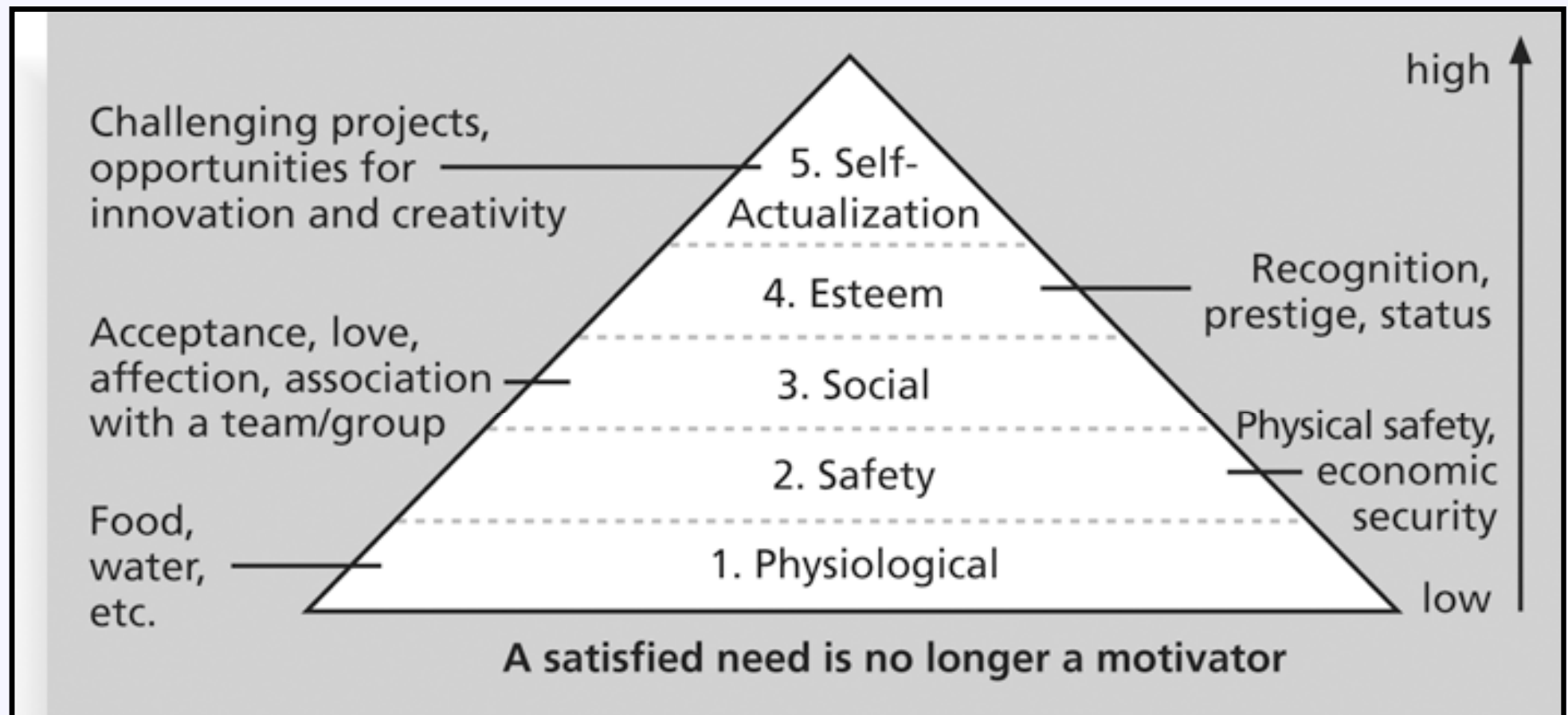
Intrinsic and Extrinsic Motivation

- **Intrinsic motivation** causes people to participate in an activity for their own enjoyment
- **Extrinsic motivation** causes people to do something for a reward or to avoid a penalty
- For example, some children take piano lessons for intrinsic motivation (they enjoy it) while others take them for extrinsic motivation (to get a reward or avoid punishment)

Maslow's Hierarchy of Needs

- Abraham Maslow argued that humans possess unique qualities that enable them to make independent choices, thus giving them control of their destiny
- Maslow developed a **hierarchy of needs** that states that people's behaviors are guided or motivated by a sequence of needs

Maslow's Hierarchy of Needs



Herzberg's Motivational and Hygiene Factors

- Frederick Herzberg wrote several famous books and articles about worker motivation; he distinguished between:
 - ❖ Motivational factors: achievement, recognition, the work itself, responsibility, advancement, and growth, which produce job satisfaction
 - ❖ Hygiene factors: cause dissatisfaction if not present, but do not motivate workers to do more; examples include larger salaries, more supervision, and a more attractive work environment²¹

McGregor's Theory of X and Y

- **Theory X**
 - Authoritarian Management Style
 - People prefer to be directed and controlled. Workers are naturally lazy, selfish, and hate work. Money is their only motivation.
- **Theory Y**
 - Participative Management Style
 - People prefer to work without supervision. Workers feel committed to their jobs, are responsible, self-directive, and exercise self-control

What is Project Human Resource Management?

- Making the most effective use of the people involved with a project
- Processes include:
 - ❖ Plan Human Resource Management
 - ❖ Acquire the project team
 - ❖ Develop the project team
 - ❖ Manage the project team
- ❖ Project management team is the subset of project team. Project management team is normally appointed earlier and project team (people who actually do the work of project) is selected later.

9.1 Plan Human Resource Management

- Develop Human Resource plan is the process of identifying and documenting project roles, responsibilities, reporting relationships and staffing management plan
- Human resource required to complete the activities are identified now
- It also contains training needs, team building strategies, plan for recognition and rewards, safety issues etc

9.1 Plan Human Resource Management

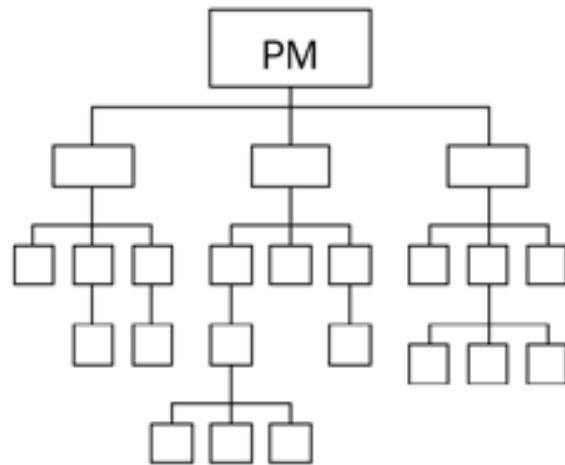
| Inputs | Tools & Techniques | Outputs |
|--|---|---|
| <ol style="list-style-type: none">1. Activity Resource Requirements2. Enterprise environmental factors3. Organizational process assets | <ol style="list-style-type: none">1. Organizational charts and position descriptions2. Networking3. Organizational theory | <ol style="list-style-type: none">1. Human Resource Plan |

9.1 Plan Human Resource Management : Tools & Techniques

1. Organization Charts and Position Description

- ❖ Many formats exist to document team member roles and responsibilities. Most of these formats fall into one of three types:
 - Hierarchical
 - Matrix
 - Text-oriented.

Templates



Hierarchical-type Organization Chart

[illegible]

Matrix-based Responsibility Chart

Role _____

Responsibilities _____

Authority _____

Text-oriented Format

Hierarchical – Type Charts

This is a traditional organization chart structure can be used to show positions and relationships in a graphic, top-down format.

How 2 get there:

WBS that are primarily designed to show how Project deliverables are broken into work packages become one way to show high-level areas of responsibility.

OBS looks similar to the WBS, but instead of being arranged according to a breakdown of Project deliverables, it is arranged according to an organization's existing departments, units, or teams i.e., Purchasing Section can see its all Project responsibilities by looking at the Purchasing portion of the OBS.

Matrix-based Charts

- The matrix format, sometimes called a table, allows a person to see all activities associated with one person or to see all staff associated with one activity. The matrix shown in the next slide figure is a type of RAM called RACI chart (why?)

RACI Chart

| RACI Chart | Person | | | | |
|------------|--------|-----|--------|------|----|
| Activity | Ann | Ben | Carlos | Dina | Ed |
| Define | A | R | I | I | I |
| Design | I | A | R | C | C |
| Develop | I | A | R | C | C |
| Test | A | I | I | R | I |

R = Responsible A = Accountable C = Consult I = Inform

Networking

- It is constructive way to understand political and interpersonal factors that will impact the effectiveness of various staffing management options.
- Here project manager try to understand which staffing options will be most effective in a particular project
- It includes proactive correspondence, luncheon meetings, informal conversations, and trade conferences.

Organizational Theory

- Information regarding the ways that people, team and Org, units behave.

- Proven principles needed to:
 - ❖ Reduce the time needed for HR planning
 - ❖ Improve the likelihood that the planning will be effective.

9.1 Plan Human Resource Management : Outputs

- Human Resource Plan : the human resource plan , a part of the project management plan, provides guidance on how project human resources should be defined , staffed , managed ,controlled and eventually released .
- The human resource plan should include , but not to be limited to the following
 1. Roles and Responsibilities
 2. Project Organization Chart
 3. Staffing Management Plan

1. Roles and Responsibilities

- **Role:** What a person e.g., Electric Engineer / Procurement officer, is accountable, liable & responsible for, clear authority, responsibilities & boundaries.
- **Authority:** It is the right to apply Project resources, make decisions and sign approvals.

Completing project activities, testing, selection and acceptance, ...are good example of decisions that always need a clear authority.

Roles and Responsibilities, Contd.

- **Responsibility**: The work that a project team member is expected to perform in order to complete the project's activities.
- **Competency**: What skill and capacity required to complete project activities?

Competency can lead to outstanding / jeopardized performance.

What if mismatches are identified? Proactive responses are initiated e.g. training, hiring, outsourcing, schedule changes, or scope changes

2. Project Organization Charts

- A graphic display of project team members and their reporting relationships
- It can be formal or informal
- Highly detailed or broadly framed, based on the needs of the project.

3. Staffing Management Plan

- The staffing management plan is included as part of the project management plan.
- ~~The project~~ how team members will be added to and released from the project.
- How you plan to develop team members.
- A staffing management plan has the following components:
 - ❖ How staff will be acquired
 - ❖ Time table for adding staff using a resource histogram
 - ❖ When and how resources will be released from the project
 - ❖ The training needs of the resources
 - ❖ Recognition and reward systems
 - ❖ How you will comply with any laws, human resource policies, etc.
 - ❖ How resources will be protected from safety hazards

3. Staffing Management Plan

- **Staff Acquisition:** It requires to answer a number of questions e.g.
 - ❖ Will the human resources come from within the organization or from external
 - ❖ Will team members need to work in a central location or from distant locations.

3. Staffing Management Plan, Contd.

- **Resource Calendars** : It describes time frames for acquisition activities e.g. when recruiting should start.

One tool for charting human resources is a resource histogram. Bars that extend beyond the maximum available hours identify the need for a resource leveling strategy, such as adding more resources or extending the length of the schedule.

9.2 Acquire Project team

- Acquire Project team
- 1. It is the process of obtaining the human resources needed to complete the project. The project management team may or may not have control over team members selected for the project .
- ❖ The project manager and the project management team should effectively negotiate and influence others who are in a position to provide the required human resources for the project

9.2 Acquire Project Team (Human Resource Management) [Executing]

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Project Management Plan 2. Enterprise environmental factors 3. Organizational process assets | <ol style="list-style-type: none"> 1. Pre-assignment 2. Negotiation 3. Acquisition 4. Virtual teams | <ol style="list-style-type: none"> 1. Project Staff Assignments 2. Resource calendars 3. Project management plan (updates) |

9.2 Acquire Project Team: Tools & Techniques

➤ 1.Pre-Assignment:

- ❖ Known in advance i.e. pre assigned.
- ❖ Expertise of particular persons
- ❖ Staff assignments are defined within the project charter.

9.2 Acquire Project Team: Tools & Techniques

2.Negotiation: PM team may need to negotiate with:

- ❖ FM to ensure availability of component staff.
- ❖ Other PM teams to assign scarce / specialized resources.

9.2 Acquire Project Team: Tools & Techniques

3.Acquisition:From Internal /External resources. Acquiring from outside may take place due to shortage / lack of staff in-house.

9.2 Acquire Project Team: Tools & Techniques

- 4.Virtual Teams: It is a group (s) of people with a shared goal, who fulfill their roles with little or no time spent meeting face to face.
Electronic communication, Such as e-mail and video conferencing, has made such teams feasible. The virtual team format makes it possible to:
- Communication planning becomes increasingly important in a virtual team environment

9.2 Acquire Project Team: Outputs

1. Project Staff Assignments:

- ❖ The project is staffed when appropriate people have been assigned to work on it
- ❖ Documentation can include a project team directory, memos to team members, and names inserted into other parts of the project management plan, such as project org. charts and schedules.

9.2 Acquire project Team: Outputs

➤ 2. Resource Calendars :

- ❖ It documents the time period each project team member can work on the project.

9.2 Acquire Project Team: Outputs

- 3. Project Management Plan (Updates): as the human resource plan can get updated

The update is always happened because:

- People seldom fit the exact staffing requirements that are planned.
- Promotions, retirements, illness, performance issues, and changing work loads....

AVOID HALO EFFECT

9.3 Develop project team

- It improves the competencies and interaction of team members to enhance project performance. Improve skills of team members. Improve feelings of trust and cohesiveness for productivity through team work.

Main objectives of develop project team are

- Improve knowledge and skills of team members
- Improve feeling of trust among team
- Create a dynamic and cohesive team culture

9.3 Develop Project Team (Human Resources Management) [Executing]

| Inputs | Tools & Techniques | Outputs |
|---|---|--|
| <ol style="list-style-type: none">1. Project staff assignments2. Project Management Plan3. Resource calendars | <ol style="list-style-type: none">1. Interpersonal skills2. Training3. Team-building activities4. Ground rules5. Co-location6. Recognition and rewards | <ol style="list-style-type: none">1. Team performance assessments2. Enterprise environmental factor updates |

9.3 Develop Project Team: Tools & Techniques

- Interpersonal Skills : Interpersonal Skills “soft skills”, are crucial and important for team development.

Skills such as empathy, influence, creativity, and group facilitation are valuable when managing the project team.

9.3 Develop Project Team: Tools & Techniques Contd.

➤ Training:

- ❖ It includes all activities designed to enhance the competencies of the project team members.
- ❖ It can be formal or informal
- ❖ Classroom, online, computer- based, on- the- job training from another project team member, mentoring and coaching are examples of training methods.

9.3 Develop project team: Tools & Techniques, Contd.

➤ 3. Team Building Activities:

- ❖ Such activities can vary from a five minute agenda item in a status, review meeting to an off-site, professionally facilitated experienced designed to improve interpersonal relationships.
- ❖ Developing the WBS, is not designed as team-building activities, but can increase team cohesiveness when what planning activity is structured and facilitated well.
- ❖ Informal communication and activities supported building trust and establishing good working relationships.

9.3 Develop project team: Tools & Techniques, Contd.

➤ 3. Team Building Activities:

One theory states that there are 5 stages of development that the teams may go through. Usually these stages occur in an order .

1. Forming : this phase is where the team meets and learns about the project and what their formal roles and responsibilities are . Team members tend to be independent and not as open in this phase
2. Storming : During this phase , the team begins to address the project work, technical decisions , and the project management approach . If team members are not collaborative and open to differing ideas and perspectives the environment can become destructive

9.3 Develop project team: Tools & Techniques, Contd.

Team Building Activities:

3. Norming : in the Norming phase , team members begin to work together and adjust work habits and behaviors that support the team . The team begins to trust each other
4. Performing : Teams that reach the performing stage function as a well-organized unit . They are interdependent and work through issues smoothly and effectively
5. Adjourning : In the adjourning phase , the team completes the work and moves on from the project .

The duration of a particular stage depends upon the team dynamics , team size, and the team leadership.

9.3 Develop Project Team: Tools & Techniques

➤ 4. Ground Rules:

- ❖ It supports clear expectations regarding acceptable behavior by project team members
- ❖ Early commitment to is highly recommended it decreases misunderstanding and increases productivity.
- ❖ Discussing ground rule allows team members to discover values that are important to one another .

9.3 Develop Project Team: Tools & Techniques

- 5. Co-Location:
 - ❖ Co-location supports working as a team by placing many or all of the most active project team members in the same physical location
 - ❖ It can be temporary, such as at strategically important time during the project, or for the entire project .
 - ❖ Co- location strategy can include a meeting room, sometimes called a war room with electronic communication devices, places to post schedule, to enhance communication and a sense of community
 - ❖ While co- location is considered good strategy, the use of virtual teams will reduce the frequency that team members are located together.

9.3 Develop Project team: Tools & Techniques

➤ 6. Recognition and Rewards

- ❖ Only desirable behavior should be rewarded e.g. the willingness to work overtime to meet an aggressive schedule objective should be rewarded or recognized ; needing to work overtime as a result of poor planning should not be rewarded.
- ❖ Win lose (zero sum) rewards that only a limited number of project team members can achieve such as team members of the month, can hurt team cohesiveness.
- ❖ Rewarding win win behavior that every one can achieve such as turning in progress reports on time, tends to increase support among team members.
- ❖ Recognition and reward should consider cultural differences. For example, developing appropriate team rewards in a culture that encourage individualism can be difficult.

9.3 Develop Project Team: Outputs

1. Team performance Assessments:

PM team makes informal or formal assessment of the project team's effectiveness.

Team assessments can identify training needs

2. Enterprise Environmental Factors Updates

9.4 Manage Project Team

➤ Manage Project Team:

It involves tracking team member performance, providing feedback, resolving issues, and coordinating changes to enhance project performance. It also observes team behavior, manages conflicts, resolves issues, and appraises team members performance.

9.4 Manage Project Team

| Inputs | Tools & Techniques | Outputs |
|--|---|--|
| <ol style="list-style-type: none">1. Project staff assignments2. Project Management Plan3. Team performance assessment4. Performance reports5. Organizational Process Assets | <ol style="list-style-type: none">1. Observation and conversation2. Project performance appraisals3. Conflict management4. Issue log5. Interpersonal Skills | <ol style="list-style-type: none">1. Enterprise Environmental factors updates2. Organizational process assets (updates)3. Change Requests4. Project management plan (updates) |

9.4 Manage Project Team: Tools & Techniques

➤ 1.Observation and conversation

It used to stay in touch with the work and attributes of project team members.

The PM team monitors indicators such as:

- *Progress towards project deliverables*
- *Accomplishment that are a source of pride for team members and interpersonal issues.*

9.4 Manage Project Team: Tools & Techniques

2. Project Performance Appraisal:

This depends on:

- Length & Complexity of the Project
- Organizational Policy
- Labor Contract Requirements
- The amount and quality of regular communication.

❖ 360 Degree Approach

9.4 Manage Project Team: Tools & Techniques

➤ 3. Conflict Management:

- Successful conflicts management results in greater productivity and positive working relationship.
- Sources of conflicts include Scarce resources, scheduling priorities, and personal work style.
- Conflicts may reduce by team ground rules, group norms and solid project management practices like communication planning and role definition.
- When the differences become a negative factor project team members are initially responsible for resolving their own conflicts.
- If escalated the project manager should help facilitate a satisfactory resolution.
- Conflict should be addressed and usually in using a direct collaborative approach. If descriptive conflicts continuously increasing formal procedures will need to be used including the possible use of disciplinary actions.

9.4 Manage Project Team: Tools & Techniques

- **Conflict Management:** When handling conflict in a team environment , project managers should recognize the following characteristics of conflict and the conflict management process :
 - ❖ Conflict is natural and forces a search for alternatives
 - ❖ Conflict is a team issue
 - ❖ Openness resolves conflicts
 - ❖ Conflict resolution should focus on issues , not personalities , and
 - ❖ Conflict resolution should focus on the present , not the past

9.4 Manage Project Team: Tools & Techniques

➤ 3. Conflict Management:

Different Project Managers may have different conflict resolution styles .Factors that influence conflict resolution methods include :

- ❖ Relative importance and intensity of the conflict
- ❖ Time pressures for resolving the conflict
- ❖ Position taken by the players involved
- ❖ Motivation to resolve conflict on a long term or a short term basis

Seven sources of conflict

- Schedules
- Project Priorities
- Resources
- Technical Opinions
- Administrative Procedure
- Cost
- Personality

1. Is conflict bad?
2. Should we spend time preventing the root causes of conflict?
3. Who should resolve the conflict?

9.4 Manage Project Team: Tools & Techniques

There are six general techniques for resolving conflict .

1. Problem solving / Confronting : Resolving the root cause of issue. Win-Win strategy and best solution
2. Forcing : pushing one's viewpoint at the expense of others ;offers only win-lose solutions (Do it my way)
3. Compromising: searching for solutions that bring some degree of satisfaction to all the parties. Loose-loose condition. (Lets implement some part of your suggestion and his suggestion also)
4. Smoothing/Accommodating : emphasizing areas of agreement rather than areas of difference (Your disagreement may cause delay and lets get in to an agreement)
5. Withdrawal/Avoiding :retreating from an actual or potential conflict situation (Lets deal with this by next meeting)

9.4 Manage Project Team: Tools & Techniques

4. Issue log

- ❖ As issues arise a written log can document persons responsible for resolving specific issues by a target date.
- ❖ The log helps the Project team monitor issues until closure
- ❖ Issue resolution addresses obstacles that can block the team from achieving its goals.

9.4 Manage Project Team: Tools & Techniques

5. Interpersonal Skills : Project managers use a combination of technical , human and conceptual skills to analyze situation and interact appropriately with the team members . Some of the interpersonal skills that a project managers use most often are the following :

- ❖ Leadership (setting goals and motivating others to achieve it)
- ❖ Influencing (Influence people to do work in a matrix organization)
- ❖ Effective Decision making

9.4 Manage Project Team: Outputs

1. Enterprise Environmental Factors Updates
2. Organizational Process Assets Updates
3. Change Requests
4. Project Management Plan Updates

Project Communication Management

Project Communications Management Processes

- Project manager is primarily responsible for communication
- Major source of problems in projects arise due to poor communication
- Communication shall be appropriately timed
- PM shall emphasize on communications which will result in positive outcomes rather than information dumping.

10.1 Plan Communication Management

- The Plan Communications process involves determining the communication needs of the stakeholders by defining
 - ❖ the types of information needed
 - ❖ the format for communicating the information,
 - ❖ how often it's distributed, and
 - ❖ who prepares it.
- Communication planning includes communication within project, outside project and within project management team members.
- Plan communication shall be done as early as possible in project
- Shall concentrate on right information given at right format at right time

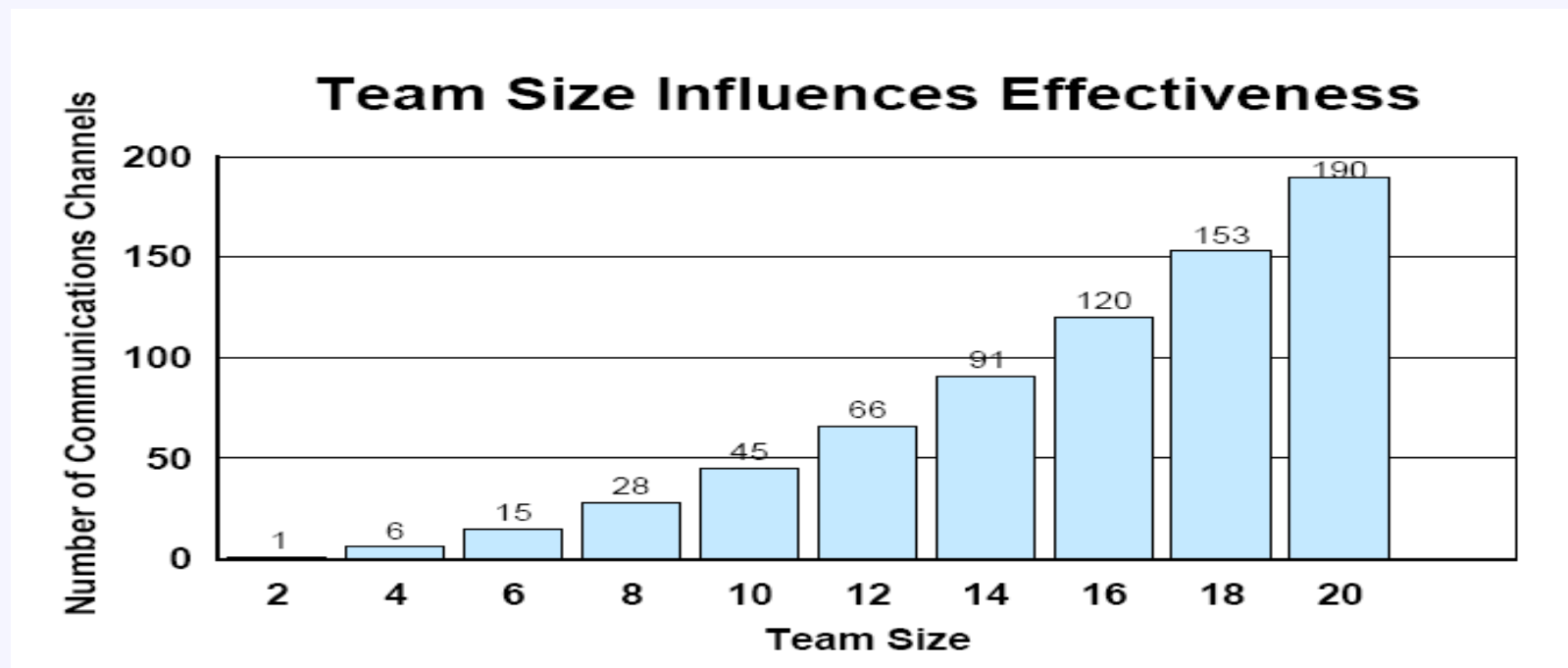
10.1 Plan Communication Management

| Inputs | Tools & Techniques | Outputs |
|--|--|--|
| <ol style="list-style-type: none"> 1. Enterprise environmental factors 2. Organizational process assets 3. Stakeholder Register 4. Stakeholder management strategy | <ol style="list-style-type: none"> 1. Communications requirements analysis 2. Communications technology 3. Communication models 4. Communication methods | <ol style="list-style-type: none"> 1. Communications management plan 2. Project document updates |

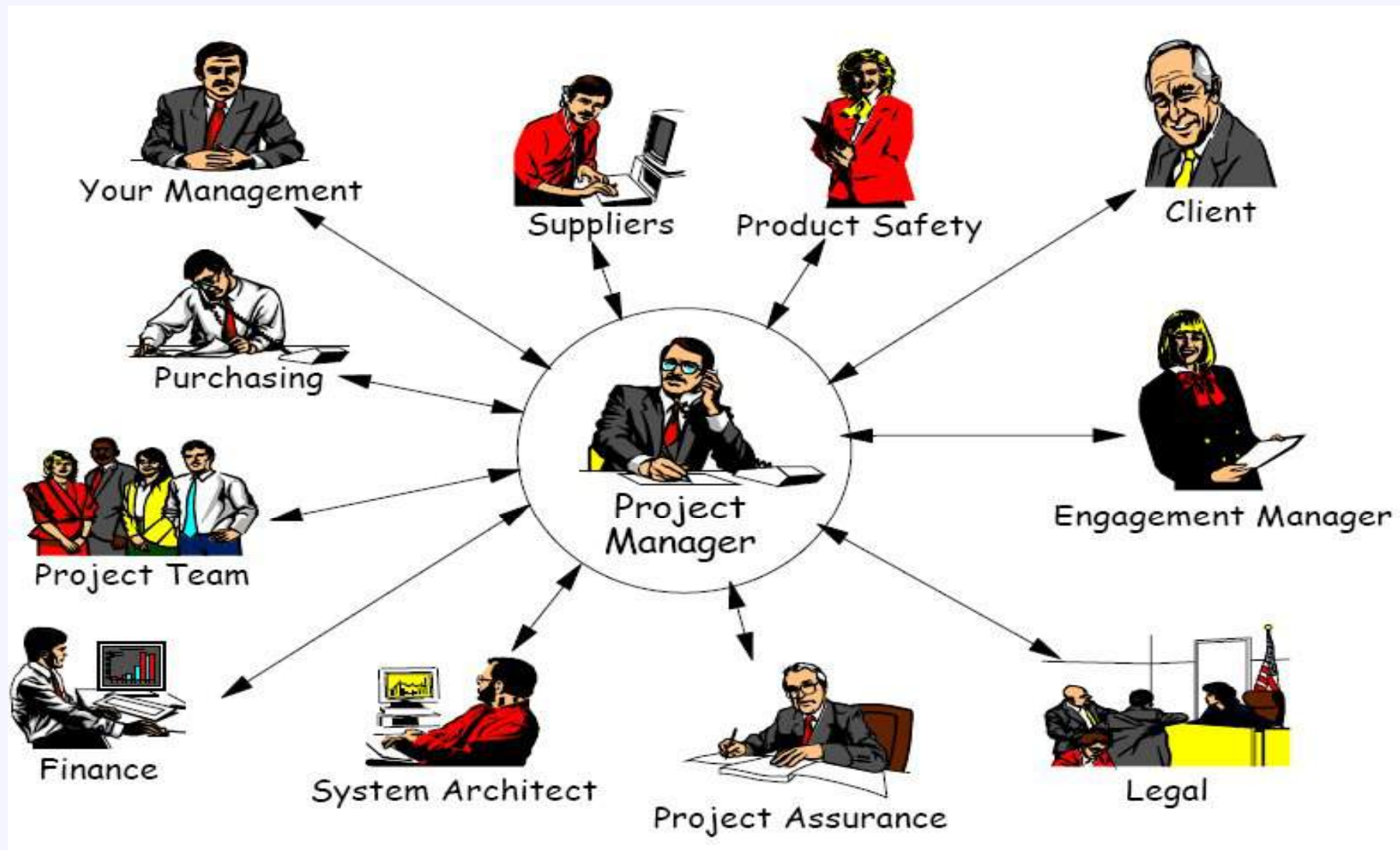
10.1 Plan Communication Management : Tools & Techniques

1. Communication Requirement Analysis

- ❖ **Complexity of communication channels** – A project with “N” number of stakeholders have $N(N-1)/2$ possible channels of communications



Determine and Limit Communication channels



Communication Requirement Analysis

- A key component is communication planning is to determine who will communicate with whom and who will receive what information.
- Project resources shall expended only on communicating information that contributes to success, or where a lack of information can lead to failure.
- This does not mean that bad news shall not be communicated, but concentrate on efforts that lead to success rather than information dumping.

10.1 Plan Communication Management :Tools & Techniques

2. Communication Technology

- ❖ As part of the communications planning, the project manager should identify all of the required and approved methods of communicating.
- ❖ Communication modalities can also include meetings, reports, memos, e-mails, and so on.
- ❖ The project manager should identify which are the preferred methods of communicating based on the conditions of the message to be communicated.

Communication Technology

- Consider the following, which may have an effect on the communication plan:
 - ❖ Urgency of the information
 - ❖ Technology
 - ❖ Project staffing
 - ❖ Project length
 - ❖ Project environment

10.1 Plan Communication Management : Tools & Techniques

2. Communication Models :

- ❖ Encode – Translate thoughts or ideas into a language that understood by others
- ❖ Message and feedback message – The output of encoding
- ❖ Medium – The method used to convey the message
- ❖ Noise – Anything that interfaces with the transmission and understanding of message (Distance, unfamiliar technology etc)
- ❖ Decode – To translate message back into meaningful thoughts or ideas

10.1 Plan Communication Management : Tools & Techniques

2. Communication Methods :

- **Interactive communication** - Between two or more parties in multidirectional (Phone calls, meetings, interviews). Most effective way.
- **Push communication** - Sent a specific information to specific recipients. Examples are letters, memos, e-mails, faxes etc. This ensures that message is sent but will not certify that it is actually received or understood. (Push the message to recipient)
- **Pull communication** – Used for large volume of information and large audiences. Examples are internet sites, company data bases, e-learning etc. Recipients has to access the communication content (Pull out information) at their own discretion.

10.1 Plan Communication Management : Outputs

1. **Communication Management Plan** : Based on stakeholder analysis, the project manager and the project team can determine what communications are needed.

- The communications management plan documents
 - ❖ How the communication needs of the stakeholders will be met,
 - ❖ The types of information that will be communicated,
 - ❖ Who will communicate it,
 - ❖ Who receives the communication,
 - ❖ The methods used to communicate,

10.1 Plan Communication Management : Outputs

2. Project Document Updates :

- Documents that may get updated include, but not limited to :
 - ❖ Project schedule
 - ❖ Stakeholder register
 - ❖ Stakeholder management strategy

10.2 Manage Communications

Manage Communications is the process of creating, collecting, distributing, storing, retrieving, and the ultimate disposition of project information in accordance to the communications management plan. The key benefit of this process is that it enables an efficient and effective communications flow between project stakeholders.

10.2 Manage Communications

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ul style="list-style-type: none"> .1 Communications management plan .2 Work performance reports .3 Enterprise environmental-factors .4 Organizational process assets | <ul style="list-style-type: none"> .1 Communication technology .2 Communication models .3 Communication methods .4 Information management systems .5 Performance reporting | <ul style="list-style-type: none"> .1 Project communications .3 Project management plan updates .2 Project documents updates .4 Organizational process assets updates |

10.2 Manage Communications – Tools & Techniques

4. Performance reporting: is the act of collecting and distributing performance information, including status reports, progress measurements, and forecasts. Performance reporting involves the periodic collection and analysis of baseline versus actual data to understand and communicate the project progress and performance as well as to forecast the project results.

10.2 Manage Communications - Outputs

1. Project Communications

The Manage Communications process involves the activities that are required for information to be created, distributed, received, acknowledged, and understood. Project communications may include but are not limited to:

performance reports, deliverables status, schedule progress, and cost incurred.

Project communications can vary significantly and are influenced by factors such as, but not limited to, the urgency and impact of the message, its method of delivery, and level of confidentiality.

10.3 Control Communications

Control Communications is the process of monitoring and controlling communications throughout the entire project life cycle to ensure the information needs of the project stakeholders are met. The key benefit of this process is that it ensures an optimal information flow among all communication participants, at any moment in time.

10.3 Control Communications

| Inputs | Tools & Techniques | Outputs |
|---|--|--|
| <ul style="list-style-type: none"> .1 Project management plan .2 Project communications .3 Issue log .4 Work performance data .5 Organizational process assets | <ul style="list-style-type: none"> .1 Information management systems .2 Expert judgment .3 Meetings | <ul style="list-style-type: none"> .1 Work performance information .2 Change requests .3 Project management plan updates .4 Project documents updates .5 Organizational process |

10.3 Control Communications: Tools & Techniques

- .1 Information management systems
- .2 Expert judgment
- .3 Meetings

Exam Points

- One of the major purpose of communication is stakeholder management
- PM spends most of time communicating (Integration is achieved through communications
- Communication becomes difficult in Matrix / Functional organization and when virtual teams are used
- Noise is the biggest issue when multi cultural / multi language teams are involved.

Project Risk Management

Aim

Understand

- Processes in risk management
- How to plan risk management
- How to identify risk and plan response to the identified risk
- How to analyze risk for qualitatively and quantitatively
- Decision tree analysis and risks associated with various contracts

Risk Management - Definitions

- Risk is an uncertain event or condition that, if it occurs, has an effect on at least one of the project objectives
- Uncertainty and associated risks are always on FUTURE. When a risk happens, then it may be called an event or issue.
- ❖ There is 25% chance that a person may develop cancer. It is an uncertain event and a risk.
- ❖ If a person develops cancer, it is no longer a risk, but a health issue. Now the uncertainty became certain.
- Uncertainty of risk assessment may change over time when more and more details are available.
- ❖ If the person get infected by HIV, risk of him dying from cancer becomes lower and risk of dying from AIDS become higher.

Risk Management - Definitions

- **Known Risks** – Project management team is aware of this risks and can be analyzed. Also called known unknowns or uncertain risks.
- **Un-Known Risks** – Project management team is aware of this risks and can be analyzed. Also called unknown unknowns or uncertain risks.
- The new food developed contains gluten and result in claims related to gluten allergy (known risk). Product label shall contain warning against any possible allergy.
- Heavy rain and tornado in Baltimore delayed shipment of cooling tower. This is an unknown risk and team can not effectively develop a response plan.
- **Negative Risks or Threats** – If occurs will negatively affect objectives
- **Positive Risks or Opportunities** - If occurs will positively affect objectives

Risk Management - Definitions

- Organizations and stakeholders have different approach towards risks. Some organizations or stakeholders are willing to accept risks for the return or some not. This is called Risk Tolerances.
- To be successful, individuals or organizations must explicitly express the attitude towards risks and all communications about risks and its handling shall be open and honest.
- Project manager normally identify stakeholder risk tolerance levels during stakeholder analysis and try to ensure all risk handlings are done according to this.

Project Risk Management Processes

1. **Plan Risk Management** : deciding how to approach and plan the risk management activities for the project
2. **Identify Risks** : determining which risks are likely to affect a project and documenting the characteristics of each
3. **Perform Qualitative risk analysis**: prioritizing risks for further analysis or action based by assessing and combining their probability of occurrence and impact
4. **Perform Quantitative risk analysis**: numerically estimating the effects of the identified risks on overall project objectives
5. **Plan Risk Responses**: taking steps to enhance opportunities and reduce threats to meeting project objectives
6. **Control Risks** : the process of implementing risk response plans , monitoring identified and residual risks, identifying new risks, and evaluating the effectiveness of risk strategies throughout the life of the project

11.1 Plan Risk Management

| Inputs | | Tools & Techniques | Outputs |
|--------|----------------------------------|-----------------------------------|-------------------------|
| 1. | Enterprise environmental factors | 1. Planning meetings and analysis | 1. Risk management plan |
| 2. | Organizational process assets | | |
| 3. | Project scope statement | | |
| 4. | Cost management plan | | |
| 5. | Schedule Management Plan | | |
| 6. | Communications Management Plan | | |

Planning for Risk Management

- Project management team decides how to approach risks, how the risk will be handled and monitored in the project.
- All policies related to risk management will be decided now
- Decisions on up to which level of rigorousness shall be applied to risk activities
- All templates and formats for risk activities will be prepared here.
- Remember, team is just planning how to approach risk. This planning shall be done as early as possible.
- All further risk activities shall comply with this management plan unless changed through change management plan.

11.1 Plan Risk Management : Tools & Techniques

1. Planning Meetings and Analysis

- Team conducts meeting with various stakeholders to develop plan how to handle risks for a specific project
- Attendees should include: The project manager, project team leaders, key stakeholders, personnel specific to risk management or simply ALL.

Team will now decide

- What risk management activities shall be included in schedule and budget for that
- What templates shall be used for this project
- Define how to calculate contingency reserves and how to apply it
- Define risk related terms specific for the project like, impact of risk, probability of risk.
- All these decisions are summarized and recoded in **Risk Management Plan**

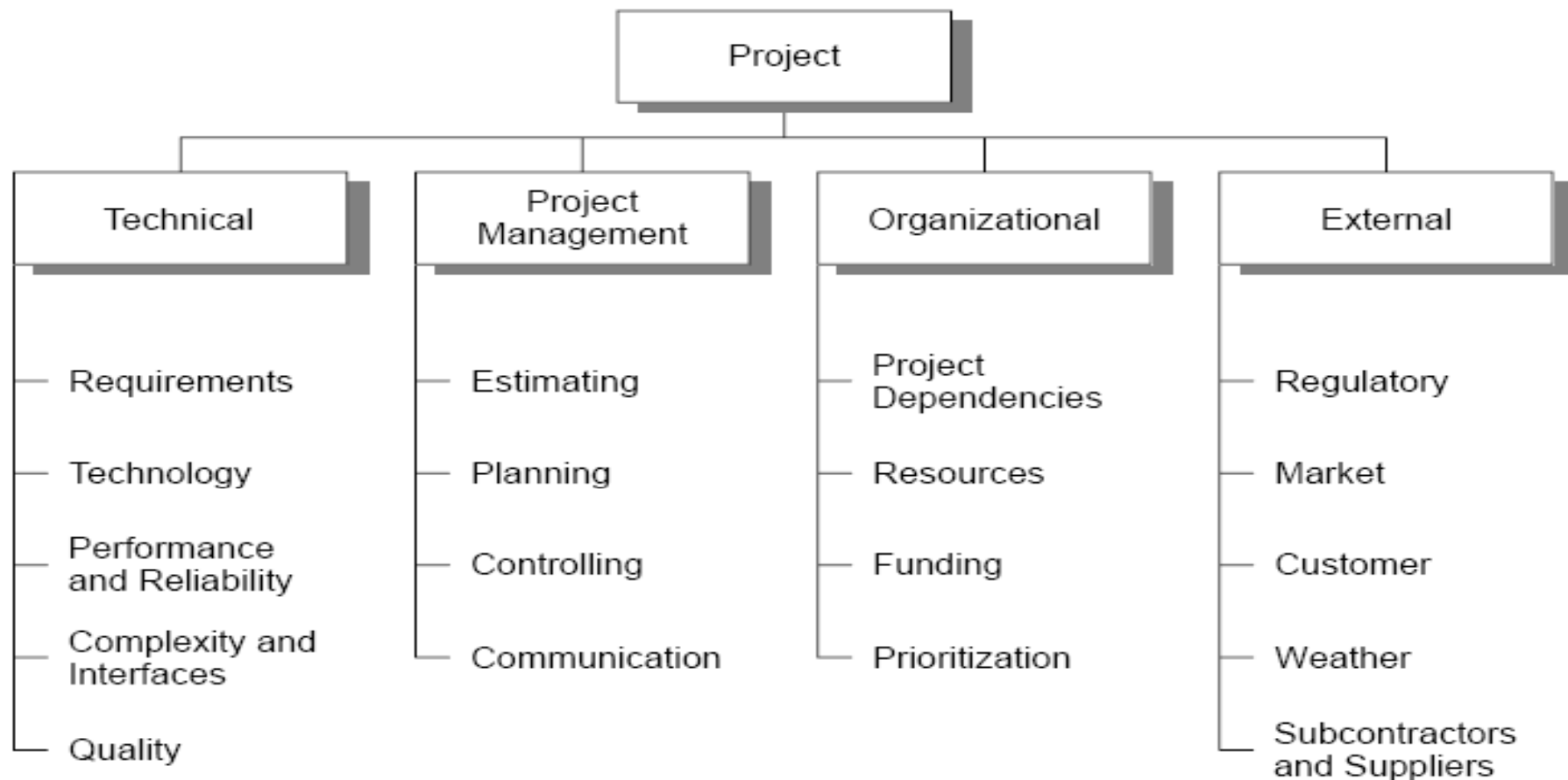
11.1 Plan Risk Management : Output

1. Risk Management Plan

- Methodology (Approach)
- Roles and responsibilities (Who will do what)
- Budget and schedule (Include activities for risk management in schedule and cost - Remember this is not contingency reserve but only cost associated with risk management activities)
- Risk categories (Different categories of risks associated with the specific risks are identified and arranged using Risk Break Down Structure (RBS))

RBS

Provides a structure for identifying Risk Categories



11.1 Plan Risk Management : Output

- Team Defines Risk probability and impact terms for the project.
- General levels of probability and impact scales are defined now for use in qualitative analysis later.
- Example for Impact on Cost
 - ❖ High – If more than 10%
 - ❖ Medium – From 5% to 10%
 - ❖ Low – Less than 5%

11.1 Plan Risk Management : Output

- Timing - Team defines timing of risk activities and how often this shall be carried out. For example,
 - ❖ Risk iterations shall be carried out at beginning of all phases
 - ❖ Identification of new risks shall be carried out at prior to appointment of any subcontractor.
 - ❖ A monthly review of risks shall be carried out irrespective of above.
- Revised Stakeholder's Tolerances – Stakeholders risk tolerances may change now and hence recorded in Risk Management Plan, if necessary.
- Reporting Formats – Team decides what kind of formats to be used for risk reporting

11.2 Identify Risks

- Now the plan is ready, team proceed with identification of all possible risks to project.
- Project manager, team, SME, Stakeholders etc contribute to risk identification (ALL can contribute to risk identification)
- Identified risks are documented for its characteristics for further analysis.
- Identification and documentation of risks (Like RBS) shall follow the procedure and format decided by team in Risk Management Plan.
- Risk identification is an iterative process, since new risks can evolve during project progress.
- Identified risks are documented in Risk Register and from now onwards, Risk Management Plan and Risk Register are the basis of all further risk analysis.

11.2 Identify Risks

| Inputs | Tools & Techniques | Outputs |
|--|---|--|
| <ol style="list-style-type: none"> 1. Enterprise environmental factors 2. Organizational process assets 3. Risk management plan 4. Activity Cost Estimates 5. Activity Duration Estimates 6. Scope baseline 7. Stakeholder register 8. Cost management Plan 9. Schedule management plan 10. Quality management plan 11. Project documents | <ol style="list-style-type: none"> 1. Documentation reviews 2. Information gathering techniques 3. Checklist analysis 4. Assumptions analysis 5. Diagramming techniques 6. SWOT analysis 7. Expert Judgement | <ol style="list-style-type: none"> 1. Risk register |

11.2 Identify Risks : Inputs

1. Risk Management Plan :The risk management plan is one of the key inputs to the risk identification process.
2. Activity Cost Estimates (Assumptions, Errors)
3. Activity Duration Estimates (Assumptions, Errors)
4. Scope Baseline (Project Assumptions & WBS)
5. Stakeholder Register
6. Cost Management Plan
7. Schedule Management Plan
8. Quality Management Plan

11.2 Identify Risks : Inputs

9. **Project Documents** : that can be useful in this process, include , but are not limited to :

- ❖ Assumptions Log
- ❖ Work performance reports
- ❖ Earned value reports
- ❖ Network diagrams, baselines and other project information proven to be valuable in identifying risks

10. **Enterprise Environmental Factors** : include, but are not limited to :

- ❖ Published information, academic studies, published checklists ,benchmarking, industry studies, and risk attitudes

11. **Organizational Process Assets** : Project files ,organizational and project process controls, Risk statement templates, and lessons learned .

11.2 Identify Risks – Tools & Techniques

1. Reviewing Project Documents

- ❖ The project plan, scope, and other project files should be reviewed.
- ❖ Constraints and assumptions should be reviewed, considered, and analyzed for risks.
- ❖ This structure review takes a very broad look at the project plan, the scope, and the activities defined within the project.

11.2 Identify Risks – Tools & Techniques

2. Information Gathering Techniques

- Brainstorming
- Delphi Technique
- Interviewing
- Root Cause Analysis

Brainstorming the Project

- Brainstorming is likely the most common approach to risk identification.
- It's usually completed together as a project team to identify the risks within the project.
- A multidisciplinary team, hosted by a project facilitator, can also complete brainstorming.
- This approach can include subject matter experts, project team members, customers, and other stakeholders who contribute to the risk identification process.

Using the Delphi Technique

- The Delphi Technique is an anonymous method to query experts about foreseeable risks within a project, phase, or component of a project.
- A facilitator uses questionnaire to obtain ideas about risks from the participants
- The responses are summarized and re-circulated to the experts for further comments.
- Consensus may be reached in a few rounds

Identifying Risks - Tools

- **Interviewing** - subject-matter experts and project stakeholders is an excellent approach to identifying risks on the current project based on the interviewee's experience.
- **Root cause analysis** - is a specific technique to identify a problem, discover the underlying causes that lead to it, and develop a preventive action.

3. Checklists Analysis :

1. Risk checklists can be developed based on historical information and knowledge that has been accumulated from previous similar projects and from other sources of information .
2. The lowest level of RBS can also be used as a checklist

4. Assumptions Analysis

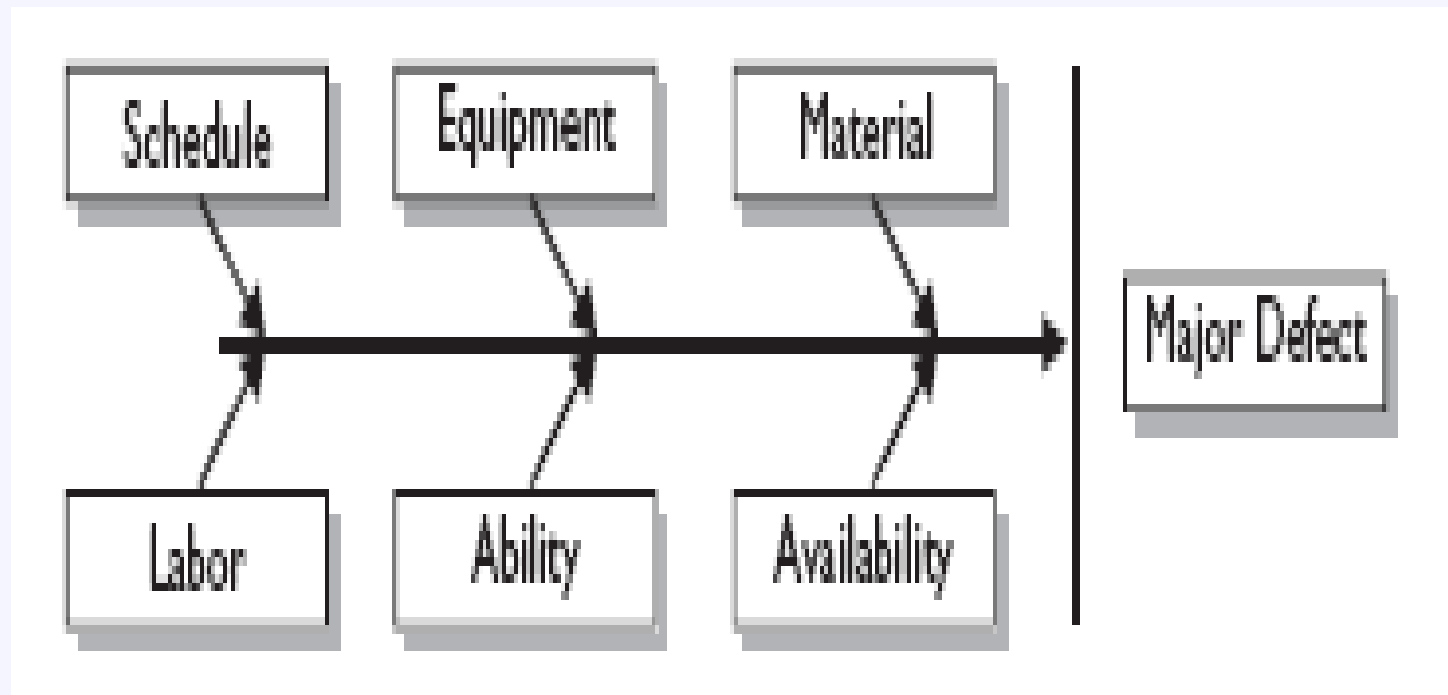
- Assumption analysis is the process of examining the assumptions to see what risk may stem from false assumptions.
- Examining assumptions is about finding the validity of the assumptions.

5. Diagramming Techniques

- There are several diagramming techniques that can be utilized by the project team to identify risks:
 - ❖ Cause and Effect or Ishikawa or Fishbone diagram
 - ❖ Flow charts
 - ❖ Influence diagrams

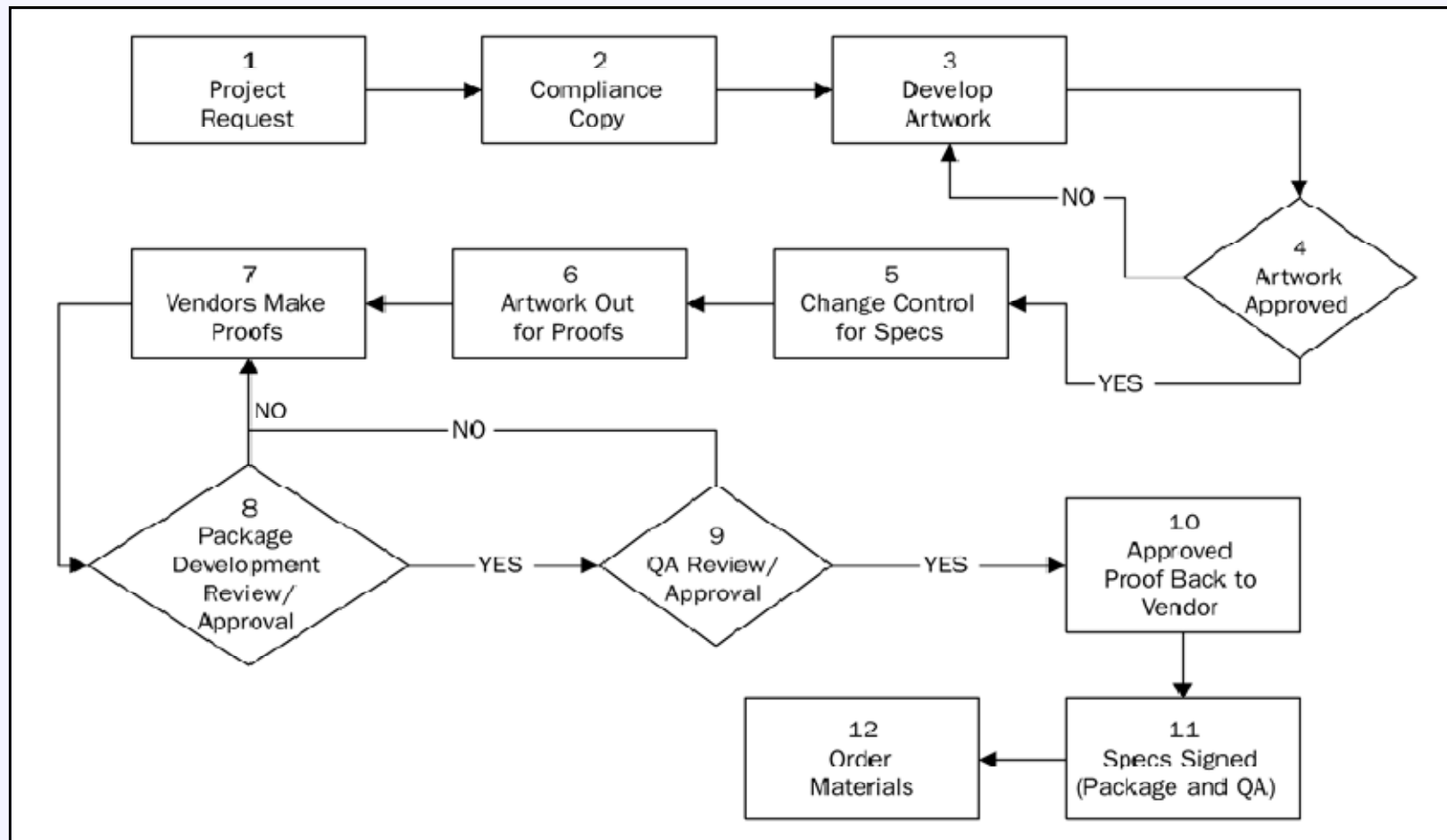
5. Diagramming Techniques

- Cause and Effect or Ishikawa or Fishbone diagram



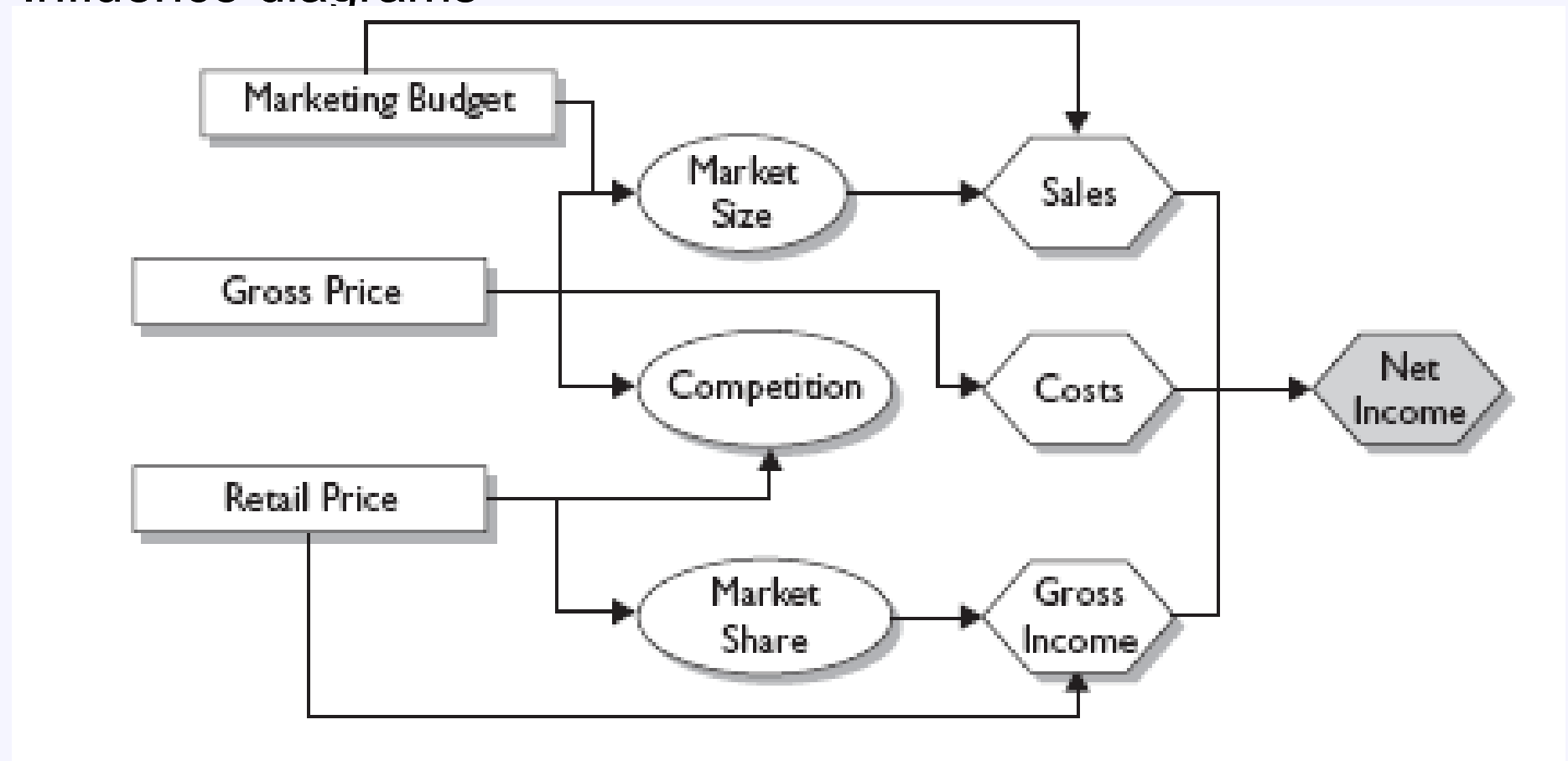
5. Diagramming Techniques

➤ Flow charts



5. Diagramming Techniques

➤ Influence diagrams



6. Analyzing SWOT

SWOT means strengths, weaknesses, opportunities, and threats.

SWOT analysis for introduction of new technology

- **Strengths** : the technology to be installed in the project has been installed by other large companies in our industries
- **Weaknesses**: we have never installed this technology before and no experienced personnel.
- **Opportunities**: the new technology will result in major time saving
- **Threats**: the time to complete the training and finding faults in the processes during implementation.

11.2 Identify Risks - Output

Risk Register

- The primary output of the risk identification process are initial entries to the risk register.
- Risk Register is not completed now and only the skeleton is formed. Risk Register will get detailed and updated through other processes in Risk.
- Risk Register at this stage may contain
 - ❖ List of identified risks
 - ❖ Characteristics of identified risks (at high level)
 - ❖ List of potential responses (In normal case responses are prepared later however an experienced person can identify possible responses now only)

11.3 Perform Qualitative Risk Analysis

- It may not be feasible or necessary for organizations to put same efforts for all risks identified. We need to prioritize now where to concentrate at a given time.
- Risks are analyzed to determining what impact the identified risks will have on the project objectives and the probability they'll occur.
- By doing so team can rank the risks in priority order according to their effect on the project objectives. Organizations now can achieve better results by concentrating of high-priority risks.
- Team now determines if Quantitative Risk Analysis should be performed or if you can skip right to developing response plans.
- Risks with lower rating may not qualify for further analysis.

11.3 Perform Qualitative Risk Analysis

| Inputs | | Tools & Techniques | Outputs |
|--------|-------------------------------|---|----------------------------|
| 1. | Organizational process assets | 1. Risk probability and impact assessment | 1. Risk register (updates) |
| 2. | Project scope statement | 2. Probability and impact matrix | |
| 3. | Risk management plan | 3. Risk data quality assessment | |
| 4. | Risk register | 4. Risk categorization | |
| | | 5. Risk urgency assessment | |
| | | 6. Expert Judgement | |

11.3 Perform Qualitative Risk Analysis – Tools & Techniques

- The Qualitative Risk Analysis process includes the following tools and techniques:
 - ❖ Risk probability and impact assessment
 - ❖ Probability and impact matrix
 - ❖ Risk data quality assessment
 - ❖ Risk categorization
 - ❖ Risk urgency assessment

Risk Probability and Impact Assessment

- This tool and technique assess the probability that the risk events you've identified will occur and it determines the effect their impacts have on the project objectives, including time, scope, quality, and cost.
- Analyzing risks in this way allows you to determine which risks require the most aggressive management.

Risk Probability and Impact Assessment

➤ Probability

- ❖ *Probability* is the likelihood that an event will occur. The classic example is flipping a coin.
- ❖ There is a .50 probability of getting heads and a .50 probability of getting tails on the flip.

➤ Impact

- ❖ Impact is the amount of pain (or the amount of gain for positive risks) the risk event poses to the project.
- ❖ The risk impact scale can be a relative scale that assigns values such as high-medium-low (or some combination of these) or a numeric scale known as a cardinal scale.

Risk Impact Scale

| Objectives | Low-Low | Low | Medium | High | High-High |
|------------|-----------------------|-------------------------|---|----------------------|------------------------|
| | 0.05 | 0.20 | 0.40 | 0.60 | 0.80 |
| Cost | No significant impact | Less than 6% increase | 7–12% increase | 13–18% increase | More than 18% increase |
| Time | No significant impact | Less than 6% increase | 7–12% increase | 13–18% increase | More than 18% increase |
| Quality | No significant impact | Few components impacted | Significant impact requiring customer approval to proceed | Unacceptable quality | Product not usable |

Results of Probability and Impact Assessment

- Risks now rated according to the definitions given in Risk Management Plan
- A relative ranking of risks created
- Team now decides whether risks with high ranking need Quantitative analysis.
- Risks with low ratings of probability and impact will be included in a **Watchlist.**
- Team shall periodically review the watchlist (normally as per timing given in Risk Management Plan) since risks with low rating may become critical in future.

Probability and Impact Matrix

- Risks are now arranged in a matrix for further analysis as per the probability and impact assessment.
- The combination of probability and impact results in a classification usually expressed as high, medium, or low priority. This shall be as per earlier decisions taken while preparing Risk Management Plan.
- Organizations normally have defined parameters for risk probability and impact rating and thresholds however team normally tailor it for specific project during creation of Risk Management Plan.
- Organizations can give weightage for any specific parameter/s (Normally Scope, Cost, Quality and Time) in definition of score.

Sample Probability and Impact Matrix

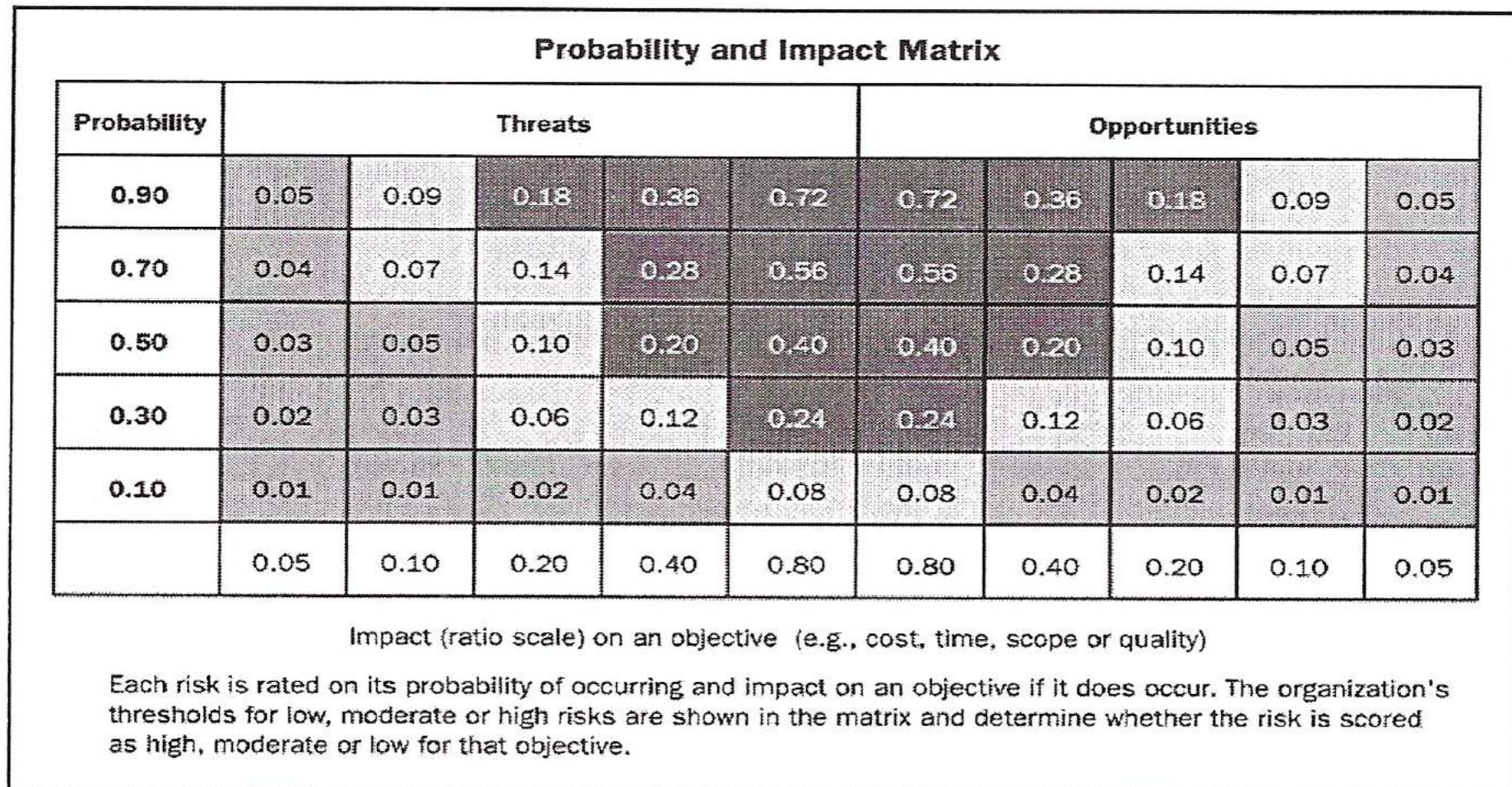


Figure 11-8. Probability and Impact Matrix

How to read Probability and Impact Matrix

- It creates a lookup table showing rating of the risks
- It can develop an over rating for risks and rating can reflect organizations preference for one objective or another.
- Risks that falls in the high priority areas may need priority response and more aggressive response plan
- Opportunities that falls in high risk areas need more attention as that can contribute more benefits
- Risks and opportunities that fall in low may not require proactive response plan and can be placed in the Watchlist for future analysis.

Risk Data Quality Assessment

- The participants in the risk identification and analysis may be biased and this may have impact on risk data collected
- Mistakes in risk data collection can lead to wrong analysis and assessment
- Team here analyze risk data collected for accuracy, quality, reliability and integrity
- If found not satisfactory, a new data shall be collected for analysis

Risk Categorizations

- Identified risks can be categorized in many ways
 - ❖ Categorization using RBS – Risks are categorized according to source of risks as identified in RBS
 - ❖ Categorization Using WBS – If risks are categorized according to WBS, it will show which part of project will be most affected by a particular risk if it happens.
 - ❖ Using Project Phase – This will show which project phase will be mostly affected if risk turns to an issue.

Risk Urgency Assessment

- Risks that may happen soon may require an urgent attention
- Following factors are considered to decide urgency of risk
 - ❖ How much time it will take for risk response plan to be effective
 - ❖ Symptoms or warning signs that one particular risk is going to happen
 - ❖ Risks with higher rating normally need urgent attention

11.3 Perform Qualitative Risk Analysis - Output

Risk Register (update)

- Initial entries in risk register after risk identification process are now updates
- You'll update the register with the following information:
 - ❖ Risk ranking (or priority) for the identified risks
 - ❖ Risks grouped by categories
 - ❖ List of risks requiring near-term responses
 - ❖ List of risks for additional analysis and response
 - ❖ Watch list of low-priority risks
 - ❖ Trends in Qualitative Risk Analysis results

11.4 Perform Quantitative Risk Analysis

- Team made the plan for risk management, identified the risks and analyzed the risks qualitatively and provided a rating for risks.
- Team now perform Quantitative Risk Analysis for Risks that has been prioritized in qualitative risk analysis.
- Qualitative analysis provided a relative ranking or rating for the risks and Quantitative risk analysis will provide a numerical figure for impact. This figures are taken into considerations during project decisions considering risk.
- Quantitative risk analysis is usually very lengthy and difficult and hence done for only high priority risks. Low priority risks are kept in watchlist and may qualify for quantitative analysis in future. That is why, a careful periodic review of risk watchlist is necessary.

11.4 Perform Quantitative Risk Analysis

- The Quantitative Risk Analysis process can follow either the Risk Identification process or the Qualitative Risk Analysis process.
- Process of Quantitative Risk analysis shall be repeated after preparation of risk response plan and during monitoring and controlling to make sure that project decisions have reduced overall risk rating for the project or to identify any new risks.

11.4 Perform Quantitative Risk Analysis

| Inputs | Tools & Techniques | Outputs |
|---|--|--|
| <ol style="list-style-type: none"> 1. Organizational process assets 2. Risk management plan 3. Risk register 4. Project management plan <ul style="list-style-type: none"> . Project schedule management plan . Project cost management plan | <ol style="list-style-type: none"> 1. Data gathering and representation techniques 2. Quantitative risk analysis and modelling techniques 3. Expert Judgement | <ol style="list-style-type: none"> 1. Risk register (updates) |

11.4 Perform Quantitative Risk Analysis – Tools & Techniques

1. Data Gathering and Representation Techniques

➤ Interviewing

- ❖ Project team members, stakeholders, and subject matter experts are prime candidates for risk interviews.
- ❖ Normally experts are asked to provide their optimistic, most likely and pessimistic estimates. Probability distribution is a powerful tool to represent and analyze expert judgments and type and quantity of data collected will depend upon which probability distribution is used.

Data Gathering and Representation Techniques

➤ Probability Distributions

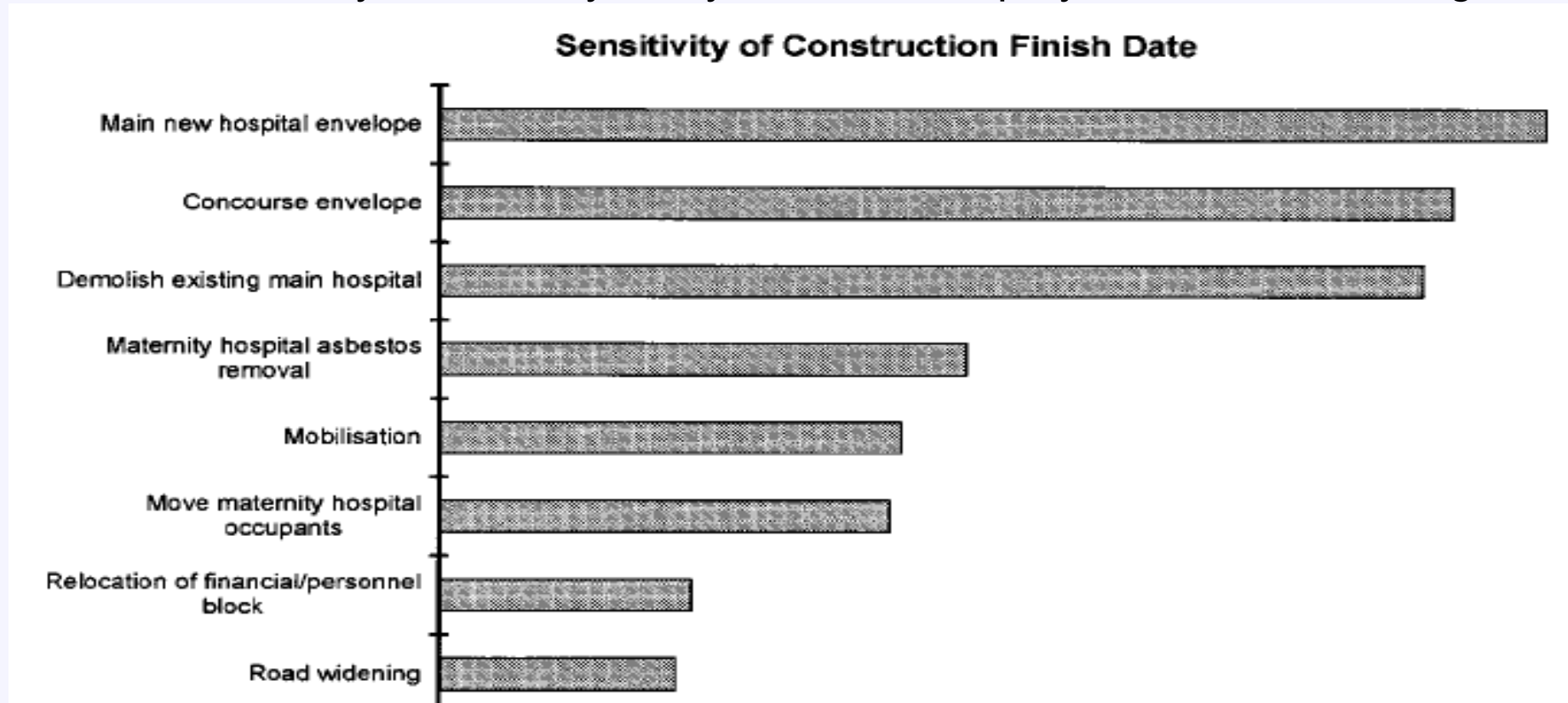
- ❖ A complete study of probabilistic distribution may not be required for PMP exam point of view but shall identify the following distributions and use of them
- ✓ Triangle distribution
- ✓ Beta (PERT) distribution
- ✓ Uniform distribution
- ✓ Discrete distribution

Quantitative Risk Analysis and Modeling Techniques

- There are four techniques encompassed in this tool and technique:
 1. Sensitivity Analysis,
 2. Expected Monetary Value Analysis,
 3. Decision Tree Analysis
 4. Modeling And Simulation.

Sensitivity Analysis

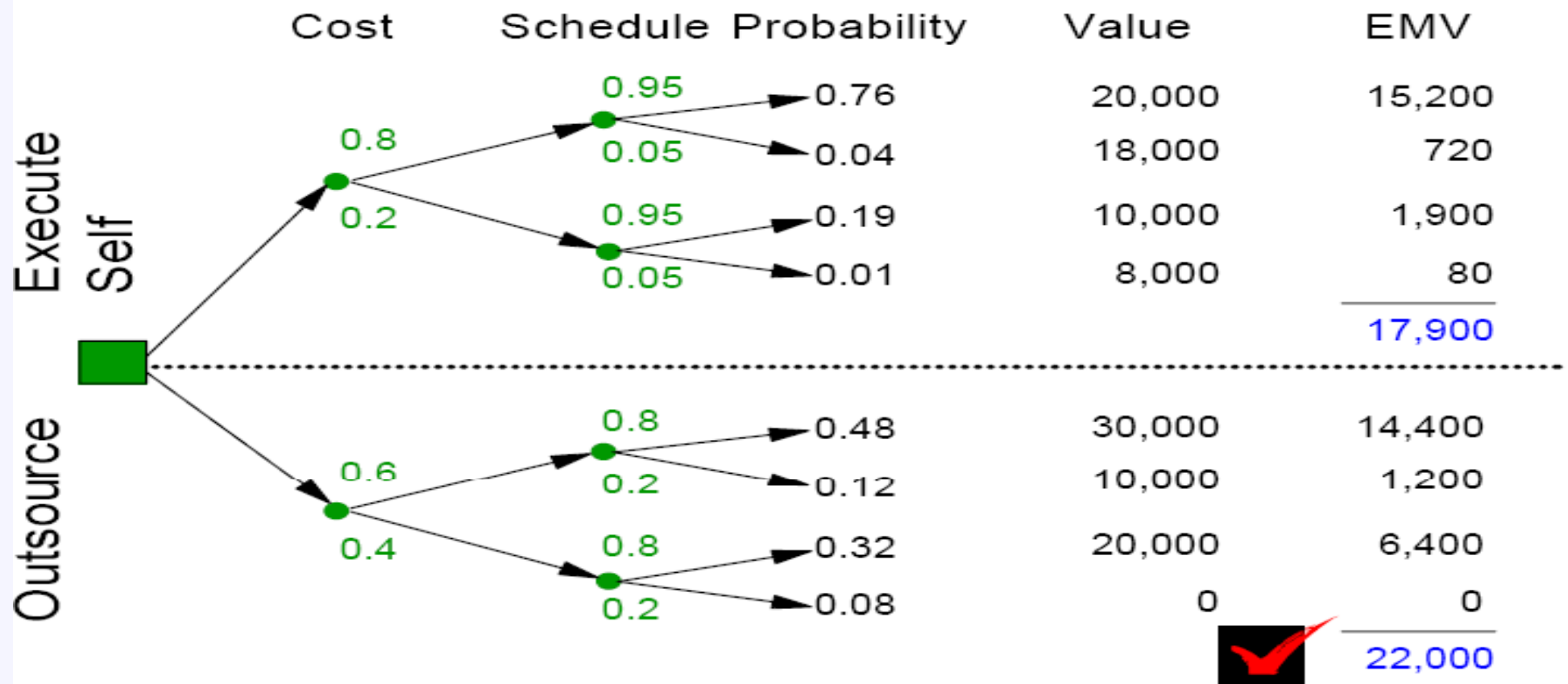
- Sensitivity analysis is a method of analyzing the potential impact of risk events on the project and determining which risk has the greatest potential for impact. All other risks are kept at the baseline while analyzing one risk
- One of the ways sensitivity analysis data is displayed is a *tornado diagram*.



Expected Monetary Value (EMV) Analysis

- Expected monetary value (EMV) analysis is a statistical technique that calculates the average, anticipated impact of the decision.
- EMV is calculated by multiplying the probability of the risk times its impact and then adding them together.
- For example, one risk may cost the project an additional \$10,000 if it occurs, but there's only a 20-percent chance of the event occurring.
- In the simplest form, the expected monetary value of this individual risk impact is thus \$2,000. Project managers can also find the expected monetary value of a decision by creating a decision tree.

Expected Monetary Value (EMV) Example



Decision Tree Analysis

- Decision trees are diagrams that show the sequence of interrelated decisions and the expected results of choosing one alternative over the other.
- A Decision Tree will have
 - ❖ Decision to make – For which answer is required
 - ❖ A Decision Node – Different options
 - ❖ A Chance Node – Where the estimated chance of outcome is placed. Each chance mode branch will have its own EMV
 - ❖ Net path Value – Payoff minus cost along the entire path.

Modeling and Simulation

- Project simulations allow the project team to play “what-if” games without affecting any areas of production. The Monte Carlo technique is the most common simulation.
- Monte Carlo, typically completed through a computer software program, completely simulates a project with values for all possible variables to predict the most likely model.
- For the exam, remember that simulation techniques are used to predict schedule or cost risks. Schedule simulations are usually performed using the precedence diagramming method, while cost simulation typically uses the WBS as its basis.

11.4 Perform Quantitative Risk Analysis Outputs

1. Risk Register (Updates)

Risk register is further updated to include

- Probabilistic analysis of the project
- Probability of achieving cost and time objectives
- Prioritized list of quantified risks
- Trend in Quantitative risk analysis results

11.5 Plan Risk Responses

- Project Management Team is now aware of the project risks, their relative ranking and quantitative impact on project. Now team proceed with preparation of response strategy for risk.
- It focuses on how to decrease the possibility of negative risks from adversely affecting the project's objectives, and on how to increase the likelihood of positive risks that can aid the project.
- Team now allocates Budget, Recourse and Activities adequately required for handling risk response plan.
- A personal is appointed now responsible to handle adequately budgeted risks response plan and is called **Risk Owner**

11.5 Plan Risk Responses– Tools & Techniques

- Different strategies are available but normally a mix response strategy is more effective.
- A **Fall Back Plan** is developed by the team, if the response strategy is found to be not effective while implementation. (Plan B if Plan A fails)
- **Secondary Risk** is the risk arises due to implementation of original risk response plan. Team shall review any possibility of secondary risk while finalizing risk response strategy. (A contingency reserve will cover cost overrun in critical path but this may strain the funding and total cost)
- **Residual Risk** is the risk that will remain even after implementation of risk response strategy (No 100% Solution) (Insurance will cover hospital charges for an accident but what about the disability)
- **Risk Trigger** is an indication that risk is imminent and risk owner will initiate response plan (Contingency). EVM calculations shows low CPI

11.5 Plan Risk Responses

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Risk management plan 2. Risk register | <ol style="list-style-type: none"> 1. Strategies for negative risk or threats 2. Strategies for positive risk or threats 3. Strategies for both threats and opportunities 4. Contingent response strategy | <ol style="list-style-type: none"> 1. Risk register (updates) 2. Project management plan (updates) 3. Risk-related contractual agreements 4. Project Document Updates |

11.5 Plan Risk Responses– Tools & Techniques

- Four main response strategies for negative risks:
 - ❖ Avoid
 - ❖ Transfer
 - ❖ Mitigate
 - ❖ Accept

11.5 Plan Risk Responses– Tools & Techniques

- Strategies for Negative Risks or Threats
- Avoiding the Negative Risks and Threats
 - ❖ Avoidance is simply avoiding the risk.
 - ❖ Examples of avoidance include the following:
 - ✓ Changing the project plan to eliminate the risk
 - ✓ Clarifying project requirements to avoid discrepancies
 - ✓ Using a proven methodology rather than a new approach

Strategies for Negative Risks or Threats

- Transferring the Negative Risk
- Transference is the process of transferring the risk (and the ownership of the risk) to a third party. The risk doesn't disappear, it's just someone else's problem. Transference of a risk usually costs a premium for the third party to own and manage that risk. Common examples of risk transference include
 - ❖ Insurance
 - ❖ Performance bonds
 - ❖ Warranties
 - ❖ Guarantees
 - ❖ Fixed-priced contracts

Strategies for Negative Risks or Threats

➤ Mitigating the Negative Risk

- ❖ Mitigating risks is an effort to reduce the probability and/or impact of an identified risk in the project. Mitigation is done—based on the logic—before the risk happens.
- ❖ The cost and time to reduce or eliminate the risks is more cost effective than repairing the damage caused by the risk. The risk event may still happen, but hopefully the cost and impact of the risk will both be very low.

Mitigating the Negative Risk

- Examples of mitigation include:
 - ❖ Adding activities to the project to reduce the risk probability or impact
 - ❖ Simplifying the processes within the project
 - ❖ Completing more tests on the project work before implementation
 - ❖ Developing prototypes, simulations, and limited releases

Response Strategies for Positive Risks

- Exploit
- Share
- Enhance
- Acceptance

Managing the Positive Risk and Opportunities

➤ Exploiting the Positive Risk or Opportunities

- ❖ When an organization would like to ensure that a positive risk definitely happens, it can exploit the risk.
- ❖ Positive risk exploitation can be realized by adding resources to finish faster than what was originally planned, increasing quality to recognize sales and customer satisfaction, utilizing a better way of completing the project work—or any other method that creates the positive outcomes of the identified risk.

Managing the Positive Risk and Opportunities

➤ **Sharing the Positive Risk**

- ❖ The idea of sharing a positive risk really means sharing a mutually beneficial opportunity between two organizations or projects, or creating a risk-sharing partnership.
- ❖ When a project team can share the positive risk, ownership of the risk is given to the organization that can best capture the benefits from the identified risk.
- ❖ Create a partnership with competitor, joint venture, focus group etc

Managing the Positive Risk and Opportunities

➤ Enhancing the Positive Risks

- ❖ This risk response seeks to modify the size of the identified opportunity. The goal is to strengthen the cause of the opportunity to ensure that the risk event does happen.

Accepting the Risks

- Risk acceptance is the process of simply accepting the risks because no other action is feasible; or the risks are deemed to be of small probability, impact, or both and that a formal response is not warranted.
- Passive acceptance requires no action; the project team deals with the risks as they happen.
- Active acceptance entails developing a contingency plan should the risk occur. Acceptance may be used for both positive and negative risks.

Accepting the Risks

| Description of Strategy | Name of Risk Response Strategy |
|--|--------------------------------|
| Remove a work package or activity from the project | Avoid |
| Assign a team member to visit the seller's manufacturing facilities frequently to learn about a problem with delivery as early as possible | Mitigate the impact |
| Move a work package to a date when a more experienced resource is available to be assigned to the project | Exploit |
| Begin negotiation for the equipment earlier than planned so as to secure a lower price | Enhance the impact |
| Outsource a work package so as to gain an opportunity | Share |
| Notify management that there could be a cost increase if a risk occurs because no action is being taken to prevent the risk | Accept |
| Remove a troublesome resource from the project | Avoid |
| Provide a team member who is less experienced with additional training | Mitigate the probability |
| Train the team on conflict resolution strategies | Mitigate the impact |
| Outsource difficult work to a more experienced company | Transfer |
| Ask the client to handle some of the work | Transfer |
| Prototype a risky piece of equipment | Mitigate the probability |

11.5 Plan Risk Responses- Output

- Risk register is further updates as per the latest information available.
- They include the following:
 - ❖ The identities of the risk owners and their assigned responsibilities
 - ❖ Secondary risks
 - ❖ Residual risks
 - ❖ Response strategies
 - ❖ The budget and schedule for risk responses
 - ❖ Both the contingency and fallback plans

Risk related contract decisions

- Some response plan will require contractual decisions.
- The contract may be needed for insurance purposes, customer acceptance, or the acknowledgement of responsibilities between the entities completing the project.
- Transference is an example of contractual agreements for the responsibility of risks within a project.
- More on procurement section

Updating the Project Plan

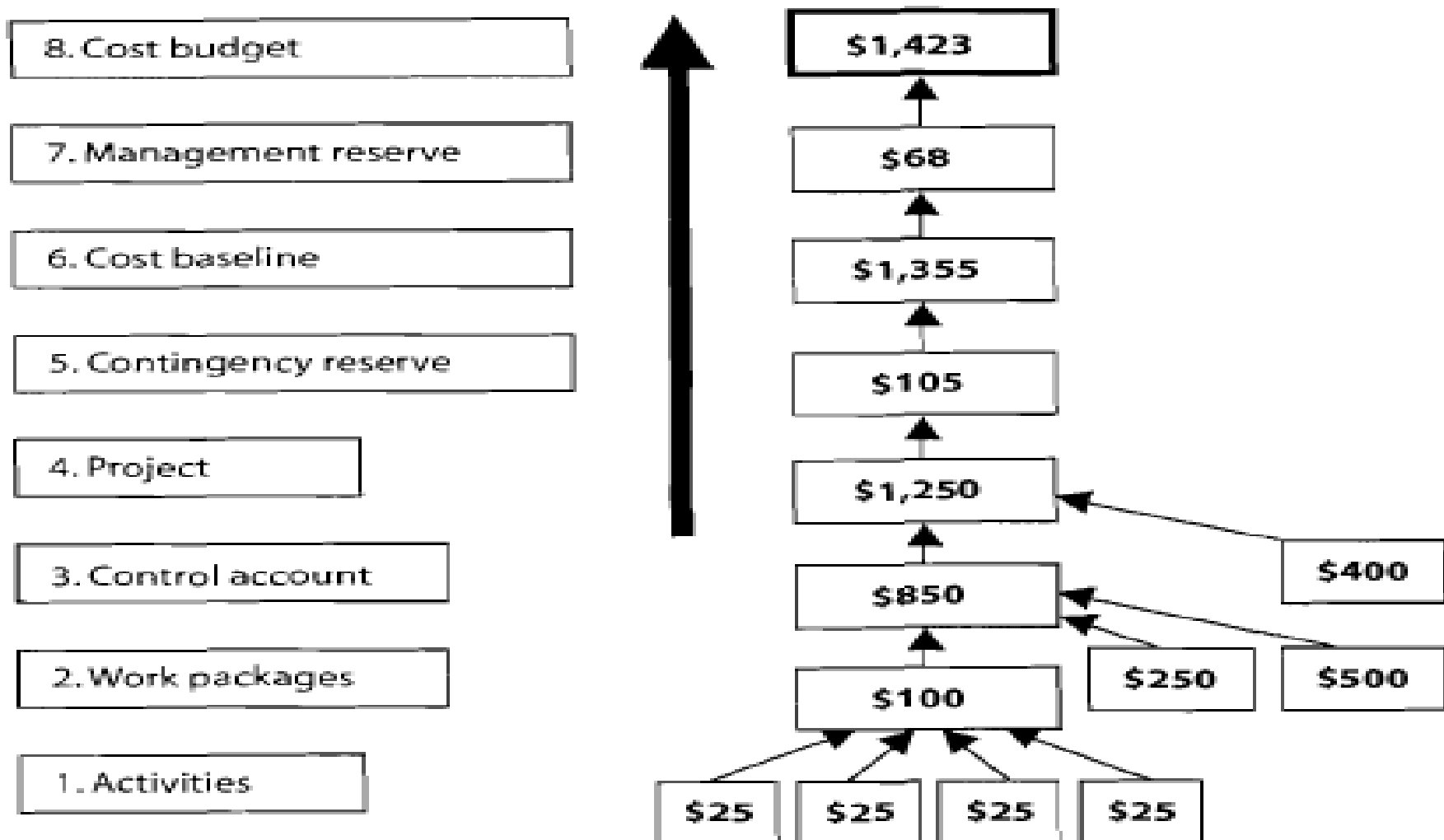
- The risk reactions, contingency plans, and fallback plans should all be documented and incorporated into the project plan—for example, updating the schedule, budget, and WBS to accommodate additional time, money, and activities for risk responses.

11.5 Plan Risk Responses– Outputs

Project Document Updates :

- Project documents that may get updated , include, but are not limited to :
 - ❖ Assumptions Log Updates
 - ❖ Technical documentation updates

11.5 Plan Risk Responses– Outputs



11.6 Control Risks

- Risk monitoring and control is the process of
 - ❖ Implementing risk response strategies
 - ❖ Tracking identified risks for signs that they may be occurring
 - ❖ Monitoring residual risks
 - ❖ Looking for new risks that may develop during project phase.
- Risk monitoring and control also is concerned with the documentation of the success or failure of risk response plans, reviewing that project assumptions are still valid, Risk Project Management plan and procedure are followed and monitor contingency reserves.

11.6 Control Risks

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ol style="list-style-type: none"> 1. Risk register 2. Project Management Plan 3. Work performance information 4. Performance reports | <ol style="list-style-type: none"> 1. Risk reassessment 2. Risk audits 3. Variance and trend analysis 4. Technical performance measurement 5. Reserve analysis 6. Status meetings | <ol style="list-style-type: none"> 1. Risk register (updates) 2. Change Requests 3. Organizational process assets (updates) 4. Project management plan (updates) 5. Project Document Updates |

11.6 Control Risks – Tools & Techniques

➤ Risk Response Audits

- ❖ A risk response audit examines the planned risk response, how well the planned actions work, and the effectiveness of the risk owner in implementing the risk response.
- ❖ The audits happen throughout the project to measure the effectiveness of mitigating, transferring, and avoiding risks.
- ❖ The risk response audit should measure the effectiveness of the decision and its impact on time and cost.

11.6 Control Risks – Tools & Techniques

➤ Periodic Risk Reviews

- ❖ The periodic risk review is a regularly scheduled discussion throughout the project to ascertain the level of foreseeable risks, the success of risk responses in the project to date, and a review of pending risks.

11.6 Control Risks – Tools & Techniques

➤ Earned Value Analysis

- ❖ Earned value analysis measures project performance. When project performance is waning, the project is likely missing targeted costs and schedule goals.
- ❖ The results of earned value analysis can signal that risks are happening within the project—or that new risks may be developing.

11.6 Control Risks – Tools & Techniques

➤ Technical Performance

- ❖ Throughout the project, the project team's technical competence with the technology being used in the project should increase.
- ❖ The level of technical achievement should be in proportion to the expected level of technical performance within the project.

11.6 Control Risks – Tools & Techniques

➤ Reserve Analysis

- ❖ Reserve analysis from starting to end of the project will give indications to health of the project and risks
- ❖ Remember Critical Chain Method

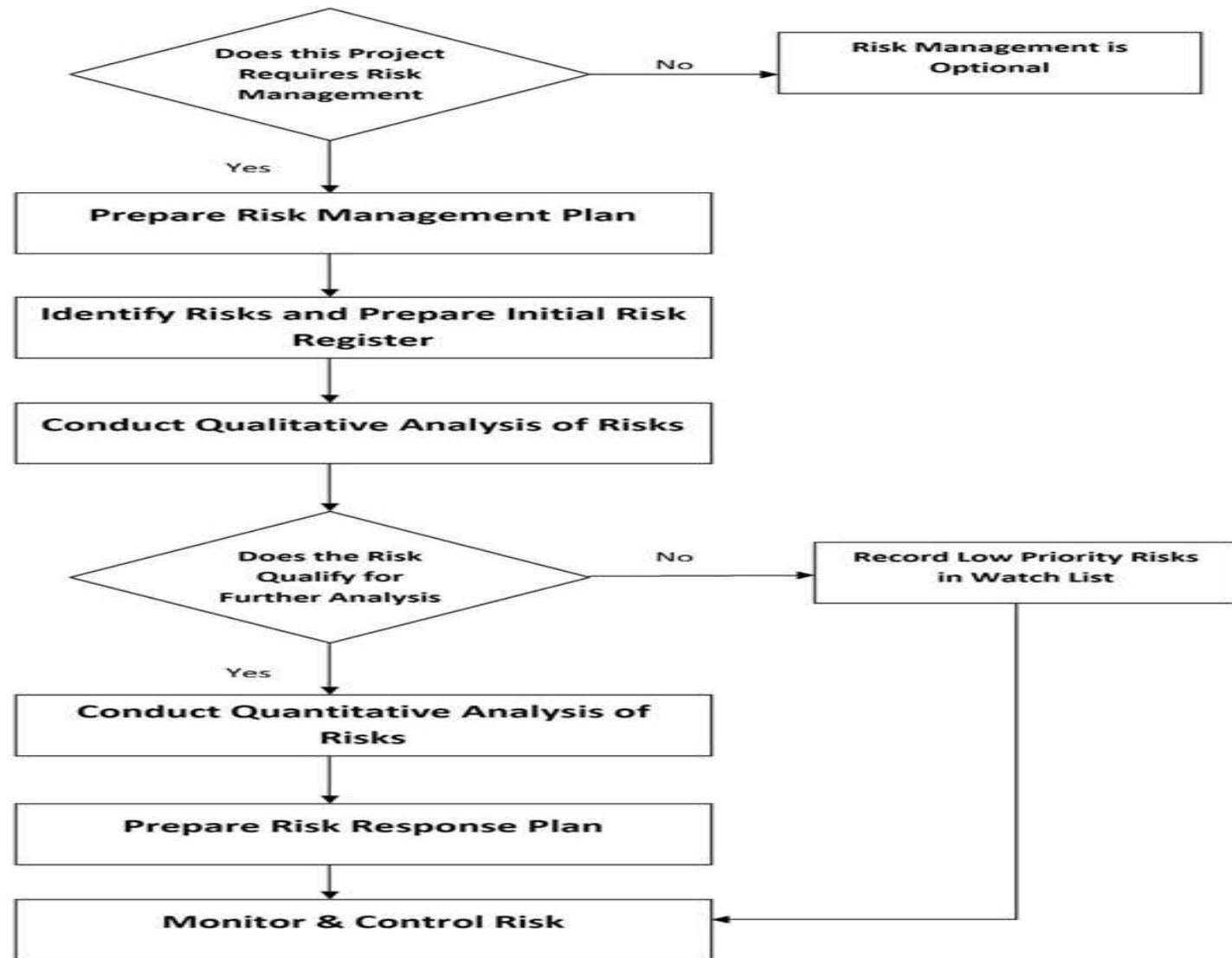
11.6 Control Risks – Tools & Techniques

➤ Status Meeting

- ❖ Status Meeting is a good place to review risks with your team
- ❖ This can help in identification of new risks

11.6 Control Risks - Outputs

1. Risk register updates
2. Change Requests : recommended corrective actions or recommended preventive actions
3. Organizational process assets updates
4. Project management plan updates
5. Project Document Updates



Project Procurement Management

Project Procurement Management

- Project need materials, equipment, consultants, training, and many other goods and services.
- Project procurement management is the process of purchasing the products necessary for meeting the needs of the project scope.
- It involves planning, acquiring the products or services from sources, choosing a source, administering the contract, and closing out the contract.
- It can be applied to internal work orders, formal agreements, and contracts between organizational units within a single entity.

Project Procurement Management

- When buying anything from a vendor, the buyer needs a contract, which becomes a key input to many of the processes within the project.
- The contract, more than anything else, specifies the rules and agreements for the project.
- The project manager should interact with a legal, contracting or procurement department to deal with contracts.
- When the seller is completing its obligations to supply a product, PMI treats those obligations as a project itself.

Project Procurement Management

- All the process in the Procurement Management will be performed for each items to be acquired or purchased.
- Centralized/Decentralized Contracting

Project Manager's Role in Procurement

- The project manager must be involved in the creation of contracts and fulfills the following key roles:
 - ❖ Know the procurement process
 - ❖ Understand contract terms and conditions
 - ❖ Make sure the contract contains all the project management requirements such as attendance at meeting, reports, actions and communications deemed necessary
 - ❖ Identify risks and incorporate mitigation and allocation of risks into the contract

Project Manager's Role in Procurement

- Help tailor the contract to the unique needs of the project
- Fit the schedule for completion of the procurement process into the schedule for the project
- Be involved during contract negotiation to protect the relationship with the seller
- Protect the integrity of the project and the ability to get the work done
- Uphold the entire contract, not just the contract statement of work
- Work with the contract manager to manage changes to the contract

The Sequential Procurement Processes

1. Plan Procurement Management
2. Conduct Procurements
3. Administer Procurement
4. Close Procurements

Project Procurement Management Processes

1. Plan Procurement Management : the process of documenting project purchasing decisions , specifying the approach , and identifying potential sellers
2. Conduct Procurements : the process of obtaining seller responses , selecting a seller , and awarding a contract
3. Administer Procurements : the process of managing procurement relationships , monitoring contract performance , and making changes and corrections as needed
4. Close Procurements : the process of completing each project procurement

12.1 Plan Procurement Management

- Is the process of documenting project purchasing decisions , specifying the approach , and identifying potential sellers.
- Procurement planning is the process of identifying which part of the project should be procured from resources outside of the organization. It is concerned with determining what to procure, when, and how
- Generally, procurement decisions are made early on in the planning processes. Procurement planning centers on four elements:
 - ❖ Whether or not procurement is needed ?
 - ❖ What to procure ?
 - ❖ How much to procure ?
 - ❖ When to procure ?

12.1 Plan Procurement Management

- This process also includes consideration of potential sellers , particularly if the buyer wishes to exercise some degree of influence and control over acquisition decisions
- The requirements of the project schedule can significantly influence the strategy during this process .
- This process includes consideration of the risks involved with each make or buy decision .
- It also includes reviewing the type of contract planned to be used with respect to mitigating risks , sometimes transferring risks to sellers

12.1 Plan Procurement Management

| Inputs | Tools & Techniques | Outputs |
|---|--|--|
| <ol style="list-style-type: none"> 1. Scope Baseline 2. Requirements Documentation 3. Teaming agreements 4. Risk register 5. Risk related contractual agreements 6. Activity Resource requirements 7. Project schedule 8. Activity cost estimates 9. Cost Performance baseline 10. Environmental factors 11. Organizational process assets | <ol style="list-style-type: none"> 1. Make-or-buy analysis 2. Expert Judgment 3. Contract types | <ol style="list-style-type: none"> 1. Procurement management Plan 2. Procurement Statements of work 3. Make-or-buy decisions 4. Procurement Documents 5. Source selection criteria 6. Change request |

12.1 Plan Procurement Management : Inputs

1. Scope Baseline : Describes the need, justification , requirements and current boundaries for the project. It contains : The scope statement (*The project scope statement defines the project work, and only the required work, to complete the project, it also defines the limitations of the project*) , WBS, and the WBS Dictionary
2. Requirements Documentation : may include :
 - Imp information about project requirements that is considered during planning for procurements
 - Requirements with contractual and legal implications that may include health, safety, security, performance, environmental ,insurance ,intellectual property rights ,licenses ,permits ,etc –all of which are considered when planning for procurements
3. Teaming Agreements : are legal contractual agreements between two or more entities to form a partnership or joint venture , or some other arrangement as defined by the parties .the agreement defines the buyer seller roles for each party . Whenever a teaming agreement is in place for a project, the roles of buyer and seller are predetermined

12.1 Plan Procurement Management : Inputs

4. **Risk Register** : Includes risk related information such as the identified risks , risk owners and risk responses
5. **Risk related contract decisions**
6. **Activity Resource Requirements** : contains information on specific needs such as people, equipment or location
7. **Project Schedule** : contains information on required timelines or mandated deliverable dates
8. **Activity Cost Estimates** : developed by the procuring activity are used to evaluate the reasonableness of the bids or the proposals received from potential sellers
9. **Cost Performance Baseline** : provides details of the planned budget overtime
10. **Enterprise Environmental Factors** : include but are not limited to : market place conditions,products,services,and results that are available in the marketplace ,suppliers, including past performance and reputation , unique local requirements ,typical terms and conditions for products, services or results or for the specific industry (Sole Sources, Single Source & Oligopoly)
11. **Organizational Process Assets** : How the procurement process work within the performing organization

12.1 Plan Procurement Management – T & T

- **Make-or-buy analysis:** general management technique used to determine whether an organization should make or perform a particular product or service inside the organization or buy from someone else
- Often involves financial analysis
- Experts, both internal and external, can provide valuable inputs in procurement decisions

12.1 Plan Procurement Management – T&T

1. Make-or-Buy Analysis

| Reasons to Make | Reasons to Buy |
|----------------------------------|--|
| Less costly | Less costly |
| Use in-house skills | In-house skills aren't available or don't exist |
| Control of work | Small volume of work |
| Control of intellectual property | More efficient |
| Learn new skills | Transfer risks |
| Available staff | Available vendor |
| Focus on core project work | Allows project team to focus on other work items |

Make or Buy Decision

➤ Sample Question:

- ❖ You are trying to decide whether to lease or buy an item for your project. The daily lease cost is Dhs. 120. To purchase the item investment cost is Dhs. 1000 and the daily cost is Dhs. 20. How long will it take for the lease cost to be the same as the purchase cost?

Make or Buy Decision

➤ Answer:

- ❖ Let D equal the number of days when the purchase and lease costs are equal.
- ❖ $QR\ 120\ D = QR\ 1000 + QR\ 20\ D$
- ❖ $QR\ 120\ D - QR\ 20\ D = QR\ 1000$
- ❖ $QR\ 100\ D = QR\ 1000$
- ❖ $D = QR\ 1000 / QR\ 100$
- ❖ $D = 10$

- ❖ The least cost will be the same as the purchase cost after ten days.

Make-or-Buy Example

- Assume you can lease an item you need for a project for \$800/day; to purchase the item, the cost is \$12,000 plus a daily operational cost of \$400/day
- How long will it take for the purchase cost to be the same as the lease cost?

Make-or Buy Solution

- Set up an equation so both options, purchase and lease, are equal
- In this example, use the following equation; let d be the number of days to use the item:

$$\$12,000 + \$400d = \$800d$$

Subtracting $\$400d$ from both sides, you get:

$$\$12,000 = \$400d$$

Dividing both sides by $\$400$, you get:

$$d = 30$$

- If you need the item for more than 30 days, it is more economical to purchase it

12.1 Plan Procurement Management – T & T

2. Expert Judgment

- ❖ Expert judgment for procurement management planning can come from the following:
 - ✓ Units or individuals within the performing organization
 - ✓ Consultants and subject matter experts
 - ✓ Professional, trade, or technical associations
 - ✓ Industry groups

12.1 Plan Procurement Management – T & T

3. Contract Types

❖ **Fixed Price Contract**

- ❖ In this type of contract one price is agreed upon for all the work.
- ❖ The buyer has the least cost risk, provided the buyer has a completely defined scope, because the risk of higher costs is borne by the seller.
- ❖ The seller is most concerned with the contract statement of work in this type of contract.

12.1 Plan Procurements – T & T

3. Contract Types

❖ Firm Fixed Price Contracts (FFP):

- ✓ The most commonly used contract type because price of the goods is set at the onset and not subject to change unless the scope of work changes .
- ✓ Any cost increase due to adverse performance is the responsibility of the seller .
- ✓ Under this type of contract the buyer must precisely specify the product or services to be procured, and any changes to the procurement specification can increase the costs to the buyer

Fixed Price Contract Variations

- Fixed Price Incentive Fee Contracts (FPIF)
 - ❖ There are also incentives for fixed price contracts.
 - ❖ Contract = Dhs. 1,100,000.
 - ❖ For every month early the project is finished, an additional Dhs. 10,000 is paid to the seller.

Fixed Price Contract Variations

➤ Fixed Price Economic Price Adjustment (FPEPA)

- ❖ Sometimes a fixed price contract allows for price increases if the contract is for multiple years.
- ❖ **Example**
- ❖ Contract = Dhs. 1,100,00 but a price increase will be allowed in year two based on the Consumer Price Increase report for year one. Or the contract price is Dhs. 1,100,000 but a price increase will be allowed in year two to account for increases in specific material costs.

Purchase Order

➤ Purchase Order

- ❖ A purchase order is the simplest type of fixed price contract.
- ❖ This type of contract is normally unilateral (signed by one party) instead of bilateral.
- ❖ It is usually used for simple commodity procurements.
- ❖ Purchase orders are considered contracts when they are accepted either by performance (Material is shipped by the seller) or by signing a purchase order.
- ❖ **Example**
- ❖ Contract to purchase 30 linear meters of wood at Dhs. 40 per meter.

Cost-reimbursable Contract

- The seller's cost are reimbursed, plus an additional amount.
- The buyer has the most cost risk because the total costs are unknown.
- This form of contract is often used when the buyer can only describe what is needed, rather than what to do.
- The seller will therefore write the detailed contract statement work.

Cost-reimbursable Contract - Variations

➤ **Cost plus Fixed Fee (CPFF)**

- This is the most common type of cost reimbursable contract.
- In this type, the buyer pays all costs, but the fee (or profit) is fixed at a specific amount.
- This helps to keep the seller's costs in line because a cost overrun will not generate any additional fee or profit. Fees only change with approved change orders.

❖ **Example**

- ❖ $\text{Contract} = \text{Cost} + \text{Fee of Dhs } 100,000$

Cost-reimbursable Contract - Variations

- Cost Plus Fee (CPF) or Cost Plus Percentage of Costs (CPPC)
- This type of cost reimbursable contract requires the buyer to pay for all costs plus a percent of costs as a fee. Sellers are not motivated to control costs because the seller will get paid profit on every cost without limit.

- ❖ **Example**

- ❖ $\text{Contract} = \text{Cost} + 10\% \text{ of costs as fee.}$

Cost-reimbursable Contract - Variations

- Cost Plus Incentive Fee (CPIF)
- This type of cost reimbursable contract pays all costs and an agreed upon fee, plus a bonus for beating the performance objectives stated in the contract.

Cost-reimbursable Contract - Variations

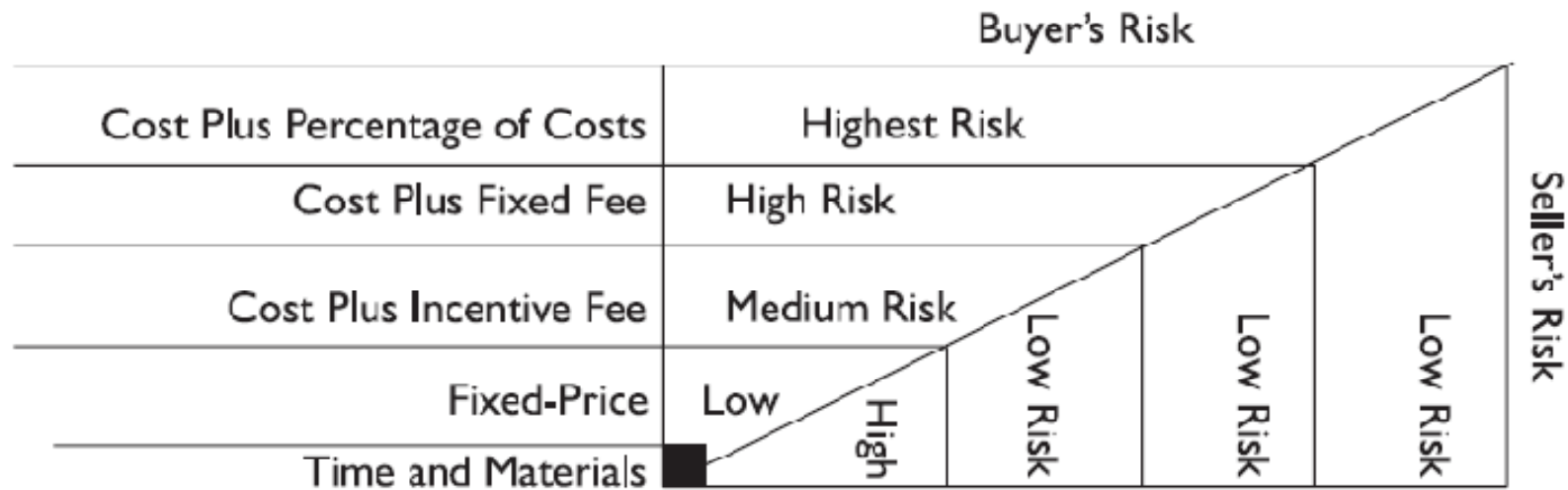
➤ Cost Plus Award Fee Contracts (CPAF) :

- ❖ The seller is reimbursed for all legitimate costs , but the majority of the fees is only earned based on the satisfaction of certain broad subjective performance criteria defined and incorporated into the contract.
- ❖ The determination of the fee is solely on the subjective determination of seller performance by the buyer , and is generally not subject to appeals

Time and Material (T&M) or Unit Price

- This type of contract is usually used for small amounts.
- The contract is priced on a per hour or per item basis and has elements of fixed price contract (in the fixed price per hour) and a cost reimbursable contract (in the material costs and the fact that the total cost is unknown).
- In this type of, the buyer has a medium amount of cost risks compared to CR and FP because the contract is usually for small amounts and for a shorter length of time.
- **Example**
- Contract = Dhs. 100 per hour + expenses or materials at cost
- or Dhs 10 per linear meter of wood.

Fixed-price contracts transfer the risk to the seller



T&M can be a high risk for buyer if contract does not include a "total not-to-exceed" clause, also called an NTE clause.

| Contract Type | Acronym | Attribute | Risk Issues |
|------------------------------|---------|---|--|
| Cost Plus Fixed Fee | CPFF | Actual costs plus profit margin for seller | Cost overruns represent risk to the buyer |
| Cost Plus Percentage of Cost | CPPC | Actual costs plus profit margin for seller | Cost overruns represent risk to the buyer. This is the most dangerous contract type for the buyer |
| Cost Plus Incentive Fee | CPIF | Actual costs plus profit margin for seller | Cost overruns represent risk to the buyer |
| Fixed-Price | FP | Agreed price for contracted product; can include incentives for the seller | Seller assumes risk |
| Lump-Sum | | Agreed price for contracted product; can include incentives for the seller | Seller assumes risk |
| Firm-Fixed-Price | FFP | Agreed price for contracted product | Seller assumes risk |
| Fixed Price Incentive Fee | FPIF | Agreed price for contracted product; can include incentives for the seller | Seller assumes risk |
| Time and Materials | T&M | Price assigned for the time and materials provided by the seller | Contracts without “not-to-exceed” clauses can lead to cost overruns |
| Unit-Price | | Price assigned for a measurable unit of product or time (for example, \$130 for engineer’s time on the project) | Risk varies with the product. Time represents the biggest risk if the amount needed is not specified in the contract |

12.1 Plan Procurement Management - Outputs

1. Procurement Management Plan

- ❖ How vendors will be selected, the type of contracts to be used
- ❖ The process of independent estimating (also known as should-cost estimates)
- ❖ The relationship between the project team and the procurement office within the performing organization (if one exists)
- ❖ The procurement forms, such as contracts, that the project team is required to use
- ❖ How multiple vendors will be managed to supply their contracted product
- ❖ The coordination between sellers and the project team and among project activities, project reporting, scheduling, business operations, and other project concerns
- ❖ Risk management issues etc

12.1 Plan Procurement Management - Outputs

2. Procurement Statements of Work

- ❖ A procurement statement of work (SOW) contains the details of the procurement item in clear, concise terms. It includes the following elements:
- ❖ The project objectives
- ❖ A description of the work of the project and any post-project operational support needed
- ❖ Concise specifications of the product or services required
- ❖ The project schedule, time period of services, and work location

Statement of Work (SOW) Template

- I. **Scope of Work:** Describe the work to be done to detail. Specify the hardware and software involved and the exact nature of the work.
- II. **Location of Work:** Describe where the work must be performed. Specify the location of hardware and software and where the people must perform the work
- III. **Period of Performance:** Specify when the work is expected to start and end, working hours, number of hours that can be billed per week, where the work must be performed, and related schedule information.
- IV. **Deliverables Schedule:** List specific deliverables, describe them in detail, and specify when they are due.
- V. **Applicable Standards:** Specify any company or industry-specific standards that are relevant to performing the work.
- VI. **Acceptance Criteria:** Describe how the buyer organization will determine if the work is acceptable.
- VII. **Special Requirements:** Specify any special requirements such as hardware or software certifications, minimum degree or experience level of personnel, travel requirements, and so on.

12.1 Plan Procurement Management - Outputs

3. Make-or-Buy Decisions

- Change Requests : change requests to the project management plan, its subsidiary plans , or other components may result from this process
- Procurement Documents : are used to solicit proposals from the prospective sellers .
 - ❖ Request for Proposals: used to solicit proposals from prospective sellers
 - ✓ A proposal is a document prepared by a seller when there are different approaches for meeting buyer needs
 - ❖ Requests for Quotes: used to solicit quotes or bids from prospective suppliers
 - ✓ A bid, also called a tender or quote (short for quotation), is a document prepared by sellers providing pricing for standard items that have been clearly defined by the buyer

4. Procurement Documents

- Procurement documents may include the following:
- Information for Sellers
 - ❖ Background information
 - ❖ Procedures for replying
 - ❖ Guidelines for preparation of the response
 - ❖ Form of response required
 - ❖ Evaluation Criteria
 - ❖ Pricing forms
- Contract Statement of work
- Proposed terms and conditions of the contract (legal and business)

Procurement Documents

➤ **Non-Disclosure Agreement**

- ❖ This is an agreement between the buyer and any prospective sellers stating what information or documents they will hold confidential and control, and who in their organization will gain access to the confidential information.

➤ **Standard Contract**

- ❖ Companies frequently have standard, preauthorized contracts for the purchase of goods or services. These types of standard contracts need no further legal review if used as they are.

➤ **Special Provisions (Special Conditions)**

- ❖ The project manager should determine what needs to be added, changed or removed from the standard provisions, so that the resulting contract addresses the particular needs of the project.

Procurement Documents

➤ Letter of Intent

- ❖ NOT a contract but a letter, without legal binding, that says the buyer intends to hire the seller.

➤ Privity

- ❖ Contractual relationship.

➤ Example

- ❖ Company A hires company B to do some work for them. Company B subcontracts to company C. The project manager for A is at the job site and tells company C to stop work. Generally, does company C have to listen?

Procurement Documents

| Document | Purpose |
|----------------------------|---|
| Bid | From seller to buyer. Price is the determining factor in the decision-making process |
| Quotation | From seller to buyer. Price is the determining factor in the decision-making process |
| Proposal | From seller to buyer. Other factors—such as skill sets, reputation, ideas for the project solution—may be used in the decision-making process |
| Invitation for bid (IFB) | From buyer to seller. Requests the seller to provide a price for the procured product or service |
| Request for quote (RFQ) | From buyer to seller. Requests the seller to provide a price for the procured product or service |
| Request for proposal (RFP) | From buyer to seller. Requests the seller to provide a proposal to complete the procured work or to provide the procured product |

12.1 Plan Procurement Management - Outputs

5. Source Selection Criteria :

- ❖ Source Selection criteria are included in the procurement document to give the seller an understanding of the buyer's needs and help them decide if they should bid or make a proposal on the work.
- ❖ During Select sellers, this criteria become the basis by which the bids or proposal are evaluated by the buyer.
- ❖ Selection criteria can be limited to purchase price if the procurement item is readily available from a number of acceptable sellers .

12.1 Plan Procurement Management - Outputs

- The following list includes some of the criteria you can consider using for evaluating proposals and bids:
 - ❖ Comprehension and understanding of the needs of the project as documented in the contract SOW
 - ❖ Technical ability of vendor and their proposed team and the technical approach
 - ❖ Experience on projects of similar size and scope, including references, past performance of sellers
 - ❖ Project management approach
 - ❖ Management approach

12.1 Plan Procurement Management - Outputs

- The following list includes some of the criteria you can consider using for evaluating proposals and bids:
 - ❖ Financial stability and capacity , production capacity and interest
 - ❖ Intellectual and proprietary rights
 - ❖ Overall or life cycle cost : will the selected seller produce the lowest total cost of ownership purchase cost plus operating cost)
 - ❖ Risk
 - ❖ Warranty
 - ❖ Business Size and type, references

12.2 Conduct Procurements

- Is the process of obtaining seller responses, selecting a seller and awarding a contract.
- In this process the team will receive bids or proposals and will apply precisely defined selection criteria to select one or more sellers who are qualified to perform the work and acceptable as a seller

12.2 Conduct Procurements

| Inputs | Tools & Techniques | Outputs |
|--|--|--|
| <ol style="list-style-type: none"> 1. Procurement management plan 2. Procurement Documents 3. Source Selection Criteria 4. Qualified seller list 5. Seller proposals 6. Project documents 7. Make or buy decisions 8. Teaming agreements 9. Organizational Process Assets | <ol style="list-style-type: none"> 1. Bidder Conferences 2. Proposal evaluation techniques 3. Independent estimates 4. Expert judgement 5. Advertising 6. Internet search 7. Procurement Negotiations | <ol style="list-style-type: none"> 1. Selected sellers 2. Procurement contract award 3. Resource calendars 4. Change requests 5. Project management plan 6. Project document updates |

12.2 Conduct Procurements

- Procurement management plan
- Procurement Documents
- Source Selection Criteria
- Qualified seller list
- Seller proposals
- Project documents : risk register, risk related contract decisions
- Make or buy decisions
- Teaming agreements
- Organizational Process Assets : include , but are not limited to : listings of prospective and previously qualified sellers, information on the relevant past experience with the sellers , good and bad

12.2 Conduct Procurements – Tools & Techniques

- **Bidder Conferences** : Bidder conferences are meetings with prospective vendors or sellers that occur prior to the completion of their response proposal.
- **Proposal evaluation techniques**
- **Independent estimates / Should-Cost Estimate** : Comparing the cost to an estimate created in-house or with outside assistance.
- **Expert judgement**
- **Advertising** : Advertising is letting potential vendors know that an RFP is available.
- **Internet search**
- **Procurement Negotiations** : The project manager may be involved during negotiations to clarify project requirements, and if for no other reason than to protect the relationship to clarify project requirements, and if for no other reason than to protect the relationship with the other side.
 - ❖ Many projects go bad because of how negotiations were handled.
 - ❖ The objectives of negotiation are to:
 - ✓ Obtain a fair and reasonable price
 - ✓ Develop a good relationship with the seller

12.2 Conduct Procurements – Tools & Techniques

- Main Items to Negotiate
 - ❖ Responsibilities
 - ❖ Authority
 - ❖ Applicable Law
 - ❖ Technical and business management approaches
 - ❖ Contract financing
 - ❖ Schedule
 - ❖ Payment and price

12.2 Conduct Procurements – Outputs

1. Selected Sellers :

- A seller may simply be selected and asked to sign a standard contract
- A seller may be asked to make a presentation and then, if all goes well, go on to negotiations
- The list of sellers may be narrowed down to a few
- The short-listed sellers may be asked to make presentations and the selected seller then asked to go on to negotiations
- The buyer can negotiate with more than one seller
- Or some combination of presentations and negotiations

12.2 Conduct Procurements – Outputs

2. Procurement Contract Award :

- ❖ Contracts are known by many names: Agreement, Subcontract, Purchase order , Memorandum of understanding
- ❖ Is awarded to each selected seller .
- ❖ A contract can be in the form of a simple purchase order or a complex document .
- ❖ A contract is a mutually binding legal agreement that obligates the seller to provide the specified products, services or results and obligates the buyer to compensate the seller
- ❖ What do you need to have a legal contract?
 - ✓ An offer
 - ✓ Acceptance
 - ✓ Consideration - Something of value, not necessarily money
 - ✓ Legal capacity - Separate legal parties, competent parties
 - ✓ Legal purpose - You cannot have a contract for the sale of illegal goods

12.2 Conduct Procurements – Outputs

3. **Resource Calendars** : the quantity and the availability of contracted resources and those dates on which each specific resource can be active or idle are documented
4. **Change Requests**
5. **Project Management Plan Updates** : components of the plan that may get updated include, but are not limited to :
 - ❖ Cost baseline
 - ❖ Scope baseline
 - ❖ Schedule baseline
 - ❖ Procurement Management Plan
6. **Project Document Updates** : docs that may get updated include, but are not limited to :
 - ❖ Requirements documentation
 - ❖ Requirements traceability documentation , and ,
 - ❖ Risk register

12.3 Administer Procurements

- This process consists of assuring that the performance of both parties to the contract meets contractual requirements.
- The Contract Administration process concerns monitoring the vendor's performance and ensuring that all the requirements of the contract are met.
- Contracts are legal relationships, so it is important that legal and contracting professionals be involved in writing and administering contracts

12.3 Administer Procurements

| Inputs | Tools & Techniques | Outputs |
|---|--|---|
| <ol style="list-style-type: none"> 1. Contract 2. Project Management Plan <ul style="list-style-type: none"> - Contract management plan 3. Procurement Documents 4. Performance reports 5. Approved change requests 6. Work performance Information | <ol style="list-style-type: none"> 1. Contract change control system 2. Procurement performance review 3. Inspections and audits 4. Performance reporting 5. Payment system 6. Claims administration 7. Records management system | <ol style="list-style-type: none"> 1. Procurement documentation 2. Change Requests 3. Organizational process assets (updates) 4. Project management plan (updates) <ul style="list-style-type: none"> . Procurement management plan . Contract management plan |

12.3 Administer Procurements : Inputs

- Contract
- Project Management Plan
 - Contract management plan
- Procurement Documents : contain complete supporting records for administration of the procurement processes. This includes procurement contract awards and the statement of work
- Performance reports : seller performance related documentation includes :
 - ❖ Seller developed technical documentation and other deliverable information provided in accordance with the terms of the contract
 - ❖ Seller performance reports that indicate which deliverables have been completed and which have not

12.3 Administer Procurements : Inputs

- Approved change requests : can include modifications to the terms & conditions of the contract.
- Work performance Information : the extent to which the quality standards are being satisfied , what costs have been incurred , which seller invoices have been paid, etc

12.3 Administer Procurements – Tools & Techniques

1. Contract change control system
2. Procurement performance reviews
3. Inspections and audits
4. Performance reporting
5. Payment system
6. Claims administration
7. Records management system

Contract change control system

- The contract change control system defines the procedures for how the contract may be changed.
- The system is part of integrated change control.
- It documents how to submit changes, establishes the approval process, and outlines authority levels.
- It includes a tracking system to number the change requests and record their status

Suggestions for Change Control in Contracts

- Changes to any part of the project need to be reviewed, approved, and documented by the same people in the same way that the original part of the plan was approved
- Evaluation of any change should include an impact analysis; how will the change affect the scope, time, cost, and quality of the goods or services being provided?
- Changes must be documented in writing; project team members should also document all important meetings and telephone phone calls

Procurement performance reviews

- Buyer conducted performance reviews examine the seller's performance on the contract to date.
- These reviews may be conducted at the end of the contract or at intervals during the contract period.
- Buyer reviews examine the contract terms and seller performance for elements such as these:
 - ❖ Meeting project scope
 - ❖ Meeting project quality
 - ❖ Staying within project budgets
 - ❖ Meeting the project schedule

Inspections and audits

- As the vendor completes the contracted work, the seller will need to inspect the work for progress, compliance with contract requirements, and adherence to agreed-to time, cost, and quality constraints.

Performance reporting

- This tool and technique entails providing your managers and stakeholders with information about the vendor's progress meeting the contract objectives.
- Performance reporting is part of communications and should be documented within the communications management plan.

Payment system

- Vendors submit seller invoices as an input to this process, and the payment system is the tool and technique used to issue payment.
- The organization may have a dedicated department, such as accounts payable, that handles vendor payments, or it might fall to the project manager.
- In either case, follow the policies and procedures the organization established regarding vendor payments.

Claims administration

- A claim is an assertion that the buyer did something that has hurt the seller and the seller asking for compensation.
- Another way of looking at claims is that they are a form of seller's change requests.
- Claims can get nasty. Imagine a seller that is not making as much profit as he hoped for, issuing claims for every action taken by the buyer.
- Claims administration involves documenting, monitoring, and managing changes to the contract.

Claims administration

- Changes that cannot be agreed upon are called **contested changes**.
- Contested changes usually involve a disagreement about the compensation to the vendor for implementing the change.
- You might believe the change is not significant enough to justify additional compensation, whereas the vendor believes they'll lose money by implementing the change free of charge.

Claims Administration

- Contested changes are also known as disputes, claims, or appeals. These can be settled directly between the parties themselves, through the court system, or by a process called arbitration.
- Arbitration involves bringing all parties to the table with a third, disinterested party who is not a participant in the contract to try to reach an agreement.
- The purpose of arbitration is to reach an agreement without having to go to court.

Records Management System

- A contract is a formal, legal document. Recording keeping can be critical if actions taken or situations faced during a project are ever in question after the work is completed.
- This can happen related to unresolved claims or legal actions, or even in order to satisfy insurance needs.
- A record management system can be quite extensive, with one person assigned just to manage these records.
- They can also include indexing systems, archiving systems and information retrieval systems for projects with extensive documentation.

12.3 Administer Procurements - Outputs

1. Procurement documentation
2. Change Requests
3. Organizational process asset updates : correspondence, payment schedules and requests , seller performance evaluation documentation
4. Project management plan updates : docs that can get updated include : but are not limited to : procurement management plan , baseline schedule , etc

Procurement documentation

- This output includes (but isn't limited to) all of the following:
 - ❖ Contract
 - ❖ Performance information
 - ❖ Warranties
 - ❖ Financial information (like invoices and payment records)
 - ❖ Inspection and audit results
 - ❖ Supporting schedules
 - ❖ Approved and unapproved changes

12.4 Close Procurements

- This process consists of finishing all the loose ends of the contract.
- This process is part of the close project process described in integration.
- Contract closure is done:
 - ❖ When a contract ends
 - ❖ When a contract is terminated before the work is completed

12.4 Close Procurements

- This process is concerned with completing and settling the terms of the contract.
- It supports the Close Project process because the Contract Closure process determines if the work described in the contract was completed accurately and satisfactorily.
- This is called product verification.

12.4 Close Procurements

- Close Project verifies and documents the project outcomes just like the Contract Closure process.
- Keep in mind that not all projects are performed under contract so not all projects require Contract Closure.
- However, all projects do require the Close Project process.
- Since verification and documentation of the project outcomes occur in both of these processes, projects that are performed under contract need to have project results verified only one time.

12.4 Close Procurements

| Inputs | Tools & Techniques | Outputs |
|--|--|--|
| <ol style="list-style-type: none"> 1. Project Management Plan – Procurement management plan 2. Procurement Documentation | <ol style="list-style-type: none"> 1. Procurement audits 2. Records management system 3. Negotiated Settlements | <ol style="list-style-type: none"> 1. Closed Procurements 2. Organizational process assets (updates) |

12.4 Close Procurements : Inputs

The Contract Closure process has two inputs:

- Project Management Plan – Procurement management plan
- Procurement Documentation

12.4 Close Procurements – Tools & Techniques

- The Contract Closure process has three tools and techniques:
 1. Procurement audits
 2. Records management system.
 3. Negotiated Settlements : In all procurement relationships the final equitable settlement of all outstanding issues , claims , and disputes by negotiations is a primary goal. Whenever settlement cannot be achieved by direct negotiation , some form of alternative dispute resolution (ADR) including mediation or arbitration may be explored . When all else fails , litigation in the courts is the least desirable option

Procurement audits

- Procurement audits examine the procurement process to determine areas of improvement and to identify flawed processes or procedures.
- The primary purpose of the procurement audit is to identify lessons learned during the procurement process.
- This allows you to reuse the successful processes on other procurement items for this project, on future projects, or elsewhere in the organization.
- It also alerts you to problems in the process so that you don't repeat them.

12.4 Close Procurements - Outputs

1. Closed Procurements :

- This is formal acceptance and closure of the contract.
- The buyer provides the seller with a formal written notice that the contract has been completed .Requirements for formal procurement closure are usually defined in the terms and conditions of the contract and are included in the procurement management plan
- It's your responsibility as project manager to document the formal acceptance of the contract.
- Many times the provisions for formalizing acceptance and closing the contract are spelled out in the contract itself.

12.4 Close Procurements - Outputs

1. Organizational process assets (updates) : assets that may get updated , include but are not limited to :
 - Procurement File : a complete set of indexed contract documentation , including the closed contract, is prepared for inclusion with the final project files
 - Deliverable acceptance : the buyer provides the seller with a formal written notice that the deliverables have been accepted or rejected .
 - Lessons learned documentation

STAKEHOLDER MANAGEMENT

13.1 Identify Stakeholders

- It this process, Project Manager and Project Team identify all people or organizations impacted by the project
- Stakeholders interests may be positively or negatively impacted by the execution or completion of the project . (Positive and Negative Stakeholders)
- Stakeholder identification shall be carried out as early as possible, preferably during initiation and definitely prior to starting of planning.
- Project team shall attempt to maximize positive influences and mitigate potential negative impacts .
- An un-identified key stakeholder can potentially turn high risk to project.

13.1 Identify Stakeholders

| Inputs | Tools & Techniques | Outputs |
|--|---|--|
| <ol style="list-style-type: none">1. Enterprise environmental factors2. Organizational process assets3. Project Charter4. Procurement Documents | <ol style="list-style-type: none">1. Stakeholder Analysis2. Expert Judgement | <ol style="list-style-type: none">1. Stakeholder Register2. Stakeholder management strategy |

13.1 Identify Stakeholders : Tools & Techniques

1. Stakeholder Analysis :

- In a large project, it may not be practical to manage all stakeholders at the same level. Stakeholders are classified according to their interest, influence and involvement in project.
- Project manager should follow steps while doing stakeholder analyses :
 - ❖ **Step 1** : Identify all potential project stakeholders and relevant information such as their roles, departments, interest, knowledge levels, expectations and influence levels . Key stakeholders are easy to identify and identifying other stakeholders is usually done by interviewing identified stakeholders and expanding the list until all potential stakeholders are included.

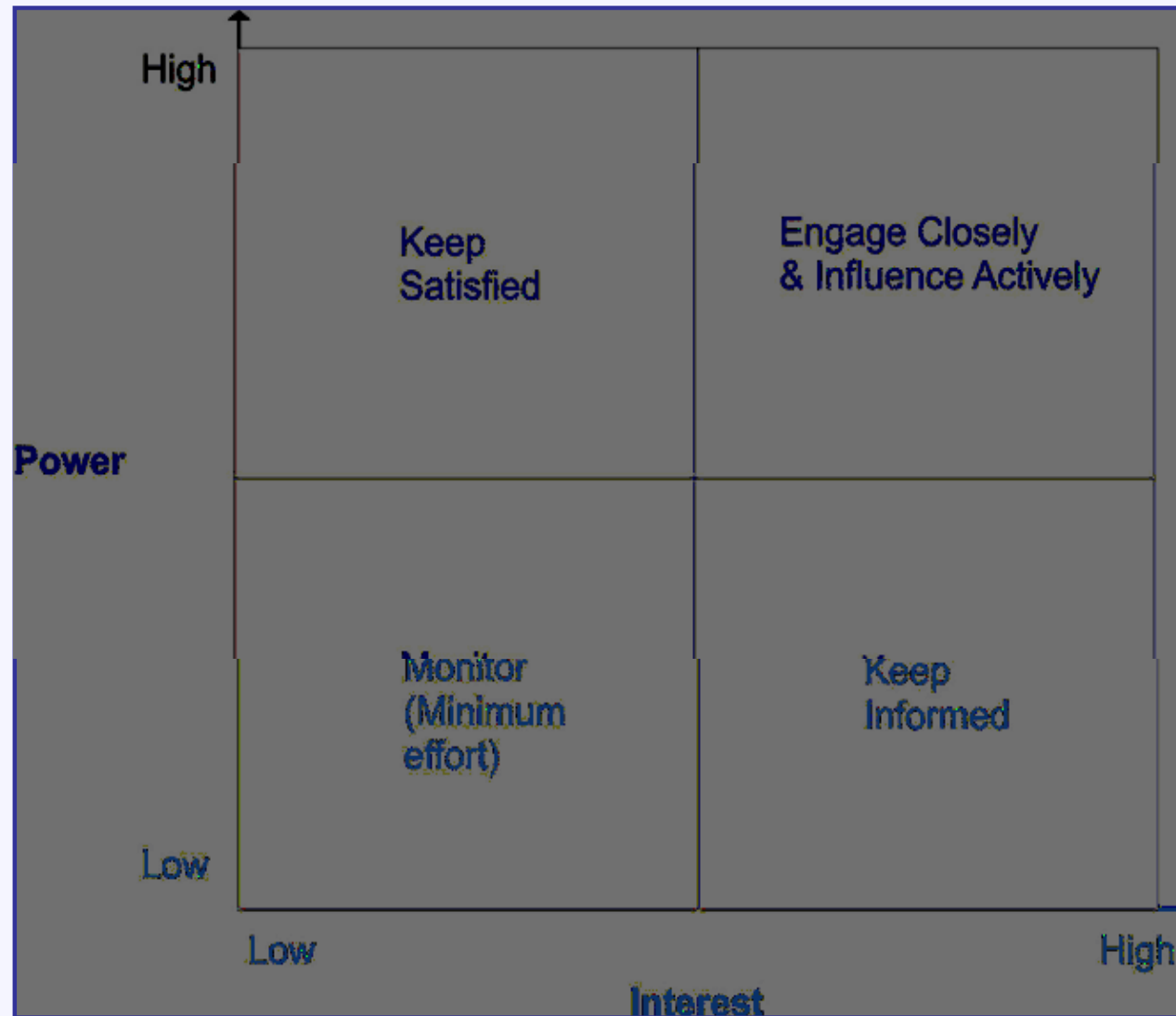
13.1 Identify Stakeholders : Tools & Techniques

1. Stakeholder Analysis :

❖ Step 2 :

- ✓ Identify the potential impact or support each stakeholder could generate and classify them so as to define an approach strategy .
- ✓ There are multiple classification models available including , but not limited to :
 - Power/interest grid (Authority / Concern)
 - Power/influence grid (Authority / involvement)
 - Influence/impact grid (Involvement / ability to effect changes)
 - Salience model (Classify stakeholders according to their power, urgency and legitimacy)

13.1 Identify Stakeholders : Tools & Techniques



13.1 Identify Stakeholders : Tools & Techniques

1. Stakeholder Analysis :

❖ Step 3 :

- ✓ Access how key stakeholders are likely to react in various situations and plan how to influence them for their support and mitigate potential negative impact
- ✓ **CEO**
 - ❖ Category – High Power & High Influence
 - ❖ Strategy – Involve in all high level decisions.
 - ❖ Doesn't like schedule delays and quality problems but not very specific with cost . However additional cost shall come with a value addition.
 - ❖ Very particular about company image
 - ❖ Will not tolerate any safety or environmental violations.

13.1 Identify Stakeholders : Outputs

1. Stakeholder Register :

- The main output of this process , contains all details related to the identified stakeholders including , but not limited to :
 - ❖ **Identification information** : Name, organizational position, location, role in the project, contact information
 - ❖ **Assessment Information** : Major requirements , main expectations ,potential influence in the project, phase in the life cycle with the most interest
 - ❖ **Stakeholder Classification** : internal/external, supporter/neutral/resistor, etc

13.1 Identify Stakeholders : Outputs

1. Stakeholder Management Strategy :

- This strategy defines an approach to increase the support and minimize negative impacts of the stakeholders throughout the entire project life cycle . It includes elements such as :
 - ❖ Key stakeholders who can significantly impact the project
 - ❖ Level of participation in the project desired for each identified stakeholder, and
 - ❖ Stakeholder groups and their management (as groups)

13.1 Identify Stakeholders : Outputs

1. Stakeholder Management Strategy :

- A common way of representing the stakeholder management strategy is a stakeholder analysis matrix with column headers as shown below . Some of the information related to certain stakeholder management strategies could be too sensitive to be included in a shared document , hence the project manager must exercise his judgment with respect to the same :

| Stakeholder | Stakeholder Interest(s) in the project | Assessment Of Impact | Potential Strategies for Gaining support or reducing obstacles |
|-------------|---|----------------------|--|
| | | | |
| | | | |

13.2 Plan Stakeholder Management

Plan stakeholder Management is the process of developing appropriate management strategies to effectively engage stakeholders throughout the project life cycle, based on the analysis of their needs, interests and potential impact on project success. The key benefit of this process is that it provides a clear, actionable plan to interact with project stakeholders to support the project's interest

13.2 Plan Stakeholder Management

| Inputs | Tools & Techniques | Outputs |
|---|---|---|
| <ul style="list-style-type: none">1 Project Management Plan2. Stakeholder register3. Enterprise Environmental factors4. Organisational Process asset | <ul style="list-style-type: none">1. Meetings2. Expert Judgement .3 Analytical techniques | <ul style="list-style-type: none">1.Stakeholder Management plan2.Project documents updates |

13.1 Plan Stakeholder Management- Outputs

1. Stakeholder Management Plan

The stakeholder management plan is a component of the project management plan and identifies the management strategies required to effectively engage stakeholders. The stakeholder management plan can be formal or informal, highly detailed or broadly framed, based on the needs of the project

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13.2 Manage Stakeholder Expectations

- It is the process of communicating and working with the stakeholders to meet their needs and addressing issues as they occur
- PMI emphasize on the word “**ACTIVELY**” when it comes to stakeholder management
- PM shall **actively** manage stakeholders to
 - ❖ Obtain project acceptance
 - ❖ Negotiate and influence stakeholders for decisions favorable to project
 - ❖ Obtain approval for change requests, if necessary
 - ❖ Obtain approval on deliverables

Active and proper stakeholder management = Lower the risks in your project

13.2 Manage Stakeholder Expectations

| Inputs | Tools & Techniques | Outputs |
|--|--|---|
| <ol style="list-style-type: none"> 1. Stakeholder Register 2. Stakeholder Management Strategy 3. Project Management Plan 4. Issue Log 5. Change Log 6. Organizational process assets | <ol style="list-style-type: none"> 1. Communications methods 2. Interpersonal Skills 3. Management Skills | <ol style="list-style-type: none"> 1. Organizational process assets (updates) 2. Change Requests 3. Project management plan (updates): 4. Project Documents Updates |

13.2 Manage Stakeholder Expectations : Tools & Techniques

1. Communication Methods : the methods of communication identified for each stakeholder in the communication management plan are utilized during stakeholder management
2. Interpersonal Skills : building trust, resolving conflict, active listening, overcoming resistance to change ,etc
3. Management Skills : management is an art of directing and controlling a group of people for the purpose of coordinating and harmonizing the group towards accomplishing a goal beyond the scope of individual effort . Management skills used by the project manager include but are not limited to : presentation skills, negotiation, writing skills and public speaking , etc

13.2 Manage Stakeholder Expectations : Outputs

1. Organizational Process Assets Updates : assets that may get updated include, but not limited to : Causes of issues, reasoning behind corrective actions chosen, and lessons learned from managing stakeholder expectations
2. Change Requests : change request to the product or the project. It may also include corrective or preventive actions
3. Project Management Plan Updates
4. Project Document Updates : docs that may get updated include, but are not limited to : Stakeholder Management Strategy, stakeholder register ,issue log, etc

13.2 Manage Stakeholder Engagement

- It is the process of communicating and working with the stakeholders to meet their needs and addressing issues as they occur
- PMI emphasize on the word “**ACTIVELY**” when it comes to stakeholder management
- PM shall **actively** manage stakeholders to
 - ❖ Obtain project acceptance
 - ❖ Negotiate and influence stakeholders for decisions favorable to project
 - ❖ Obtain approval for change requests, if necessary
 - ❖ Obtain approval on deliverables

Active and proper stakeholder management = Lower the risks in your project

13.2 Manage Stakeholder Engagement

| Inputs | Tools & Techniques | Outputs |
|--|--|---|
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13.2 Manage Stakeholder Engagement : Tools & Techniques

1. Communication Methods : the methods of communication identified for each stakeholder in the communication management plan are utilized during stakeholder management
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2. Change Requests : change request to the product or the project. It may also include corrective or preventive actions
3. Project Management Plan Updates
4. Project Document Updates : docs that may get updated include, but are not limited to : Stakeholder Management Strategy, stakeholder register ,issue log, etc

13.3 Control Stakeholders Engagement

Control Stakeholder Engagement is the process of monitoring Overall project stakeholder relationships and adjusting strategies and plans for engaging stakeholders. The key benefit of this process is that it will maintain or increase the efficiency and effectiveness of stakeholder engagement activities as the project evolves and its environment changes

10.2 Control Stakeholder Engagement

| Inputs | Tools & Techniques | Outputs |
|---|---|--|
| <ul style="list-style-type: none">1. Project Management Plan2. Issue Log3. Work Performance Data4. Project documents | <ul style="list-style-type: none">1. Information Management Systems2. Expert Judgement3. Meetings | <ul style="list-style-type: none">1. Work performance information2. Change requests3. Project document updates4. Project Management Plan updates5. Organisation Process assets updates |