Knowledge Areas	Project Management Process Groups				
	Initiating	Planning	Executing	Monitoring & Controlling	Closing
Integration	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Work	Monitor and Control Project Work	Close Project or Phase
				Perform Integrated Change Control	
Scope		Plan Scope Management			
		Collect Requirements		Validate Scope	
		Define Scope		Control Scope	
		Create WBS			
Time		Plan Schedule Management		Control Schedule	
		Define Activities			
		Sequence Activities			
		Estimate Activity Resources			
		Estimate Activity Durations			
		Develop Schedule			
Cost		Plan Cost Management		Control Costs	
		Estimate Costs			
		Determine Budget			
Quality		Plan Quality Management	Perform Quality Assurance	Control Quality	
Human Resource		Plan Human Resource Management	Acquire Project Team		
			Develop Project Team		
			Manage Project Team		
Communications		Plan Communications Management	Manage Communications	Control Communications	
Risk		Plan Risk Management		Control Risks	
		Identify Risks			
		Perform Qualitative Risk Analysis			
		Perform Quantitative Risk Analysis			
		Plan Risk Responses			
Procurement		Plan Procurement Management	Conduct Procurements	Control Procurements	Close Procurements
Stakeholder	Identify Stakeholders	Plan Stakeholder Management	Manage Stakeholder Engagement	Control Stakeholder Engagement	

4.2 Develop Project Management Plan

PMBOK Page 72

5.1 Plan Scope Management

PMBOK Page 107

5.2 Collect Requirements

PMBOK Page 110

5.3 Define Scope

PMBOK Page 120

5.4 Create WBS

PMBOK Page 125

Create WBS

What's the purpose?

- Produce the **Work Breakdown Structure (WBS)**, a graphical subdivision of project deliverables – beginning with the Scope Statement – into smaller, more manageable components.

How does it help?

- It provides, in the form of the WBS, **a structured picture of all project deliverables.**

When does it happen?

- After **Define Scope** process – and **before Time Management processes.**

Create WBS

Inputs / Tools & Techs / Outputs

PMBOK 5.4

Create WBS

Knowledge Area: **Scope Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Scope Management Plan ❑ Project Scope Statement ❑ Requirements Documentation ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ **Decomposition** ✓ Expert Judgment	❑ **Scope Baseline** ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Create WBS

Tools & Techs

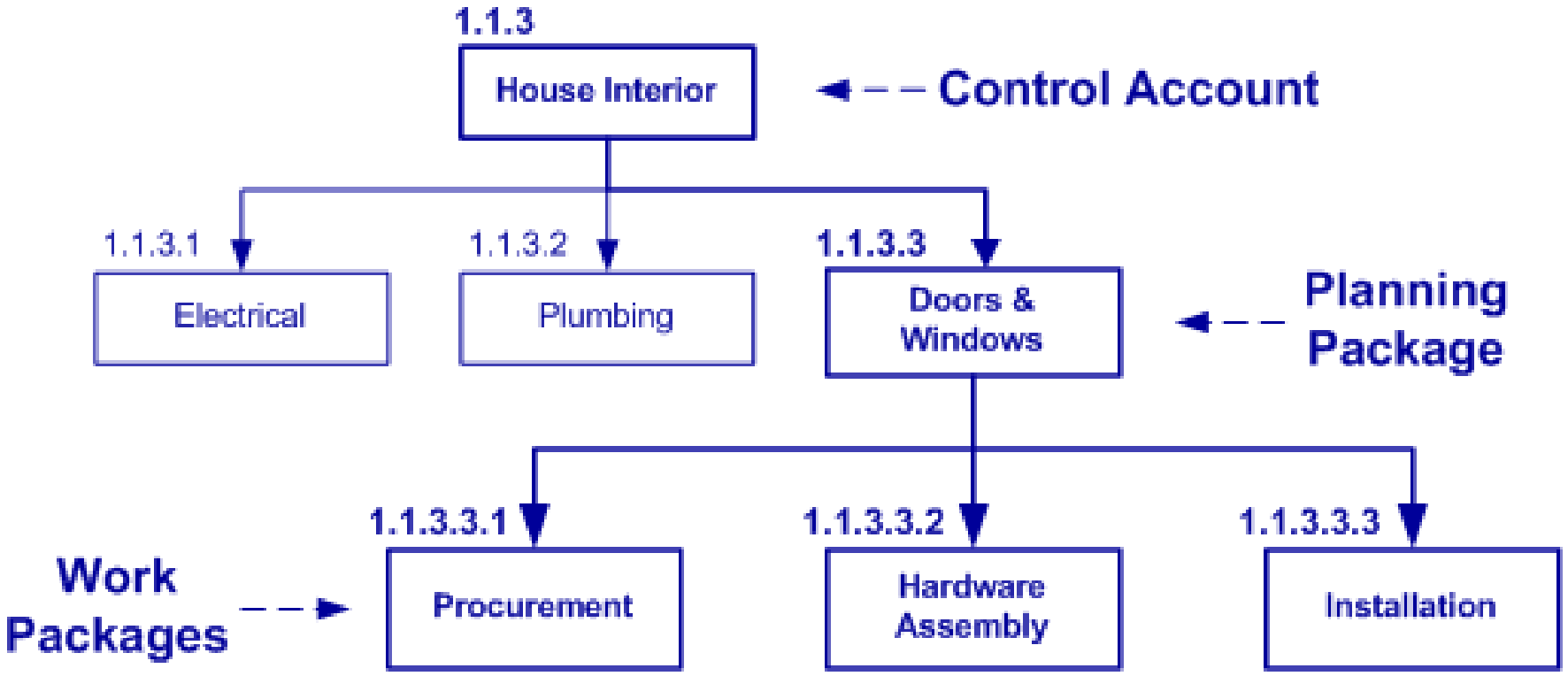
- **Decomposition** **PMBOK 128**
  - The WBS is constructed through a **"breakdown process"** known as **Decomposition**.
  - Decomposition starts with the Deliverables as presented in the Project Scope Statement.
  - **Progresses from top to bottom**, level by level.
  - As levels become lower, the scope, complexity, and cost of each element become smaller.
  - **Lowest level** is known as **Work Package** level.

Tools & Techs – Decomposition

- Work Packages are **manageable units of work** that can be **planned, budgeted, scheduled, and controlled** as individual entities.
  - **Work Package size** is very important:
    - Should be small enough to allow making **realistic estimates.**
    - But not so small that number of WBS elements overwhelms the planning/control process.
  - Useful rule of thumb is **80 Hour Rule:** a work package should generally be no more than 80 hours effort.

Create WBS

Tools & Techs – Decomposition



Example of a Work Breakdown Structure (WBS) Showing Control Accounts, Planning Packages, Work Packages

Create WBS

Outputs

- **Scope Baseline** **PMBOK 131**
  - Comprised of three components:
    - **Project Scope Statement**. From Define Scope.
    - **Work Breakdown Structure**. Developed in this process – and the purpose of this process! A **graphic picture** of project hierarchy, WBS provides a **firm basis for both planning and controlling** – shows how each Work Package contributes to overall project objectives. **Basic foundation** on which the project is built. An **essential step** in planning the project.

Create WBS

Outputs

- **WBS Dictionary**. Contains **detailed information** related to each **Work Package**. Contents of the WBS Dictionary could include:
  - **SOW** Reference
  - Planned **Duration**
  - Estimated **Budget**
  - Responsibility
  - **Resource Requirements**
- But remember: ***Progressive Elaboration!*** Most of the above contents of the WBS Dictionary are not known at the time of WBS creation.

6.1 Plan Schedule Management

PMBOK Page 145

Plan Schedule Management

What's the purpose?

– Produce the **Schedule Management Plan**, a document that explains the policies, procedures, and documentation required to properly manage – that is, plan, develop, execute, and control – the project schedule.

How does it help?

– This document will provide **guidance and direction on how to manage the schedule** during all Project Life Cycle phases.

When does it happen?

– After **Project Charter** has been developed – but before **Define Activities process**.

Plan Schedule Management
Inputs / Tools & Techs / Outputs

PMBOK 6.1

Plan Schedule Management

Knowledge Area: **Schedule Management**
Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Project Management Plan ❑ Project Charter ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Expert Judgment ✓ Analytical Techniques ✓ Meetings	❑ **Schedule Management Plan**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Plan Schedule Management

Outputs

- **Schedule Management Plan** **PMBOK 148**
  - A **how-to subsidiary management plan** that becomes part of the Project Management Plan.
  - Establishes the **criteria** and the **activities** that will be used to **develop, monitor, and control** the Project Schedule. Contents of the plan may include:
    - **Level of Accuracy** to be considered acceptable in determining duration estimates for schedule activities.
    - **Performance Measurement Rules,** which may include Earned Value Measurements (SPI, SV)
    - **Reporting Formats.**

6.2 Define Activities

PMBOK Page 149

Define Activities

What's the purpose?

- Develop and document – in the **Activity List** – the **activities that must be performed** to produce the project's deliverables.

How does it help?

- It provides a basis for estimating, scheduling, executing, monitoring, and controlling the work involved in the Work Packages by **breaking down the Work Packages into the specific activities** required for the completion of the Work Packages, all of which is displayed in the **Activities List**.

When does it happen?

- After **Create WBS and Plan Schedule Management** processes – and before **Sequence Activities** process.

Define Activities

Inputs / Tools & Techs / Outputs

PMBOK 6.2

Define Activities

Knowledge Area: **Time Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Schedule Management Plan ❑ Scope Baseline ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Decomposition ✓ **Rolling Wave Planning** ✓ Expert Judgment	❑ **Activity List** ❑ **Activity Attributes** ❑ **Milestone List**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Outputs

- **Activity List** PMBOK 152
  - The result of the Decomposition effort in this process – decomposing each Work Package in the WBS into the actual **efforts needed to complete a Work Packages** – and then compiling all of these efforts in a document called the **Activities List.**
- **Activity Attributes** PMBOK 153
  - The **characteristics associated with the activities** on the **Activities List,** including identifiers, resource requirements, Leads and Lags, Predecessor and Successor activities, activity codes, and more!

Define Activities

Outputs

Example of Activity List

Project Name:				Activity Attributes			
Prepared By:							
Date:							
Project Phase:				Duration	Start Date	End Date	Resource
Control Account:							
	Planning Package:						
		Work Package:					
			Activity:				
Construction							
House Interior							
	Doors & Windows						
		Procurement					
			Determine specific hardware				
			Order hardware through Purchasing				
			Receive and inventory hardware				
		Hardware Assembly					
			Build frames				
			Attach hand-holds				
			Attach swing latches				
		Installation					

Outputs

- **Milestone List** **PMBOK 153**
  - Milestone: a **significant point or event,** with zero duration (unlike ordinary schedule activities).
  - Milestone List should also include indication of whether the milestone is **mandatory** (required by contract) or **optional.**

6.3 Sequence Activities

PMBOK Page 153

Sequence Activities

What's the purpose?

- Identify and document – in a **Project Schedule Network Diagram** – the **relationships among the activities** previously identified in the Define Activities process.

How does it help?

- This process **defines the logical order of work to be performed** to obtain maximum efficiency.

When does it happen?

- After **Define Activities** process, in which activities have been identified – but before **Develop Schedule** process.

Sequence Activities
Inputs / Tools & Techs / Outputs

PMBOK 6.3

Sequence Activities

Knowledge Area: **Time Management**
Process Group: **Planning**

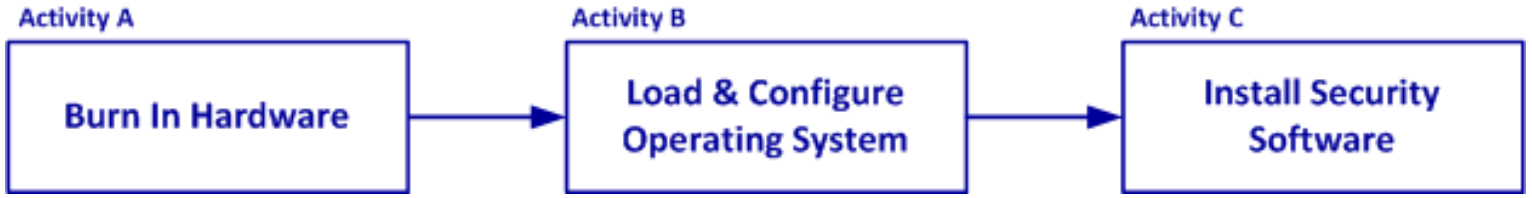
INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Schedule Management Plan ❑ Activity List ❑ Activity Attributes ❑ Milestone List ❑ Project Scope Statement ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ **Precedence Diagramming Method (PDM)** ✓ **Dependency Determination** ✓ **Leads and Lags**	❑ **Project Schedule Network Diagrams** ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Sequence Activities

Tools & Techs

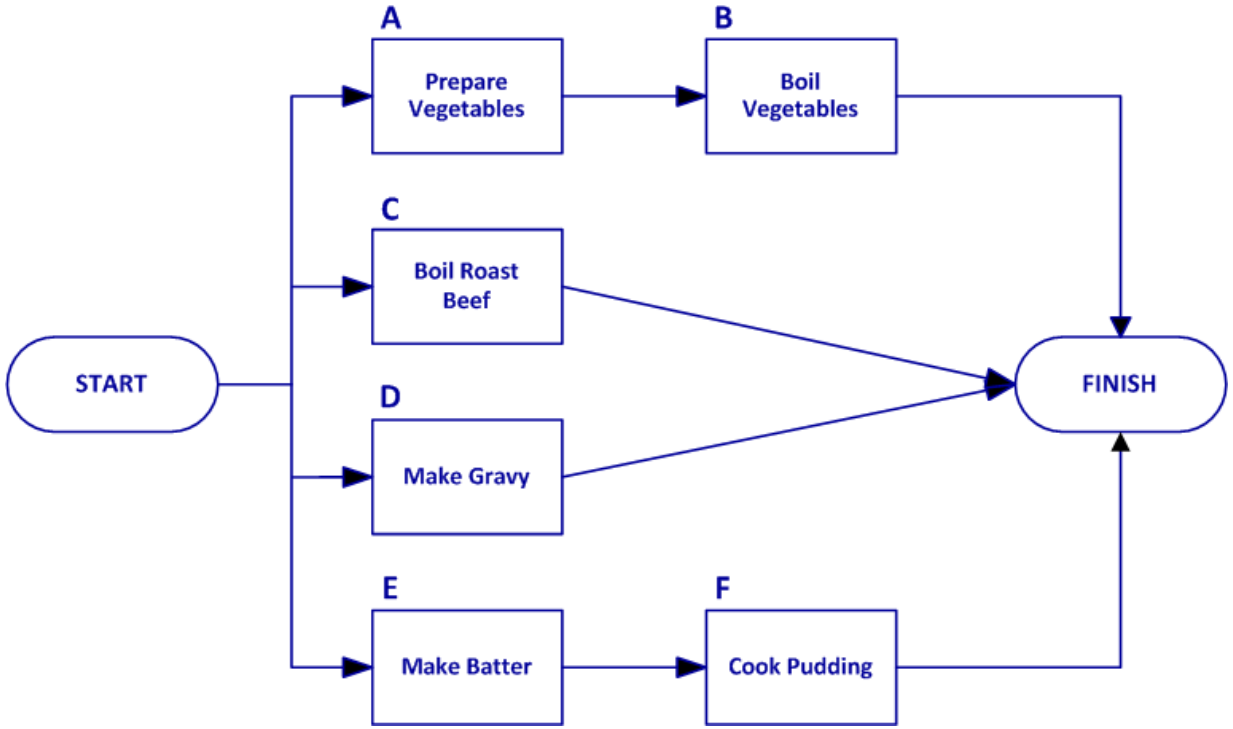
- **Precedence Diagramming Method** PMBOK 156
  - The Precedence Diagramming Method (PDM) creates a **network of activities** using boxes (called **nodes**) to show the activities and arrows to link them. Also know as **Activity-On-Node** (AON).
  - PDM is about establishing proper **relationships** among the activities. The activities below, for example, must be related in this way:



Sequence Activities

Outputs

- **Project Schedule Network Diagram** PMBOK 158
  - Diagram showing the activities in their **logical relationships** (also referred **dependencies**).



6.4 Estimate Activity Resources

PMBOK Page 160

Estimate Activity Resources

What's the purpose?

- **Estimate the resources** – the **type and quantity** of all equipment and supplies, as well as human resources – that are **needed to complete the work** involved in each activity documented in the Activity List**.**

How does it help?

- Identification of these resources leads to **more accurate cost and schedule estimates**.

When does it happen?

- After the **Project Schedule Network Diagrams** have been developed in the Sequences Activities process – but before the **Estimate Activity Durations** process.

Estimate Activity Resources

Inputs / Tools & Techs / Outputs

PMBOK 6.4

Estimate Activity Resources

Knowledge Area: **Time Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Schedule Management Plan ❑ Activity List ❑ Activity Attributes ❑ **Resource Calendars** ❑ **Risk Register** ❑ **Activity Cost Estimates** ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Expert Judgment ✓ **Alternatives Analysis** ✓ **Published Estimating Data** ✓ **Bottom-Up Estimating** ✓ **Project Management Software**	❑ **Activity Resource Requirements** ❑ **Resource Breakdown Structure (RBS)** ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Estimate Activity Resources

Tools & Techs

- **Published Estimating Data** PMBOK 164
  - Published **production rates** and **resource unit costs.**
  - Frequently updated for a wide variety of **material, equipment,** and **labor trades.**
  - Available for different countries and even the numerous geographical locations within countries.

Estimate Activity Resources

Tools & Techs

- **Bottom Up Estimating** **PMBOK 164**
  - A **key estimating tool** – Considered **more expensive** and **time consuming** than other methods– but also **more accurate!**
  - Estimating resources by **starting at the bottom of the WBS** – at the Work Package level – and then **aggregating up to the Control Account level.**
  - Usually relies on estimates from the **functional organizations** or **subject matter experts most familiar with the work** of the package.

Estimate Activity Resources

Tools & Techs

- **Project Management Software** **PMBOK 164**
  - Any software tool that (a) provides the Project Manager with the ability to **develop resource estimates** and (b) assists him/her in the **planning, organization,** and **management** of resource pools.
  - Examples include **Microsoft Project** and **Primavera.**

Estimate Activity Resources

Outputs

- **Activity Resource Requirements** PMBOK 165
  - The **resource type** and **quantity** for **each activity** in every Work Package (all of which now appear in the Activity List).
  - Example content per activity includes:
    - **Basis** of each resource estimate.
    - **Assumptions** relating the types of resources are applied; the availability of resources needed, and the quantities to be used.

Estimate Activity Resources

Outputs

- **Resource Breakdown Structure (RBS)** PMBOK 164
  - **Hierarchical structure** of resources.
  - Organized by **resource category** and **resource type**.
  - Resource **categories** include:
    - Labor, materials, equipment, and supplies.
  - Resource **types** include:
    - Skill level or grade level.
  - RBS is useful for reporting resource utilization along side schedule data.

6.5 Estimate Activity Durations

PMBOK Page 165

Estimate Activity Durations

What's the purpose?

- **Estimate the time,** with the resources previously identified, **needed to complete the work** involved in each activity documented in the Activity List.

How does it help?

- It **provides activity duration estimates,** the key input into the development of the project schedule.

When does it happen?

- After **Estimate Activity Resources** process – in which resources have been determined – and immediately prior to **Develop Schedule process.**

Estimate Activity Durations

Inputs / Tools & Techs / Outputs

PMBOK 6.5

Estimate Activity Durations

Knowledge Area: **Time Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Schedule Management Plan ❑ Activity List ❑ Activity Attributes ❑ Activity Resource Requirements ❑ Resource Calendars ❑ Project Scope Statement ❑ Risk Register ❑ Resource Breakdown Structure ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Expert Judgment ✓ **Analogous Estimating** ✓ **Parametric Estimating** ✓ **Three-Point Estimating** ✓ Group Decision-Making Techniques ✓ **Reserve Analysis**	❑ **Activity Duration Estimates** ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Estimate Activity Durations

Tools & Techs

- **Analogous (Top-Down) Estimating** **PMBOK 169**
  - A **key estimating tool** – Considered **less expensive** and **less time consuming** than other methods – but also **less accurate!**
  - Also known as **Top-Down Estimating.**
  - As a basis for estimating, uses cost/schedule data of **an activity from a previous project** that is similar to the activity currently being estimated.

Estimate Activity Durations

Tools & Techs – Analogous Estimating

- Heavily reliant on **Historical Information** and the **Expert Judgment** of the user.
- Often used when estimating **time is limited** or when there is a **little known** about the activity or the project.
- May be used for estimating both **cost** and **duration.**

Estimate Activity Durations

Tools & Techs

- **Parametric Estimating** PMBOK 170
  - Use **simple mathematical relationships** based on standard or historic data - for example, number of bricks laid per hour to estimate how long to build a wall.
  - Uses statistical relationship between **historical data** and other variables to calculate an estimate for such activity parameters as **cost budget** and **duration.**
  - Can produce high levels of accuracy and can be applied to a total project or segments of a project.

Estimate Activity Durations

Tools & Techs

- **Three-Point Estimating** PMBOK 170
  - Also known as the **Program Evaluation and Review Technique (PERT)**, Three-Point Estimating takes into consideration the **uncertainty of estimates.**
  - Uses three estimates – **Optimistic, Pessimistic,** and **Most Likely** (or Most Realistic).
  - Two commonly used calculations are **Triangular Distribution** (left) and **Beta Distribution** (right):

(O + ML + P) ÷ 3 **(O + 4ML + P) ÷ 6**

Tools & Techs – PERT and SD

- Three-Point (or PERT) Estimating (Beta Distribution) may be used with **Standard Deviation** for estimating that results in **ranges.**
- Therefore, in addition to the **PERT** calculation, a **short-cut Standard Deviation calculation** (for project management estimating purposes) is used :

$$\frac{O + (4ML) + P}{6} \qquad \frac{P - O}{6}$$

Outputs

- **Activity Duration Estimates** PMBOK 172
  - The "…quantitative assessments of the **likely number of time periods** that are required to complete an activity." PMBOK 172
  - Activity Duration Estimates **do not include Leads or Lags** but **may include ranges** – for example, an estimate may be **5 days + 1 day.**

6.6 Develop Schedule

PMBOK Page 172

Develop Schedule

What's the purpose?

- Produce the **Schedule Baseline** by way of a thorough analysis of the key Outputs from preceding processes – specifically, the **activity sequences**, **resource** and **duration requirements**, and **schedule constraints**.

How does it help?

- It results in **a credible schedule model, complete with planned start and finish dates** for all project activities.

When does it happen?

- After **Identify Risks**, **Plan Human Resource Management**, and **all Scope and Time Knowledge Area** planning processes.

Develop Schedule

Inputs / Tools & Techs / Outputs

PMBOK 6.6

Develop Schedule

Knowledge Area: **Time Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Schedule Management Plan ❑ Activity List ❑ Activity Attributes ❑ Project Schedule Network Diagrams ❑ Activity Resource Requirements ❑ Resource Calendars ❑ Activity Duration Estimates ❑ Project Scope Statement ❑ Risk Register ❑ **Project Staff Assignments** ❑ Resource Breakdown Structure ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ **Schedule Network Analysis** ✓ **Critical Path Method** ✓ **Critical Chain Method** ✓ **Resource Optimization Techniques** ✓ **Modeling Techniques** ✓ Leads and Lags ✓ **Schedule Compression** ✓ **Scheduling Tool**	❑ **Schedule Baseline** ❑ **Project Schedule** ❑ **Schedule Data** ❑ **Project Calendars** ❑ PMP Updates ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Develop Schedule

Tools & Techs

- **Schedule Network Analysis** **PMBOK 176**
  - A technique that **generates the project schedule model.**
  - Employs various analytical techniques – **Critical Path Method**, **Critical Chain Method**, **What-If Analysis**, **Resource Optimization Techniques** – to calculate the early and late start and finish dates.

Develop Schedule

Tools & Techs

- **Critical Path Method** PMBOK 176
  - Used for two purposes:
    - To determine the **minimum duration** of the project.
    - To determine where there is **flexibility** in the Project Schedule Network Diagram, and how much of it there is!
  - CPM is covered in detail at the end of this process, in the **Special Attention** section.

Develop Schedule

Tools & Techs

- **Resource Optimization Techniques** PMBOK 179
  - Techniques used to adjust the Schedule Model, due to resource demand and supply, include:
    - **Resource Leveling** attempts to balance the **demand** for resources with the supply of resources that are available by **adjusting the activities' start/finish dates.** May be used to keep resource usage at a constant level – or in situations where resources are **limited, over-allocated**, or **available only at certain times.** Often results in an increase to the original Critical Path.

Develop Schedule

Tools & Techs – Resource Optimization

- **Resource Smoothing** aims to ensure that the **resource requirements do not exceed certain predefined resource limits** by adjusting the activities of the Schedule Model. In contrast to Resource Leveling, Resource Smoothing **does not result in a changed Critical Path or completion date.** Therefore, resources may not be fully optimized with use of Resource Smoothing.

Cost Management PMBOK 193

Those processes necessary to ensure that the project is delivered **within the Cost Baseline.**

Cost Management

7.1 Plan Cost Management

- Produce the **Cost Management Plan**, a document that explains the policies, procedures, and documentation required to properly "manage" – that is, plan, expend, and control – project costs.

7.2 Estimate Costs

- **Estimate the costs,** with the resources identified and the durations estimated, **needed to complete the work** involved in each activity documented in the Activity List.

Cost Management

7.3 Determine Budget

- Produce the **Cost Baseline**, an aggregation of all costs estimated for each activity in the Activity List.

7.4 Control Costs

- **Monitor the status** of activities in order to update project costs, and **manage changes** to the Cost Baseline.

7.1 Plan Cost Management

PMBOK Page 195

Plan Cost Management

What's the purpose?

- Produce the **Cost Management Plan**, a document that explains the policies, procedures, and documentation required to properly "manage" – that is, plan, expend, and control – project costs.

How does it help?

- This document provides **guidance and direction on how to manage project costs** during all phases of the Project Life Cycle.

When does it happen?

- After **Project Charter** has been developed – but before **Estimate Costs** process.

Plan Cost Management

Inputs / Tools & Techs / Outputs

PMBOK 7.1

Plan Cost Management

Knowledge Area: **Cost Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Project Management Plan ❑ Project Charter ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Expert Judgment ✓ Analytical Techniques ✓ Meetings	❑ **Cost Management Plan**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

7.2 Estimate Costs

PMBOK Page 200

Estimate Costs

What's the purpose?

- **Estimate the costs,** with the resources identified and the durations estimated, **needed to complete the work** involved in each activity documented in the Activity List.

How does it help?

- It **provides a monetary approximation of the costs** needed to complete the work of the project.

When does it happen?

- After **Plan Cost Management** process – and before **Determine Budget.**

Estimate Costs

Inputs / Tools & Techs / Outputs

PMBOK 7.2

Estimate Costs

Knowledge Area: **Cost Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Cost Management Plan ❑ Human Resource Management Plan ❑ Scope Baseline ❑ Project Schedule ❑ Risk Register ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Expert Judgment ✓ Analogous Estimating ✓ Parametric Estimating ✓ Bottom-Up Estimating ✓ Three-Point Estimating ✓ Reserve Analysis ✓ **Cost of Quality (COQ)** ✓ Project Management Software ✓ Vendor Bid Analysis ✓ Group Decision-Making Techniques	❑ **Activity Cost Estimates** ❑ **Basis of Estimates (BOE)** ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Estimate Costs
Tools & Techs

- **Cost of Quality** PMBOK 206, 235
  - Includes **all costs incurred over the life of the product** by investment in preventing nonconformance to requirements, appraising the product or service for conformance to requirements, and failing to meet requirements (rework).
  - Failure costs often categorized into **internal** (found by project) and **external** (found by Customer).
  - Failure Costs are also called Cost of Poor Quality (COPQ).

Estimate Costs

Tools & Techs

- **Vendor Bid Analysis** PMBOK 207
  - Analysis of what the project should cost, based on the responsive bids from qualified vendors.
  - In a competitive bid context, additional analysis may be needed to examine the **prices of individual deliverables** and to derive a **cost that supports the final total project cost.**
- **Group Decision-Making Techniques** PMBOK 207
  - Common techniques here are **Brainstorming,** the **Delphi Method,** and **Nominal Group Techniques.**

Outputs

- **Activity Cost Estimates** PMBOK 207
  - The "quantitative assessments of the probable costs required to complete project work." PMBOK 207
  - Estimates **developed for *every* activity on the Activity List.**
  - All resources related to every activity on the Activity List is cost-estimated:
    - Direct **Labor** and **Materials**
    - **Contingency Reserves** and **Indirect Costs** (if included in the project estimate)

Estimate Costs

Outputs

- **Basis of Estimates** PMBOK 208
  - Details that serve to support the development of each cost estimate, BOEs should provide a thorough understanding of how each estimate was derived:
    - Assumptions, constraints made in developing the estimate and the confidence levels.
    - Indication of possible range of estimates.
- **Project Document Updates**
  - In this process, updates may be made to:
    - **Risk Register**

7.3 Determine Budget

PMBOK Page 208

Determine Budget

What's the purpose?

- Produce the **Cost Baseline**, an aggregation of all costs estimated for each activity in the Activity List.

How does it help?

- It produces a Cost Baseline, against which the **project performance** can be **measured**, **monitored**, and **controlled**.

When does it happen?

- After **costs have been estimated** – and well before **completion of project planning**.

Determine Budget
Inputs / Tools & Techs / Outputs

PMBOK 7.3

Determine Budget

Knowledge Area: **Cost Management**
Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Cost Management Plan ❑ Scope Baseline ❑ Activity Cost Estimates ❑ Basis of Estimates (BOE) ❑ Project Schedule ❑ Resource Calendars ❑ Risk Register ❑ Agreements ❖ Organizational Process Assets	✓ **Cost Aggregation** ✓ Reserve Analysis ✓ Expert Judgment ❖ **Historical Relationships** ✓ **Funding Limit Reconciliation**	❑ **Cost Baseline** ❑ **Project Funding Requirements** ❑ Project Document Updates

Determine Budget

Tools & Techs

- **Cost Aggregation** **PMBOK 211**
  - Cost estimates developed for each Work Package, in accord with the WBS, are **summed up** – or **"aggregated"** – to the higher component levels of the WBS, such as **Control Accounts.**
  - Ultimately, Cost Aggregation proceeds until a single figure at the top of the WBS is reached – the **Cost Baseline.**

Determine Budget
Tools & Techs

- **Reserve Analysis**
  - What are the **two types** of "reserves"?
  - Which is for **"known unknown,"** and which is for **"unknown unknowns"**?
  - Which may be included in the **Cost Baseline**, and which in the **Project Budget?**
- **Expert Judgment**
  - What might be the actual "content" of Expert Judgment with respect to this process?

Determine Budget
Tools & Techs

- **Historical Relationships** PMBOK 212
  - Any historical relationship that results in **Parametric Estimates** or **Analogous Estimates** and involves the use of “parameters” (project characteristics) to develop **mathematical models that predict total project costs.**
  - Such models may be **simple** (residential home construction based on a cost per square foot of space) or **complex** (a software development costing model using multiple separate adjustment factors).

Determine Budget
Tools & Techs

- **Funding Limit Reconciliation** PMBOK 212
  - **Funds expenditure** should always be **reconciled with** any **funding limits** on the commitment of funds for the project.
  - A **variance** between the funding limits and the planned expenditures **may require a rescheduling of work** to level out the expenditure rate – accomplished by placing imposed date constraints for work into the project schedule.

Determine Budget

Outputs

- **Cost Baseline** PMBOK 212
  - The approved **time-phased budget** for the project.
  - Estimates for the **Work Packages** (with respective **Contingency Reserves**) are **aggregated** up to the **Control Account** level.
  - All Control Account budgets summed up = **Cost Baseline.** (Often displayed in an **S-Curve.**)
  - Then, **Management Reserves** added to the Cost Baseline = **Project Budget!**

Determine Budget

Outputs

- **Project Funding Requirements** **PMBOK 214**
  - Funding Requirements (Total and Periodic) are **derived from the Cost Baseline.**
  - Often occurs **in discontinuous, incremental amounts.**
  - The "total funds required" include **Cost Baseline,** plus **Management Reserves** (if any).

Risk Management

Risk Management PMBOK 309

The processes necessary for **risk management planning**, **risk identification** and **analysis**, **risk response planning**, and **risk control** throughout the entire project.

Risk Management

11.1 Plan Risk Management

- Produce a **Risk Management Plan,** in which the Project Manager defines and documents how the project's risk management activities will be conducted.

11.2 Identify Risks

- **Identify "uncertain events"** – positive as well as negative – that may impact the project, and then **document their characteristics** in the **Risk Register,** the only Output of the process.

Risk Management

11.3 Perform Qualitative Risk Analysis

- **Prioritizing the risks** identified in the Identify Risks process for more analysis in the Perform Quantitative Risk Analysis process by assessing each risk's **probability of occurrence** and its **impact on the budget** using, among other tools, the **Probability-Impact Matrix**.

11.4 Perform Quantitative Risk Analysis

- **Understand the impact of the high-priority risks** derived from the Qualitative Risk Analysis by analyzing them numerically – and monetarily – using **Expected Monetary Value (EMV)** analysis, among other tools.

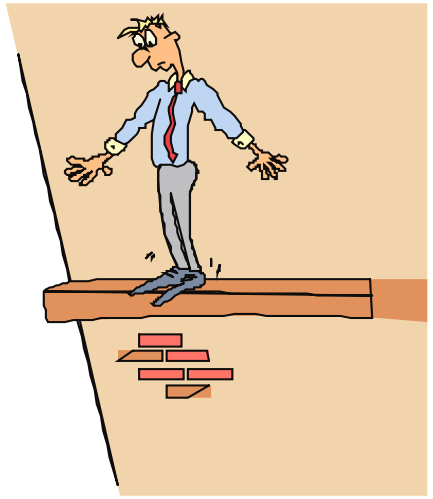
Risk Management

11.5 Plan Risk Responses

- **Develop plans based on time-tested strategies** to reduce the impact of negative risks and enhance the probability that positive risks will occur.

11.6 Control Risks

- **Keep track** of identified risks, **watch out** for new ones, **implement** Risk Response Plans, and **evaluate** the overall effectiveness of the team's risk approach.



11.1 Plan Risk Management

PMBOK Page 313

Plan Risk Management
Inputs / Tools & Techs / Outputs

PMBOK 11.1

Plan Risk Management

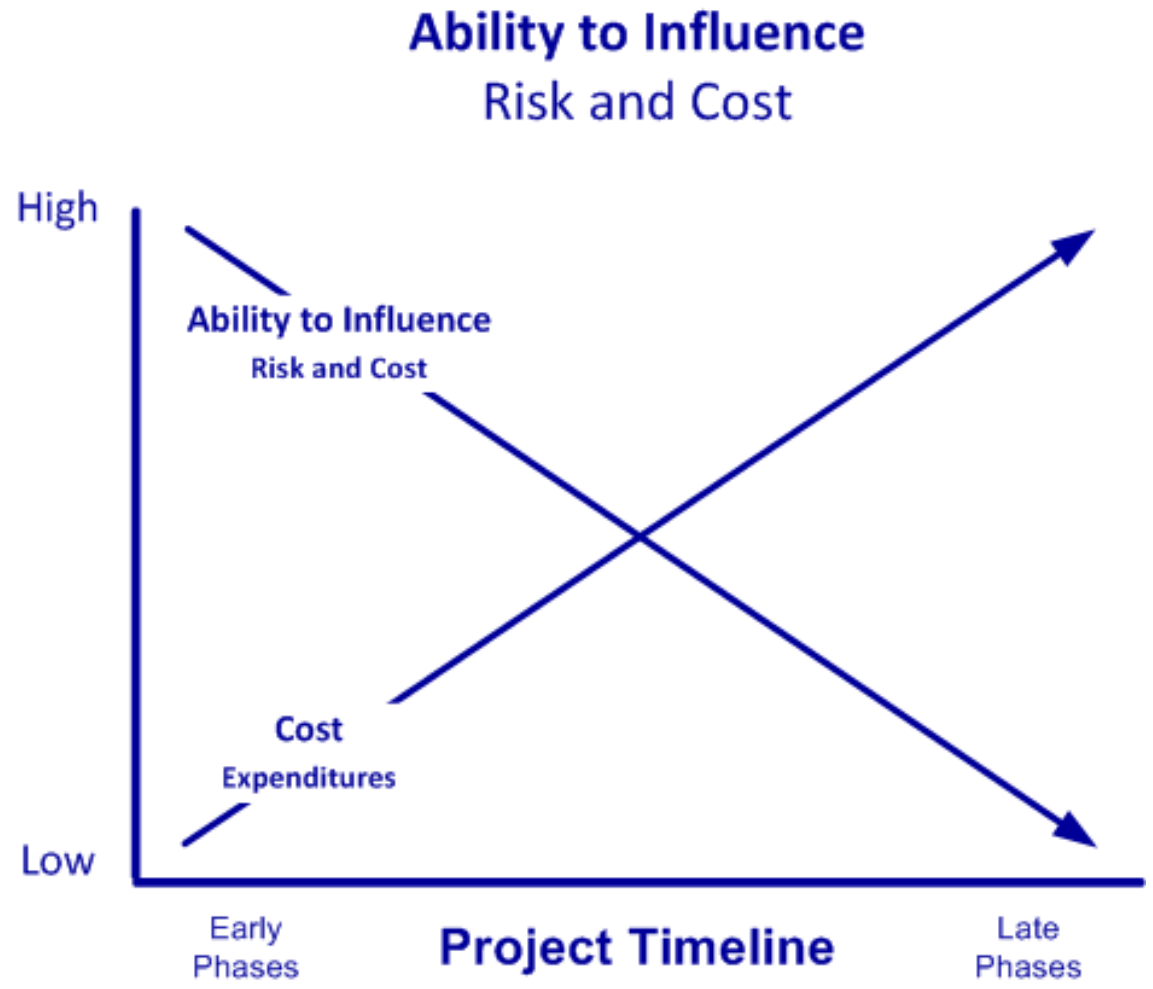
Knowledge Area: **Risk Management**
Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Project Management Plan ❑ Project Charter ❑ Stakeholder Register ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ Analytical Techniques ✓ Expert Judgment ✓ Meetings	❑ **Risk Management Plan**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Plan Risk Management

The Process



Identify Risks

What's the purpose?

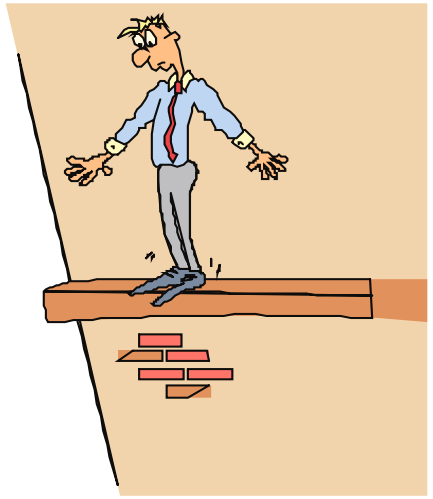
- **Identify "uncertain events"** – positive as well as negative – that may impact the project, and then **document their characteristics** in the **Risk Register,** the only Output of the process.

How does it help?

- With the Risk Register, this process provides the team with **a repository of all information regarding the project's risks**.

When does it happen?

- After the **Plan Risk Management** process – and **throughout the entire Project Life Cycle.**



11.2 Identify Risks

PMBOK Page 319

Identify Risks

Inputs / Tools & Techs / Outputs

PMBOK 11.2

Identify Risks

Knowledge Area: **Risk Management**
Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Risk Management Plan ❑ Cost Management Plan ❑ Schedule Management Plan ❑ Quality Management Plan ❑ Human Resource Management Plan ❑ Scope Baseline ❑ Activity Cost Estimates ❑ Activity Duration Estimates ❑ Stakeholder Register ❑ Project Documents ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	❖ **Documentation Reviews** ✓ **Information Gathering Techniques** ❖ **Checklist Analysis** ✓ **Assumptions Analysis** ❖ **Diagramming Techniques** ✓ **SWOT Analysis** ✓ Expert Judgment	❑ **Risk Register**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Identify Risks

Outputs

- **Risk Register** PMBOK 327
  - Key document in which **all identified risks,** including their attributes, **are recorded.** Also includes the results of all other risk processes that pertain to risks – for example, **risk response strategies, qualitative** and **quantitative risk scores,** and more.
  - With the results of the Perform Quantitative Risk Analysis process, the Risk Register serves as **input to** the **Estimate Costs** process for contingency planning purposes.

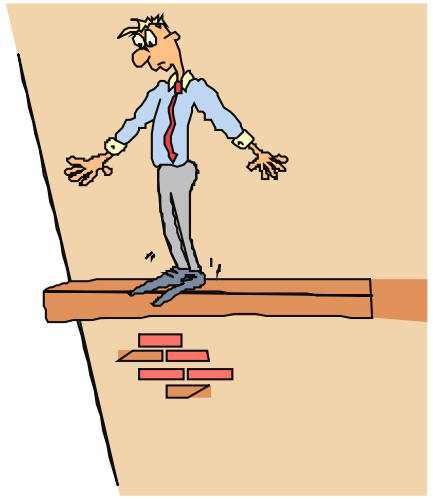
Table 11-1. Definition of Impact Scales for Four Project Objectives

Defined Conditions for Impact Scales of a Risk on Major Project Objectives (Examples are shown for negative impacts only)					
Project Objective	Relative or numerical scales are shown				
	Very low /0.05	Low /0.10	Moderate /0.20	High /0.40	Very high /0.80
Cost	Insignificant cost increase	< 10% cost increase	10 – 20% cost increase	20 – 40% cost increase	> 40% cost increase
Time	Insignificant time increase	< 5% time increase	5 – 10% time increase	10 – 20% time increase	> 20% time increase
Scope	Scope decrease barely noticeable	Minor areas of scope affected	Major areas of scope affected	Scope reduction unacceptable to sponsor	Project end item is effectively useless
Quality	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires sponsor approval	Quality reduction unacceptable to sponsor	Project end item is effectively useless

This table presents examples of risk impact definitions for four different project objectives. They should be tailored in the Risk Management Planning process to the individual project and to the organization's risk thresholds. Impact definitions can be developed for opportunities in a similar way.

Project: …… Key: H – High; M – Medium; L - Low	Prepared by: ……	Reference: …… Date: ……

Type of Risk	Description of Risk	Probability			Impact			Risk reduction strategy	Contingency plans	Risk owner
		H	M	L	Perf.	Cost	Time			



11.3 Perform Qualitative Risk Analysis

PMBOK Page 328

Perform Qualitative Risk Analysis

What's the purpose?

- **Prioritizing the risks** identified in the Identify Risks process for more analysis in the Perform Quantitative Risk Analysis process by assessing each risk's **probability of occurrence** and its **impact on the budget** using, among other tools, the **Probability-Impact Matrix**.

How does it help?

- Provides the Project Manager with the opportunity to determine the high-priority risks, and thereby **reduce the project's level of uncertainty.**

When does it happen?

- After **Risk Register** has been developed.

Perform Qualitative Risk Analysis

Inputs / Tools & Techs / Outputs

PMBOK 11.3

Perform Qualitative Risk Analysis

Knowledge Area: **Risk Management**

Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Risk Management Plan ❑ Scope Baseline ❑ Risk Register ❑ Project Scope Statement ❖ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ **Risk Probability and Impact Assessment** ❖ **Probability-Impact (P-I) Matrix** ✓ **Risk Data Quality Assessment** ✓ **Risk Categorization** ✓ **Risk Urgency Assessment** ✓ Expert Judgment	❑ **Project Document Updates**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Perform Qualitative Risk Analysis

Inputs

- **Risk Management Plan**
  - Which process produced this Input as an Output?
- **Scope Baseline**
  - Which process produced this Input as an Output?
  - What are the contents of the Scope Baseline? (Hint: there are three components!)
  - Is this part of the PMP or one of the many Project Documents?

Perform Qualitative Risk Analysis

Inputs

- **Risk Register**
  - Which process produced this Input as an Output?
  - What's the difference between the Risk Register and the Risk Management Plan?
- **Enterprise Environmental Factors (EEFs)**
  - Name two internal EEFs and two external EEFs
  - Can you think of an EEF that could have an impact on this process?

Perform Qualitative Risk Analysis

Inputs

- **Organizational Process Assets (OPAs)**
  - Of all the organization's OPAs, what might be of value as an Input to this process?
  - What are the two main categories of OPAs?

Perform Qualitative Risk Analysis

Tools & Techs

- **Risk Probability & Impact Assessment** PMBOK 330
  - An assessment of the likelihood that each of the identified risks will occur – the **probability** – and the effect of the risk, should it occur – the **impact.**
  - Assessment is made by way of **interviews** or **meetings** with all involved in the risk processes, internal or external.
  - Probabilities and impacts are rated based on the **definitions** given in the **Risk Management Plan.**
  - Risks rated as low in both probability and impact are placed on a **Watch List** in the Risk Register.

Perform Qualitative Risk Analysis

Tools & Techs

- **Probability & Impact Matrix** PMBOK 331
  - Used in conjunction with the Risk Probability & Impact Assessment tool to **graphically prioritize risks.**
  - Those risks rated in this process as **high priority risks** – those appearing in red in the matrix on the next page – are **moved to Perform Quantitative Risk Analysis** process for "further analysis" – that is, for quantitative analysis. Those rated as low (in green) are placed on a **Watch List** in the Risk Register.

Perform Qualitative Risk Analysis

Tools & Techs

The P-I Matrix Method

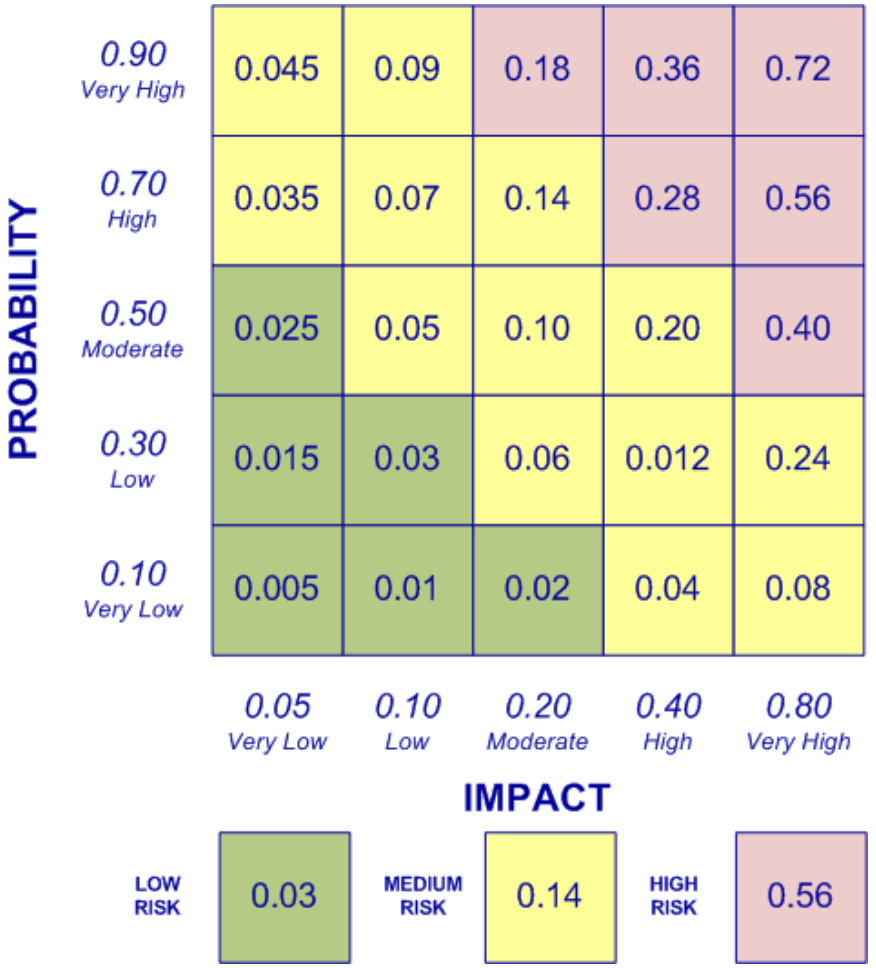
Used here with scales of 0.1 to 0.9 applied to Probability and 0.05 to 0.08 applied to Impact.

Exposure = Probability x Impact

Drawback

The P-I Matrix Method gives the **same weight to both probability and impact.**

However, in many cases, **high impact items warrant attention** even if they have a low probability of occurring.



Perform Qualitative Risk Analysis

Tools & Techs

- **Risk Data Quality Assessment** PMBOK 332
  - Used to **evaluate the degree to which the data about risks is useful** for risk management.
  - Involves examining the degree to which the risk is understood and the **accuracy, quality, reliability**, and **integrity** of the data about the risk.

Perform Qualitative Risk Analysis

Tools & Techs

- **Risk Categorization** **PMBOK 332**
  - Used to **determine project areas most exposed,** risks may be categorized.
  - **Categories** may be by **sources of risk** (using the RBS), the **area of the project affected** (using the WBS), or other useful categories (project phase). Risks can also be categorized by common root causes.
  - Helps determine work packages, activities, project phases that may lead to the development of effective risk responses

Perform Qualitative Risk Analysis

Tools & Techs

- **Risk Urgency Assessment** PMBOK 333
  - **Near-term risks** may be more urgent to address than even high-priority far-term risks.
  - **Indicators of priority** may include probability of detecting the risk, time to implement a risk response, symptoms and warning signs, and the risk rating.
  - Risk Urgency Assessment **may be combined with risk ranking,** which is derived from the Probability and Impact Matrix, to produce a final **risk severity rating**.

Perform Qualitative Risk Analysis

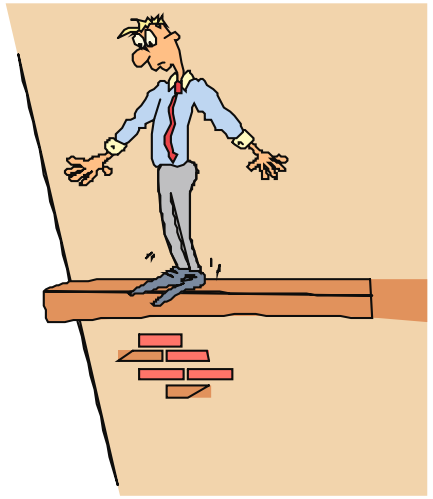
Tools & Techs

- **Expert Judgment**
  - What might be the actual “content” of Expert Judgment with respect to this process?
  - In general terms , how would you define Expert Judgment?

Perform Qualitative Risk Analysis

Outputs

- **Project Document Updates**
  - A **common output** throughout all of the processes!
  - Project Document Updates **vary**
  - In this process, updates may be made to:
    - **Risk Register**
    - **Assumptions Log**



11.4 Perform Quantitative Risk Analysis

PMBOK Page 333

Perform Quantitative Risk Analysis

What's the purpose?

- **Understand the impact of the high-priority risks** derived from the Qualitative Risk Analysis by analyzing them numerically – and monetarily – using **Expected Monetary Value (EMV)** analysis, among other tools.

How does it help?

- The quantitative information derived from this process may be useful in **determining the contingency reserves** for each risk and in **developing appropriate Risk Response Plans**.

When does it happen?

- After the **Risk Register** and key plans* have been developed and the **Qualitative Risk Analysis process** has been completed.

* The Cost, Schedule, Human Resource, Quality, and Risk Management Plans.

Perform Quantitative Risk Analysis
Inputs / Tools & Techs / Outputs

PMBOK 11.4

Perform Quantitative Risk Analysis

Knowledge Area: **Risk Management**
Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Risk Management Plan ❑ Cost Management Plan ❑ Schedule Management Plan ❑ Risk Register ❑ Enterprise Environmental Factors ❖ Organizational Process Assets	✓ **Data Gathering and Representation Techniques** ✓ **Quantitative Risk Analysis and Modeling Techniques** ✓ Expert Judgment	❑ **Project Document Updates**

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Perform Quantitative Risk Analysis

Inputs

- **Risk Management Plan**
  - Which process produced this Input as an Output?
- **Cost Management Plan**
  - Which process produced this Input as an Output?
  - Is this part of the PMP or one of the many Project Documents?
- **Schedule Management Plan**
  - Which process produced this Input as an Output?
  - Which came first – the Cost Management Plan or the Schedule Management Plan?

Perform Quantitative Risk Analysis

Inputs

- **Risk Register**
  - Which process produced this Input as an Output?
  - What's the difference between the Risk Register and the Risk Management Plan?
- **Enterprise Environmental Factors (EEFs)**
  - Can you think of an EEF that could have an impact on this process?
- **Organizational Process Assets (OPAs)**
  - Of all the organization's OPAs, what might be of value as an Input to this process?
  - What are the two main categories of OPAs?

Perform Quantitative Risk Analysis

Tools & Techs

- **Enterprise Environmental Factors (EEFs)**
  - Name two internal EEFs and two external EEFs
  - Can you think of an EEF that could have an impact on this process?
- **Organizational Process Assets (OPAs)**
  - Of all the organization's OPAs, what might be of value as an Input to this process?
  - What are the two main categories of OPAs?
- **Expert Judgment**
  - What might be the actual "content" of Expert Judgment with respect to this process?

Perform Quantitative Risk Analysis

Tools & Techs

- **Data Gathering & Representation Techniques** **PMBOK 336**
  - **Interviewing**
    - **Experience and historical data** used to quantify **the probability and the impact** of risks on project objectives.
    - Information **needed depends on type of probability distributions** used. For some commonly used distributions, information is gathered on the optimistic (low), pessimistic (high), and most likely scenarios

Perform Quantitative Risk Analysis
Tools & Techs – Data Gathering & Representation Techniques

– **Interviewing** (cont'd)

- Important component of the risk interview is to **document the rationale of the risk ranges** (and the assumptions behind them) – they can shed light on the **reliability and credibility of the analysis.**

- **Probability Distributions**
  - **Continuous probability distributions,** used extensively in **modeling and simulation,** represent the uncertainty in values such as durations of schedule activities and costs of project components.

Perform Quantitative Risk Analysis

Tools & Techs – Data Gathering & Representation Techniques

– **Probability Distributions** (cont'd)

- Discrete **distributions** can be used to represent **uncertain events,** such as the outcome of a test or a possible scenario in a decision tree.
- Two examples of widely used continuous distributions are the **Beta Distributions** and the **Triangular Distributions** – both of which show the shapes compatible with the data typically developed during the quantitative risk analysis.

Perform Quantitative Risk Analysis

Tools & Techs

- **Quantitative Risk Analysis & Modeling Techniques** **PMBOK 338**
  - **Sensitivity Analysis**
    - Helps determine the **risks with the most potential impact on the project.** Also helps explain the variations in project's objectives correlated with variations in different uncertainties.
    - Often displayed in a **Tornado Diagram**, a bar chart **comparing the relative importance of the variables.**

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

– Expected Monetary Value Analysis (EMV)

- A statistical concept that **calculates the average outcome** when the future includes scenarios that may or may not happen.
- EMV of **opportunities** generally **expressed as positive values,** while those of **threats** are **expressed as negative values.**
- EMV requires a risk-neutral assumption— neither risk averse nor risk seeking.

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

- EMV for a project is calculated by multiplying the **Probability** of each outcome occurring by the value of each possible outcome, its **Impact**:

$$\mathbf{EMV = P \times I}$$

- A goal of the Perform Quantitative Risk Analysis process is to eventually allocate money in the Cost Baseline (the budget) – i.e., **Contingency Reserve** – to cover risk.
- To do this, the **qualitative impact scales** of the P-I Matrix are converted **to actual costs** for each risk deemed in the preceding process to be high-priority.

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

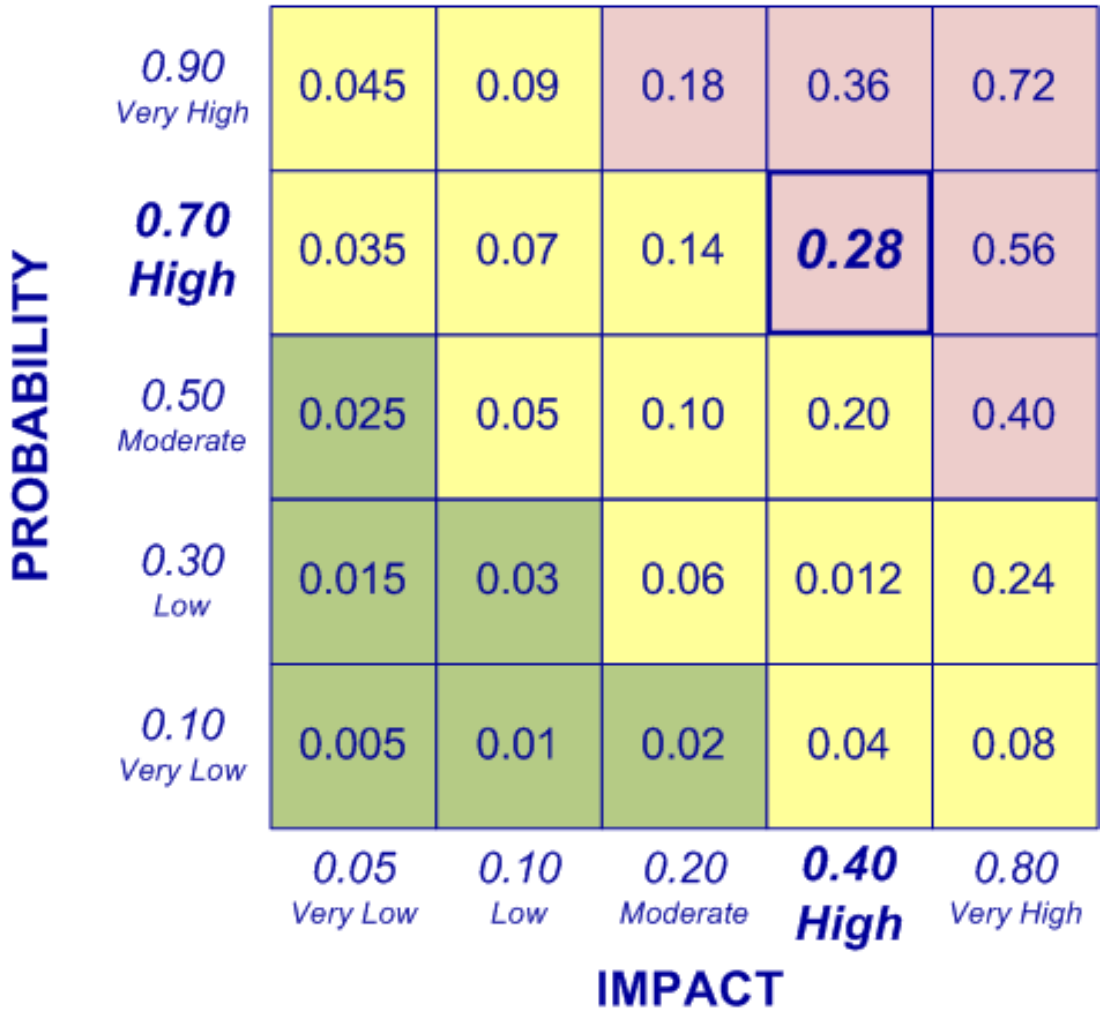
- For example, if the 0.40 impact rating shown for the risk in the matrix on the next slide means a "20 – 40% cost increase" (see PMBOK 318)…
- …and if the total costs estimated for the activities most impacted by the occurrence of this risk is $20,000, then the "impact" in monetary terms is between $4,000 and $8,000 or, an average of $6,000.
- That figure – $6,000 – would then be multiplied by the probability of the risk occurring using the **Expected Monetary Value** equation:

EMV = P x I

EMV = 0.7 x $6,000 = $4,200

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques



Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

- This above amount – **$4,200** – should then constitute the **Contingency Reserve** to be added to the Cost Baseline to cover this risk.
- This data is recorded in – that is, progressively elaborated back to - the Risk Register, which can then serve as Input to the Estimate Costs process for purposes of calculating Contingency Reserve.
- EMV is often used with **Decision Trees,** two examples of which are shown in the following slides.

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

- Use of **Decision Trees** requires an appreciation of the concept of "expected value" – or **"Expected Monetary Value"** – a concept similar to **Exposure**.
- For example, imagine buying a sweepstake ticket for $1.00. There are two possible prizes: $100.00 and $10. 00.
  - 0.5% of tickets pay out $100.
  - 2.0% pay out $10.
  - Remaining 97.5% pay nothing!

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

Prize Value	Probablity of Winning	Average Return
$100.00	0.005	$0.50
$10.00	0.020	$0.20
$0.00	0.975	$0.00
Total	**1.000**	**$0.70**

- The average outcome for any single bet is – in the example above – $0.70. This **"average outcome"** is called the **Expected Value.**
- We can never win the expected value on a single bet – but if we repeated the bet many times, we would on average receive $0.70 for every $1.00 wagered.

Perform Quantitative Risk Analysis

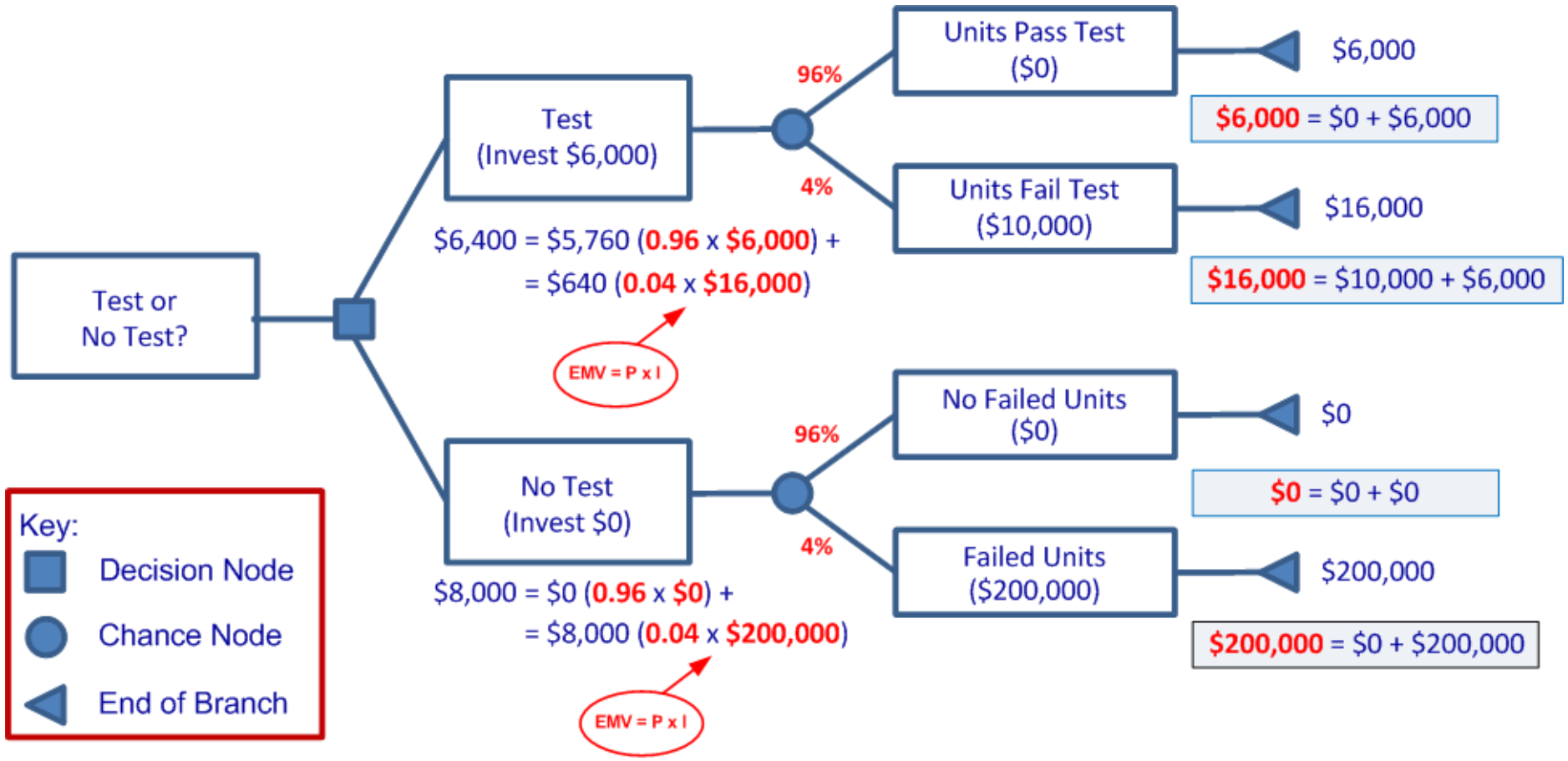
Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

EMV and Decision Trees – Example 1:

- Your project requires **500 ruggedized computers** but the supplier has a history of quality problems.
- **Decision:** (a) **test** the computers before site installation, or (b) **do not test** but install, anyway.
- The following data is available:
  - Historical failure rate of the software is 4%.
  - Tests will cost $6,000 per module.
  - In-house repair costs of failed units: $10,000.
  - Cost of repairing installed units: $200,000.

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques



Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

EMV and Decision Trees – Example 2:

- A business owner wishes to improve her business.
- **Decision:** (a) **improve** the old location for $5,000, or (b) **move** to a better location for $12,000.
- She believes with either choice, the chance or likelihood of a **strong demand** is **60%** and the probability of a **weak demand** is **40%.**
  - If demand is strong at the **new location** she will earn **$20,000,** but only **$9,000** if demand is weak.
  - If demand is strong at the **old place,** she will earn **$12,000,** only **$6,000** if demand is weak**.**

Perform Quantitative Risk Analysis

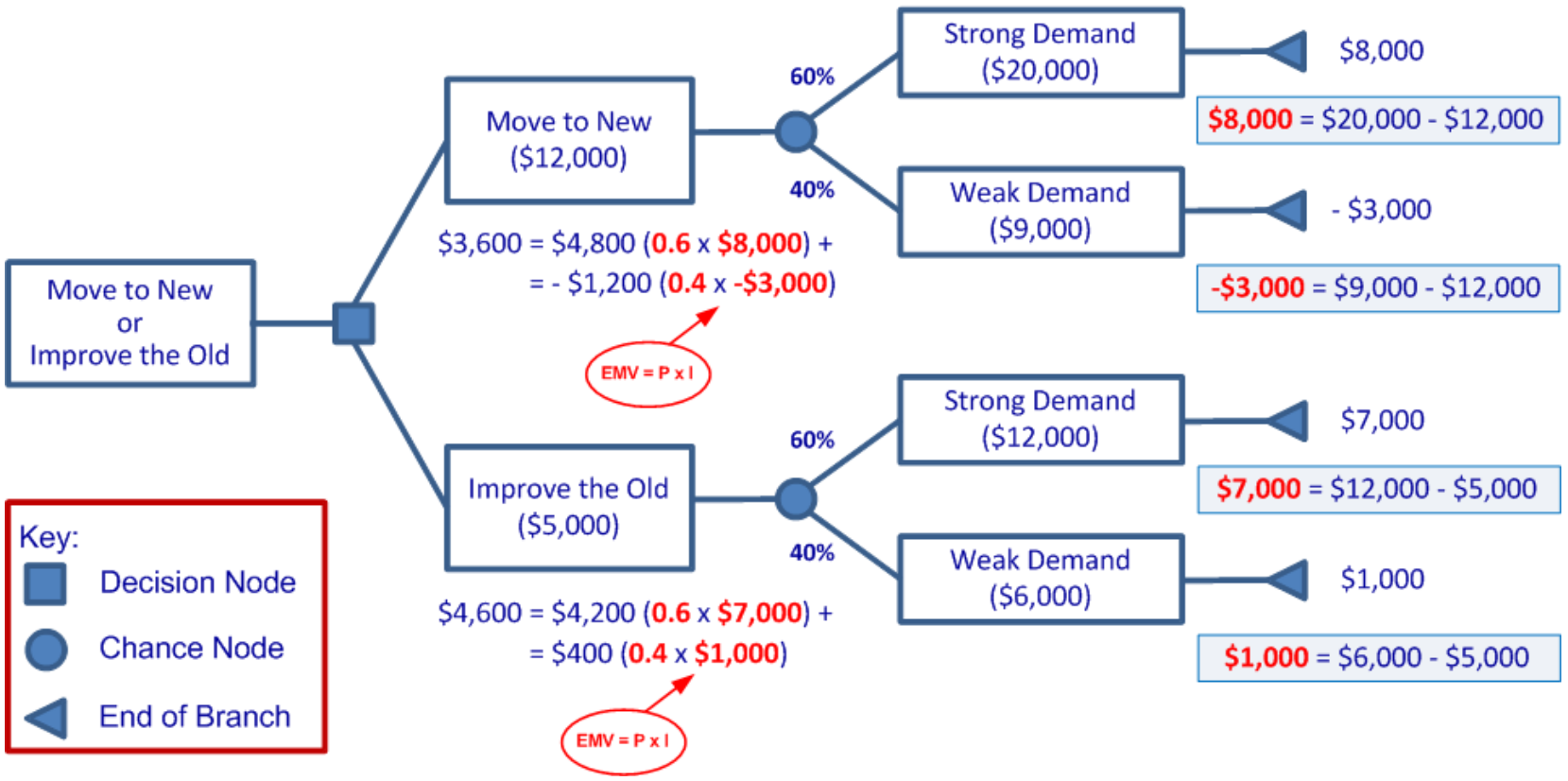
Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

- Therefore, there are four possible outcomes:
  1. **Strong demand** at the **new** location: $20,000 earnings minus $12,000 investment = **$8,000**
  2. **Weak demand** at the new location: $9,000 earnings minus $12,000 investment = **-$3,000**
  3. **Strong demand** at the **old but improved** premises: $12,000 earnings minus $5,000 investment = **$7,000**
  4. **Weak demand** at the improved premises: $6,000 earnings minus $5,000 investment = **$1,000**

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

Expected Monetary Value (EMV)
As Applied in a Decision Tree
(Example 2 of 2)



Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

What is the total EMV of Project ABC?

Risk A: 20% probability of occurring with a positive impact of $180,000.

Risk B: 15% probability of occurring with a negative impact of $2,000.

Risk C: 65% probability of occurring with a negative impact of $8,000.

EMV = $36,000 – $300 – $5,200

= $30,500

Perform Quantitative Risk Analysis

Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

– Modeling and Simulation

- A model is used (to simulate a project) that translates project uncertainties into their **potential impact on project objectives.**
- Normally, these simulations are performed using the **Monte Carlo Technique.**
- In such a simulation, the **project model is iterated many times,** with the input values (such as cost estimates or activity durations) randomly selected for each iteration from the probability distributions of these variables.

Perform Quantitative Risk Analysis

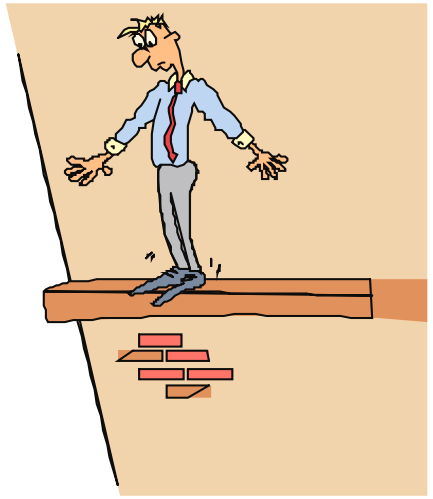
Tools & Techs – Quantitative Risk Analysis & Modeling Techniques

- Based on these many iterations, a **Histogram is built** showing, for example, total cost or completion date.
- Such a simulation would use **cost estimates for a cost risk analysis,** and a **schedule network diagram and duration estimates for a schedule analysis.** The Histogram would then be used to show the output of the simulation.
- Similar curves can be developed for **other project objectives.**

Perform Quantitative Risk Analysis

Outputs

- **Project Document Updates**
  - In this process, updates may be made to:
    - **Risk Register,** which would include:
      - Probabilistic analysis of the project
      - Probability of achieving cost/time objectives
      - Prioritized list of quantified risks
      - Trends in the quantitative risk analysis results



11.5 Plan Risk Responses

PMBOK Page 342

Plan Risk Responses

What's the purpose?

- **Develop plans based on time-tested strategies** to reduce the impact of negative risks and enhance the probability that positive risks will occur.

How does it help?

- It allows **each risk to be addressed by its level of priority** and provides guidance in **factoring needed resources and risk-related activities** to manage the risk into the budget, schedule, and other areas of the Project Management Plan.

When does it happen?

- After the **Risk Management Plan** and the **Risk Register** have been developed.

Plan Risk Responses
Inputs / Tools & Techs / Outputs

PMBOK 11.5

Plan Risk Responses

Knowledge Area: **Risk Management**
Process Group: **Planning**

INPUTS	TOOLS & TECHNIQUES	OUTPUTS
❑ Risk Management Plan ❑ Risk Register	✓ **Strategies for Negative Risks** ✓ **Strategies for Positive Risks** ✓ **Contingency Response Strategies** ✓ Expert Judgment	❑ **PMP Updates** ❑ Project Document Updates

❑ = Documentation. ❖ = Mix of documentation and activity. ✓ = Action or Activity. ➢ = Non-document Output.

Plan Risk Responses

Inputs

- **Risk Management Plan**
  - Which process produced this Input as an Output?
- **Risk Register**
  - Which process produced this Input as an Output?
  - What's the difference between the Risk Register and the Risk Management Plan?

Plan Risk Responses

Tools & Techs

- **Strategies for Negative Risks** PMBOK 344
  - **Avoidance**
    - Chosen if a particular **risk is simply not acceptable.** Find another approach to get the job done or, even if it means **abandoning the project,** just do not do at all.
  - **Transfer**
    - There are multiple ways in which risk may be transferred to another party, including:
      - Buy **insurance**, use a **performance bond** or **warranty.**
      - Use a subcontractor with a **back-to-back agreement** (e.g., passing penalties to the subcontractors).

      See Plan Procurement Management for more **contract types that may be used in transferring risk.**

Plan Risk Responses

Tools & Techs – Negative Risk Strategies

- **Mitigation**
  - Mitigation involves taking actions - within the current project plan – that would **reduce the probability** of the risk happening and/or its **impact,** if it does. One form of mitigation is putting contingency plans in place, such that if the risk event does occur, its impact would be reduced.
- **Acceptance**
  - In this case, the **risk is acceptable** – or the **team just can't think of a suitable response strategy.** Go ahead with the project, and live with the risk. May still need to calculate total exposure and include adequate contingency in the Cost Baseline.

Plan Risk Responses

Tools & Techs

- **Strategies for Positive Risks** PMBOK 345
  - **Exploit**
    - Make the most of the opportunity: **allocate more budget,** resources; **give it more management attention.**
  - **Enhance**
    - **Increase the probability** and/or the positive **impact** of an opportunity. For example, to **obtain an incentive fee** based on early completion, the Project Manager might apply additional resources to an activity to ensure it is completed ahead of schedule.

Tools & Techs – Positive Risk Strategies

- **Share**
  - Allocating a portion – possibly the major portion – of an opportunity to a **party best positioned to make it happen.** Examples include **risk-sharing partnerships, joint ventures** – in fact, any action that would result in the opportunity happening to the benefit of both parties involved.
- **Acceptance**
  - Being ready and willing to accept the opportunity, in the event that it occurs – but **not ready and not willing to expend resources** in pursuing the opportunity beyond allocating some contingency.

Plan Risk Responses

Tools & Techs

- **Contingent Response Strategies** **PMBOK 346**
  - Some responses are **designed for use only if certain events occur** – requiring **a response plan that will be executed only under certain predefined conditions.**
  - Risk Responses identified using this technique are often called **Contingency Plans** or **Fallback Plans.**
- **Expert Judgment**
  - How would you define Expert Judgment?

Plan Risk Responses

Outputs

- **PMP Updates**
  - In this process, updates may be made to:
    - The **Schedule**, **Cost**, **Quality**, **Procurement**, and **Human Resource Management Plans**
    - All **Baselines**
- **Project Document Updates**
  - In this process, updates may be made to:
    - **Risk Register**, which would include:
      - **Fallback Plans**, **Residual Risks**, **Secondary Risks**, **Contingency Reserves**…and more!

10.1 Plan Communication management

PMBOK Page 291

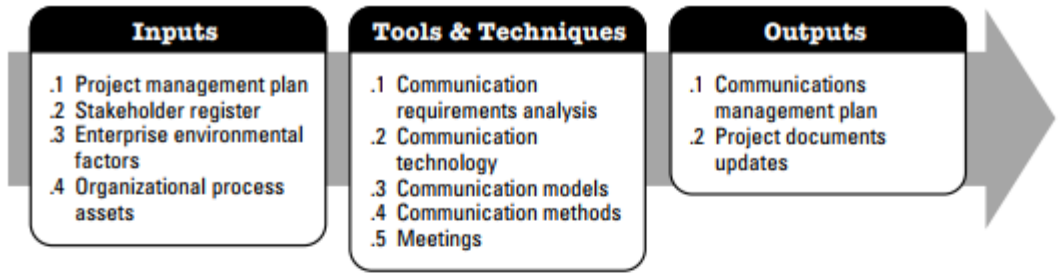


Figure 10-2. Plan Communications Management: Inputs, Tools & Techniques, and Outputs

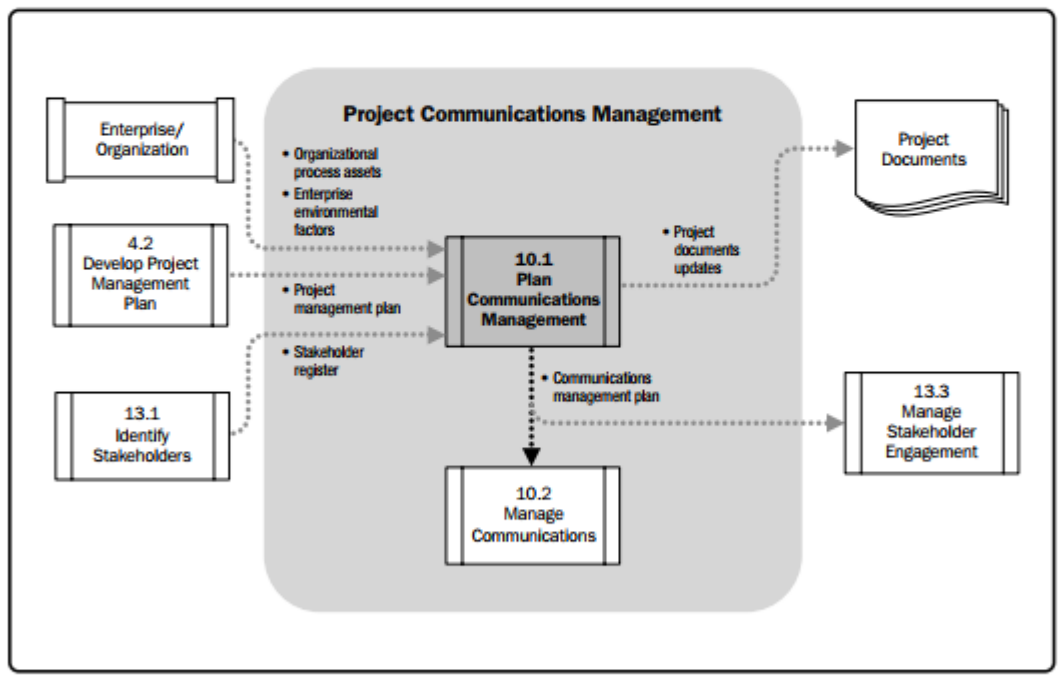


Figure 10-3. Plan Communications Management Data Flow Diagram

13.2 Plan Stakeholder management

PMBOK Page 399

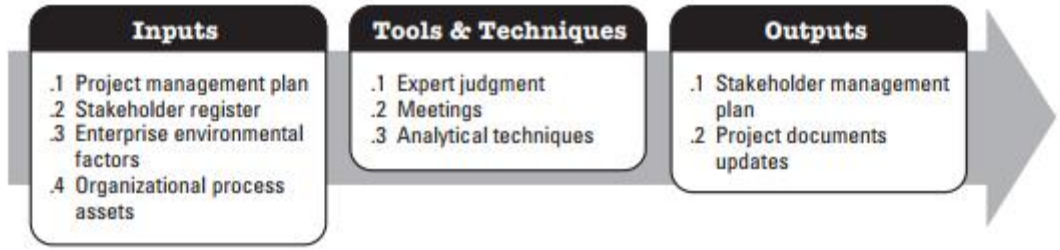


Figure 13-5. Plan Stakeholder Management: Inputs, Tools & Techniques, and Outputs

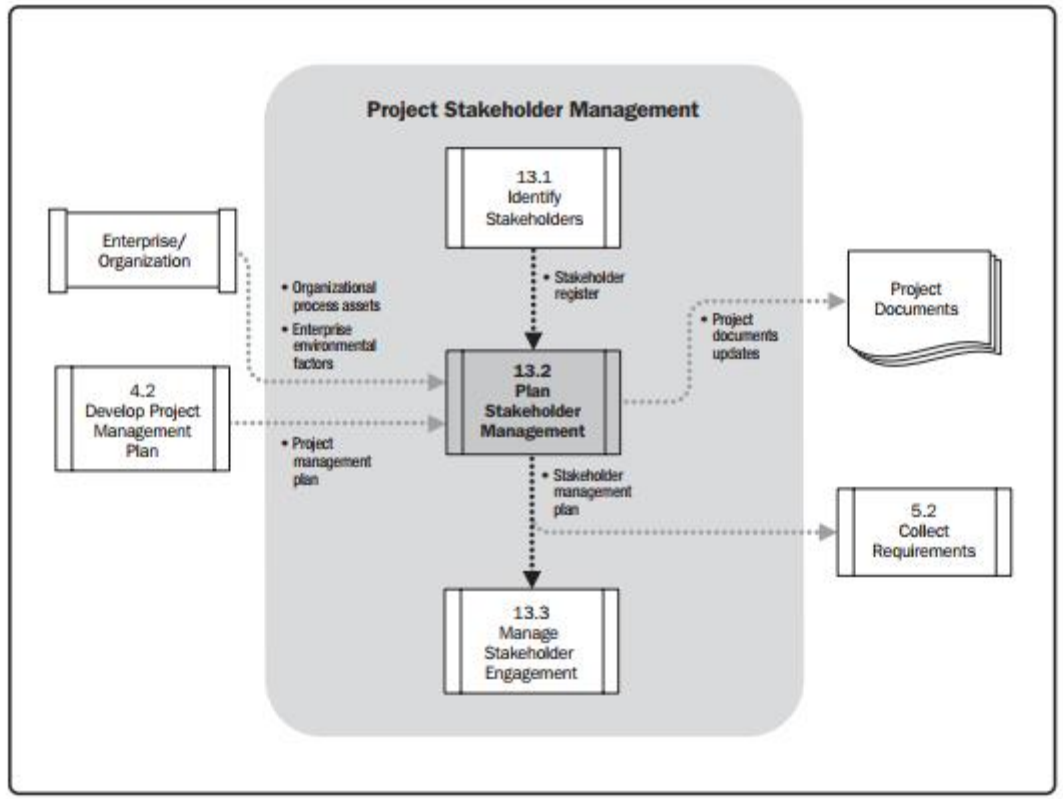


Figure 13-6. Plan Stakeholder Management Data Flow Diagram

Agile

- 2.4.2.4 Adaptive Life Cycles Adaptive life cycles (also known as change-driven or agile methods) are intended to respond to high levels of change and ongoing stakeholder involvement. Adaptive methods are also iterative and incremental, but differ in that iterations are very rapid (usually with a duration of 2 to 4 weeks) and are fixed in time and cost. Adaptive projects generally perform several processes in each iteration, although early iterations may concentrate more on planning activities. The overall scope of the project will be decomposed into a set of requirements and work to be performed, sometimes referred to as a product backlog. At the beginning of an iteration, the team will work to determine how many of the highest priority items on the backlog list can be delivered within the next iteration. At the end of each iteration, the product should be ready for review by the customer. This does not mean that the customer is required to accept delivery, just that the product should not include unfinished, incomplete, or unusable features. The sponsor and customer representatives should be continuously engaged with the project to provide feedback on deliverables as they are created and to ensure that the product backlog reflects their current needs. Adaptive methods are generally preferred when dealing with a rapidly changing environment, when requirements and scope are difficult to define in advance, and when it is possible to define small incremental improvements that will deliver value to stakeholders.