

C303 IT Project Management

Lesson 1

Learning Outcomes

- State the characteristics of a project.
- State the purpose of project management.
- State the roles and responsibilities of key stakeholders in an IT project, for example, the project manager, technical lead, business analyst and project sponsor.
- Explain the structure of a project management framework.
- Distinguish between project management plans, project management documents, and product development documents.

What is a Project?

A project is a temporary endeavor undertaken to create a **unique product, service, or result.**

Fulfillment of project objectives may produce:

- A unique product
- A unique service or a capability to perform a service
- A unique result, such as an outcome or document
- A unique combination of one or more products, services, or results

Projects are different from operations. Operations have on-going, repetitive activities, such as accounting or production.

Assumptions, Constraints, Risks

- Assumptions

Expectations about the future which, if not fulfilled, will have an impact on the project. For example, an assumption that savings achieved will be similar to a project undertaken several years earlier.

Beliefs of what you assume to be true in the future based on your knowledge, experience or information available on hand

- Constraints

Limitations imposed on project

- Risks

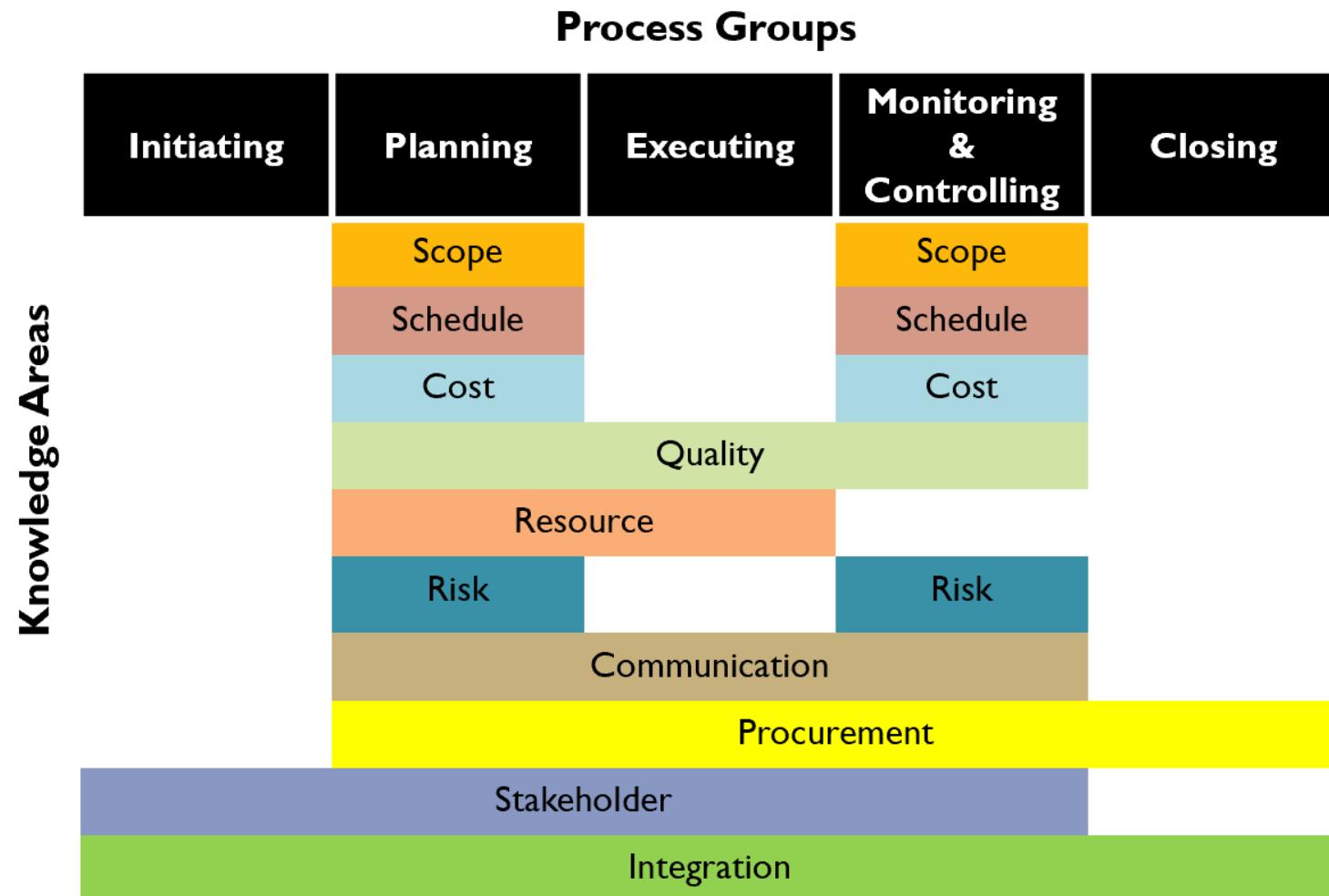
Uncertain events which may have an impact on the project. For example, the uncertain event may be the unexpected absence of specialist staff, and the impact if this happened would be a delay to the project.

“You can live with your assumptions, but you must manage your risks.” ~ unknown

Process Groups, Processes, Knowledge Areas

- All of the work to be done on a project is made up of processes.
- Processes are described in terms of
 1. Inputs (documents, plans, designs, etc.)
 2. Tools and Techniques (mechanisms applied to inputs)
 3. Outputs (documents, plans, designs, etc.)
- Processes are categorised into **5** basic process groups and **10** knowledge areas under the Project Management Framework.

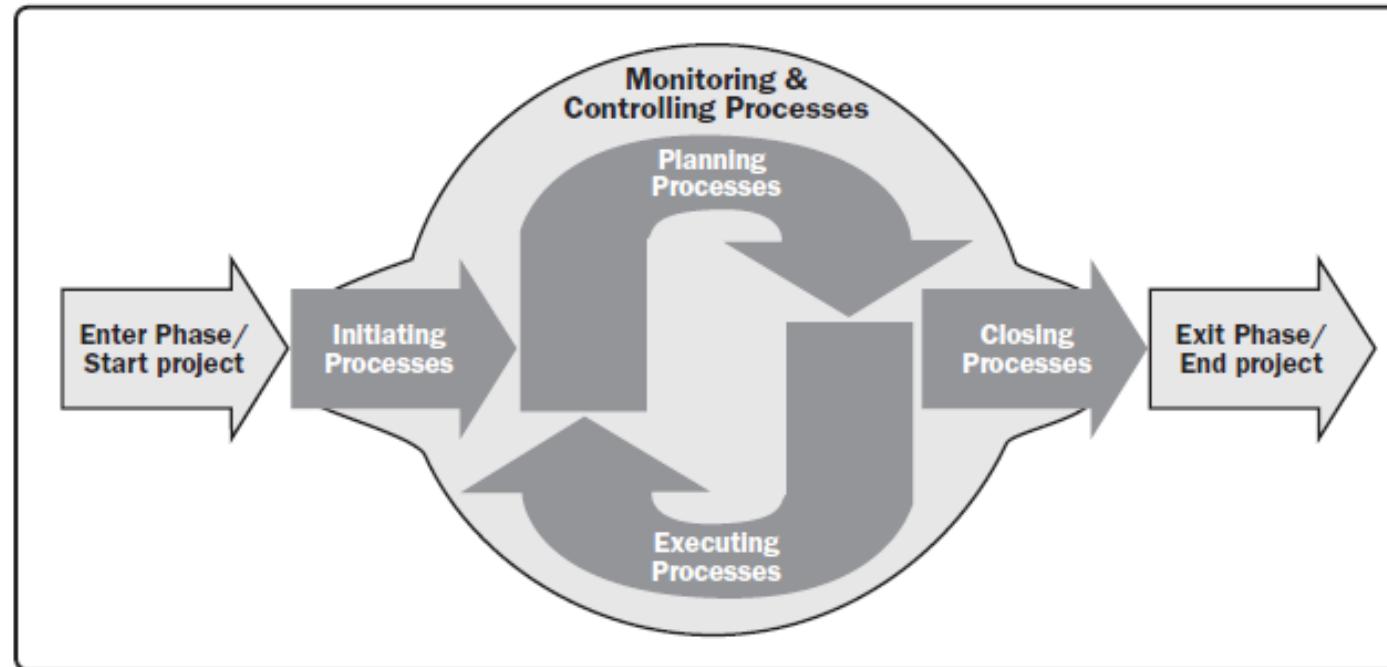
Project Management Framework



Adapted from PMBOK® Guide – Sixth Edition

Process Groups

- The Process Groups Are NOT Project Life Cycle Phases



- In software development projects, we can apply the distinct SDLC phases of analysis, design, develop, test etc., and within the phases, some parts of the Process Groups will be repeated for each phases.

Initiating

- A project typically starts off with a project sponsor who has some needs to be achieved, provides the funding and expected timeline for the project.
- In this lesson, the class lecturer is the project sponsor for themed party project.
- There should be a project manager or project leader appointed to lead the entire team, and to direct and control the activities.

Planning

- Team members may be assigned or selected by the project manager.
- Project manager should observe the strengths of each team member, distribute tasks based on his/her strengths and interests.
- After understanding and firming up the requirements, the team needs to develop the timeline, activities and work allocations.
- The team should also validate that the requirements can be met given the budget and schedule. If not, additional resources or budget required should be discussed and/or requested.
- Break the main activities into smaller and manageable activities. Prioritize the activities so that the important ones get done first.
- In addition, the team needs to determine what can go wrong, prevent them, and/or have possible resolutions.

Executing

- The project manager needs to ensure that the project runs smoothly according to plan.(e.g. the party proposal is according to the party theme).
- Along the way, the project manager needs to provide project stakeholders with regular reports on the progress and issues encountered during the project.

Monitoring and Controlling

- The team needs to ensure that the plan will run accordingly to the given time, budget, and scope.
- The team also needs to monitor the performance of any vendors or suppliers engaged.
- The team needs to keep a lookout for risks and have suitable backup plans.
- When developing the party proposal, your team would have to consistently check that the items in the proposal are in accordance with the party theme.

Closing

- When the event has finally completed, the project team needs to close the project. This may include handover of documentations, equipment, unutilised funds, make final payment, etc.
- The team would prepare a report or conduct a presentation to the project sponsor. The report should include feedback from the stakeholders, and document the experiences gathered.
- The team could celebrate the completion of a successful project.

In Summary

- Project

A temporary endeavour undertaken to create a unique product, service or result.

Examples include Final Year Project, Student Overseas Trip, etc.

- Project management

The application of knowledge, tools, skills and techniques to manage project activities to meet project desired outcomes.

- Project manager

A role or job position that is responsible for ensuring appropriate project management processes are in place and carried out in order to meet the objectives and deliverables of the project.

Thank you!

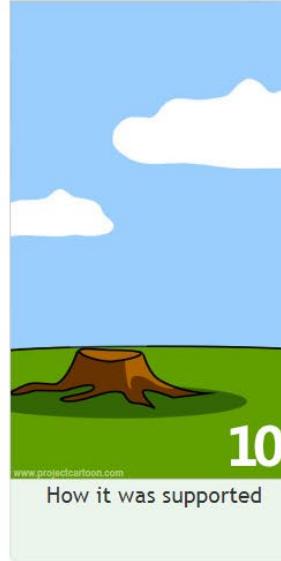
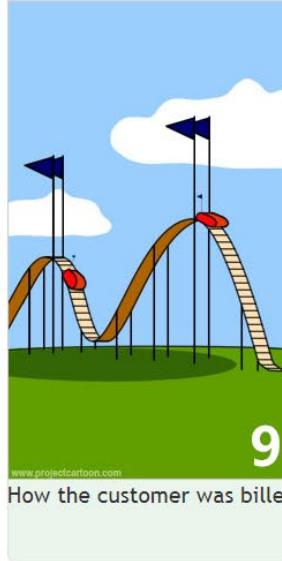
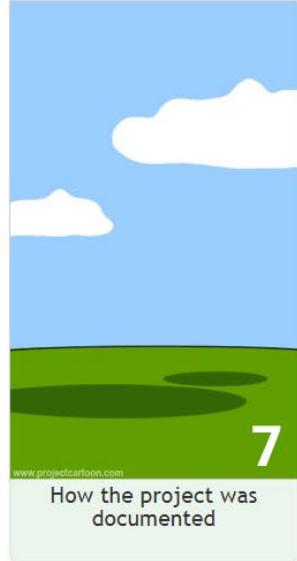
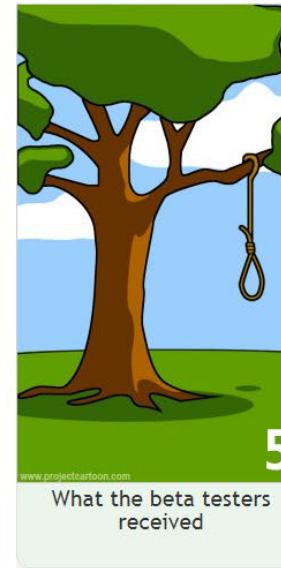
C303 IT Project Management

Lesson 3

Learning Outcomes

- State the purpose of project management
- Distinguish between project management plans, project management documents and product development documents
- Determine appropriate project methodology, methods and practices
- Explain the Delivery Approaches: Predictive, Adaptive, and Hybrid Methods

Project Management - A Tree Swing Story



Recap: What is a Project?

A project is a temporary endeavor undertaken to create a **unique product, service, or result.**

Fulfillment of project objectives may produce:

- A unique product
- A unique service or a capability to perform a service
- A unique result, such as an outcome or document
- A unique combination of one or more products, services, or results

Projects are different from operations. Operations have on-going, repetitive activities, such as accounting or production.

Project Temporary endeavor

Projects are temporary, but their deliverables may exist beyond the end of the project.

Projects may produce deliverables of a social, economic, material, or environmental nature.

The end of the project is reached :

- The project's objectives have been achieved
- The objectives will not or cannot be met
- Funding is exhausted or no longer available for allocation to the project
- The need for the project no longer exists
- The human or physical resources are no longer available
- The project is terminated for legal cause or convenience



Read Details in PMBOK Guide 6th Edition Part 1: 1.2.1 Projects

Project Management

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.

Project management enables organizations to execute projects effectively and efficiently.

Poorly managed projects or the absence of project management may result in:

- Missed deadlines
- Cost overruns
- Poor quality
- Rework
- Uncontrolled expansion of the project
- Loss of reputation for the organization
- Unsatisfied stakeholders
- Failure in achieving the objectives for which the project was undertaken



Read Details in PMBOK Guide 6th Edition Part 1: 1.2.2 The Importance of Project Management

Project Management

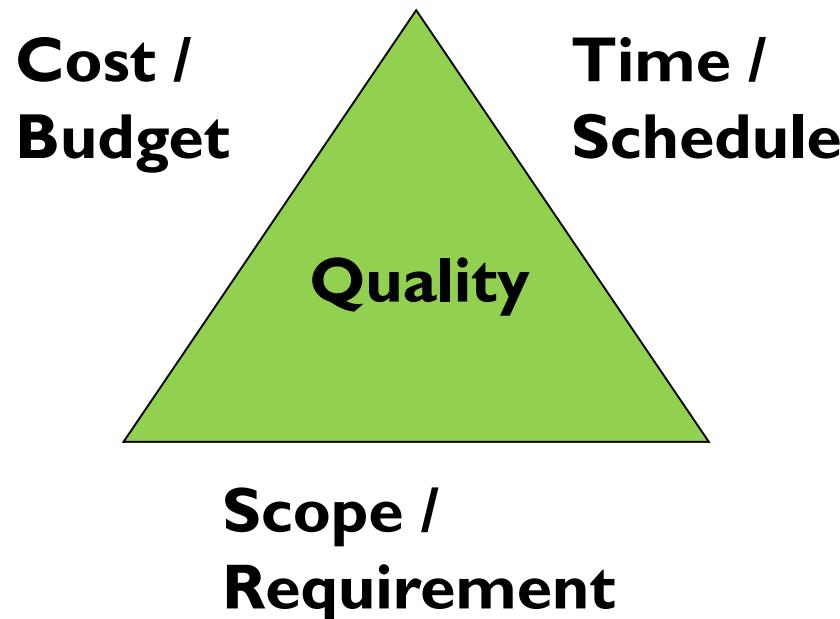
Managing a project typically includes but is not limited to:

- Identifying project requirements;
- Addressing the various needs, concerns, and expectations of stakeholders;
- Establishing and maintaining active communication with stakeholders;
- Managing resources; and
- Balancing the competing project constraints typically include: Scope, Schedule, Cost, Quality, Resources, and Risk.



Read Details in PMBOK Guide 6th Edition Part 2: 1.1 Projects and Project Management

Triple Constraints in Project Management



The triple constraints of project management describe the interdependency between the three cornerstones of a project.

Scope, Schedule, Cost form the building blocks of any project plans, and yet in nature they are opposing constraints.

Relationship of Project, Program, Portfolio

- A **project** may be managed in three separate scenarios: as a stand-alone project (outside of a portfolio or program), within a program, or within a portfolio.
- A **program** is defined as a group of related projects, subsidiary programs, and program activities managed in a coordinated manner to obtain benefits not available from managing them individually.
- A **portfolio** is defined as projects, programs, subsidiary portfolios, and operations managed as a group to achieve strategic objectives.



Read Details in PMBOK Guide 6th Edition 1.2.3 Relationship of Project, Program, Portfolio, and Operations Management

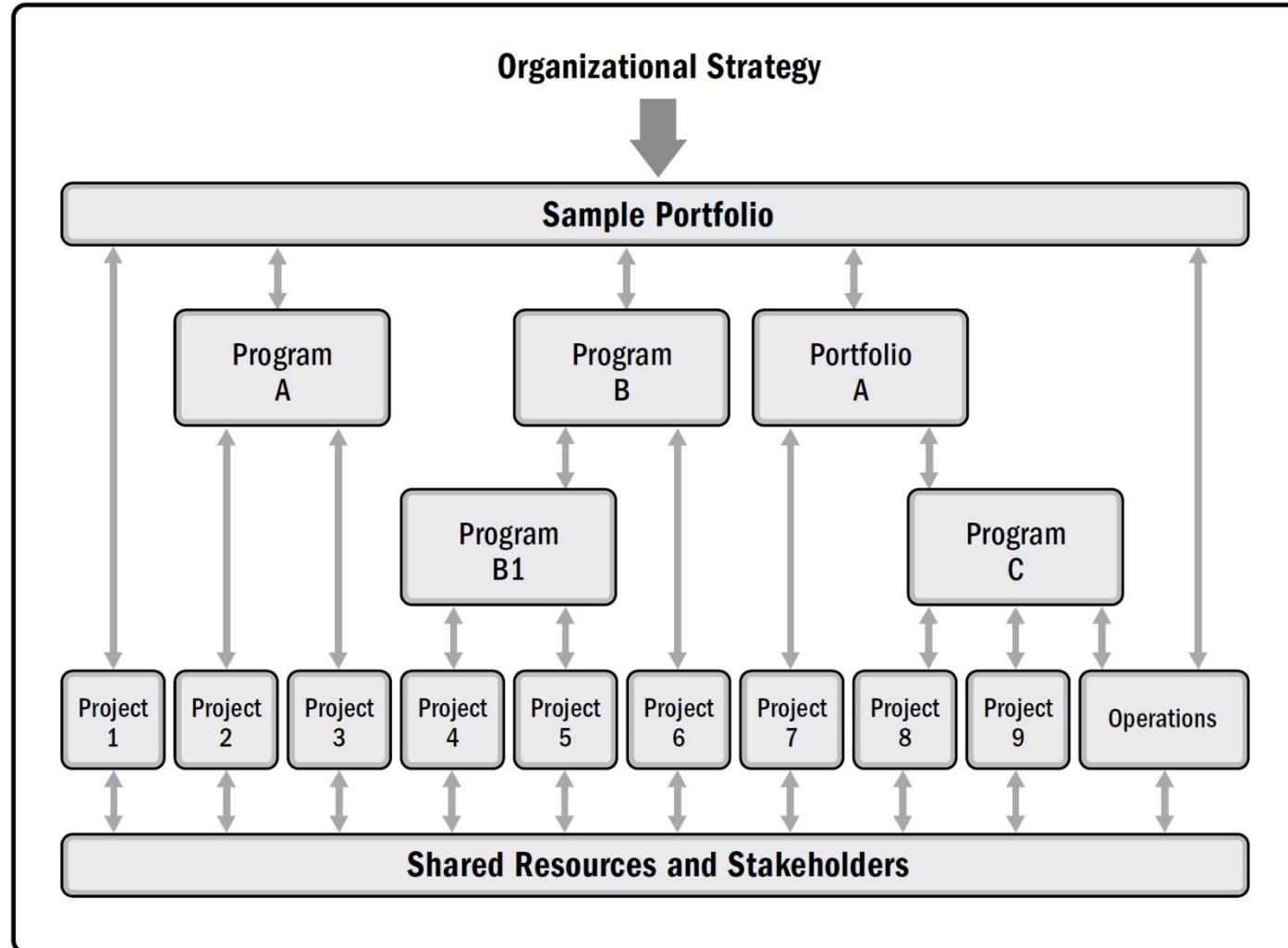
Relationship of Project, Program, Portfolio

Portfolios, programs, and projects are aligned with or driven by organizational strategies and differ in the way each contributes to the achievement of strategic goals:

- Portfolio management aligns portfolios with organizational strategies by selecting the right programs or projects, prioritizing the work, and providing the needed resources.
- Program management harmonizes its program components and controls interdependencies in order to realize specified benefits.
- Project management enables the achievement of organizational goals and objectives.

Program and project management focus on doing programs and projects the “right” way; and Portfolio management focuses on doing the “right” programs and projects.

Relationship of Project, Program, Portfolio



Relationship of Project, Program, Portfolio

Organizational Project Management			
	Projects	Programs	Portfolios
Definition	A project is a temporary endeavor undertaken to create a unique product, service, or result.	A program is a group of related projects, subsidiary programs, and program activities that are managed in a coordinated manner to obtain benefits not available from managing them individually.	A portfolio is a collection of projects, programs, subsidiary portfolios, and operations managed as a group to achieve strategic objectives.
Scope	Projects have defined objectives. Scope is progressively elaborated throughout the project life cycle.	Programs have a scope that encompasses the scopes of its program components. Programs produce benefits to an organization by ensuring that the outputs and outcomes of program components are delivered in a coordinated and complementary manner.	Portfolios have an organizational scope that changes with the strategic objectives of the organization.
Change	Project managers expect change and implement processes to keep change managed and controlled.	Programs are managed in a manner that accepts and adapts to change as necessary to optimize the delivery of benefits as the program's components deliver outcomes and/or outputs.	Portfolio managers continuously monitor changes in the broader internal and external environments.
Planning	Project managers progressively elaborate high-level information into detailed plans throughout the project life cycle.	Programs are managed using high-level plans that track the interdependencies and progress of program components. Program plans are also used to guide planning at the component level.	Portfolio managers create and maintain necessary processes and communication relative to the aggregate portfolio.
Management	Project managers manage the project team to meet the project objectives.	Programs are managed by program managers who ensure that program benefits are delivered as expected, by coordinating the activities of a program's components.	Portfolio managers may manage or coordinate portfolio management staff, or program and project staff that may have reporting responsibilities into the aggregate portfolio.
Monitoring	Project managers monitor and control the work of producing the products, services, or results that the project was undertaken to produce.	Program managers monitor the progress of program components to ensure the overall goals, schedules, budget, and benefits of the program will be met.	Portfolio managers monitor strategic changes and aggregate resource allocation, performance results, and risk of the portfolio.
Success	Success is measured by product and project quality, timeliness, budget compliance, and degree of customer satisfaction.	A program's success is measured by the program's ability to deliver its intended benefits to an organization, and by the program's efficiency and effectiveness in delivering those benefits.	Success is measured in terms of the aggregate investment performance and benefit realization of the portfolio.

Role of Project Manager

- The project manager leads the project team to meet the project's objectives and stakeholders' expectations.
- Many project managers become involved in a project from its initiation through closing. However, in some organizations, a project manager may be involved in evaluation and analysis activities prior to project initiation.
- The project manager also performs communication roles between the project sponsor, team members, and other stakeholders. He/ she uses soft skills (e.g., interpersonal skills and the ability to manage people) to balance the conflicting and competing goals of the project stakeholders in order to achieve consensus.
- The role of a project manager is distinct from that of a functional manager or operations manager.

Project Stakeholders

A stakeholder is an individual, group, or organization that may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project.

Examples of Internal Stakeholders:

- Sponsor
- Resource manager,
- Project management office (PMO)
- Portfolio steering committee
- Program manager
- Project managers of other projects
- Team members

Examples of External Stakeholders:

- Customers
- End users
- Suppliers
- Shareholders
- Regulatory bodies
- Competitors



Read Details in PMBOK Guide 6th Edition Part 2: 1.6 Projects Stakeholders

Project Artifacts

The project manager and the project management team select and adapt the appropriate artifacts for use on their specific project. Project Artifacts includes project management processes, inputs, tools, techniques, outputs, enterprise environmental factors (EEFs) and organizational process assets (OPAs).

The **Project Management Plan** is one of the primary project artifacts, but there are other documents that are not part of the project management plan that are used to manage the project. These other documents are called project documents.

The **Project Manager** is accountable for identifying the project documents needed for a process and the project documents that will be updated as an output of a process.

Project Management Plan and Project Documents

Project Management Plan	Project Documents	
1. Scope management plan	1. Activity attributes	19. Quality control measurements
2. Requirements management plan	2. Activity list	20. Quality metrics
3. Schedule management plan	3. Assumption log	21. Quality report
4. Cost management plan	4. Basis of estimates	22. Requirements documentation
5. Quality management plan	5. Change log	23. Requirements traceability matrix
6. Resource management plan	6. Cost estimates	24. Resource breakdown structure
7. Communications management plan	7. Cost forecasts	25. Resource calendars
8. Risk management plan	8. Duration estimates	26. Resource requirements
9. Procurement management plan	9. Issue log	27. Risk register
10. Stakeholder engagement plan	10. Lessons learned register	28. Risk report
11. Change management plan	11. Milestone list	29. Schedule data
12. Configuration management plan	12. Physical resource assignments	30. Schedule forecasts
13. Scope baseline	13. Project calendars	31. Stakeholder register
14. Schedule baseline	14. Project communications	32. Team charter
15. Cost baseline	15. Project schedule	33. Test and evaluation documents
16. Performance measurement baseline	16. Project schedule network diagram	
17. Project life cycle description	17. Project scope statement	
18. Development approach	18. Project team assignments	



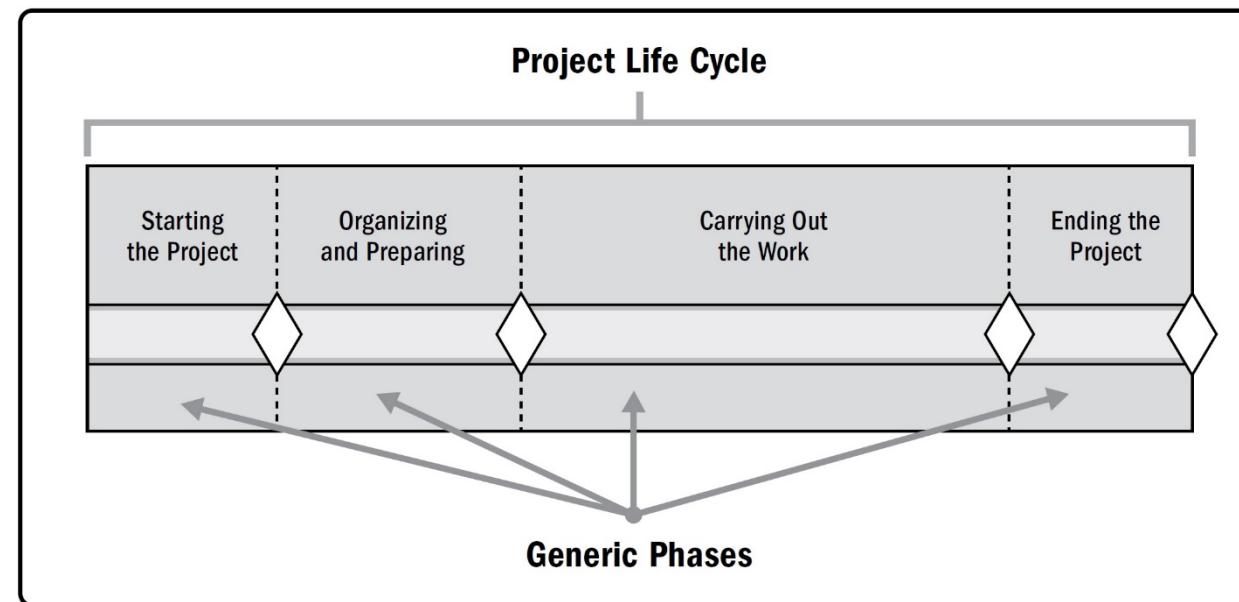
Read Details in PMBOK Guide 6th Edition Part 2: 1.11 Tailoring the Project Artifacts

Project Life Cycle

A project life cycle is the series of phases that a project passes through from its start to its completion. The life cycle provides the basic framework for managing the project.

A project phase is a collection of logically related project activities that culminates in the completion of one or more deliverables. The phases can be sequential, iterative, or overlapping.

A typical project follows the following project life cycle structure:

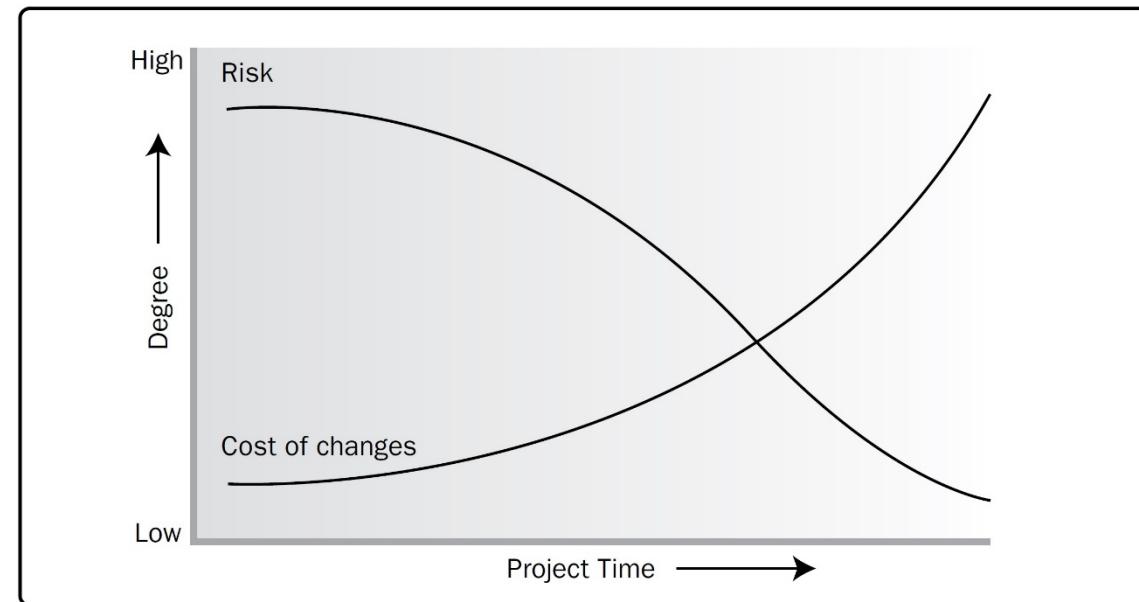


Project Life Cycle

Cost and staffing levels are low at the start, increase as the work is carried out, and drop rapidly as the project draws to a close.

Risk is greatest at the start of the project.

Cost of making changes and correcting errors typically increases substantially as the project approaches completion.



Read Details in PMBOK Guide 6th Edition Part 2: 1.5 The Project Life Cycle

Development Approach

- **Deliverable:** Any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.
- **Development Approach:** A method used to create and evolve the product, service, or result during the project life cycle, such as a predictive, iterative, incremental, adaptive, or hybrid method.
- **Cadence:** A rhythm of activities conducted throughout the project.
- **Project Phase:** A collection of logically related project activities that culminates in the completion of one or more deliverables.
- **Project Life Cycle:** The series of phases that a project passes through from its start to its completion.



Read Details in PMBOK Guide 7th Edition: 2.3 Development Approach and Life Cycle Performance Domain

Delivery Cadence

Delivery cadence refers to the timing and frequency of project deliverables.

- Single delivery

Projects that have a single delivery deliver at the end of the project.

- Multiple Deliveries

Some projects have multiple deliveries. A project may have multiple components that are delivered at different times throughout the project.

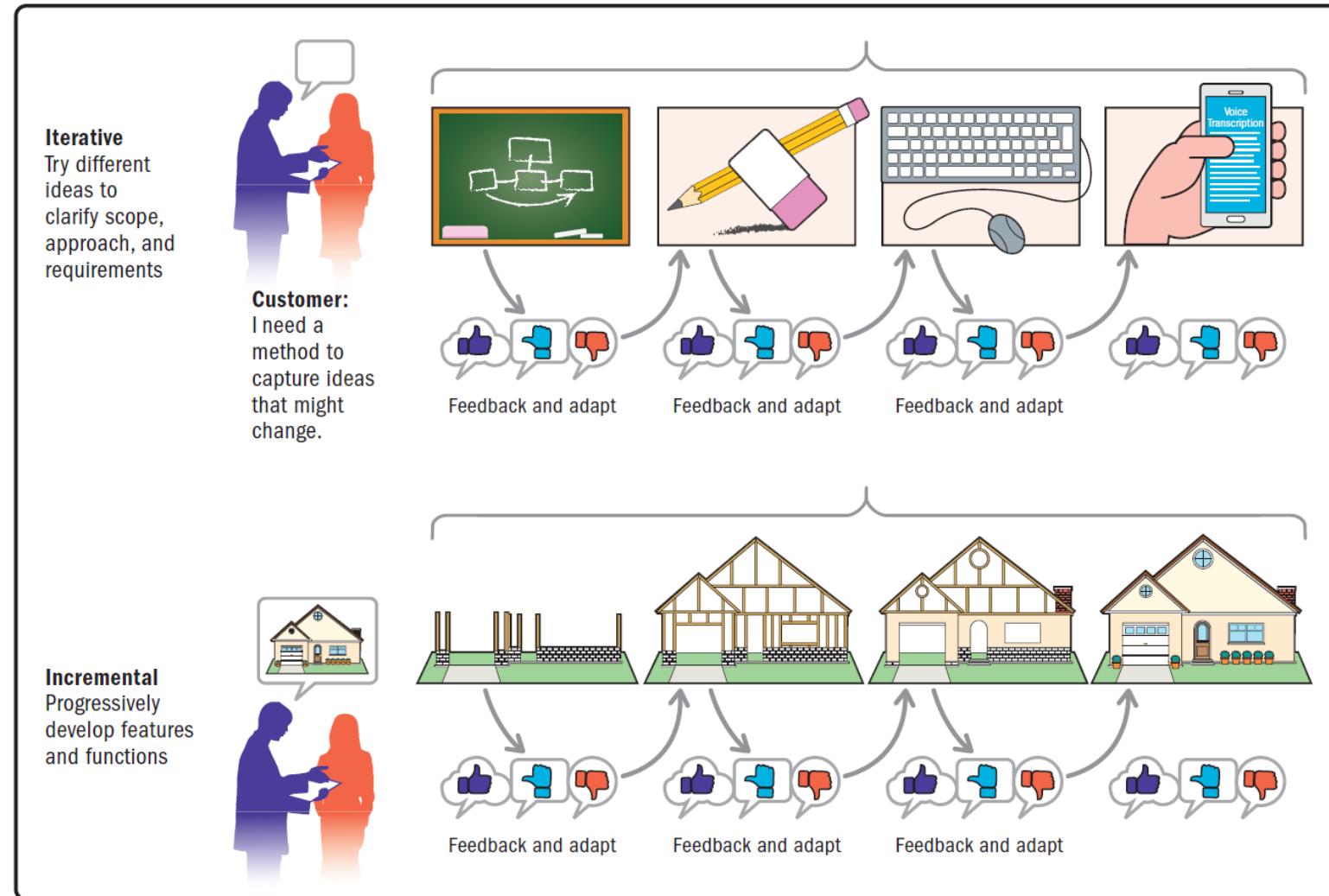
- Periodic Deliveries

Periodic deliveries are like multiple deliveries, but they are on a fixed delivery schedule, such as monthly or bimonthly.

- Continuous Delivery

Continuous delivery is the practice of delivering feature increments immediately to customers, often through the use of small batches of work and automation technology.

Iterative and Incremental Development



Selecting a Development Approach

There are several factors that influence the selection of a development approach.

Product, Service, or Result	Project	Organization
<ul style="list-style-type: none">▪ Degree of innovation▪ Requirements certainty▪ Scope stability▪ Ease of change▪ Delivery options▪ Risk▪ Safety requirements▪ Regulations	<ul style="list-style-type: none">▪ Stakeholders▪ Schedule Constraints▪ Funding Availability	<ul style="list-style-type: none">▪ Organizational Structure▪ Culture▪ Organizational Capability▪ Project Team Size And Location



Read Details in PMBOK Guide 7th Edition: 2.3.4 Considerations For Selecting A Development Approach

Thank you!

C303 IT Project Management

Lesson 5

Learning Outcomes

- State the purpose of scope management
- Describe the processes related to scope management
- Explain the causes and impact of scope creep
- Explain the organisation, roles and responsibilities of change control board in managing scope creep
- Explain the purpose of a work breakdown structure (WBS) and its components such as milestones and deliverables

Project Scope Management

Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully.

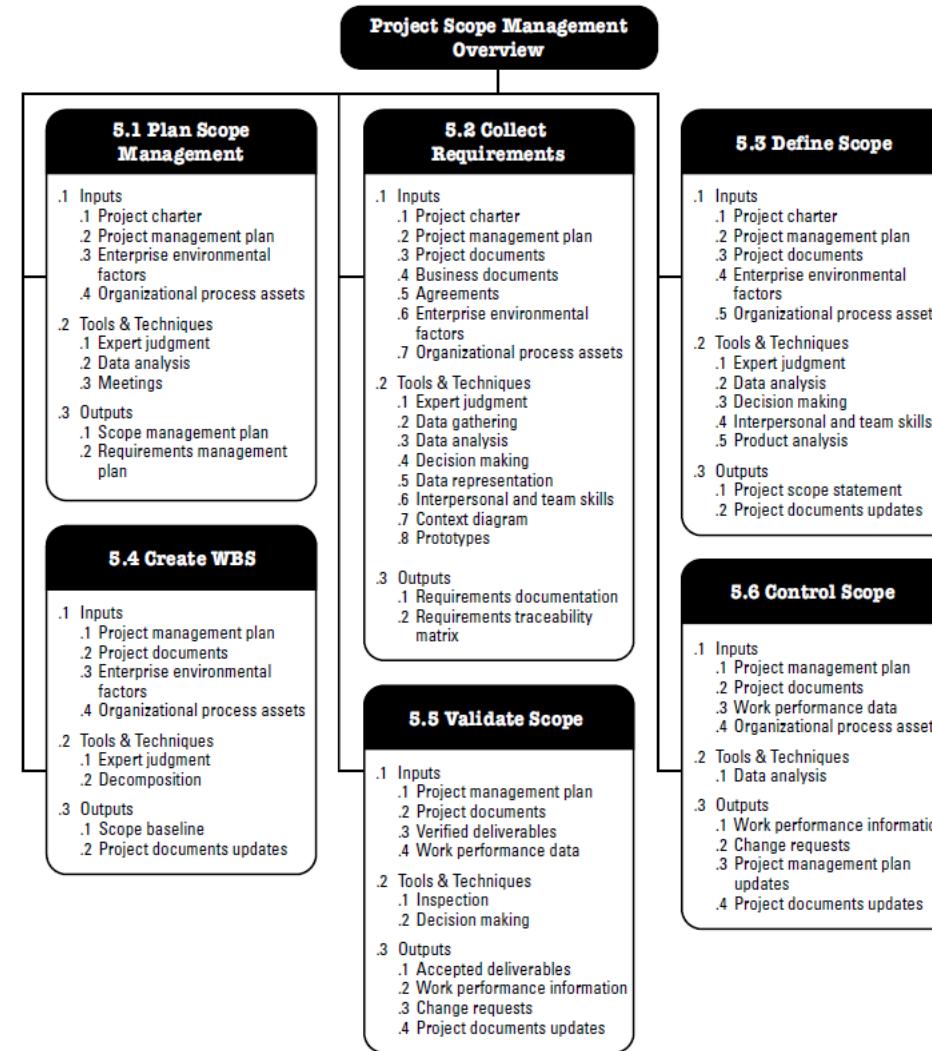
The Project Scope Management processes are:

1. Plan Scope Management
2. Collect Requirements
3. Define Scope
4. Create WBS
5. Validate Scope
6. Control Scope



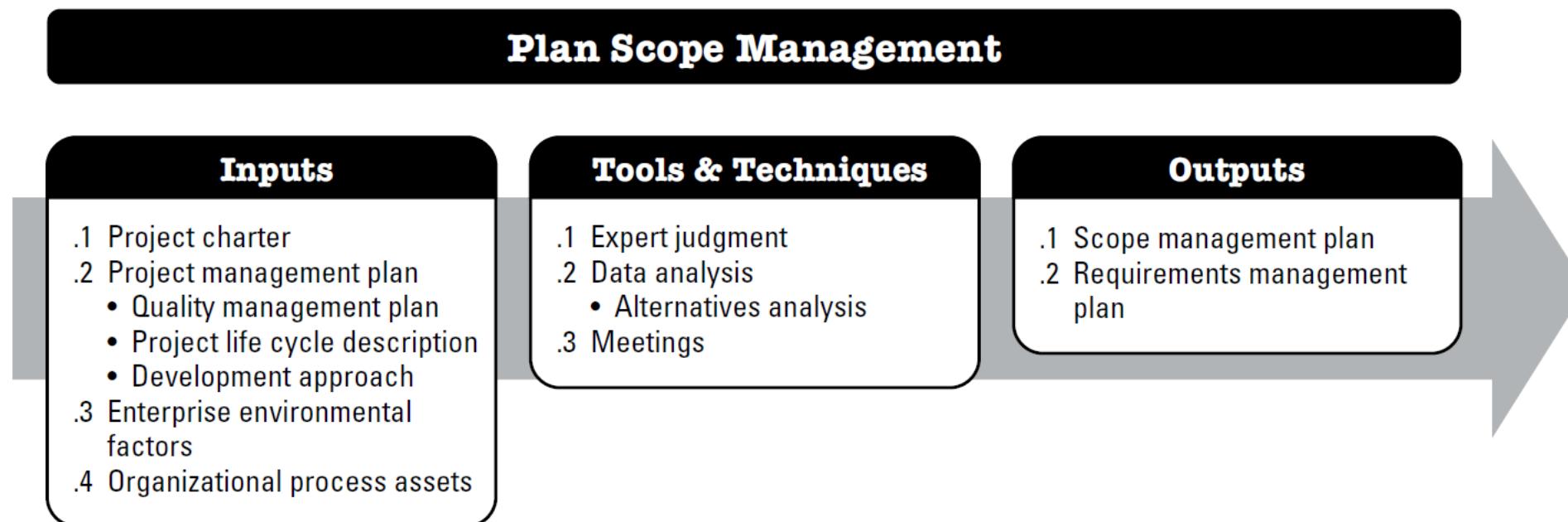
Read Details in PMBOK Guide 6th Edition Part 1: 5. Project Scope Management

Project Scope Management Overview



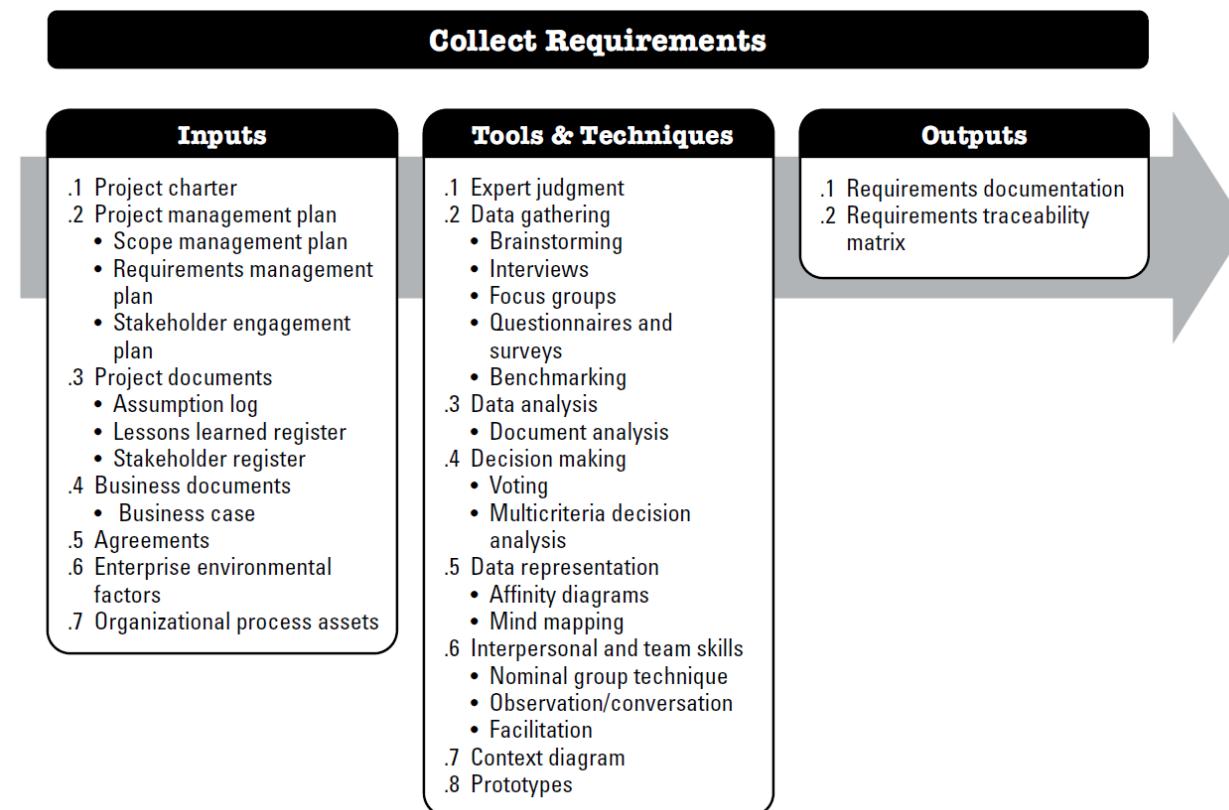
Plan Scope Management

Plan Scope Management is the process of creating a scope management plan that documents how the project and product scope will be defined, validated, and controlled.



Collect Requirements

Collect Requirements is the process of determining, documenting, and managing stakeholder needs and requirements to meet objectives.



Collect Requirements: Tools and Techniques

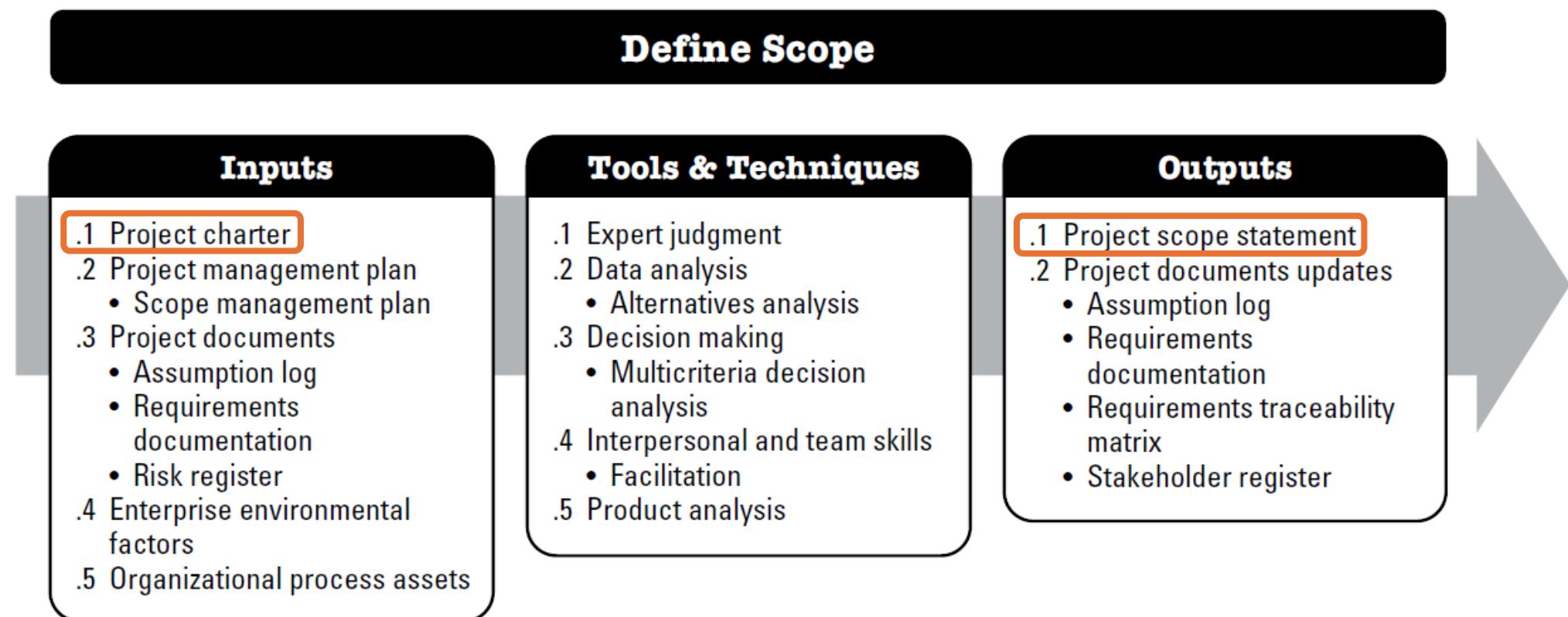
- Expert Judgment

Expertise should be considered from individuals or groups with specialized knowledge.

- Data Gathering
 - Brainstorming
 - Interviews
 - Focus groups
 - Questionnaires and surveys
 - Benchmarking

Define Scope

Define Scope is the process of developing a detailed description of the project and product.



Project Charter and Project Scope Statement

- Define Scope: Inputs

- Project Charter

The project charter provides the high-level project description, product characteristics, and approval requirements.

- Define Scope: Outputs

- Project Scope Statement

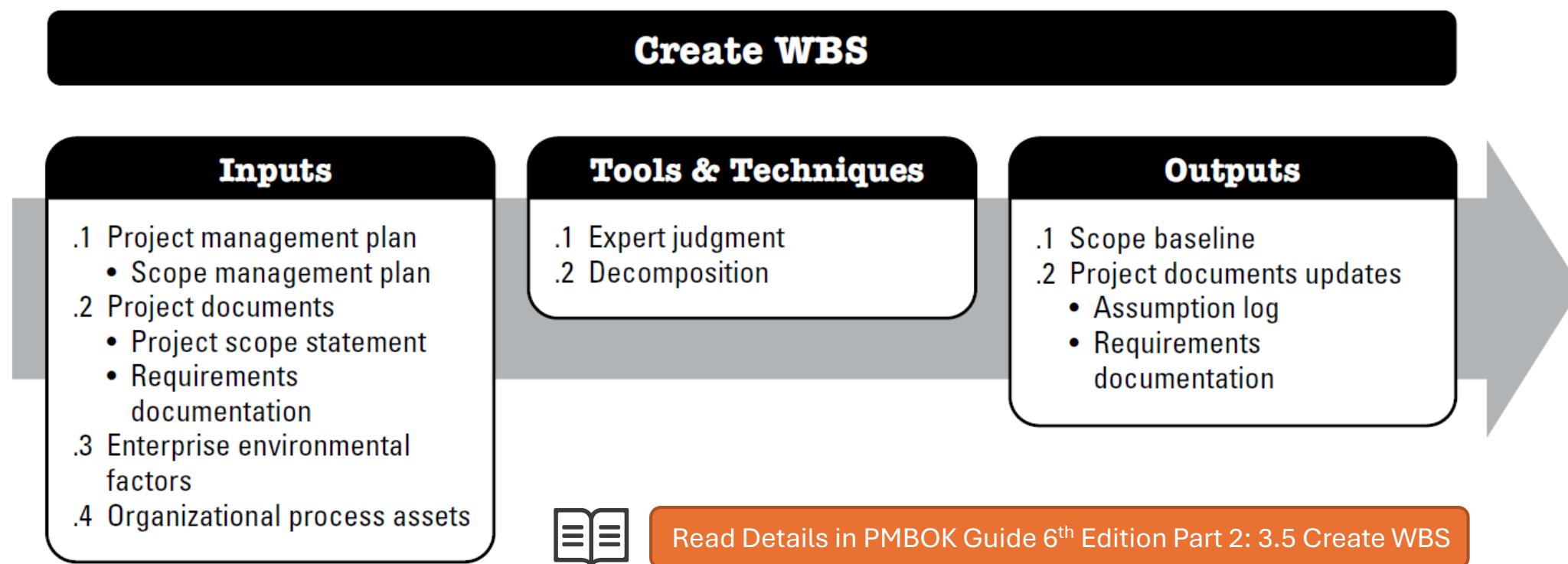
The project scope statement is the description of the project scope, major deliverables, assumptions, and constraints. The project scope statement documents the entire scope, including project and product scope.

Elements of the Project Charter and Project Scope Statement

Project Charter	Project Scope Statement
Project purpose	Project scope description (progressively elaborated)
Measurable project objectives and related success criteria	Project deliverables
High-level requirements	Acceptance criteria
High-level project description, boundaries, and key deliverables	Project exclusions
Overall project risk	
Summary milestone schedule	
Preapproved financial resources	
Key stakeholder list	
Project approval requirements (i.e., what constitutes success, who decides the project is successful, who signs off on the project)	
Project exit criteria (i.e., what are the conditions to be met in order to close or to cancel the project or phase)	
Assigned project manager, responsibility, and authority level	
Name and authority of the sponsor or other person(s) authorizing the project charter	

Create WBS

Create WBS is the process of subdividing project deliverables and project work into smaller, more manageable components. The key benefit of this process is that it provides a framework of what has to be delivered.



Create WBS: Decomposition

Decomposition of the total project work into work packages generally involves the following activities:

- Identifying and analyzing the deliverables and related work,
- Structuring and organizing the WBS,
- Decomposing the upper WBS levels into lower-level detailed components,
- Developing and assigning identification codes to the WBS components, and
- Verifying that the degree of decomposition of the deliverables is appropriate.

Elements in WBS

- Phase: Refers to a **stage** in the life cycle or methodology adopted by the project.
- Deliverable: Refers to **outcomes** such as presentation, reports, prototypes, website, or hardware
 - Naming convention: Noun
 - E.g. Project Documentation; Website
- Activity / Task: Refers to **work to be performed**.
 - Naming convention: Verb Noun
 - E.g. install Database; conduct Meeting, develop prototype
 - Assign an ActivityID or TaskID to each Activity / Task.
- Milestone: Refers to a significant event or achievement that provides evidence that a deliverable has been completed or a phase is formally over. It is usually marked as **0 day duration** on Microsoft Project.
 - Naming convention: Named as past events.
 - E.g. “Testing Completed”, Test Results Signoff

Steps to solve the problem

Identify the scope of the project including all deliverables to complete the project



Decompose the deliverables of the project into manageable parts, including project management deliverables



Identify the activities/tasks needed to create the deliverables



Identify any significant milestones for the deliverables



Organise the deliverables, activities and milestones into work packages, using either phase and/or product approach

Step 1: Identify All Deliverables

Deliverable #6

Deliverable #7

Deliverable #3

Deliverable #8

Deliverable #5

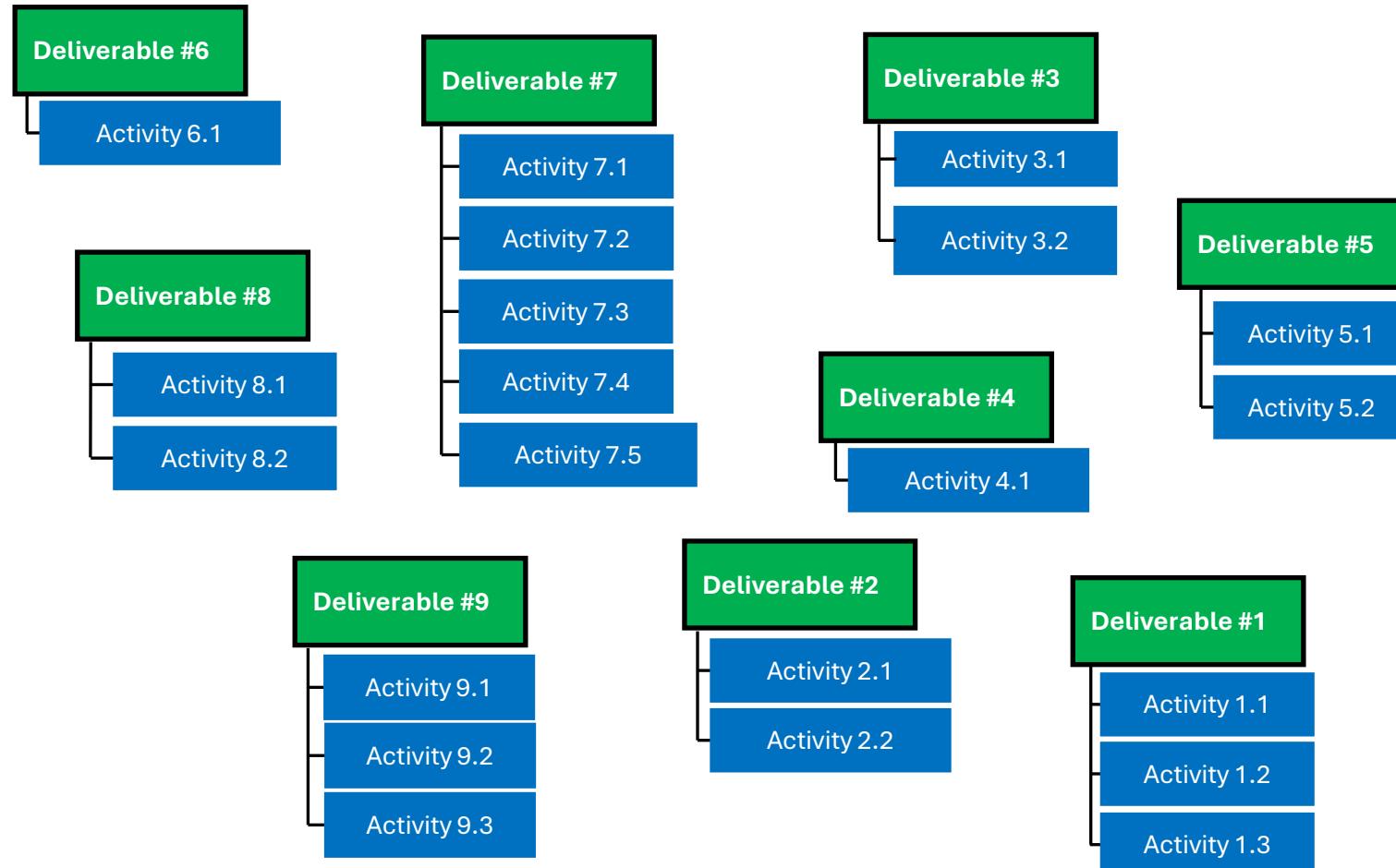
Deliverable #4

Deliverable #9

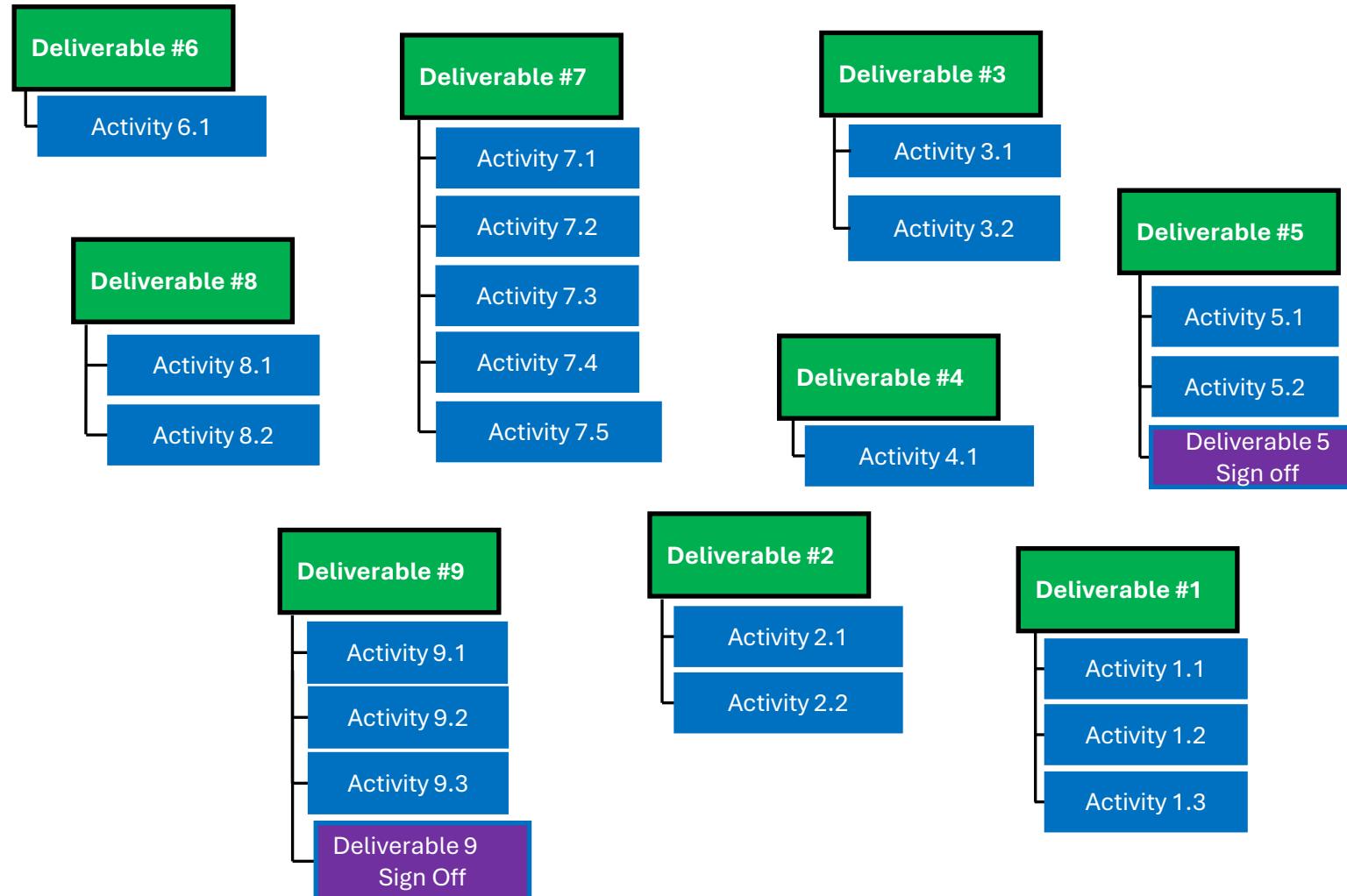
Deliverable #2

Deliverable #1

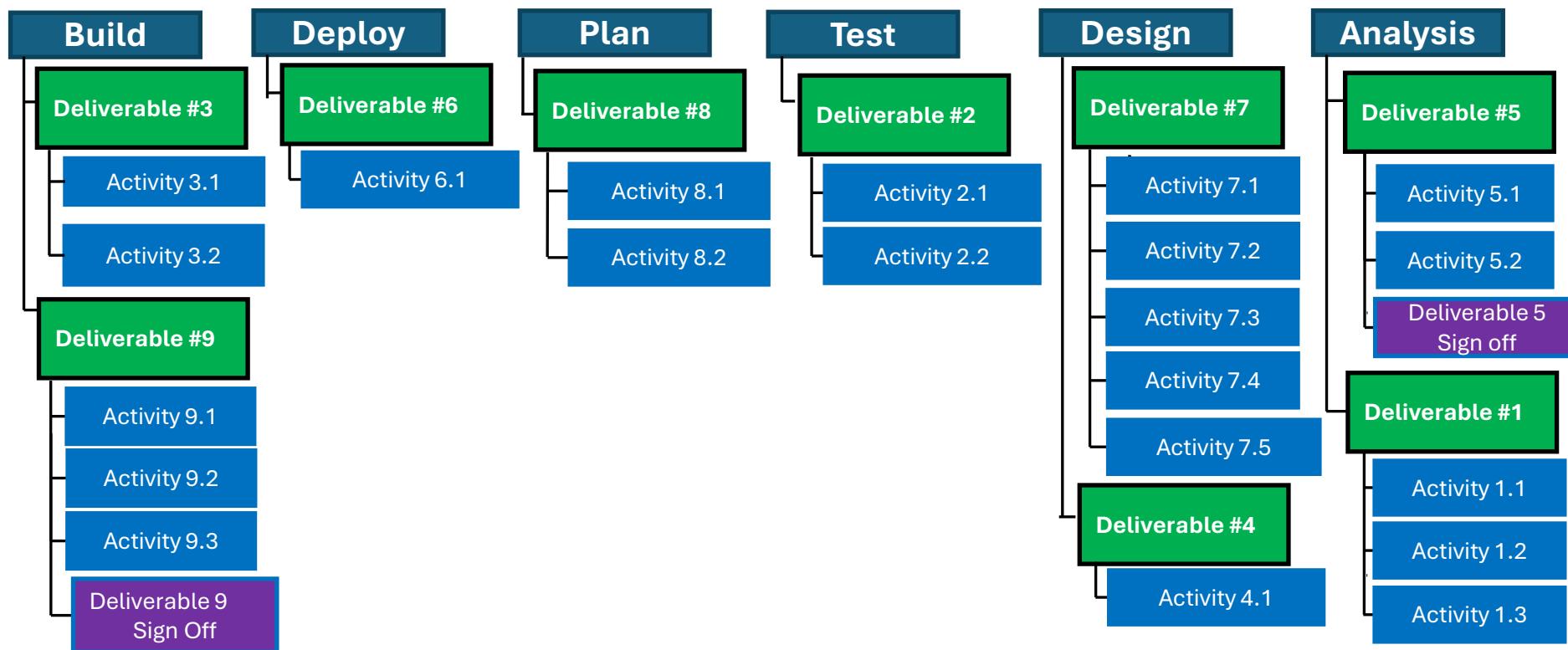
Step 2: Identify corresponding activities



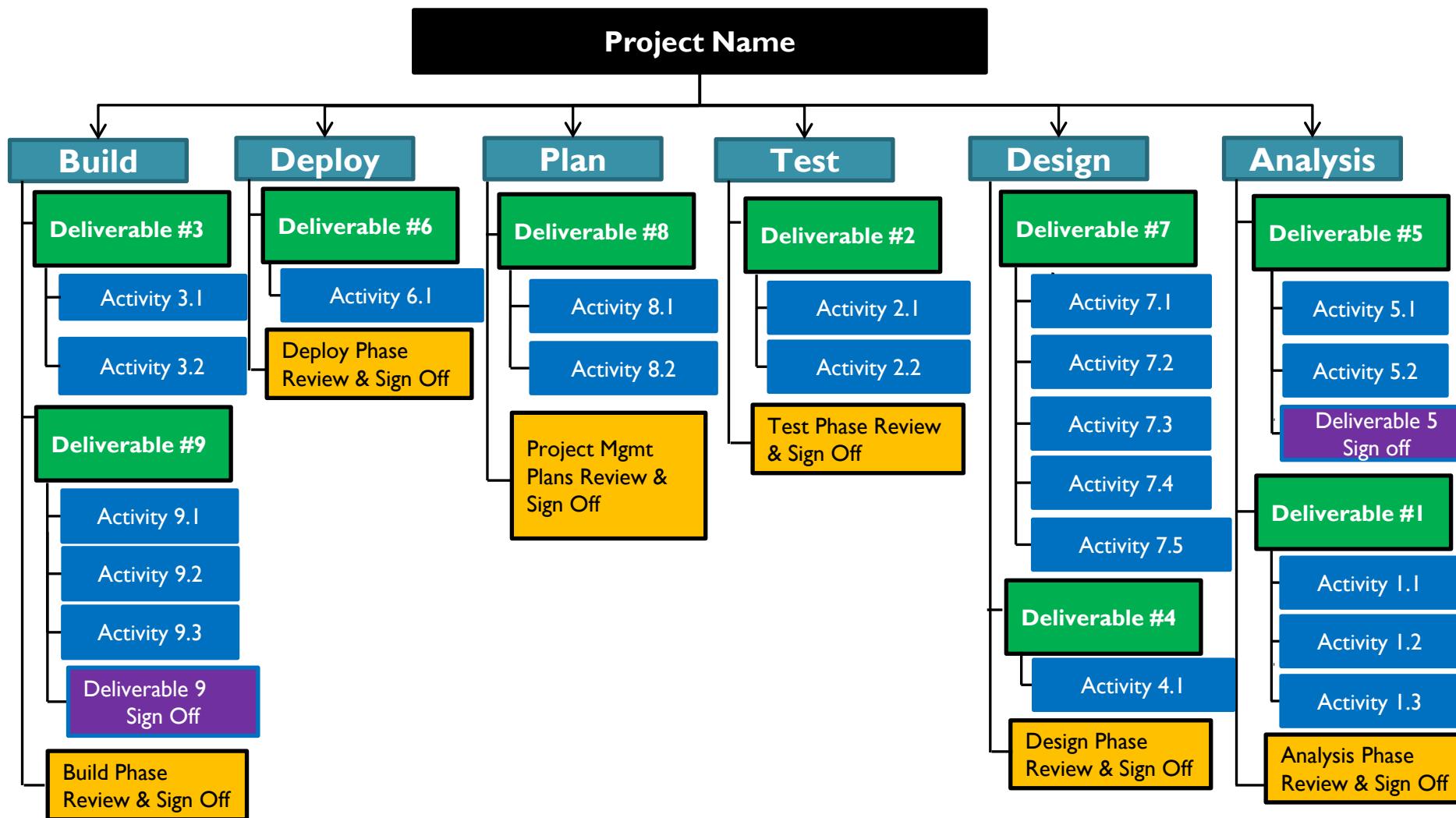
Step 3: Identify significant milestones



Step 4: Organise into SDLC Phases for Software Development Projects

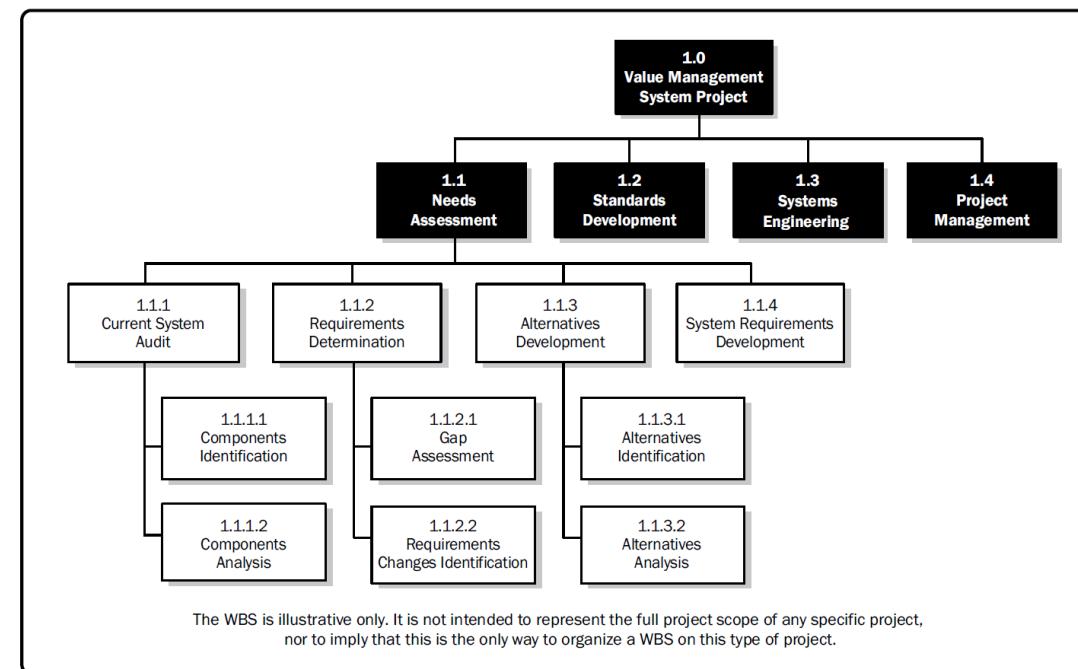


Step 5: Add milestones



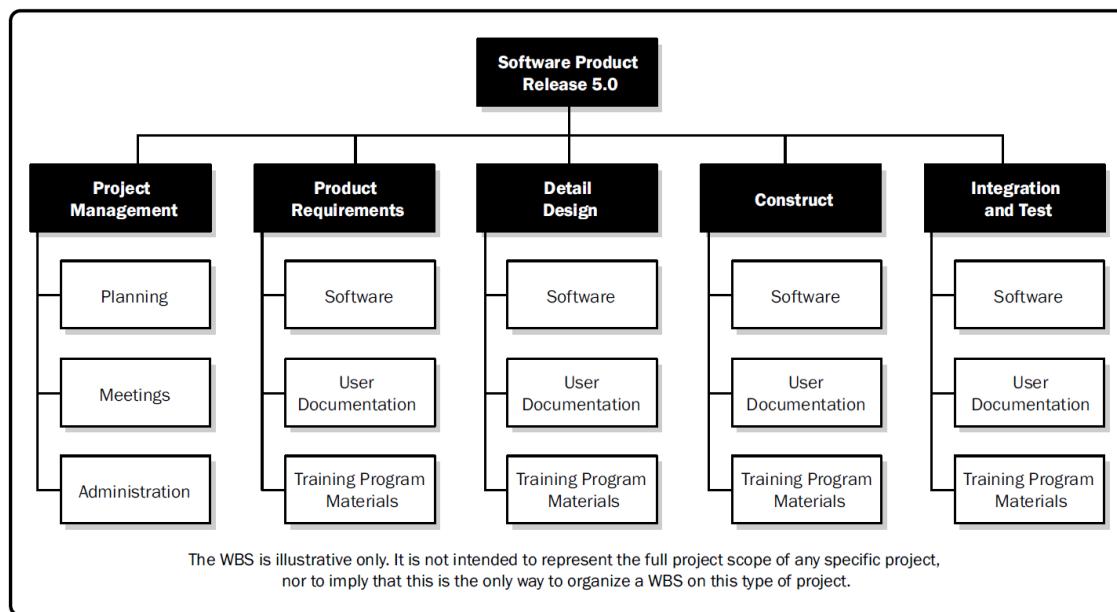
Sample WBS

Decomposition is a technique used for dividing and subdividing the project scope and project deliverables into smaller, more manageable parts. The work package is the work defined at the lowest level of the WBS for which cost and duration can be estimated and managed.

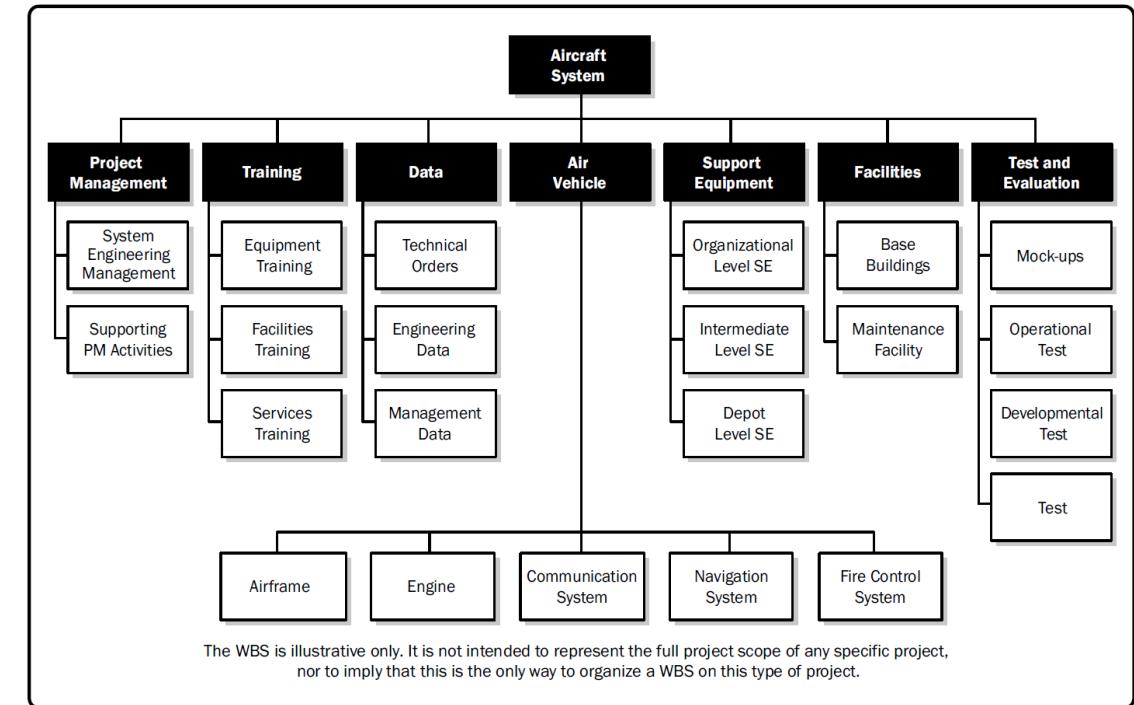


Sample WBS Decomposed Down Through Work Packages

Sample WBS



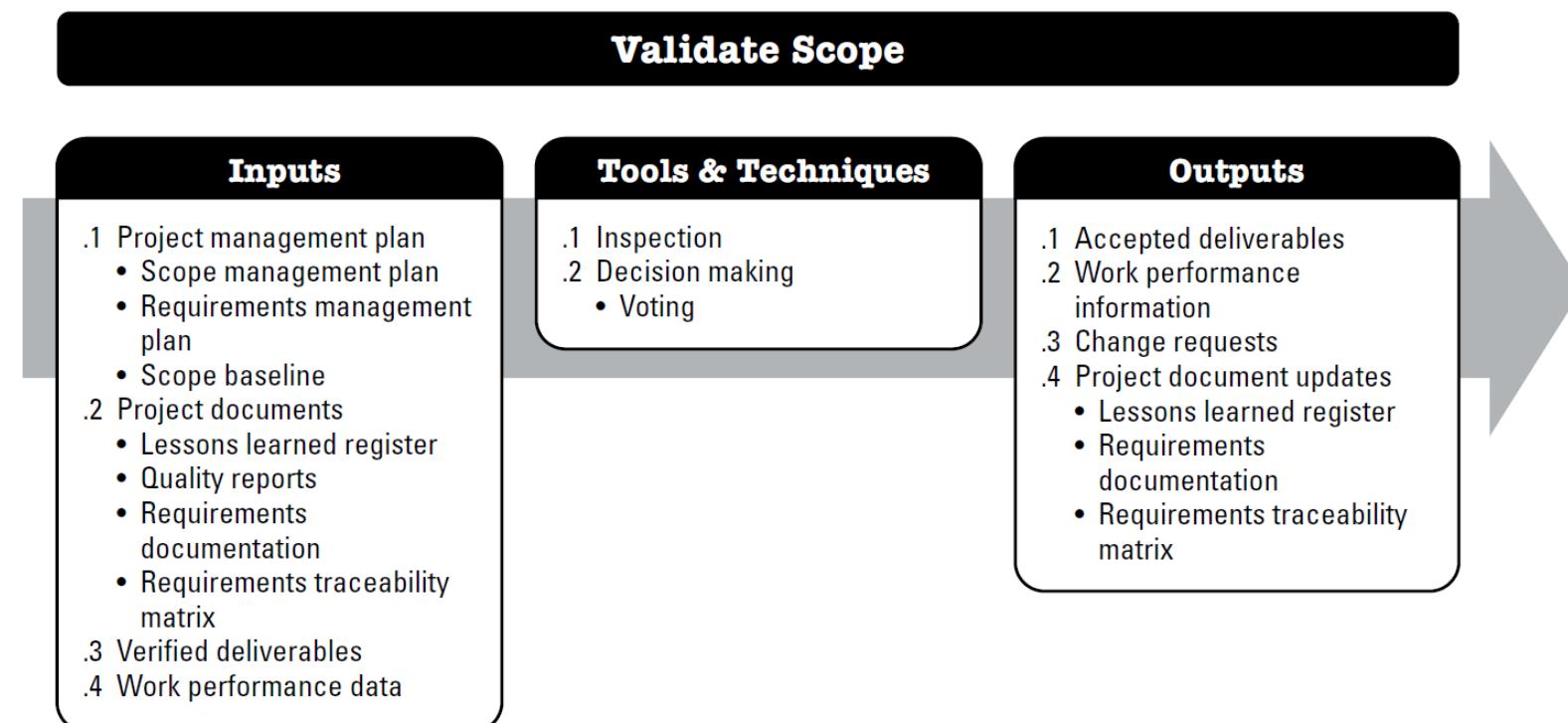
Sample WBS Organized by Phase



Sample WBS with Major Deliverables

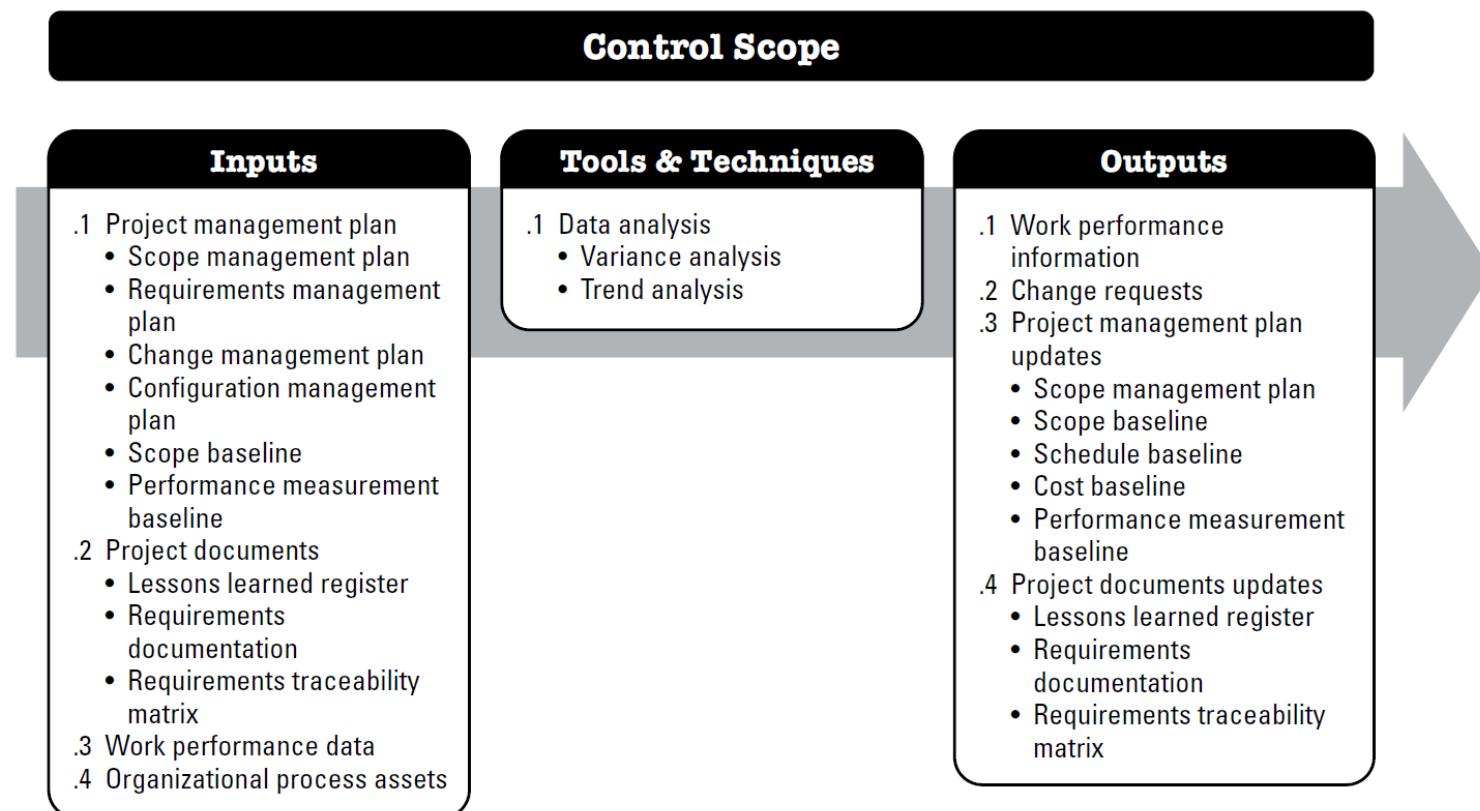
Validate Scope

Validate Scope is the process of formalizing acceptance of the completed project deliverables.



Control Scope

Control Scope is the process of monitoring the status of the project and product scope and managing changes to the scope baseline.



Scope Creep

Scope creep is the uncontrolled expansion to product or project scope without adjustments to time, cost, and resources.

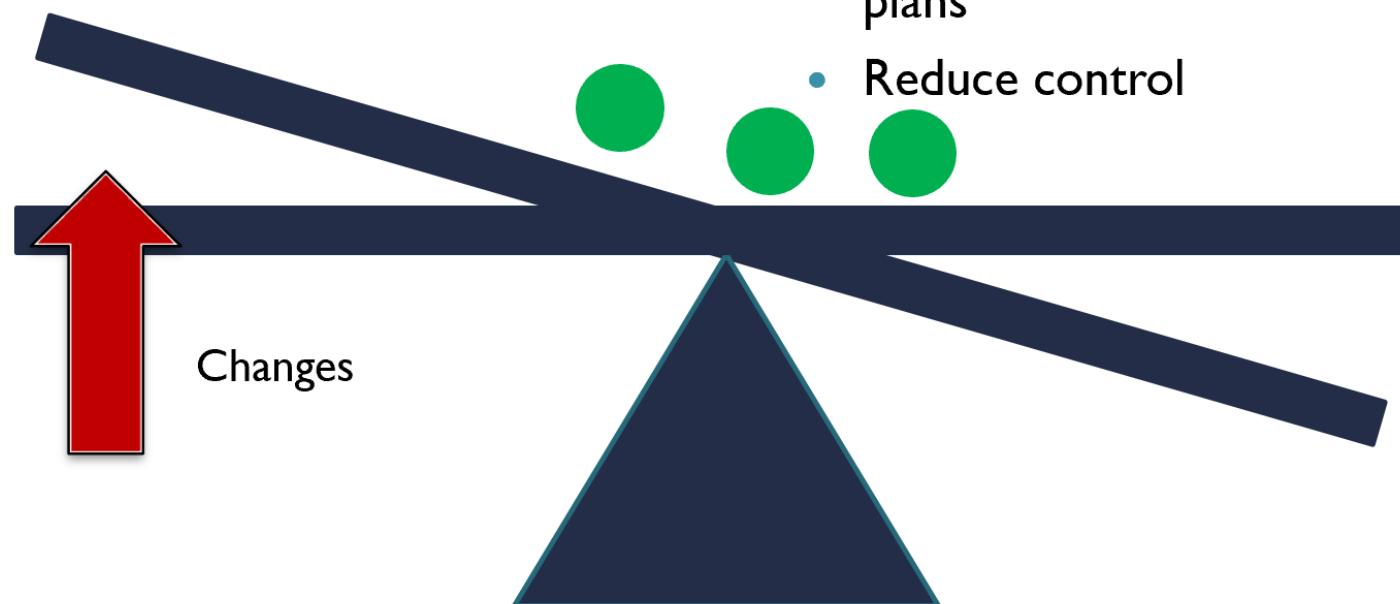
It occurs when features and functionality are added or removed without addressing the effects on time, costs, resources, and quality.

How can Scope Creep happen?

- Typically occurred when an end-user approached a developer directly with an idea without the knowledge of the project manager.
- The team was too eager to promise the client the requested functionalities without consulting his team early to determine if the deadline can be met.
- The project manager may not be in the best position to evaluate the impact of the new requirements.

Scope Creep Implications

- Increase in cost
 - Increase in time
 - Increase complexity
 - Increase rework
-
- Lower the team morale
 - Lower quality of deliverables
 - Frequent change in project plans
 - Reduce control



Thank you!

C303 IT Project Management

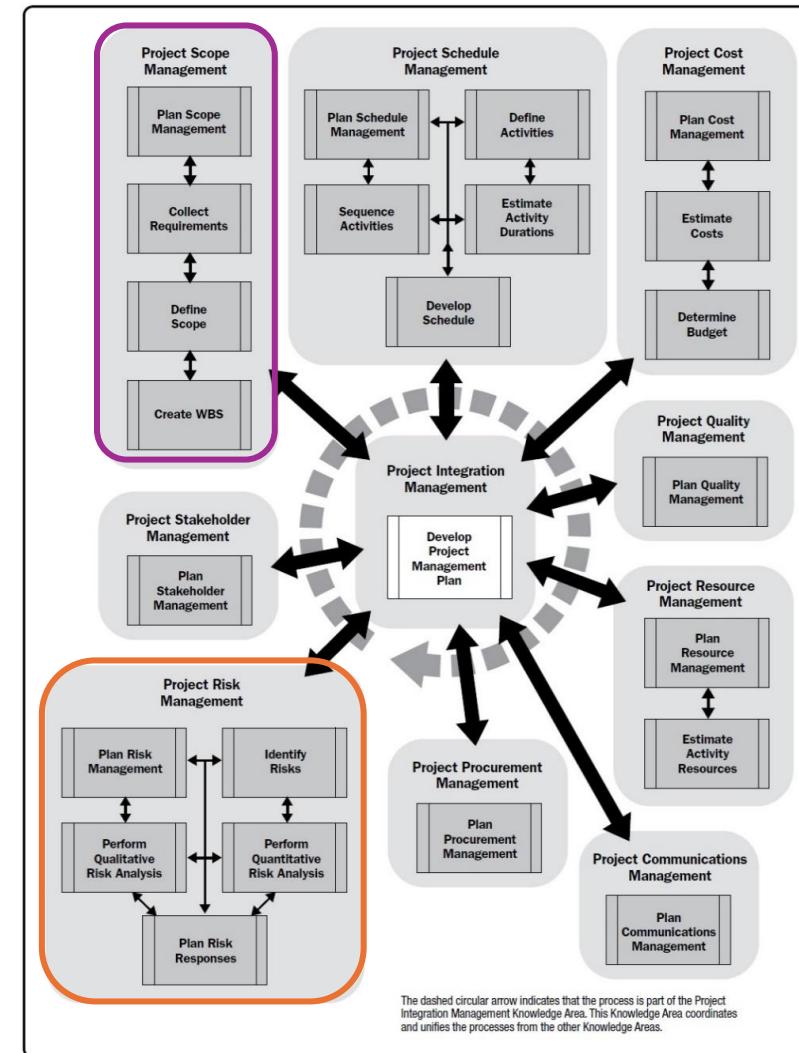
Lesson 7

Learning Outcomes

- State the processes related to risk management
- Explain the types of project risks, including Individual and Overall Project risk
- Explain risk response strategies, such as risk mitigation and acceptance
- Evaluate and prioritise risks using suitable risk assessment methods
- Recommend suitable risk response strategies

Planning Process Group

The Planning Process Group consists of those processes that establish the total scope of the effort, define and refine the objectives, and develop the course of action required to attain those objectives.



Read Details in PMBOK Guide 6th Edition Part 2: 3 Planning Process Group

Project Risk Management

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project.

The objectives of project risk management are to increase the probability and/or impact of positive risks and to decrease the probability and/or impact of negative risks, in order to optimize the chances of project success.

The Project Risk Management processes are:

- Plan Risk Management
- Identify Risks
- Perform Qualitative Risk Analysis
- Perform Quantitative Risk Analysis
- Plan Risk Responses
- Implement Risk Responses
(Executing Process Group)
- Monitor Risks
(Monitoring & Controlling Process Group)



Read Details in PMBOK Guide 6th Edition Part 1: 11 Project Risk Management

What is a Risk?



- All projects are **RISKY**
 - Varying degrees of complexity
 - Constraints and Assumptions
 - Stakeholder expectations that may conflict or change
- **RISK** is:
 - An uncertain event or condition that, if occurs, has a **positive or negative effect** on one or more project objectives such as scope, schedule, cost, and quality.
 - Risks that have positive effects are also known as opportunities.



Levels of Risk

Risk exists at two levels within every project.

Project Risk Management processes address both levels of risk in projects, and these are defined as follows:

- Individual project risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives.
- Overall project risk is the effect of uncertainty on the project as a whole, arising from all sources of uncertainty including individual risks, representing the exposure of stakeholders to the implications of variations in project outcome, both positive and negative.

Individual vs Overall Project Risk

Individual Project Risk

The **project manager** is accountable for the delivery of project objectives, and therefore needs to be aware of any risks that could affect that delivery, either positively or negatively. His or her scope of interest is focused on specific sources of uncertainty within the project. These sources are likely to be particular future events or sets of circumstances or conditions that are uncertain to a greater or lesser extent, and that would have some degree of impact on the project if they occurred. The project manager asks, “**What are the risks in my project?**” and the answer is usually recorded in a risk register or similar document.

Overall Project Risk

The **project sponsor**, on the other hand, is interested in risk at a different level. He or she is less interested in specific risks within the project, and more in the overall picture. The question is, “**How risky is my project?**” and the answer does not usually come from a risk register. Instead of wanting to know about specific risks, the project sponsor is concerned about the overall riskiness of the project. This represents his or her exposure to the effects of uncertainty across the project as a whole.

Project Risk Management

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project.

The objectives of project risk management are to increase the probability and/or impact of positive risks and to decrease the probability and/or impact of negative risks, in order to optimize the chances of project success.



Read Details in PMBOK Guide 6th Edition Part 1: 11 Project Risk Management

Project Risk Management

- Plan Risk Management

Define how to conduct risk management activities for a project

- Identify Risks

Determine which risks may affect the project and document their characteristics

- Perform Qualitative Risk Analysis

Prioritise risks for further analysis or action by assessing and combining their probability of occurrence and impact

- Perform Quantitative Risk Analysis

Numerically analyse the effect of identified risks on overall project objectives

- Plan Risk Responses

Develop options and actions to enhance opportunities and to reduce threats to project objectives

- Implement Risk Responses

The process of implementing agreed-upon risk response plans

- Monitor Risks

Monitor the implementation of agreed upon risk response plans, track identified risks, monitor residual risks, identify and analyse new risks, and evaluate risk processes effectiveness throughout the project

Plan Risk Management: Risk Categories

Provide a means for grouping individual project risks.

A common way to structure risk categories is with a **risk breakdown structure (RBS)**, which is a hierarchical representation of potential sources of risk.

RBS LEVEL 0	RBS LEVEL 1	RBS LEVEL 2
0. ALL SOURCES OF PROJECT RISK	1. TECHNICAL RISK	1.1 Scope definition 1.2 Requirements definition 1.3 Estimates, assumptions, and constraints 1.4 Technical processes 1.5 Technology 1.6 Technical interfaces Etc.
	2. MANAGEMENT RISK	2.1 Project management 2.2 Program/portfolio management 2.3 Operations management 2.4 Organization 2.5 Resourcing 2.6 Communication Etc.
	3. COMMERCIAL RISK	3.1 Contractual terms and conditions 3.2 Internal procurement 3.3 Suppliers and vendors 3.4 Subcontracts 3.5 Client/customer stability 3.6 Partnerships and joint ventures Etc.
	4. EXTERNAL RISK	4.1 Legislation 4.2 Exchange rates 4.3 Site/facilities 4.4 Environmental/weather 4.5 Competition 4.6 Regulatory Etc.

Plan Risk Management: Stakeholder Risk Appetite

- The risk appetites of key stakeholders on the project are recorded in the risk management plan, as they inform the details of the Plan Risk Management process.
- In particular, stakeholder risk appetite should be expressed as **measurable risk thresholds** around each project objective.
- These thresholds will determine the **acceptable** level of overall project risk exposure, and they are also used to inform the **definitions of probability and impacts** to be used when assessing and prioritizing individual project risks.

Plan Risk Management: Probability And Impact Matrix

- Opportunities and threats are represented in a common probability and impact matrix using positive definitions of impact for opportunities and negative impact definitions for threats.
- Descriptive terms (such as very high, high, medium, low, and very low) or numeric values can be used for probability and impact.
- Where numeric values are used, these can be multiplied to give a **probability-impact score** for each risk, which allows the relative priority of individual risks to be evaluated within each priority level.

		Threats					Opportunities						
		Very High 0.90	High 0.70	Medium 0.50	Low 0.30	Very Low 0.10	Very High 0.90	High 0.70	Medium 0.50	Low 0.30	Very Low 0.10		Probability
Probability	Very High 0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05		Very High 0.90
	High 0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04		High 0.70
Probability	Medium 0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03		Medium 0.50
	Low 0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02		Low 0.30
Probability	Very Low 0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01		Very Low 0.10
		Very Low 0.05	Low 0.10	Moderate 0.20	High 0.40	Very High 0.80	Very High 0.80	High 0.40	Moderate 0.20	Low 0.10	Very Low 0.05		
Negative Impact							Positive Impact						

Identify Risks: Tools and Techniques

Where to look for potential risks in your projects?

- You can't always depend on all the resources you were promised – e.g.. people, equipment, rooms, etc.
- “When you assume...” – your assumptions may become false and it can turn into a risk
- The Critical path is full of risks – activities with No float
- Look outside your project – e.g. new laws, new standards, new products, etc.

Tools & Techniques

- .1 Expert judgment
- .2 Data gathering
 - Brainstorming
 - Checklists
 - Interviews
- .3 Data analysis
 - Root cause analysis
 - Assumption and constraint analysis
 - SWOT analysis
 - Document analysis
- .4 Interpersonal and team skills
 - Facilitation
- .5 Prompt lists
- .6 Meetings



Read Details in PMBOK Guide 6th Edition Part 1: 11.2 Identify Risks

Perform Qualitative Risk Analysis

Perform **Qualitative** Risk Analysis is the process of **prioritising** individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics.

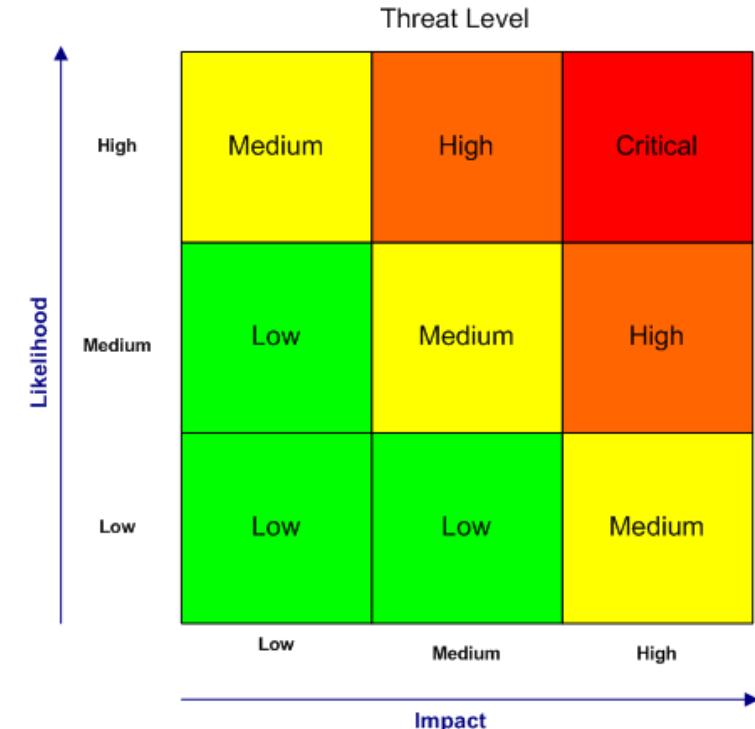
- Probability/Likelihood and Impact matrix

A table (see right) where all the risks are plotted according to the values assigned.

Probability of each risk and impact can be categorized from High, Medium, Low

- Impact

Can be Revenue, Cost, Schedule, Scope, no of affected customers etc.



Example of a Probability and Impact Matrix



Read Details in PMBOK Guide 6th Edition Part 1: 11.3 Perform Qualitative Risk Analysis

Perform Quantitative Risk Analysis

Perform **Quantitative** Risk Analysis is the process of **numerically analyzing** the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives

Expected Monetary Value (EMV) analysis is a statistical concept that calculates the average outcome when the future includes scenarios that may or may not happen (i.e., analysis under uncertainty).

- Steps
 1. Determine the probability of the risk event happening based on historical data, expert opinion, statistical data
 2. Determine the impact risk event (**negative** if it results in a loss, **positive** if it results in an opportunity)
 3. Calculate **Expected Monetary Value (EMV)** as

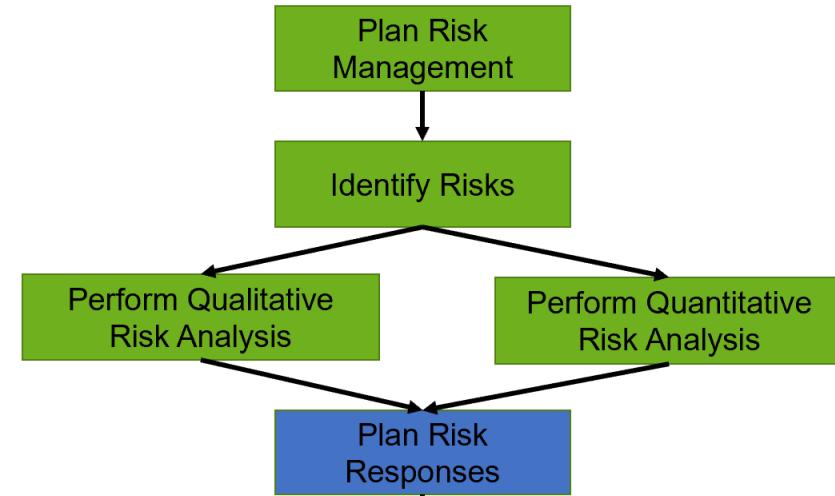
$$\text{EMV} = \text{Probability of event} \times \text{Impact}$$



Read Details in PMBOK Guide 6th Edition Part 1: 11.4 Perform Quantitative Risk Analysis

Plan Risk Responses: Strategies

Plan Risk Responses is the process of **developing options, selecting strategies**, and agreeing on actions to address overall project risk exposure, as well as to treat individual project risks.



- Strategies for Threats
- Strategies for Opportunities



Read Details in PMBOK Guide 6th Edition Part 1: 11.5 Plan Risk Responses

Plan Risk Responses: Strategies for Threats

Escalate	Threat is outside the scope of the project or exceed the project manager authority. Escalated to relevant party in organization
Avoid	Usually requires changing the project management plans or project approach (e.g. switch from unfamiliar technology to proven technology)
Transfer	Give the responsibility for managing the risk or financial impact to someone who is better to manage it. Normally involves a “premium” to the other party taking the risk (e.g. transfer the work to a subcontractor)
Mitigate	Reduce the probability and/or the impact of the risk occurring (e.g. invest and install a UPS for home computers)
Accept	Do nothing, hope for the best

Plan Risk Responses: Strategies for Threats

If your project requires that you stand on the edge of a cliff...

1) Avoid

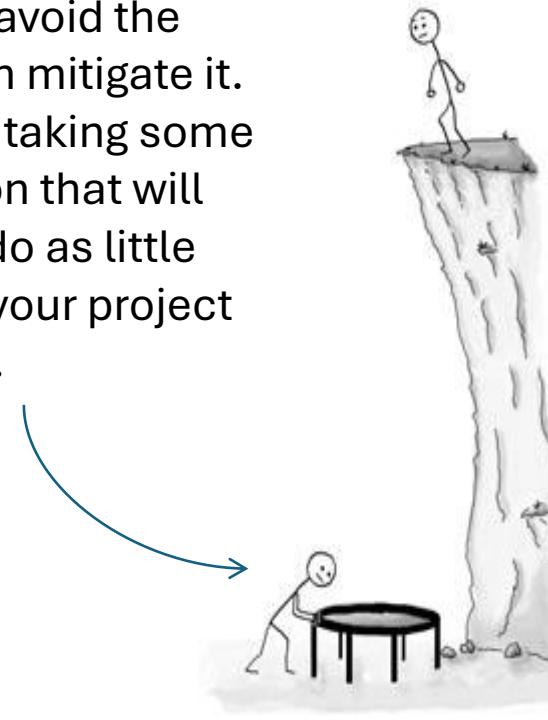
The best thing that you can do with a risk is avoid it—if you can prevent it from happening, it definitely won't hurt your project

The easiest way to avoid this risk is to walk away from the cliff... but that may not be an option on this project



2) Mitigate

If you can't avoid the risk, you can mitigate it. This means taking some sort of action that will cause it to do as little damage to your project as possible.



Plan Risk Responses: Strategies for Threats

If your project requires that you stand on the edge of a cliff...

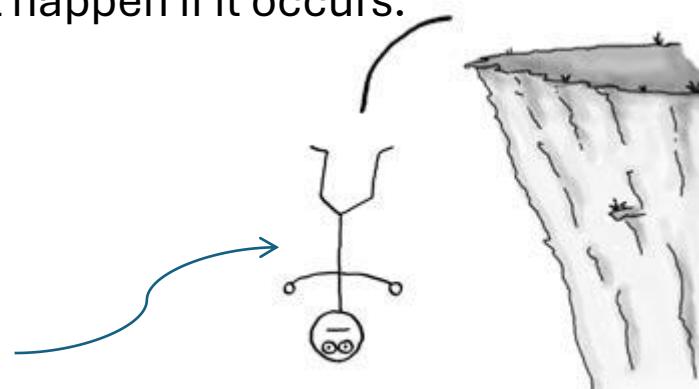
3) Transfer

One effective way to deal with a risk is to pay someone else to accept it for you. The most common way to do this is to buy insurance.



4) Accept

When you can't avoid, mitigate, or transfer a risk, then you have to accept it. But even when you accept a risk, at least you've looked at the alternatives and you know what will happen if it occurs.

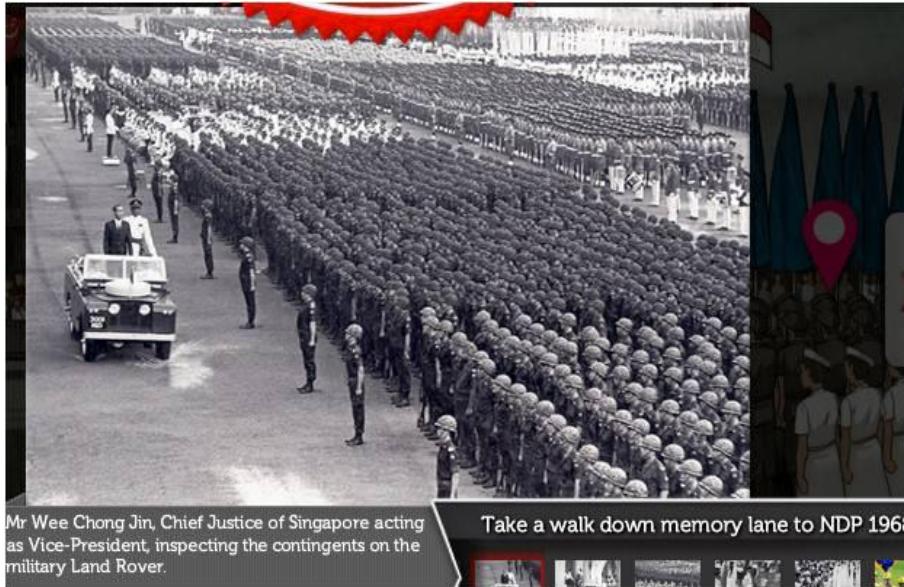


If you can't avoid the risk, and there's nothing you can do to reduce its impact, then accepting it is your only choice.

Plan Risk Responses: Strategies for Opportunities

Escalate	Opportunity is outside the scope of the project or exceed the project manager authority. Escalated to relevant party in organization
Exploit	Ensure everything is in place to increase the probability of the occurrence of the risk
Share	Collaborate with another department or organization to exploit a positive risk
Enhance	Identify the root cause of a positive risk so that you can influence it for a greater likelihood of the opportunity occurring
Accept	Do nothing, hope for the best

Examples of risks in real life



Risk faced when organizing large scale outdoor event
- Extreme weather



Examples of risks in real life



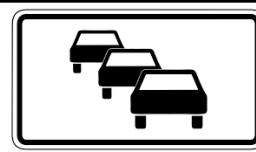
Risk in construction sites
- Falling objects



Examples of risks in real life



Risk in driving to Malaysia before public holidays
- Traffic jams at Causeway



Summary

- Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project.
- Qualitative Risk Analysis is the process of prioritising individual project risks by assessing their probability of occurrence and impact.
- In Perform Quantitative Risk Analysis, $EMV = \text{Probability of event} \times \text{Impact}$
- There are different strategies for threats and opportunities in Plan Risk Responses.

C303 IT Project Management

Lesson 9 (Schedule Management)

Learning Outcomes

- Explain the use of the critical path method (CPM) in managing project schedule
- Identify the critical paths
- Create and assign project resources
- Change task durations by adding resources
- Revise a project schedule with elapsed duration and recurring tasks

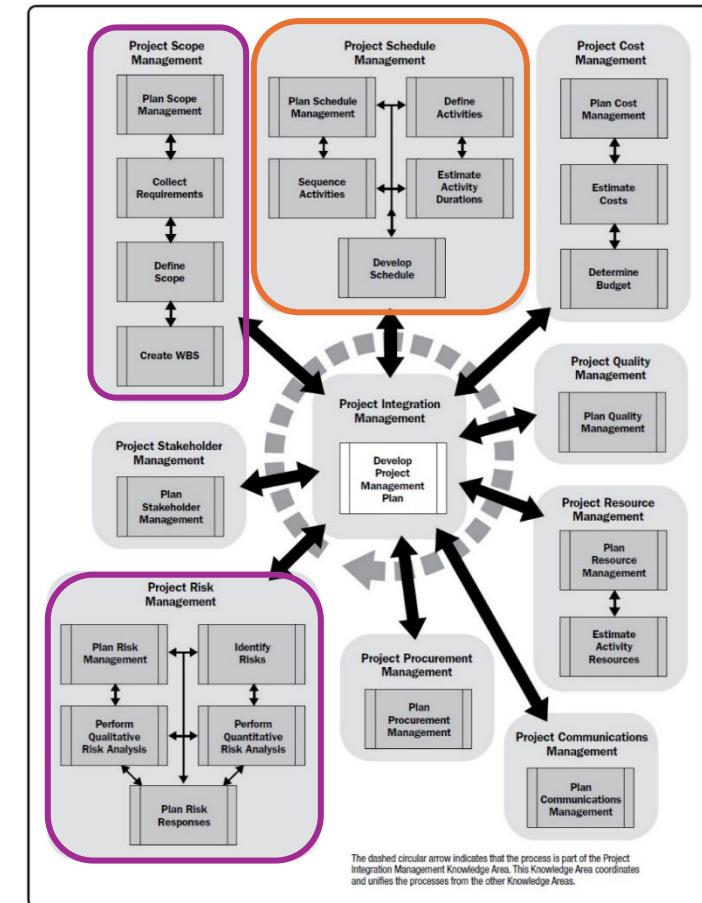
Project Schedule Management

Project Schedule Management includes the processes required to manage the timely completion of the project.

The Project Schedule Management processes are:

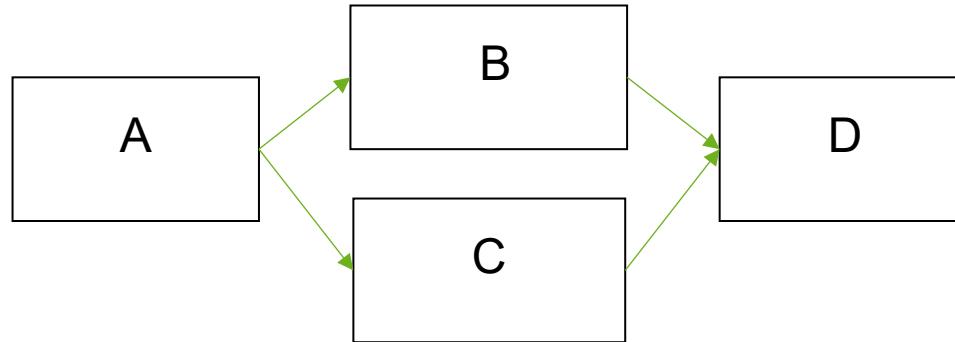
- Plan Schedule Management
- Define Activities
- **Sequence Activities**
- Estimate Activity Durations
- Develop Schedule
- Control Schedule

(Monitoring & Controlling Process Group)



Read Details in PMBOK Guide 6th Edition Part 1: 6. Project Schedule Management

Project Schedule Network Diagram



Activity	Duration (Days)
A	3
B	5
C	9
D	4

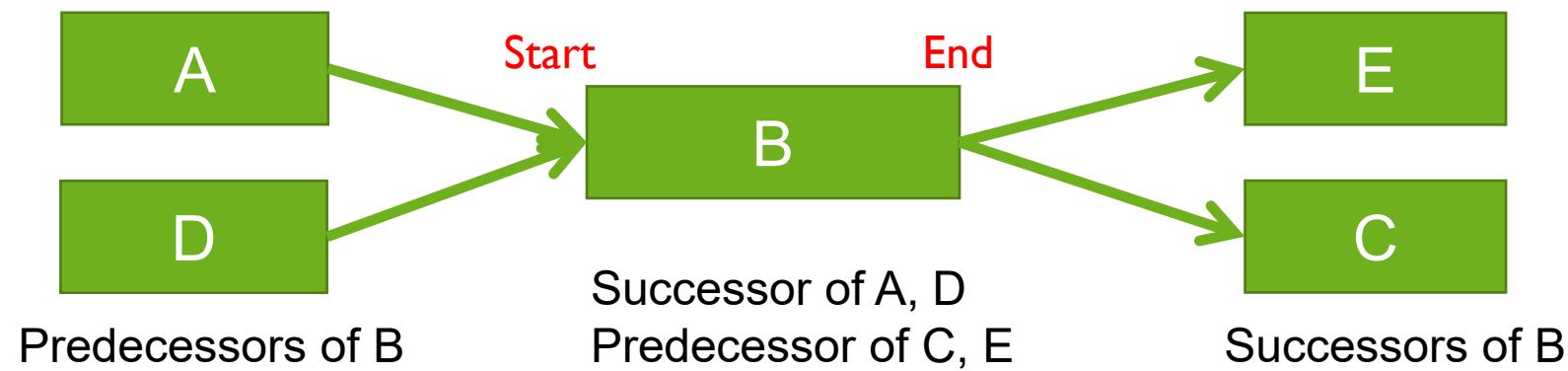
A project schedule network diagram is a graphical representation of the logical relationships, also referred to as dependencies, among the project schedule activities.

- Project duration is 16 days. This could be deducted by “observations”.
- Project typically consists more than 4 activities.
- If it is too complicated, “observations” method will NOT work.

Sequence Activities: Tools and Techniques

The **precedence diagramming method (PDM)** is a technique used for constructing a schedule model in which activities are represented by **nodes** and are graphically linked by one or more **logical relationships** to show the sequence in which the activities are to be performed.

- No activity exists in a vacuum. In a project plan, you must also be aware of the way activities depend on each other.
- An activity dependency is a relationship between activities in which one activity depends on the start or finish of other activities in order to begin or end.



Note: Activity is often referred to as task.

Precedence Diagramming Method

A predecessor activity is an activity that logically comes before a dependent activity in a schedule.

A successor activity is a dependent activity that logically comes after another activity in a schedule.

PDM includes four types of dependencies or logical relationships:

- Finish-to-start (FS)
- Finish-to-finish (FF)
- Start-to-start (SS)
- Start-to-finish (SF)

In PDM, FS is the most commonly used type of precedence relationship.

Types of Activity Dependency

FS,FF,SS,SF - For the above relationship, the first letter defines the predecessor behaviour and the second letter is the successor:

- Finish-to-start (FS)

A successor activity cannot start until a predecessor activity has finished.

- Finish-to-finish (FF)

A successor activity cannot finish until a predecessor activity has finished.

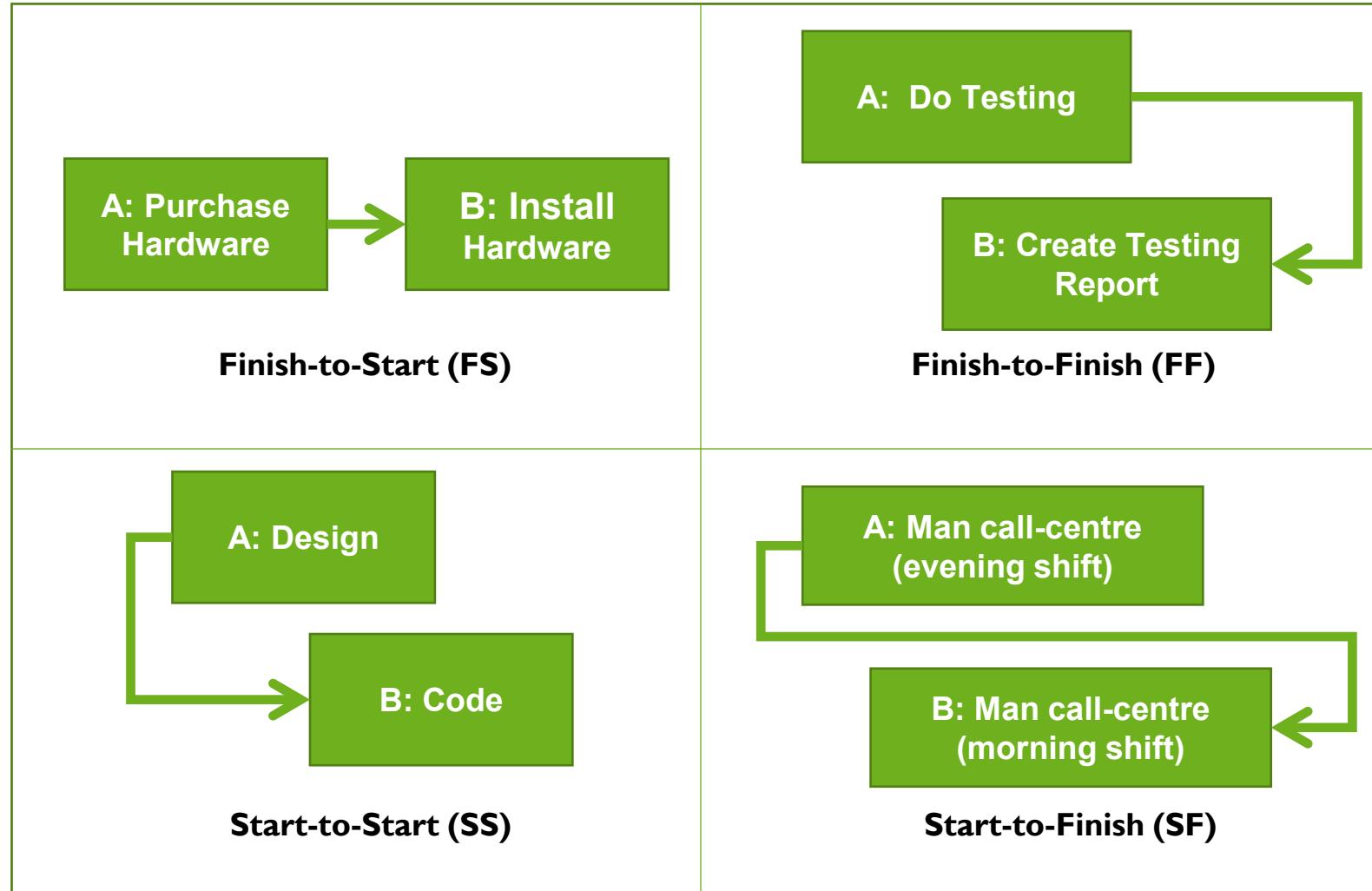
- Start-to-start (SS)

A successor activity cannot start until a predecessor activity has started.

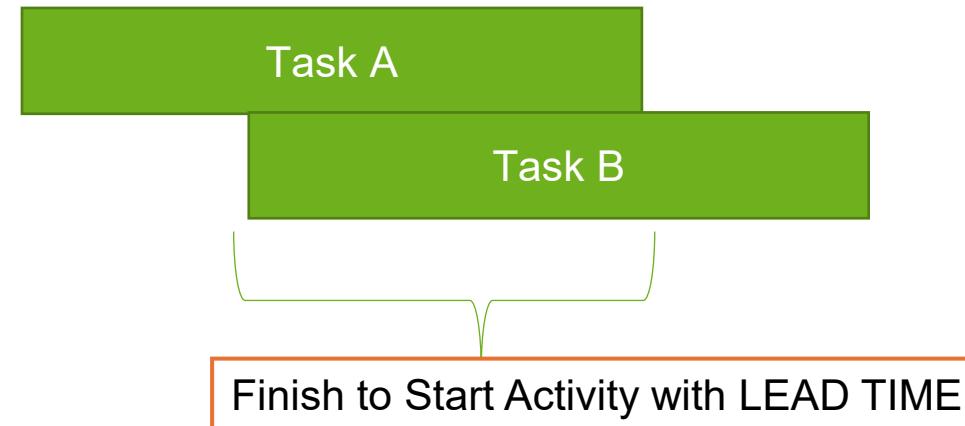
- Start-to-finish (SF)

A successor activity cannot finish until a predecessor activity has started.

Types of Activity Dependency



Lead Time between Activities



- When Task A is still running and Task B starts, this is called LEAD. The balance of time for Task A is known as the LEAD time. Lead Time is the overlap between the Task A and Task B.
- Lead is the acceleration of a successor activity.
- Lead Time can occur in all types of dependencies – Start to Start, Start to Finish, Finish to Finish and Finish to Start.
- Note that some part of Task B will be done in parallel with Task A.



Read Details in PMBOK Guide 6th Edition Part 1: 6.3.2.3 Leads and Lags

Lead Time between Activities

Task	Description	Duration (Days)
A	Write 12 page Report	6
B	Review 12 page Report	4

- Task A and Task B has finish to start dependency.
- To complete the above project, will require 10 days.
- Assume it takes 1 day to write 2 pages of the report.
- Assume it takes 1 day to review 3 pages of report.
- If Task B can start on the 4th day, it will only take a total of 7 days to complete.
Lead time (shown in green) is 3 days.

Task	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
A	Write 2 pages	Write 2 pages	Write 2 pages	Write 2 pages	Write 2 pages	Write 2 pages	
B				Review 3 pages	Review 3 pages	Review 3 pages	Review 3 pages

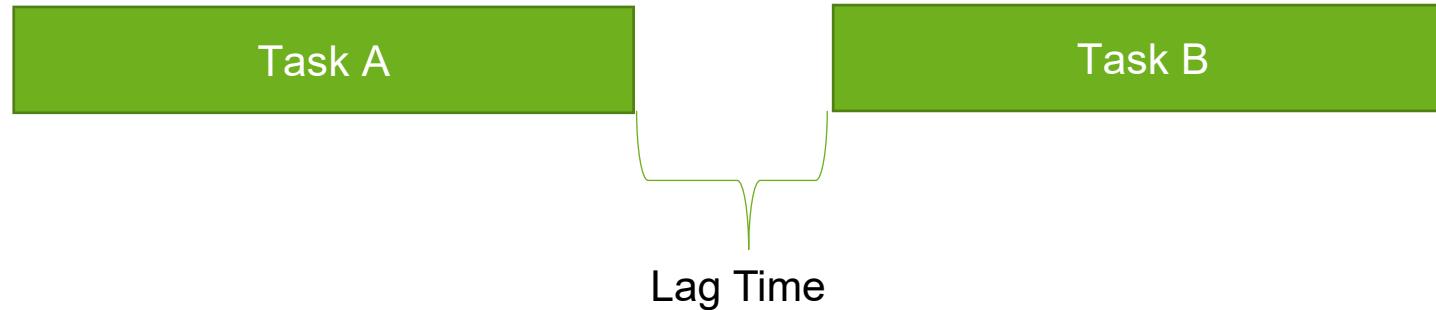
Lead Time between Activities



- Lead is always denoted by a negative sign. For the above it means Start of Task B before Finish of Task A with a lead of 3 days.
- Lead Time can occur in all types of dependencies – Start to Start, Start to Finish, Finish to Finish and Finish to Start.

Assumption: All duration in days

Lag Time between Activities



- When Task A completes, if there is a delay or wait period before Task B starts, this is called Lag and the delay is known as the Lag Time.
- Lag Time can occur in all types of dependencies – Start to Start, Start to Finish, Finish to Finish and Finish to Start.

Note that Task A must complete before Task B can start.

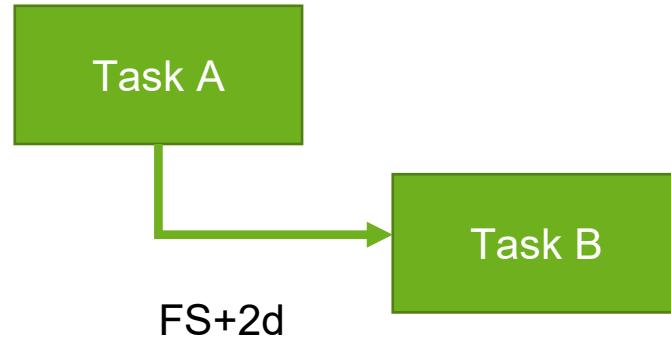
Lag Time between Activities

Task	Description	Duration (Days)
A	Cement Plastering of Wall	1
B	Painting of Wall	1

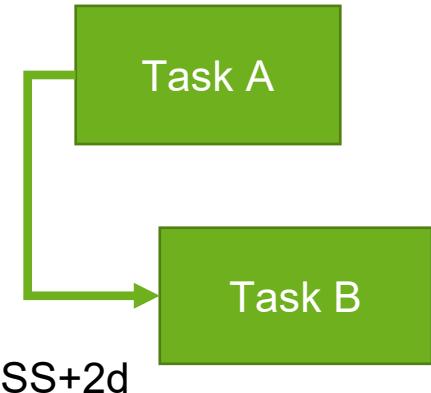
- Assume Task A and Task B has finish to start dependency.
- To complete the above project, will require 2 days.
- Assume it takes 1 day to cement plastering of wall.
- Assume it takes 1 day to paint the wall.
- However, cement needs 1 day to dry. Lag time (shown in green) is 1 day.
- Total project duration is 3 days.

Task	Day 1	Day 2	Day 3
A	Cement Plastering of Wall		
		1 day to dry	
B			Painting of Wall

Lag Time between Activities



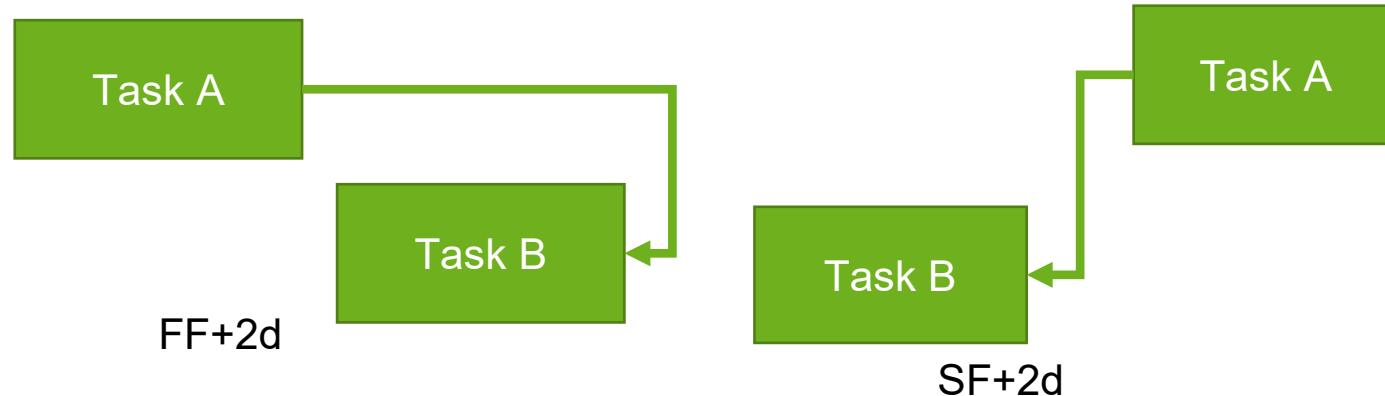
Lag is always denoted by a positive sign. For the above it means Task B can start 2 days after Task A finish.



Lag is always denoted by a positive sign. For the above it means Task B can start 2 days after start of Task A.d

Assumption: All duration in days

Lag Time between Activities



Lag is always denoted by a positive sign. For the above it means Task B can finish 2 days after Task A finish.

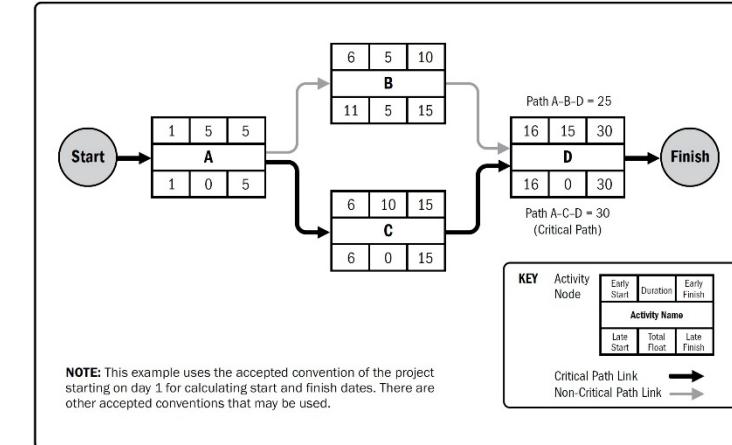
Lag is always denoted by a positive sign. For the above it means Task B can finish 2 days after start of Task A.

Assumption: All duration in days

Critical Path Method (CPM)

The critical path method (CPM) is used to estimate the minimum project duration and determine the amount of schedule flexibility on the logical network paths within the schedule model.

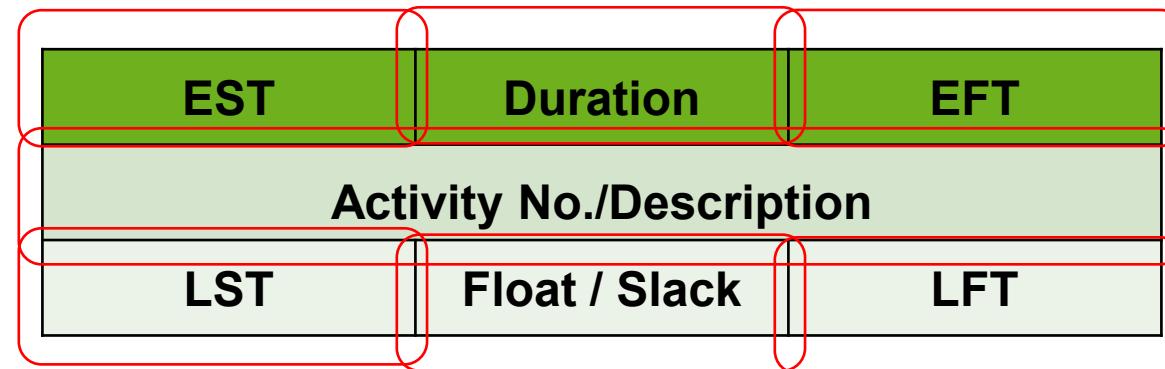
This schedule network analysis technique calculates the early start, early finish, late start, and late finish dates for all activities by performing a forward and backward pass analysis through the schedule network.



Key Points:

- Used when the estimated duration of activities are predictable.
- Does not take into account the uncertainties involved in estimation.
- Ignores the probabilistic element of the estimation.

Activity Representation in Critical Path Method (CPM)



- EST – Earliest Start Time of activity
- EFT – Earliest Finish Time of activity
- LST – Latest Start Time of activity
- LFT – Latest Finish Time of activity
- Total Float (Slack) - Amount of time an activity can be delayed or extended without affecting the project end date

Total Float

The amount of time that a schedule activity can be delayed or extended from its early start date **without delaying the project finish date** or violating a schedule constraint.

Formula to calculate total float:

LS (Late Start) – ES (Early Start) or **LF (Late, Finish) – EF (Early Finish)**

Free Float

The amount of time that a schedule activity can be delayed **without delaying the early start date of any successor** or violating a schedule constraint.

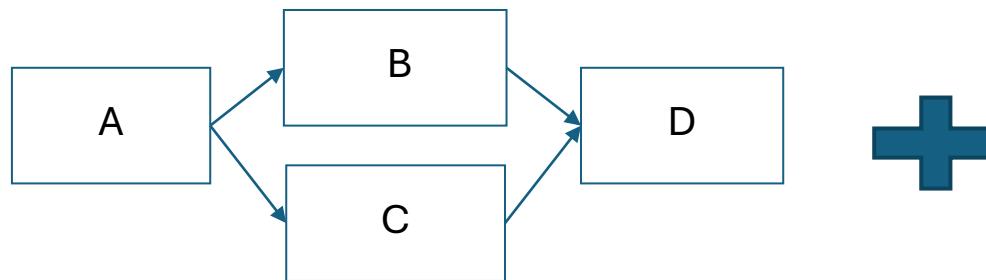
- Formula to calculate Free Float is

ES (of successor) – EF of current activity

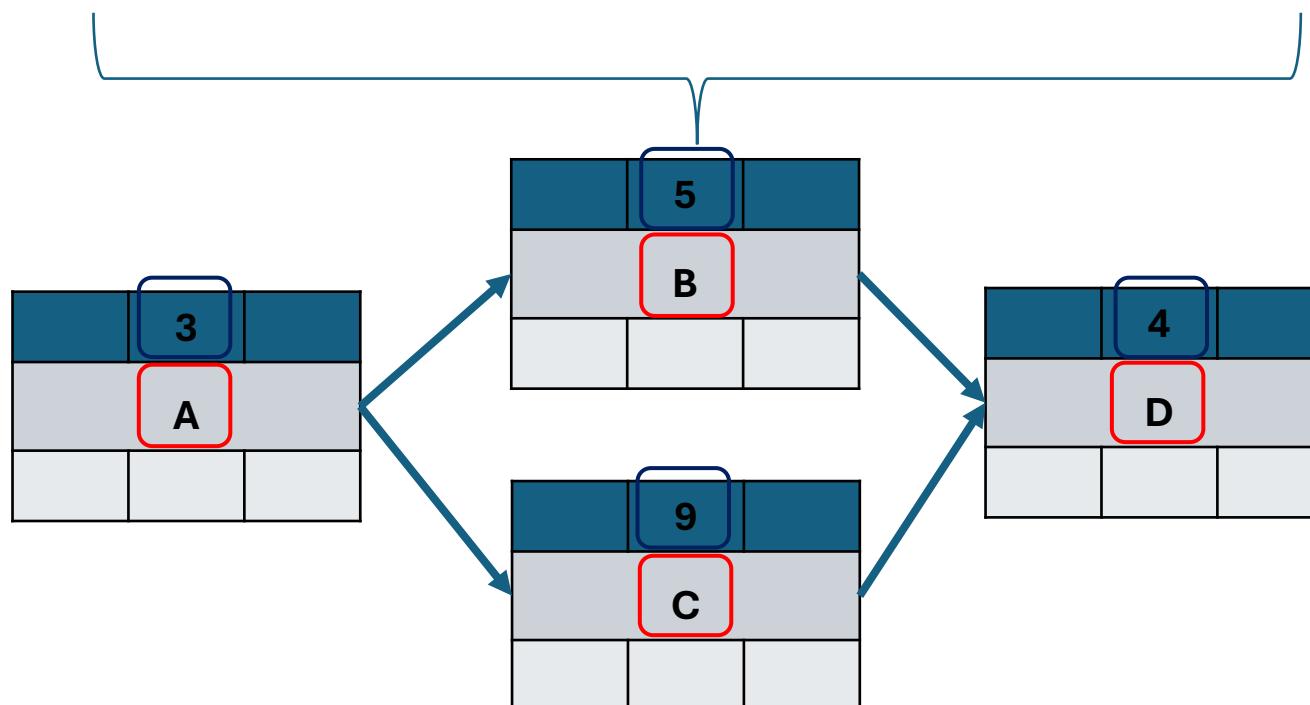
Total Float vs Free Float

Total Float	Free Float
Calculated at path level of activities	Calculated at the activity level
Define flexibility of a path w.r.t project end date	Define flexibility of activity w.r.t its successor start
Formula: LS-ES or LF-EF	Formula: ES (of successors) – EF of current activity
Can come into existence if network diagram has multiple path and there are activities which are not there on Critical Path	Can come into existence if successor is having more than one activity converging on it or the successor activity is having a constraint applied

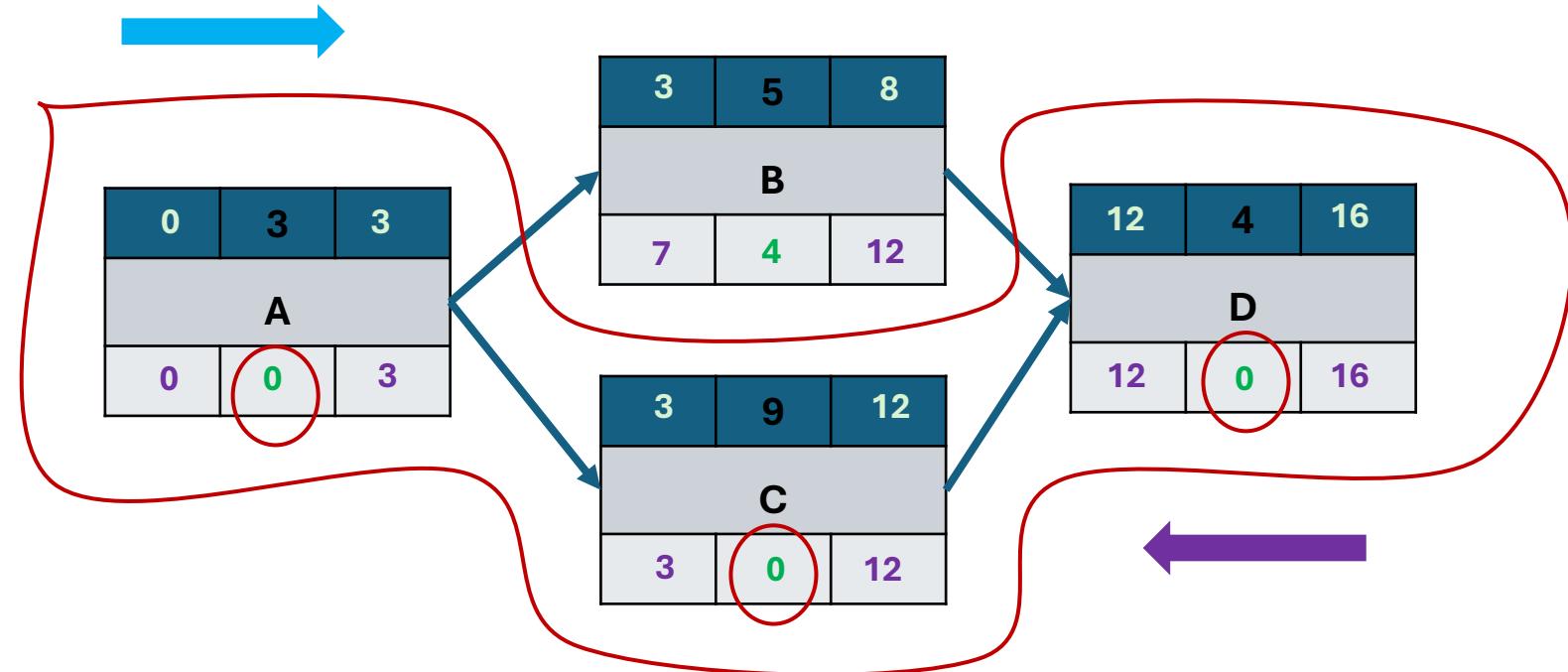
CPM - Example



Activity	Duration (Days)
A	3
B	5
C	9
D	4



CPM – 4 Phases



Phase 1: Forward pass calculations

Phase 2: Backward pass calculations

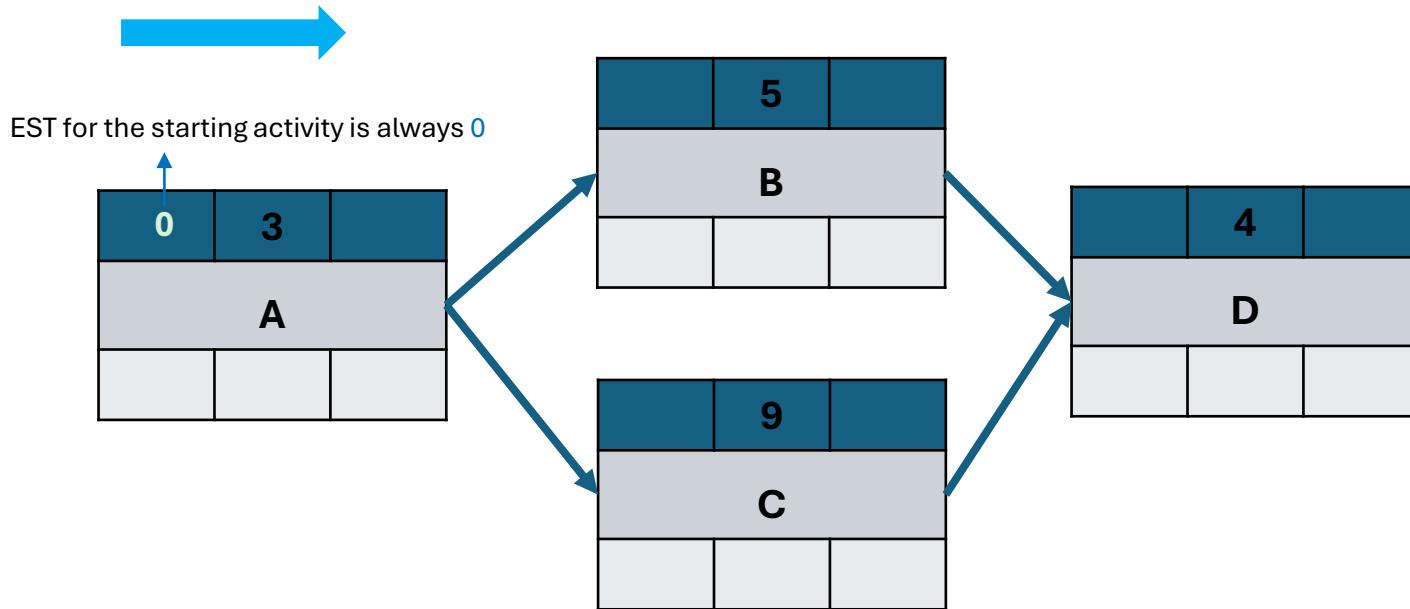
Phase 3: Calculations of float/slack

Phase 4: Identification of critical path

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 1 – Forward Pass Calculations

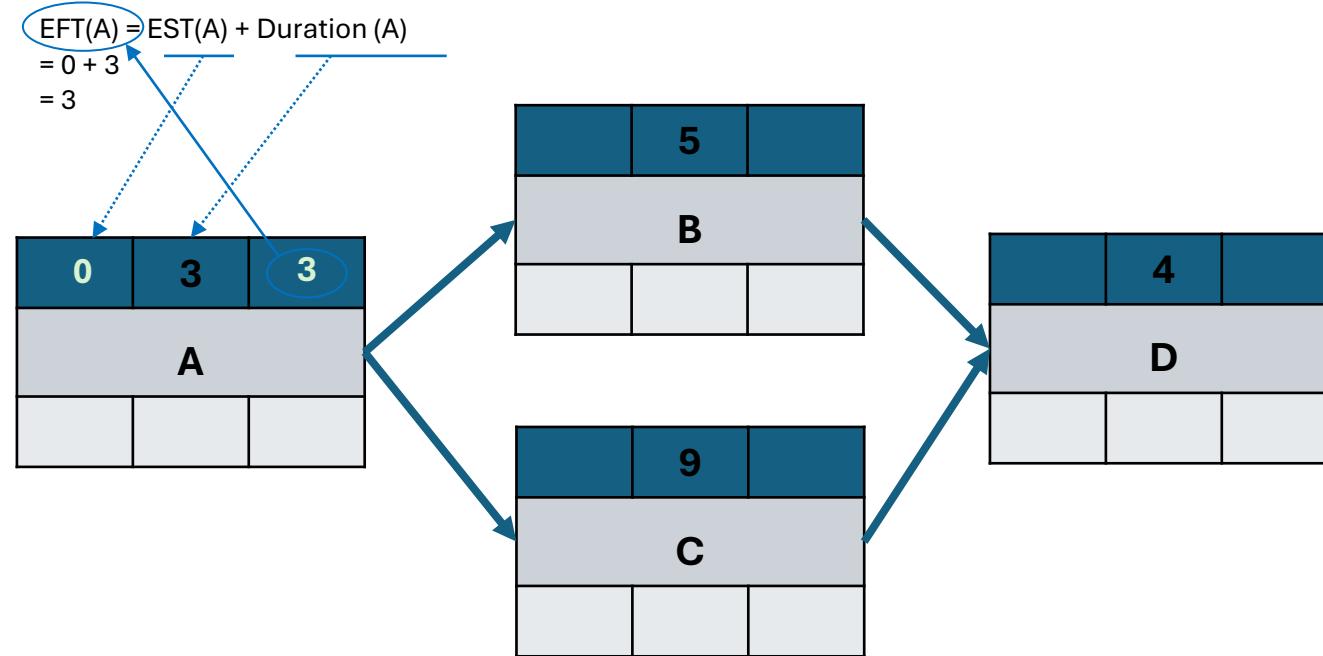


Phase 1: Forward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 1 – Forward Pass Calculations

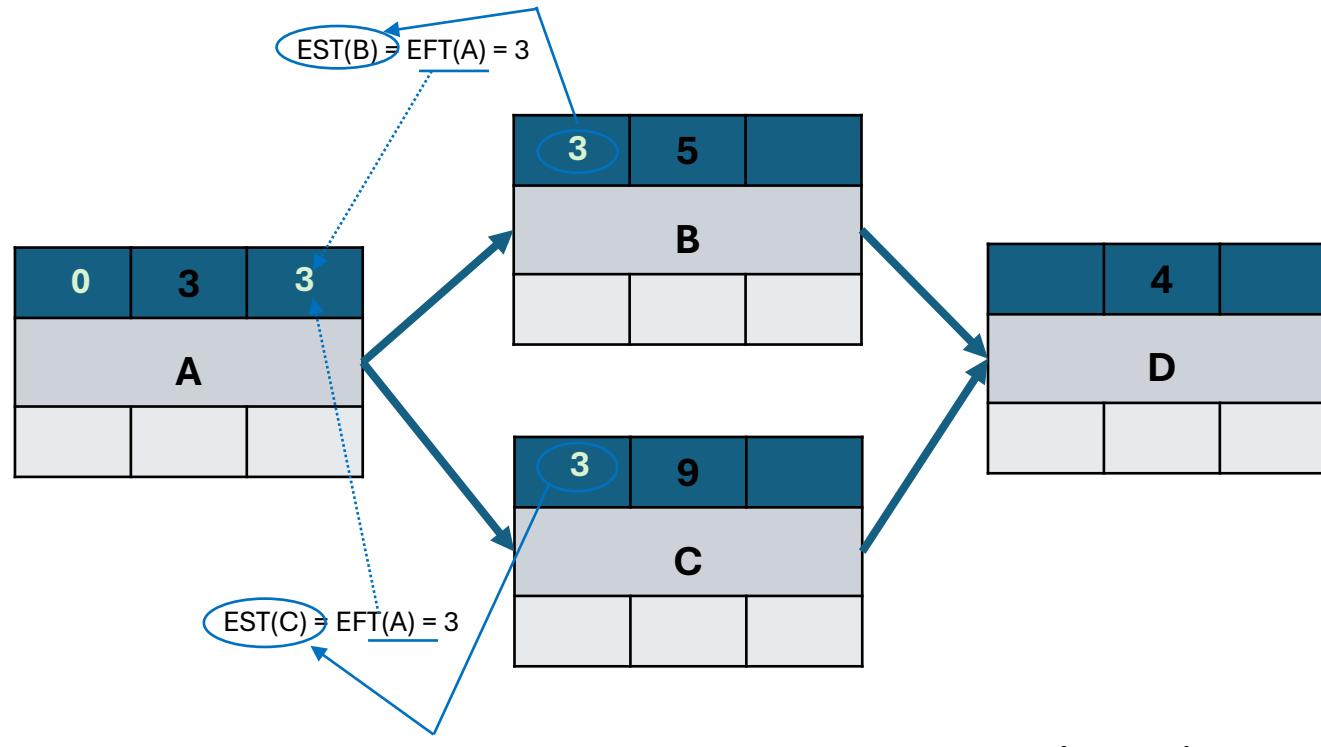


Phase 1: Forward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 1 – Forward Pass Calculations

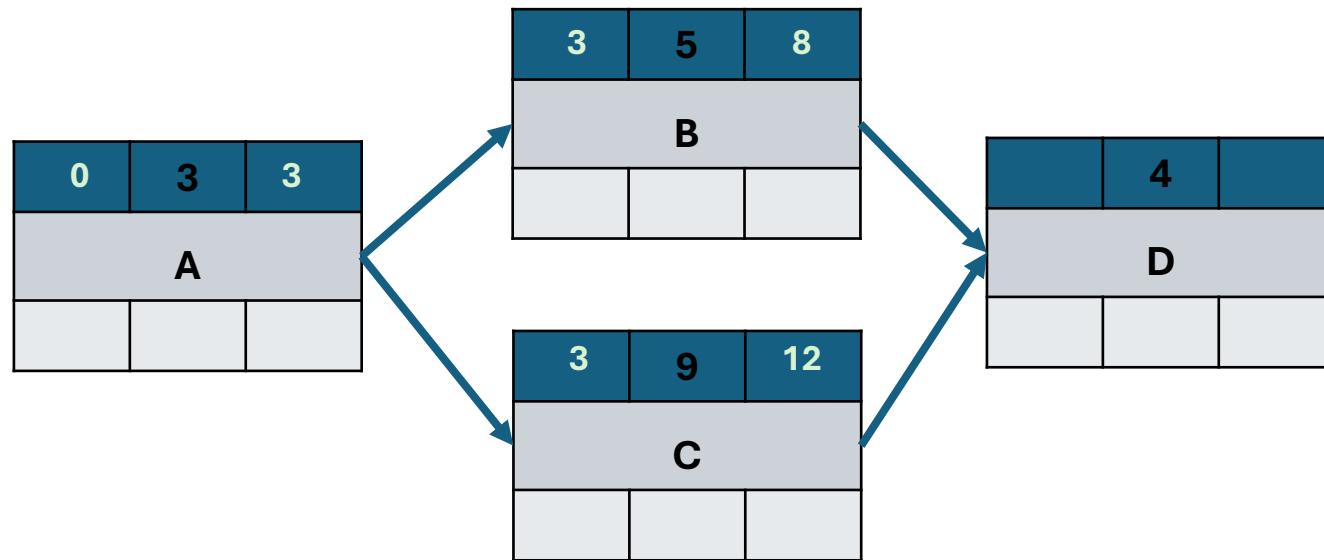


Phase 1: Forward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 1 – Forward Pass Calculations

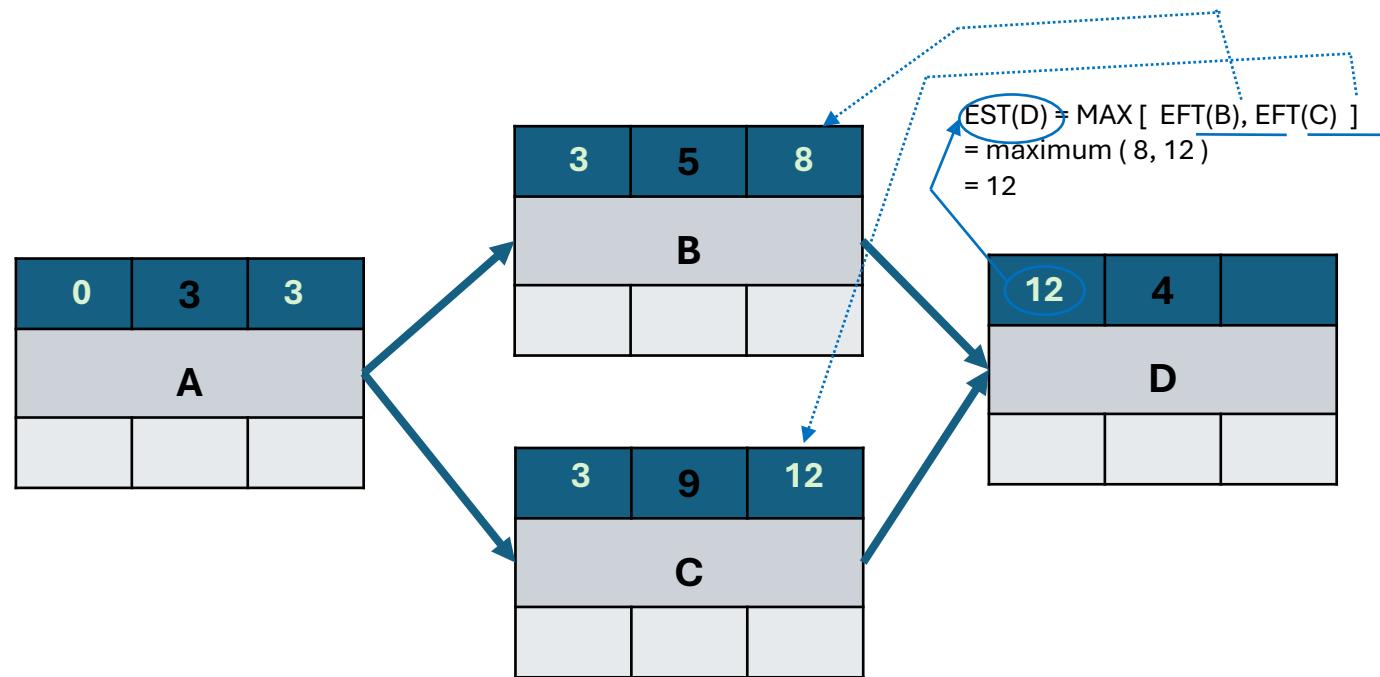


Phase 1: Forward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 1 – Forward Pass Calculations

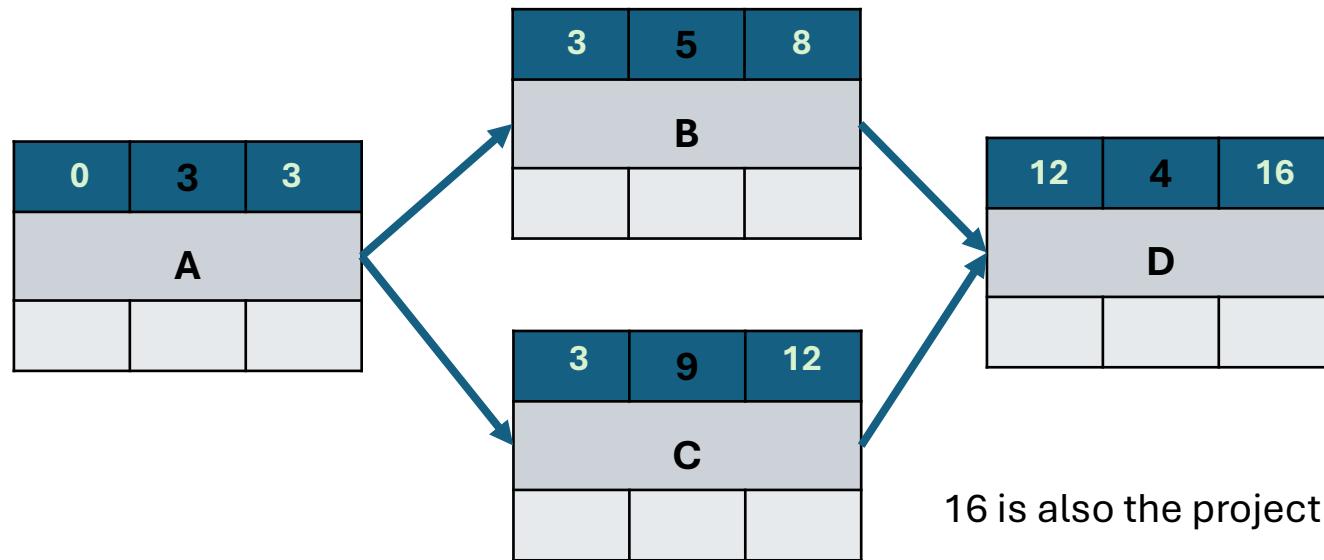


Phase 1: Forward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 1 – Forward Pass Calculations

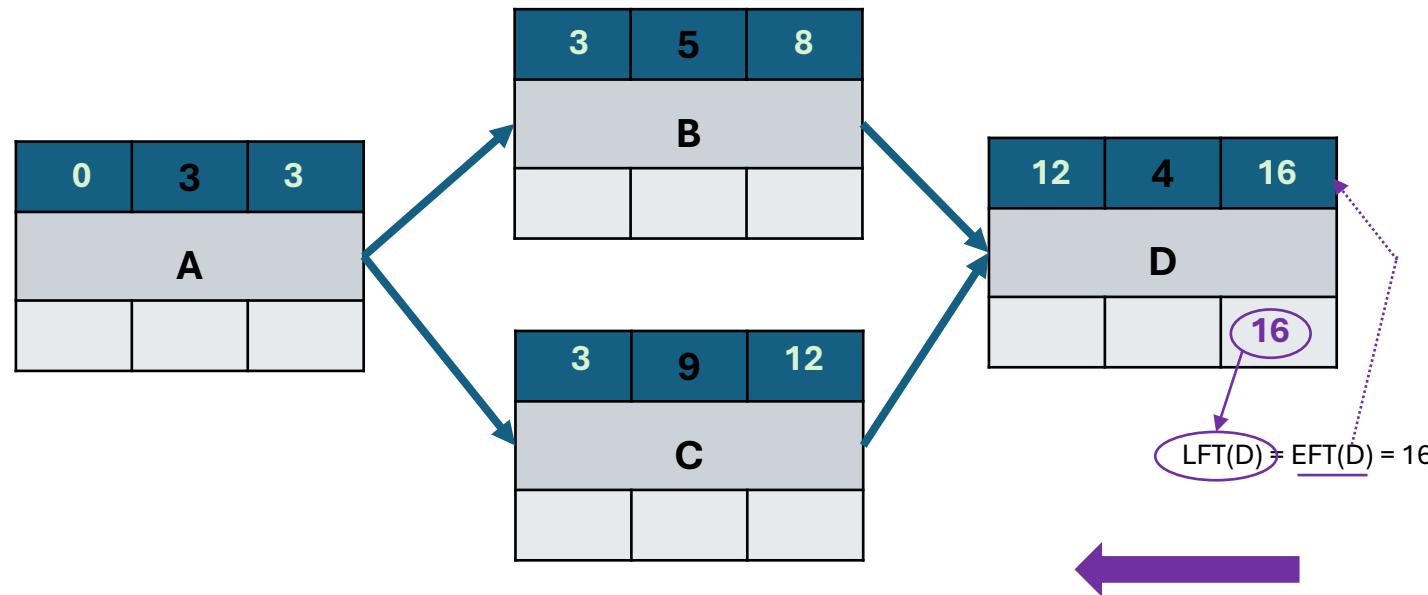


Phase 1: Forward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 2 – Backward Pass Calculations



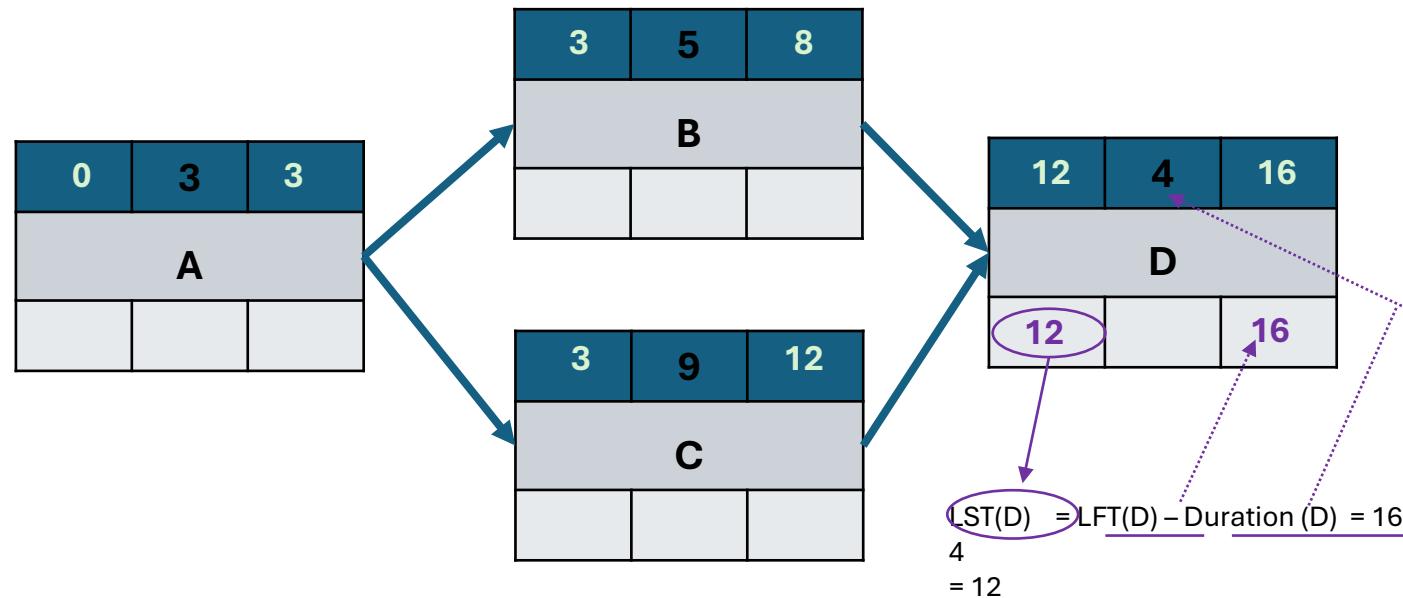
Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 2 – Backward Pass Calculations



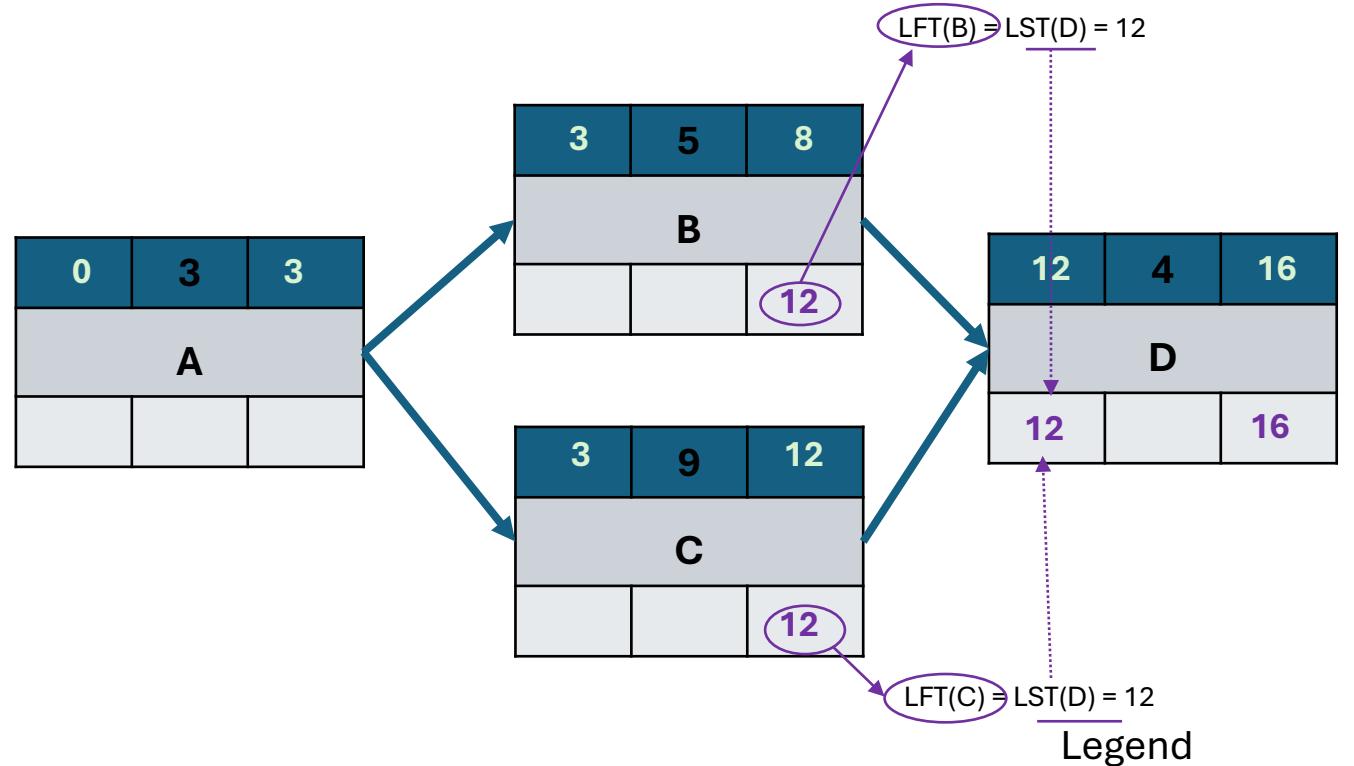
Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 2 – Backward Pass Calculations

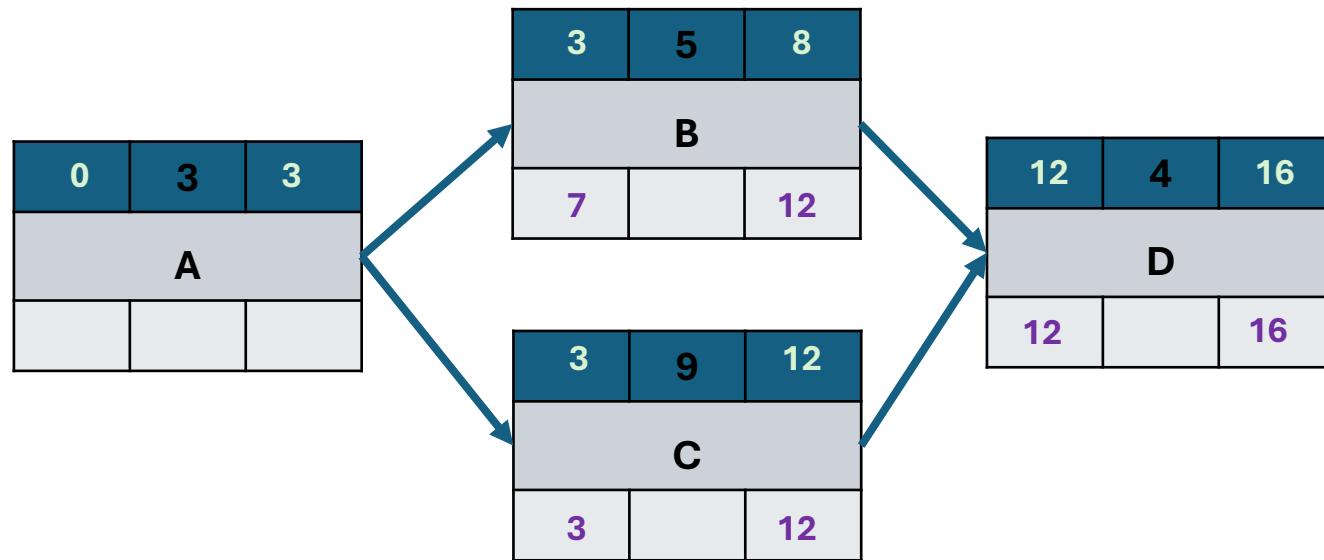


Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 2 – Backward Pass Calculations



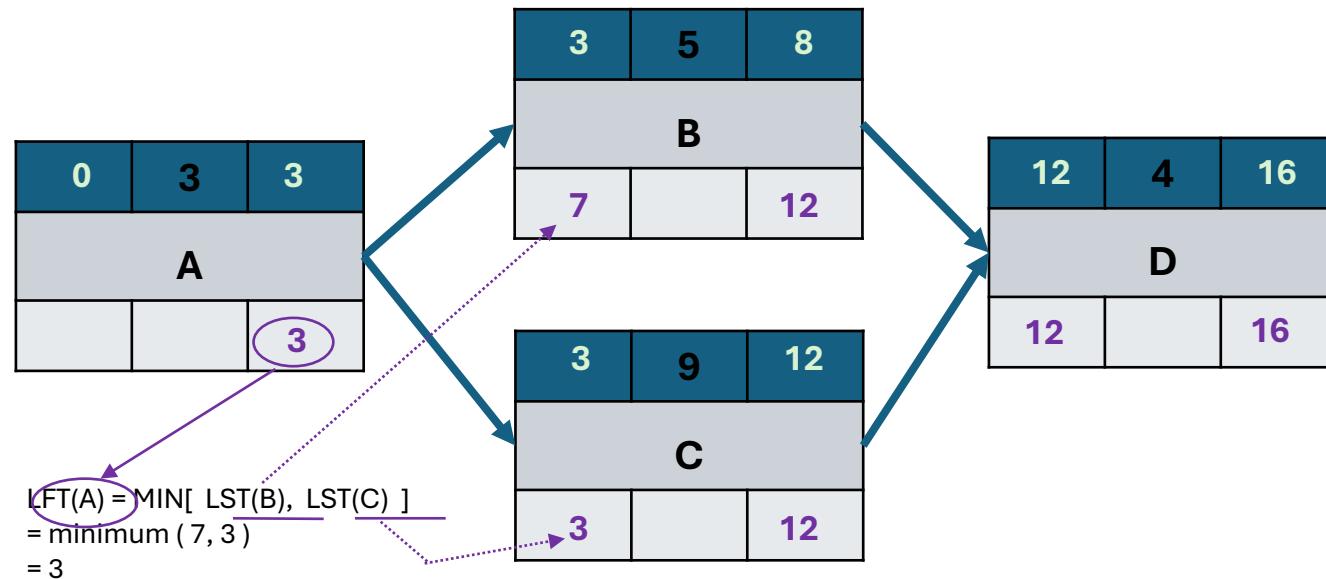
Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 2 – Backward Pass Calculations



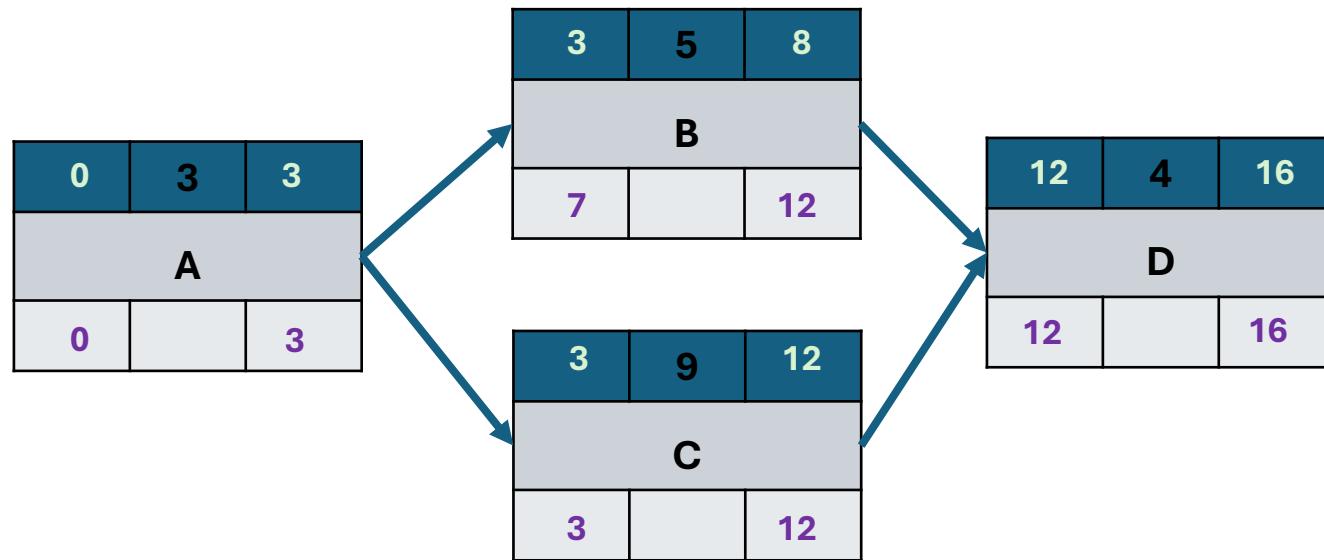
Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 2 – Backward Pass Calculations



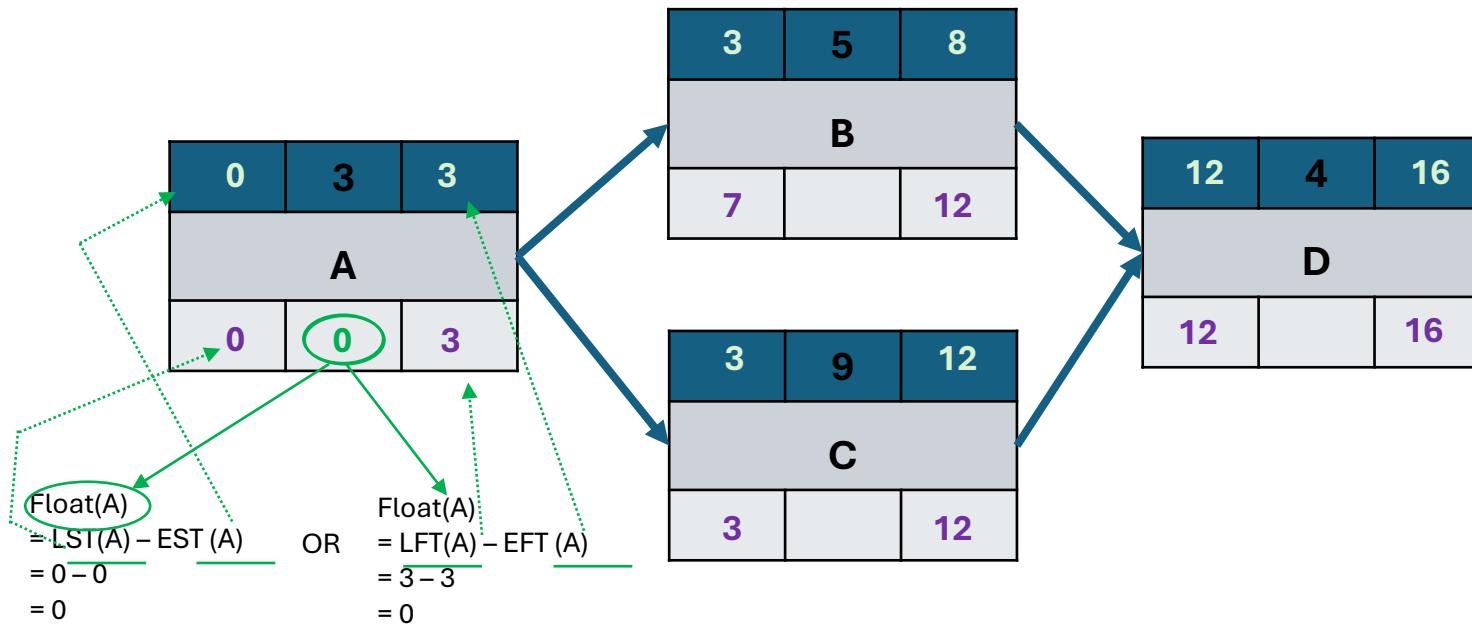
Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations (Completed)

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 3 – Total Float/Slack Calculations



Phase 1: Forward pass calculations (Completed)

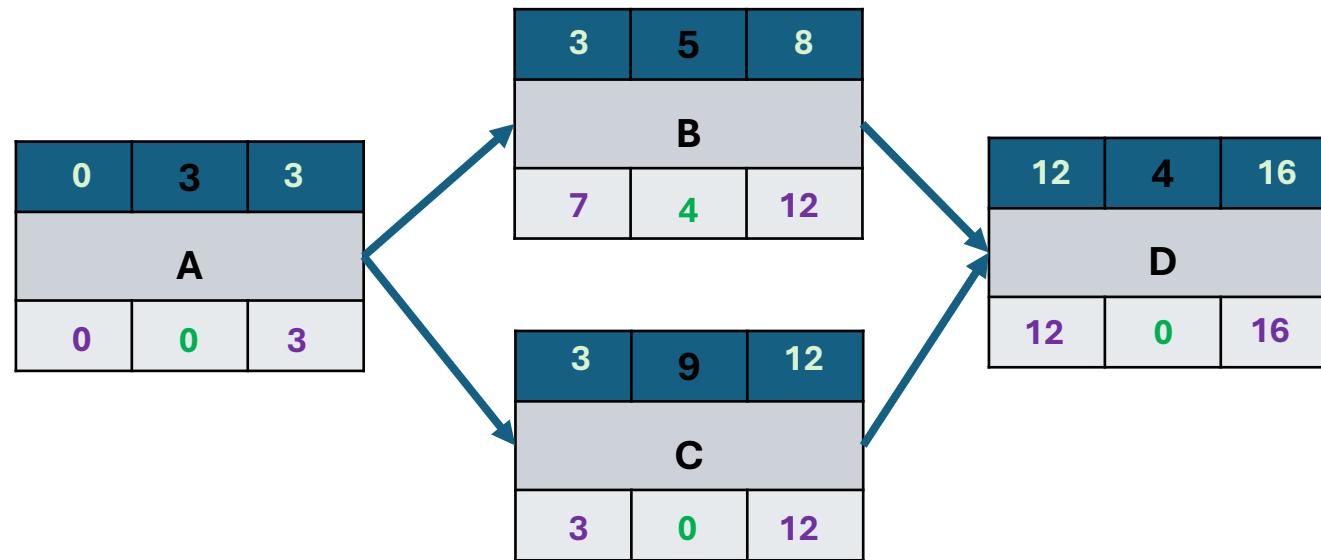
Phase 2: Backward pass calculations (Completed)

Phase 3: Calculations of float/slack

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 3 – Total Float/Slack Calculations



Phase 1: Forward pass calculations (Completed)

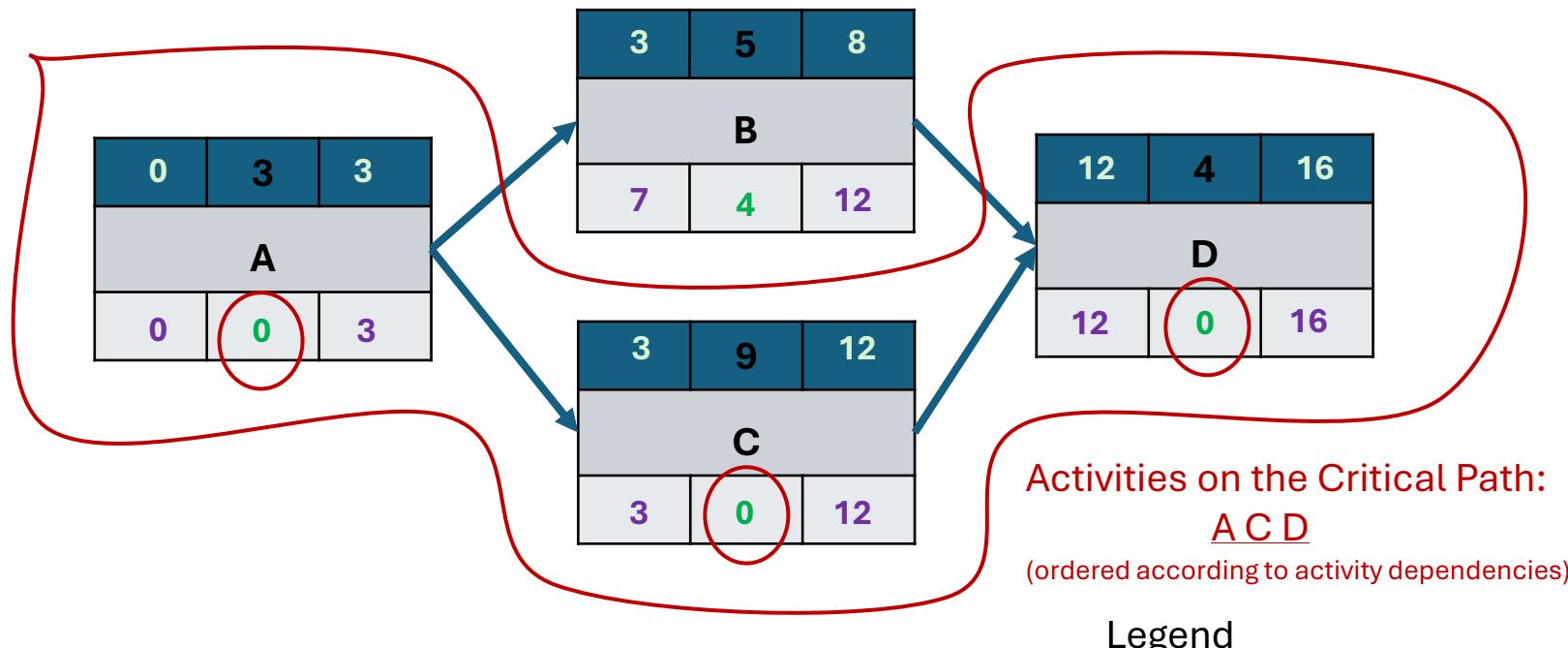
Phase 2: Backward pass calculations (Completed)

Phase 3: Calculations of float/slack (Completed)

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM Phase 4 – Critical Path Identification



Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations (Completed)

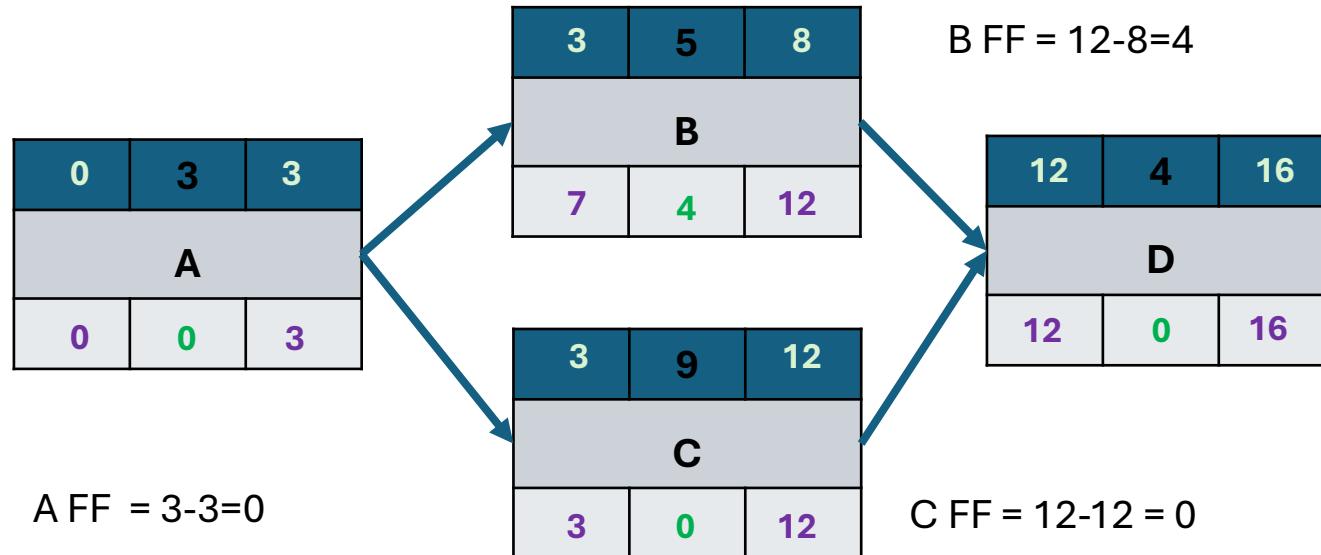
Phase 3: Calculations of float/slack (Completed)

Phase 4: Identification of critical path (Completed)

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

CPM – Free Float Calculations

FF = ES of successor activity – EF of current activity



Phase 1: Forward pass calculations (Completed)

Phase 2: Backward pass calculations (Completed)

Calculations of float/slack (Completed)

Legend

EST	Duration	EFT
Activity No.		
LST	Float/Slack	LFT

Free Float

- Free Float \leq Total Float for that activity
- Free Float can only occur when 2 or more activities share a common successor.
- If there are 2 successors, then:

FF of current activity = min (ES of successor1, ES of successor 2) – EF of current activity

- There is no free float on any activity on the critical path.

What is a Critical Path?

It is the **longest** (duration) path of planned activities through the network diagram and determines the **shortest possible time** to complete a project.

Implications of a Change in an Activity's Duration

- If any activity on the critical path finished later than expected (i.e. the calculated EFT), the project duration will be extended
- If any activity on the critical path finished earlier than expected, the project duration will be shortened
- If any activity NOT on the critical path finished earlier than expected, the project duration will remain the same
- If any activity NOT on the critical path finished later than expected, the project duration may be extended

Analysis

- The critical activities are **A,C,D** as they have zero float.
 - Activities must be listed in order according to the activity dependencies
- If any of these activities exceeds their expected durations, the project end date will slip
- The overall project duration will be 16 days, assuming we do not take into considerations of holidays and weekends

Important Activities to Monitor

Anywhere on the critical path:

- If any activity is delayed, it will delay all of its successors
- A small risk of delay for each activity adds up to a large delay for the overall task sequence.

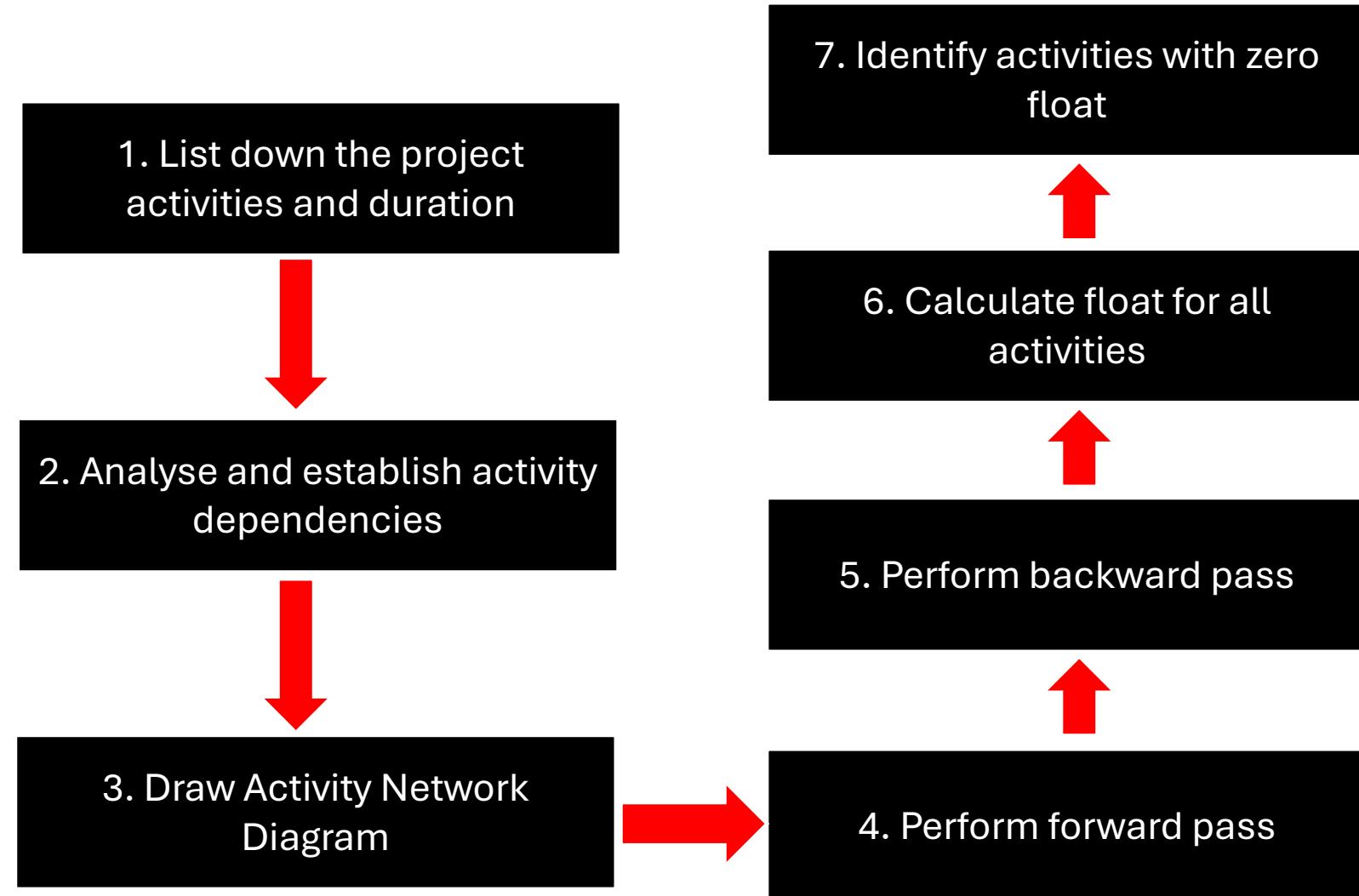
Where a critical activity has many predecessors:

- If any one predecessor activity is delayed, then the activity may also be delayed.

Where a critical activity has many successors:

- If any one predecessor activity is delayed, then the successor activity may also be delayed.

Summary: Steps To Find Critical Path



Summary

- PDM activities are represented by nodes and linked by relationships to show the sequence in which the activities are to be performed.
- Critical Path is the longest (duration) path of planned activities through the network diagram and determines the shortest possible time to complete a project.
- Total Float (Slack) is the amount of time an activity can be delayed or extended without affecting the project end date.
- Formula to calculate total float is LS (Late Start) – ES (Early Start) or LF (Late, Finish) – EF (Early Finish).

Thank you!

C303 IT Project Management

Lesson 11 (Schedule Management II)

Learning Outcomes

- Explain the Develop Schedule Process in the Project Schedule Management
- Explain the processes related to Adaptive Schedule Planning
- Explain the techniques and challenges of resource levelling and schedule compression such as fast tracking and crashing
- Apply the use of Critical Path in resource levelling and schedule compression

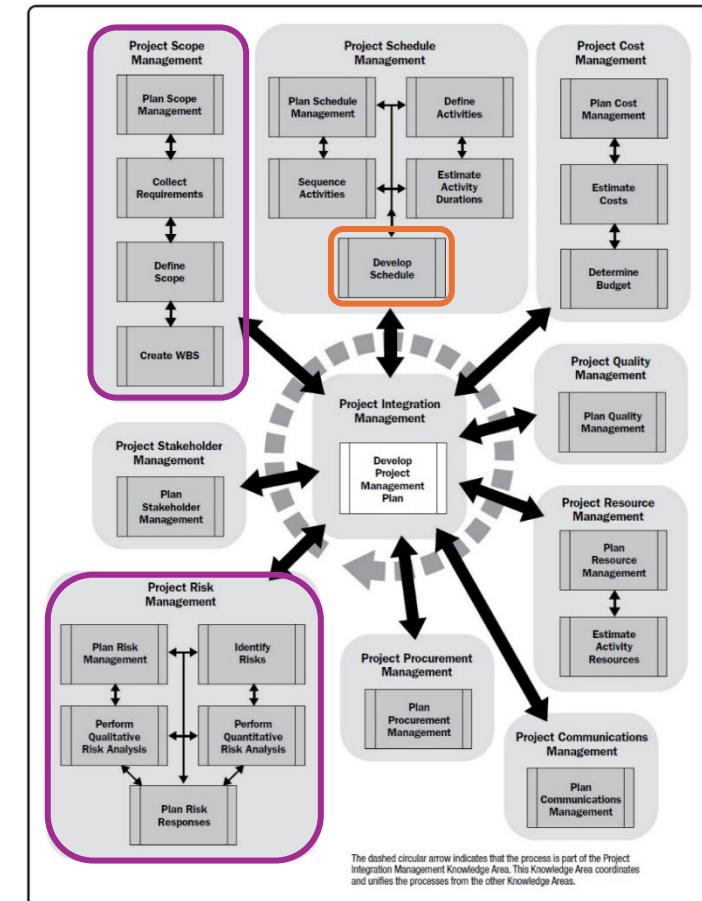
Continue: Project Schedule Management

Project Schedule Management includes the processes required to manage the timely completion of the project.

The Project Schedule Management processes are:

- Plan Schedule Management
- Define Activities
- ***Sequence Activities (Previous Lesson)***
- Estimate Activity Durations
- **Develop Schedule**
 - Tools and Techniques
 - Outputs
- Control Schedule

(Monitoring & Controlling Process Group)

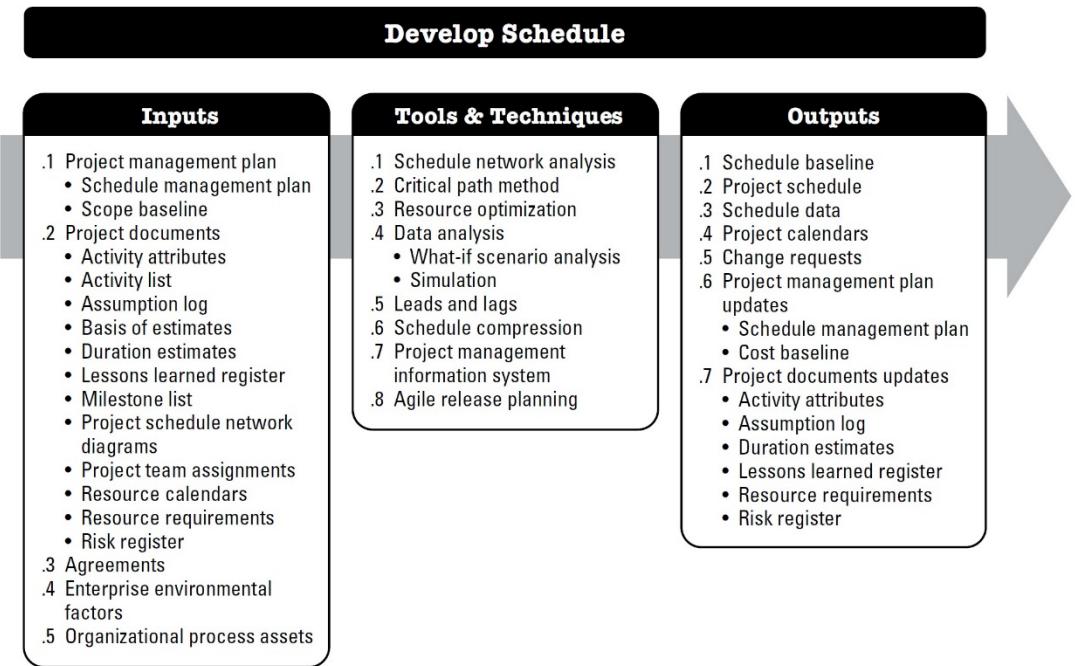


Read Details in PMBOK Guide 6th Edition Part 1: 6. Project Schedule Management

Develop Schedule

Develop Schedule is the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create a schedule model for project execution and monitoring and controlling.

The key benefit of this process is that it generates a schedule model with planned dates for completing project activities.



Read Details in PMBOK Guide 6th Edition Part 1: 6.5 Develop Schedule

Schedules

A schedule is a model for executing the project's activities, including durations, dependencies, and other planning information.

Predictive approaches follow a stepwise process as follows:

- Step 1. Decompose the project scope into specific activities.
- Step 2. Sequence related activities.
- Step 3. Estimate the effort, duration, people, and physical resources required to complete the activities.
- Step 4. Allocate people and resources to the activities based on availability.
- Step 5. Adjust the sequence, estimates, and resources until an agreed-upon schedule is achieved.



Read Details in PMBOK Guide 7th Edition Part 2: 2.4.2.3 Schedules

Resource Optimisation

Resource optimization is used to adjust the **start and finish dates** of activities to adjust planned resource use to be equal to or less than resource availability.

2 examples of resource optimization techniques:

- Resource Leveling

A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing the demand for resources with the available supply.

Resource leveling can often cause the original critical path to change.

- Resource Smoothing

A technique that adjusts the activities of a schedule model such that the requirements for resources on the project do not exceed certain predefined resource limits.

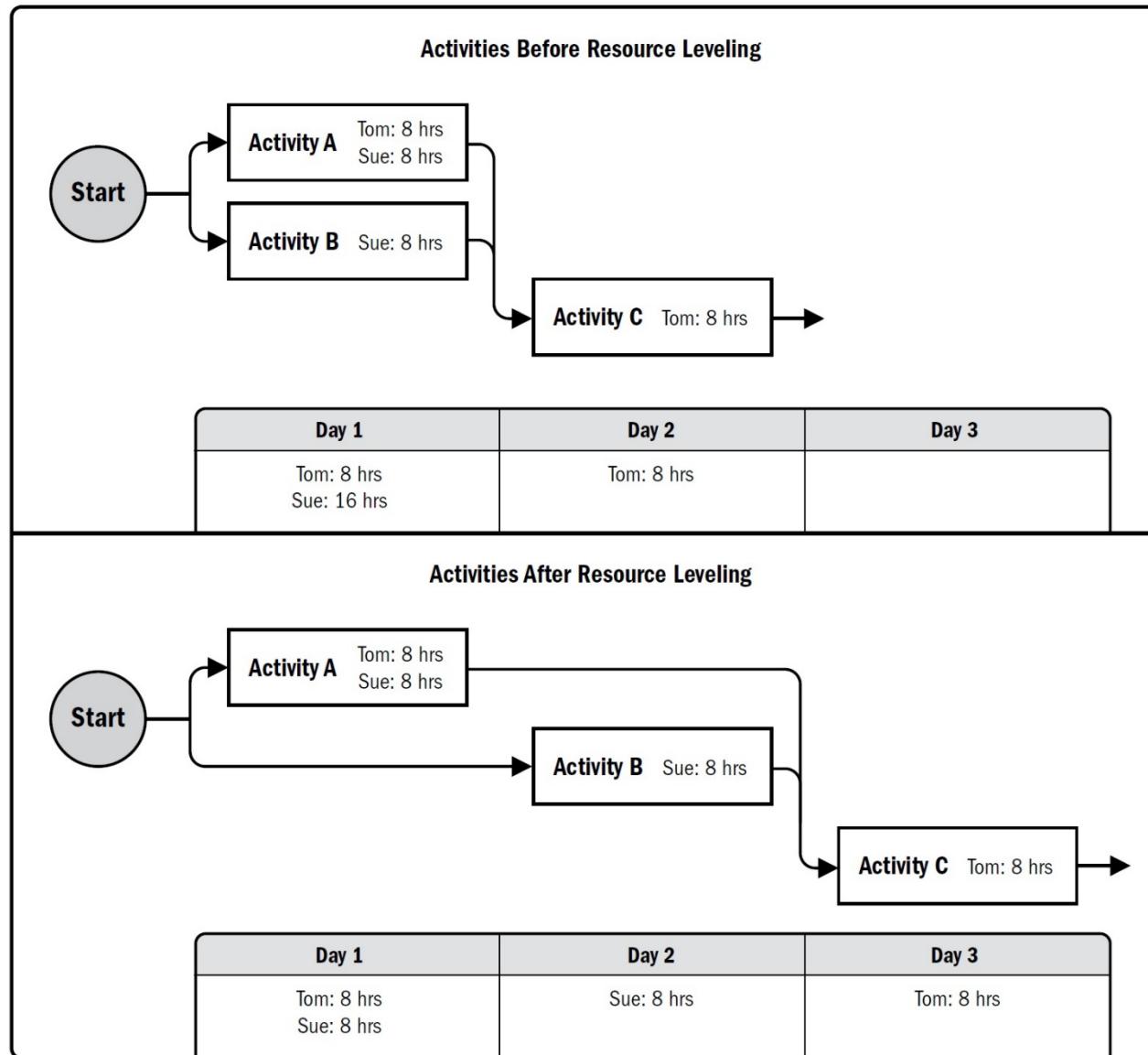
In resource smoothing, as opposed to resource leveling, the project's critical path is not changed, and the completion date may not be delayed.

Activities may only be delayed within their free and total float. Resource smoothing may not be able to optimize all resources.



Read Details in PMBOK Guide 6th Edition Part 1: 6.5.2.3 Resource Optimization

Resource Optimisation



Resource leveling can also be used when shared or critically required resources are available only at certain times or in limited quantities, or are overallocated, such as when a resource has been assigned to two or more activities during the same time period (as shown in the Figure), or there is a need to keep resource usage at a constant level.

Schedule Compression

Schedule compression techniques are used to shorten or accelerate the schedule duration without reducing the project scope in order to meet schedule constraints, imposed dates, or other schedule objectives.

A helpful technique is the negative float analysis.

- The critical path is the one with the least float.
- Due to violating a constraint or imposed date, the total float can become negative.



Read Details in PMBOK Guide 6th Edition Part 1: 6.5.2.6 Schedule Compression

Schedule Compression

Schedule compression techniques include:

- Fast Tracking

A schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration.

- Crashing

A technique used to shorten the schedule duration for the least incremental cost by adding resources.

Challenges: Resource Leveling, Fast Tracking, Crashing

Resource Leveling	Fast Tracking	Crashing
May cause the end-date to change to later.	Need to know which activities are not dependent on each other in order to execute in parallel.	Takes time to find new, willing and appropriate resources.
May increase cost due to committing resources to a longer duration.	Increase coordination effort	Cost increase - Very likely to increase resulting from billable hours, extra office space, equipment.
May increase project risks and affect the overall quality if certain tasks are moved too early or too late from original schedule.	May lead to resource over-allocation.	<p>Learning curve, for examples:</p> <ul style="list-style-type: none"> ▪ New staff may not be familiar with work or environment ▪ New staff often require time to train ▪ New staff may disrupt or frustrate existing staff and cause overall productivity to drop
	Increase Risk	May lead to problem of resource over-allocation.
	Increase Rework	

Critical Path Method and Impact on Activity Sequencing and Resource Utilisation

For activities ON the critical path:

- Could be assigned to competent project team members to ensure timely completion.
- Additional resources may be deployed to further compress the activities duration and hence reduce the project duration.
- Arrange some activities to be parallel or with some start-to-start dependency.

For activities NOT ON the critical path there is some flexibility for such activities to delay or take longer time to complete without affecting the project end date.

- Resources assigned to these activities could be temporary deployed to assist those activities on the critical path.

Use of the Critical Path

Recap: It is the longest (duration) path of planned activities through the network diagram and determines the shortest possible time to complete a project.

To achieve the greatest schedule compression, crashing and fast tracking should target on **activities on critical path**.

To minimize the impact to the schedule when performing resource leveling, we should target at **activities not on the critical path**.

Develop Schedule: 2 Outputs

- Schedule Baseline

A schedule baseline is the approved version of a schedule model that can be changed only through formal change control procedures and is used as a basis for comparison to actual results.

- Project Schedule

The project schedule is an output of a schedule model that presents linked activities with planned dates, durations, milestones, and resources.

At a minimum, the project schedule includes a planned start date and planned finish date for each activity.



Read Details in PMBOK Guide 6th Edition Part 1: 6.5.3 Develop Schedule: Outputs

Develop Schedule Output: Project Schedule

A project schedule model can be presented in the following formats:

- Bar charts

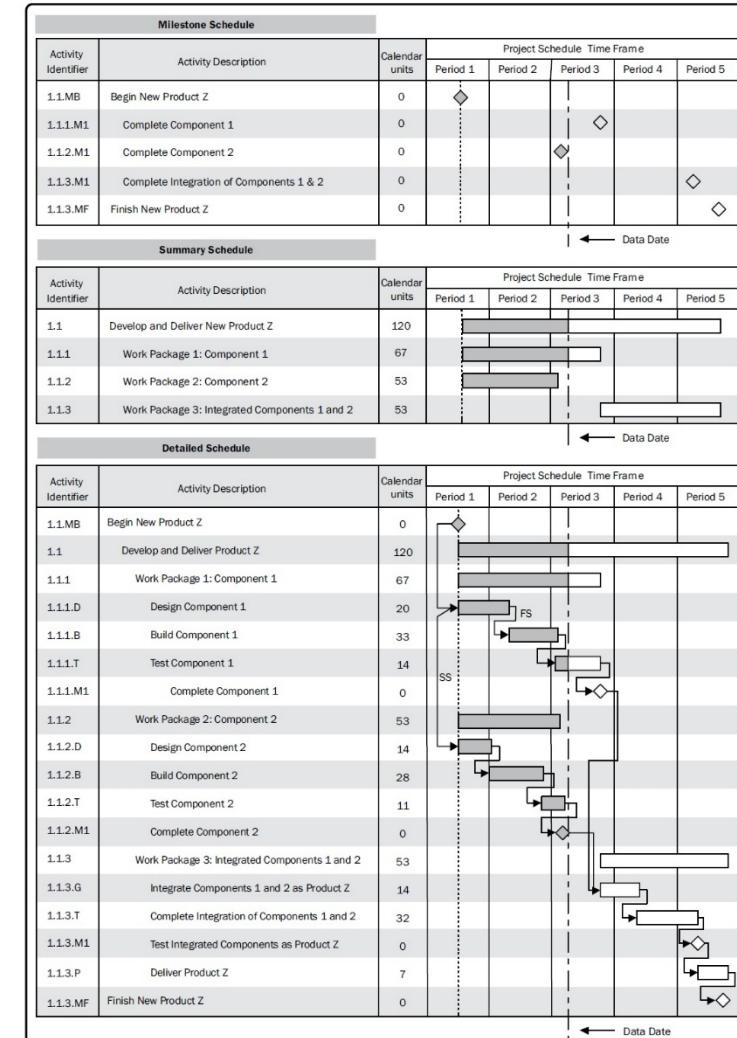
Also known as Gantt charts, bar charts represent schedule information.

- Milestone charts

These charts are similar to bar charts, but only identify the scheduled start or completion of major deliverables and key external interfaces.

- Project schedule network diagrams

These diagrams, with activity date information, usually show both the project network logic and the project's critical path schedule activities.



Dependencies

When compressing the schedule, it is important to determine the nature of the dependencies between activities. The four types of dependencies are:

- Mandatory dependency. A relationship that is contractually required or inherent in the nature of the work. This type of dependency usually **cannot be modified**.
- Discretionary dependency. A relationship that is based on best practices or project preferences. This type of dependency **may be modifiable**.
- External dependency. A relationship between project activities and non-project activities. This type of dependency usually **cannot be modified**.
- Internal dependency. A relationship between one or more project activities. This type of dependency **may be modifiable**.

Adaptive Schedule Planning

Adaptive schedule planning uses incremental planning.

- Iterations and releases:

A high-level release plan is developed that indicates the basic features and functionality to be included in each release.

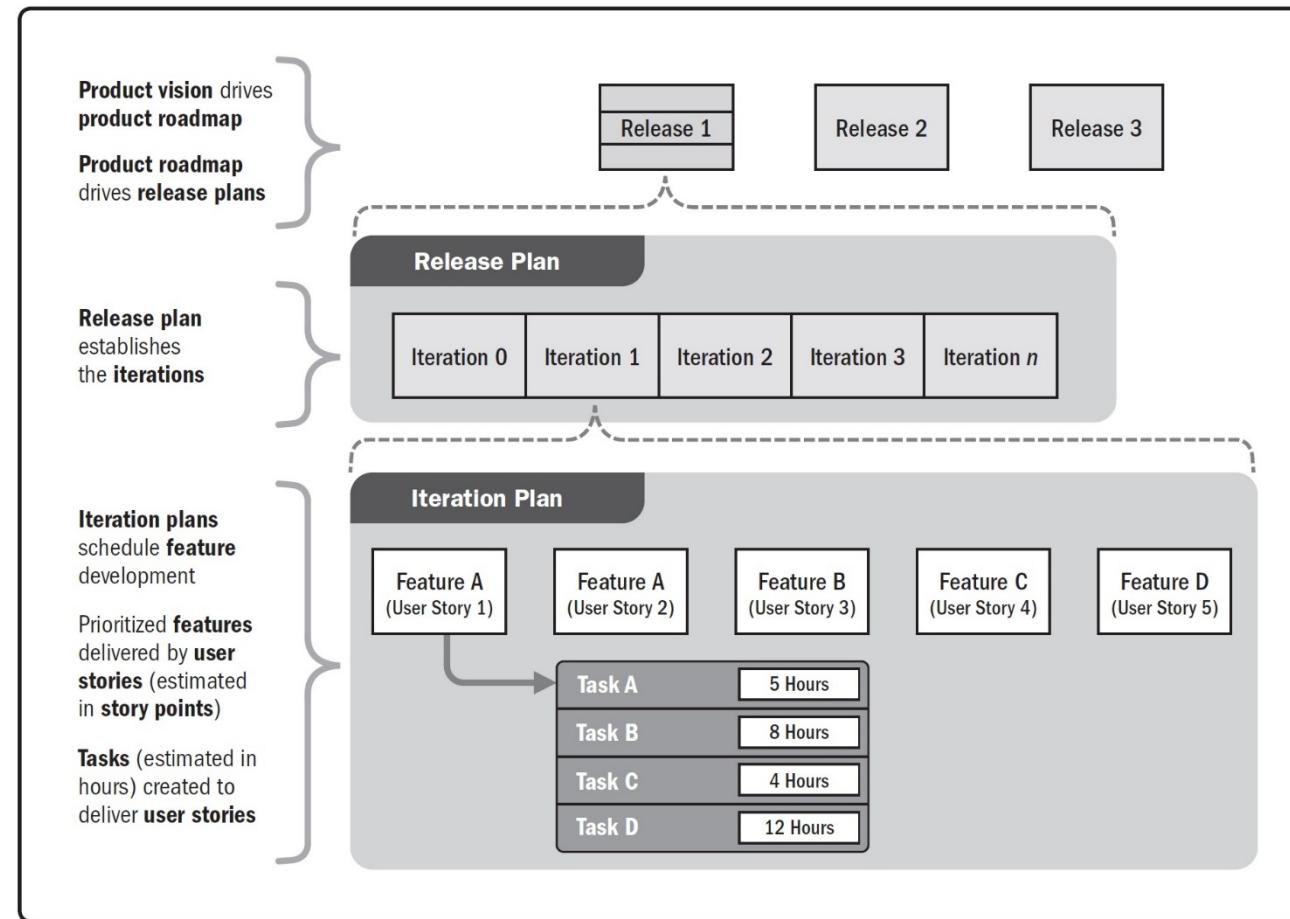
Within each release, there will be two or more iterations. Each iteration adds value.

- Timeboxes:

The work in each timebox is based on a prioritized backlog.

At the end of the timebox, the project team demonstrates the work completed. At that point, the backlog and estimates of work available to be done may be updated or reprioritized for the next timebox.

Iterations and Releases



Thank you!