

Credits

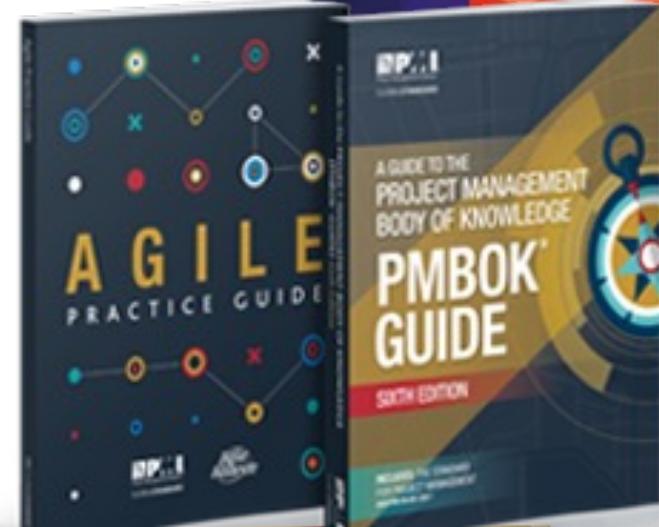
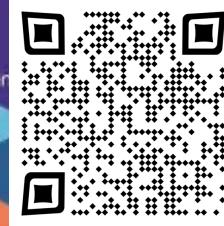
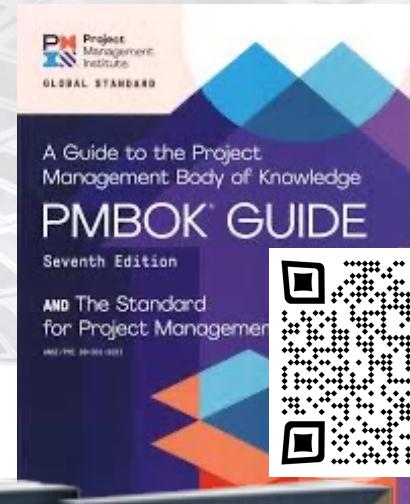
This course is based on the following:

- *PMBOK® Guide, 6th edition*
- *PMBOK® Guide, 7th edition*
- *PMI Agile Practice Guide*
- PM Certified LLC

Websites:

- www.pmi.org
- www.pmcertified.net
- <https://home.pearsonvue.com>

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First Edition
(1996)

Second Edition
(2000)

Third Edition
(2004)

Fourth Edition
(2008)

Fifth Edition
(2013)

Learning Objectives

- Create your *PMBOK®*-to-English decoder ring.
- Get an introduction to the PMI project management “good practice.”
- Learn the *PMBOK® Guide* terminology.
- Understand the concepts behind all components of a Project Management Plan.
- Understand how to use all of the tools and techniques discussed in the *PMBOK® Guide*.
- Learn how to use PMI terms to defeat test questions.
- Understand how methodology can affect “good practice.”

Course Administrative Notes

- This course is four days in duration.
- It meets from 7:30 a.m. to 4:00 p.m.
- Lunch is at 12:00 p.m.
- Breaks will be taken as needed.

Course Agenda

Day 1: PMI's PMP Credential; Initiating Process Group

- PMI
- The PMP Exam
- Application and Study Methods
- Business Application
- The Initiating Process Group
- PMI's "good practice" in organizational project planning and how that's tested on the PMP exam

Day 2: Planning Process Group

- PMI's "good practice" in project planning and how that's tested on the PMP exam

Day 3: Planning Process Group

- PMI's "good practice" in project management and how that's tested on the PMP exam

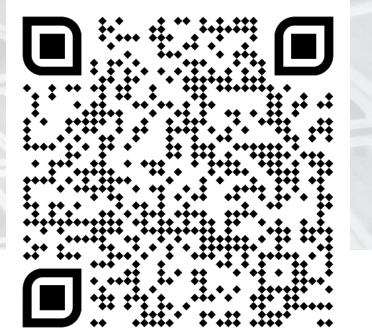
Day 4: Executing Group; Monitoring and Controlling Process Group

- PMI's PMP credential review and application information, followed by a PMP exam simulation based on the current PMI testing program

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

Table 1-4 (Guide). Project Management Process Group and Knowledge Area Mapping
A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Sixth Edition.
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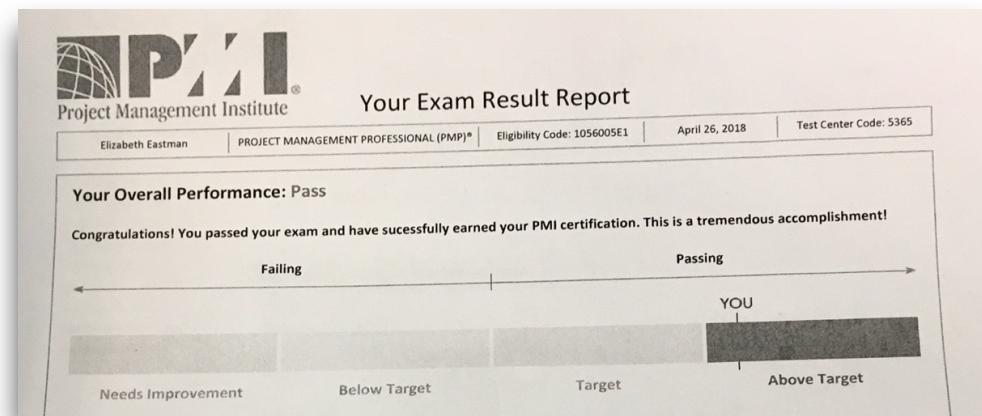
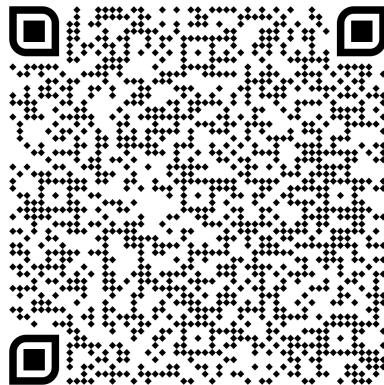
The PMP Credential

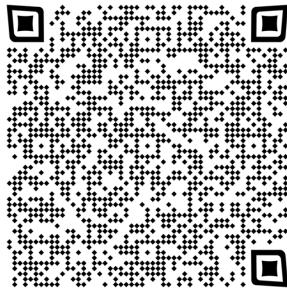


- It does not mean that you are a good project manager.
- It signifies that you have years of project management experience.
- It tells others that you are fluent in the global language of project management as defined in the PMI lexicon.
- It indicates that you are familiar with the 40,000+ industry studies that have been used to create the “good practice” that makes up the *PMBOK® Guide*.
- It is also supposed to mean that you have studied a variety of methodologies.

The PMP Exam

- There are 180 questions randomly selected when you start the test.
- You have 3 hours and 50 minutes to complete the test.
- Questions are multiple-choice, diagrams, matching, etc.
- Five of the questions are not graded (they are experimental).
- You only get points for correct answers.
- You can mark questions for review, and you can skip questions.
- You can go back and change any answer during the exam.
- You are not given a score at the end of the exam.





The PMP Exam

- All test questions are scenario-based and comprised of three parts:
 - The background
 - The question
 - The answer block
- 180 total questions (5 are experimental)

Domain	Methodologies		
People	42%	Predictive	50%
Process	50%	Agile	25%
Business Environment	8%	Hybrid	25%

Read more: *Project Management Professional (PMP)® Examination Content Outline*, January 2021.

https://www.pmi.org/-/media/pmi/documents/public/pdf/certifications/pmp-examination-content-outline.pdf?v=0c0b33c1-dc44-4fa9-9111-a403abcb23f4&sc_lang_temp=en



The Application

- The PMP application process is the largest barrier to achieving the credential.
- There are two prerequisites that you must meet in order to take the exam:
 - Formal Project Management Education
 - 35 hours: This course will give you the 35 hours required.
 - Months of Project Management Experience
 - 4-year degree or higher: 36 months
 - No degree: 60 months

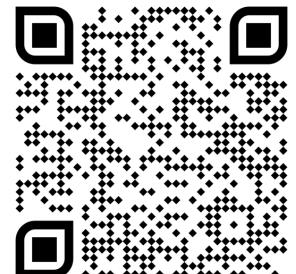
<https://www.pmi.org/certifications/project-management-pmp/earn-the-pmp/how-to-apply>

If You Get Audited

Most audits are cleared up within a few weeks, but the audit must be completed in 90 days. If you are selected for random audit, you must:

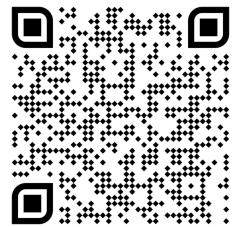
- Verify your education level
 - This does not need to be an official transcript.
- Prove your PM education
 - You will be given a PDF certificate of completion for this course on the last day.
- Get signatures from each point of contact
 - This is what will take the longest, depending on how many entries you had on the application.

<https://www.pmi.org/certifications/certification-resources/faq>



The PMBOK® Guide

- PMI was founded in 1969 by a group of project managers focusing on best practice observed in the emerging aerospace industry.
- The first *PMBOK® Guide* was printed in 1996 after 15 years of development and industry study.
- The *PMBOK® Guide* has been updated every four to five years.
- The *PMBOK® Guide* is a collection of “good practices” grouped into processes.
- The knowledge that is retained in the *PMBOK® Guide* has grown over time and will continue to grow as the industry changes.

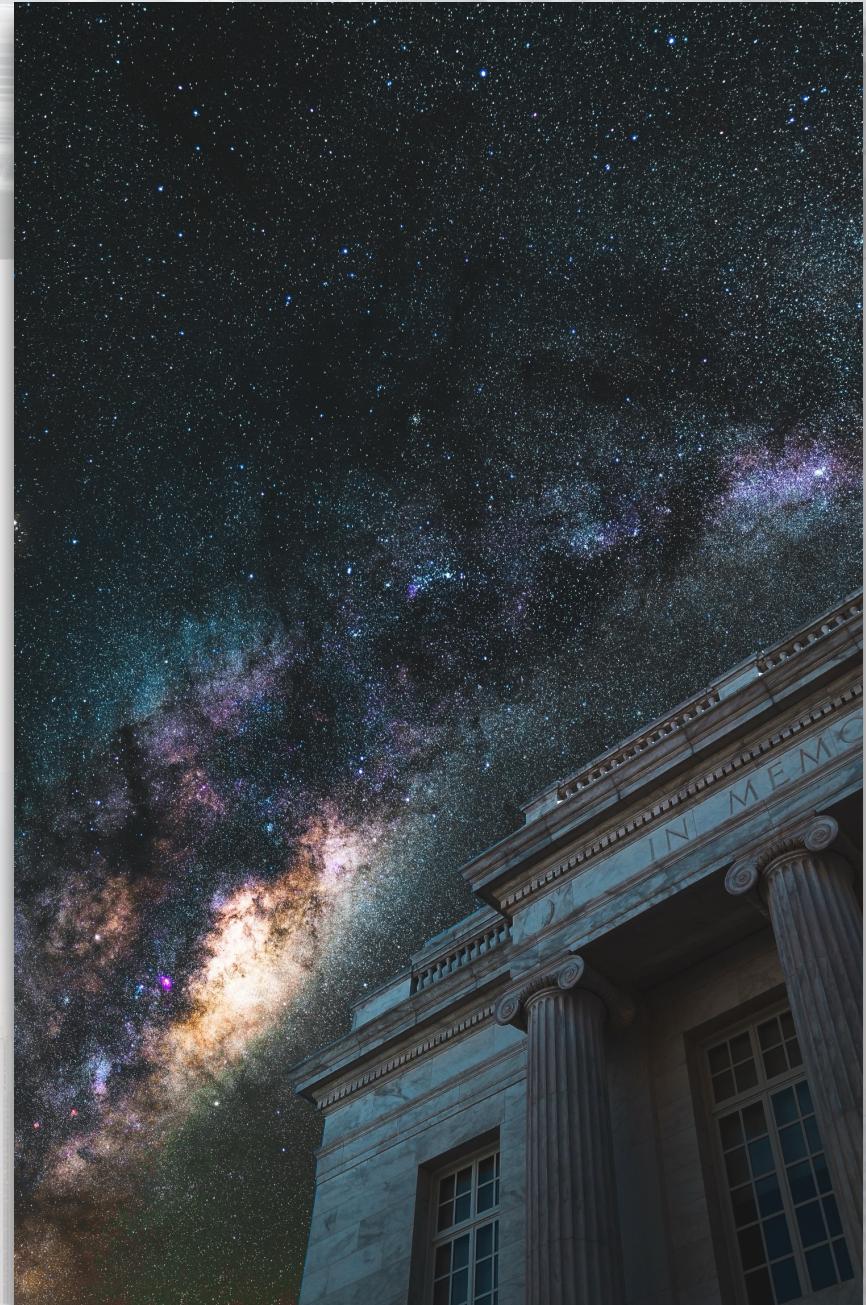


All Referenced Materials on the PMP Exam

1. ***Agile Practice Guide***
2. ***A Guide to the Project Management Body of Knowledge (PMBOK® Guide)****
3. ***Project Management: A Systems Approach to Planning, Scheduling, and Controlling***
4. ***Effective Project Management: Traditional, Agile, Extreme, Hybrid***
5. ***Fundamentals of Technology Project Management, 2nd Edition***
6. ***Project Managers Portable Handbook, 3rd Edition***
7. ***Information Technology Project Management, 7th Edition***
8. ***Essential Scrum: A Practical Guide to the Most Popular Agile Process***
9. ***Project Management: The Managerial Process***
10. ***The Project Management Tool Kit: 100 Tips and Techniques for Getting the Job Done Right***

[https://www.pmi.org/certifications/project -management-pmp/earn-the-pmp/pmp-exam-preparation/pmp-reference-list](https://www.pmi.org/certifications/project-management-pmp/earn-the-pmp/pmp-exam-preparation/pmp-reference-list)

Exam Concepts

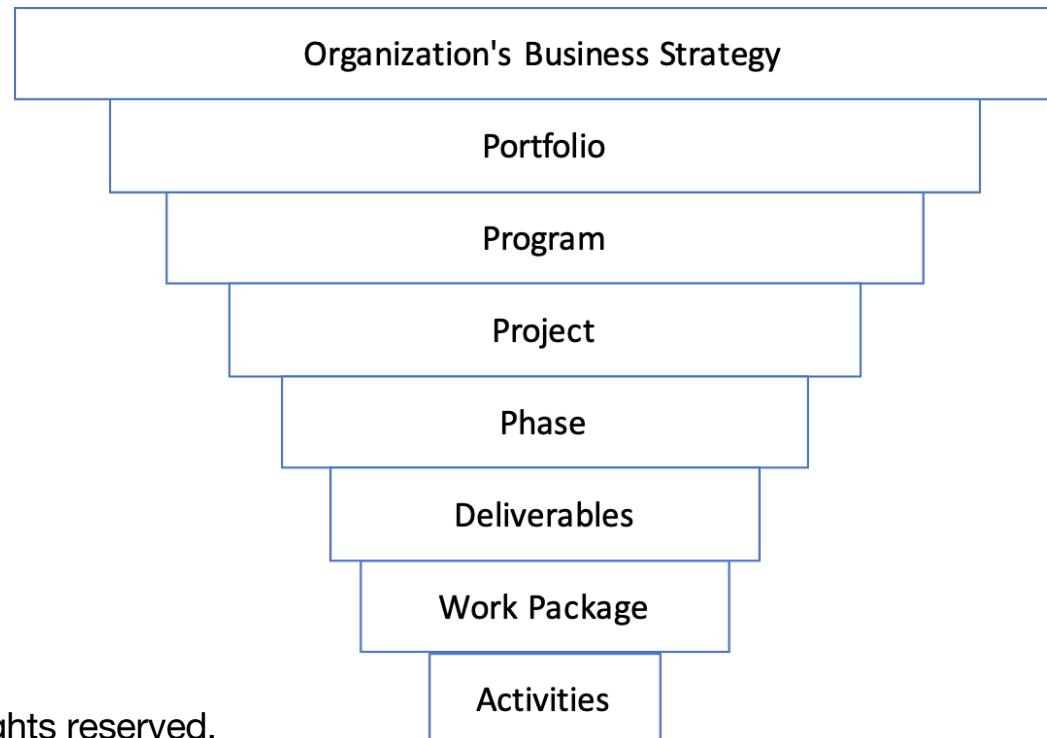


Project, Program, and Portfolio

- Project definition from the *PMBOK® Guide*:

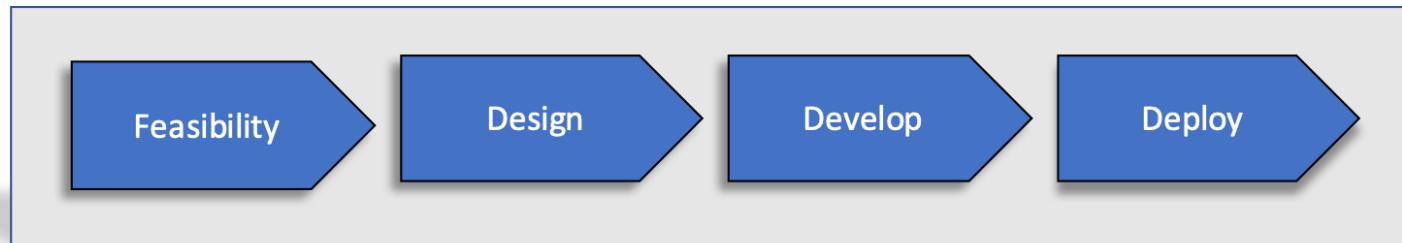
“A project is a temporary endeavor undertaken to create a unique product, service, or result.” (*PMBOK® Guide, 6th edition*, p. 4)

Projects are typically created to enhance operations or as a result of operations (see *PMBOK® Guide*, p. 9).



What Is a Phase?

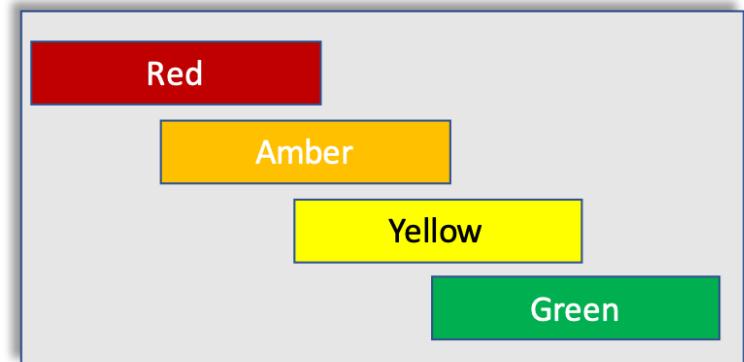
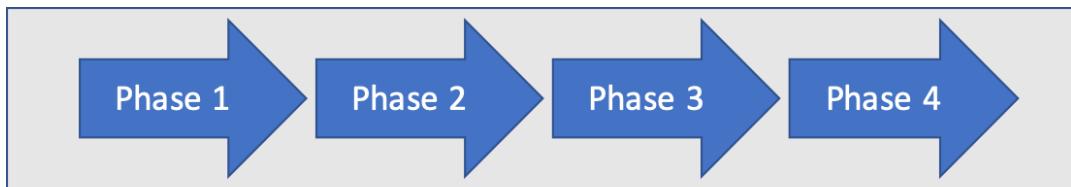
- **Phases** are used as divisions within a project or program and are usually named after terms common to the organization.



- **Phase-to-Phase Relationships**

Sequential: A phase can only start once the previous phase is completed.

Overlapping: A phase starts prior to the completion of the previous phase.



Project Methodologies

- Remember: The PMP is **NOT** a methodology!
- All planning methodologies were taken into consideration in the creation of the *PMBOK® Guide*.
- “Tailoring” is used to take the “good practice” and create your own or an organization’s methodology.
- Examples of a few project management methods:

- Waterfall
- Stem and Leaf
- PERT
- Critical Path
- Rolling Wave
- Agile
- Scrum
- Kanban
- Extreme Programming
- LEAN

PMI has grouped all of the different methodologies into five project life cycles. They are defined on page 19, but there's a better graphic on page 666 to explain them.

Key Concept: The project methodology that is used for a project is largely determined by the environment the project exists in. No one project life cycle is better than another.

Project Methodologies

- The 2022 PMP exam forces students to understand at least two groups or “buckets” of project methodology.
- **Predictive:** All project methodologies that intentionally have one planning phase
- **Agile:** All project methodologies for which a firm grasp of all project requirements is not needed to start work. Work is used as a way of discovering requirements through a cyclical pattern of plan-work-validate. In this method, each cycle has a mini “planning phase.”

“About half of the examination will represent predictive project management approaches, and the other half will represent agile or hybrid approaches.”

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Project Management Professional (PMP)® Examination Content Outline, January 2021.

Understanding Agile

- **Agile** is an umbrella term that covers a variety of methods. All of these methods are grouped into the “agile” category because they fulfill the agile values.
 - Scrum
 - Crystal
 - Scrumban
 - Agile Unified Process (AUP)
 - Extreme Programming
 - Feature-Driven Development (FDD)
 - Scaled Agile Framework (SAFe)
- Agile brings order to chaos using structured processes done in iteration; each iteration is referred to as a *sprint*. The length of the iterations can be uniform (*iteration-based agile*) or varying in length (*flow-based agile*). A product backlog is a tool typically used in agile to understand all of the work that needs to be done to complete that product. As requirements are defined, work is added to the product backlog.

Understanding Agile

- **Agile Alliance vs. Scrum Alliance:** Two competing organizations that offer certificates in agile methodology. PMI has partnered with the Agile Alliance to write the *Agile Practice Guide*.
- **Agile Mindset:** “A way of thinking and behaving underpinned by the four values and 12 principles of the *Agile Manifesto*.”
- **Servant Leadership:** The practice of leading the team by focusing on understanding and addressing the needs and development of team members to enable the highest possible team performance
- **Self-Organizing Team:** A team in which people fluidly assume leadership as needed to achieve the team’s objectives

Understanding Agile

Agile Manifesto: Written in a Snowbird, Utah, ski resort in 2001 by 17 developers

Four Paired Values:

1. **Individuals and interactions** over processes and tools
2. **Working software** over comprehensive documentation
3. **Customer collaboration** over contract negotiation
4. **Responding to change** over following a plan

Understanding Agile

12 Agile Principles

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.

Understanding Agile

12 Agile Principles (cont.)

7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity—the art of maximizing the amount of work not done—is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Understanding Agile

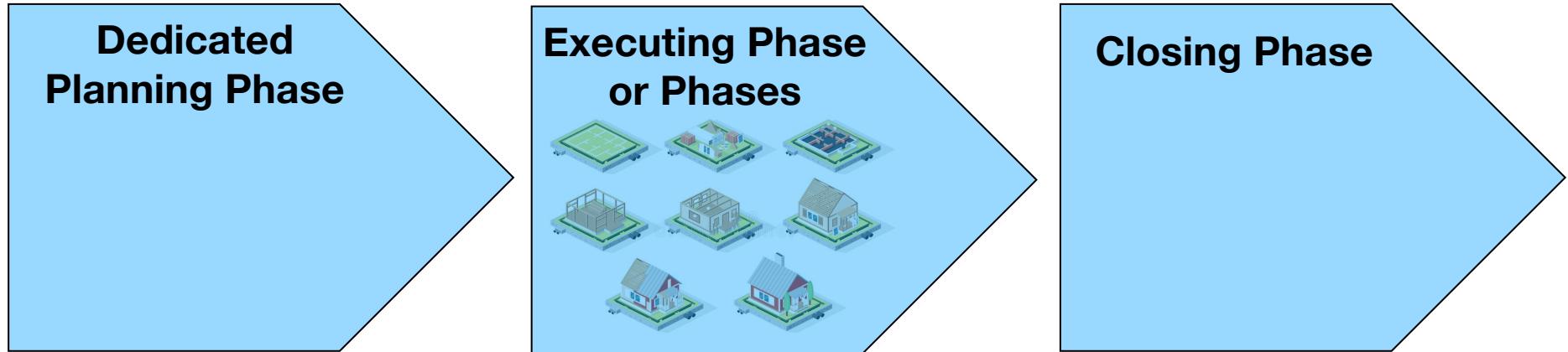
Agile Project Team Positions

- **Team Facilitator:** Sometimes called a project manager, scrum master, project team lead, or team coach. Uses servant leadership, which focuses on understanding and addressing the needs of the team in order to enable high performance. Removes project impediments and paves the way for others' contributions
- **Product Owner:** Guides the direction of the product by prioritizing work based on its business value from the perspective of the end user
- **Team Member:** Cross-functional teams can deliver finished work in the shortest possible time with higher quality and fewer external dependencies.
- **Agile Coach:** Focused on ensuring that agile development and project life cycles are being done properly. Can be internal or external to the organization

Agile vs. Predictive

Let's say we're going to use a **predictive** project methodology to build a home.

- Planning: Usually, a phase is dedicated to planning for the entire project. This mitigates risk in the execution of project work.



Agile vs. Predictive

Now let's say we're going to use an **agile** project methodology to build a home.

- Each phase or cycle of the agile project typically follows the same rhythm of events, which are referred to as “Common Agile Practice” or the “Scrum Ceremonies.”

- Time-boxed events that occur once in a cycle:

Backlog Preparation

The Sprint

Sprint Review

Sprint Retrospective

- Repeated or never-ending events:

The Daily Standup

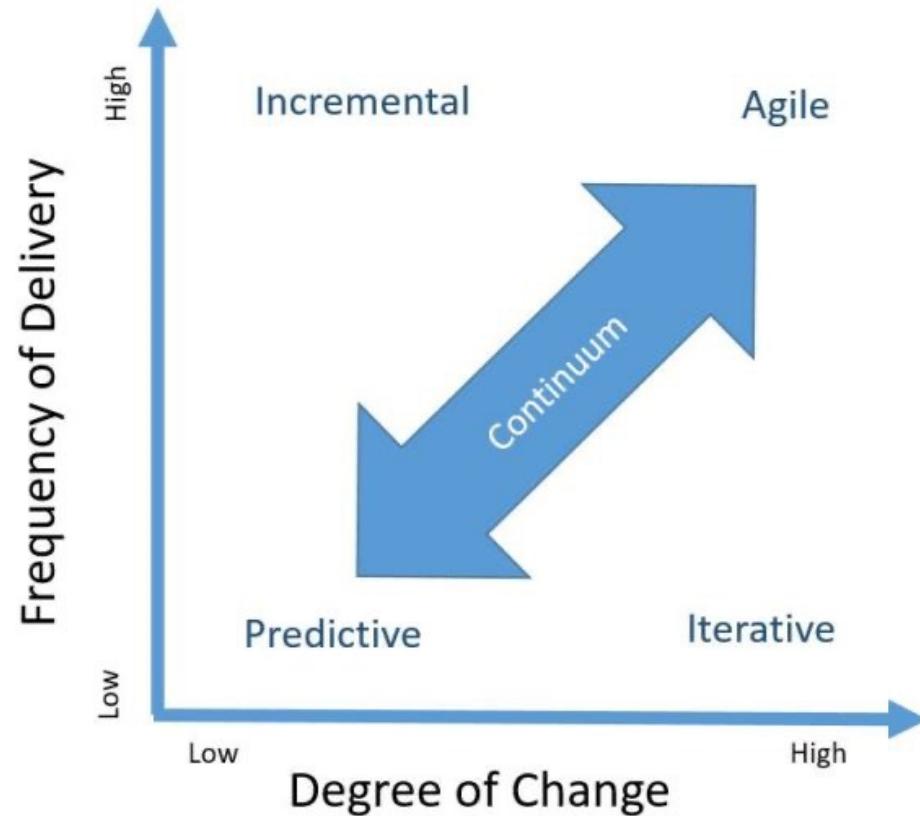
Backlog Refinement

Agile vs. Predictive

- Now planning has been spread across the project as a portion of each phase or cycle. This allows the team to take advantage of ***progressive elaboration*** to maximize business value in the final product.
- As a result of this method, risk in the execution of the work takes a back seat to the risks at the end of the project, such as customer satisfaction.

Agile vs. Predictive

The *Agile Practice Guide* attempts to show the difference on page 19.



© Project Management Institute, *Agile Practice Guide*, Figure 3-1, p. 19, 2017. All rights reserved.

The PMO

and How Organizations Affect Project Management

- The PMO is a segment of the organization created with the intent of aiding the organization's project management efforts by:
 - Gathering and disseminating "best practices"
 - Coordinating resources between projects
 - Developing project managers
 - Providing governance to project management with policies, procedures, and templates
- The PMO can be structured in many ways. PMI has categorized all PMOs by power.
 - **Supportive:** Passive, almost no power
 - **Controlling:** Actively implements project governance
 - **Directive:** Directly manages the PMs
- How the organization is structured can also affect how project management is conducted. PMI has attempted to group all organizations into 10 types on page 47, Table 2-1.

*Agile Center of Excellence (ACoEs)

The Project Management Plan

- The **Project Management Plan** is the document created by the project manager detailing how the project will meet the project objectives and goals. Typically, this is done with the use of three baselines:
 - **Scope Baseline**
 - **Schedule Baseline**
 - **Cost Baseline**
- The Project Management Plan also details how the project will be controlled and reported as it moves through time to completion. To do this, we usually use something called the **Performance Measurements Baseline**.
- The Project Management Plan can also include a variety of additional plans and project documents, depending on the type of project. All of this appears in the *PMBOK® Guide* on page 89.

What Is a Process?

- PMI has divided the “good practices” into 49 processes. These processes make up the *PMBOK® Guide*. Each process is an attempt to create something, referred to as a process ***output***. A process will always have at least one output but may have many.
- To create this output, PMI has recognized several ***tools and techniques*** that could be used to make the outputs.
- Depending on the tool and technique deemed best or most appropriate, the process will require several ***inputs***.
- For this reason, PMI has broken down each process into “Inputs,” “Tools and Techniques,” and “Outputs.”

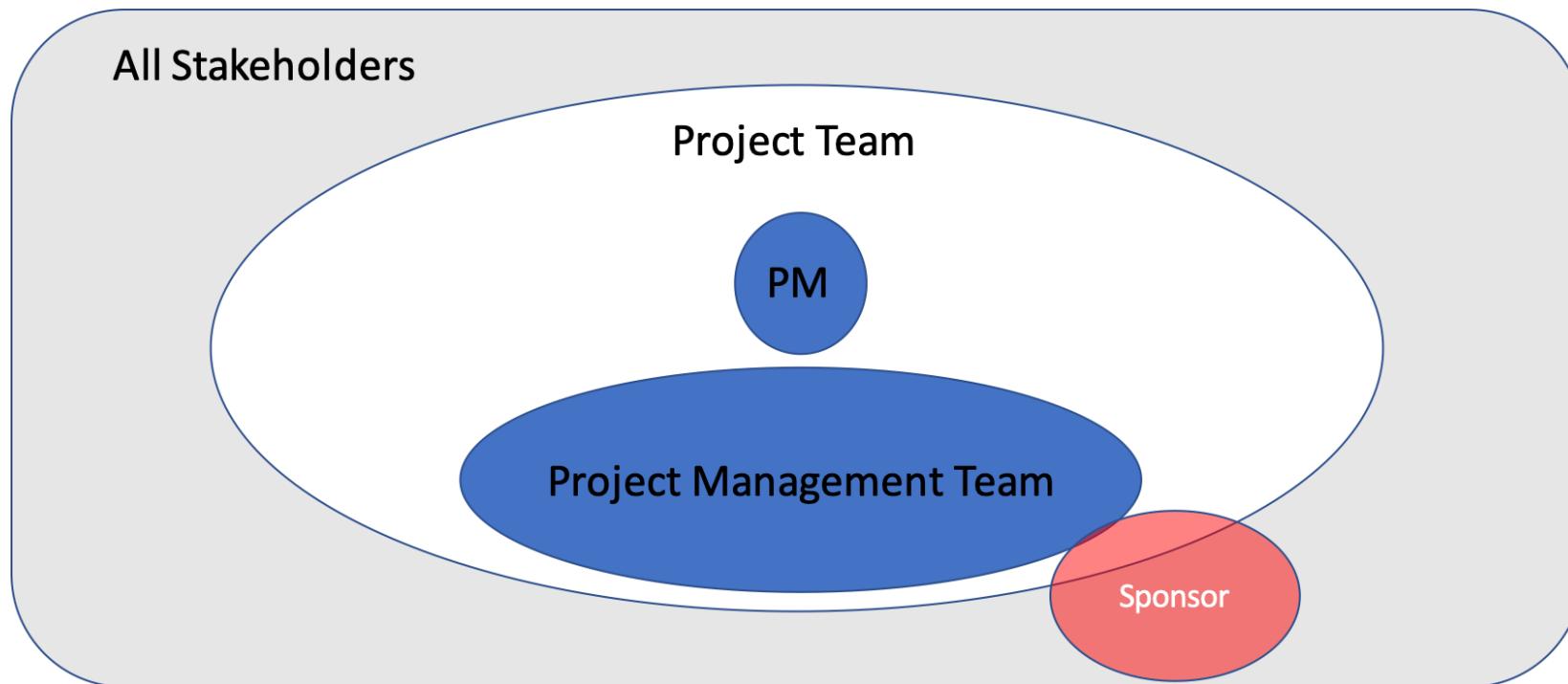
Inputs	Tools and Techniques	Outputs
1. Blah blah blah 2. Blah blah blah 3. Blah blah blah	1. Blah blah blah 2. Blah blah blah	1. Blah blah blah

The Tools and Techniques

- A “tool and technique” is a way of doing a process. This is how the project manager turns inputs into outputs.
- Not all tools and techniques discussed for a process are necessary to create the outputs. Usually, the project manager will use one or a combination of some of the tools, but not all of them.
- Starting on page 685 in the *PMBOK® Guide*, PMI has grouped the tools and techniques into seven types. It’s helpful to know the seven types, as well as each subtype, for exam success:
 - Data Gathering
 - Data Analysis
 - Data Representation
 - Decision-Making
 - Communication Skills
 - Interpersonal and Team Skills
 - Ungrouped Tools

Stakeholders

- A **stakeholder** is any entity affected by the project.



EEFs and OPAs

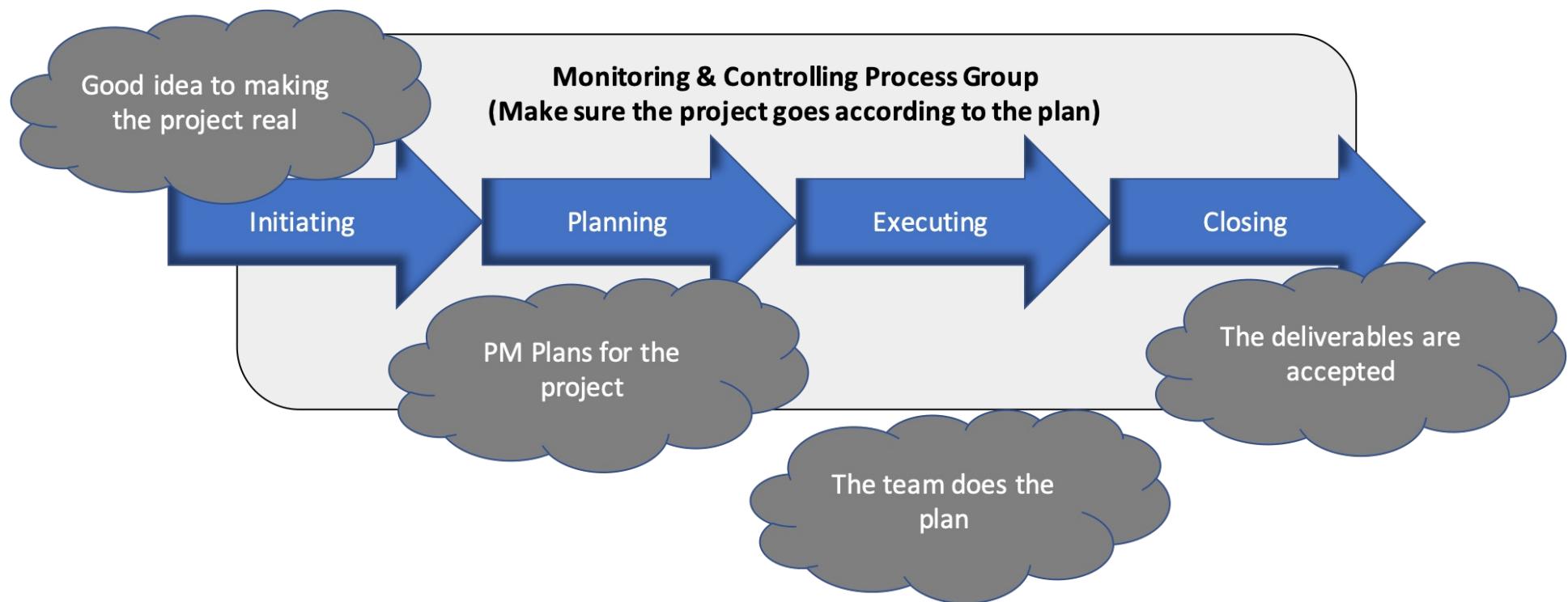
- **Organizational Process Assets**, or OPAs: The things you use by preference to help you do a process. There are two subtypes:
 - Processes and Procedures
 - Organizational Knowledge Repositories
- **Enterprise Environmental Factors**, or EEFs: Laws, rules, regulations, and culture
 - Internal to the organization
 - External to the organization
- Don't worry about the general difference between the two; it will be clearer in the context of a process.

The Ten Knowledge Areas

- A ***knowledge area*** is a group of processes that are similar in the type of experience or insight needed to do a task.
- PMI has grouped all of the processes in the *PMBOK® Guide* by knowledge area so that the guide reads as follows:
 - (4.0) Project Integration Management
 - (5.0) Project Scope Management
 - (6.0) Project Time Management
 - (7.0) Project Cost Management
 - (8.0) Project Quality Management
 - (9.0) Project Human Resource Management
 - (10.0) Project Communications Management
 - (11.0) Project Risk Management
 - (12.0) Project Procurement Management
 - (13.0) Project Stakeholder Management

The Five Process Groups

- A **process group** is a collection of processes grouped by what they create, not necessarily a timeline in which they are done.



Initiating Process Group

In this grouping of processes, the organization works to make the project real. There are only two processes in this group:

- 4.1 Develop Project Charter
- 13.1 Identify Stakeholders



Integration Knowledge Area

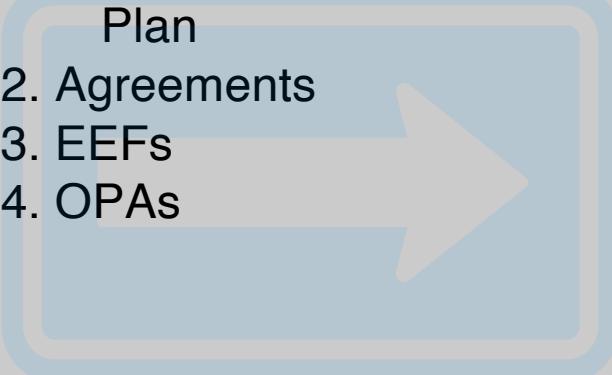
This knowledge area is used to tie all of the processes within process groups together into the big “so what.”

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



4.1 Develop Project Charter

Key Concept: This process formally authorizes the existence of a project and empowers the project manager with *limited* authority to ensure project success.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Business Documents<ul style="list-style-type: none">- Business Case- Benefits Management Plan2. Agreements3. EEFs4. OPAs 	<ul style="list-style-type: none">1. Expert Judgment2. Data Gathering<ul style="list-style-type: none">- Brainstorming- Focus Group- Interviews3. Interpersonal and Team Skills<ul style="list-style-type: none">- Conflict Management- Facilitation- Meeting Management4. Meetings 	<ul style="list-style-type: none">1. Project Charter2. Assumption Log 

4.1 Develop Project Charter

Inputs

1. Business Documents

- Business Case: This is a document that explains why this project was selected over competing efforts—maybe because of a strategic opportunity or market conditions.
- Benefits Management Plan: This plan lists the tangible and intangible benefits expected from the project. It can also detail how these benefits align with other efforts within the organization to contribute to business goals. More on benefits management appears on page 33 of the *PMBOK® Guide*.

2. Agreements: These are typically contracts, but not always; they could also be in the form of an MOU, for example.

3. EEFs

4. OPAs

4.1 Develop Project Charter

Tools and Techniques

1. **Expert Judgment:** One of the most common tools, this is just the utilization of an expert or SME, perhaps the project management office.
2. **Data Gathering**
 - Brainstorming
 - Focus Group
 - Interviews
3. **Interpersonal and Team Skills**
 - Conflict Management
 - Facilitation
 - Meeting Management
4. **Meetings**

4.1 Develop Project Charter

Outputs

- 1. Project Charter:** This is a document that defines the project at a high level, empowers the project manager, and controls the project manager. It should be approved by the sponsor.
 - **Defining the project:** Typically, this is from the SOW or contract that was used to create the project. This definition includes high-level requirements, details about the project deliverables and high-level risk events, and a strategic reason as to why this project was selected.
 - **Empowering the PM:** The charter should name the PM and should empower that person with control over resources to get the project done.
 - **Controlling the PM:** The charter often uses different mechanisms to control the project manager. Examples include deadlines, milestones, reports, the definition of “done,” and success criteria.
- 2. Assumption Log:** This is a list of items that are true but will require clarification as the project moves forward.

4.1 Develop Project Charter

New Terms from the 2021 Exam Change

- **Project Overview Statement:** Communicates enterprise-wide the intent and the vision of the project
- **Definition of *Done* (DoD):** Criteria that must be met so that the deliverable can be considered ready for customer use
- **Definition of *Ready* (DoR):** A set of user-centric requirements that includes all of the information needed by the team in order to start working
- **Project Governance:** The framework and processes that guide project management activities to meet organizational, strategic, and operational goals

4.1 Develop Project Charter

ID #	Enabler	Primary Reference
1.2.1	Set a clear vision and mission	4.1
1.2.4	Determine an appropriate leadership style (e.g., directive, collaborative)	4.1, 9.1, 9.5
2.6.6	Coordinate with other projects and other operations	NEW 4.1, p. 543, APG pp. 82 and 111
2.9.5	Determine critical information requirements	4.1, 5.2, 4.5
2.10.1	Anticipate and embrace the need for change (e.g., follow change management practices)	4.1, 4.2, 4.6
2.12.1	Determine the requirements (what, when, where, who, etc.) for managing the project artifacts	4.1, 4.2, 5.2
2.13.1	Assess project needs, complexity, and magnitude	4.1, 4.2
2.13.2	Recommend project execution strategy (e.g., contracting, finance)	4.1, 4.2
2.13.3	Recommend a project methodology/approach (i.e., predictive, agile, hybrid)	NEW 4.1
2.14.1	Determine appropriate governance for the project (e.g., replicate organizational governance)	4.1
2.14.2	Define escalation paths and thresholds	4.1, 9.1, 13.3
2.16.3	Confirm approach for knowledge transfers	NEW 4.1, 4.4
2.17.1	Determine criteria to close the project or phase successfully	4.1, 5.2, 4.2
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2, 8.1, 11.1, 11.2, 13.1
3.2.1	Investigate that benefits are identified	4.1, 5.2, 8.1
3.2.2	Document agreements on ownership for ongoing benefits	NEW 4.1, 8.1, 4.4
3.3.1	Survey changes to external business environment (e.g., regulations, technology, geopolitical, market)	4.1
3.3.2	Assess and prioritize impact on project scope/backlog based on changes in external business environment	NEW 4.1, 4.3
3.3.3	Recommend options for scope/backlog changes (e.g., schedule, cost changes)	NEW 4.1, 4.3
3.3.4	Continually review external business environment for impacts on project scope/backlog	NEW 4.1, 4.3
3.4.1	Assess organizational culture	NEW 4.1
3.4.3	Evaluate impact of the project to the organization and determine required actions	NEW 4.1, 4.2

4.1 Develop Project Charter

ID #	Enabler	Primary Reference
1.2.1	Set a clear vision and mission	4.1
2.6.6	Coordinate with other projects and other operations	NEW 4.1, 6.3, 6.6, p. 543, APG pp. 82 and 111
2.13.3	Recommend a project methodology/approach (i.e., predictive, agile, hybrid)	NEW 4.1
2.14.1	Determine appropriate governance for the project (e.g., replicate organizational governance)	4.1
3.3.1	Survey changes to external business environment (e.g., regulations, technology, geopolitical, market)	4.1
3.2.1	Investigate that benefits are identified	NEW 4.1, 8.1, 4.4
3.4.1	Assess organizational culture	NEW 4.1

Project Stakeholder Management

This knowledge area is used to understand who the project stakeholders are and how to manage their engagement.

- 13.1 Identify Stakeholders
- 13.2 Plan Stakeholder Engagement
- 13.3 Manage Stakeholder Engagement
- 13.4 Monitor Stakeholder Engagement



13.1 Identify Stakeholders

Key Concept: This is the process of identifying all people or entities that are affected by the project. It begins the documentation to understand how they are affected and their project involvement levels.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Charter 2. Business Documents <ul style="list-style-type: none"> - Business Case - Benefits Management Plan 3. Project Management Plan <ul style="list-style-type: none"> - Communications Management Plan - Stakeholder Engagement Plan 4. Project Documents <ul style="list-style-type: none"> - Change Log - Issue Log - Requirements Documentation 5. Agreements 6. EEFs 7. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Data Gathering <ul style="list-style-type: none"> - Brainstorming - Questionnaires and Surveys 3. Data Analysis <ul style="list-style-type: none"> - Stakeholder Analysis - Document Analysis 4. Data Representation <ul style="list-style-type: none"> - Stakeholder Mapping 5. Meetings 	<ol style="list-style-type: none"> 1. Stakeholder Register 2. Change Requests 3. Project Management Plan Updates <ul style="list-style-type: none"> - Requirements Management Plan - Communications Management Plan - Risk Management Plan - Stakeholder Engagement Plan 4. Project Document Updates <ul style="list-style-type: none"> - Assumption Log - Issue Log - Risk Register

13.1 Identify Stakeholders

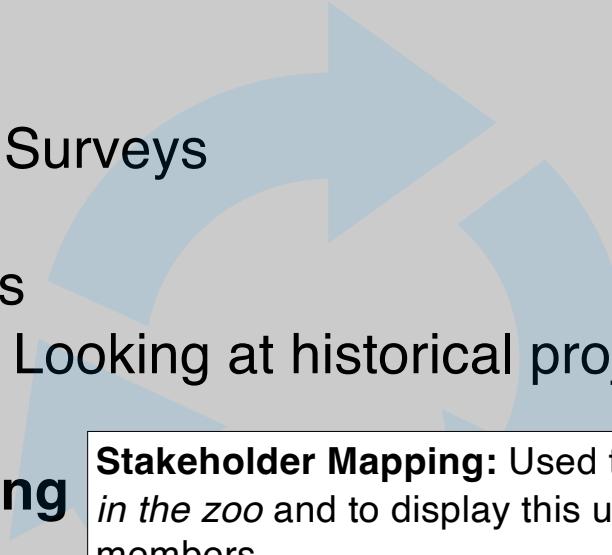
Inputs

1. Project Charter
2. Business Documents
 - Business Case
 - Benefits Management Plan
3. Project Management Plan
 - Communications Management Plan
 - Stakeholder Engagement Plan
4. Project Documents
 - Change Log
 - Issue Log
 - Requirements Documentation
5. Agreements
6. EEFs
7. OPAs

13.1 Identify Stakeholders

Tools and Techniques

1. Expert Judgment
2. Data Gathering
 - Brainstorming
 - Questionnaires and Surveys
3. Data Analysis
 - Stakeholder Analysis
 - Document Analysis: Looking at historical project data
4. Data Representation
 - **Stakeholder Mapping**
5. Meetings



Stakeholder Mapping: Used to help the PM understand *who is who in the zoo* and to display this understanding to key project team members

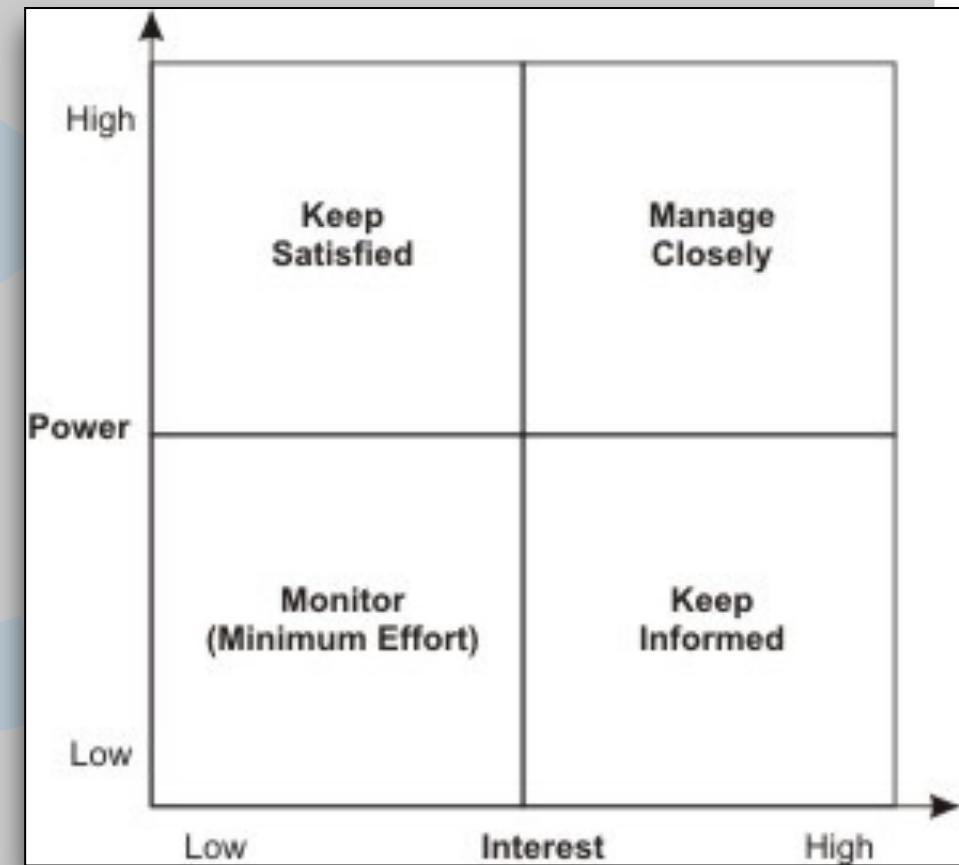
Stakeholder Grid: Compares a group of stakeholders to two variables
Salience Model: Compares a stakeholder to three variables
Stakeholder Cube: Compares a stakeholder to three variables

13.1 Identify Stakeholders

Tools and Techniques

Stakeholder Mapping

1. Stakeholder Grid: Compares all stakeholders to two variables—for example, ranking the stakeholders by power and interest

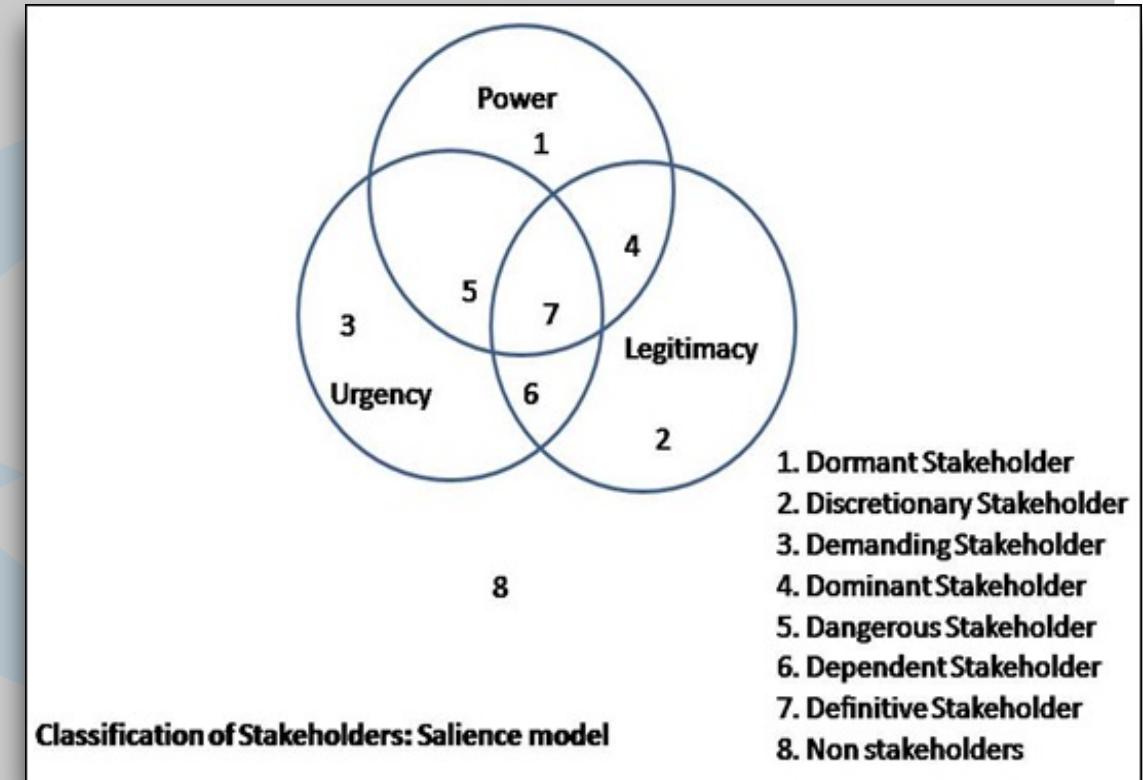


13.1 Identify Stakeholders

Tools and Techniques

Stakeholder Mapping

2. Salience Model: Compares three variables using a Venn diagram to create eight types of stakeholder categories



13.1 Identify Stakeholders

Tools and Techniques

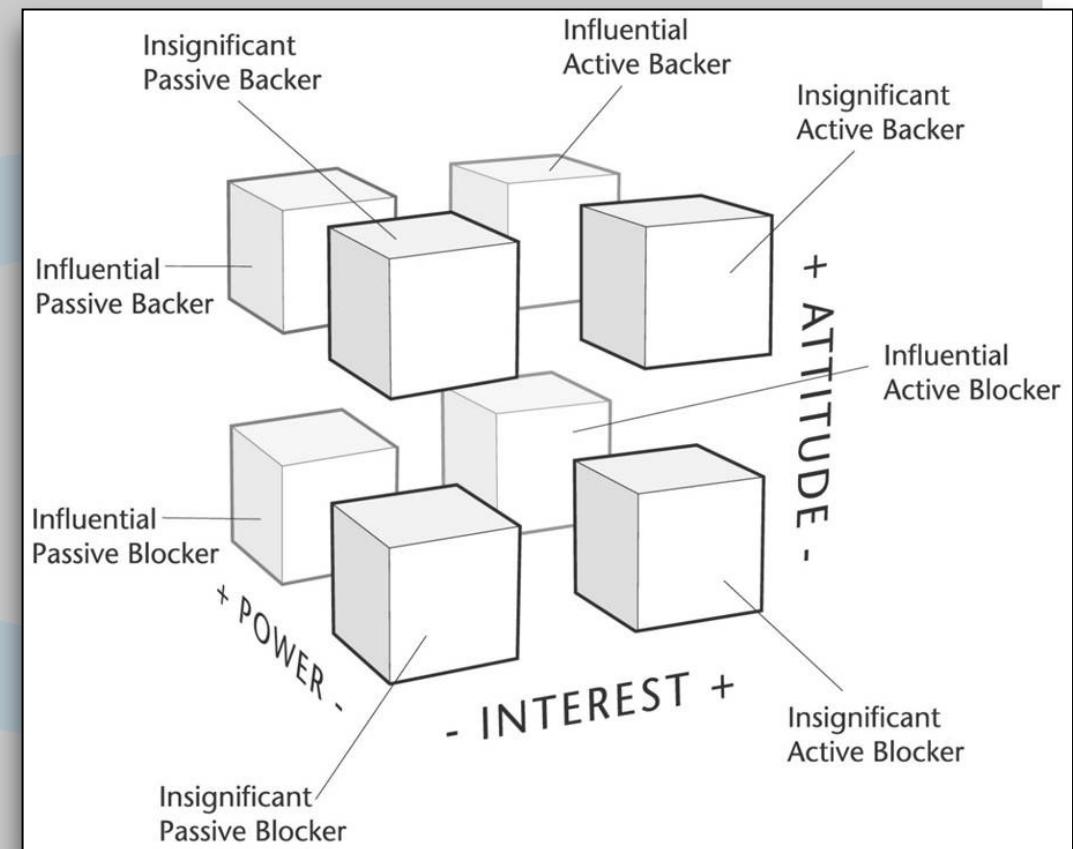
Stakeholder Mapping

3. Stakeholder Cube: Compares a stakeholder to three variables to create typologies as a way of categorizing stakeholders

Power: Active or Passive

Interest: Active or Passive

Attitude: Backer or Blocker



13.1 Identify Stakeholders

Outputs

1. Stakeholder Register
2. Change Requests
3. Project Management Plan Updates
 - Requirements Management Plan
 - Communications Management Plan
 - Risk Management Plan
 - Stakeholder Engagement Plan
4. Project Document Updates
 - Assumption Log
 - Issue Log
 - Risk Register

13.1 Identify Stakeholders

Outputs

1. Stakeholder Register (EXAMPLE ONLY!)

STAKEHOLDER REGISTER								
Project Name:			<optional>					
Project Manager Name:			<required>					
ID	Name	Title	Organization	Contact Information	Location	Common Types	Rank In Project	Comments

13.1 Identify Stakeholders

ID #	Enabler	Primary Reference
1.2.6	Analyze team members' and stakeholders' influence	13.1
1.9.2	Optimize alignment between stakeholder needs, expectations, and project objectives	13.1
2.4.1	Analyze stakeholders (e.g., power interest grid, influence, impact)	13.1
2.4.2	Categorize stakeholders	13.1
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2, 8.1, 11.1, 11.2, 13.1

Planning Process Group

- 4.2 Develop Project Management Plan
- 5.1 Plan Scope Management
- 5.2 Collect Requirements
- 5.3 Define Scope
- 5.4 Create WBS
- 6.1 Plan Schedule Management
- 6.2 Define Activities
- 6.3 Sequence Activities
- 6.4 Estimate Activity Durations
- 6.5 Develop Schedule
- 7.1 Plan Cost Management
- 7.2 Estimate Costs
- 7.3 Determine Budget
- 8.1 Plan Quality Management
- 9.1 Plan Resource Management
- 9.2 Estimate Activity Resources
- 10.1 Plan Communications Management
- 11.1 Plan Risk Management
- 11.2 Identify Risks
- 11.3 Perform Qualitative Risk Analysis
- 11.4 Perform Quantitative Risk Analysis
- 11.5 Plan Risk Responses
- 12.1 Plan Procurement Management
- 13.2 Plan Stakeholder Engagement



Planning Process Group

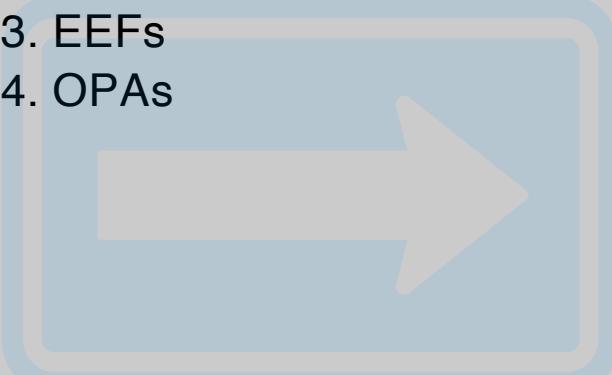


Table 1-4 (Guide). Project Management Process Group and Knowledge Area Mapping
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Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

4.2 Develop Project Management Plan

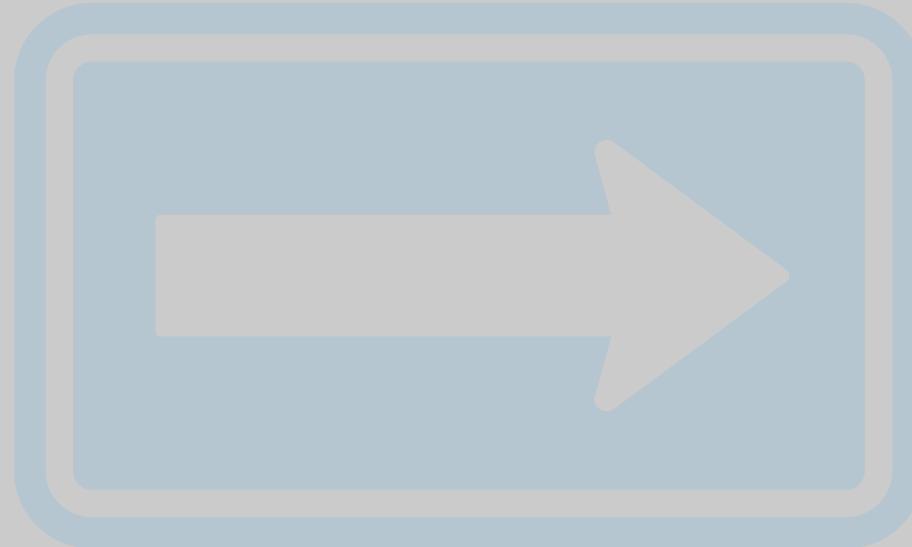
Key Concept: This is the act of synchronizing the planning processes necessary to develop the Project Management Plan. The plan is approved when completed and usually revolves around scope, schedule, and cost baselines.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Outputs from Other Processes3. EEFs4. OPAs 	<ul style="list-style-type: none">1. Expert Judgment2. Data Gathering<ul style="list-style-type: none">- Brainstorming- Checklists- Focus Groups- Interviews3. Interpersonal and Team Skills<ul style="list-style-type: none">- Conflict Management- Facilitation- Meeting Management4. Meetings 	<ul style="list-style-type: none">1. Project Management Plan 

4.2 Develop Project Management Plan

Inputs

1. Project Charter
2. **Outputs from Other Processes**
3. EEFs
4. OPAs



4.2 Develop Project Management Plan

Tools and Techniques

1. Expert Judgment
2. Data Gathering
 - Brainstorming
 - **Checklists**
 - Focus Groups
 - Interviews
3. Interpersonal and Team Skills
 - Conflict Management
 - Facilitation
 - Meeting Management
4. Meetings



4.2 Develop Project Management Plan

Outputs

- 1. Project Management Plan:** This is the combination of all necessary project plans and documents listed on page 89 of the *PMBOK® Guide* for that project. It could be completed in one phase of a project or released in iterations, depending on the methodology.

It is key for your exam success to know and understand all possible components of the Project Management Plan—all 19 management plans, as well as the 33 documents.

Components of the Project Management Plan



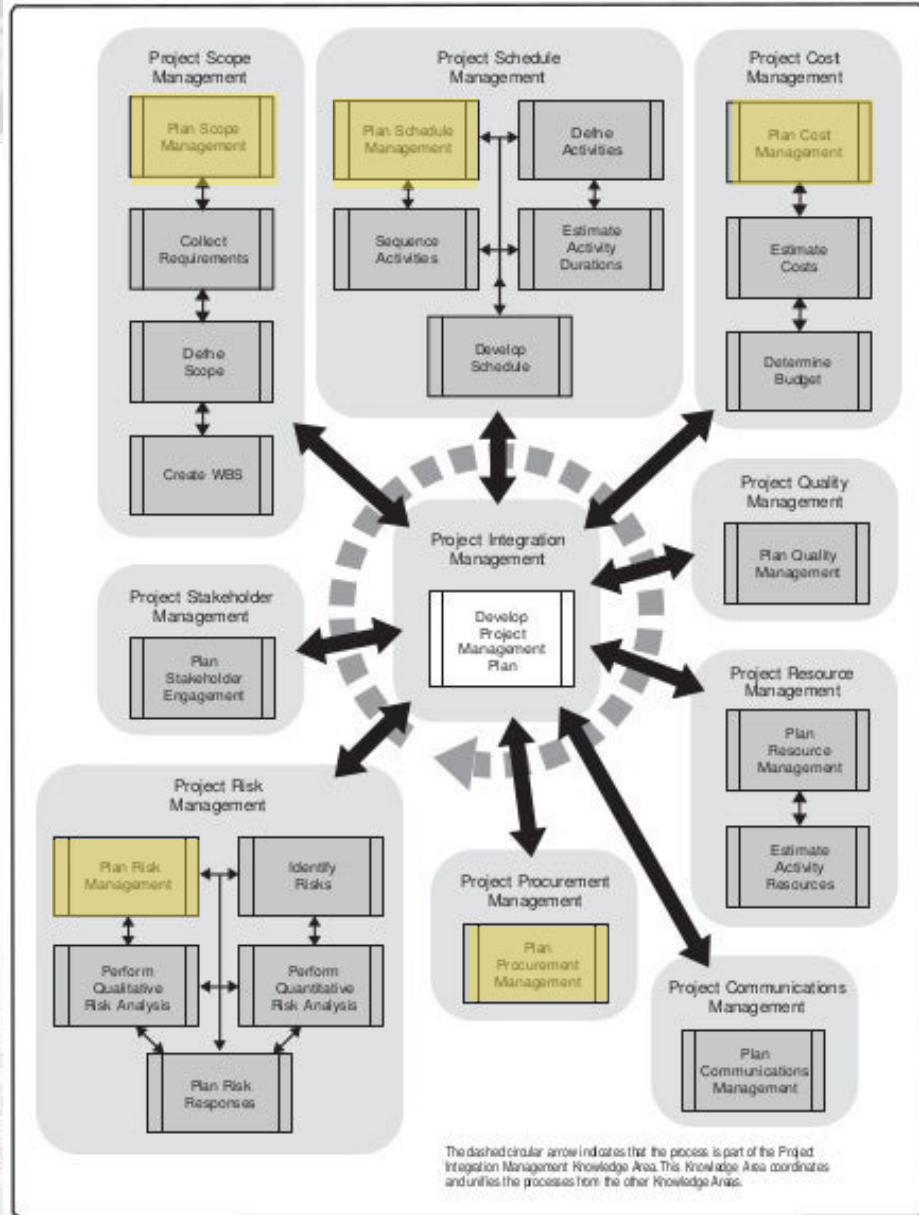
Project Management Plan	Project Documents	
1. Scope Management Plan	1. Activity Attributes	20. Quality Metrics
2. Requirements Management Plan	2. Activity List	21. Quality Reports
3. Schedule Management Plan	3. Assumption Log	22. Requirements Documentation
4. Cost Management Plan	4. Basis of Estimates	23. Requirements Traceability Matrix
5. Quality Management Plan	5. Change Log	24. Resource Breakdown Structure
6. Resource Management Plan	6. Cost Estimates	25. Resource Calendars
7. Communications Management Plan	7. Cost Forecasts	26. Resource Requirements
8. Risk Management Plan	8. Duration Estimates	27. Risk Register
9. Procurement Management Plan	9. Issue Log	28. Risk Reports
10. Stakeholder Engagement Plan	10. Lessons Learned Register	29. Schedule Data
11. Change Management Plan	11. Milestone List	30. Schedule Forecasts
12. Configuration Management Plan	12. Physical Resource Assignments	31. Stakeholder Register
13. Scope Baseline	13. Project Calendars	32. Team Charter
14. Schedule Baseline	14. Project Communications	33. Test and Evaluation Documents
15. Cost Baseline	15. Project Schedule	
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	
19. Management Review	19. Quality Control Measurements	

Which Plans Are Made in the Project and Which Are Made by the Organization



Project Management Plan	Project Documents
1. Scope Management Plan	1. Activity Attributes
2. Requirements Management Plan	2. Activity List
3. Schedule Management Plan	3. Assumption Log
4. Cost Management Plan	4. Basis of Estimates
5. Quality Management Plan**	5. Change Log
6. Resource Management Plan	6. Cost Estimates
7. Communications Management Plan	7. Cost Forecasts
8. Risk Management Plan	8. Duration Estimates
9. Procurement Management Plan	9. Issue Log
10. Stakeholder Engagement Plan	10. Lessons Learned Register
11. Change Management Plan?	11. Milestone List
12. Configuration Management Plan?	12. Physical Resource Assignments
13. Scope Baseline	13. Project Calendars
14. Schedule Baseline	14. Project Communications
15. Cost Baseline	15. Project Schedule
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
19. Management Review?	19. Quality Control Measurements

Another Perspective



- Most PMBOK® processes are done by the project team, but not all.
- Some PMBOK® processes were done before the project was even thought of. These processes make up *standard operating procedures*, or SOPs, that give the PM guidance on how to make certain project artifacts.
- The SOPs are created in all of the process highlighted in yellow.

4.2 Develop Project Management Plan

Additional Components NOT Made in a PMBOK® Process:

- **Change Management Plan:** This plan describes any change control policies or systems that will be used in the project (could be OPA or EEF).
- **Configuration Management Plan:** This plan discusses any other type of control system in the project.
 - All configuration management systems
 - IDs each article
 - Reflects the status of the article
 - Allows the user to audit the system
- **Performance Measurement Baseline:** This is a combination of cost, scope, and schedule baseline and is used to evaluate the project.
- **Development Approach:** This plan describes how the Project Management Plan will be built and is dependent upon the planning methodology selected.
- **Project Life Cycle Description:** This explains the overarching methodology that the organization uses to complete projects.
- **Management Review:** This is a template of normal audits/reviews and reports that the organization will use to keep tabs on the project.

4.2 Develop Project Management Plan

ID #	Enabler	Primary Reference
2.1.1	Assess opportunities to deliver value incrementally	NEW 4.2, p. 23, APG
2.9.1	Consolidated the project/phase plans	4.2
2.10.2	Determine strategy to handle change	4.2
2.13.1	Assess project needs, complexity, and magnitude	4.1, 4.2
2.13.2	Recommend project execution strategy (e.g., contracting, finance)	4.1, 4.2
2.13.4	Use iterative, incremental practices throughout the project lifecycle (e.g., lessons learned, stakeholder engagement, risk)	NEW 4.2
2.17.1	Determine criteria to close the project or phase successfully	4.1, 5.2, 4.2
3.4.3	Evaluate impact of the project to the organization and determine required actions	NEW 4.1, 4.2

The SOP Processes

These processes are not separated in any formal way by PMI, but through research we can see their similarities and their importance to the project.

- 5.1 Plan Scope Management
- 6.1 Plan Schedule Management
- 7.1 Plan Cost Management
- 11.1 Plan Risk Management
- 12.1 Plan Procurement Management

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
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6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
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10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

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5.1 Plan Scope Management

Key Concept: This process lays out the plan for tracking and archiving requirements in order to create the scope baseline and its supporting documents.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Quality Management Plan- Project Life Cycle Description- Development Approach3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Data Analysis<ul style="list-style-type: none">- Alternative Analysis- Document Analysis3. Meetings	<ul style="list-style-type: none">1. Scope Management Plan2. Requirements Management Plan

5.1 Plan Scope Management

Inputs

1. Project Charter
2. Project Management Plan
 - **Quality Management Plan:** This plan could lay out additional requirements based on how testing is done or the training that must be done by the tester.
 - **Project Life Cycle Description**
 - **Development Approach**
3. EEFs
4. OPAs

5.1 Plan Scope Management

Tools and Techniques

1. Expert Judgment
2. Data Analysis
 - Alternative Analysis
 - Document Analysis
3. Meetings



5.1 Plan Scope Management

Outputs

- 1. Scope Management Plan:** This plan discusses how the scope baseline will be created, approved, or changed if needed and how it will be controlled/evaluated. It discusses how the three components of the baseline will be made.
 - Scope Statement
 - WBS
 - WBS Dictionary
- 2. Requirements Management Plan:** This plan discusses the use of two project documents that are used to archive information and track the status of project requirements.
 - Requirements Documentation
 - Requirements Traceability Matrix

5.1 Plan Scope Management

ID #	Enabler	Primary Reference
3.1.2	Classify compliance categories	NEW 5.1, 8.1, 11.1

6.1 Plan Schedule Management

Key Concept: This process lays out the plan for creating the project schedule baseline and its supporting documents. It outlines the scheduling systems and any scheduling policies, such as how reporting is done and how estimating is done.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Scope Management Plan- Development Approach3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Data Analysis3. Meetings	<ul style="list-style-type: none">1. Schedule Management Plan

6.1 Plan Schedule Management

Inputs

1. Project Charter
2. Project Management Plan
 - Scope Management Plan
 - **Development Approach:** This input is not an output of any process; it is used to explain how deliverables are created and released using predictive, iterative, incremental, agile, or hybrid methods. If used, it will be a driving factor in how scheduling is done.
3. EEFs
4. OPAs

6.1 Plan Schedule Management

Tools and Techniques

1. Expert Judgment
2. **Data Analysis:** This is the process of looking at past projects to determine estimating techniques or to understand how accurate the schedule must be.
3. Meetings

6.1 Plan Schedule Management

Outputs

1. **Schedule Management Plan:** This plan tells you how to plan. It will be the how-to guide when it comes to filling out all scheduling documentation (see *PMBOK® Guide*, p. 89). It also lays out several key scheduling policies:
 - When and how schedule reporting is done
 - How estimating duration is done (also contingency reserve)
 - What the project duration and units of measure are
 - The use of any project management information systems (PMIS)
 - How the schedule baseline is approved
 - How to change the schedule baseline when needed
 - Who can update the schedule, and how schedule updates are made

6.1 Plan Schedule Management

ID #	Enabler	Primary Reference
2.6.3	Prepare schedule based on methodology	6.1, 6.5
2.6.4	Measure ongoing progress based on methodology	6.1, 6.6

7.1 Plan Cost Management

Key Concept: This process lays out the plan for creating the project cost baseline and its supporting documents. It outlines the accounting systems and any accounting policies, such as how reporting is done and how estimating is done.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Schedule Management Plan- Risk Management Plan3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Data Analysis3. Meetings	<ul style="list-style-type: none">1. Cost Management Plan

7.1 Plan Cost Management

Inputs

1. Project Charter
2. Project Management Plan
 - Schedule Management Plan
 - Risk Management Plan
3. EEFs
4. OPAs

7.1 Plan Cost Management

Tools and Techniques

1. Expert Judgment
2. Data Analysis
3. Meetings



7.1 Plan Cost Management

Outputs

- 1. Cost Management Plan:** This plan is the how-to for everything in cost. It explains how to create the cost baseline, who will approve it, and how it is changed, if it needs to be changed. It also discusses some important things moving forward, such as what currency will be used for the project or the assumed exchange rates. When you are estimating, the plan tells you what's considered an accurate estimate and how to set aside contingency reserves. It can also discuss reporting using earned value management and when that is done.

7.1 Plan Cost Management

ID #	Enabler	Primary Reference
2.5.2	Anticipate future budget challenges	7.1, 7.3, 7.4
2.5.4	Plan and manage resources	7.1, 7.2, 7.3, 7.4

11.1 Plan Risk Management

Key Concept: This process lays out the plan for handling risk during the project. It also gives guidance on using several important risk tools.

There are zero risk events in the Risk Management Plan.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- All Components3. Project Documents<ul style="list-style-type: none">- Stakeholder Register4. EEFs5. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Data Analysis<ul style="list-style-type: none">- Stakeholder Analysis3. Meetings	<ul style="list-style-type: none">1. Risk Management Plan 

11.1 Plan Risk Management

Inputs

1. Project Charter
2. Project Management Plan
 - All Components
3. Project Documents
 - Stakeholder Register
4. EEFs
5. OPAs

11.1 Plan Risk Management

Tools and Techniques

1. Expert Judgment
2. Data Analysis
 - Stakeholder Analysis
3. Meetings



11.1 Plan Risk Management

Outputs

1. **Risk Management Plan:** This plan covers how risk will be tracked, evaluated, reported, and controlled during the project. Possible components of the plan include:

- Risk Strategy
- Methodologies
- Roles and Responsibilities
- Funding
- Timing
- Risk Categories
- Stakeholder Risk Appetite
- Definitions of Risk Probability and Impact
- Probability and Impact Matrix
- Reporting Formats
- Tracking

11.1 Plan Risk Management

New Terms from the 2021 Exam Change

- **Risk Tolerance:** The maximum amount of risk, and the potential impact of that risk occurring, that a project manager is allowed to handle
- **Risk Appetite:** The degree of uncertainty that an organization or a key stakeholder is willing to accept in anticipation of a reward
- **Risk Threshold:** The level of risk exposure above which risks are addressed and below which risks may be accepted (watch-listed)

11.1 Plan Risk Management

ID #	Enabler	Primary Reference
2.3.1	Determine risk management options	11.1
2.15.3	Collaborate with relevant stakeholders on the approach to resolve the issues	10.1, 11.1, 13.2
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2 , 8.1, 11.1, 11.2, 13.1
3.1.2	Classify compliance categories	NEW 5.1, 8.1, 11.1

12.1 Plan Procurement Management

Key Concept: This is the process of creating the how-to guide for buying things. These are almost all EEFs.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Charter 2. Business Documents <ul style="list-style-type: none"> - Business Case - Benefits Management Plan 3. Project Management Plan <ul style="list-style-type: none"> - Scope Management Plan - Quality Management Plan - Resource Management Plan - Scope Baseline 4. Project Documents <ul style="list-style-type: none"> - Milestone List - Project Team Assignments - Requirements Documentation - Requirements Traceability Matrix - Resource Requirements - Risk Register - Stakeholder Register 5. EEFs 6. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Data Gathering <ul style="list-style-type: none"> - Market Research 3. Data Analysis <ul style="list-style-type: none"> - Make or Buy Analysis 4. Source Selection Analysis 5. Meetings 	<ol style="list-style-type: none"> 1. Procurement Management Plan 2. Procurement Strategy 3. Bid Documents 4. Procurement Statement of Work 5. Source Selection Criteria 6. Make or Buy Decisions 7. Independent Cost Estimates 8. Change Requests 9. Project Document Updates <ul style="list-style-type: none"> - Lessons Learned Register - Milestone List - Requirements Documentation - Requirements Traceability Matrix - Risk Register - Stakeholder Register 10. OPA Updates

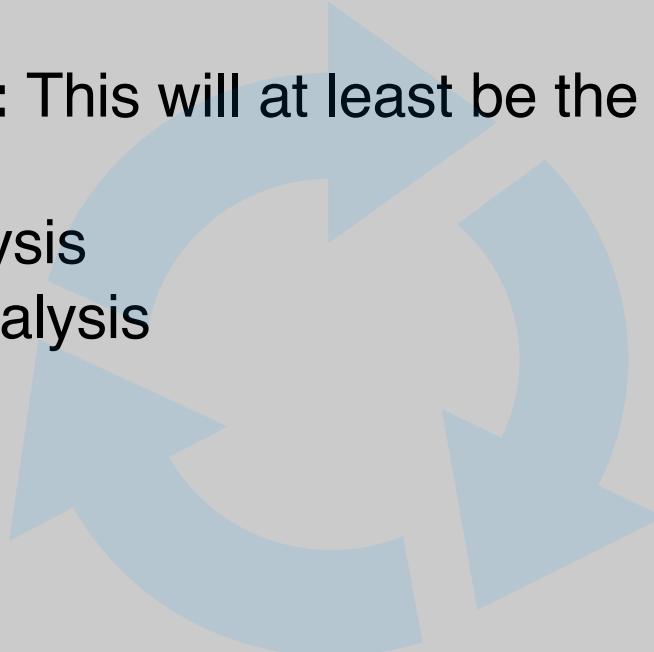
12.1 Plan Procurement Management

Inputs	
<ol style="list-style-type: none">1. Project Charter2. Business Documents<ul style="list-style-type: none">- Business Case- Benefits Management Plan3. Project Management Plan<ul style="list-style-type: none">- Scope Management Plan- Quality Management Plan- Resource Management Plan- Scope Baseline	<ol style="list-style-type: none">4. Project Documents<ul style="list-style-type: none">- Milestone List- Project Team Assignments- Requirements Documentation- Requirements Traceability Matrix- Resource Requirements- Risk Register- Stakeholder Register5. EEFs6. OPAs

12.1 Plan Procurement Management

Tools and Techniques

1. Expert Judgment
2. Data Gathering
 - **Market Research:** This will at least be the preferred vendors list.
3. Data Analysis
 - Make or Buy Analysis
4. Source Selection Analysis
5. Meetings



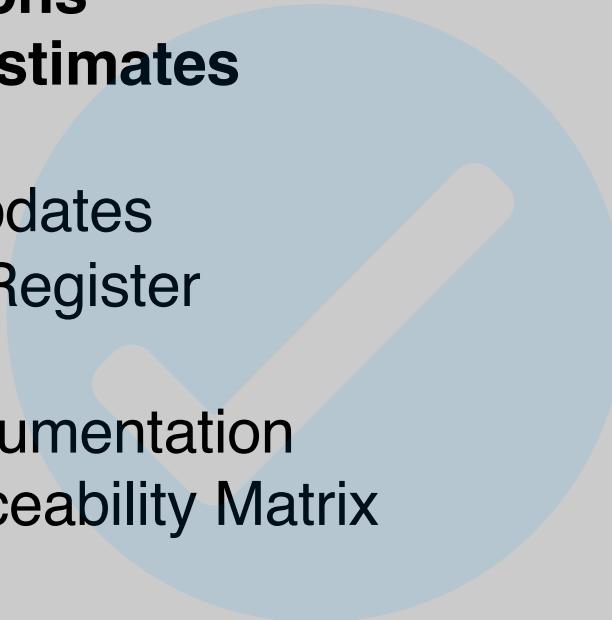
12.1 Plan Procurement Management

Outputs

- 1. Procurement Management Plan:** This plan is typically tiered by dollar amount and usually already exists in the organization.
- 2. Procurement Strategy:** In the event that a decision has already been made to buy a specific item, this document will be a tailored version of the Procurement Management Plan for the life cycle of that procurement.
- 3. Bid Documents:** These describe how to use RFIs, RFQs, and RFPs.
- 4. Procurement Statement of Work:** This document's creation should be described in the Procurement Management Plan. It should clarify quantity, quality levels, performance data, period of performance, work locations, and detailed requirements.

12.1 Plan Procurement Management

Outputs



5. Source Selection Criteria
6. Make or Buy Decisions
7. Independent Cost Estimates
8. Change Requests
9. Project Document Updates
 - Lessons Learned Register
 - Milestone List
 - Requirements Documentation
 - Requirements Traceability Matrix
 - Risk Register
 - Stakeholder Register
10. OPA Updates

12.1 Plan Procurement Management

ID #	Enabler	Primary Reference
1.8.1	Analyze the bounds of the negotiations for agreement	12.1
1.8.5	Determine a negotiation strategy	12.1
2.11.1	Define resource requirements and needs	9.2, 12.1
2.11.2	Communicate resource requirements	5.2, 9.2, 12.1, 12.2
2.11.4	Plan and manage procurement strategy	12.1, 12.2, 12.3

SOP Management Plans

Summary

- **Scope Management Plan:** This plan discusses how the scope baseline will be created, approved, or changed if needed and how it will be controlled/evaluated. It also includes how the three components of the baseline will be made.
- **Requirements Management Plan:** This plan discusses the use of two project documents that are used to archive information and track the status of project requirements.
- **Schedule Management Plan:** This plan explains how to schedule. It tells the PM when and how schedule reporting is done, tells how estimating duration is done, defines project units of measure, explains the use of any PMIs, explains how the schedule baseline is approved, explains who can update the schedule, and provides templets.

SOP Management Plans

Summary

- **Cost Management Plan:** This plan is the how-to for everything in cost. It explains how to create the cost baseline, who will approve it, and how it will be changed, if it needs to be changed. This plan also covers reporting for cost management.
- **Procurement Management Plan:** This plan typically explains purchasing rules that all PMs must follow. The policies are usually tiered by dollar amount. This plan usually already exists in the organization.
- **Risk Management Plan:** This plan covers how risk will be tracked, evaluated, reported, and controlled during the project.

Project Scope Management

This knowledge area is used to make sure that all project requirements are planned into the project—and nothing more.

- 5.1 Plan Scope Management
- 5.2 Collect Requirements
- 5.3 Define Scope
- 5.4 Create WBS
- 5.5 Validate Scope
- 5.6 Control Scope



5.2 Collect Requirements

Key Concept: This is the process of finding and documenting all project requirements. This doesn't mean only product requirements; it can also include stakeholder requirements.

Inputs	Tools and Techniques	Outputs
<p>1. Project Charter</p> <p>2. Project Management Plan</p> <ul style="list-style-type: none"> - Scope Management Plan - Requirements Management Plan - Stakeholder Engagement Plan <p>3. Project Documents</p> <ul style="list-style-type: none"> - Assumption Log - Lessons Learned Register - Stakeholder Register <p>4. Business Documents</p> <ul style="list-style-type: none"> - Business Case <p>5. Agreements</p> <p>6. EEFs</p> <p>7. OPAs</p>	<p>1. Expert Judgment</p> <p>2. Data Gathering</p> <ul style="list-style-type: none"> - Brainstorming - Interviews - Focus Groups - Questionnaires and Surveys - Benchmarking <p>3. Data Analysis</p> <ul style="list-style-type: none"> - Document Analysis <p>4. Decision-Making</p> <ul style="list-style-type: none"> - Voting - Multi-Criteria Decision Analysis <p>5. Data Representation</p> <ul style="list-style-type: none"> - Affinity Diagrams - Mind Mapping <p>6. Interpersonal and Team Skills</p> <ul style="list-style-type: none"> - Nominal Group Technique - Observation/Conversation - Facilitation <p>7. Context Diagram</p> <p>8. Prototypes</p>	<p>1. Requirements Documentation</p> <p>2. Requirements Traceability Matrix</p>

5.2 Collect Requirements

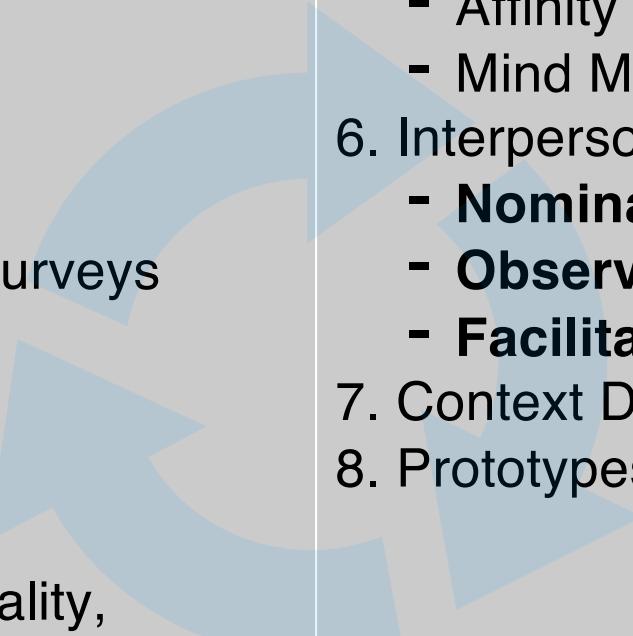
Inputs

<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Scope Management Plan- Requirements Management Plan- Stakeholder Engagement Plan3. Project Documents<ul style="list-style-type: none">- Assumption Log- Lessons Learned Register- Stakeholder Register	<ul style="list-style-type: none">4. Business Documents<ul style="list-style-type: none">- Business Case5. Agreements6. EEFs7. OPAs
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5.2 Collect Requirements

Tools and Techniques



1. Expert Judgment
2. Data Gathering
 - **Brainstorming**
 - Interviews
 - Focus Groups
 - Questionnaires and Surveys
 - Benchmarking
3. Data Analysis
 - **Document Analysis**
4. Decision-Making
 - **Voting** (Majority, Plurality, Unanimous, Autocratic)
 - Multi-Criteria Decision Analysis
5. Data Representation
 - Affinity Diagrams
 - Mind Mapping
6. Interpersonal and Team Skills
 - **Nominal Group Technique**
 - **Observation/Conversation**
 - **Facilitation**
7. Context Diagram
8. Prototypes

5.2 Collect Requirements

Outputs

- Requirements Documentation:** This is a document designed to capture all of the data about one requirement.
- Requirements Traceability Matrix:** This is a list of all of the project requirement, enabling the project manager to sort through them quickly and to understand the status of any one of them. (EXAMPLE ONLY!)

Requirements Traceability Matrix								
Project:		<optional>						
PM Name:		<required>						
<i>ID</i>	<i>Type</i>	<i>Name</i>	<i>Description</i>	<i>Status</i>	<i>Owner</i>	<i>Expected Completion</i>	<i>Verification</i>	<i>Additional Comments</i>
001								
002								
003								
004								
005								
006								

5.2 Collect Requirements

New Terms from the 2021 Exam Change

- **De Facto Regulations:** Regulations that are widely accepted but for which no official documentation exists
- **De Jure Regulations:** Regulations mandated by written law or official policy
- **XP Metaphor:** Team members try to describe aspects of a solution in the same way that a marketer might describe a product's features and benefits

5.2 Collect Requirements

ID #	Enabler	Primary Reference
1.10.2	Survey all necessary parties to reach consensus	5.2
2.8.1	Determine and prioritize requirements	5.2
2.12.1	Determine the requirements (what, when, where, who, etc.) for managing the project artifacts	4.1, 4.2, 5.2
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2 , 8.1, 11.1, 11.2, 13.1

5.3 Define Scope

Key Concept: In this process, the written definition of the project is created. It explains how each requirement will be completed and discusses what is not in the project.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Scope Management Plan3. Project Documents<ul style="list-style-type: none">- Assumption Log- Requirements Documentation- Risk Register4. EEFs5. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Data Analysis<ul style="list-style-type: none">- Alternative Analysis3. Decision-Making<ul style="list-style-type: none">- Multi-Criteria Decision Analysis4. Interpersonal and Team Skills<ul style="list-style-type: none">- Facilitation5. Product Analysis	<ul style="list-style-type: none">1. Scope Statement2. Project Document Updates<ul style="list-style-type: none">- Assumption Log- Requirements Documentation- Requirements Traceability Matrix- Stakeholder Register

5.3 Define Scope

Inputs

1. Project Charter
2. Project Management Plan
 - Scope Management Plan
3. Project Documents
 - Assumption Log
 - Requirements Documentation
 - Risk Register
4. EEFs
5. OPAs

5.3 Define Scope

Tools and Techniques

1. Expert Judgment
2. Data Analysis
 - **Alternative Analysis:** This tool is about looking at the requirements in a different way.
3. Decision-Making
 - Multi-Criteria Decision Analysis
4. Interpersonal and Team Skills
 - Facilitation
5. **Product Analysis:** For this process, this tool is used to focus on each product that the project will create and then uses that breakdown as a way of organizing the Scope Statement.

5.3 Define Scope

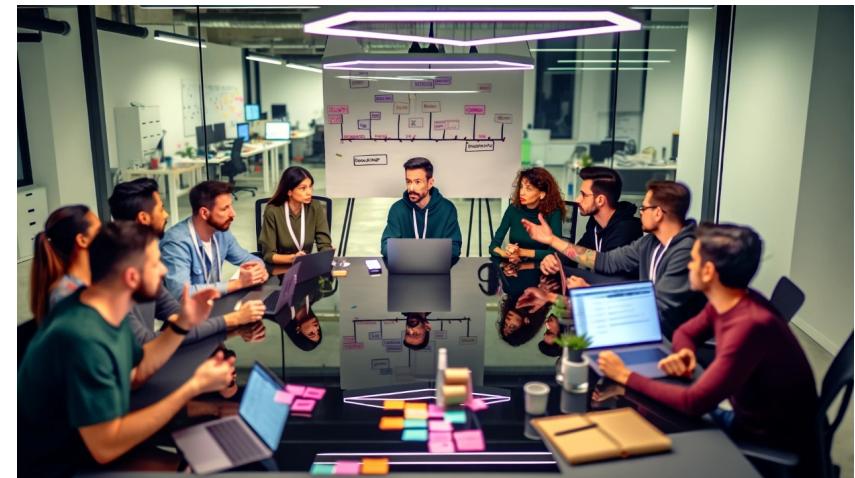
Outputs

- 1. Scope Statement:** This is a highly detailed document that defines everything that is considered within scope for the project. It can be written in many ways; some people organize it by product, others by phase. The idea is that you can hand it to someone, and that person will be able to understand what the project is and is not.
- 2. Project Document Updates**
 - Assumption Log
 - Requirements Documentation
 - Requirements Traceability Matrix
 - Stakeholder Register

5.3 Define Scope

New Terms from the 2021 Exam Change

- **Product Roadmap:** An image that gives the team a big-picture view of the product and the anticipated sequence of deliverables and that, over time, is progressively elaborated as more information is known and as the vision is refined; usually illustrated as a high-level Gantt chart or through Kanban (now, next, later)



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5.3 Define Scope

ID #	Enabler	Primary Reference
2.8.2	Break down scope (e.g., WBS, backlog)	5.3, 5.4

5.4 Create WBS

Key Concept: This is the process of using a chart called the WBS to display 100% of the work and then making a dictionary of all of the terms seen on the WBS. The combination of the WBS, the WBS Dictionary, and the Scope Statement make up the Scope Baseline. This process covers its creation and its approval.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Scope Management Plan2. Project Documents<ul style="list-style-type: none">- Project Scope Statement- Requirements Documentation3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Decomposition	<ul style="list-style-type: none">1. Scope Baseline2. Project Document Updates<ul style="list-style-type: none">- Assumption Log- Requirements Documentation

5.4 Create WBS

Inputs

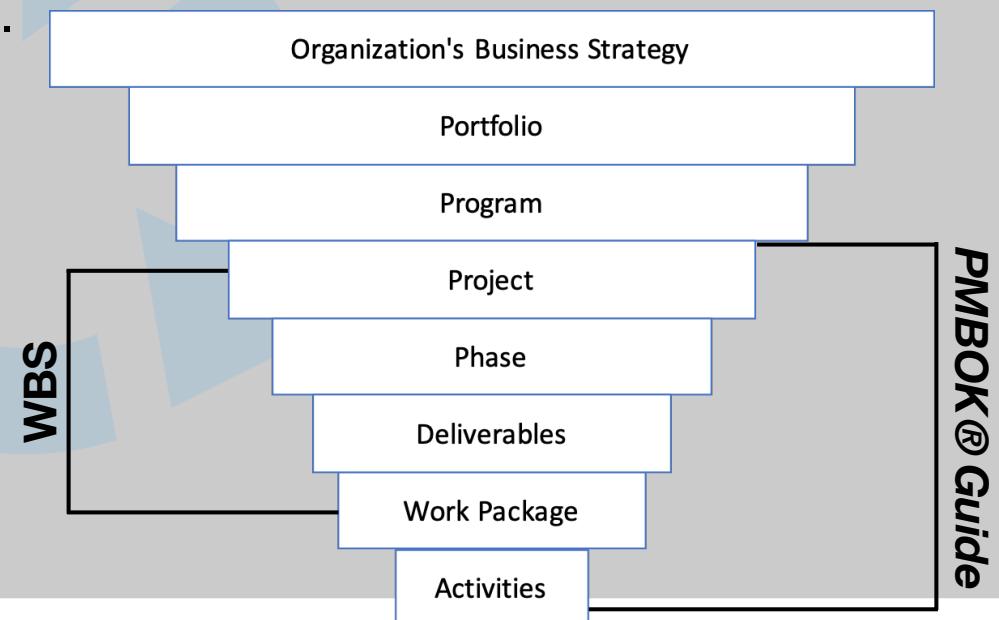
1. Project Management Plan
 - Scope Management Plan
2. Project Documents
 - Project Scope Statement
 - Requirements Documentation
3. EEFs
4. OPAs

5.4 Create WBS

Tools and Techniques

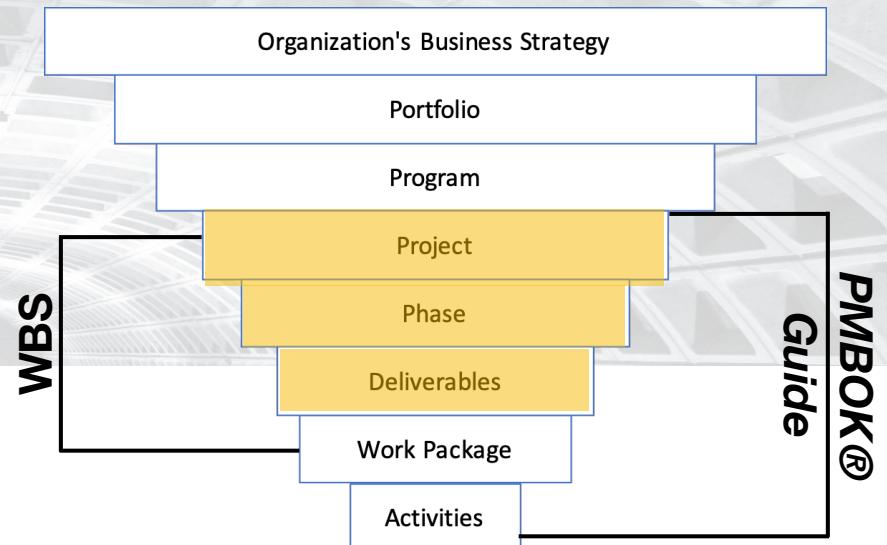
1. Expert Judgment
2. **Decomposition:** This tool is about breaking down the project to the lowest level you choose to control it. To control it, you estimate for that piece of work in planning so that during execution, you can compare what has occurred to what was planned.

On the exam, the lowest level of work on the WBS will be the Work Package.

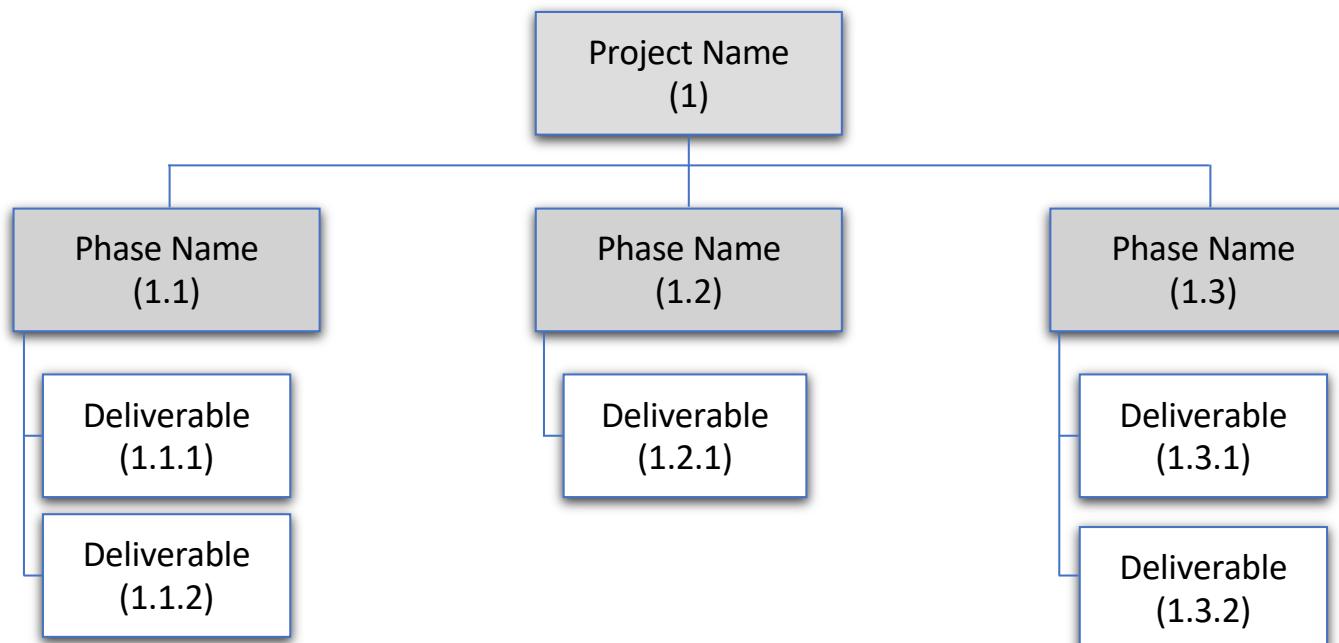


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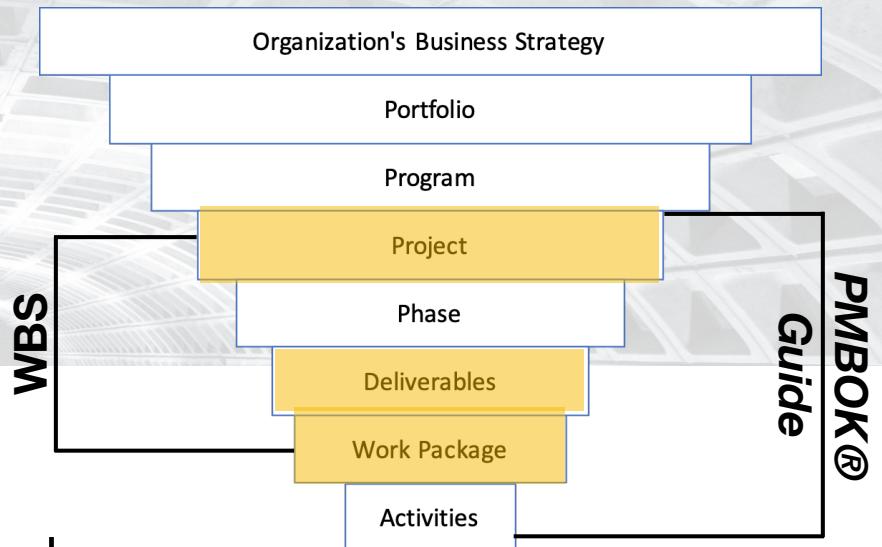
The WBS



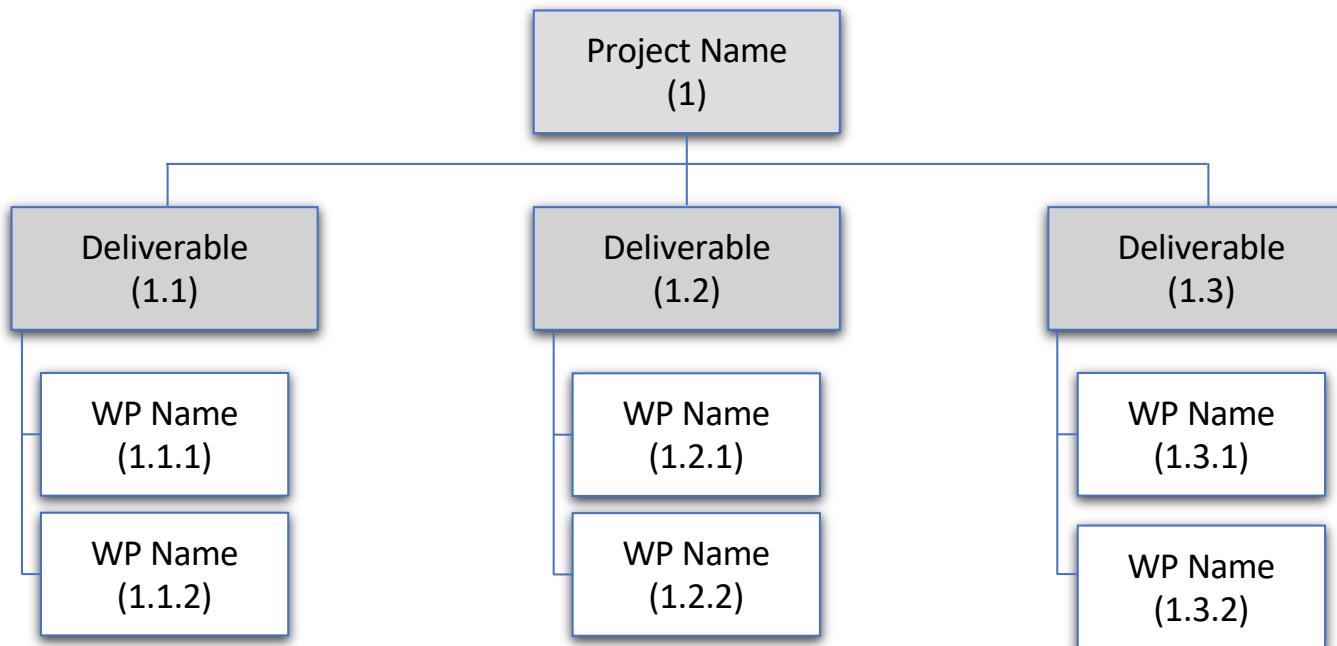
Organized by Phase to Deliverables



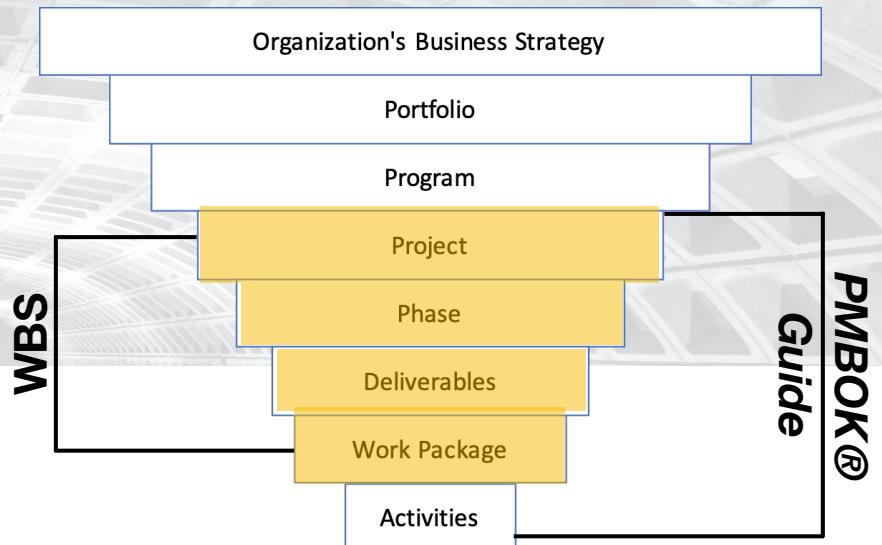
The WBS



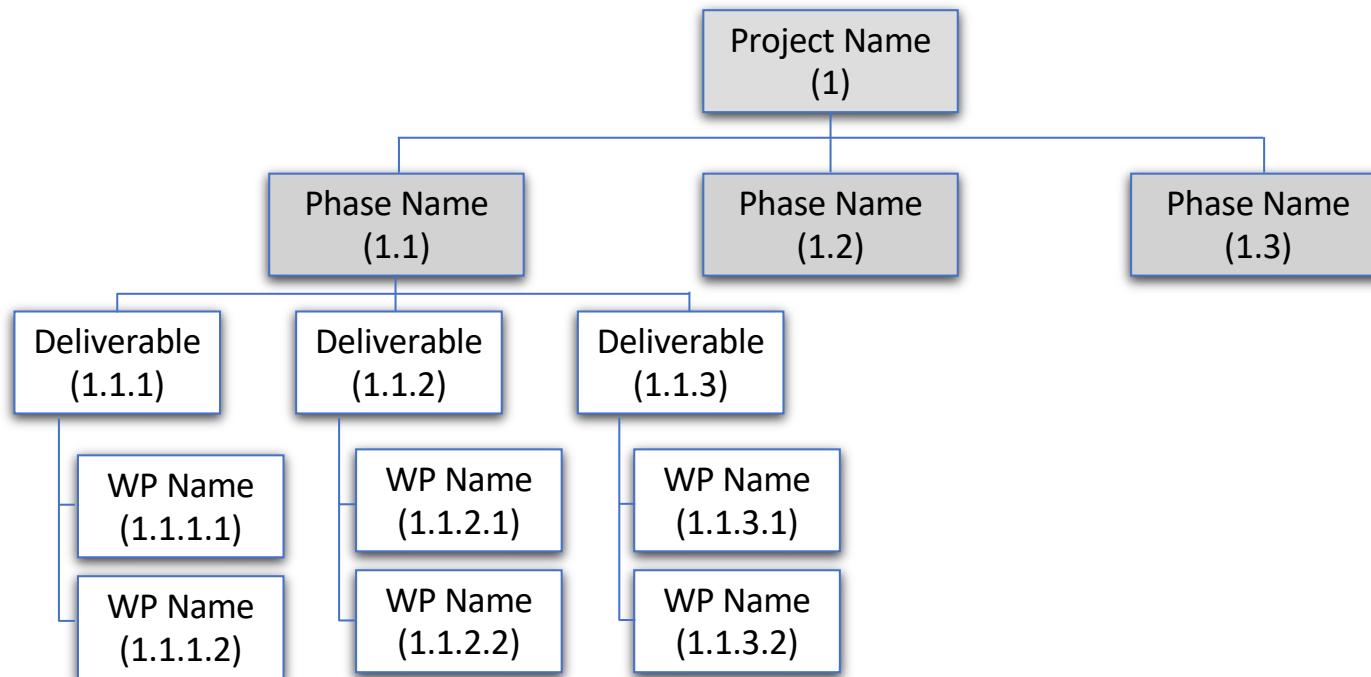
Organized by Deliverables to Work Package



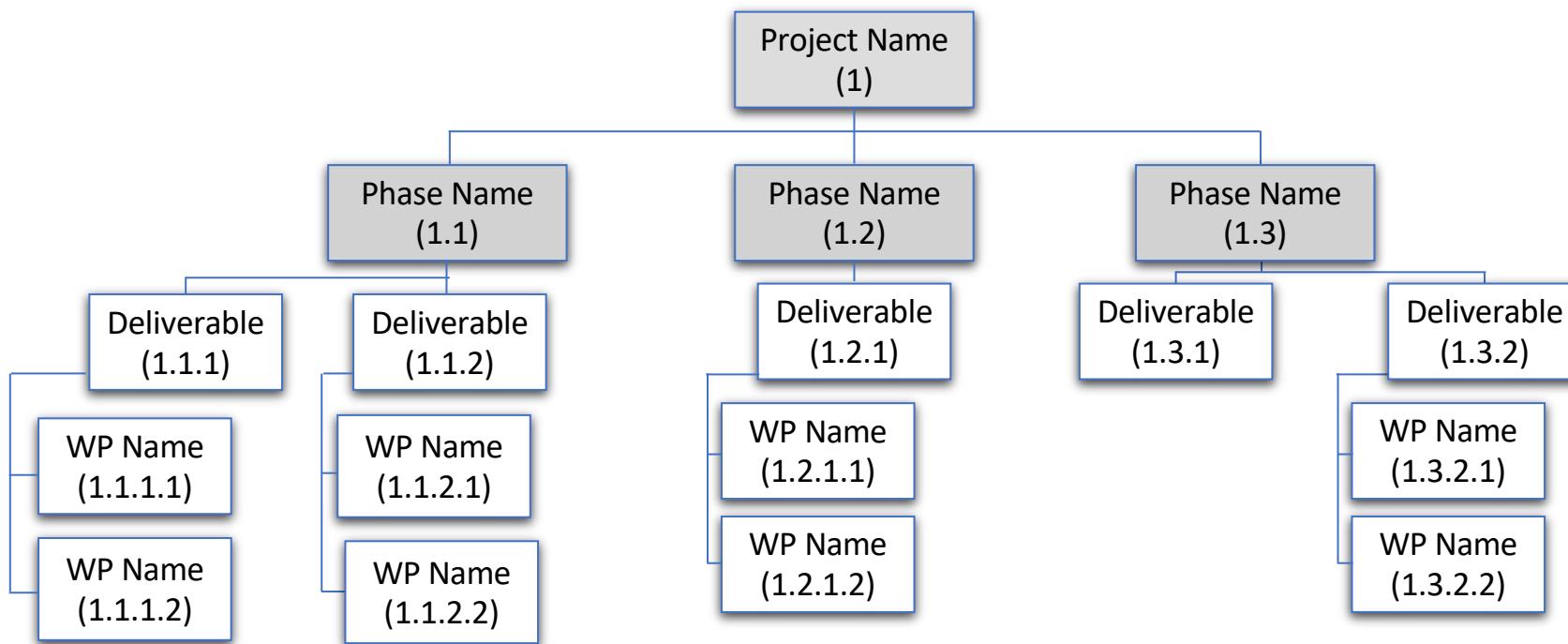
The WBS



Organized by Phase, Then Deliverables, Then Work Package



The WBS



WBS Terms to Know:

- **Control Accounts:** The level of work chosen in order to control that part of the project
- **Code of Accounts:** The count numbering system (*comes from the Scope Management Plan*)
- **Chart of Accounts:** All of the account codes in the whole organization

Product Backlog

Product Backlog						
Project Name		PM Certified Example				
Story ID	Story name	Status	Size	Sprint	Priority	Comments
1	Architecture	Done	3	2	1	
2	Get referrals	Ongoing	5	2	2	
3	Metrics	Ongoing	3	2	3	
4	Interface	Ongoing	8	3	4	
5	Design	Ongoing	5	3	5	

- **Product Backlog:** A tool used in virtually every agile methodology to display the work as it relates to requirements as the requirements are defined. This allows the scrum team to prioritize the work and determine which user stories will be completed within that sprint.
- **User Story:** A piece of work that has been defined
- **Velocity:** The number of user stories that the scrum team can complete in one sprint

5.4 Create WBS

Outputs

- 1. Scope Baseline:** This is the combination of the Scope Statement, the WBS, and the WBS Dictionary that is approved by the sponsor. After its approval, any additions to it are called *scope creep*. Exactly how to add scope creep should be outlined in the Scope Management Plan.
- 2. Project Document Updates**
 - Assumption Log
 - Requirements Documentation

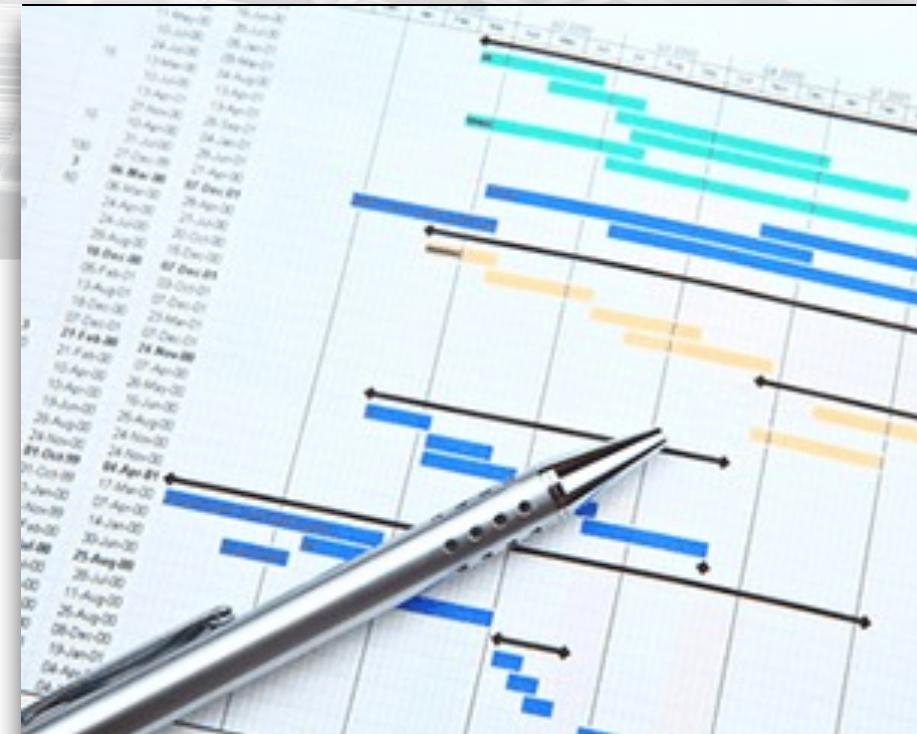
5.4 Create WBS

ID #	Enabler	Primary Reference
2.1.2	Examine the business value throughout the project	5.4, 5.5, APG
2.8.2	Break down scope (e.g., WBS, backlog)	5.3, 5.4

Project Schedule Management

This knowledge area is used to create and control the schedule of project activities. The approved project schedule is referred to as the *schedule baseline*.

- 6.1 Plan Schedule Management
- 6.2 Define Activities
- 6.3 Sequence Activities
- 6.4 Estimate Activity Durations
- 6.5 Develop Schedule
- 6.6 Control Schedule



6.2 Define Activities

Key Concept: This process breaks down the project to its lowest level, determines the name of each activity, and starts the documenting of information about each activity in the project.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Schedule Management Plan- Scope Baseline3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Decomposition3. Rolling Wave4. Meetings	<ul style="list-style-type: none">1. Activity List2. Activity Attributes3. Milestone List4. Change Requests5. Project Management Plan Updates<ul style="list-style-type: none">- Schedule Baseline- Cost Baseline

6.2 Define Activities

Inputs

1. Project Charter
2. Project Management Plan
 - **Schedule Management Plan:** This plan explains exactly how to fill out the activity documentation, milestone list, and activity list and where to archive.
 - Scope Baseline
3. EEFs
4. OPAs

6.2 Define Activities

Tools and Techniques

1. Expert Judgment
2. Decomposition
3. Rolling Wave
4. Meetings



6.2 Define Activities

Outputs

- 1. Activity List:** This is a list of all project activities and is considered a project document on page 89 of the *PMBOK® Guide*. Imagine an Excel doc covering every activity in the project.
- 2. Activity Attributes:** This is a document that explains one activity and is the most granular project-scheduling document.
- 3. Milestone List:** This is a separate list from the activity list. Milestones do not have durations but might be tied to activities.
- 4. Change Requests**
- 5. Project Management Plan Updates**
 - Schedule Baseline
 - Cost Baseline

6.2 Define Activities

Activity Attributes

Activity Attributes		
Project:		Date:
Activity ID: This information comes from the project activity list.	Activity: This is the name of the activity from the project activity list.	WBS No: This identifies where this activity can be found in the WBS.
Activity Description: This is a detailed description of the work to be performed for this activity and should be consistent with what is provided in the project activity list.		
Activity Responsibility: This section lists who is responsible for executing the work associated with this activity.	Resources and Skill Sets Required: This section describes the resources needed to perform the work. For human resources, this section should include necessary skill sets and skill levels required to complete the work.	
Activity Predecessors: This section lists other activities that must occur before this activity.	Predecessor Scheduling: This describes if the predecessor has a start-start, start-finish, or other type of scheduling relationship.	Predecessor Dependency: This section describes any dependencies on predecessor activities, such as lead times, lag times, or other requirements.
Activity Successors: This section lists other activities that must occur after this activity.	Successor Scheduling: This describes if the successor has a start-start, start-finish, or other type of scheduling relationship.	Successor Dependency: This section describes any dependencies on successor activities, such as lead times, lag times, or other requirements.

6.2 Define Activities

Activity List

6.2 Define Activities

New Terms from the 2021 Exam Change

- **User Story:** A brief description of deliverable value from the perspective of the end user
- **Feature:** A piece of work typically comprised of several user stories

6.2 Define Activities

ID #	Enabler	Primary Reference
2.6.2	Utilize benchmarks and historical data	6.2

6.3 Sequence Activities

Key Concept: This is the art of project management. In this process, the activities are sequenced so that the project is efficient with project resources and still flexible. The visual aid that is used to display this to others is the schedule network diagram.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Schedule Management Plan- Scope Baseline2. Project Documents<ul style="list-style-type: none">- Activity Attributes- Activity List- Assumption Log- Milestone List3. EEFs4. OPAs	<ul style="list-style-type: none">1. Precedence Diagramming Method2. Dependency Determination and Integration3. Leads and Lags4. Project Management Information System	<ul style="list-style-type: none">1. Project Schedule Network Diagram2. Project Document Updates<ul style="list-style-type: none">- Activity Attributes- Activity List- Assumption Log- Milestone List

6.3 Sequence Activities

Inputs

1. Project Management Plan
 - Schedule Management Plan
 - Scope Baseline
2. Project Documents
 - Activity Attributes
 - Activity List
 - Assumption Log
 - Milestone List
3. EEFs
4. OPAs

6.3 Sequence Activities

Tools and Techniques

- 1. Precedence Diagramming Method:** This technique allows the PM to display the flow of activities across the project, phase, deliverable, or work package. This comes from critical path project planning methodology, and in this process, this is the tool that builds the schedule network diagram.
- 2. Dependency Determination and Integration:** This is the reason that an activity is sequenced the way it is on the schedule network diagram.
- 3. Leads and Lags**
- 4. Project Management Information System**

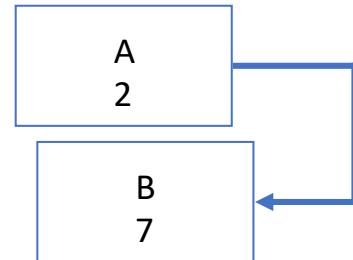
6.3 Sequence Activities

Precedence Diagramming Method: This type of diagram can be used to show the four different kinds of relationships.

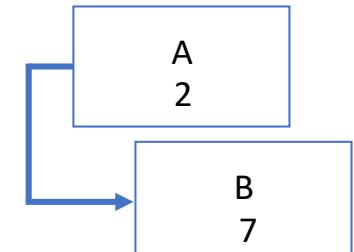
Finish to Start



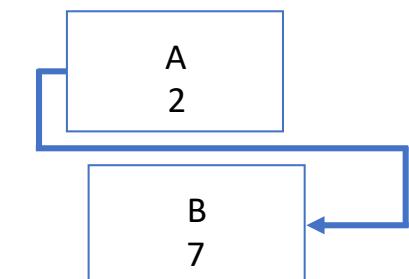
Finish to Finish



Start to Start



Start to Finish



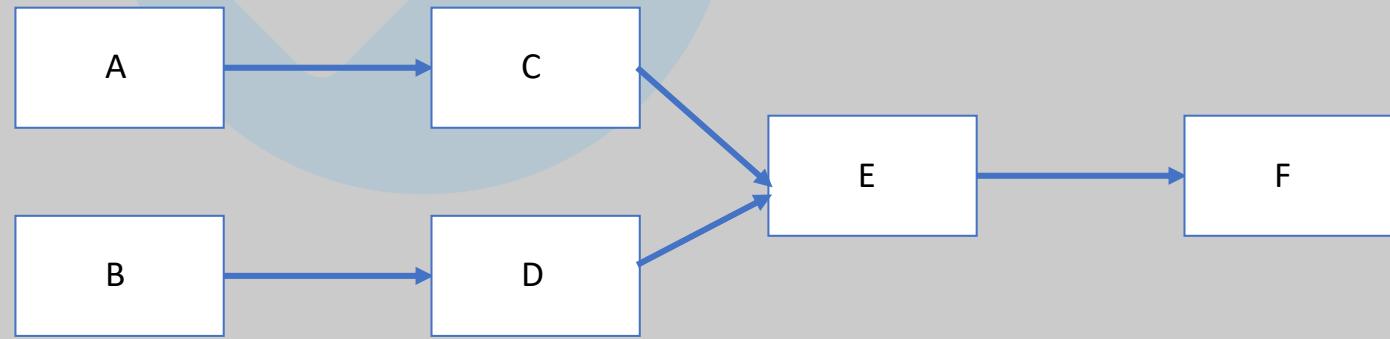
Dependency Determination and Integration: This explains why the activities are sequenced as they are.

Mandatory (Hard Logic)	Discretionary (Soft Logic)
Mandatory Internal	Discretionary Internal
Mandatory External	Discretionary External

6.3 Sequence Activities

Outputs

- 1. Project Schedule Network Diagram:** This is the visual aid that allows others to understand the flow of activities throughout the project, phase, deliverable, or work package. The diagram does not explain *why* the activities are arranged in a certain precedence; to understand why, you have to read that activity's activity attribute.
- 2. Project Document Updates**
 - Activity Attributes:** This is where the “why” is recorded. It’s called the *dependence determination*.
 - Activity List**
 - Assumption Log**
 - Milestone List**



6.3 Sequence Activities

ID #	Enabler	Primary Reference
2.6.6	Coordinate with other projects and other operations	NEW 4.1 , 6.3, 6.6, p. 543, APG pp. 82 and 111

6.4 Estimate Activity Durations

Key Concept: This process attempts to determine the expected duration of a particular activity. Once that's done, it is added to it the contingency reserve. $tE + (x\sigma)$

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Schedule Management Plan - Scope Baseline 2. Project Documents <ul style="list-style-type: none"> - Activity Attributes - Activity List - Assumption Log - Milestone List - Project Team Assignments - Resource Breakdown Structure - Resource Calendars - Resource Requirements - Risk Register 3. EEFs 4. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Analogous Estimating 3. Parametric Estimating 4. Three-Point Estimating 5. Bottom-Up Estimating 6. Data Analysis <ul style="list-style-type: none"> - Alternative Analysis - Reserve Analysis 7. Decision-Making 8. Meetings 	<ol style="list-style-type: none"> 1. Duration Estimates 2. Basis of Estimates 3. Project Document Updates <ul style="list-style-type: none"> - Activity Attributes - Assumption Log - Lessons Learned Register

6.4 Estimate Activity Durations

Terms:

Effort: The number of work hours needed to complete a task

Duration: Those work hours over the project calendar

ROM: Estimate considered to be accurate between -25% and +75%

Definitive: Estimate considered to be accurate between -5% and +10%

Contingency Reserve: Extra time or dollars the PM sets aside for risk

Management Reserve: Extra time or dollars the sponsor sets aside for risk

Law of Diminishing Returns: When adding additional resources to an activity, you will not get the exact same return; it will be slightly less.

PERT: The Program Evaluation Review Technique developed for government program and project management in 1958. It uses critical path as well as earned value management.

6.4 Estimate Activity Durations

Inputs

1. Project Management Plan
 - Schedule Management Plan
 - Scope Baseline
2. Project Documents
 - Activity Attributes
 - Activity List
 - Assumption Log
 - Milestone List
 - Project Team Assignments
 - Resource Breakdown Structure
 - Resource Calendars
 - Resource Requirements
 - Risk Register
3. EEFs
4. OPAs

6.4 Estimate Activity Durations

Tools and Techniques

1. Expert Judgment
2. **Analogous Estimating:** A method of estimating in which the estimate comes from someone above you on the organization chart
3. **Parametric Estimating:** A method of estimating that is based on one metric
4. **Three-Point Estimating:** A method of refining estimates by averaging them together
 - There are two types of three-point estimating:
 - o Triangular Distribution (simple average)
$$[\text{Estimate A} + \text{Estimate B} + \text{Estimate C}] / 3 = tE$$
 - o Beta Distribution (from PERT)
$$[\text{Optimistic} + (4 \times \text{Most Likely}) + \text{Pessimistic}] / 6 = tE$$
5. **Bottom-Up Estimating:** The most accurate estimating method; done by asking those closest to the work for estimates
6. Data Analysis
 - Alternative Analysis
 - **Reserve Analysis:** Adding a contingency reserve to an activity to account for risk
7. Decision-Making
8. Meetings

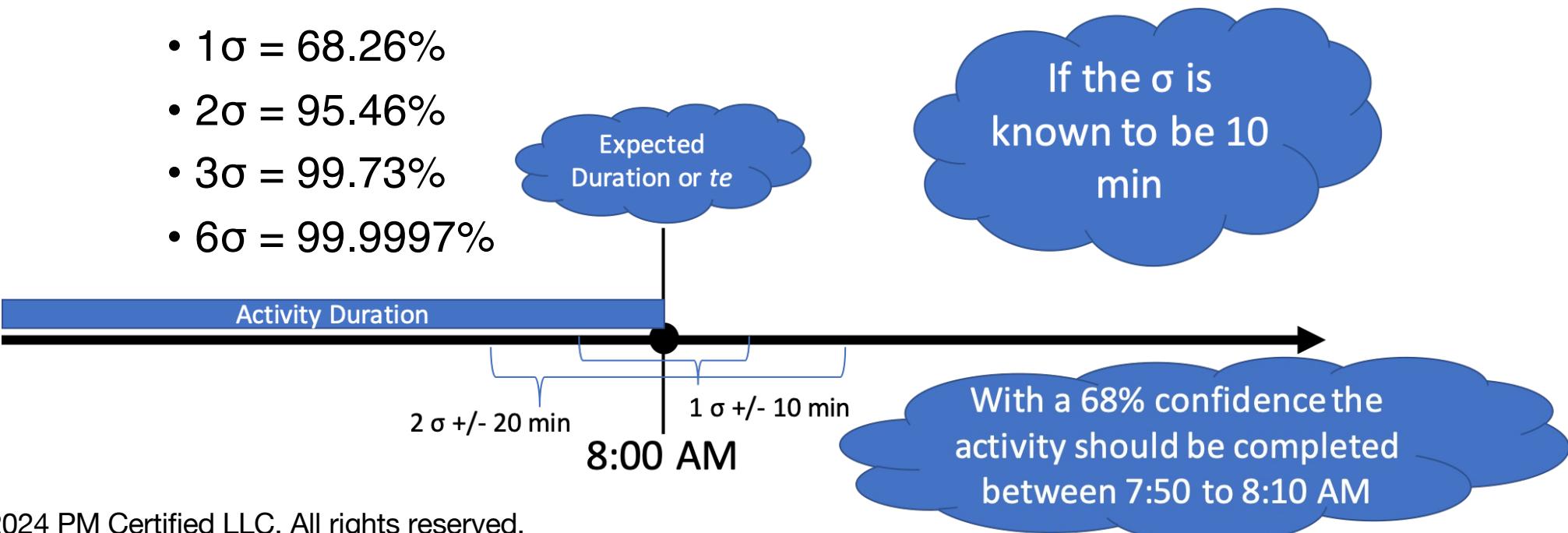
Estimating with PERT

- **The Program Evaluation and Review Technique** was developed in 1958 by the U.S. Navy. PERT is used to determine the estimated duration and/or cost of a given activity by determining the *expected outcome* (In duration, this is represented by tE ; in cost, it's cE .) from a population of estimates, taking into consideration the entire range. $tE=[O+(4xM)+P]/6$
- After finding the expected outcome (sometimes referred to as a goal), PERT can be used to determine the *standard deviation* (represented as σ) by subtracting the extremes of the range from each other and dividing the difference by six. $\sigma=(P-O)/6$

PERT Formulas for the PMP Exam	
Duration Estimate	$DE= tE+(x\sigma)$
Time Expected / Goal Time	$tE=[O+(4xM)+P]/6$
Standard Deviation	$\sigma=(P-O)/6$
Range of Estimates	$ROE=tE +/- (x\sigma)$

Estimating with PERT

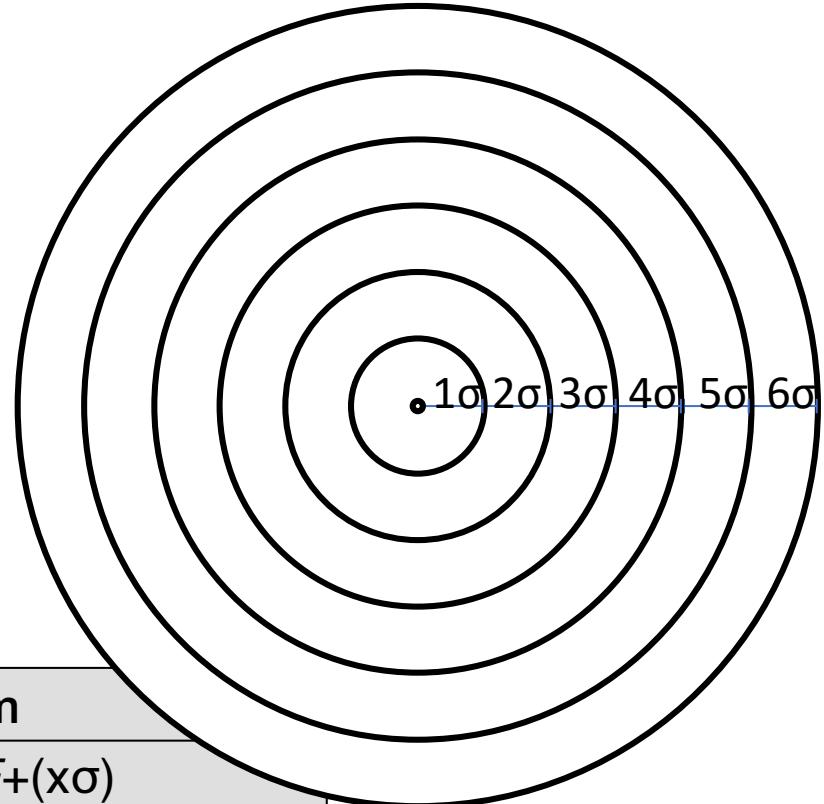
- In this process, the duration estimate equals $tE + (x\sigma)$.
- The x in the above equation is used to represent the required confidence level for that activity.
- Confidence can be explained as the likelihood, expressed as a percentage, of hitting a target. In this process, that target is an amount of time.
 - $1\sigma = 68.26\%$
 - $2\sigma = 95.46\%$
 - $3\sigma = 99.73\%$
 - $6\sigma = 99.9997\%$



Estimating with PERT

Another way of understanding the confidence intervals:

- $1\sigma = 68.26\%$
- $2\sigma = 95.46\%$
- $3\sigma = 99.73\%$
- $6\sigma = 99.9997\%$



PERT Formulas for the PMP Exam	
Duration Estimate	$DE = tE + (x\sigma)$
Time Expected / Goal Time	$tE = [O + (4xM) + P] / 6$
Standard Deviation	$\sigma = (P - O) / 6$
Range of Estimates	$ROE = tE +/-(x\sigma)$

Estimating with PERT

Imagine that you have three estimates in hours ($O = 10$, $M = 25$, $P = 40$). You need 95% confidence in each estimate.

- Expected Activity Duration, or $tE = [O + (4 \times M) + P] / 6$
- $(10 + 100 + 40) / 6 = 25 \text{ hrs.}$
- Activity Standard Deviation, or $\sigma = (P - O) / 6$
- $(40 - 10) / 6 = 5 \text{ hrs.}$
- With 95% confidence, this activity's duration estimate is $tE+(x\sigma)$.

$$25 + (2 \times 5) = 35 \text{ hrs.}$$

This could also be expressed as a range: $25 \text{ hr. } +/-10 \text{ hrs.}$

PERT Formulas for the PMP Exam	
Duration Estimate	$DE= tE+(x\sigma)$
Time Expected / Goal Time	$tE=[O+(4\times M)+P]/6$
Standard Deviation	$\sigma=(P-O)/6$
Range of Estimates	$ROE=tE +/- (x\sigma)$

6.4 Estimate Activity Durations

Outputs

- 1. Duration Estimates:** This is a document that explains the estimated duration of each of the project's activities (it includes the contingency reserve). Remember, *effort* and *duration* are different terms. You usually get the estimate in effort, and in this process, you turn it into duration.
Activity Duration Estimate = $tE + (x\sigma)$
- 2. Basis of Estimates:** This is a project document that explains why you believe an activity's estimate to be correct.
- 3. Project Document Updates**
 - Activity Attributes
 - Assumption Log
 - Lessons Learned Register

6.4 Estimate Activity Durations

New Terms from the 2021 Exam Change

- **Consensus Tools:** Methods used to gain information from the perspective of the agile team

Polling

- Fist of Five
- Roman Voting
- Dot Voting

Estimating

- Planning Poker
- T-Shirt Sizing
- 100-Point Method

6.4 Estimate Activity Durations

ID #	Enabler	Primary Reference
2.6.1	Estimate project tasks (milestones, dependencies, story points)	6.4

6.5 Develop Schedule

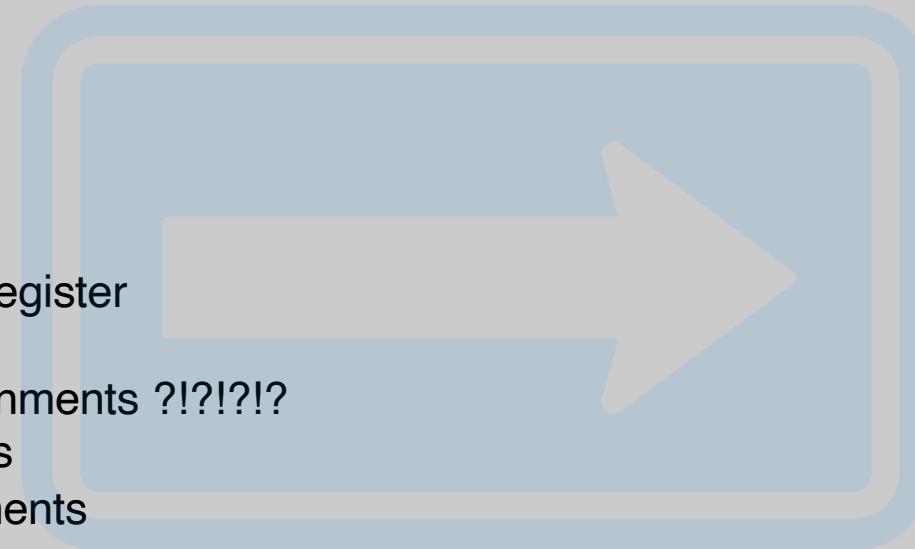
Key Concept: Now it's time to put it all together and create the project schedule. The approved version of the project schedule is called the Schedule Baseline.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Schedule Management Plan - Scope Baseline 2. Project Documents <ul style="list-style-type: none"> - Activity Attributes - Activity List - Assumption Log - Basis of Estimates - Lessons Learned Register - Milestone List - Project Team Assignments - Resource Calendars - Resource Requirements - Risk Register 3. Agreements 4. EEFs 5. OPAs 	<ol style="list-style-type: none"> 1. Schedule Network Analysis 2. Critical Path Method 3. Resource Optimization 4. Data Analysis <ul style="list-style-type: none"> - What-If Scenario Analysis - Simulation 5. Leads and Lags 6. Schedule Compression 7. Project Management Information System 8. Agile Release Planning 	<ol style="list-style-type: none"> 1. Schedule Baseline 2. Project Schedule 3. Schedule Data 4. Project Calendars 5. Change Requests 6. Project Management Plan Updates <ul style="list-style-type: none"> - Schedule Management Plan - Cost Baseline 7. Project Document Updates <ul style="list-style-type: none"> - Activity Attributes - Assumption Log - Duration Estimates - Lessons Learned Register - Resource Requirements - Risk Register

6.5 Develop Schedule

Inputs

1. Project Management Plan
 - Schedule Management Plan
 - Scope Baseline
2. Project Documents
 - Activity Attributes
 - Activity List
 - Assumption Log
 - Basis of Estimates
 - Lessons Learned Register
 - Milestone List
 - Project Team Assignments ?!?!?!
 - Resource Calendars
 - Resource Requirements
 - Risk Register
3. Agreements
4. EEFs
5. OPAs



6.5 Develop Schedule

Tools and Techniques

1. **Schedule Network Analysis:** The below-listed tools combined in some way to generate the project schedule model
2. **Critical Path Method:** A scheduling methodology that enhances the schedule network diagram with the activity durations in order to represent the chain of activities that makes the critical path
3. **Resource Optimization:** The process of moving around the work between resources and/or the timeline. Two terms to know: “Resource Leveling” and “Resource Smoothing”
4. Data Analysis
 - What-If Scenario Analysis
 - Simulation
5. Leads and Lags
6. **Schedule Compression**
7. Project Management Information System
8. **Agile Release Planning**

Resource Optimization

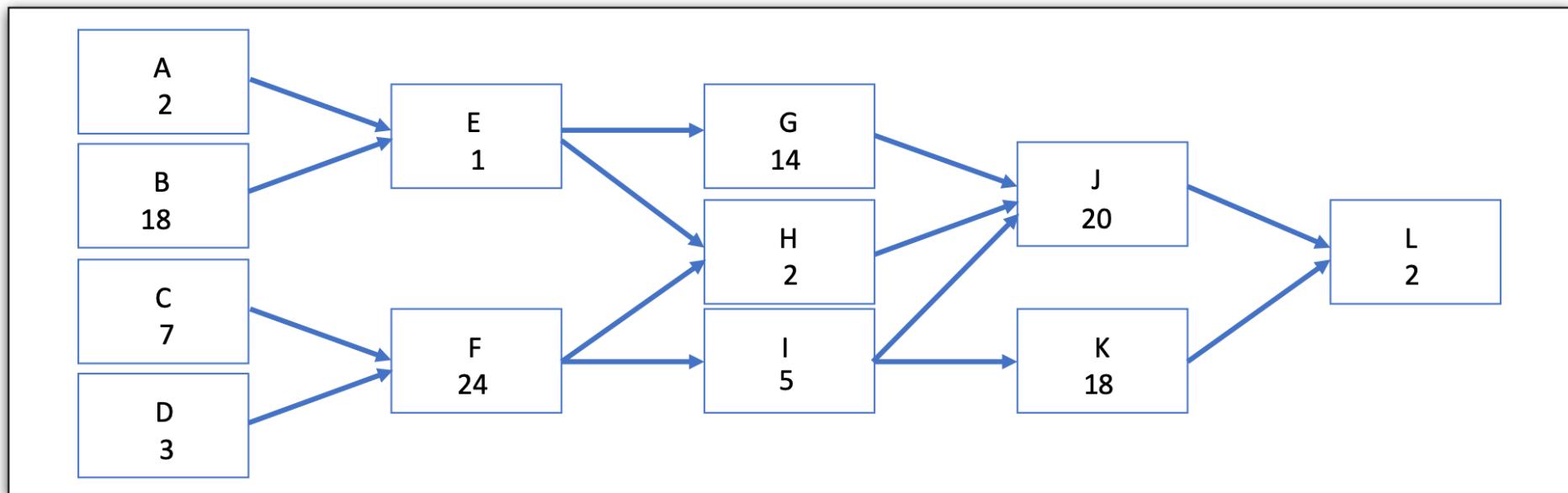
- Resource Leveling: Will affect the planned end date of the project
- Resource Smoothing: Will not affect the planned end date of the project

Schedule Compression

- Fast-Tracking: Increases risk
- Crashing: Increases spending

Critical Path Method

- This tool enhances the schedule network diagram by adding start and end times to each task.
- By using this tool, the PM can determine the path through the diagram that takes the longest, called the *critical path*.
- The critical path method is broken into two steps:
 - Forward Pass: Solving each task's "Early Start" and "Early Finish" times
 - Backward Pass: Solving each task's "Late Finish" and "Late Start" times



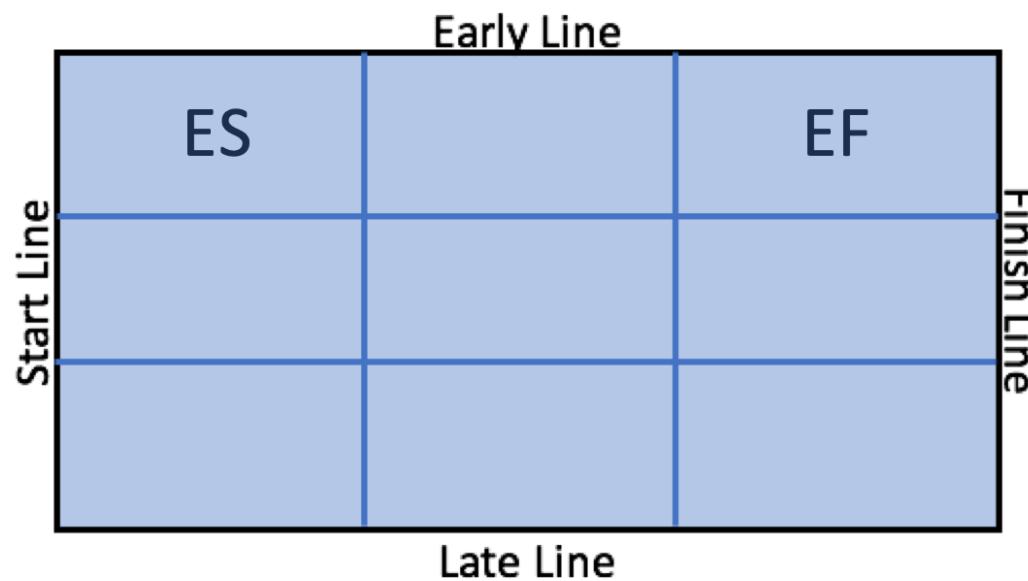
Critical Path Method

Organize Chart: The chart should be organized and neat. In order to prevent mistakes, try drawing lines to create tiers within the chart.

- Forward Pass
 - A. Early Start $ES = \text{The EF from the activity behind it} + 1$
 - B. Early Finish $EF = ES + D - 1$
- Backward Pass
 - A. Late Finish $LF = \text{LS of the next activity in line} - 1$
 - B. Late Start $LS = LF - D + 1$
- Determine Float
 - A. Total Float
 - B. Free Float
 - C. Project Float

Critical Path Method

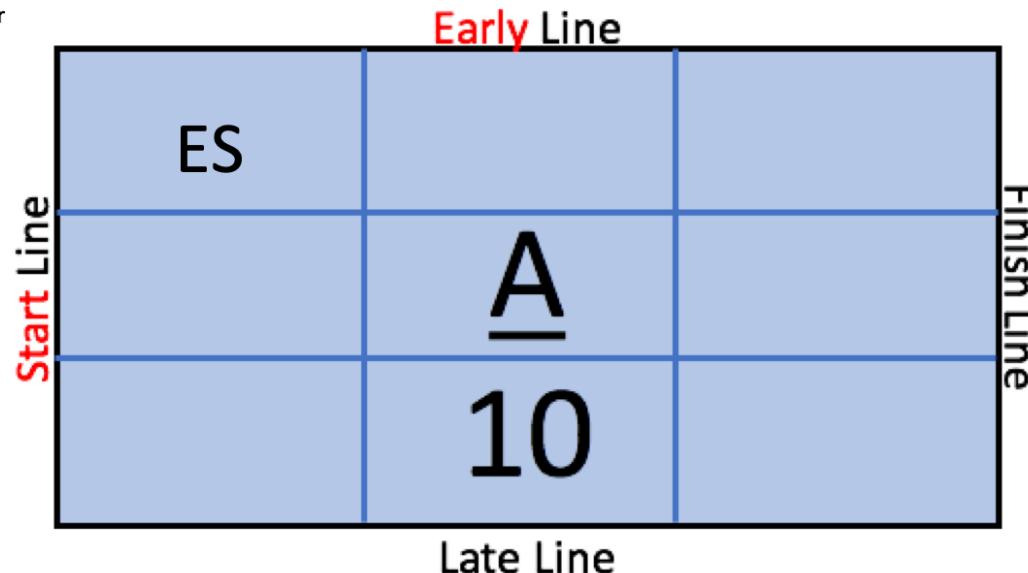
Step One: Solve Along the Early Line using FORWARD PASS



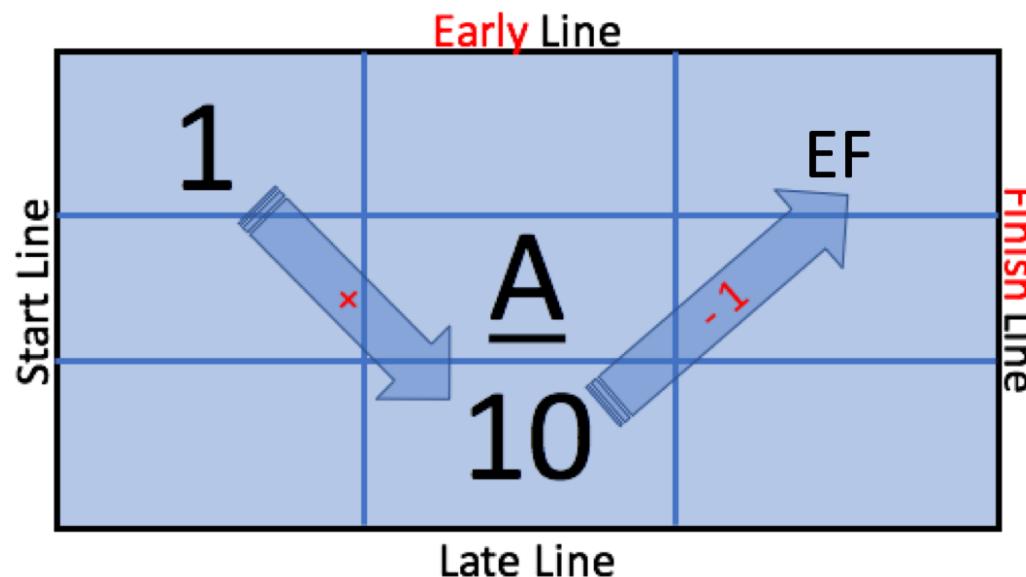
Critical Path Method

Earliest Start

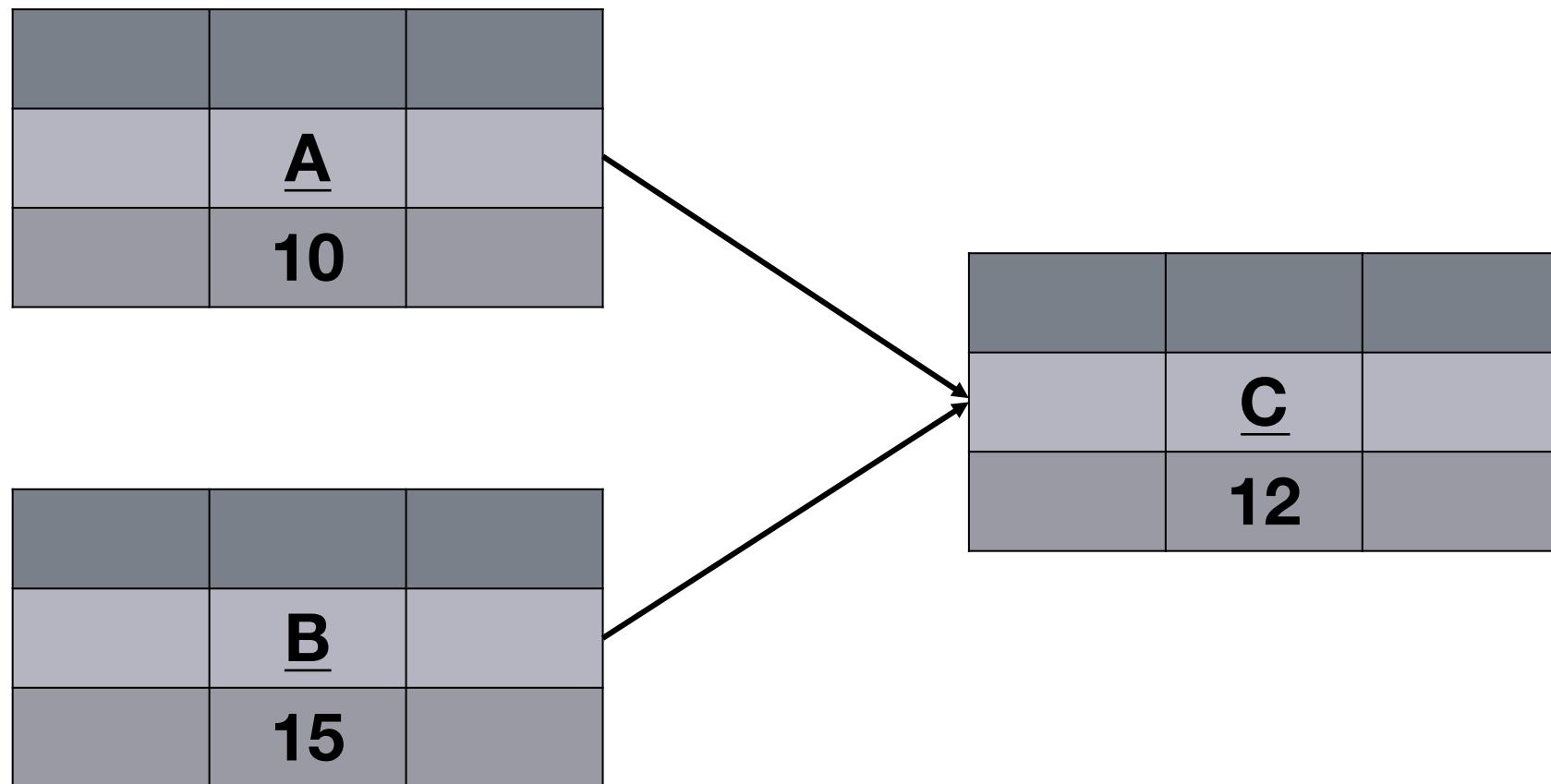
$ES=EF+1$ the ***EF*** is bold in the equation to show that it is the largest value from the predecessor



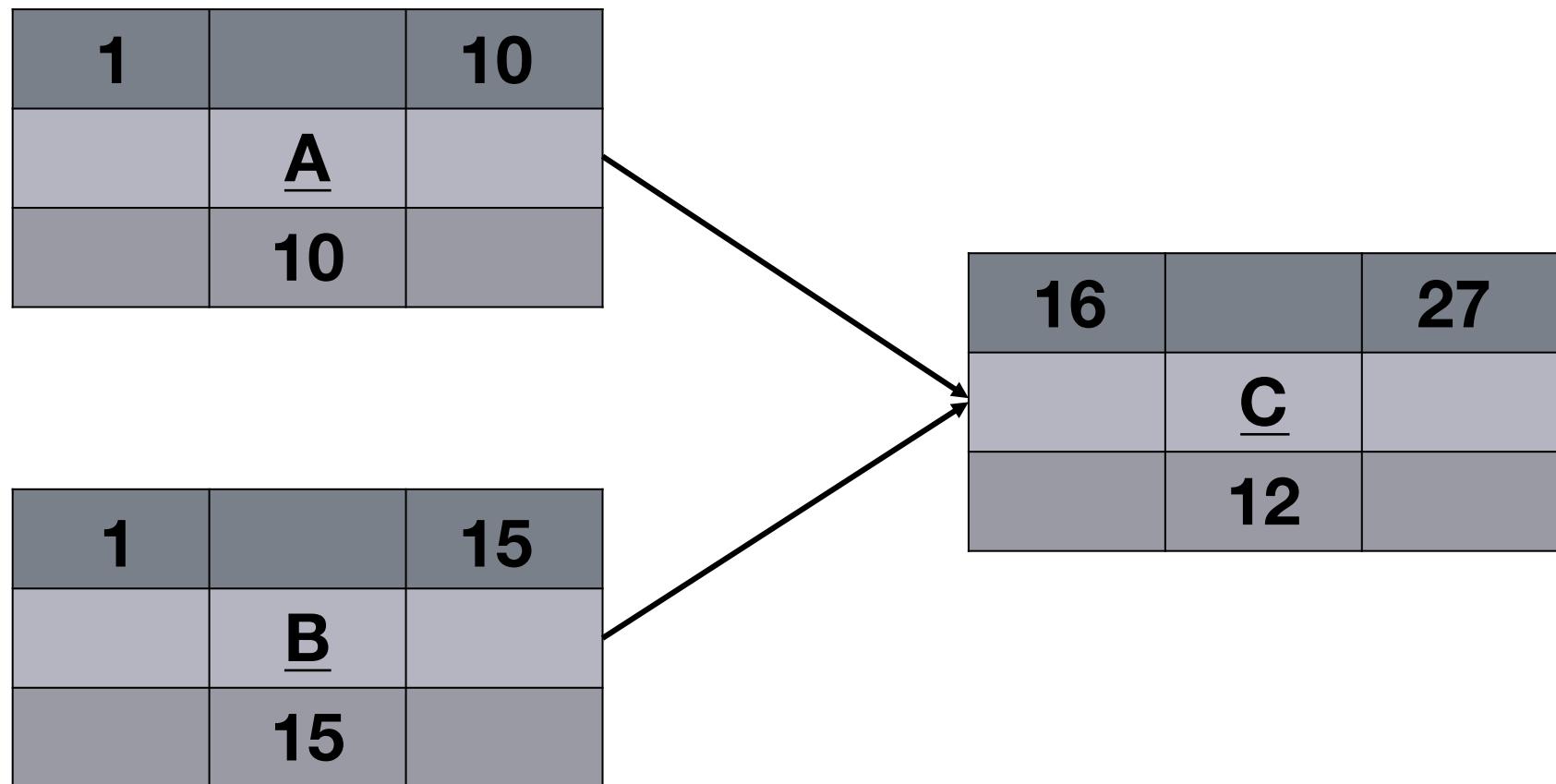
Critical Path Method



Critical Path Method

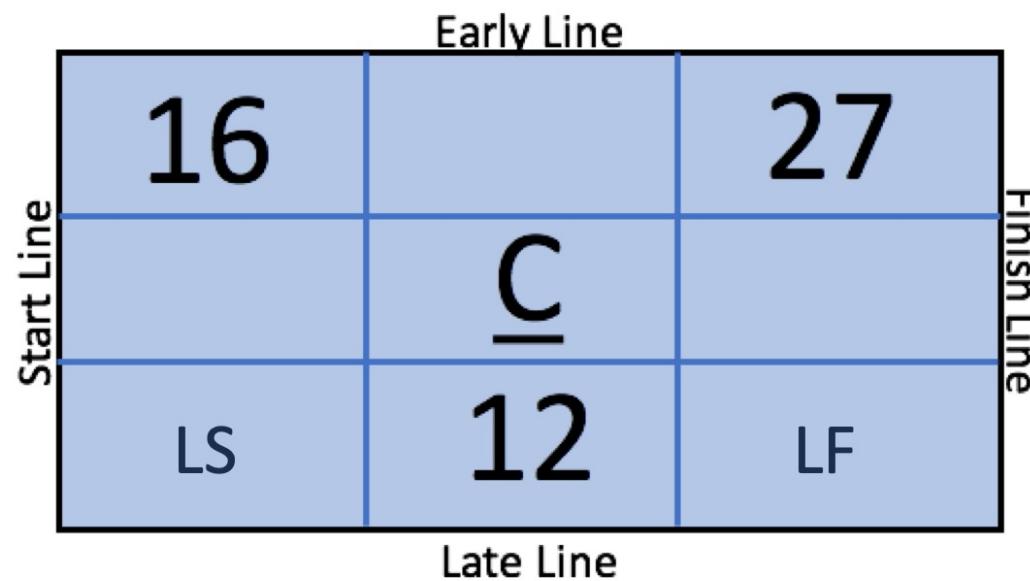


Critical Path Method

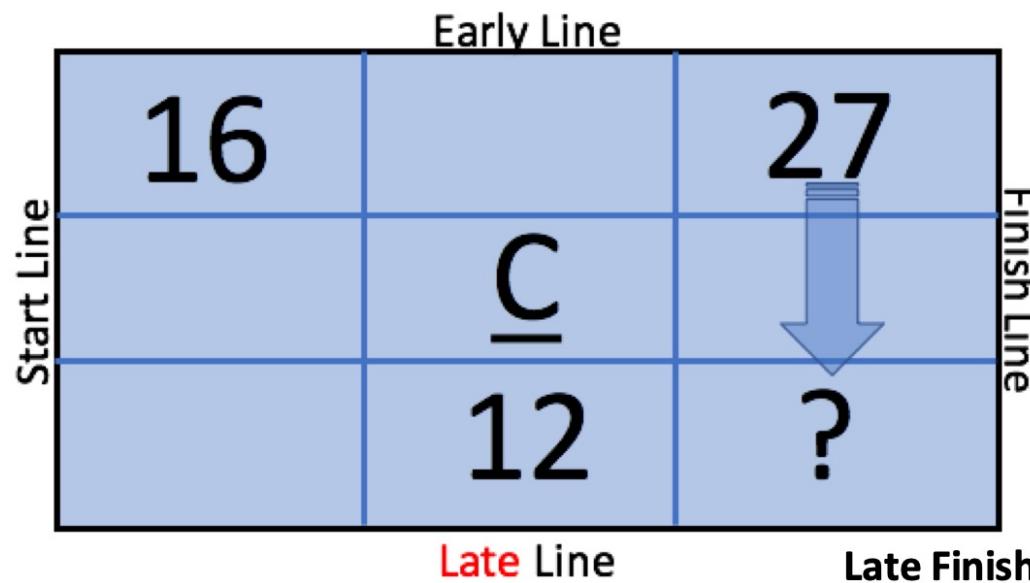


Critical Path Method

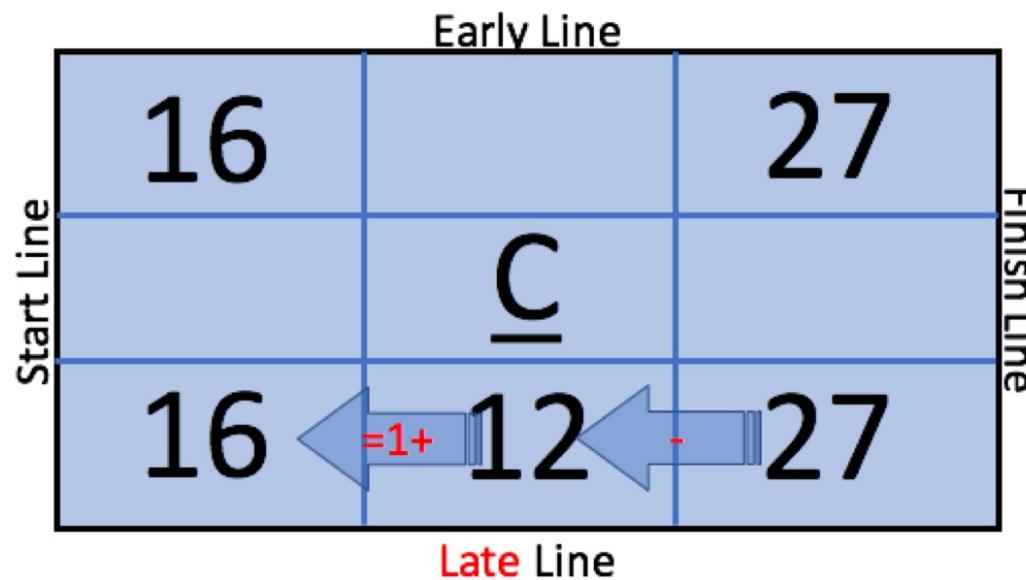
Step Two: Solve Along the Late Line using BACKWARD PASS



Critical Path Method



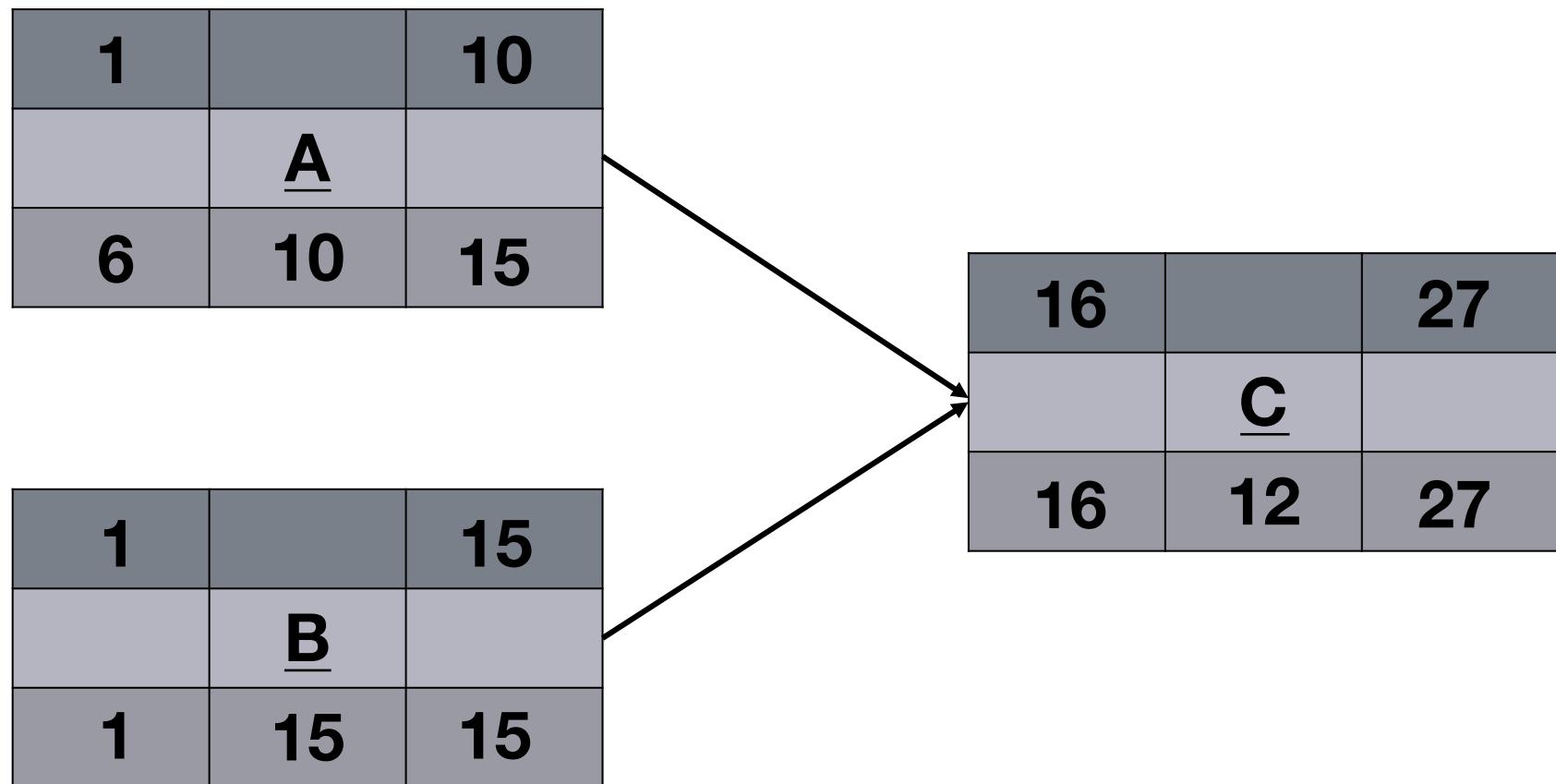
Critical Path Method



Late Start

$$LS = LF - D + 1$$

Critical Path Method

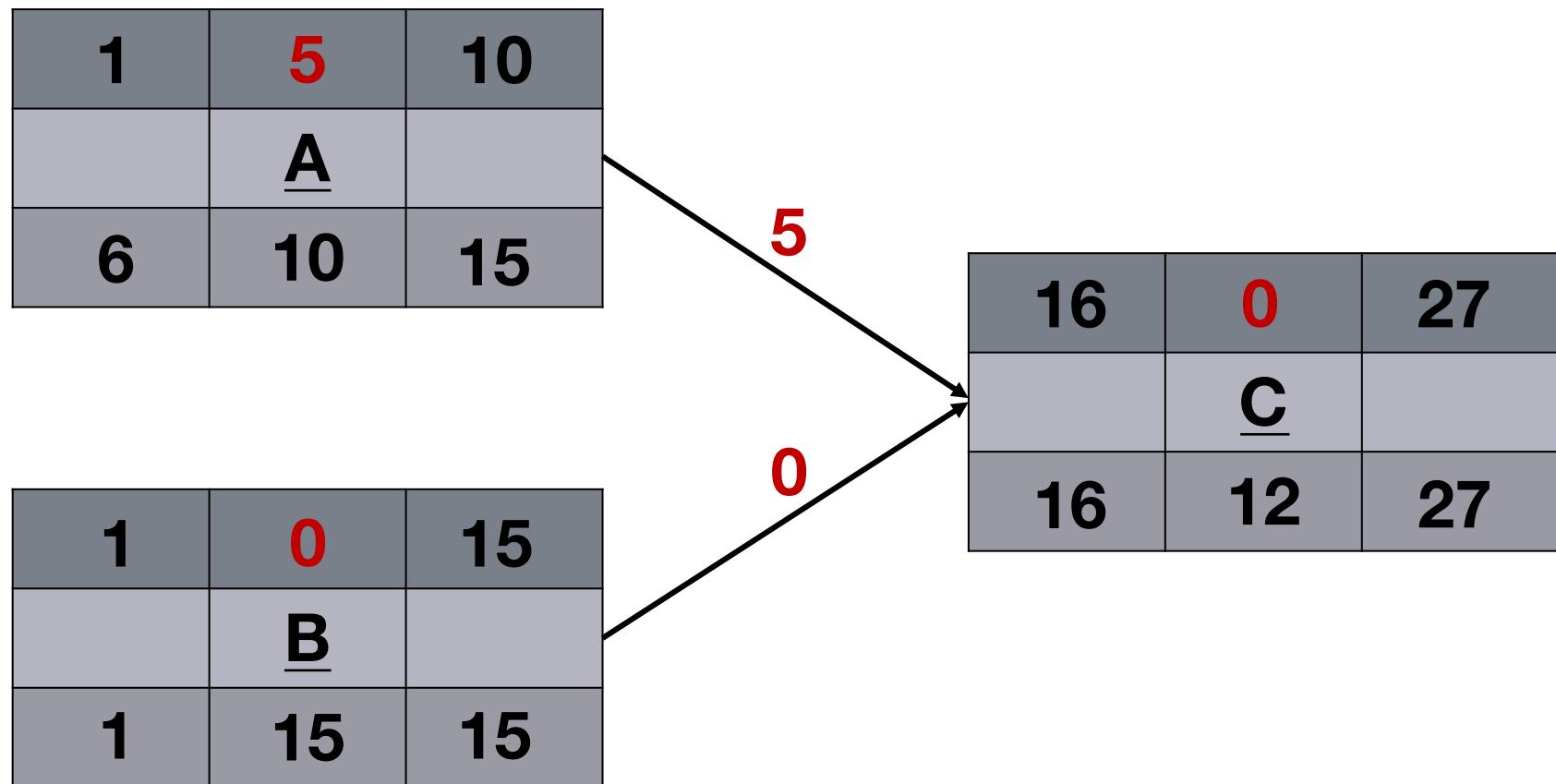


Critical Path Method

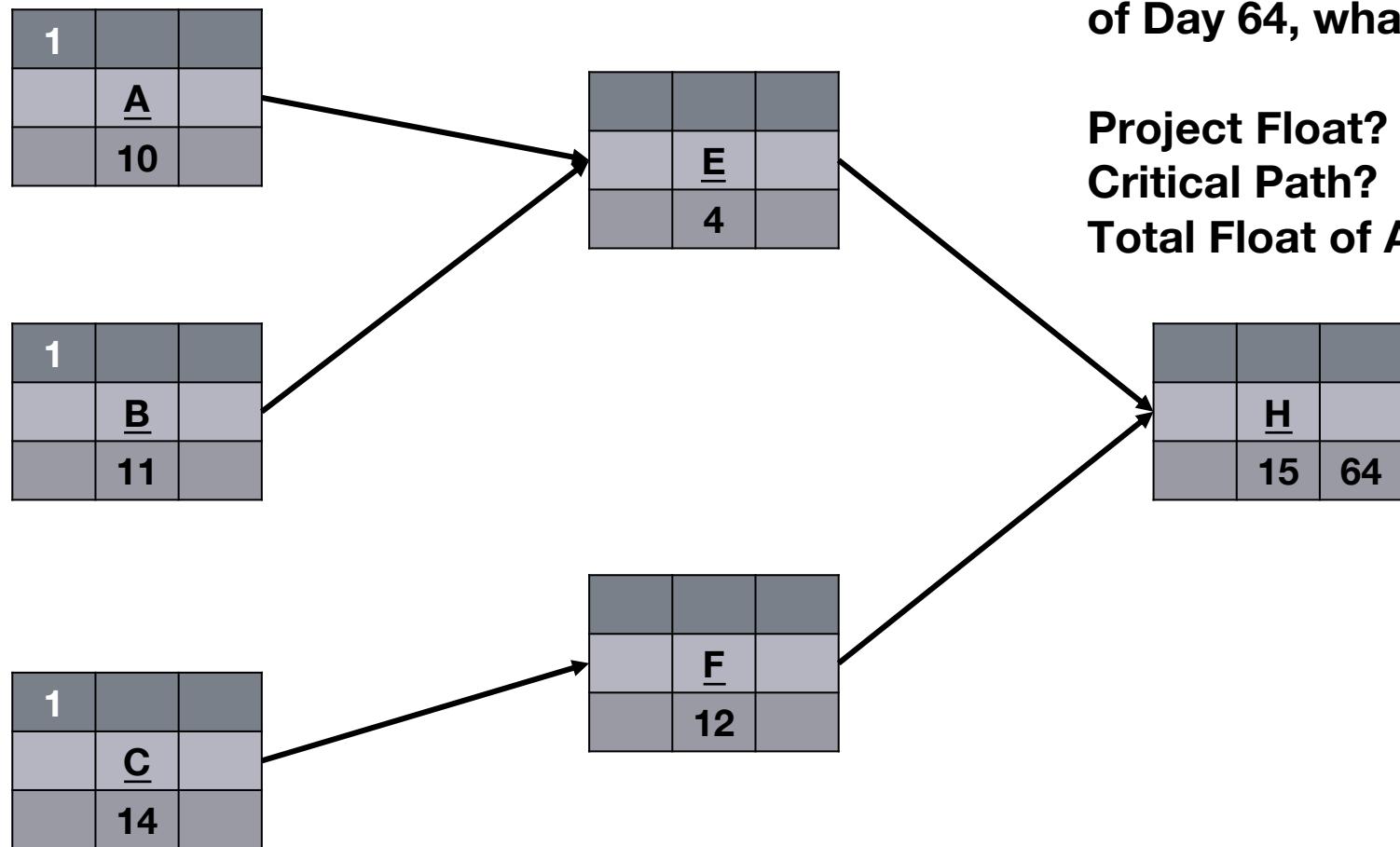
Three Types of Float:

- **Total Float, aka slack or wiggle room:** The amount of time that an activity can be delayed without delaying the expected end date of the project. **Activity vs. The Project's Expected Duration**
- **Free Float:** The amount of time that an activity can be delayed without delaying the next activity in line. **Activity vs. The Next Activity**
- **Project Float:** The amount of time a project can be delayed before it misses the project deadline set by the sponsor.
The Project's Expected Duration vs. The Project's Deadline

Critical Path Method



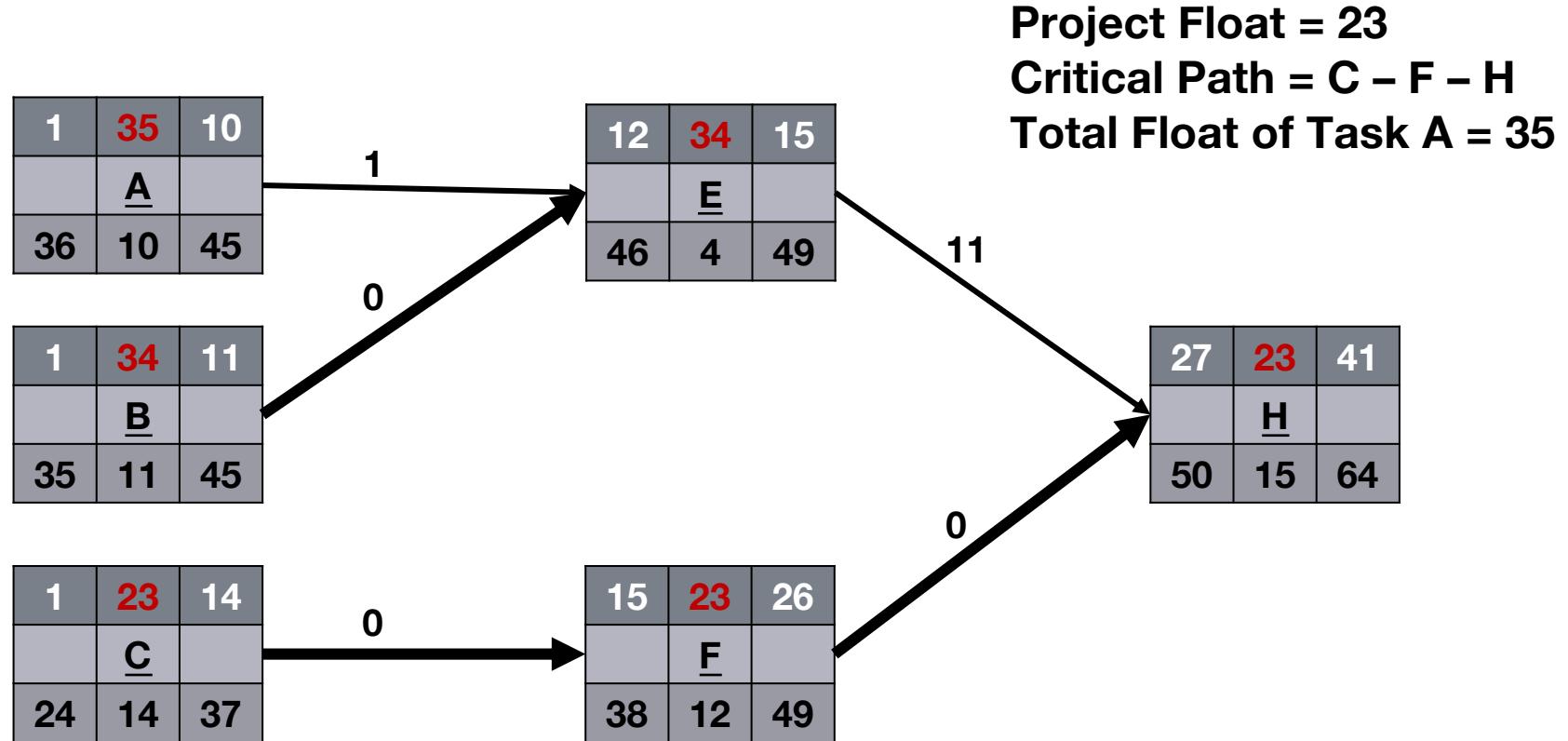
Critical Path Method



If the project has a deadline of Day 64, what is the:

Project Float?
Critical Path?
Total Float of A?

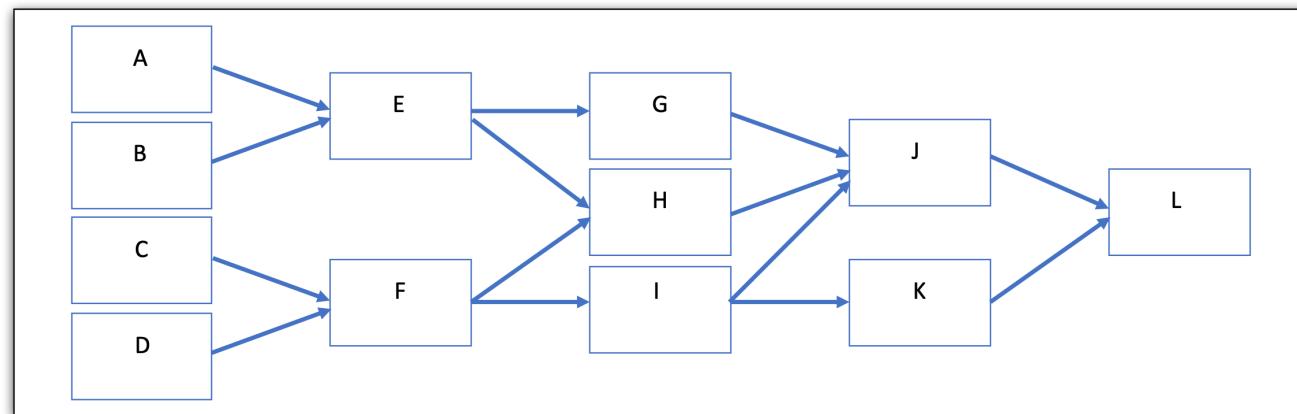
Critical Path Method



Critical Path Method

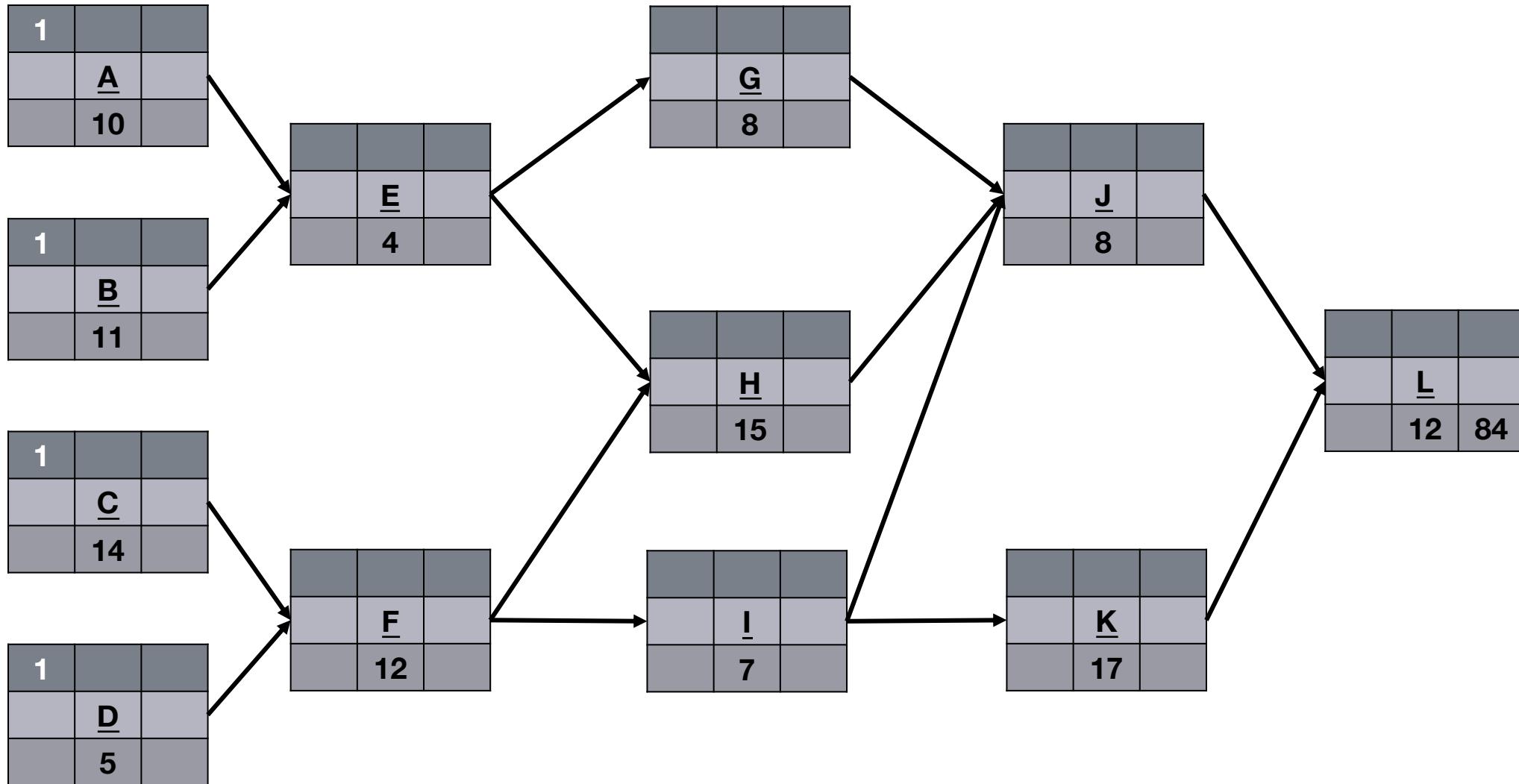
Activity	Duration
A	10
B	11
C	14
D	5
E	4
F	12
G	8
H	15
I	7
J	8
K	17
L	12

THE DEADLINE IS DAY 84

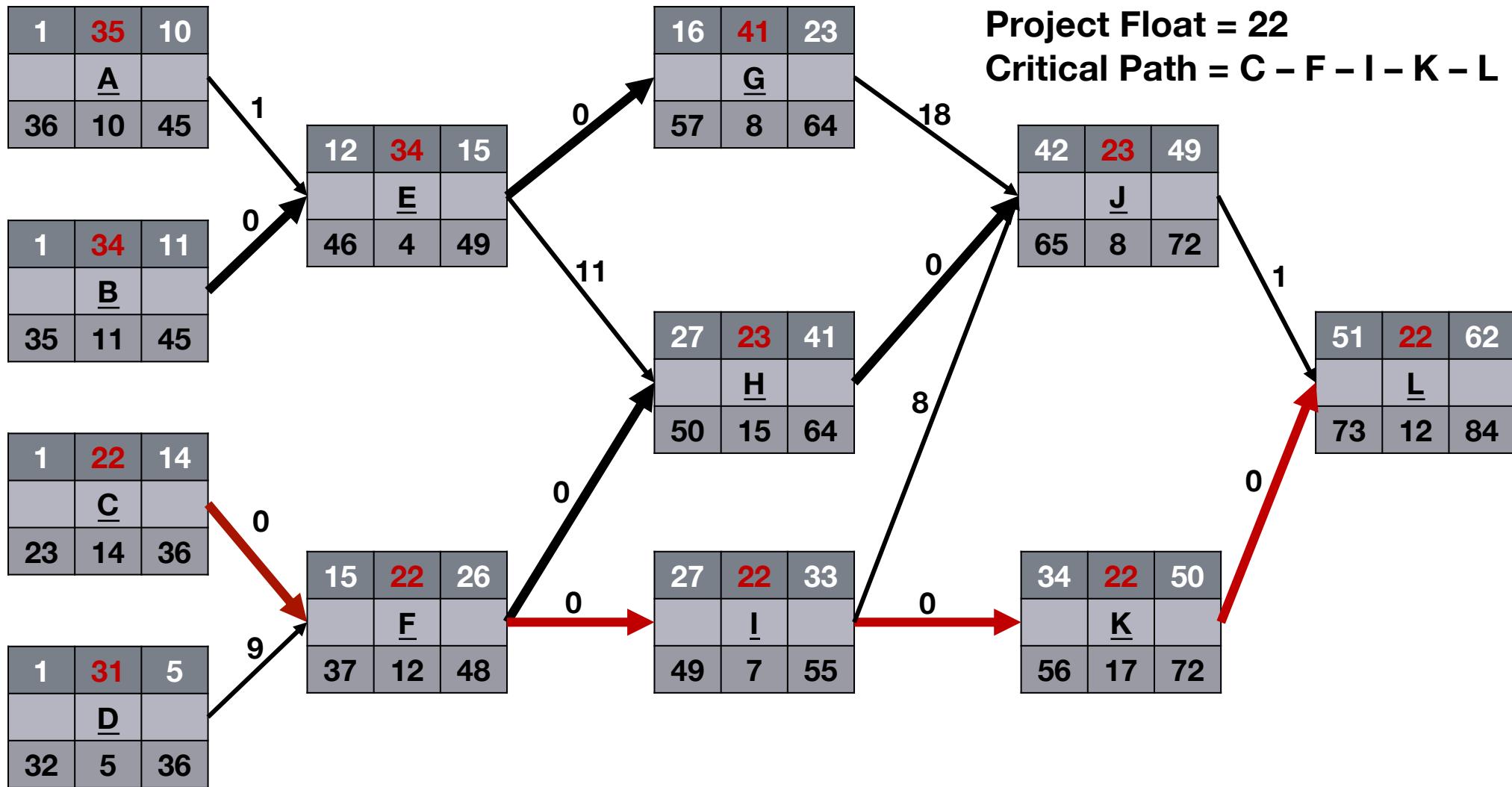


1. **What is the critical path?**
2. **What is the PED, or project estimated end date?**
3. **What is the project float?**
4. **What is the total float of A?**
5. **What is the free float between E and H?**

Critical Path Method



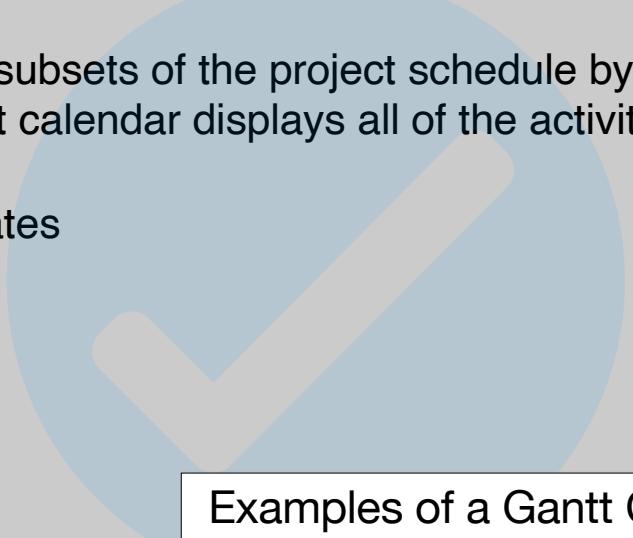
Critical Path Method



6.5 Develop Schedule

Outputs

1. **Schedule Baseline:** The approved project schedule, along with schedule data explaining it
2. **Project Schedule:** Displays all activities planned for the project, usually in a Gantt chart
3. **Schedule Data:** Explains the project milestone, funding, and contingency reserve as they relate to the project schedule
4. **Project Calendars:** These are subsets of the project schedule by time—the Phase 3 calendar, or the FY 2029 calendar. A project calendar displays all of the activities planned in a window of time.
5. Change Requests
6. Project Management Plan Updates
 - Schedule Management Plan
 - Cost Baseline
7. Project Document Updates
 - Activity Attributes
 - Assumption Log
 - Duration Estimates
 - Lessons Learned Register
 - Resource Requirements
 - Risk Register



Examples of a Gantt Chart and a Milestone Chart appear on page 218 of the *PMBOK® Guide*.

6.5 Develop Schedule

New Terms from the 2021 Exam Change

- **On-Demand Scheduling:** Based on the theory of constraints and pull-based scheduling concepts from lean manufacturing; limits a team's work in progress in order to balance demand against the team's delivery throughput
- **Iteration Backlog:** Items from the product backlog that can conceivably be completed within a given time period

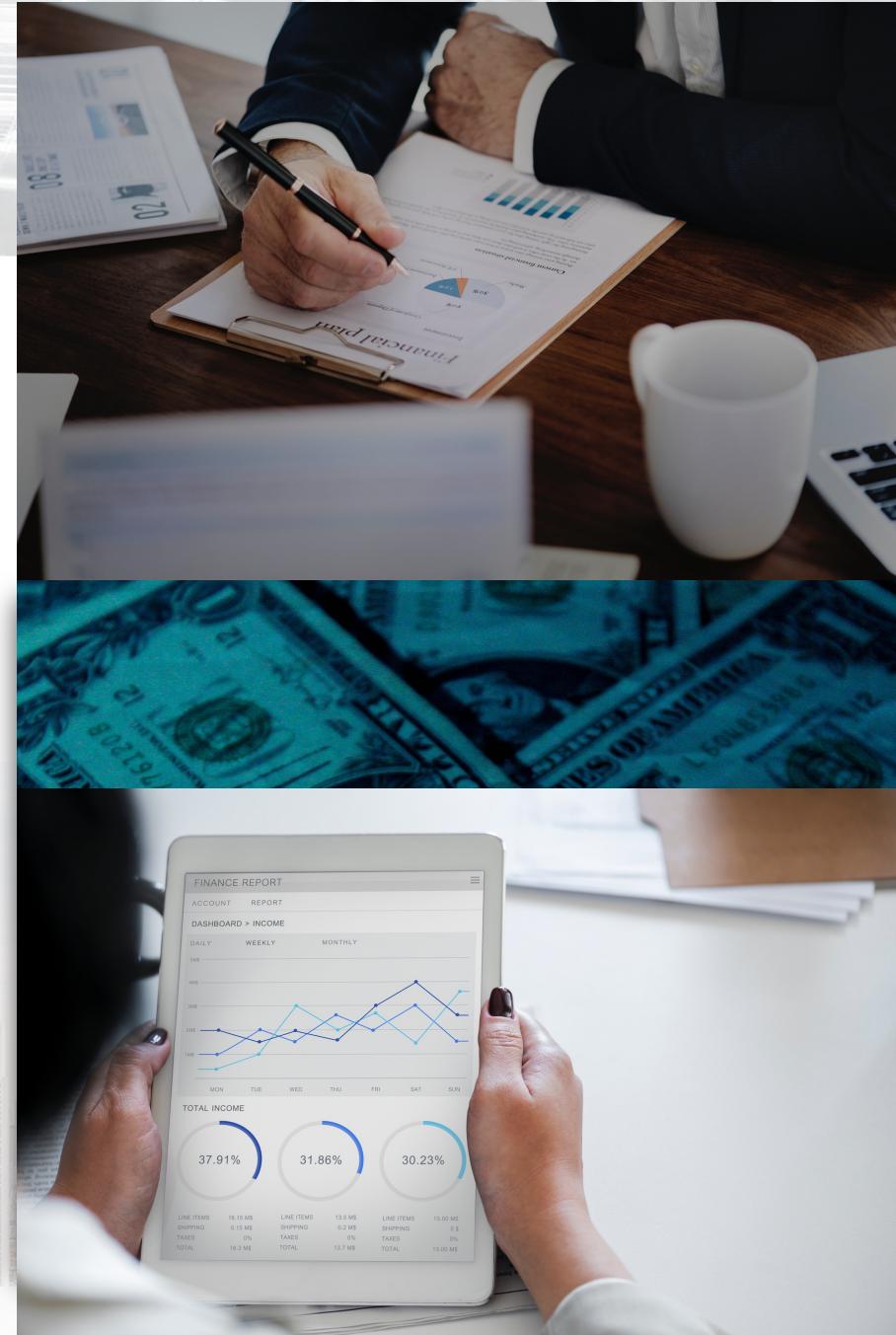
6.5 Develop Schedule

ID #	Enabler	Primary Reference
2.6.3	Prepare schedule based on methodology	6.1, 6.5
2.6.5	Modify schedule as needed based on methodology	6.1, 6.5, 6.7

Project Cost Management

This knowledge area is used to create and control the cost of the project. The aggregated cost of all project tasks is referred to as the *cost baseline*. These processes create the cost baseline and control it.

- 7.1 Plan Cost Management
- 7.2 Estimate Costs
- 7.3 Determine Budget
- 7.4 Control Costs



7.2 Estimate Costs

Key Concept: This process attempts to determine the cost expected for a particular activity. Once that's done, that cost is added to the activity contingency reserve: $cE + (x\sigma)$. This creates the output cost estimates.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Cost Management Plan- Quality Management Plan- Scope Baseline2. Project Documents<ul style="list-style-type: none">- Lessons Learned Register- Project Schedule- Resource Requirements- Risk Register3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Analogous Estimating3. Parametric Estimating4. Three-Point Estimating5. Bottom-Up Estimating6. Data Analysis<ul style="list-style-type: none">- Alternative Analysis- Reserve Analysis- Cost of Quality7. Project Management Information System8. Decision-Making<ul style="list-style-type: none">- Voting	<ul style="list-style-type: none">1. Cost Estimates2. Basis of Estimates3. Project Document Updates<ul style="list-style-type: none">- Assumption Log- Lessons Learned Register- Risk Register

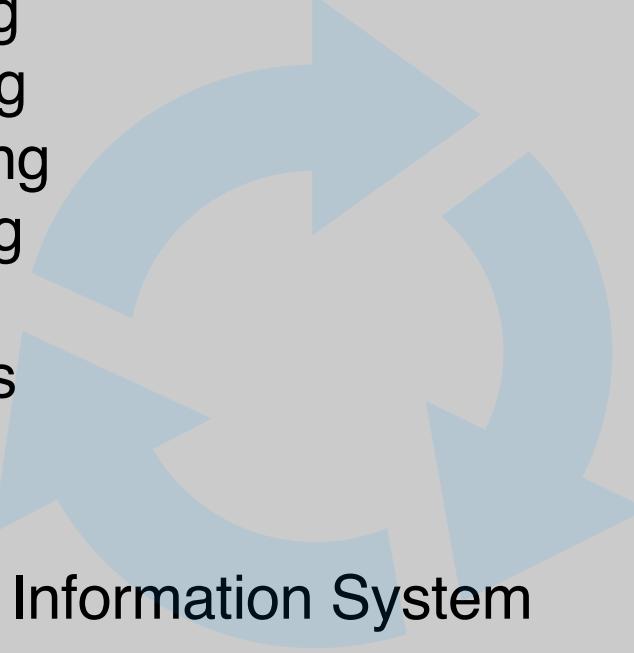
7.2 Estimate Costs

Inputs

1. Project Management Plan
 - Cost Management Plan
 - **Quality Management Plan**
 - Scope Baseline
2. Project Documents
 - **Lessons Learned Register**
 - Project Schedule
 - **Resource Requirements**
 - **Risk Register**
3. EEFs
4. OPAs

7.2 Estimate Costs

Tools and Techniques



1. Expert Judgment
2. Analogous Estimating
3. Parametric Estimating
4. Three-Point Estimating
5. Bottom-Up Estimating
6. Data Analysis
 - Alternative Analysis
 - Reserve Analysis
 - Cost of Quality**
7. Project Management Information System
8. Decision-Making
 - Voting

7.2 Estimate Costs

Outputs

1. Cost Estimates
2. Basis of Estimates
3. Project Document Updates
 - Assumption Log
 - Lessons Learned Register
 - Risk Register

7.2 Estimate Costs

ID #	Enabler	Primary Reference
2.5.1	Estimate budgetary needs based on the scope of the project and lessons learned from historical projects	7.2, 7.3
2.5.4	Plan and manage resources	7.1, 7.2, 7.3, 7.4

7.3 Determine Budget

Key Concept: This is the process of rolling up all of the activity costs into the work package, then moving on to the phase of creating the cost baseline. The cost baseline is approved in this process.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Cost Management Plan- Resource Management Plan- Scope Baseline2. Project Documents<ul style="list-style-type: none">- Basis of Estimates- Cost Estimates- Project Schedule- Risk Register3. Agreements4. EEFs5. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Cost Aggregation3. Data Analysis<ul style="list-style-type: none">- Reserve Analysis4. Historical Information Review5. Funding Limit Reconciliation6. Financing	<ul style="list-style-type: none">1. Cost Baseline2. Project Funding Requirements3. Project Document Updates<ul style="list-style-type: none">- Cost Estimates- Project Schedule- Risk Register

7.3 Determine Budget

Inputs

1. Project Management Plan
 - Cost Management Plan
 - Resource Management Plan
 - Scope Baseline
2. Project Documents
 - Basis of Estimates
 - Cost Estimates
 - Project Schedule
 - Risk Register
3. Agreements
4. EEFs
5. OPAs

7.3 Determine Budget

Tools and Techniques

1. Expert Judgment
2. **Cost Aggregation:** The rolling up of all project costs (see *PMBOK® Guide*, p. 255)
3. Data Analysis
 - Reserve Analysis
4. **Historical Information Review:** Using a past project as a historical reference for future phases
5. **Funding Limit Reconciliation:** Moving the work around the schedule depending on the available funds to do the work in the organization
6. Financing

7.3 Determine Budget

Outputs

- 1. Cost Baseline:** This plan is the approved time-phase project budget, excluding management reserves; it contains all other project costs.
2. Project Funding Requirements
3. Project Document Updates
 - Cost Estimates
 - Project Schedule
 - Risk Register

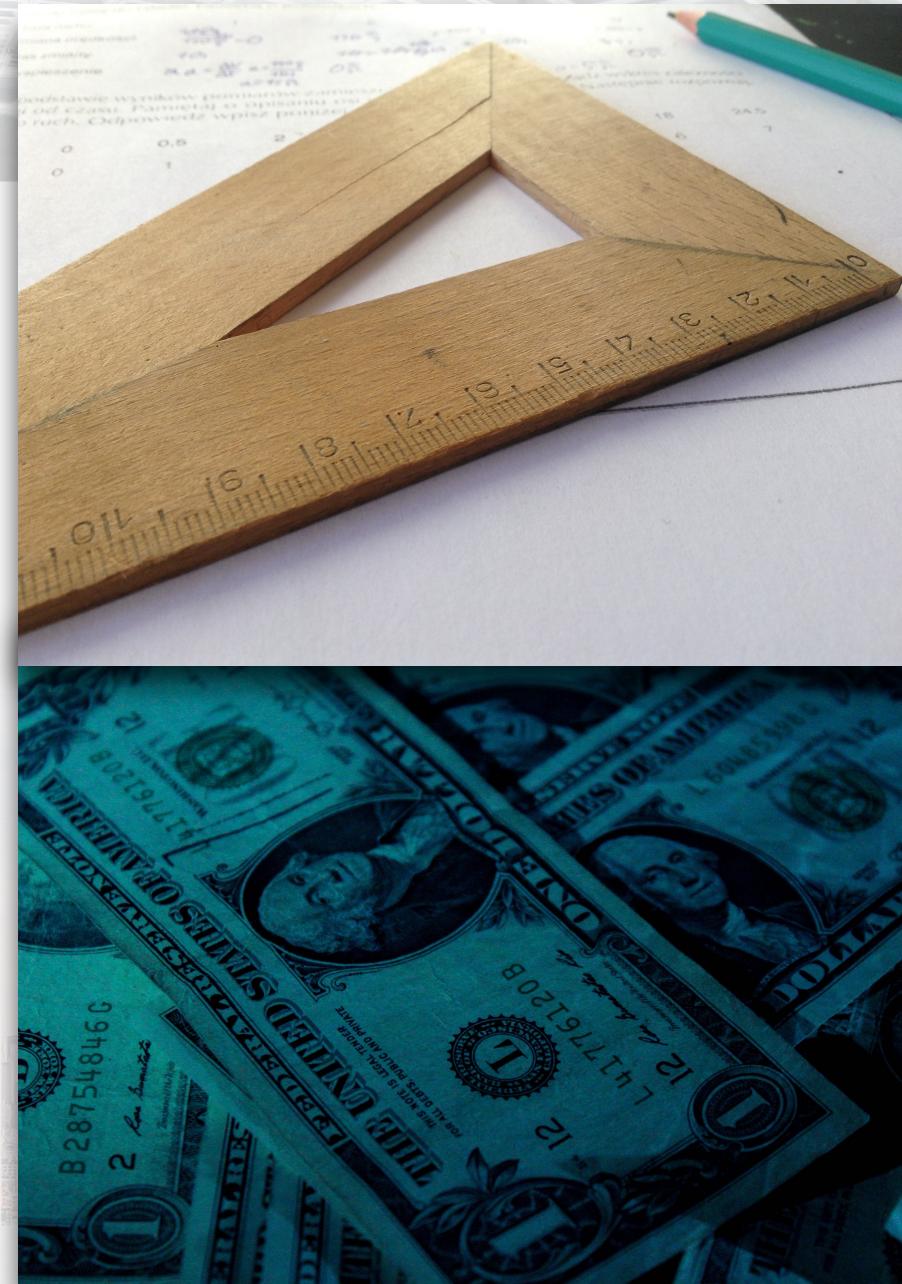
7.3 Determine Budget

ID #	Enabler	Primary Reference
2.5.1	Estimate budgetary needs based on the scope of the project and lessons learned from historical projects	7.1, 7.3, 7.4
2.5.2	Anticipate future budget challenges	7.1, 7.3
2.5.4	Plan and manage resources	7.1, 7.2, 7.3, 7.4

Project Quality Management

This is the most confusing knowledge area in the course. It's about trying to understand what quality means for the deliverables in the project and making sure that they will meet the sponsor's expectations.

- 8.1 Plan Quality Management **Plan**
- 8.2 Manage Quality **Check**
- 8.3 Control Quality **Do**



8.1 Plan Quality Management

Key Concept: This process defines what quality means to the project. It also determines how, when, and by whom testing will be done and then documented.

Inputs	Tools and Techniques	Outputs
<p>1. Project Charter</p> <p>2. Project Management Plan</p> <ul style="list-style-type: none"> - Requirements Management Plan - Risk Management Plan - Stakeholder Engagement Plan - Scope Baseline <p>3. Project Documents</p> <ul style="list-style-type: none"> - Assumption Log - Requirements Documentation - Requirements Traceability Matrix - Risk Register - Stakeholder Register <p>4. EEFs</p> <p>5. OPAs</p>	<p>1. Expert Judgment</p> <p>2. Data Gathering</p> <ul style="list-style-type: none"> - Benchmarking - Brainstorming - Interviews <p>3. Data Analysis</p> <ul style="list-style-type: none"> - Cost-Benefit Analysis - Cost of Quality <p>4. Decision-Making</p> <ul style="list-style-type: none"> - Multi-Criteria Decision Analysis <p>5. Data Representation</p> <ul style="list-style-type: none"> - Flowcharts - Logical Data Model - Matrix Diagrams - Mind Mapping <p>6. Test and Inspection Planning</p> <p>7. Meetings</p>	<p>1. Quality Management Plan</p> <p>2. Quality Metrics</p> <p>3. Project Management Plan Updates</p> <ul style="list-style-type: none"> - Risk Management Plan - Scope Baseline <p>4. Project Document Updates</p> <ul style="list-style-type: none"> - Lessons Learned Register - Requirements Traceability Matrix - Risk Register - Stakeholder Register

8.1 Plan Quality Management

Inputs

1. Project Charter
2. Project Management Plan
 - Requirements Management Plan
 - Risk Management Plan
 - Stakeholder Engagement Plan
 - Scope Baseline
3. Project Documents
 - Assumption Log
 - Requirements Documentation
 - Requirements Traceability Matrix
 - Risk Register
 - Stakeholder Register
4. EEFs
5. OPAs

8.1 Plan Quality Management

Quality Terms and Concepts

Quality vs. Grade

Quality is the ability of an item to do its intended job.

Grade is the category of competing goods.

Zero Defects

A concept centered around striving for perfection through prevention and a conscious desire to do the job right the first time to achieve zero defects. It was first written about by Philip Crosby in *Absolutes of Quality Management* (1979).

Six Sigma

The concept of achieving a certain number of defects. At 6σ you will have 3.4 defects per million.

Lean Six Sigma

Combines the concept of Six Sigma with the lean manufacturing concepts, which focus on the reduction of waste. The seven original concepts are:

1. Transportation
2. Inventory
3. Motion
4. Waiting
5. Overproduction
6. Overprocessing
7. Defects

Remember the acronym:
TIMWOOD

8.1 Plan Quality Management

Quality Terms and Concepts

Kanban

The use of a visual aid to display the status of the work with a board that is sectioned off into the categories of work and cards representing tasks

Quality Function Deployment

Used to understand what quality means to the end user or customer, then designs that understanding into the project deliverables

Prevention Preferred Over Inspection

A concept suggesting that the PM should use the Quality Management Plan as a way to pick up the data points in order to forecast and prevent issues from ever occurring

Attribute Sampling: Pass-Fail

Variable Sampling: A certain amount of failure is expected.

Tolerance: The amount of expected failure

Five Increasing Levels of Quality Management

1. Relies on customers to find defects
2. Defects are found and corrected before they are ever sent out
3. Iterative updating or correcting quality processes
4. Incorporates quality into all aspects of planning
5. Quality-aware culture



8.1 Plan Quality Management

Quality Terms and Concepts

Precision

The ability to repeat the same action with a small standard deviation

Accuracy

The ability to hit the target

Organizations and Standards

ISO

International Standards Organization

CMMI

Capability Maturity Model Integration: Five levels of maturity for software development:

1. Initial
2. Managed
3. Defined
4. Quantitative Managed
5. Optimizing

8.1 Plan Quality Management

Names to Know

Edward Deming

Most known for his paper “14 points of Total Quality” and the concept that *Quality is a management problem 85% of the time.*

Philip Crosby

Published the methodology for zero defects; also developed the “Cost of Quality”

Joseph Juran

Most of his work is about quality by design; he came up with “Fitness for Use.” His work focuses on understanding what quality is and designing it into every step of production.

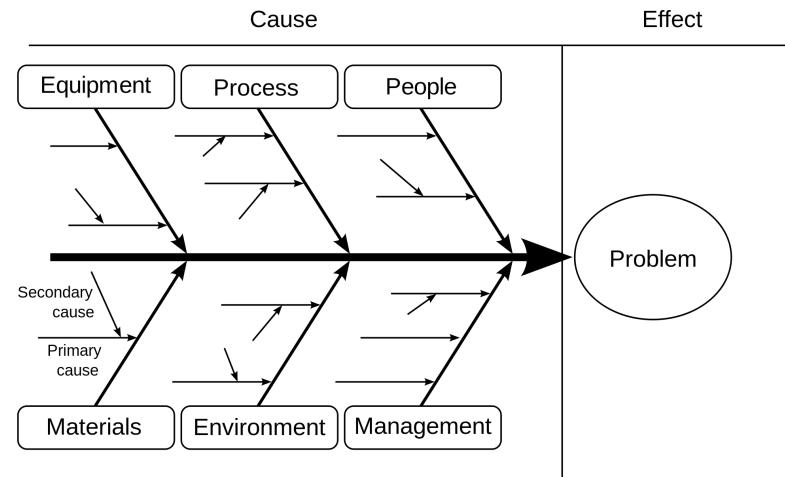
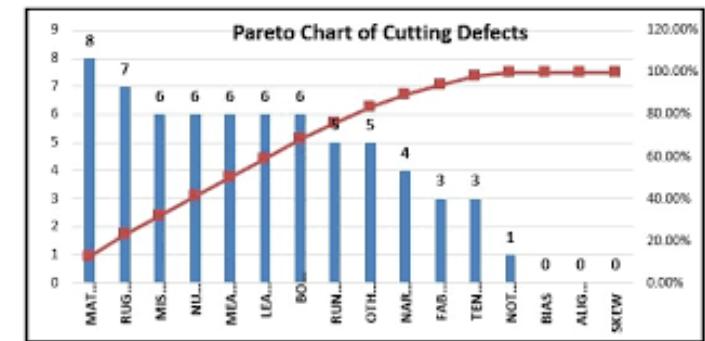
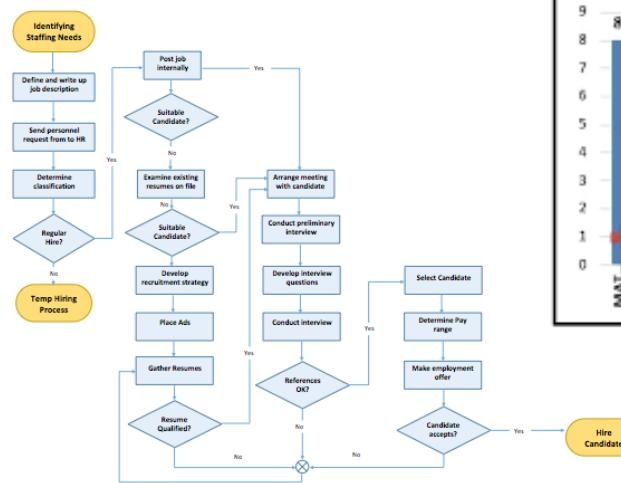
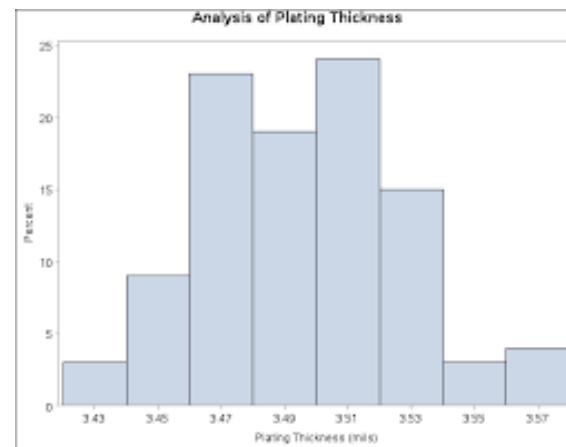
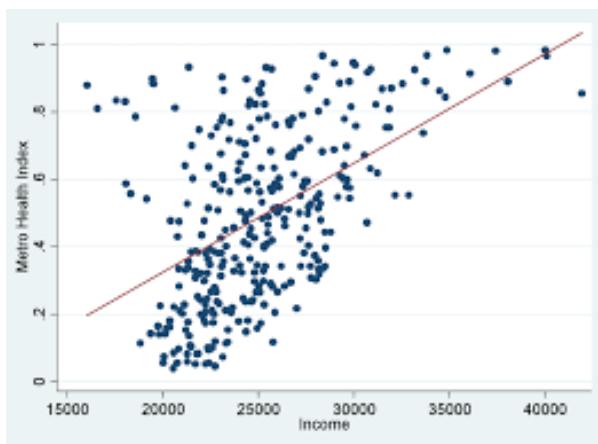
Kaoru Ishikawa

Worked with Deming and is credited with the cause-and-effect diagram; also the author of *What Is Quality Control* (1985), in which he stressed a product life cycle approach to the Plan-Do-Check-Act model and turned the four-step loop into six

8.1 Plan Quality Management

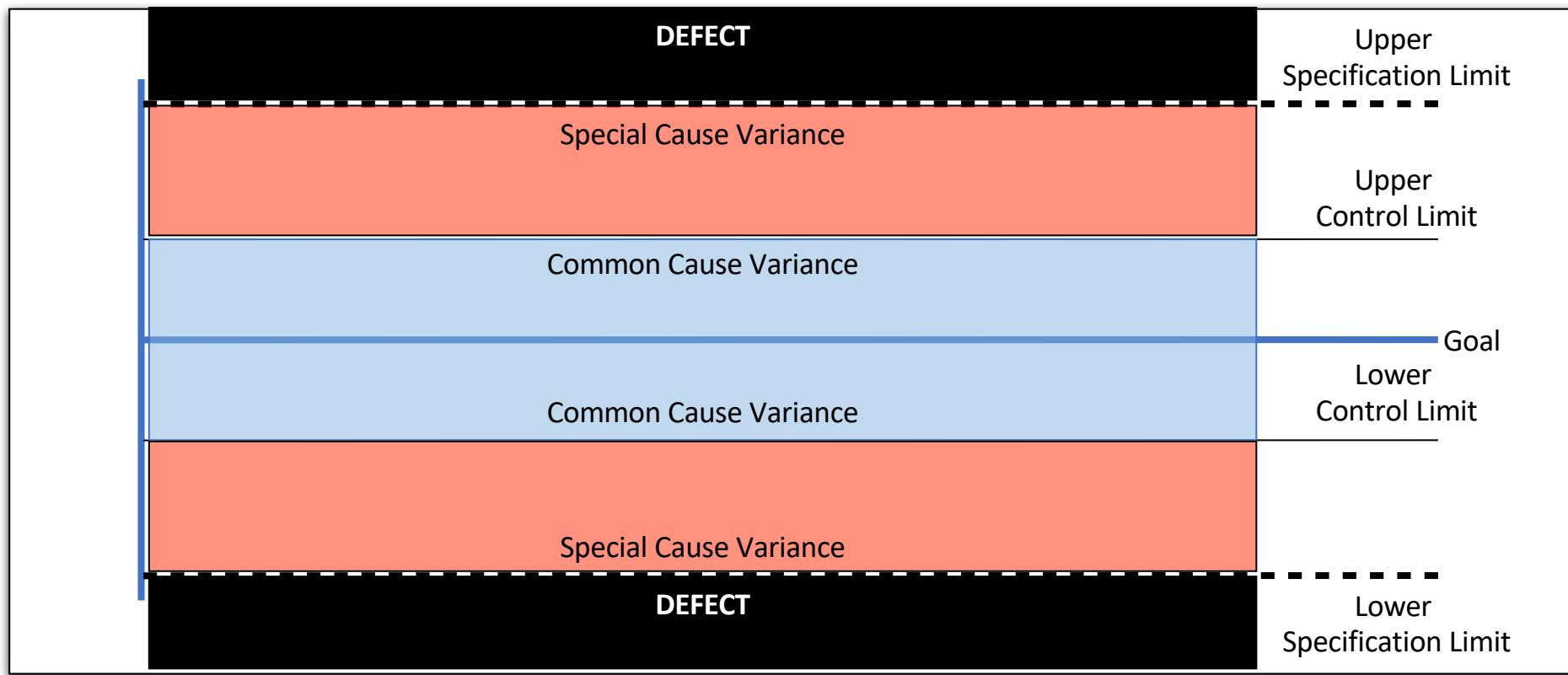
7 Quality Control Tools

1. Process Flowcharts
2. Check Sheets
3. Histograms
4. Scatter Diagrams
5. Pareto Diagrams
6. Cause-and-Effect Diagrams
7. Control Charts



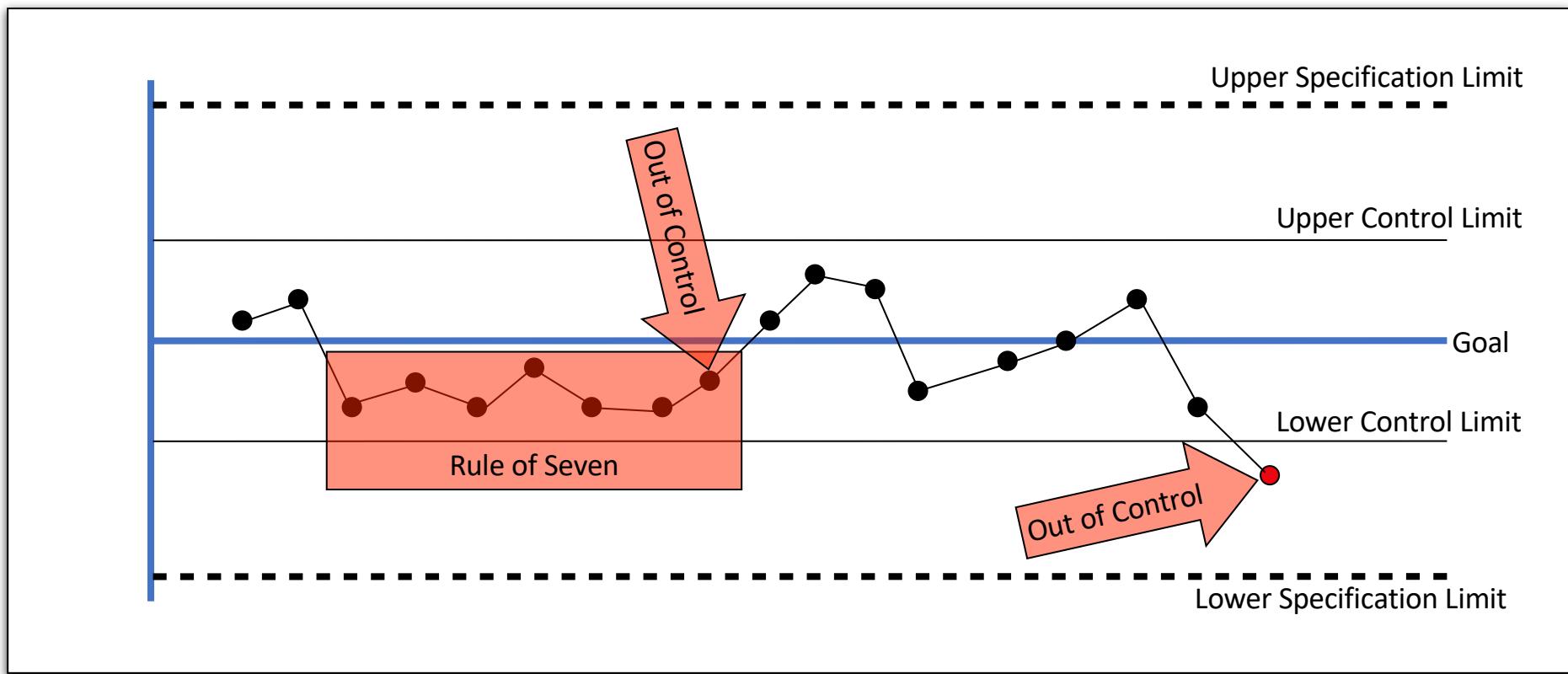
8.1 Plan Quality Management

Control Charts



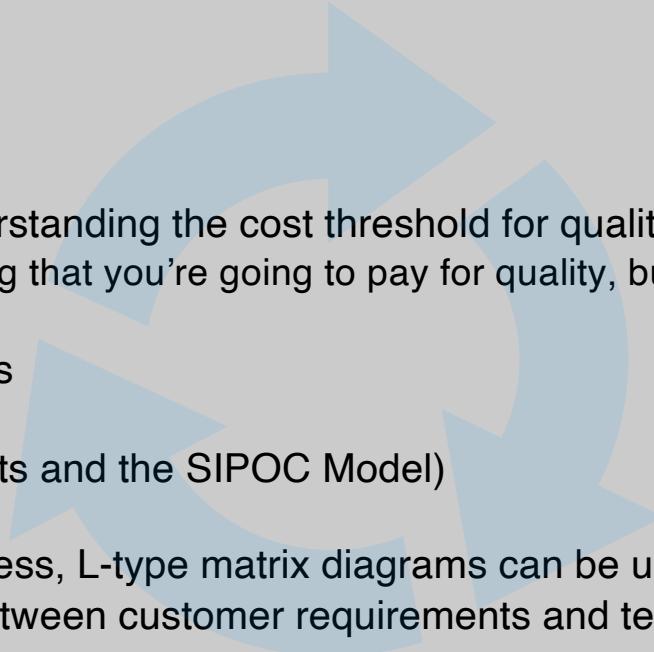
8.1 Plan Quality Management

Control Charts



8.1 Plan Quality Management

Tools and Techniques



1. Expert Judgment
2. Data Gathering
 - Benchmarking
 - Brainstorming
 - Interviews
3. Data Analysis
 - **Cost-Benefit Analysis:** Understanding the cost threshold for quality in a portion of the project
 - **Cost of Quality:** Understanding that you're going to pay for quality, but you have the choice of when
4. Decision-Making
 - Multi-Criteria Decision Analysis
5. Data Representation
 - Flowcharts (Process Flowcharts and the SIPOC Model)
 - Logical Data Model
 - **Matrix Diagrams:** In this process, L-type matrix diagrams can be used in quality function deployment to understand the relationship between customer requirements and technical requirements.
 - Mind Mapping
6. Test and Inspection Planning
7. Meetings

8.1 Plan Quality Management

Cost of Quality Terms

Cost of Conformance	Cost of Nonconformance
Prevention Costs	Internal Failure Costs
<ul style="list-style-type: none"> • Training • Documenting Processes • Equipment • Time to Do It Right 	<ul style="list-style-type: none"> • Reworking • Scrapping
Appraisal Costs	External Failure Costs
<ul style="list-style-type: none"> • Testing • Destructive Testing Loss • Inspections 	<ul style="list-style-type: none"> • Liabilities • Warranty Work • Lost Business

Matrix Diagram

Project Name		Customer Requirements			
Deliverable		Item 1	Item 2	Item 3	Item 4
Technical Requirements	Item 1	*		**	*
	Item 2	*	*	*	
	Item 3			*	
	Item 4		*****		**

8.1 Plan Quality Management

Outputs

1. **Quality Management Plan:** This plan spells out exactly what quality means for each deliverable. It also details who will be conducting each quality activity and when it will occur. Often, quality or the results of quality are displayed to others using graphs, tables, or charts; this plan discusses how they are populated and supplies the template. One of the most important components of this plan is providing guidance on how to document and archive the results from testing. That document is called *Quality Control Measurements*.
2. **Quality Metrics:** This is what's actually being measured—for example, the number of bugs per line of code
3. Project Management Plan Updates
 - Risk Management Plan
 - Scope Baseline
4. Project Document Updates
 - Lessons Learned Register
 - Requirements Traceability Matrix
 - Risk Register
 - Stakeholder Register

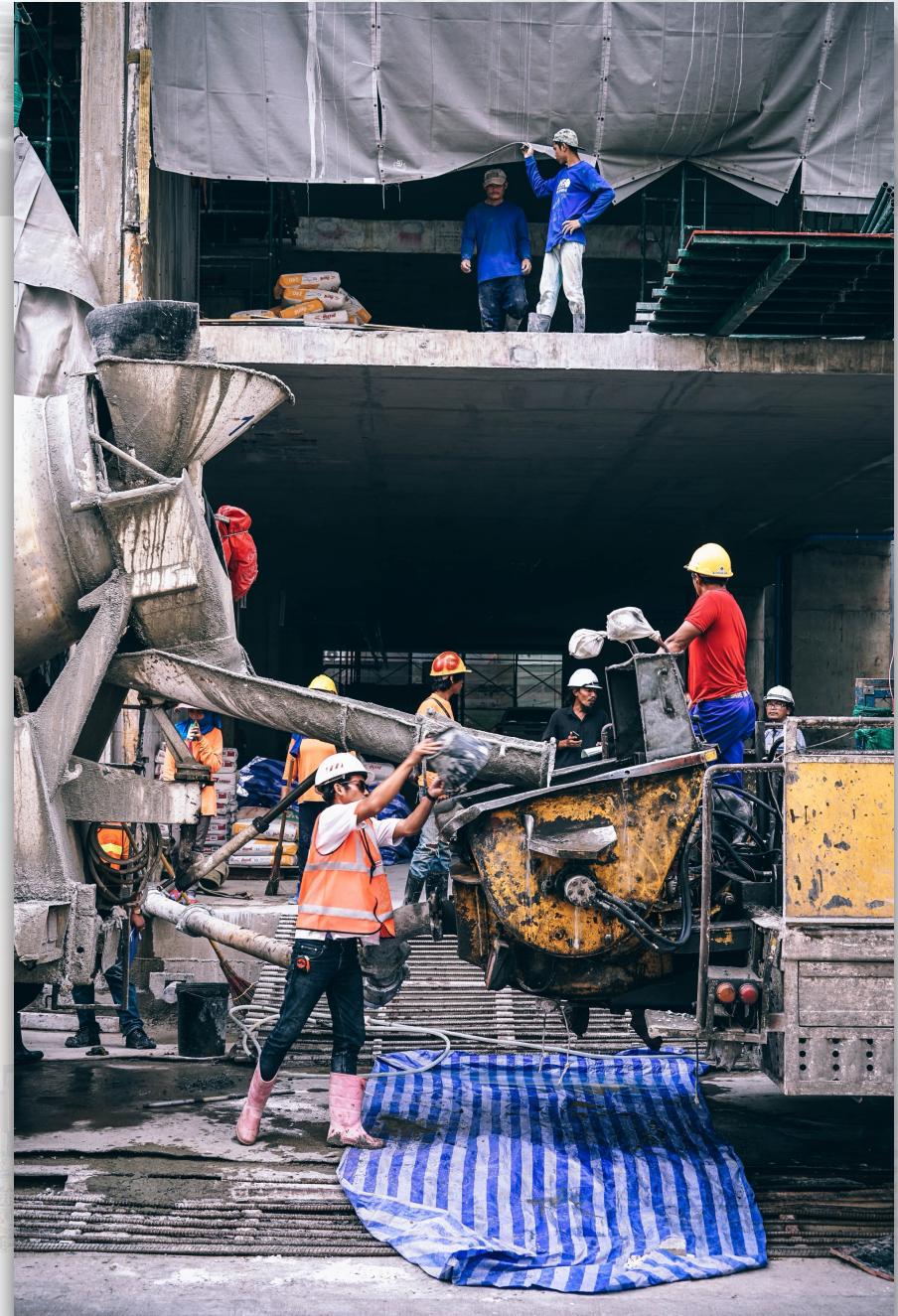
8.1 Plan Quality Management

ID #	Enabler	Primary Reference
2.7.1	Determine quality standard required for project deliverables	8.1
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2 , 8.1, 11.1, 11.2, 13.1
3.1.2	Classify compliance categories	NEW 5.1, 8.1 , 11.1
3.1.3	Determine potential threats to compliance	NEW 5.2, 8.1, 11.2
3.1.5	Analyze the consequences of noncompliance	NEW 5.2, 8.1, 11.2
3.1.6	Determine necessary approach and action to address compliance needs (e.g., risk, legal)	NEW 5.2, 8.1, 11.2
3.2.1	Investigate that benefits are identified	4.1 , 5.2, 8.1
3.2.2	Document agreements on ownership for ongoing benefits	NEW 4.1 , 8.1, 4.4

Project Resource Management

This is the estimating, obtaining, and controlling of project resources, both physical and human.

- 9.1 Plan Resource Management
- 9.2 Estimate Activity Resources
- 9.3 Acquire Resources
- 9.4 Develop Team
- 9.5 Manage Team
- 9.6 Control Resources



9.1 Plan Resource Management

Key Concept: This process creates the plan for laying out exactly how estimating for and requesting resources will work for the project. It also discusses roles and responsibilities, training, evaluations, and how conflicts are resolved.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Quality Management Plan- Scope Baseline3. Project Documents<ul style="list-style-type: none">- Project Schedule- Requirements Documentation- Risk Register- Stakeholder Register4. OPAs5. EEFs	<ul style="list-style-type: none">1. Expert Judgment2. Data Analysis<ul style="list-style-type: none">- Hierarchical Charts- Responsibility Assignment Matrix- Organizational Theory3. Meetings	<ul style="list-style-type: none">1. Resource Management Plan2. Team Charter3. Project Document Updates<ul style="list-style-type: none">- Assumption Log- Risk Register

9.1 Plan Resource Management

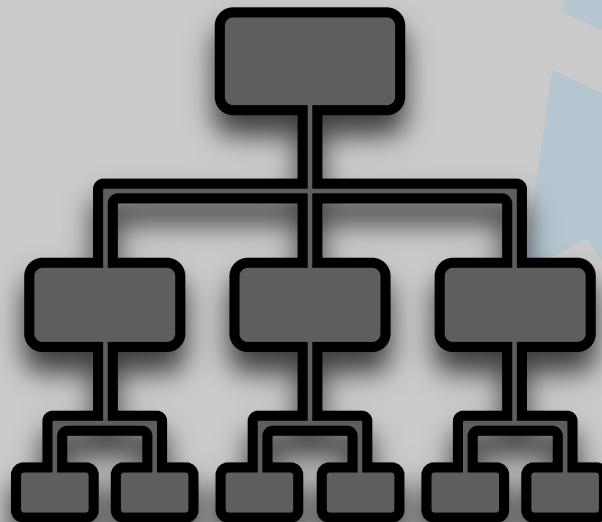
Inputs

1. Project Charter
2. Project Management Plan
 - Quality Management Plan
 - Scope Baseline
3. Project Documents
 - Project Schedule
 - Requirements Documentation
 - Risk Register
 - Stakeholder Register
4. OPAs
5. EEFs

9.1 Plan Resource Management

Tools and Techniques

1. Expert Judgment
2. Data Analysis
 - Hierarchical Charts
 - Responsibility Assignment Matrix
 - Organizational Theory
3. Meetings



Project Deliverable (or Activity)	Project Leadership					Project Team Members			
	Executive Spon	Project Spons	Steering Comm	Advisory Comm	Role #5	Project Manag	Tech Lead	Functional Lead	SME
Initiate Phase Activities									
- Submit Project Request	A/C	R/A				R/A	A/C	A/C	C
- Request Review by PMO						R			
- Research Solution	I	C				R/A	A/C	A/C	C
- Develop Business Case	I	A/C	I	I		R/A	C	C	C
Plan Phase Activities									
- Create Project Charter	C	C				R/A	C	C	C
- Create Schedule	I	I	I	I		R/A	C	C	C
- Create Additional Plans as required	I	I	I	I		R/A			I
Execute Phase Activities									
- Build Deliverables	C/I	C/I	C/I	C/I		R/A	R/A	R/A	R/A
- Create Status Report	I	I	I	I		R/A	R/A	R/A	R/A
Control Phase Activities									
- Perform Change Management		C	C	C		R	A	A	A
Close Phase Activities									
- Create Lessons Learned	C	C	C	C		R/A	C	C	C
- Create Project Closure Report	I	I	I	I		R/A	I	I	I

9.1 Plan Resource Management

Outputs

1. Resource Management Plan: This is one of the larger plans discussed in the *PMBOK® Guide*; make sure to know all components.

- Team Development: Team-building and evaluations
- Training: Team and collective
- Project Organization Chart: Shows team members' reporting relationships
- Resource Controls: Ensure that adequate resources are available as needed
- Recognition Plan: Explains how rewards are given
- Project Team Resource Management Plan: The human resources part of this
- Roles and Responsibilities: Written to cover all human resources on the project
- Acquiring Resources: How resources are requested
- Identification of Resources: How estimating for resources will be done

9.1 Plan Resource Management

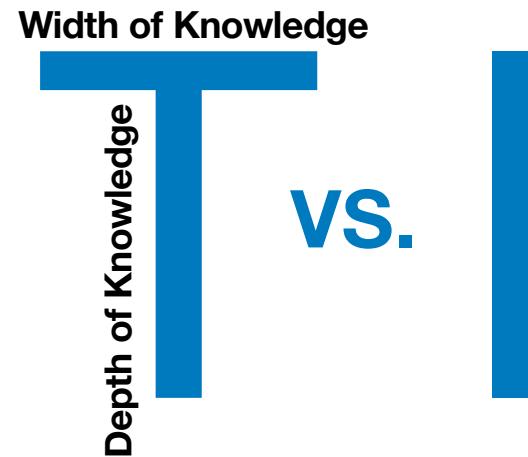
Outputs

2. **Team Charter:** The goal of this document is to create an agile environment so that the team members can work together as a team. It achieves this by defining ground rules, group norms, team values, and working agreements.
3. Project Document Updates
 - Assumption Log
 - Risk Register

9.1 Plan Resource Management

New Terms from the 2021 Exam Change

- **Team Skill Appraisal:** Enables the team to identify its strengths and weaknesses, assess opportunities for improvement, build trust, and establish communication mechanisms holistically
- **T vs. I Skills:** Broad skills vs. narrow ones. The *Agile Practice Guide* uses this concept to describe the optimal agile team as being comprised of team members with T skills rather than I skills.



9.1 Plan Resource Management

ID #	Enabler	Primary Reference
1.2.2	Support diversity and inclusion (e.g., behavior types, thought processes)	9.1
1.2.7	Distinguish various options to lead various team members and stakeholders	9.1
1.4.1	Organize around team strengths	9.1
1.7.1	Determine critical impediments, obstacles, and blockers for the team	9.1, APG
1.13.1	Allocate time to mentoring	9.1, APG
2.1.3	Support the team to subdivide project tasks as necessary to find the minimum viable product	NEW 9.1, p. 33, APG

9.1 Plan Resource Management

ID #	Enabler	Primary Reference
1.4.4	Determine and bestow level(s) of decision-making authority	9.1, 9.3
1.5.2	Determine training options based on training needs	9.1, 9.2, 9.3
1.12.2	Establish an environment that fosters adherence to the ground rules	13.3, 9.1
2.14.2	Define escalation paths and thresholds	4.1, 9.1, 13.2
2.16.1	Discuss project responsibilities within team	4.4, 9.1

9.2 Estimate Activity Resources

Key Concept: This process attempts to determine the number and type of resources needed to do a particular activity; resources include people, machinery, facilities, and materials.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Resource Management Plan- Scope Baseline2. Project Documents<ul style="list-style-type: none">- Activity Attributes- Activity List- Assumption Log- Cost Estimates- Resource Calendars- Risk Register3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Bottom-Up Estimating3. Analogous Estimating4. Parametric Estimating5. Data Analysis<ul style="list-style-type: none">- Alternative Analysis6. Project Management Information System7. Meetings	<ul style="list-style-type: none">1. Resource Requirements2. Basis of Estimates3. Resource Breakdown Structure4. Project Document Updates<ul style="list-style-type: none">- Activity Attributes- Assumption Log- Lessons Learned Register

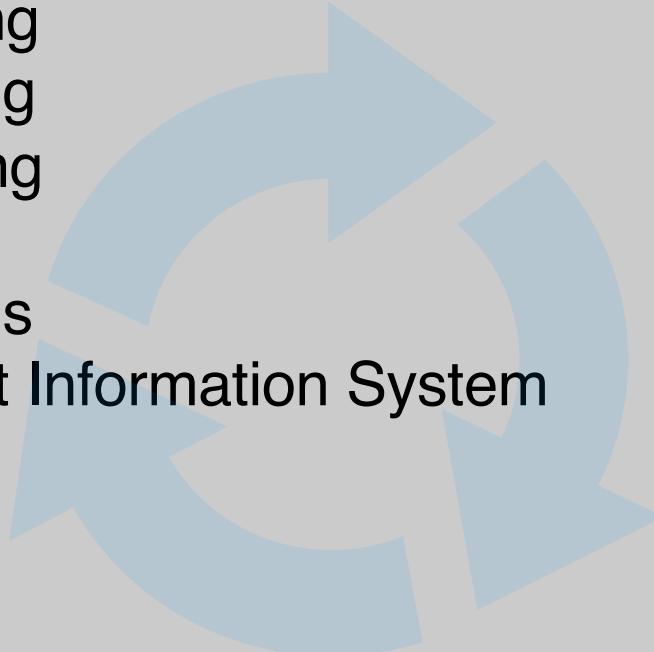
9.2 Estimate Activity Resources

Inputs

1. Project Management Plan
 - Resource Management Plan
 - Scope Baseline
2. Project Documents
 - Activity Attributes
 - Activity List
 - Assumption Log
 - Cost Estimates
 - Resource Calendars
 - Risk Register
3. EEFs
4. OPAs

9.2 Estimate Activity Resources

Tools and Techniques



1. Expert Judgment
2. Bottom-Up Estimating
3. Analogous Estimating
4. Parametric Estimating
5. Data Analysis
 - Alternative Analysis
6. Project Management Information System
7. Meetings

9.2 Estimate Activity Resources

Outputs

- 1. Resource Requirements:** This document explains the number of resources and the type of resources needed to do a particular activity.
2. Basis of Estimates
- 3. Resource Breakdown Structure**
4. Project Document Updates
 - Activity Attributes
 - Assumption Log
 - Lessons Learned Register

9.2 Estimate Activity Resources

ID #	Enabler	Primary Reference
1.4.2	Support team task accountability	9.1, 9.2, 9.3 , 9.6
1.5.1	Determine required competencies and elements of training	9.1, 9.2
1.5.2	Determine training options based on training needs	9.1, 9.2, 9.3 , 9.6
1.5.3	Allocate resources for training	9.2 , 9.6
1.6.2	Deduce project resource requirements	9.2 , 9.6
1.11.1	Examine virtual team member needs (e.g., environment, geography, culture, global, etc.)	9.2
1.11.2	Investigate alternatives (e.g., communication tools, co-location) for virtual team member engagement	APG, 10.1, 9.2
2.11.1	Define resource requirements and needs	9.2, 12.1
2.16.2	Outline expectations for working environment	4.4, 9.2

Project Communications Management

This knowledge area covers the planning of communication, the act of communicating, and making sure that the team is following the plan when communicating.

- 10.1 Plan Communications Management
- 10.2 Manage Communications
- 10.3 Monitor Communications



10.1 Plan Communications Management

Key Concept: This process takes into consideration the different platforms of communication in the organization to write the plan for how the team will use the selected platforms, as well as the appropriate use of those platforms.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- Resource Management Plan- Stakeholder Engagement Plan3. Project Documents<ul style="list-style-type: none">- Requirements Documentation- Stakeholder Register4. OPAs5. EEFs	<ul style="list-style-type: none">1. Expert Judgment2. Communication Requirements Analysis3. Communication Technology4. Communication Models5. Communication Methods6. Interpersonal and Team Skills<ul style="list-style-type: none">- Communication Styles Assessment- Political Awareness- Cultural Awareness7. Data Representation8. Meetings	<ul style="list-style-type: none">1. Communications Management Plan2. Project Management Plan Updates<ul style="list-style-type: none">- Stakeholder Engagement Plan3. Project Document Updates<ul style="list-style-type: none">- Project Schedule- Stakeholder Register

10.1 Plan Communications Management

Inputs

1. Project Charter
2. Project Management Plan
 - Resource Management Plan
 - Stakeholder Engagement Plan
3. Project Documents
 - Requirements Documentation
 - Stakeholder Register
4. OPAs
5. EEFs

10.1 Plan Communications Management

Tools and Techniques

1. Expert Judgment
2. **Communication Requirements Analysis:** $n(n-1)/2$ one-to-one formula
3. **Communication Technology**
4. Communication Models
5. **Communication Methods**
 - Interactive
 - Push
 - Pull
6. Interpersonal and Team Skills
 - Communication Styles Assessment
 - Political Awareness
 - Cultural Awareness
7. **Data Representation:** The use of a stakeholder grid or RACI chart
8. Meetings

Factors that can affect the choice of communication technology

- ✓ Urgency of the need for information
- ✓ Availability and reliability of technology
- ✓ Ease of use
- ✓ Project environment
- ✓ Sensitivity of the information

10.1 Plan Communications Management

Outputs

- 1. Communications Management Plan:** This is the plan that covers the approved types of project communications. It could be phase-oriented or arranged by groups of stakeholders; either way, it covers how communication is created, archived, and destroyed.
- 2. Project Management Plan Updates**
 - Stakeholder Engagement Plan
- 3. Project Document Updates**
 - Project Schedule
 - Stakeholder Register

10.1 Plan Communications Management

ID #	Enabler	Primary Reference
1.11.2	Investigate alternatives (e.g., communication tools, co-location) for virtual team member engagement	APG, 10.1, 10.3, 9.2
2.2.1	Analyze communication needs of all stakeholders	13.1, 10.1
2.2.2	Determine communications methods, channels, frequency, and level of detail for all stakeholders	10.1
2.15.3	Collaborate with relevant stakeholders on the approach to resolve the issues	10.1, 11.1, 13.2

Project Risk Management

This knowledge area covers policies for handling risk, identifying risk, planning for risk, and controlling risk in the project.

- 11.1 Plan Risk Management
- 11.2 Identify Risks
- 11.3 Perform Qualitative Risk Analysis
- 11.4 Perform Quantitative Risk Analysis
- 11.5 Plan Risk Responses
- 11.6 Implement Risk Responses
- 11.7 Monitor Risks



Project Risk Management

Risk Approaches, Tools, and Data Sources

- Risk Breakdown Structure
- Risk Register
- The Watch List
- Probability and Impact Matrix
- Prompt Lists
- Questionnaires
- Checklists
- Root-Cause Analysis
- Failure Modes and Effect Analysis
- Delphi Technique
- Assumptions and Constraint Analysis
- Brainstorming
- Cause-and-Effect Diagrams
- Nominal Group Technique

Project Risk Management

Risk Approaches, Tools, and Data Sources

- **Prompt Lists:** This is a set of risk categories that can be used to identify risk events during planning.

PESTLE

Political
Economic
Social
Technological
Legal
Environmental

TECOP

Technical
Environmental
Commercial
Operational
Political

VUCA

Volatility
Uncertainty
Complexity
Ambiguity

SPECTRUM

Socio-Cultural
Political
Economic
Competitive
Technology
Regulatory/Legal
Uncertainty/Risk
Market

Project Risk Management

Risk Approaches, Tools, and Data Sources

- **RBS, or Risk Breakdown Structure:** This tool can be used to understand the different categories of risk in a project.

Project Number ###	RBS Level 1	RBS Level 2
All Sources of Project Risk	Phase 1	1.1 Political 1.2 Economic 1.3 Social 1.4 Technological 1.5 Legal 1.6 Environmental
	Phase 2	2.1 Political 2.2 Economic 2.3 Social 2.4 Technological 2.5 Legal 2.6 Environmental
	Phase 3	3.1 Political 3.2 Economic 3.3 Social 3.4 Technological 3.5 Legal 3.6 Environmental

Project Risk Management

Risk Approaches, Tools, and Data Sources

- The **Probability and Impact Matrix**: This tool can be used in combination with risk thresholds to understand risk within a project. It is one of the most effective tools a PM can use to rank risk across the project. It can also be used by the organization to give the PM guidance on how to handle a particular risk event.

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

Project Risk Management

Risk Approaches, Tools, and Data Sources

- The **Risk Register** is the preferred method to track and archive project risk.
- When used in organizational risk management, the ID numbers can be used to build lessons learned, best practice, and refined strategies for a particular risk event.

Risk Identification		Qualitative Rating				Risk Response											
ID Number	Risk	Opportunity or Threat	Risk Category	Probability	Impact	Risk Score	Risk Ranking	Risk Response Strategy	Approval Required	Secondary Risks	Trigger	Primary Risk Owner	Secondary Risk Owner	Link to Contingency Plan	Link to Fallback Plan	Notes or Qualitative Value	Result
0	1																
0	2																
0	3																
0	4																
0	5																
0	6																
0	7																
0	8																
0	9																
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11.2 Identify Risks

Key Concept: This process is always going on. The PM is always looking to identify risks throughout the project, not just in planning.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan</p> <ul style="list-style-type: none"> - Requirements Management Plan - Schedule Management Plan - Cost Management Plan - Quality Management Plan - Resource Management Plan - Risk Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline <p>2. Project Documents</p> <ul style="list-style-type: none"> - Assumption Log - Cost Estimates - Duration Estimates - Issue Log - Lessons Learned Register - Requirements Documentation - Resource Requirements - Stakeholder Register <p>3. Agreements</p> <p>4. Procurement Documentation</p> <p>5. EEFs</p> <p>6. OPAs</p>	<p>1. Expert Judgment</p> <p>2. Data Gathering</p> <ul style="list-style-type: none"> - Brainstorming - Checklists - Interviews <p>3. Data Analysis</p> <ul style="list-style-type: none"> - Root Cause Analysis - Assumption and Constraint Analysis - SWOT Analysis - Document Analysis <p>4. Interpersonal and Team Skills</p> <ul style="list-style-type: none"> - Facilitation <p>5. Prompt Lists</p> <p>6. Meetings</p>	<p>1. Risk Register</p> <p>2. Risk Reports</p> <p>3. Project Document Updates</p> <ul style="list-style-type: none"> - Assumption Log - Issue Log - Lessons Learned Register

11.2 Identify Risks

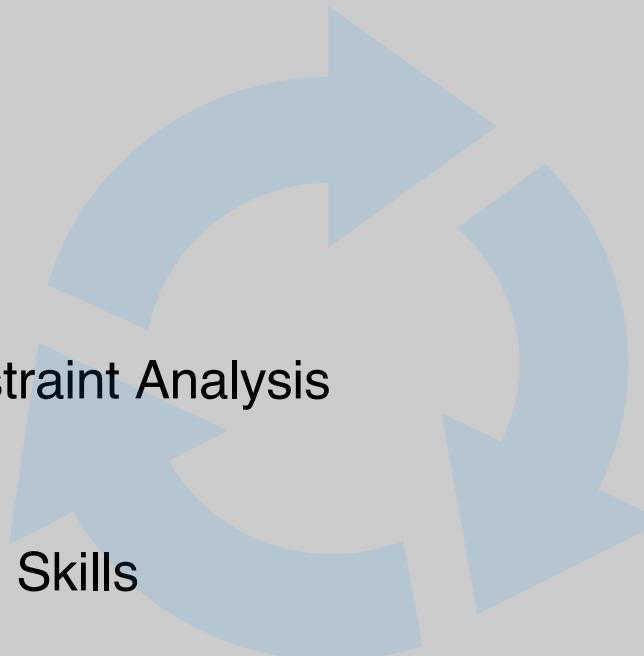
Inputs

<p>1. Project Management Plan</p> <ul style="list-style-type: none">- Requirements Management Plan- Schedule Management Plan- Cost Management Plan- Quality Management Plan- Resource Management Plan- Risk Management Plan- Scope Baseline- Schedule Baseline- Cost Baseline	<p>2. Project Documents</p> <ul style="list-style-type: none">- Assumption Log- Cost Estimates- Duration Estimates- Issue Log- Lessons Learned Register- Requirements Documentation- Resource Requirements- Stakeholder Register
	<p>3. Agreements</p>
	<p>4. Procurement Documentation</p>
	<p>5. EEFs</p>
	<p>6. OPAs</p>

11.2 Identify Risks

Tools and 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



11.2 Identify Risks

Outputs

1. **Risk Register**
2. **Risk Reports:** These are reports on the overall project summarizing key risk events or categories of risk and risk drivers. When and how this is done should have been described in the Risk Management Plan.
3. Project Document Updates
 - Assumption Log
 - Issue Log
 - Lessons Learned Register

11.2 Identify Risks

ID #	Enabler	Primary Reference
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2 , 8.1, 11.1, 11.2, 13.1
3.1.3	Determine potential threats to compliance	NEW 5.2, 8.1, 11.2
3.1.5	Analyze the consequences of noncompliance	NEW 5.2, 8.1, 11.2 , 11.3
3.1.6	Determine necessary approach and action to address compliance needs (e.g., risk, legal)	NEW 5.2, 8.1, 11.2

11.3 Perform Qualitative Risk Analysis

Key Concept: This is the process of comparing risk events to one another in order to distinguish high risk versus low risk.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Risk Management Plan2. Project Documents<ul style="list-style-type: none">- Assumption Log- Risk Register- Stakeholder Register3. EEFs4. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Data Gathering<ul style="list-style-type: none">- Interviews3. Data Analysis<ul style="list-style-type: none">- Risk Data Quality Assessment- Risk Probability and Impact Assessment- Assessment of Other Risk Parameters4. Interpersonal and Team Skills Facilitation5. Risk Categorization6. Data Representation<ul style="list-style-type: none">- Probability and Impact Matrix- Hierarchical Charts7. Meetings	<ul style="list-style-type: none">1. Project Document Updates<ul style="list-style-type: none">- Assumption Log- Issue Log- Risk Register- Risk Reports

11.3 Perform Qualitative Risk Analysis

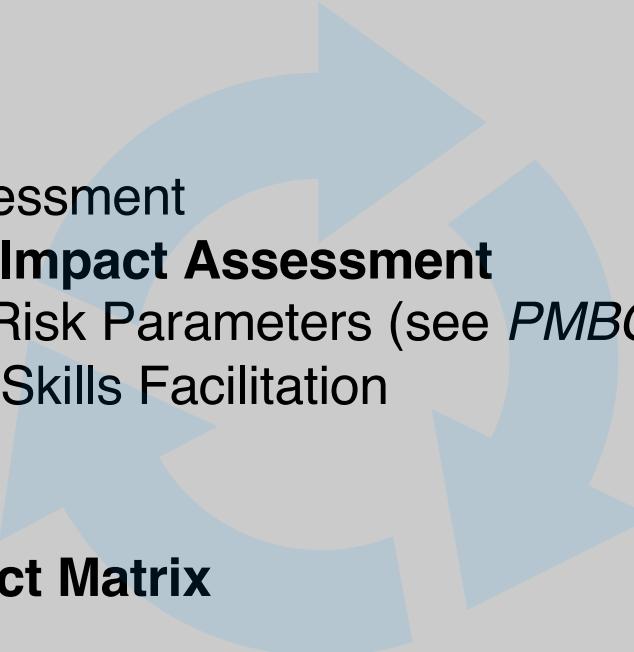
Inputs

1. Project Management Plan
 - Risk Management Plan
2. Project Documents
 - Assumption Log
 - Risk Register
 - Stakeholder Register
3. EEFs
4. OPAs

11.3 Perform Qualitative Risk Analysis

Tools and Techniques

1. Expert Judgment
2. Data Gathering
 - Interviews
3. Data Analysis
 - Risk Data Quality Assessment
 - **Risk Probability and Impact Assessment**
 - Assessment of Other Risk Parameters (see *PMBOK® Guide*, pp. 423-424)
4. Interpersonal and Team Skills Facilitation
5. Risk Categorization
6. **Data Representation**
 - **Probability and Impact Matrix**
 - **Hierarchical Charts**
7. **Meetings:** These are often called *risk workshops*.



11.3 Perform Qualitative Risk Analysis

Outputs

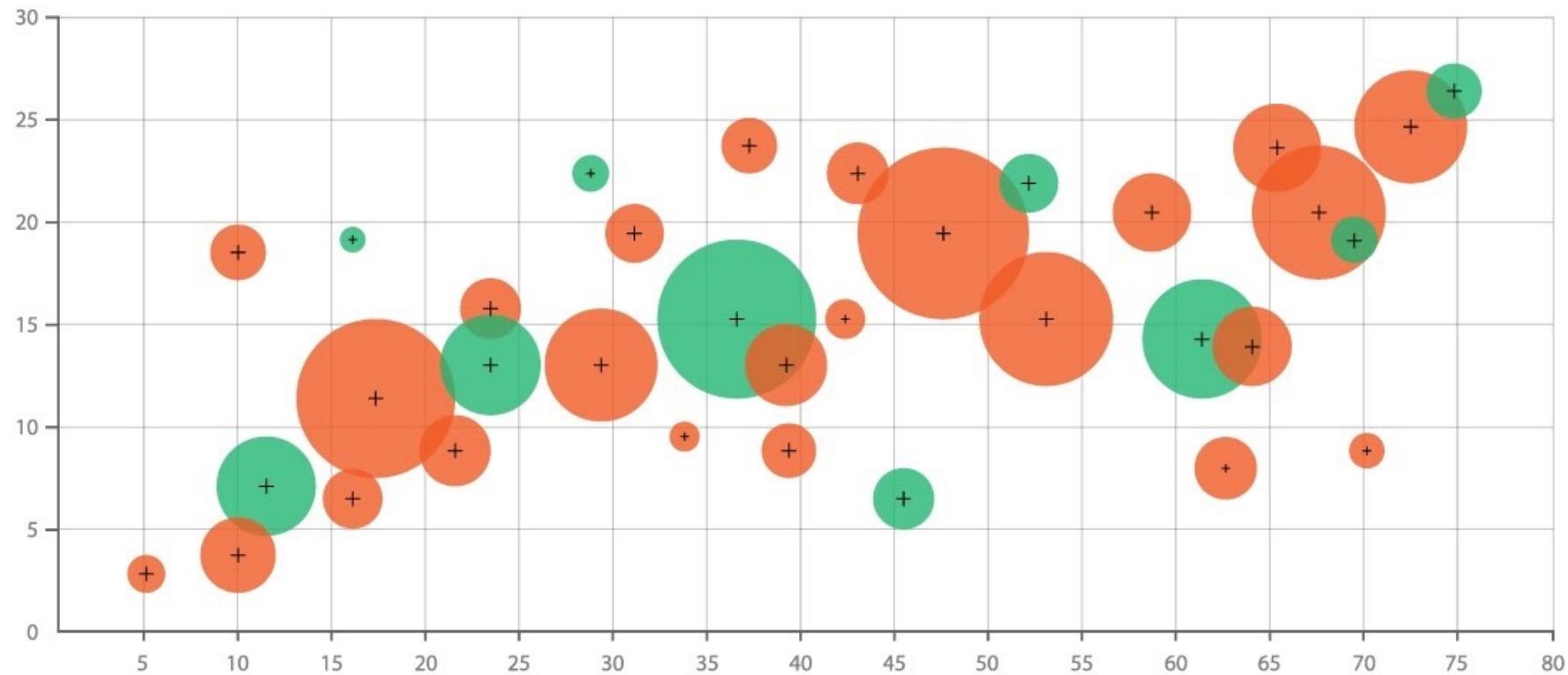
1. Project Document Updates

- Assumption Log
- Issue Log
- **Risk Register**
- **Risk Reports**



11.3 Perform Qualitative Risk Analysis

The Bubble Chart



11.3 Perform Qualitative Risk Analysis

ID #	Enabler	Primary Reference
3.1.5	Analyze the consequences of noncompliance	NEW 5.2, 8.1, 11.2, 11.3

11.4 Perform Quantitative Risk Analysis

Key Concept: This process quantifies the potential risk impacts to the project, allowing the PM to assign contingency reserves for risk events that touch on many areas of the project.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan</p> <ul style="list-style-type: none"> - Risk Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline <p>2. Project Documents</p> <ul style="list-style-type: none"> - Assumption Log - Basis of Estimates - Cost Estimates - Cost Forecasts - Duration Estimates - Milestone List - Resource Requirements - Risk Register - Risk Reports - Schedule Forecasts <p>3. EEFs</p> <p>4. OPAs</p>	<p>1. Expert Judgment</p> <p>2. Data Gathering</p> <ul style="list-style-type: none"> - Interviews <p>3. Interpersonal and Team Skills</p> <ul style="list-style-type: none"> - Facilitation <p>4. Representations of Uncertainty</p> <p>5. Data Analysis</p> <ul style="list-style-type: none"> - Simulations - Sensitivity Analysis - Decision Tree Analysis - Influence Diagrams 	<p>1. Project Document Updates</p> <ul style="list-style-type: none"> - Risk Reports

11.4 Perform Quantitative Risk Analysis

Inputs

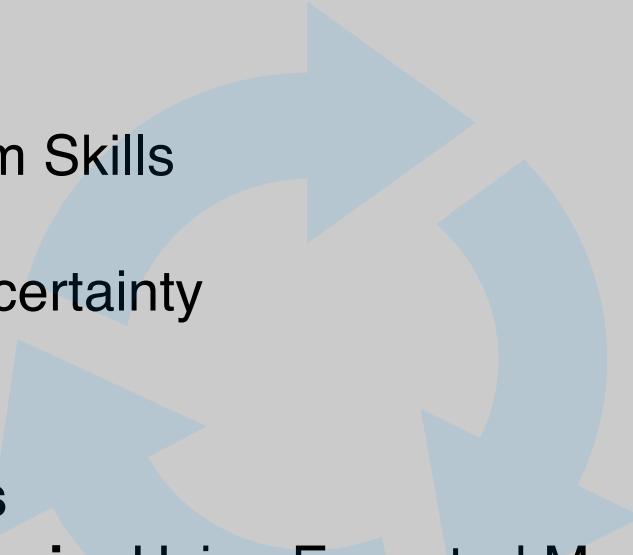
1. Project Management Plan
 - Risk Management Plan
 - Scope Baseline
 - Schedule Baseline
 - Cost Baseline
2. Project Documents
 - Assumption Log
 - Basis of Estimates
 - Cost Estimates
 - Cost Forecasts
 - Duration Estimates
 - Milestone List
 - Resource Requirements
 - Risk Register
 - Risk Reports
 - Schedule Forecasts
3. EEFs
4. OPAs



11.4 Perform Quantitative Risk Analysis

Tools and Techniques

1. Expert Judgment
2. Data Gathering
 - Interviews
3. Interpersonal and Team Skills
 - Facilitation
4. Representations of Uncertainty
5. Data Analysis
 - Simulations
 - **Sensitivity Analysis**
 - **Decision Tree Analysis:** Using Expected Monetary Value
 $EMV = \text{Probability} \times \text{Impact}$ (see *PMBOK® Guide*, p. 435, for example)
 - Influence Diagrams



11.4 Perform Quantitative Risk Analysis

Outputs

1. Project Document Updates
 - **Risk Reports**



11.4 Perform Quantitative Risk Analysis

ID #	Enabler	Primary Reference
2.15.2	Attack the issue with the optimal action to achieve project success	11.4, 11.5, 11.6

11.5 Plan Risk Responses

Key Concept: In this process, strategies are assigned to address individual risk events.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan</p> <ul style="list-style-type: none"> - Resource Management Plan - Risk Management Plan - Cost Baseline <p>2. Project Documents</p> <ul style="list-style-type: none"> - Schedule Forecasts - Lessons Learned Register - Project Schedule - Project Team Assignments - Resource Calendars - Risk Register - Risk Reports - Stakeholder Register <p>3. EEFs</p> <p>4. OPAs</p>	<ol style="list-style-type: none"> 1. Expert Judgment 2. Data Gathering <ul style="list-style-type: none"> - Interviews 3. Interpersonal and Team Skills <ul style="list-style-type: none"> - Facilitation 4. Strategies for Threats 5. Strategies for Opportunities 6. Contingent Response Strategies 7. Strategies for Overall Project Risk 8. Data Analysis <ul style="list-style-type: none"> - Simulations - Alternative Analysis - Cost-Benefit Analysis 9. Decision-Making <ul style="list-style-type: none"> - Multi-Criteria Decision Analysis 	<p>1. Change Requests</p> <p>2. Project Management Plan Updates</p> <ul style="list-style-type: none"> - Schedule Management Plan - Cost Management Plan - Quality Management Plan - Resource Management Plan - Procurement Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline <p>3. Project Document Updates</p> <ul style="list-style-type: none"> - Assumption Log - Cost Forecasts - Lessons Learned Register - Project Schedule - Project Team Assignments - Risk Register - Risk Reports

11.5 Plan Risk Responses

Inputs

1. Project Management Plan
 - Resource Management Plan
 - Risk Management Plan
 - Cost Baseline
2. Project Documents
 - Schedule Forecasts
 - Lessons Learned Register
 - Project Schedule
 - Project Team Assignments
 - Resource Calendars
 - Risk Register
 - Risk Reports
 - Stakeholder Register
3. EEFs
4. OPAs

11.5 Plan Risk Responses

Tools and Techniques

1. Expert Judgment
2. Data Gathering
 - Interviews
3. Interpersonal and Team Skills
 - Facilitation
4. **Strategies for Threats**
5. **Strategies for Opportunities**
6. **Contingent Response Strategies**
7. Strategies for Overall Project Risk
8. Data Analysis
 - Simulations
 - Alternative Analysis
 - Cost-Benefit Analysis
9. Decision-Making
 - Multi-Criteria Decision Analysis

Strategies for Threats

- Escalate
- Avoid
- Transfer
- Mitigate
- Accept

Strategies for Opportunities

- Escalate
- Exploit
- Share
- Enhance
- Accept

11.5 Plan Risk Responses

Outputs

<ul style="list-style-type: none">1. Change Requests2. Project Management Plan Updates<ul style="list-style-type: none">- Schedule Management Plan- Cost Management Plan- Quality Management Plan- Resource Management Plan- Procurement Management Plan- Scope Baseline- Schedule Baseline- Cost Baseline	<ul style="list-style-type: none">3. Project Document Updates<ul style="list-style-type: none">- Assumption Log- Cost Forecasts- Lessons Learned Register- Project Schedule- Project Team Assignments- Risk Register- Risk Reports
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A Venn diagram with two overlapping circles. The left circle is labeled 'Change Requests' and the right circle is labeled 'Project Management Plan Updates'. Their intersection area is shaded in light blue.

11.5 Plan Risk Responses

ID #	Enabler	Primary Reference
2.15.3	Collaborate with relevant stakeholders on the approach to resolve the issues	10.1, 11.1, 11.5, 13.2

Project Procurement Management

This knowledge is used to buy things for the project. In this knowledge area, the PM acts as the sponsor for mini-projects.

- 12.1 Plan Procurement Management
- 12.2 Conduct Procurements
- 12.3 Control Procurements



Contract Terms

Centralized Purchasing: A dedicated portion of the company handles most of the procurement work.

Decentralized Purchasing: The PM leads the procurement process.

Sole Source: A seller that is the only source for a required product or service

Tender: A term used interchangeably with *bid*

Privity: A contractual relationship between two entities

Force Majeure: A contract vehicle that allows for non-performance when unforeseeable and uncontrollable events occur (natural disasters, riots, etc.)

Service-Level Agreement: A contract between a service provider (internal or external) and the end user that describes the level of service expected from the service provider

Contract Types

Contract types are used to shift risk in different ways.

Fixed-Price Contracts

Firm Fixed Price (FFP)

Fixed Price Plus Incentive Fee (FPPIF)

Fixed Price with Economic Price Adjustment (FP-EPA)

Cost-Reimbursable Contract

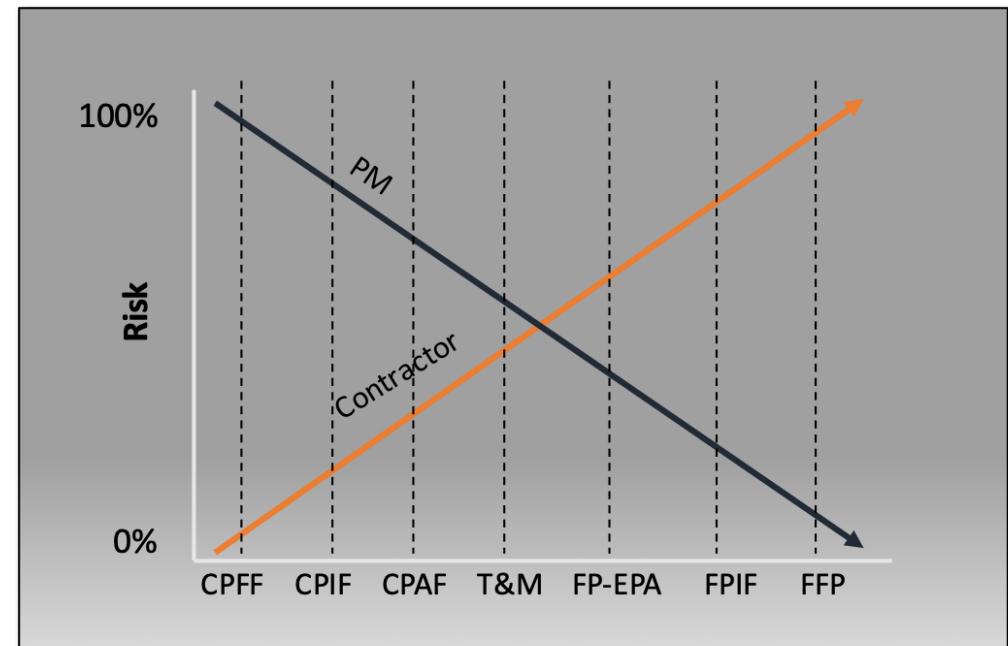
Cost Plus Fixed Fee (CPFF)

Cost Plus Incentive Fee (CPIF)

Cost Plus Award Fee (CPAF)

Time and Materials Contracts

Often contain a “not to exceed” clause



13.2 Plan Stakeholder Engagement

Key Concept: This is a tailored plan focused on getting a stakeholder (or group) to the desired level of engagement during the project.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Charter 2. Project Management Plan <ul style="list-style-type: none"> - Resource Management Plan - Communications Management Plan - Risk Management Plan 3. Project Documents <ul style="list-style-type: none"> - Assumption Log - Change Log - Issue Log - Project Schedule - Risk Register - Stakeholder Register 4. Agreements 5. EEFs 6. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Data Gathering <ul style="list-style-type: none"> - Benchmarking 3. Data Analysis <ul style="list-style-type: none"> - Assumption and Constraint Analysis - Root Cause Analysis 4. Decision-Making <ul style="list-style-type: none"> - Prioritization 5. Data Representation <ul style="list-style-type: none"> - Mind Mapping - Stakeholder Engagement Assessment Matrix 6. Meetings 	<ol style="list-style-type: none"> 1. Stakeholder Engagement Plan 

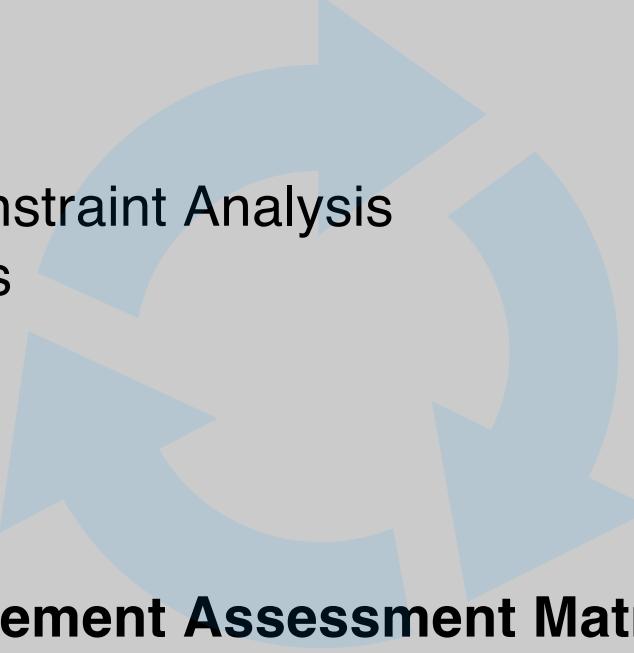
13.2 Plan Stakeholder Engagement

Inputs

1. Project Charter
2. Project Management Plan
 - Resource Management Plan
 - Communications Management Plan
 - Risk Management Plan
3. Project Documents
 - Assumption Log
 - Change Log
 - Issue Log
 - Project Schedule
 - Risk Register
 - Stakeholder Register
4. Agreements
5. EEFs
6. OPAs

13.2 Plan Stakeholder Engagement

Tools and Techniques



1. Expert Judgment
2. Data Gathering
 - Benchmarking
3. Data Analysis
 - Assumption and Constraint Analysis
 - Root Cause Analysis
4. Decision-Making
 - Prioritization
5. Data Representation
 - Mind Mapping
 - **Stakeholder Engagement Assessment Matrix**
6. Meetings

13.2 Plan Stakeholder Engagement

Outputs

- 1. Stakeholder Engagement Plan:** This plan details the desired level of engagement for a particular stakeholder or a group of stakeholders for the entire project or by phase. It also describes the strategy to get that stakeholder or group of stakeholders to the desired level and maintain it during the project using the communication platforms discussed in the Communications Management Plan.

13.2 Plan Stakeholder Engagement

ID #	Enabler	Primary Reference
1.9.1	Evaluate engagement needs for stakeholders	13.1, 13.2
1.14.2	Analyze personality indicators and adjust to the emotional needs of key project stakeholders	NEW 13.2
2.4.4	Develop, execute, and validate a strategy for stakeholder engagement	13.2
2.15.3	Collaborate with relevant stakeholders on the approach to resolve the issues	10.1, 11.1, 11.5, 13.2

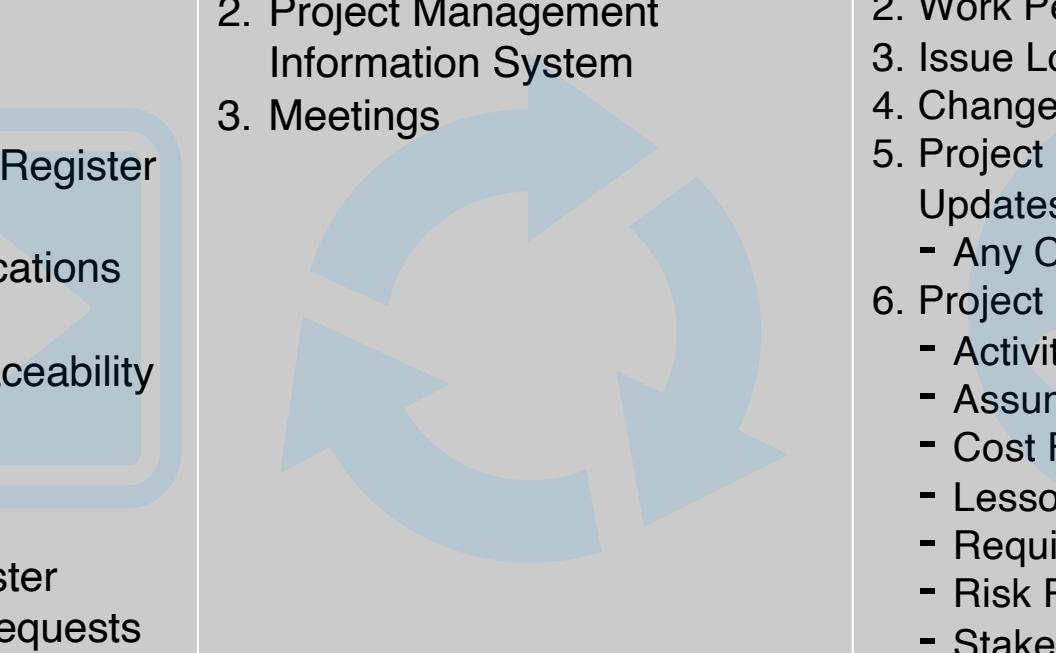
Executing Process Group

- 4.3 Direct and Manage Project Work
- 4.4 Manage Project Knowledge
- 8.2 Manage Quality
- 9.3 Acquire Resources
- 9.4 Develop Team
- 9.5 Manage Team
- 10.2 Manage Communications
- 11.6 Implement Risk Responses
- 12.2 Conduct Procurements
- 13.3 Manage Stakeholder Engagement



4.3 Direct and Manage Project Work

Key Concept: This is the process of doing the planned work and creating deliverables.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Any Component 2. Project Documents <ul style="list-style-type: none"> - Change Log - Lessons Learned Register - Milestone List - Project Communications - Project Schedule - Requirements Traceability Matrix - Risk Register - Risk Reports - Stakeholder Register 3. Approved Change Requests 4. EEFs 5. OPAs 	 <ol style="list-style-type: none"> 1. Expert Judgment 2. Project Management Information System 3. Meetings 	<ol style="list-style-type: none"> 1. Deliverables 2. Work Performance Data 3. Issue Log 4. Change Requests 5. Project Management Plan Updates <ul style="list-style-type: none"> - Any Component 6. Project Document Updates <ul style="list-style-type: none"> - Activity List - Assumption Log - Cost Forecasts - Lessons Learned Register - Requirements Documentation - Risk Register - Stakeholder Register 7. OPA Updates

4.3 Direct and Manage Project Work

Inputs

1. Project Management Plan

- Any Component

2. Project Documents

- **Change Log:** A list of all project change requests
- Lessons Learned Register
- Milestone List
- Project Communications
- Project Schedule
- Requirements Traceability Matrix
- Risk Register
- Risk Reports
- Stakeholder Register

3. Approved Change Requests

4. EEFs

5. OPAs

Fixing the Project with Change Requests

Change requests are submitted throughout the project. In “4.6 Integrated Change Control,” change requests can be accepted.

Defect: Any deliverable that does not meet the project requirements

Corrective Action: Any fix after a defect has occurred

Preventative Action: Any fix before the defect has occurred

4.3 Direct and Manage Project Work

Tools and Techniques

1. Expert Judgment
2. Project Management Information System
3. Meetings



4.3 Direct and Manage Project Work

Outputs

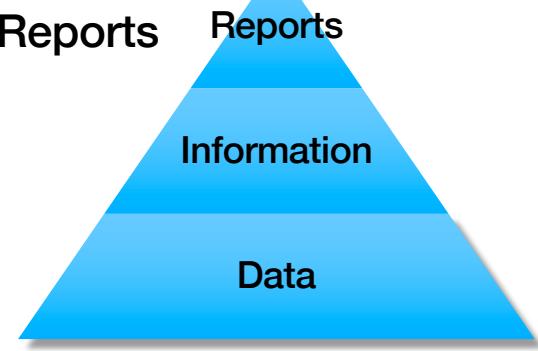
1. **Deliverables:** Once these are checked in Control Quality, they are called *verified deliverables*; once checked by the sponsor or customer, they become *accepted deliverables*.
2. **Work Performance Data:** Data is created when doing the project work. Linked data is called *work performance information*, and it's this information that can be rolled up into a Work Performance Report.
3. Issue Log
4. Change Requests
5. Project Management Plan Updates
 - Any Component
6. Project Document Updates
 - Activity List
 - Assumption Log
 - Cost Forecasts
 - Lessons Learned Register
 - Requirements Documentation
 - Risk Register
 - Stakeholder Register
7. OPA Updates

Work Performance Summary

4.3: Work Performance Data

M&C: Work Performance Information

4.5: Work Performance Reports



4.3 Direct and Manage Project Work

ID #	Enabler	Primary Reference
2.9.3	Analyze the data collected	4.3, 4.4 , all M/C
2.9.4	Collect and analyze data to make informed project decisions	4.3, 4.6 , all M/C
2.9.5	Determine critical information requirements	4.1, 4.3, 5.2, 4.5
2.10.1	Anticipate and embrace the need for change (e.g., follow change management practices)	4.1, 4.2, 4.3, 4.6
2.10.3	Execute change management strategy according to the methodology	4.3, 4.6
2.10.4	Determine a change response to move the project forward	4.6, 4.3
2.12.2	Validate that the project information is kept up to date (i.e., version control) and accessible to all stakeholders	4.4, 4.3, 4.5
2.13.4	Use iterative, incremental practices throughout the project lifecycle (e.g., lessons learned, stakeholder engagement, risk)	NEW 4.2 , 4.3
2.16.1	Discuss project responsibilities within team	4.3, 4.4, 9.1
3.1.4	Use methods to support compliance	NEW 4.3 , 8.3, 11.6
3.2.3	Verify measurement system is in place to track benefits	NEW 4.3 , 8.2
3.3.2	Assess and prioritize impact on project scope/backlog based on changes in external business environment	NEW 4.1 , 4.3
3.3.3	Recommend options for scope/backlog changes (e.g., schedule, cost changes)	NEW 4.1 , 4.3
3.3.4	Continually review external business environment for impacts on project scope/backlog	NEW 4.1 , 4.3

4.4 Manage Project Knowledge

Key Concept: This is the process of actively gathering lessons learned through the project and, at project or phase closing, rolling up the lessons learned into the lessons learned repository.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Any Component2. Project Documents<ul style="list-style-type: none">- Lessons Learned Register- Project Team Assignments- Resource Breakdown Structure- Source Selection Criteria- Stakeholder Register3. Deliverables4. EEFs5. OPAs	<ol style="list-style-type: none">1. Expert Judgment2. Knowledge Management3. Information Management4. Interpersonal and Team Skills<ul style="list-style-type: none">- Active Listening- Facilitation- Leadership- Networking- Political Awareness	<ol style="list-style-type: none">1. Lessons Learned Register2. Project Management Plan Updates<ul style="list-style-type: none">- Any Component3. OPA Updates

4.4 Manage Project Knowledge

Inputs

1. Project Management Plan

- Any Component

2. Project Documents

- Lessons Learned Register
- Project Team Assignments
- Resource Breakdown Structure
- Source Selection Criteria
- Stakeholder Register

3. Deliverables

4. EEFs

5. OPAs

4.4 Manage Project Knowledge

Tools and Techniques

1. Expert Judgment
2. Knowledge Management
3. Information Management
4. Interpersonal and Team Skills
 - Active Listening
 - Facilitation
 - Leadership
 - Networking
 - Political Awareness

Knowledge

Knowledge is split in to two categories: *explicit* and *tacit*.

Explicit Knowledge: Knowledge that can be quantified or measured. Example: Our estimate was off by 30% because...

Tacit Knowledge: Knowledge that can't be measured with numbers. Example: The boss prefers text messages for all communication after 4:00 p.m.

4.4 Manage Project Knowledge

Outputs

- 1. Lessons Learned Register:** This is a list of best practices and lessons learned that have been gathered as the project moves forward in time. Typically, the use of this document is disclosed in the Benefits Management Plan as a way of feeding the PMO with information to disseminate to other PMs.
- 2. Project Management Plan Updates**
 - Any Component
- 3. OPA Updates**

4.4 Manage Project Knowledge

ID #	Enabler	Primary Reference
1.6.4	Maintain team and knowledge transfer	NEW 4.4
2.1.1	Assess opportunities to deliver value incrementally	NEW 4.2, p. 23, APG
2.9.3	Analyze the data collected	4.3, 4.4, all M/C
2.12.2	Validate that the project information is kept up to date (i.e., version control) and accessible to all stakeholders	4.4, 4.3, 4.5
2.12.3	Continually assess the effectiveness of the management of the project artifacts	4.4, 4.5
2.16.1	Discuss project responsibilities within team	4.3, 4.4, 9.1
2.16.2	Outline expectations for working environment	4.4, 9.2
2.16.3	Confirm approach for knowledge transfers	NEW 4.1, 4.4
2.17.3	Conclude activities to close out project or phase (e.g., final lessons learned, retrospective, procurement, financials, resources)	4.4, 12.3, 4.7, APG
3.2.2	Document agreements on ownership for ongoing benefits	NEW 4.1, 8.1, 4.4

8.2 Manage Quality

Key Concept: This process checks the Quality Management Plan and the PM's understanding of the project requirements. This can also be done in executing to make sure that the plan is being followed.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan - Quality Management Plan</p> <p>2. Project Documents - Lessons Learned Register - Quality Metrics - Quality Control Measurements - Risk Reports</p> <p>3. OPAs</p>	<p>1. Data Gathering</p> <p>2. Data Analysis - Alternative Analysis - Document Analysis - Process Analysis - Root Cause Analysis</p> <p>3. Decision-Making - Multi-Criteria Decision Analysis</p> <p>4. Data Representation - Affinity Diagrams - Cause-and-Effect Diagrams - Flowcharts - Matrix Diagrams - Scatter Diagrams</p> <p>5. Audits</p> <p>6. Design for X</p> <p>7. Problem-Solving</p> <p>8. Quality Improvement Methods</p>	<p>1. Quality Reports</p> <p>2. Testing Evaluation Documents</p> <p>3. Change Requests</p> <p>4. Project Management Plan Updates - Quality Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline</p> <p>5. Project Document Updates - Issue Log - Lessons Learned Register - Risk Register</p>

8.2 Manage Quality

Inputs

1. Project Management Plan

- Quality Management Plan

2. Project Documents

- Lessons Learned Register
- **Quality Metrics**
- **Quality Control Measurements**
- Risk Reports

3. OPAs

8.2 Manage Quality

Tools and Techniques



1. Data Gathering
2. Data Analysis
 - Alternative Analysis
 - Document Analysis
 - Process Analysis
 - Root Cause Analysis
3. Decision-Making
 - Multi-Criteria Decision Analysis
4. Data Representation
 - Affinity Diagrams
 - Cause-and-Effect Diagrams
 - Flowcharts
 - Matrix Diagrams
 - Scatter Diagrams
5. Audits
6. Design for X
7. Problem-Solving
8. Quality Improvement Methods

8.2 Manage Quality

Outputs

1. **Quality Reports**
2. **Testing Evaluation Documents**
3. Change Requests
4. Project Management Plan Updates
 - Quality Management Plan
 - Scope Baseline
 - Schedule Baseline
 - Cost Baseline
5. Project Document Updates
 - Issue Log
 - Lessons Learned Register
 - Risk Register

8.2 Manage Quality

ID #	Enabler	Primary Reference
2.7.2	Recommend options for improvement based on quality gaps	8.2
3.1.7	Measure the extent to which the project is in compliance	NEW 4.5, 8.2, 11.6
3.2.3	Verify measurement system is in place to track benefits	NEW 4.3 , 8.2

9.3 Acquire Resources

Key Concept: In this process, the PM receives, commandeers, and obtains the resources to do the project work.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Resource Management Plan - Procurement Management Plan - Cost Baseline 2. Project Documents <ul style="list-style-type: none"> - Project Schedule - Resource Calendars - Resource Requirements - Stakeholder Register 3. EEFs 4. OPAs 	<ol style="list-style-type: none"> 1. Decision-Making 2. Interpersonal and Team Skills <ul style="list-style-type: none"> - Multi-Criteria Decision Analysis 3. Pre-Assignment <ul style="list-style-type: none"> - Negotiation 4. Virtual Teams 	<ol style="list-style-type: none"> 1. Physical Resource Assignments 2. Project Team Assignments 3. Resource Calendars 4. Change Requests 5. Project Management Plan Updates <ul style="list-style-type: none"> - Resource Management Plan - Cost Baseline 6. Project Document Updates <ul style="list-style-type: none"> - Lessons Learned Register - Project Schedule - Resource Breakdown Structure - Resource Requirements - Risk Register - Stakeholder Register 7. EEF Updates 8. OPA Updates

9.3 Acquire Resources

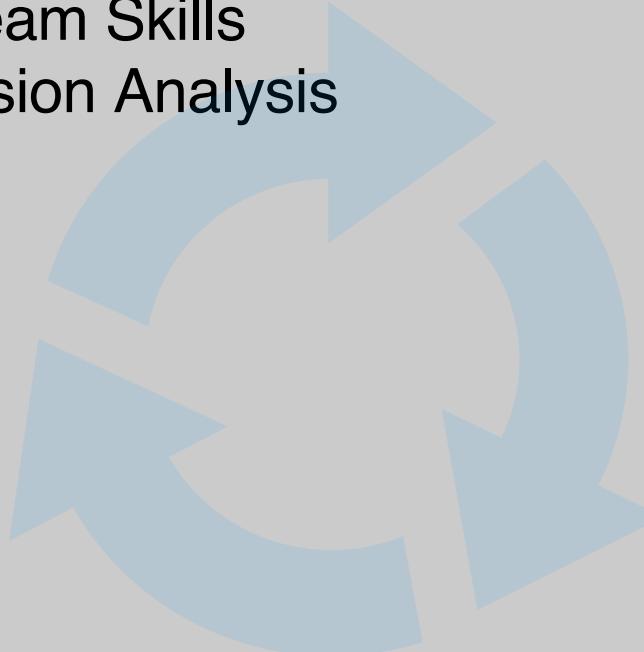
Inputs

1. Project Management Plan
 - Resource Management Plan
 - Procurement Management Plan
 - Cost Baseline
2. Project Documents
 - Project Schedule
 - Resource Calendars
 - Resource Requirements
 - Stakeholder Register
3. EEFs
4. OPAs

9.3 Acquire Resources

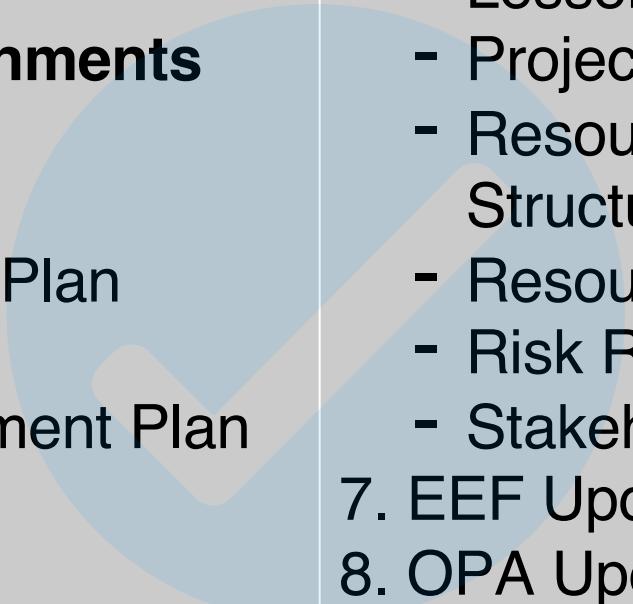
Tools and Techniques

1. Decision-Making
2. Interpersonal and Team Skills
 - Multi-Criteria Decision Analysis
3. Pre-Assignment
 - **Negotiation**
4. Virtual Teams



9.3 Acquire Resources

Outputs



- 1. Physical Resource Assignments**
- 2. Project Team Assignments**
3. Resource Calendars
4. Change Requests
5. Project Management Plan Updates
 - Resource Management Plan
 - Cost Baseline
6. Project Document Updates
 - Lessons Learned Register
 - Project Schedule
 - Resource Breakdown Structure
 - Resource Requirements
 - Risk Register
 - Stakeholder Register
7. EEF Updates
8. OPA Updates

9.3 Acquire Resources

New Terms from the 2021 Exam Change

- **Personality Profile Assessment:** A tool used to determine a person's personality traits or type; most widely used: Myers-Briggs Type Indicator
- **Pairing:** The concept of pairing team members together in order to increase work production—usually pairing senior team members with newer team members
- **Virtual Pairing:** Same as above, but in the virtual environment, time zone and work culture are also considered
- **Fishbowl Window:** A semipermanent video conference link between two locations

9.3 Acquire Resources

ID #	Enabler	Primary Reference
1.4.2	Support team task accountability	9.1, 9.2, 9.3 , 9.6
1.4.4	Determine and bestow level(s) of decision-making authority	9.1, 9.3
1.5.2	Determine training options based on training needs	9.1, 9.2, 9.3, 9.6
1.12.1	Communicate organizational principles with team and external stakeholders	13.3, 9.3
1.14.1	Assess behavior through the use of personality indicators	NEW 9.1, 9.3 , 9.5

9.4 Develop Team

Key Concept: This process focuses on collective training and evaluation of the team in order to create a team culture that can accomplish the planned project goals.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Resource Management Plan 2. Project Documents <ul style="list-style-type: none"> - Lessons Learned Register - Project Schedule - Project Team Assignments - Resource Calendars - Team Charter 3. EEFs 4. OPAs 	<ol style="list-style-type: none"> 1. Co-Location 2. Virtual Team 3. Communication Technology 4. Interpersonal and Team Skills <ul style="list-style-type: none"> - Conflict Management - Motivation - Negotiation - Team Building 5. Recognition and Rewards 6. Training 7. Individual and Team Assessments 8. Meetings 	<ol style="list-style-type: none"> 1. Team Performance Assessments 2. Change Requests 3. Project Management Plan Updates <ul style="list-style-type: none"> - Resource Management Plan 4. Project Document Updates <ul style="list-style-type: none"> - Lessons Learned Register - Project Schedule - Project Team Assignments - Resource Calendars - Team Charter 5. EEF Updates 6. OPA Updates

9.4 Develop Team

Inputs

1. Project Management Plan
 - Resource Management Plan
2. Project Documents
 - Lessons Learned Register
 - Project Schedule
 - Project Team Assignments
 - Resource Calendars
 - Team Charter
3. EEFs
4. OPAs

9.4 Develop Team

Tools and Techniques

1. Co-Location
2. Virtual Team
3. Communication Technology
4. **Interpersonal and Team Skills**
 - **Conflict Management**
 - **Motivation**
 - Negotiation
 - **Team Building**
5. Recognition and Rewards
6. Training
7. Individual and Team Assessments
8. Meetings

The Tuckman Ladder

- Forming
- Storming
- Norming
- Performing
- Adjourning

9.4 Develop Team

Outputs

1. Team Performance Assessments
2. Change Requests
3. Project Management Plan Updates
 - Resource Management Plan
4. Project Document Updates
 - Lessons Learned Register
 - Project Schedule
 - Project Team Assignments
 - Resource Calendars
 - Team Charter
5. EEF Updates
6. OPA Updates

9.4 Develop Team

New Terms from the 2021 Exam Change

- **Emotional Intelligence:** The intangible quality of a leader that allows the leader to know exactly what to say, when to say it, and how to say it
 - Personal Skills
 - Self-Awareness
 - Self-Regulation
 - Motivation
 - Interpersonal Skills
 - Social Skills
 - Empathy
- **Active Listening:** Communicating with others in a way that demonstrates to speakers that their views are important and are being understood
 - Reflective
 - Attentive
 - Following

9.4 Develop Team

ID #	Enabler	Primary Reference
1.3.4	Verify performance improvements	9.4, 9.6
1.4.3	Evaluate demonstration of task accountability	9.4, 9.5
1.5.4	Measure training outcomes	NEW 9.1, 9.4, 9.6
1.6.1	Appraise stakeholder skills	9.4
1.6.3	Continuously assess and refresh team skills to meet project needs	9.4
1.7.2	Prioritize critical impediments, obstacles, and blockers for the team	9.1, 9.4, APG
1.7.3	Use network to implement solutions to remove impediments, obstacles, and blockers for the team	9.1, 9.4, APG
1.7.4	Re-assess continually to ensure impediments, obstacles, and blockers for the team are being addressed	9.4, APG
1.12.3	Manage and rectify ground rule violations	9.4, 9.5

9.5 Manage Team

Key Concept: This process focuses on individual team member training and managing issues among team members when needed.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Resource Management Plan2. Project Documents<ul style="list-style-type: none">- Issue Log- Lessons Learned Register- Project Team Assignments- Team Charter3. Work Performance Reports4. Team Performance Assessments5. EEFs6. OPAs	<ol style="list-style-type: none">1. Interpersonal and Team Skills<ul style="list-style-type: none">- Conflict Management- Decision-Making- Emotional Intelligence- Influence- Leadership2. Project Management Information System	<ol style="list-style-type: none">1. Change Requests2. Project Management Plan Updates<ul style="list-style-type: none">- Resource Management Plan- Schedule Baseline- Cost Baseline3. Project Document Updates<ul style="list-style-type: none">- Issue Log- Lessons Learned Register- Project Team Assignments4. EEF Updates

9.5 Manage Team

Inputs

1. Project Management Plan
 - Resource Management Plan
2. Project Documents
 - Issue Log
 - Lessons Learned Register
 - Project Team Assignments
 - Team Charter
3. Work Performance Reports
4. Team Performance Assessments
5. EEFs
6. OPAs

9.5 Manage Team

Tools and Techniques

1. Interpersonal and Team Skills

- **Conflict Management**
- Decision-Making
- **Emotional Intelligence**
- **Influence**
- **Leadership**

2. Project Management Information System

Techniques for Resolving Conflicts

- Withdrawal/Avoid (lose-lose)
- Smooth/Accommodate (lose-lose)
- Force/Direct (win-lose)
- Compromise/Reconcile (win-win / lose-lose)
- Collaborate/Problem-Solve (win-win)

Motivational Theories

Expectancy Theory: This theory attempts to understand motivation as interactions between the follower and the leader.

Theory of Needs: This is the work **McClelland** adds to Expectancy Theory, which categorizes the competing needs of the follower.

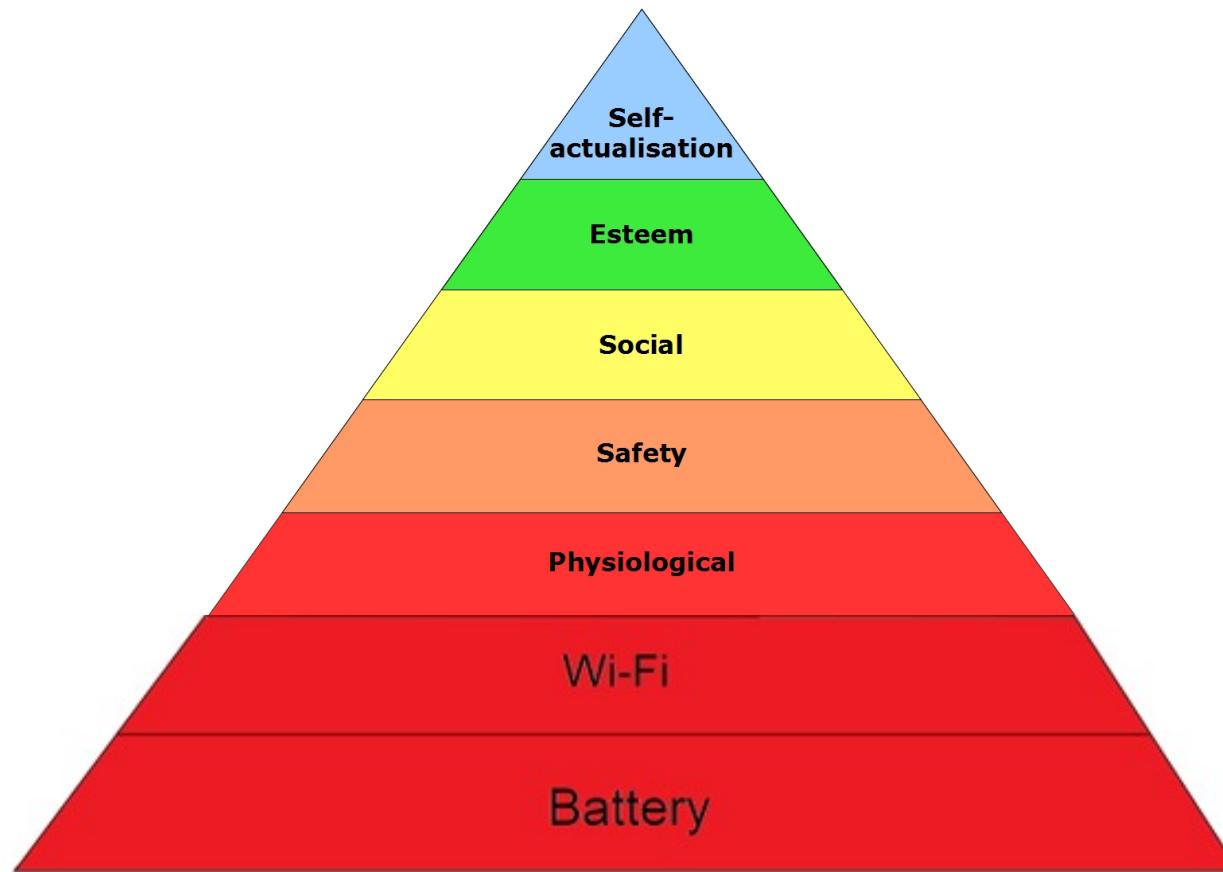
Hierarchy of Needs: **Maslow** builds on general motivation theory by categorizing human needs into five levels.

Two-Factor Theory: **Herzberg** emphasizes two factors affecting motivation (*hygiene factors* and *motivators*).

Theory Z: This is **Ouchi**'s long-term employment theory, which aims to increase loyalty via a career path and holistic employee development.

Motivational Theories

Hierarchy of Needs



9.5 Manage Team

Outputs

1. Change Requests
2. Project Management Plan Updates
 - Resource Management Plan
 - Schedule Baseline
 - Cost Baseline
3. Project Document Updates
 - **Issue Log**
 - Lessons Learned Register
 - Project Team Assignments
4. EEF Updates

9.5 Manage Team

ID #	Enabler	Primary Reference
1.1.1	Interpret the source and stage of the conflict	9.5
1.1.2	Analyze the context for the conflict	9.5
1.1.3	Evaluate/recommend/reconcile the appropriate conflict resolution solution	9.5
1.2.4	Determine an appropriate leadership style (e.g., directive, collaborative)	4.1, 9.1, 9.5
1.2.5	Inspire, motivate, and influence team members/stakeholders (e.g., team contract, social contract, reward system)	9.5
1.3.1	Appraise team member performance against key performance indicators	9.5
1.3.2	Support and recognize team member growth and development	9.5
1.3.3	Determine appropriate feedback approach	9.5
1.4.3	Evaluate demonstration of task accountability	9.4, 9.5
1.10.1	Break down situation to identify the root cause of a misunderstanding	13.3, 9.5 , 9.6
1.10.3	Support outcome of parties' agreement	9.5, 13.3
1.10.4	Investigate potential misunderstandings	9.5
1.12.3	Manage and rectify ground rule violations	9.4, 9.5
1.13.2	Recognize and act on mentoring opportunities	9.5, APG
1.14.1	Assess behavior through the use of personality indicators	NEW 9.1, 9.3, 9.5

10.2 Manage Communications

Key Concept: This one is pretty simple. In this process, the team communicates. Making sure the plan works is a different process.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan</p> <ul style="list-style-type: none"> - Resource Management Plan - Communications Management Plan - Stakeholder Engagement Plan <p>2. Project Documents</p> <ul style="list-style-type: none"> - Change Log - Issue Log - Lessons Learned Register - Quality Reports - Risk Reports - Stakeholder Register <p>3. OPAs</p> <p>4. EEFs</p>	<p>1. Communication Technology</p> <p>2. Communication Methods</p> <p>3. Communication Skills</p> <ul style="list-style-type: none"> - Communication Competence - Feedback - Nonverbal - Presentation <p>4. Project Management Information System</p> <p>5. Project Reporting</p> <p>6. Interpersonal and Team Skills</p> <ul style="list-style-type: none"> - Active Listening - Political Awareness - Cultural Awareness - Meeting Management - Networking <p>7. Meetings</p>	<p>1. Project Communications</p> <p>2. Project Management Plan Updates</p> <ul style="list-style-type: none"> - Communications Management Plan - Stakeholder Engagement Plan <p>3. Project Document Updates</p> <ul style="list-style-type: none"> - Issue Log - Lessons Learned Register - Project Schedule - Risk Register - Stakeholder Register <p>4. OPA Updates</p>

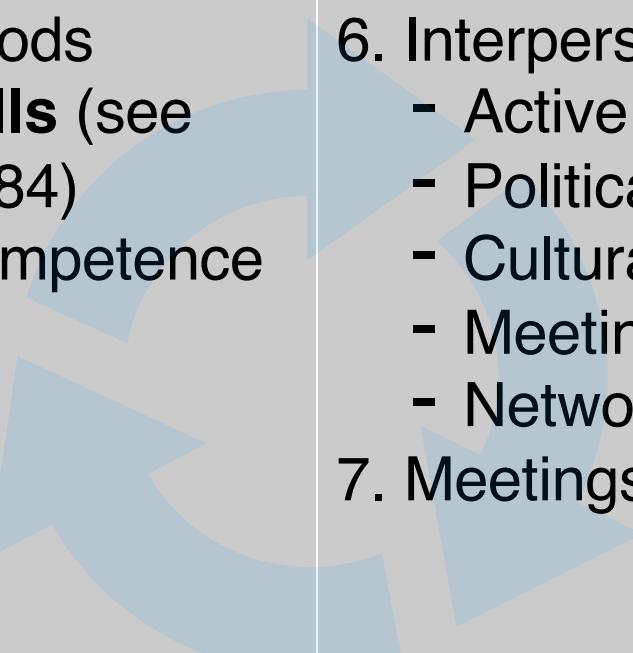
10.2 Manage Communications

Inputs

1. Project Management Plan
 - Resource Management Plan
 - Communications Management Plan
 - Stakeholder Engagement Plan
2. Project Documents
 - Change Log
 - Issue Log
 - Lessons Learned Register
 - Quality Reports
 - Risk Reports
 - Stakeholder Register
3. OPAs
4. EEFs

10.2 Manage Communications

Tools and Techniques



1. Communication Technology
2. Communication Methods
3. **Communication Skills** (see *PMBOK® Guide*, p. 384)
 - Communication Competence
 - Feedback
 - Nonverbal
 - Presentation
4. Project Management Information System
5. **Project Reporting**
6. Interpersonal and Team Skills
 - Active Listening
 - Political Awareness
 - Cultural Awareness
 - Meeting Management
 - Networking
7. Meetings

10.2 Manage Communications

Outputs

- 1. Project Communications**
- 2. Project Management Plan Updates**
 - Communications Management Plan
 - Stakeholder Engagement Plan
- 3. Project Document Updates**
 - Issue Log
 - Lessons Learned Register
 - Project Schedule
 - Risk Register
 - Stakeholder Register
- 4. OPA Updates**

10.2 Manage Communications

ID #	Enabler	Primary Reference
1.11.3	Implement options for virtual team member engagement	10.2, 13.3
2.2.3	Communicate project information and updates effectively	10.2
2.2.4	Confirm communication is understood and feedback is received	10.2
2.15.3	Collaborate with relevant stakeholders on the approach to resolve the issues	10.1, 10.2, 11.1, 13.2

11.6 Implement Risk Responses

Key Concept: Once a trigger event has occurred, the contingency plan is started. If the contingency plan fails, the fallback plan will be initiated. The role of the risk owner and the PM should have been defined in the Risk Management Plan, but the specifics for one risk event will be in the Risk Register.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Risk Management Plan2. Project Documents<ul style="list-style-type: none">- Lessons Learned Register- Risk Register- Risk Reports3. OPAs	<ul style="list-style-type: none">1. Expert Judgment2. Interpersonal and Team Skills<ul style="list-style-type: none">- Influencing3. Project Management Information System	<ul style="list-style-type: none">1. Change Requests2. Project Document Updates<ul style="list-style-type: none">- Issue Log- Lessons Learned Register- Project Team Assignments- Risk Register- Risk Reports

11.6 Implement Risk Responses

Inputs

1. Project Management Plan
 - **Risk Management Plan**
2. Project Documents
 - Lessons Learned Register
 - **Risk Register**
 - Risk Reports
3. OPAs

11.6 Implement Risk Responses

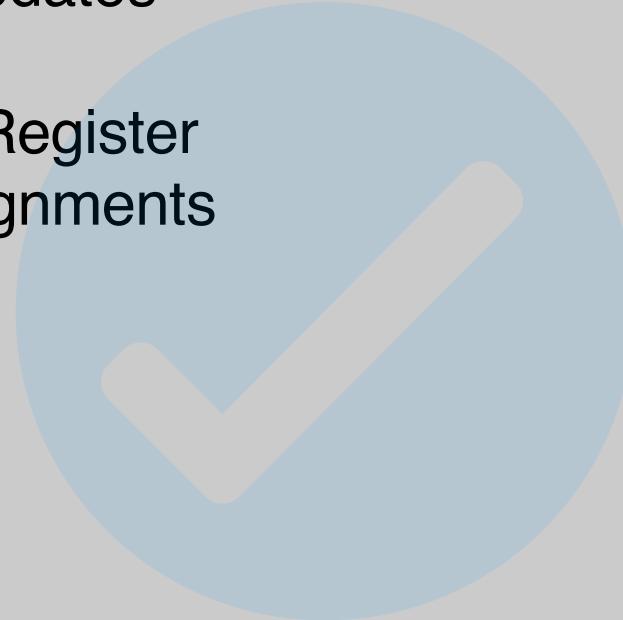
Tools and Techniques

1. Expert Judgment
2. Interpersonal and Team Skills
 - **Influencing:** At times, the risk response strategy could be owned by someone outside the project team.
3. Project Management Information System

11.6 Implement Risk Responses

Outputs

1. Change Requests
2. Project Document Updates
 - Issue Log
 - Lessons Learned Register
 - Project Team Assignments
 - Risk Register
 - Risk Reports



11.6 Implement Risk Responses

ID #	Enabler	Primary Reference
2.15.1	Recognize when a risk becomes an issue	11.6
2.15.2	Attack the issue with the optimal action to achieve project success	11.4, 11.5, 11.6
3.1.4	Use methods to support compliance	NEW 4.3, 8.3, 11.6
3.1.7	Measure the extent to which the project is in compliance	NEW 4.5, 8.2, 11.6

12.2 Conduct Procurements

Key Concept: This process is comprised of three distinct actions: collecting proposals, selecting a vendor, and awarding the contract. In a centralized procurement office, the PM will not lead any of this.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan</p> <ul style="list-style-type: none"> - Scope Management Plan - Requirements Management Plan - Communications Management Plan - Risk Management Plan - Procurement Management Plan - Configuration Management Plan - Cost Baseline <p>2. Project Documents</p> <ul style="list-style-type: none"> - Lessons Learned Register - Project Schedule - Requirements Documentation - Risk Register - Stakeholder Register <p>3. Procurement Documentation</p> <p>4. Seller Proposals</p> <p>5. EEFs</p> <p>6. OPAs</p>	<p>1. Expert Judgment</p> <p>2. Advertising</p> <p>3. Bidder Conferences</p> <p>4. Data Analysis</p> <ul style="list-style-type: none"> - Influencing - Proposal Evaluation Techniques <p>5. Interpersonal and Team Skills</p> <ul style="list-style-type: none"> - Negotiation 	<p>1. Selected Sellers</p> <p>2. Agreements</p> <p>3. Change Requests</p> <p>4. Project Management Plan Updates</p> <ul style="list-style-type: none"> - Requirements Management Plan - Quality Management Plan - Communications Management Plan - Risk Management Plan - Procurement Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline <p>5. Project Document Updates</p> <ul style="list-style-type: none"> - Lessons Learned Register - Requirements Documentation - Requirements Traceability Matrix - Resource Calendars - Risk Register - Stakeholder Register <p>6. OPA Updates</p>

12.2 Conduct Procurements

Inputs

1. Project Management Plan
 - Scope Management Plan
 - Requirements Management Plan
 - Communications Management Plan
 - Risk Management Plan
 - Procurement Management Plan
 - Configuration Management Plan
 - Cost Baseline

2. Project Documents
 - Lessons Learned Register
 - Project Schedule
 - Requirements Documentation
 - Risk Register
 - Stakeholder Register
3. Procurement Documentation
4. Seller Proposals
5. EEFs
6. OPAs

12.2 Conduct Procurements

Tools and Techniques

1. Expert Judgment
2. Advertising
3. Bidder Conferences
4. Data Analysis
 - Influencing
 - **Proposal Evaluation Techniques**
5. Interpersonal and Team Skills
 - **Negotiation:** This is usually led by someone from the procurement office, unless the organization uses a decentralized procurement strategy.

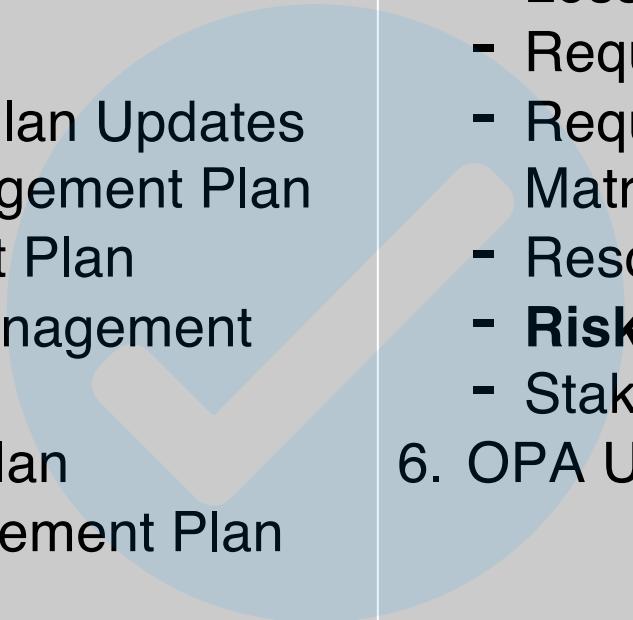
Effective Vendor Management

- Use an SOW to define scope.
- Use reports and milestones to control the vendor.
- Manage the quality of the deliverables with inspections and audits.
- Relationship management is key for future procurements!

Basically, the PM acts like a sponsor.

12.2 Conduct Procurements

Outputs



1. Selected Sellers
2. Agreements
3. Change Requests
4. Project Management Plan Updates
 - Requirements Management Plan
 - Quality Management Plan
 - Communications Management Plan
 - Risk Management Plan
 - Procurement Management Plan
 - Scope Baseline
 - Schedule Baseline
 - Cost Baseline
5. Project Document Updates
 - Lessons Learned Register
 - Requirements Documentation
 - Requirements Traceability Matrix
 - Resource Calendars
 - **Risk Register**
 - Stakeholder Register
6. OPA Updates

12.2 Conduct Procurements

ID #	Enabler	Primary Reference
1.8.2	Assess priorities and determine ultimate objective(s)	12.2
1.8.4	Participate in agreement negotiations	12.2
2.11.2	Communicate resource requirements	5.2, 9.2, 12.1, 12.2
2.11.4	Plan and manage procurement strategy	12.1, 12.2, 12.3
2.11.5	Develop a delivery solution	12.2

13.3 Manage Stakeholder Engagement

Key Concept: This is the process of creating the Stakeholder Engagement Plan.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Communications Management Plan - Risk Management Plan - Stakeholder Engagement Plan 2. Project Documents <ul style="list-style-type: none"> - Assumption Log - Change Log - Issue Log - Lessons Learned Register - Stakeholder Register 3. EEFs 4. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Communication Skills <ul style="list-style-type: none"> - Feedback 3. Interpersonal Skills <ul style="list-style-type: none"> - Conflict Management - Cultural Awareness - Negotiation - Observation/Conversation - Political Awareness 4. Ground Rules 5. Meetings 	<ol style="list-style-type: none"> 1. Change Requests 2. Project Management Plan Updates <ul style="list-style-type: none"> - Communications Management Plan - Stakeholder Engagement Plan 3. Project Document Updates <ul style="list-style-type: none"> - Change Log - Issue Log - Lessons Learned Register - Stakeholder Register

13.3 Manage Stakeholder Engagement

Inputs

1. Project Management Plan
 - Communications Management Plan
 - Risk Management Plan
 - Stakeholder Engagement Plan
2. Project Documents
 - Assumption Log
 - **Change Log**
 - Issue Log
 - Lessons Learned Register
 - Stakeholder Register
3. EEFs
4. OPAs

13.3 Manage Stakeholder Engagement

Tools and Techniques

1. Expert Judgment
2. Communication Skills
 - Feedback
3. Interpersonal Skills
 - Conflict Management
 - Cultural Awareness
 - Negotiation
 - Observation/Conversation
 - Political Awareness
4. Ground Rules
5. Meetings



13.3 Manage Stakeholder Engagement

Outputs

1. Change Requests
2. Project Management Plan Updates
 - Communications Management Plan
 - Stakeholder Engagement Plan
3. Project Document Updates
 - Change Log
 - Issue Log
 - Lessons Learned Register
 - Stakeholder Register

13.3 Manage Stakeholder Engagement

ID #	Enabler	Primary Reference
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2, 8.1, 11.1, 11.2, 13.1, 13.3

Monitoring and Controlling Process Group

- 4.5 Monitor and Control Project Work
- 4.6 Perform Integrated Change Control
- 5.5 Validate Scope
- 5.6 Control Scope
- 6.6 Control Schedule
- 7.4 Control Costs
- 8.3 Control Quality
- 9.6 Control Resources
- 10.3 Monitor Communications
- 11.7 Monitor Risks
- 12.3 Control Procurements
- 13.4 Monitor Stakeholder Engagement



4.5 Monitor and Control Project Work

Key Concept: This is the process in which all reports are made, except quality reports, risk reports, and closing reports.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Any Component 2. Project Documents <ul style="list-style-type: none"> - Assumption Log - Basis of Estimates - Cost Forecasts - Issue Log - Lessons Learned Register - Milestone List - Quality Reports - Risk Register - Risk Reports - Schedule Forecasts 3. Work Performance Information 4. Agreements 5. EEFs 6. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Data Analysis <ul style="list-style-type: none"> - Alternative Analysis - Cost-Benefit Analysis - Earned Value Analysis - Root Cause Analysis - Trend Analysis - Variance Analysis 3. Decision-Making 4. Meetings 	<ol style="list-style-type: none"> 1. Work Performance Reports 2. Change Requests 3. Project Management Plan Updates <ul style="list-style-type: none"> - Any Component 4. Project Document Updates <ul style="list-style-type: none"> - Cost Forecasts - Issue Log - Lessons Learned Register - Risk Register - Schedule Forecast

4.5 Monitor and Control Project Work

Inputs	
<ol style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Any Component2. Project Documents<ul style="list-style-type: none">- Assumption Log- Basis of Estimates- Cost Forecasts- Issue Log- Lessons Learned Register- Milestone List- Quality Reports- Risk Register- Risk Reports- Schedule Forecasts	<ol style="list-style-type: none">3. Work Performance Information4. Agreements5. EEFs6. OPAs

4.5 Monitor and Control Project Work

Tools and Techniques

1. Expert Judgment
2. Data Analysis
 - Alternative Analysis
 - Cost-Benefit Analysis
 - **Earned Value Analysis**
 - **Root Cause Analysis**
 - **Trend Analysis**
 - **Variance Analysis**
3. Decision-Making
4. Meetings



4.5 Monitor and Control Project Work

Outputs

1. Work Performance Reports
2. Change Requests
3. Project Management Plan Updates
 - Any Component
4. Project Document Updates
 - Cost Forecasts
 - Issue Log
 - Lessons Learned Register
 - Risk Register
 - Schedule Forecast

4.5 Monitor and Control Project Work

ID #	Enabler	Primary Reference
2.9.2	Assess consolidated project plans for dependencies, gaps, and continued business value	4.2, 4.4, 4.5, APG
2.9.5	Determine critical information requirements	4.1, 4.3, 5.2, 4.5
2.12.2	Validate that the project information is kept up to date (i.e., version control) and accessible to all stakeholders	4.4, 4.3, 4.5
2.12.3	Continually assess the effectiveness of the management of the project artifacts	4.4, 4.5
3.1.7	Measure the extent to which the project is in compliance	NEW 4.5, 8.2, 11.6
3.2.4	Evaluate delivery options to demonstrate value	NEW 4.2, 4.5, 5.5

4.6 Perform Integrated Change Control

Key Concept: This is the only process that approves changes to the project.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Change Management Plan - Configuration Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline 2. Project Documents <ul style="list-style-type: none"> - Basis of Estimates - Requirements Traceability Matrix - Risk Reports 3. Work Performance Reports 4. Change Requests 5. EEFs 6. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Change Control Tools 3. Data Analysis <ul style="list-style-type: none"> - Alternative Analysis - Cost-Benefit Analysis 4. Decision-Making <ul style="list-style-type: none"> - Voting - Autocratic Decision-Making - Multi-Criteria Decision Analysis 5. Meetings 	<ol style="list-style-type: none"> 1. Approved Change Requests 2. Project Management Plan Updates <ul style="list-style-type: none"> - Any Component 3. Project Document Updates <ul style="list-style-type: none"> - Change Log

4.6 Perform Integrated Change Control

Inputs	
1. Project Management Plan <ul style="list-style-type: none">- Change Management Plan- Configuration Management Plan- Scope Baseline- Schedule Baseline- Cost Baseline	3. Work Performance Reports 4. Change Requests 5. EEFs 6. OPAs
2. Project Documents <ul style="list-style-type: none">- Basis of Estimates- Requirements Traceability Matrix- Risk Reports	

4.6 Perform Integrated Change Control

Tools and Techniques

1. Expert Judgment
2. **Change Control Tools**
3. Data Analysis
 - Alternative Analysis
 - Cost-Benefit Analysis
4. Decision-Making
 - Voting
 - Autocratic Decision-Making
 - Multi-Criteria Decision Analysis
5. **Meetings:** A change control board (CCB) is a type of meeting. On the exam, assume that you have a change control board unless the question states otherwise.

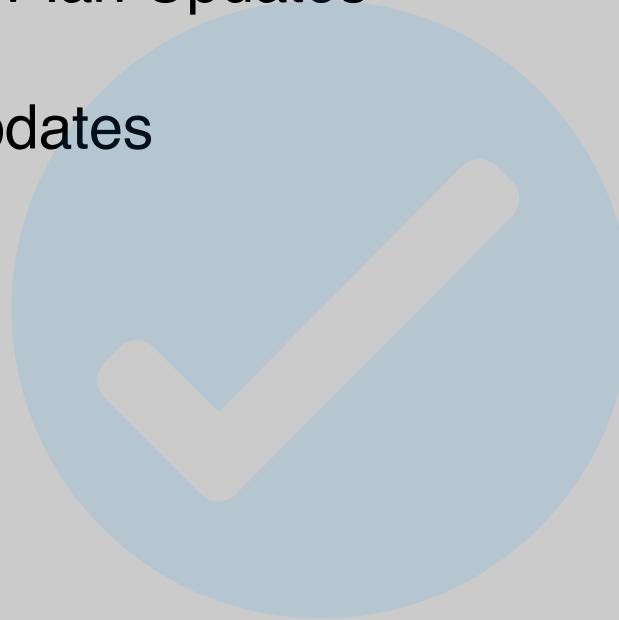
Flow of Change Management Activities

1. Create change control tools and a plan.
2. Identify the need for a change.
3. Document the change.
4. Approve, defer, or reject the change.
5. Update all affected plans and documents.
6. Get buy-in or feedback from stakeholders.
7. Track the change.

4.6 Perform Integrated Change Control

Outputs

1. Approved Change Requests
2. Project Management Plan Updates
 - Any Component
3. Project Document Updates
 - **Change Log**



4.6 Perform Integrated Change Control

New Terms from the 2021 Exam Change

- **Change Management Theory:**
 - **McKinsey 7-S Model:** A tool that analyzes a firm's organizational design by looking at seven key internal elements—strategy, structure, systems, shared values, style, staff, and skills—in order to identify whether they are effectively aligned and to allow the organization to achieve its objectives
 - **Kotter's Model:** A tool created by John Kotter after his study showed that organizational change has a 30% chance of success
 - 1. Create a sense of urgency
 - 2. Create a guiding coalition
 - 3. Create a vision for change
 - 4. Communicate the vision
 - 5. Remove obstacles
 - 6. Create short-term wins
 - 7. Consolidate improvements
 - 8. Anchor the changes

4.6 Perform Integrated Change Control

ID #	Enabler	Primary Reference
2.9.4	Collect and analyze data to make informed project decisions	4.3, 4.6, all M/C
2.10.1	Anticipate and embrace the need for change (e.g., follow change management practices)	4.1, 4.2, 4.3, 4.6
2.10.3	Execute change management strategy according to the methodology	4.3, 4.6
2.10.4	Determine a change response to move the project forward	4.6, 4.3
3.4.2	Evaluate impact of organizational change to project and determine required actions	NEW 4.3, 4.6

5.5 Validate Scope

Key Concept: This is the process turning verified deliverables into accepted deliverables.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Scope Management Plan- Requirements Management Plan- Scope Baseline2. Project Documents<ul style="list-style-type: none">- Lessons Learned Register- Quality Reports- Requirements Documentation- Requirements Traceability Matrix3. Verified Deliverables4. Work Performance Data	<ul style="list-style-type: none">1. Inspections2. Decision-Making<ul style="list-style-type: none">- Voting	<ul style="list-style-type: none">1. Accepted Deliverables2. Work Performance Information3. Change Requests4. Project Document Updates<ul style="list-style-type: none">- Lessons Learned Register- Requirements Documentation- Requirements Traceability Matrix

5.5 Validate Scope

Inputs

1. Project Management Plan
 - Scope Management Plan
 - Requirements Management Plan
 - Scope Baseline
2. Project Documents
 - Lessons Learned Register
 - **Quality Reports**
 - **Requirements Documentation**
 - **Requirements Traceability Matrix**
3. **Verified Deliverables:** This is an output from Control Quality, and now it's possible to see the flow of deliverables: "Direct and Manage Project Work" creates *deliverables*; "Control Quality" checks them and makes *verified deliverables*; this process turns them into *validated deliverables*.
4. Work Performance Data

5.5 Validate Scope

Tools and Techniques

- 1. Inspections:** Best-case scenario, the person who will sign off on the deliverables does the inspection.
2. Decision-Making
 - Voting



5.5 Validate Scope

Outputs

- 1. Accepted Deliverables**
- 2. Work Performance Information**
- 3. Change Requests**
- 4. Project Document Updates**
 - Lessons Learned Register
 - Requirements Documentation
 - Requirements Traceability Matrix

5.5 Validate Scope

ID #	Enabler	Primary Reference
2.1.2	Examine the business value throughout the project	5.4, 5.5 , APG
2.8.3	Monitor and validate scope	5.5, 5.6
2.17.2	Validate readiness for transition (e.g., to operations team or next phase)	8.3, 5.5, 4.7
3.1.7	Measure the extent to which the project is in compliance	NEW 4.5, 8.2, 5.5, 11.6

5.6 Control Scope

Key Concept: This is the process of understanding how scope creep is entering the project and also of eliminating unapproved scope creep (gold plating).

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Scope Management Plan - Requirements Management Plan - Change Management Plan - Configuration Management Plan - Scope Baseline - Performance Measurement Baseline 2. Project Documents <ul style="list-style-type: none"> - Lessons Learned Register - Requirements Documentation - Requirements Traceability Matrix 3. Work Performance Data 4. OPAs 	<ol style="list-style-type: none"> 1. Data Analysis <ul style="list-style-type: none"> - Variance Analysis - Trend Analysis 	<ol style="list-style-type: none"> 1. Work Performance Information 2. Change Requests 3. Project Management Plan Updates <ul style="list-style-type: none"> - Scope Management Plan - Scope Baseline - Schedule Baseline - Cost Baseline - Performance Management Plan 4. Project Document Updates <ul style="list-style-type: none"> - Lessons Learned Register - Requirements Documentation - Requirements Traceability Matrix

5.6 Control Scope

Inputs

1. Project Management Plan
 - Scope Management Plan
 - Requirements Management Plan
 - Change Management Plan
 - Configuration Management Plan
 - **Scope Baseline**
 - Performance Measurement Baseline
2. Project Documents
 - Lessons Learned Register
 - Requirements Documentation
 - Requirements Traceability Matrix
3. Work Performance Data
4. OPAs

5.6 Control Scope

Tools and Techniques

1. Data Analysis

- Variance Analysis
- Trend Analysis



5.6 Control Scope

Outputs

- 1. Work Performance Information**
- 2. Change Requests**
- 3. Project Management Plan Updates**
 - Scope Management Plan
 - Scope Baseline
 - Schedule Baseline
 - Cost Baseline
 - Performance Management Plan
- 4. Project Document Updates**
 - Lessons Learned Register
 - Requirements Documentation
 - Requirements Traceability Matrix

5.6 Control Scope

ID #	Enabler	Primary Reference
2.8.3	Monitor and validate scope	5.5, 5.6

6.6 Control Schedule

Key Concept: This is the most common process in project management: looking at the plan and comparing it to how much work has been completed to stay ahead of or on schedule.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Schedule Management Plan - Schedule Baseline - Scope Baseline - Performance Measurement Baseline 2. Project Documents <ul style="list-style-type: none"> - Lessons Learned Register - Project Calendars - Project Schedule - Resource Calendars - Schedule Data 3. Work Performance Data 4. OPAs 	<ol style="list-style-type: none"> 1. Data Analysis <ul style="list-style-type: none"> - Earned Value Analysis - Iteration Burndown Chart - Performance Reviews - Variance Analysis - Trend Analysis - What-If Scenario Analysis 2. Critical Path Method 3. Project Management Information System 4. Resource Optimization Techniques 5. Leads and Lags 6. Schedule Compression 	<ol style="list-style-type: none"> 1. Work Performance Information 2. Schedule Forecasts 3. Change Requests 4. Project Management Plan Updates <ul style="list-style-type: none"> - Schedule Management Plan - Schedule Baseline - Cost Baseline - Performance Management Plan 5. Project Document Updates <ul style="list-style-type: none"> - Assumptions Log - Basis of Estimates - Lessons Learned Register - Project Schedule - Resource Calendars - Risk Register - Scheduling Data

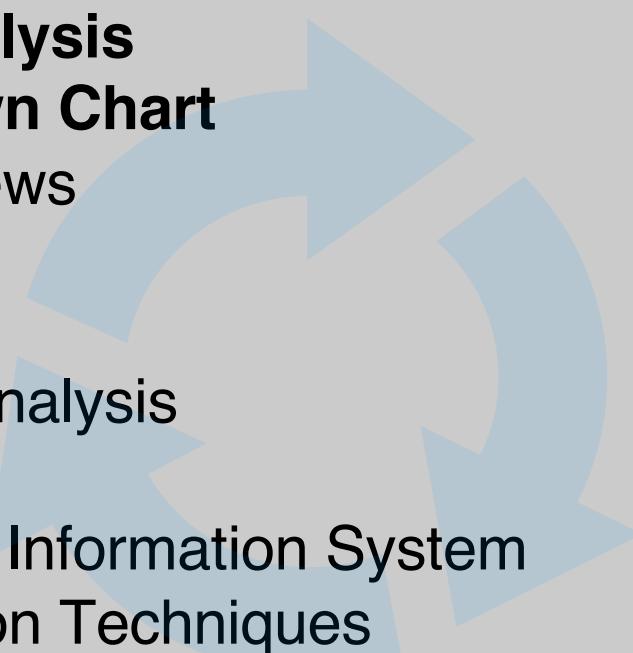
6.6 Control Schedule

Inputs

1. Project Management Plan
 - Schedule Management Plan
 - Schedule Baseline
 - Scope Baseline
 - Performance Measurement Baseline
2. Project Documents
 - Lessons Learned Register
 - Project Calendars
 - Project Schedule
 - Resource Calendars
 - Schedule Data
3. Work Performance Data
4. OPAs

6.6 Control Schedule

Tools and Techniques



1. Data Analysis
 - **Earned Value Analysis**
 - **Iteration Burndown Chart**
 - Performance Reviews
 - Variance Analysis
 - Trend Analysis
 - What-If Scenario Analysis
2. Critical Path Method
3. Project Management Information System
4. Resource Optimization Techniques
5. Leads and Lags
6. Schedule Compression

6.6 Control Schedule

Outputs

<ul style="list-style-type: none">1. Work Performance Information: This is usually represented as SV or SPI.2. Schedule Forecasts: Based on what is known in the project now and the rate of work achieved so far, the PM can create a forecast as to when the project should end.3. Change Requests	<ul style="list-style-type: none">4. Project Management Plan Updates<ul style="list-style-type: none">- Schedule Management Plan- Schedule Baseline- Cost Baseline- Performance Management Plan5. Project Document Updates<ul style="list-style-type: none">- Assumptions Log- Basis of Estimates- Lessons Learned Register- Project Schedule- Resource Calendars- Risk Register- Scheduling Data
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6.6 Control Schedule

ID #	Enabler	Primary Reference
2.6.4	Measure ongoing progress based on methodology	6.1, 6.6
2.6.5	Modify schedule as needed based on methodology	6.1, 6.5, 6.6
2.6.6	Coordinate with other projects and other operations	NEW 4.1, 6.3, 6.6 , p. 543, APG pp. 82 and 111

7.4 Control Costs

Key Concept: In this process, the PM compares all of the project spending to the planned spending to stay on or under budget, and from this the PM can create a cost forecast.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Cost Management Plan- Cost Baseline- Performance Measurement Baseline2. Project Documents<ul style="list-style-type: none">- Lessons Learned Register3. Project Funding Requirements4. Work Performance Data5. OPAs	<ol style="list-style-type: none">1. Expert Judgment2. Data Analysis<ul style="list-style-type: none">- Earned Value Analysis- Variance Analysis- Trend Analysis- Reserve Analysis3. To Completion Performance Index4. Project Management Information System	<ol style="list-style-type: none">1. Work Performance Information2. Cost Forecasts3. Change Requests4. Project Management Plan Updates<ul style="list-style-type: none">- Cost Management Plan- Cost Baseline- Performance Management Plan5. Project Document Updates<ul style="list-style-type: none">- Assumptions Log- Basis of Estimates- Cost Estimates- Lessons Learned Register- Risk Register

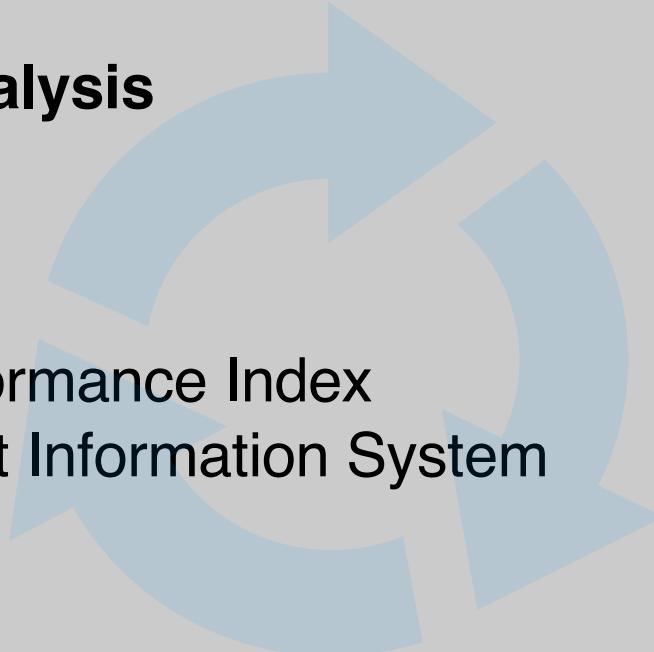
7.4 Control Costs

Inputs

1. Project Management Plan
 - Cost Management Plan
 - Cost Baseline
 - Performance Measurement Baseline
2. Project Documents
 - Lessons Learned Register
3. Project Funding Requirements
4. Work Performance Data
5. OPAs

7.4 Control Costs

Tools and Techniques



1. Expert Judgment
2. Data Analysis
 - **Earned Value Analysis**
 - Variance Analysis
 - Trend Analysis
 - Reserve Analysis
3. To Completion Performance Index
4. Project Management Information System

Earned Value

This method of determining project health and forecasting can be difficult and is considered the hardest area on the exam. To make this easy on yourself when reading the test questions, turn time into dollars, then work into dollars. Or just check C...

	Term	Definition	PG
BAC	Budget at Completion	Value of all of the work	Planning
PV	Planned Value	Budgeted value of the work created from estimates	Planning
EV	Earned Value	Value of the work actually completed	Executing
AC	Actual Cost (Total)	How much was actually spent to get the work done	Executing
CV	Cost Variance	How many dollars you are off by	M&C
SV	Schedule Variance	Whether you are ahead of or behind schedule	M&C
CPI	Cost Performance Index	Rate of spending vs. work completed	M&C
SPI	Schedule Performance Index	Speed that work is getting completed vs. the plan	M&C
EAC	Estimate at Completion	Updated total cost forecast (based on progress)	M&C
ETC	Estimate to Complete	Expected costs remaining (now until end)	M&C
VAC	Variance at Completion	Expected variance over/under budget	M&C
TCPI	To Completion Performance Index	Optimal CPI needed for the remainder of the project	M&C

Earned Value

4 Basic Values

	Term	Explanation
BAC	Budget at Completion	Work x total units of work
PV	Planned Value	# of units that should have been done x the value of each unit
EV	Earned Value	# of units complete right now x the value of each unit
AC	Actual Cost (Total)	Actual cost of work completed

	Term	Formula	Explanation
CV	Cost Variance	$CV = EV - AC$	– Over Budget, + Under Budget
SV	Schedule Variance	$SV = EV - PV$	– Behind Schedule, + Ahead of Schedule
CPI	Cost Performance Index	$CPI = EV / AC$	Less than 1 Over, Greater than 1 Under
SPI	Schedule Performance Index	$SPI = EV / PV$	Less than 1 Behind, Greater than 1 Ahead
EAC	Estimate at Completion	Four Types	Forecasted ending dollar amount
ETC	Estimate to Complete	$ETC = EAC - AC$	How many more dollars until you hit EAC
VAC	Variance at Completion	$VAC = BAC - EAC$	How far off you are from the BAC
TCPI	To Completion Performance Index	Two Types	At this CPI, you can fix the project.

Earned Value

	Term	Formula	Explanation
EAC	Estimate at Complete	BAC / Cumulative CPI or BAC / CPI	When you believe that what has happened so far will continue to happen; used when variances are expected to continue
		AC + (BAC – EV)	Ignores the past and uses the planned rate; used for anomalies
		AC + Bottom-Up ETC	Used to re-baseline the project
		AC + $\left[\frac{(BAC - EV)}{(CPI * SPI)} \right]$	Assumes both poor cost and poor schedule performance will continue
TCPI	To Completion Performance Index	$\frac{(BAC - EV)}{(BAC - AC)}$	Used to fix the problem and hit the BAC at the end of the project
		$\frac{(BAC - EV)}{(EAC - AC)}$	When the original budget is not possible and you have re-baselined the project, now you will try to hit the new EAC.

7.4 Control Costs

You are managing the development of a neighborhood comprised of 12 homes of equal value estimated at \$200,000 each. This project was estimated to take 24 months; currently you are 12 months into it. According to the plan, you should have completed a home every two months. Unfortunately, you have experienced labor shortages, and because of this, you are currently 2 homes behind schedule. You have spent \$1,000,000 to complete the 4 homes, and your variances are expected to continue. What is your TCPI?

BAC =

CV =

EAC =

PV =

SV =

ETC =

EV =

CPI =

VAC =

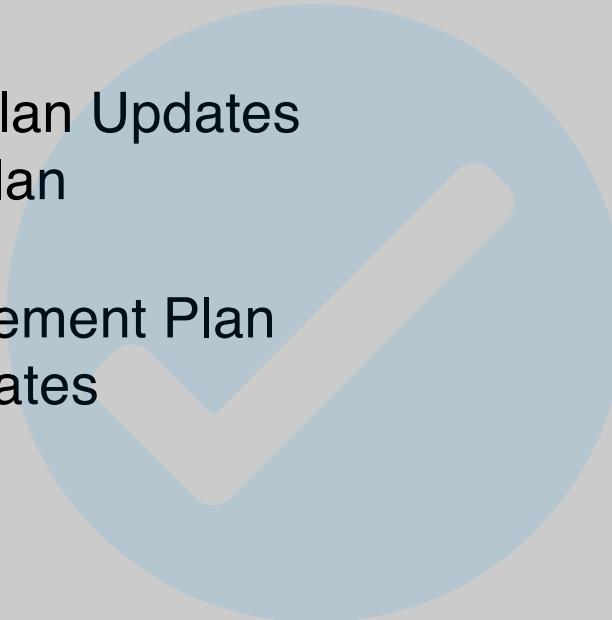
AC =

SPI =

TCPI =

7.4 Control Costs

Outputs



1. Work Performance Information
2. Cost Forecasts
3. Change Requests
4. Project Management Plan Updates
 - Cost Management Plan
 - Cost Baseline
 - Performance Management Plan
5. Project Document Updates
 - Assumptions Log
 - Basis of Estimates
 - Cost Estimates
 - Lessons Learned Register
 - Risk Register

7.4 Control Costs

ID #	Enabler	Primary Reference
2.5.2	Anticipate future budget challenges	7.1, 7.3, 7.4
2.5.3	Monitor budget variations and work with governance process to adjust as necessary	7.4
2.5.4	Plan and manage resources	7.1, 7.2, 7.3, 7.4

8.3 Control Quality

Key Concept: This process checks deliverables to determine whether they are defective or they meet the requirements. It also creates the documents that prove that this check actually happened.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Quality Management Plan 2. Project Documents <ul style="list-style-type: none"> - Lessons Learned Register - Quality Metrics - Test and Evaluation Documents 3. Approved Change Requests 4. Deliverables 5. Work Performance Data 6. EEFs 7. OPAs 	<ol style="list-style-type: none"> 1. Data Gathering <ul style="list-style-type: none"> - Checklists - Check Sheets - Statistical Sampling - Questionnaires and Surveys 2. Data Analysis <ul style="list-style-type: none"> - Performance Reviews - Root Cause Analysis 3. Inspections 4. Testing/Product Evaluation 5. Data Representation <ul style="list-style-type: none"> - Cause-and-Effect Diagrams - Control Charts - Histograms - Scatter Diagrams 6. Meetings 	<ol style="list-style-type: none"> 1. Quality Control Measurements 2. Verified Deliverables 3. Work Performance Information 4. Change Requests 5. Project Management Plan Updates <ul style="list-style-type: none"> - Quality Management Plan 6. Project Document Updates <ul style="list-style-type: none"> - Issue Log - Lessons Learned Register - Test and Evaluation Documents

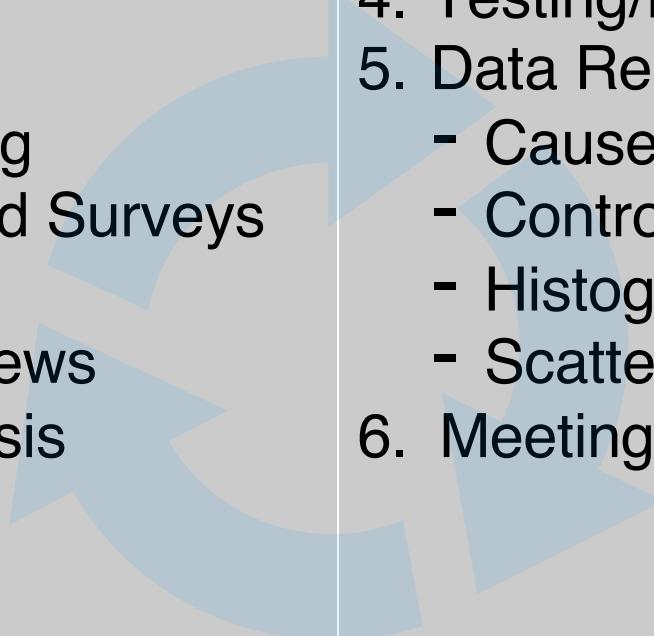
8.3 Control Quality

Inputs

1. **Project Management Plan:** This tells the person doing the check exactly what to do and how to do it.
 - Quality Management Plan
2. Project Documents
 - Lessons Learned Register
 - **Quality Metrics**
 - Test and Evaluation Documents
3. Approved Change Requests
4. **Deliverables**
5. Work Performance Data
6. EEFs
7. OPAs

8.3 Control Quality

Tools and Techniques



1. Data Gathering
 - Checklists
 - Check Sheets
 - Statistical Sampling
 - Questionnaires and Surveys
2. Data Analysis
 - Performance Reviews
 - Root Cause Analysis
3. Inspections
4. Testing/Product Evaluation
5. Data Representation
 - Cause-and-Effect Diagrams
 - Control Charts
 - Histograms
 - Scatter Diagrams
6. Meetings

8.3 Control Quality

Outputs

1. **Quality Control Measurements:** These are the documents that are filled out every time a check is done on a deliverable. They should all be filled out and archived according to the Quality Management Plan.
2. **Verified Deliverables**
3. Work Performance Information
4. Change Requests
5. Project Management Plan Updates
 - Quality Management Plan
6. Project Document Updates
 - Issue Log
 - Lessons Learned Register
 - Test and Evaluation Documents

8.3 Control Quality

ID #	Enabler	Primary Reference
2.7.3	Continually survey project deliverables quality	8.3
3.1.1	Confirm project compliance requirements (e.g., security, health and safety, regulatory compliance)	4.1, 5.2 , 8.1, 8.2, 8.3, 11.1, 11.2, 13.1
3.1.4	Use methods to support compliance	NEW 4.3, 8.3, 11.6

9.6 Control Resources

Key Concept: This process checks to ensure that resources assigned to the project are available to the project. It also makes sure that those resources are returned to the organization according to the plan.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Resource Management Plan 2. Project Documents <ul style="list-style-type: none"> - Lessons Learned Register - Physical Resource Assignments - Project Schedule - Resource Breakdown Structure - Resource Requirements - Risk Register 3. Work Performance Data 4. Agreements 5. OPAs 	<ol style="list-style-type: none"> 1. Data Analysis <ul style="list-style-type: none"> - Performance Reviews - Alternative Analysis - Cost-Benefit Analysis - Performance Reviews - Trend Analysis 2. Problem-Solving 3. Interpersonal and Team Skills <ul style="list-style-type: none"> - Negotiation - Influencing 4. Project Management Information System 	<ol style="list-style-type: none"> 1. Work Performance Information 2. Change Requests 3. Project Management Plan Updates <ul style="list-style-type: none"> - Resource Management Plan - Schedule Baseline - Cost Baseline 4. Project Document Updates <ul style="list-style-type: none"> - Assumptions Log - Issue Log - Lessons Learned Register - Physical Resource Assignments - Resource Breakdown Structure - Risk Register

9.6 Control Resources

Inputs

1. Project Management Plan
 - Resource Management Plan
2. Project Documents
 - Lessons Learned Register
 - Physical Resource Assignments
 - Project Schedule
 - Resource Breakdown Structure
 - Resource Requirements
 - Risk Register
3. Work Performance Data
4. Agreements
5. OPAs

9.6 Control Resources

Tools and Techniques

1. Data Analysis

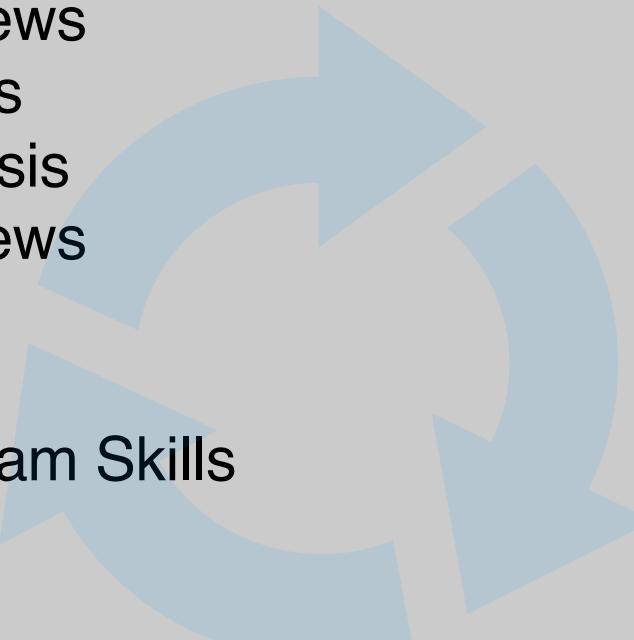
- Performance Reviews
- Alternative Analysis
- Cost-Benefit Analysis
- Performance Reviews
- Trend Analysis

2. Problem-Solving

3. Interpersonal and Team Skills

- **Negotiation**
- Influencing

4. Project Management Information System



9.6 Control Resources

Outputs

1. Work Performance Information
2. Change Requests
3. Project Management Plan Updates
 - Resource Management Plan
 - Schedule Baseline
 - Cost Baseline
4. Project Document Updates
 - Assumptions Log
 - Issue Log
 - Lessons Learned Register
 - Physical Resource Assignments
 - Resource Breakdown Structure
 - Risk Register

9.6 Control Resources

ID #	Enabler	Primary Reference
1.3.4	Verify performance improvements	9.4, 9.6
1.4.2	Support team task accountability	9.1, 9.2, 9.3 , 9.6
1.4.3	Evaluate demonstration of task accountability	9.4, 9.5 , 9.6
1.5.2	Determine training options based on training needs	9.1, 9.2, 9.3 , 9.6
1.5.3	Allocate resources for training	9.2 , 9.6
1.5.4	Measure training outcomes	NEW 9.1, 9.4 , 9.6
1.6.2	Deduce project resource requirements	9.2 , 9.6

10.3 Monitor Communications

Key Concept: This process involves making sure that the plan that was created is working and that the information needs of the stakeholders are being met. If not, this process is used to change the plan.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Resource Management Plan- Communications Management Plan- Stakeholder Engagement Plan2. Project Documents<ul style="list-style-type: none">- Issue Log- Lessons Learned Register- Project Communications3. Work Performance Data4. EEFs5. OPAs	<ol style="list-style-type: none">1. Expert Judgment2. Project Management Information System3. Data Analysis<ul style="list-style-type: none">- Stakeholder Engagement Assessment Matrix4. Interpersonal and Team Skills<ul style="list-style-type: none">- Observation/Conversation5. Meetings	<ol style="list-style-type: none">1. Work Performance Information2. Change Requests3. Project Management Plan Updates<ul style="list-style-type: none">- Communications Management Plan- Stakeholder Engagement Plan4. Project Document Updates<ul style="list-style-type: none">- Issue Log- Lessons Learned Register- Stakeholder Register

10.3 Monitor Communications

Inputs

1. Project Management Plan
 - Resource Management Plan
 - Communications Management Plan
 - Stakeholder Engagement Plan
2. Project Documents
 - Issue Log
 - Lessons Learned Register
 - Project Communications
3. Work Performance Data
4. EEFs
5. OPAs

10.3 Monitor Communications

Tools and Techniques

1. Expert Judgment
2. **Project Management Information System**
3. Data Analysis
 - **Stakeholder Engagement Assessment Matrix**
4. Interpersonal and Team Skills
 - **Observation/Conversation**
5. Meetings

10.3 Monitor Communications

Outputs

1. Work Performance Information
2. Change Requests
3. Project Management Plan Updates
 - Communications Management Plan
 - Stakeholder Engagement Plan
4. Project Document Updates
 - Issue Log
 - Lessons Learned Register
 - Stakeholder Register

10.3 Monitor Communications

ID #	Enabler	Primary Reference
1.11.2	Investigate alternatives (e.g., communication tools, co-location) for virtual team member engagement	APG, 10.1, 10.3, 9.2
1.11.4	Continually evaluate effectiveness of virtual team member engagement	10.3

11.7 Monitor Risks

Key Concept: This is the process of re-evaluating risks and changing the strategies for handling risks if needed, as well as determining whether a risk response was a success or a failure.

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Risk Management Plan2. Project Documents<ul style="list-style-type: none">- Issue Log- Lessons Learned Register- Risk Register- Risk Reports3. Work Performance Data4. Work Performance Reports	<ul style="list-style-type: none">1. Data Analysis<ul style="list-style-type: none">- Technical Performance Analysis- Reserve Analysis2. Audits3. Meetings	<ul style="list-style-type: none">1. Work Performance Information2. Change Requests3. Project Management Plan Updates<ul style="list-style-type: none">- Any Component4. Project Document Updates<ul style="list-style-type: none">- Assumptions Log- Issue Log- Lessons Learned Register- Risk Register- Risk Reports5. OPA Updates

11.7 Monitor Risks

Inputs

1. Project Management Plan
 - Risk Management Plan
2. Project Documents
 - Issue Log
 - Lessons Learned Register
 - **Risk Register**
 - Risk Reports
3. Work Performance Data
4. Work Performance Reports

11.7 Monitor Risks

Tools and Techniques

1. Data Analysis

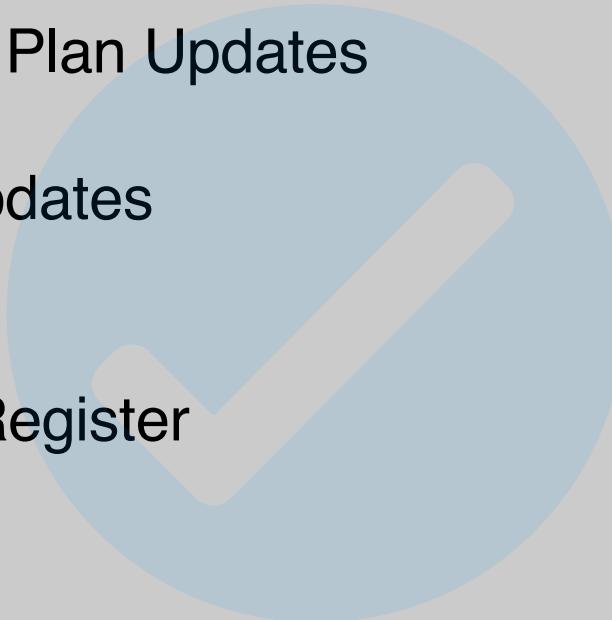
- **Technical Performance Analysis:** Compares what was planned to occur with what actually happened
- **Reserve Analysis**

2. Audits: The risk audit is performed by someone who is not a risk owner.

3. Meetings

11.7 Monitor Risks

Outputs



1. Work Performance Information
2. Change Requests
3. Project Management Plan Updates
 - Any Component
4. Project Document Updates
 - Assumptions Log
 - Issue Log
 - Lessons Learned Register
 - Risk Register
 - Risk Reports
5. OPA Updates

11.7 Monitor Risks

ID #	Enabler	Primary Reference
2.3.2	Iteratively assess and prioritize risks	11.7

12.3 Control Procurements

Key Concept: In this process, the PM monitors the contractor's performance against the contract and the SOW.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan <ul style="list-style-type: none"> - Requirements Management Plan - Risk Management Plan - Procurement Management Plan - Change Management Plan - Schedule Baseline 2. Project Documents <ul style="list-style-type: none"> - Assumption Log - Lessons Learned Register - Milestone List - Quality Reports - Requirements Documentation - Requirements Traceability Matrix - Risk Register - Stakeholder Register 3. Agreements 4. Procurement Documents 5. Approved Change Requests 6. Work Performance Data 7. EEFs 8. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Claims Administration 3. Data Analysis <ul style="list-style-type: none"> - Technical Performance Analysis - Reserve Analysis 4. Inspections 5. Audits 	<ol style="list-style-type: none"> 1. Closed Procurement 2. Work Performance Information 3. Procurement Documentation Updates 4. Change Requests 5. Project Management Plan Updates <ul style="list-style-type: none"> - Risk Management Plan - Procurement Management Plan - Schedule Baseline - Cost Baseline 6. Project Document Updates <ul style="list-style-type: none"> - Lessons Learned Register - Resource Requirements - Requirements Traceability Matrix - Risk Register - Stakeholder Register 7. OPA Updates

12.3 Control Procurements

Inputs

<ul style="list-style-type: none">1. Project Management Plan<ul style="list-style-type: none">- Requirements Management Plan- Risk Management Plan- Procurement Management Plan- Change Management Plan- Schedule Baseline2. Project Documents<ul style="list-style-type: none">- Assumption Log- Lessons Learned Register- Milestone List- Quality Reports- Requirements Documentation- Requirements Traceability Matrix- Risk Register- Stakeholder Register	<ul style="list-style-type: none">3. Agreements4. Procurement Documents5. Approved Change Requests6. Work Performance Data7. EEFs8. OPAs
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12.3 Control Procurements

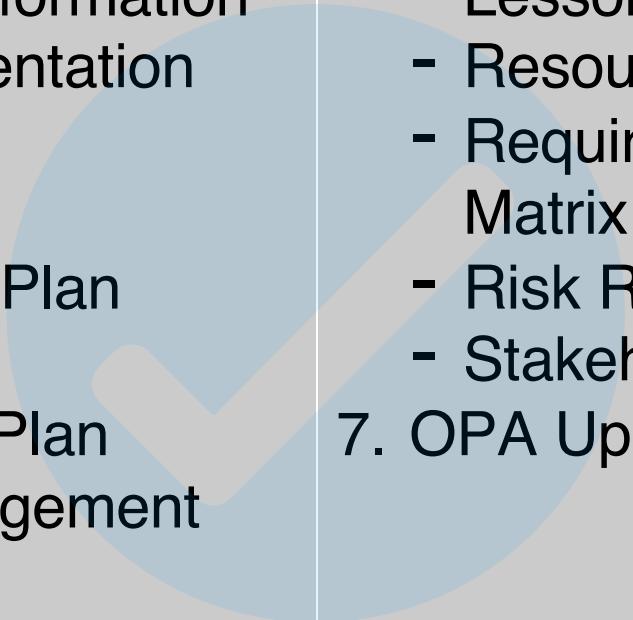
Tools and Techniques

1. Expert Judgment
2. **Claims Administration**
3. Data Analysis
 - Technical Performance Analysis
 - Reserve Analysis
4. **Inspections**
5. **Audits**



12.3 Control Procurements

Outputs



1. **Closed Procurement**
2. Work Performance Information
3. Procurement Documentation Updates
4. **Change Requests**
5. Project Management Plan Updates
- Risk Management Plan
- Procurement Management Plan
- Schedule Baseline
- Cost Baseline

6. Project Document Updates
- Lessons Learned Register
- Resource Requirements
- Requirements Traceability Matrix
- Risk Register
- Stakeholder Register
7. OPA Updates

12.3 Control Procurements

ID #	Enabler	Primary Reference
1.8.3	Verify objectives of the project agreement are met	12.3
2.11.3	Manage suppliers/contracts	12.3
2.11.4	Plan and manage procurement strategy	12.1, 12.2, 12.3

13.4 Monitor Stakeholder Engagement

Key Concept: This is the process of ensuring that the strategies used to get a stakeholder engaged in the project are working.

Inputs	Tools and Techniques	Outputs
<p>1. Project Management Plan</p> <ul style="list-style-type: none"> - Resource Management Plan - Communications Management Plan - Stakeholder Engagement Plan <p>2. Project Documents</p> <ul style="list-style-type: none"> - Issue Log - Lessons Learned Register - Project Communications - Risk Register - Stakeholder Register <p>3. Work Performance Data</p> <p>4. EEFs</p> <p>5. OPAs</p>	<p>1. Data Analysis</p> <ul style="list-style-type: none"> - Technical Performance Analysis - Reserve Analysis <p>2. Decision-Making</p> <ul style="list-style-type: none"> - Multi-Criteria Decision Analysis - Voting <p>3. Data Representation</p> <ul style="list-style-type: none"> - Stakeholder Engagement Assessment Matrix <p>4. Communication Skills</p> <ul style="list-style-type: none"> - Feedback - Presentations <p>5. Interpersonal and Team Skills</p> <ul style="list-style-type: none"> - Active Listening - Cultural Awareness - Leadership - Networking - Political Awareness <p>6. Meetings</p>	<p>1. Work Performance Information</p> <p>2. Change Requests</p> <p>3. Project Management Plan Updates</p> <ul style="list-style-type: none"> - Resource Management Plan - Communications Management Plan - Stakeholder Engagement Plan <p>4. Project Document Updates</p> <ul style="list-style-type: none"> - Issue Log - Lessons Learned Register - Risk Register - Stakeholder Register

13.4 Monitor Stakeholder Engagement

Inputs

1. Project Management Plan
 - Resource Management Plan
 - Communications Management Plan
 - Stakeholder Engagement Plan
2. Project Documents
 - Issue Log
 - Lessons Learned Register
 - Project Communications
 - Risk Register
 - Stakeholder Register
3. Work Performance Data
4. EEFs
5. OPAs

13.4 Monitor Stakeholder Engagement

Tools and Techniques

1. Data Analysis

- Technical Performance Analysis
- Reserve Analysis

2. Decision-Making

- Multi-Criteria Decision Analysis
- Voting

3. Data Representation

- Stakeholder Engagement Assessment Matrix

4. Communication Skills

- Feedback
- Presentations

5. Interpersonal and Team Skills

- Active Listening
- Cultural Awareness
- Leadership
- Networking
- Political Awareness

6. Meetings

13.4 Monitor Stakeholder Engagement

Outputs

1. Work Performance Information
2. Change Requests
3. Project Management Plan Updates
 - Resource Management Plan
 - Communications Management Plan
 - Stakeholder Engagement Plan
4. Project Document Updates
 - Issue Log
 - Lessons Learned Register
 - Risk Register
 - **Stakeholder Register**

13.4 Monitor Stakeholder Engagement

ID #	Enabler	Primary Reference
1.2.6	Analyze team members' and stakeholders' influence	13.1, 13.4
1.9.1	Evaluate engagement needs for stakeholders	13.1, 13.2, 13.4
1.9.2	Optimize alignment between stakeholder needs, expectations, and project objectives	13.1, 13.4
2.2.1	Analyze communication needs of all stakeholders	13.1, 13.4, 10.1
2.4.1	Analyze stakeholders (e.g., power interest grid, influence, impact)	13.1, 13.4
3.2.5	Appraise stakeholders of value gain progress	13.3, 13.4, 4.5, 4.7, APG

Closing Process Group

- 4.7 Close Project or Phase



4.7 Close Project or Phase

Key Concept: This is the formal closing of a project or phase.

Inputs	Tools and Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Charter 2. Project Management Plan <ul style="list-style-type: none"> - All Components 3. Project Documents <ul style="list-style-type: none"> - Assumption Log - Basis of Estimates - Change Log - Issue Log - Lessons Learned Register - Milestone List - Project Communications - Quality Control Measurements - Quality Reports - Requirements Documentation - Risk Register - Risk Reports 4. Accepted Deliverables 5. Business Documents <ul style="list-style-type: none"> - Business Case - Benefits Management Plan 6. Agreements 7. Procurement Documents 8. OPAs 	<ol style="list-style-type: none"> 1. Expert Judgment 2. Data Analysis <ul style="list-style-type: none"> - Document Analysis - Regression Analysis - Variance Analysis 3. Meetings 	<ol style="list-style-type: none"> 1. Project Document Updates <ul style="list-style-type: none"> - Lessons Learned Register 2. Final Product, Service, or Result Transition 3. Final Report 4. OPA Updates

4.7 Close Project or Phase

Inputs

<ul style="list-style-type: none">1. Project Charter2. Project Management Plan<ul style="list-style-type: none">- All Components3. Project Documents<ul style="list-style-type: none">- Assumption Log- Basis of Estimates- Change Log- Issue Log- Lessons Learned Register- Milestone List- Project Communications	<ul style="list-style-type: none">- Quality Control Measurements- Quality Reports- Requirements Documentation- Risk Register- Risk Reports4. Accepted Deliverables5. Business Documents<ul style="list-style-type: none">- Business Case- Benefits Management Plan6. Agreements7. Procurement Documents8. OPAs
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4.7 Close Project or Phase

Tools and Techniques

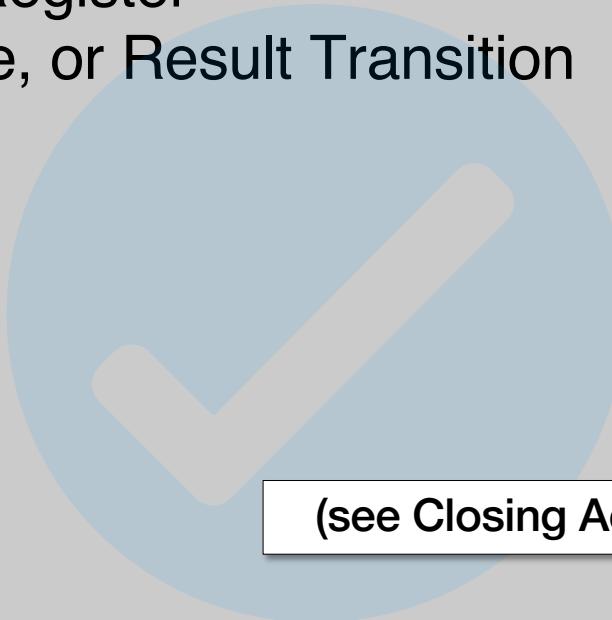
1. Expert Judgment
2. Data Analysis
 - Document Analysis
 - **Regression Analysis**
 - Variance Analysis
3. Meetings



4.7 Close Project or Phase

Outputs

1. Project Document Updates
 - Lessons Learned Register
2. Final Product, Service, or Result Transition
3. **Final Report**
4. OPA Updates



(see Closing Activities, *PMBOK® Guide*, p.

123)

4.7 Close Project or Phase

ID #	Enabler	Primary Reference
2.17.2	Validate readiness for transition (e.g., to operations team or next phase)	8.3, 5.5, 4.7
2.17.3	Conclude activities to close out project or phase (e.g., final lessons learned, retrospective, procurement, financials, resources)	4.4, 12.3, 4.7 , APG
3.2.5	Appraise stakeholders of value gain progress	13.3, 13.4, 4.5, 4.7, APG