PMP STUDY GUIDE in plain English


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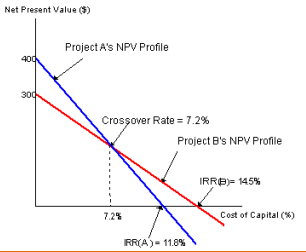
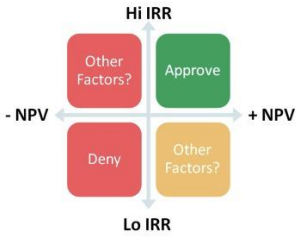
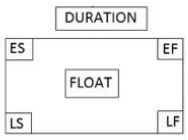
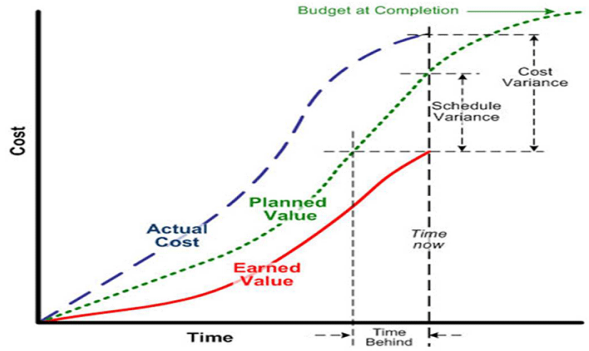
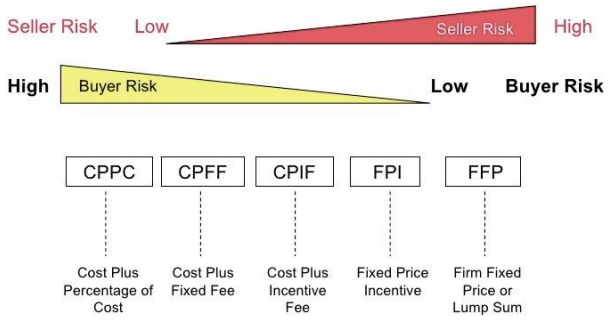
	PROJECT SELECTION		
	Term	**Formula**	**Explanation**
1	**Present Value**	$\frac{FV}{(1+r)^n}$	The result – amount of money to invest today **(PV)** for "**n**" years at **r%** interest in order to end up with the target sum **(PV- Future Value)**. **r** = discount rate; **n** = valuation period in years; FV = Future Value. The bigger the better
2	**Net Present Value**	$NPV = PV_{Benefits} - PV_{Costs}$	NPV = Initial Investment less cumulative **PV** of all cash flows for "**n**" years NPV > 0; accept project NPV< 0; reject project
3	**Payback Period**		Length of time it takes the company to get back the initial cost of producing a product/service. The shorter the better the project
4	**IRR**	$0 = \sum_{t=0}^{N} \frac{CF_t}{(1+IRR)^t}$	IRR = Internal Rate of Return. IRR is the discount rate at which NPV is zero  
5	**Benefit Cost Ratio (BCR)**	$\frac{Revenue}{Costs}$	It compares the Benefits (or Revenues) of a project to its Costs: BCR < 1 : Benefits are less than Costs → reject project. BCR > 1 : Benefits are greater than Costs → approve/accept project
6	**Return on Capital (ROC)**	Net Income (After tax) from project / Total Capital invested in the project	It is a profitability ratio. It measures the return that an investment generates for capital contributors, i.e. bondholders and stockholders. Return on capital indicates how effective a company is at turning capital into profits
7	**Economic Value Add Benefit Measurement (EVA)**	EVA = Net Operating Profit After Tax – Cost of Capital – (Investment Capital X % Cost of Capital)	It is a profitability ratio used in finance and accounting. It measures the return that an investment generates for those who have provided capital, i.e. bondholders and stockholders. ROIC tells us how good a company is at turning capital into profits
8	**Opportunity Cost**	Value of the project not selected	The loss of potential gain from other alternatives when one alternative is chosen
9	**Working Capital**	Current Assets – Current Liabilities	It is the capital of a business that is used in its day-to-day operations, calculated as the current assets minus the current liabilities
10	**Return on Investment (ROI)**	[Gain from Investment – Cost of Investment] / Cost of Investment	It measures the gain or loss generated on an investment relative to the amount of money invested. ROI is usually expressed as a percentage and is used to compare a company's profitability or the efficiency of different investments
11	**Discounted Cash Flow (DCF)**	Cash Flow X Discount Factor	A discounted cash flow (DCF) is a valuation method used to estimate the attractiveness of an project investment opportunity
12	**Depreciation**	Straight-Line Depreciation	Depreciation expense = Asset Cost / Useful life Depreciation rate = 100 % / Useful life
		Double Declining Balance Method	Depreciation rate = 2 * (100% / Useful life) Depreciation expense = Depreciation rate * Book Value at Beginning of Year Book Value = Book Value at Beginning of Year – Depreciation Expense
		Sum-of-Years Digit Method	Sum of Digits = (Useful Life – 1) + (Useful Life – 2) + etc Depreciation rate = fraction of years left and sum of the digits (1.e. 4/15th)
13	**Expected Monetary Value (EMV)**	EMV = Probability * Impact in currency	

	NETWORK DIAGRAM		
1	**Critical Path**		The combination of activities that, if any are delayed, will delay the project's finish
2	**Total Float (or Slack)**	 FLOAT =LS-ES OR FLOAT =LF-EF	ES: Early Start EF: Early Finish LS: Late Start LF: late Finish Total Float (Slack): LS - ES Total Float is the length of time that the start of an activity can be delayed without delaying the finish date of the project. Total Float can be +/-
3	**Free Float (or Slack)**		Free Float (Slack): LF– EF → ES of following – ES of Present – Duration of Present The amount of time an activity can be delayed before delaying the Early Start of a successor activity
4	**Project Slack**		The amount of time a project can be delayed without affecting the required due date of the project
5	**Negative Float**		Amount of time an activity's Early Finish occurs after a subsequent activity's Early Start
6	**Activity Duration (AD)**		AD = EF – ES + 1 AD = LF– LS + 1 ES = EF + duration +1 EF = ES + duration +1 LS = LF of successor -1 LF = LS of successor -1
7	**Crashing a Project**		Crash least expensive tasks on critical path
8	**Float on Critical Path**		0 days

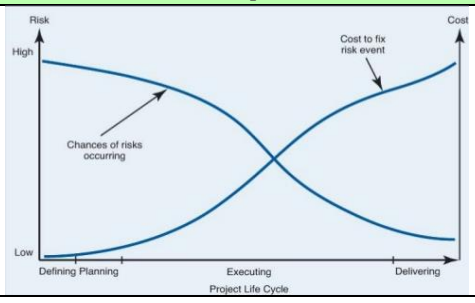
COSTS	EARNED VALUE MANAGEMENT	
Acronym	**Term**	**Definition**
PV	Planned Value (Budgeted)	Planned cost or value of the work to be done till this point in time As of today what is the estimated value of the work planned to be done? How much work (value) was expected to be finished at this point of time?
EV	Earned Value	The dollar value of the work completed until this point in time. Cost is as per the original budget As of today, what is the estimated value of the work actually accomplished? How much work (value) has actually been completed at this point of time?
AC	Actual Cost	The costs actually incurred to complete the work till this point in time As of today, what is the actual cost incurred for the work accomplished?
BAC	Budget At Completion	The total planned value or budget for completing the entire project How much did we BUDGET for the total project cost ?
SV	Schedule Variance	Difference between the scheduled completion and actual completion of an activity or group of activities. Negative SV - project is behind schedule Positive SV- project is ahead of schedule How much more/less work has been accomplished compared to what was planned?
CV	Cost Variance	Difference between the budgeted cost of completing an activity/group of activities & the actual budget spent for it Negative CV: project is over budget Positive CV: project is under budget How much more/less has the completed work cost compared to what was planned?
SPI	Schedule Performance Index	The measure of efficiency in managing the project's schedule SPI > 1 is good (project is ahead of schedule) = 1 on target < 1 poor (project is behind schedule) How does the work being completed compare to what was planned in the schedule? Know if ahead or behind schedule?
CPI	Cost Performance Index	The measure of efficiency in managing the projects budget CPI > 1 is good (cost under budget) = 1 is on target <1 is poor (cost over budget) How much is the work being completed costing compared to what was planned? Know whether over or under budget?
EAC	Estimate At Completion	Prediction of what project will cost when completed. EAC is calculated using different formulas for different possible conditions What do we currently expect the TOTAL project (at completion) to cost (a forecast)?
ETC	Estimate To Complete	How much more we expect project to cost from this point in time From now on, how much MORE money will it take to finish the project (a forecast)?
VAC	Variance At Completion	How much under budget or over budget we expect the project to be once it is completed As of today, How much over or under budget (will the total project cost be?) do we expect to be at the end of the project?
TCPI	To-Complete Performance Index	The cost performance needed in project for remaining work to stay within the planned budget (BAC) or the estimate at completion. EAC is the ratio of "work remaining" to "funds remaining" What level of performance must future project work meet in order to meet the budget (BAC)? What level of performance must future project meet in order to meet the project's cost based on past performance (EAC)?

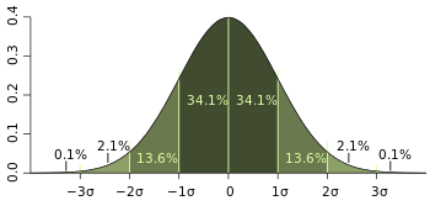
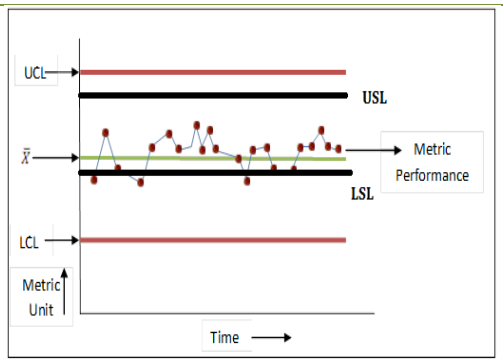
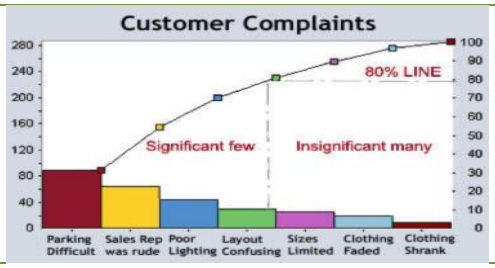
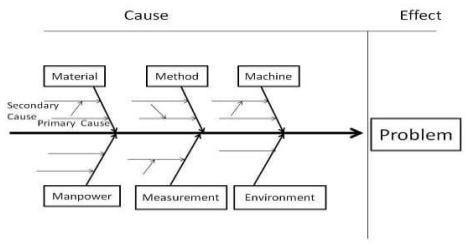
1	PV	Planned % complete * BAC	
2	EV	Actual % complete * BAC	
3	CV	CV = EV - AC	Negative is over budget; Positive is under budget
4	SV	SV = EV - PV	Negative is behind schedule; Positive is ahead of schedule
5	CPI	CPI = EV / AC	
6	SPI	SPI = EV / PV	
7	EAC	EAC = BAC / CPI	Used when there are **no variances**. Used when CPI is expected to remain the same in the future When ETC work i.e. remaining work is predicted to be performed at the cumulative CPI. This assumes the to date CPI will continue in future
		EAC = AC + (BAC-EV)	Based on **atypical** variances When remaining work is predicted to be performed exactly as per the original budget. Assumes any variances till date – both favorable or unfavorable - will not continue in future
		EAC = AC + bottom-up ETC	**Fundamentally flawed**. Used when AC and ETC are available Based on New Estimate. Equals revised estimate for work remaining (ETC). When totally new detailed bottom-up estimates are developed for the remaining work
		EAC = AC + [(BAC – EV) / (CPI x SPI)	Based on **typical** variances When both cost and schedule performance indices are considered for performing remaining work. Most useful when project schedule impacts ETC effort. CV is assumed to be negative
8	ETC	EAC - AC	
9	TCPI	$TCPI = \frac{BAC - EV}{BAC - AC}$	TCPI based on BAC
		$TCPI = \frac{BAC - EV}{EAC - AC}$	TCPI based on EAC
10	VAC	BAC- EAC	If VAC is positive, then project is under budget If VAC is negative, then project is over budget

COSTS

1	**Price**		The amount charged to buyer by seller (contractor)
2	**Target cost**		Expected cost for doing the work at time of signing the contract
3	**Target Fee**		Sellers planned profit margin or fee for doing the work. Will be increased / decreased using the Share ration based on performance
4	**Target Price**		Target cost + target fee
5	**Share ratio**		Ratio by which Buyer/Seller will share cost savings and cost overruns
6	**Ceiling Price**		The maximum amount the buyer will pay for the contract irrespective of the costs
7	**Actual Cost**		Costs that actually incurred at end of contract
8	**Cost Plus Incentive Fee (CPIF) contract**		CPIF includes all of the above terms except Ceiling Price and Point of Total Assumption (PTA) . Instead CPIF has a Minimum fee and a Maximum fee: - Minimum Fee: Minimum assured fee buyer will pay to contractor - Maximum Fee: Maximum fee that buyer will pay to contractor
9	**Point of Total Assumption (PTA)**		The point where the Seller assumes all further cost increases Costs above PTA are assumed to be the result of mismanagement. PTA is only applicable in FPIF contracts PTA = [(Ceiling price - Target price) /Buyer's share ratio] + Target cost
10	**ESTIMATES Types**	**Rough Order of Magnitude (ROM) estimate**	+/- 50%. In the Initiating phase. Provides cost estimate for selection decisions
		Preliminary Estimate	15% to +50%
		Budget Estimate	10% to +25%. Put dollars in budget plans
		Definitive or detailed estimate	+10% to -10%. Planning phase. Provides details for purchases. Estimates actual cost
		Final Estimate	0%
11			
12	**Communication Channels**		# of channels = n (n – 1) / 2 n: number of team members
13	**% Spent on Communicating**		90%

RISKS

Threats: Negative Risks	**Avoid**	Remove root cause. Project management plan changed to completely remove threat e.g. extend schedule, reduce scope by removing work package or activity, remove a team member, etc
	Transfer	Third party made financially responsible for negative impact and ownership of response. e.g. insurance, contracts, warranties etc. Transfer does not eliminate the risk
	Mitigate	Probability or Impact or both to acceptable threshold limits e.g. make a prototype, improve skills through training
	Accept	No change made in the project management plan to deal with risk or unable to select suitable response. Passive acceptance – no action taken Active acceptance - Contingency reserve commonly kept – time, money or resources to deal with the risk
Opportunities: Positive Risks	**Exploit**	Change plans to remove uncertainty to ensure the opportunity occurs
	Share	Allocate some or all ownership of opportunity to third party as they are better equipped e.g. joint ventures, teams, partnerships
	Enhance	Increase positive Impact or Probability or both of opportunity e.g. add more resources to finish early
	Accept	Accept the risk if it occurs. Not actively pursued
Risk vs. Cost Graph		Risk: as time goes on, risk on the project decrease. The highest risk in the project is early in the beginning of the project. Cost: Cost in the project are low. As project continues, the project increases.

QUALITY			
1	**3 Point Estimate: PERT – Beta Distribution**	$\frac{O + 4(ML) + P}{6}$	**O** = Optimistic; **ML** = Most Likely; **P** = Pessimistic - The Three Point Estimate technique is used to arrive at a better estimate of the time required to complete a particular activity, work package, and can be rolled up to the entire project. It can be used for Time as well as Cost - Triangular Distribution is like a simple average of the three estimates. When plotted in a chart, it usually results in a sharp peak, thus its name. - The Beta is a weighted average. More weight is given to the most likely. If plotted against a chart, it will result in a more uniform, bell shaped curve. Beta method is the most popular method among project managers. - Standard Deviation is a measure that is used to quantify the amount of variation or dispersion or risks in the estimate of an activity
2	**3 Point Estimate: Triangular Distribution**	$\frac{O + P}{3}$	
3	**Standard Deviation (SD) σ = Sigma**	$\frac{P - O}{6}$	
4	**Confidence Level**		± 1 Sigma σ = 68.26% ± 2 Sigma σ = 95.45% ± 3 Sigma σ = 99.73% ± 6 Sigma σ = 99.999%
5	**PERT Calculation**	To find the range for an Individual Activity	PERT duration for the activity ± Standard Deviation (SD) σ
		To find the range for a Project	- Step 1: Add all the durations in the critical path - Step 2: Calculate the Variance for each activity in the critical path - Step 3: Add all the variances - Step 4: Take the square root of all variances which give the SD - Step 5: Project duration range estimate is the total project PERT duration (Step 1) ± (Step 4)
6	**Control Chart**		Used to decide whether the product or service is in control or out of control Identifies special or assignable causes Has a mean or center line, an upper control limit (UCL) and a lower control limit (LCL) Does not show causes for deviation or provide solutions
7	**Control Specifications Limits**		The Uppers Specification Limits = USL and The Lower Specifications Limits = LSL. These limits in the Control Chart set by Customer Looser than Control Limits
8	**Control Limits**		3 Sigma σ from the Mean: UCL and LCL Control limits (UCL, LCL) are horizontal lines drawn on a statistical process control charts, usually at a distance of ±3 Standard Deviations from the statistic's mean. The USL and LSL are usually within the Control Limits. These limits are set by the company
9	**Pareto Chart**		- 80/20 rule. Is a histogram ranking no. of defects in order of frequency or importance - 80% quality problems due to 20% causes
10	**Cause-and-Effect diagram (Fishbone or Ishikawa diagram)**		Graphical technique that helps team to group ideas and identify the causes of a problem - Breaks down problem for analysis - Shows how different variables may be linked to the effect (problem)
11	**Sampling**		• Attribute sampling: checks that the result either conforms or does not conform – pass or fail • Variable sampling: checks the degree to which the result conforms – acceptable within a tolerance level
12	**JIT Inventory**	Just In Time (JIT) = 0%	

PROCUREMENT		
	Contract Term	**Description**
1	**Arbitration**	Settling a dispute out of court using an independent third party. The arbitrator must be agreed upon and accepted by both parties
2	**Breach of contract**	Violating or breaking of a legal obligation. Is a serious condition. Buyer should always issue letter to contractor notifying the breach
3	**Contract**	A written or oral agreement made by one party to another that has legal obligations on both parties
4	**Condition**	A term of fundamental importance in the contract. Breach of this condition can cause the contract to be terminated
5	**Design specifications**	A detailed description of the physical characteristics describing and specifying what is to be done
6	**Force Majeure**	Used in contracts to free both parties from liabilities arising from events beyond their control e. g. strikes, war, floods, earthquake etc. Common response is for buyer to extend the time
7	**Good faith**	Transparency and fair dealing between all parties
8	**Infringement**	Violation of a legally recognized right
9	**Indemnity**	A payment or compensation as protection against any future loss. It is an obligation made by one party to reimburse another party for losses that have occurred or that may occur in future
10	**Liquidation damages**	Reasonable damages to be paid by the contractor to the owner due to failure to complete the specified work as per the contract terms
11	**Negligence**	Not acting in a reasonably accepted manner
12	**Non-compete clause**	The contractor is not allowed to work for a competitor for a given time
13	**Non-disclosure / confidentiality clause**	A restriction on the contractor from disclosing some proprietary knowledge gained in doing the work
14	**Penalty clause**	An agreement made in financial terms to be paid by the contractor for not performing as per the contract terms
15	**Performance specifications**	The measurable capabilities that the product should achieve in terms of operational characteristics. They must be met by the contractor
16	**Privity of contract**	A mutual relationship that exists between a buyer and seller. The contract cannot give rights or impose obligation on any person / party / sub-contractor except the parties that have signed the contract
17	**Screening system**	A process used to determine if a contractor has the minimum qualifications to bid
18	**Sole source**	The seller is the only available source for the procurement
19	**Waiver**	Giving up of a legal right or privilege voluntarily
20	**Warranty**	A written, verbal or implied promise assuring that a specified provision in the contract is true. Provides protection to the buyer against breakdowns and major repairs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Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & 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 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 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 Time Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Resources 6.5 Estimate Activity Durations 6.6 Develop Schedule		6.7 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 Perform Quality Assurance	8.3 Control Quality	
9. Project Human Resource Management		9.1 Plan Human Resource Management	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Control 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 Control Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	12.4 Close Procurements
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Management	13.3 Manage Stakeholder Engagement	13.3 Control Stakeholder Engagement	

PRACTICE SHEET

Knowledge Areas	Project Management Process Groups				

INPUTS » TOOLS & TECHNIQUES » OUTPUTS

4. Project Integration Management

4.1 Develop Project Charter — Initiating Process Group

The process of developing a document that formally authorizes a project and provides the project manager with authority to apply organizational resources to project activities

Inputs	Tools & Techniques	Outputs
1. Project Statement of Work - SOW	1. Expert Judgment	1. Project Charter
2. Business Case	2. Facilitation Techniques	
3. Agreements		
4. Enterprise Environmental Factors		
5. Organizational Process Assets		

4.2 Develop Project Management Plan — Planning Process Group

The process of defining, preparing, and coordinating all subsidiary plans and integrating them in to a comprehensive project management plan

Inputs	Tools & Techniques	Outputs
1. Project Charter	1. Expert Judgment	1. Project management plan
2. Outputs from planning process	2. Facilitation Techniques	
3. Enterprise Environmental Factors		
4. Organizational Process Assets		

4.3 Direct and Manage Project Work — Executing Process Group

The process of leading and performing the work defined in the project management plan and implementing approved changes to achieve the project's objectives

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert Judgment	1. Deliverables
2. Approved change requests	2. Project management information system	2. Work performance data
.3 Enterprise Environmental Factors	3. Meetings	3. Change requests
4. Organizational Process Assets		4. Project management plan updates
		5. Project document updates

4.4 Monitor and Control Project Work — Monitoring & Controlling P/G

The process of tracking, reviewing and reporting the progress to meet performance objectives defined in Project Management Plan

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert Judgment	1. Change requests
2. Scheduled Forecast	2. Analytical Techniques	2. Work Performance reports
3. Cost Forecast	3. Project Management Information Systems	3. Project management plan updates
4. Validated Changes	4. Meetings	4. Project document updates
5. Work Performance Information		
6. Enterprise Environmental Factors		
7. Organizational Process Assets		

4.5 Perform Integrated Change Control — Monitoring & Controlling P/G

The process of reviewing all changes requests, approving changes, and managing changes to deliverables, organizational process assets, project documents and the project management plan and communicating their disposition

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert Judgment	1. Approved Change requests
2. Work performance reports	2. Meetings	2. Change log
3. Change requests	3. Change control meetings	3. Project management plan updates
4. Enterprise Environmental Factors		4. Project document updates
5. Organizational process assets		

4.6 Close Project or Phase — Closing Process Group

The process of finalizing all activities across all of the Project Management Process Groups to formally complete the project or phase (get customer's acceptance)

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert Judgment	1. Final product, service or result transition
2. Accepted deliverables	2. Analytical Techniques	2. Organizational process assets updates
3. Organizational Process Assets	3. Meetings	

5. Project Scope Management

5.1 Plan Scope Management — Planning Process Group

The process of creating a scope management plan that documents how the project scope will be defined, validated, and controlled

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert Judgment	1. Scope management plan
2. Project charter	2. Meetings	2. Requirements management plan
3. Enterprise Environmental Factors		
4. Organizational process assets		

5.2 Collect Requirements — Planning Process Group

The process of determining, documenting and managing stakeholders' needs and requirements to meet project objectives

Inputs	Tools & Techniques	Outputs
1. Scope management plan	1. Interviews	1. Requirements documentation
2. Requirements management plan	2. Focus Groups	2. Requirements traceability matrix
3. Stakeholder management plan	3. Facilitated workshops	
4. Project Charter	4. Group creativity techniques	
5. Stakeholder register	5. Group decision making techniques	
	6. Questionnaires and surveys	
	7. Observations	
	8. Prototypes	
	9. Benchmarking	
	10. Context Diagrams	
	11. Document Analysis	

5.3 Define Scope — Planning Process Group

The process of developing a detailed description of project and product

Inputs	Tools & Techniques	Outputs
1. Scope management plan	1. Expert Judgment	1. Project scope statement
2. Project Charter	2. Product analysis	2. Project document updates
3. Requirements documentation	3. Alternatives identification	
4. Organizational Process Assets	4. Facilitated workshops	

5.4 Create WBS — Planning Process Group

The process of subdividing project deliverables and project work into smaller more manageable components

Inputs	Tools & Techniques	Outputs
1. Scope management plan	1. Decomposition	1. Scope baseline
2. Project scope statement	2. Expert Judgment	2. Project document updates
3. Requirements documentation		
4. Enterprise Environmental Factors		
5. Organizational Process Assets		

5.5 Validate Scope — Monitoring & Controlling P/G

The process of formalizing acceptance of the completed project deliverables

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Inspection	1. Accepted deliverables
2. Requirements documentation	2. Group decision-making techniques	2. Change Requests
3. Requirements traceability matrix		3. Work performance information
4. Validated deliverables		4. Project document updates
5. Organizational Process Assets		

5.6 Control Scope — Monitoring & Controlling P/G

The process of monitoring the status of the project and product scope and managing changes to the scope baseline

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Variance analysis	1. Work performance information
2. Work performance data		2. Change requests
3. Requirements documentation		3. Project management plan updates
4. Requirements traceability matrix		4. Project documents updates
5. Organizational Process Assets		5. Organizational process assets updates

6. Project Time Management

6.1 Plan Schedule Management

Planning Process Group

The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert Judgment	1. Schedule management plan
2. Project charter	2. Analysis Techniques	
3. Enterprise Environmental Factors	3. Meetings	
4. Organizational Process Assets		

6.2 Define Activities

Planning Process Group

The process of identifying specific actions necessary to be performed to produce the project deliverables

Inputs	Tools & Techniques	Outputs
1. Schedule management plan	1. Decomposition	1. Activity list
2. Scope baseline	2. Rolling wave planning	2. Activity attributes
3. Enterprise Environmental Factors	3. Expert Judgment	3. Milestone list
4. Organizational Process Assets		

6.3 Sequence Activities

Planning Process Group

The process of identifying and documenting the relationships among the project activities

Inputs	Tools & Techniques	Outputs
1. Schedule management plan	1. Precedence diagramming method - PDM	1. Project schedule network diagram
2. Activity list	2. Dependency determination	2. Project document updates
3. Activity attributes	3. Applying leads and lags	
4. Milestone list		
5. Project scope statement		
6. Enterprise Environmental Factors		
7. Organizational Process Assets		

6.4 Estimate Activity Resources

Planning Process Group

Estimating the type and quantities of material, people, equipment or supplies required to perform each activity

Inputs	Tools & Techniques	Outputs
1. Schedule management plan	1. Expert Judgment	1. Activity resource requirements
2. Activity list	2. Alternatives analysis	2. Resource breakdown structure - RBS
3. Activity attributes	3. Published estimating data	3. Project document updates
4. Resource Calendar	4. Bottom-up estimating	
5. Risk register	5. Project management software	
6. Activity cost estimates		
7. Enterprise Environmental Factors		
8. Organizational Process Assets		

6.5 Estimate Activity Durations

Planning Process Group

Estimating the number of work periods need to complete individual activities with estimated resources

Inputs	Tools & Techniques	Outputs
1. Schedule management plan	1. Expert Judgment	1. Activity duration estimates
2. Activity list	2. Analogous estimating	2. Project document updates
3. Activity attributes	3. Parametric estimating	
4. Activity resource requirements	4. Parametric estimating	
5. Resource calendar	5. Group decision-making techniques	
6. Project scope statement	6. Reserve analysis	
7. Risk register		
8. Resource breakdown structure - RBS		
7. Enterprise Environmental Factors		
8. Organizational Process Assets		

6.6 Develop Schedule

Planning Process Group

Analyzing activity sequences, durations, resource requirements and schedule constraints to create a project schedule

Inputs	Tools & Techniques	Outputs
1. Schedule management plan	1. Schedule network analysis	1. Schedule baseline
2. Activity list	2. Critical path method	2. Project schedule
3. Activity attributes	3. Critical chain method	3. Schedule data
4. Project schedule network diagrams	4. Resource optimization techniques	4. Project calendar
5. Activity resource requirements	5. Modeling techniques	5. Project management plan updates
6. Resource calendars	6. Leads and lags	6. Project document updates
7. Activity duration estimates	7. Schedule compression	
8. Project scope statement	8. Scheduling tools	
9. Risk register		
10. Project staff assignments		

11. Resource breakdown structure - RBS 12. Enterprise Environmental Factors 13. Organizational Process Assets		

6.7 Control Schedule — **Monitoring & Controlling P/G**

The process of monitoring the status of the project activities to update project progress and manage changes to schedule baseline to achieve the plan

Inputs	Tools & Techniques	Outputs
1. Project management plan 2. Project schedule 3. Work performance data 4. Project calendars 5. Schedule data 6. Organizational Process Assets	1. Performance reviews 2. Project management software 3. Resource optimization techniques 4. Modeling techniques 5. Leads and lags 6. Schedule compression 7. Scheduling tools	1. Work performance information 2. Schedule forecasts 3. Change requests 4. Project management plan updates 5. Project document updates 6. Organizational Process Assets

7 Project Cost Management Overview

7.1 Plan Cost Management — **Planning Process Group**

The process of establishing the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.

Inputs	Tools & Techniques	Outputs
1. Project management plan 2. Project charter 3. Enterprise Environmental Factors 4. Organizational Process Assets	1. Expert Judgment 2. Analysis Techniques 3. Meetings	1. Cost management plan

7.2 Estimate Costs — **Planning Process Group**

Developing an approximation of monetary resources need to complete the project activities

Inputs	Tools & Techniques	Outputs
1. Cost management plan 2. Human resource management plan 3. Scope baseline 4. Project schedule 5. Risk register 6. Enterprise Environmental Factors 7. Organizational Process Assets	1. Expert Judgment 2. Analogous estimating 3. Parametric estimating 4. Bottom-up estimating 5. Three-point estimates 6. Reserve analysis 7. Cost of quality 8. Project management estimating software 9. Vendor bid analysis 10. Group decision-making techniques	1. Activity cost estimates 2. Basis of estimates 3. Project document updates

7.3 Determine Budget — **Planning Process Group**

Aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline

Inputs	Tools & Techniques	Outputs
1. Cost management plan 2. Scope baseline 3. Activity costs estimates 4. Basis of estimates 5. project schedule 6. Resource calendars 7. Risk register 8. Agreements 9. Organizational Process Assets	1. Cost aggregation 2. Reserve analysis 3. Expert Judgment 4. Historical relationships 5. Funding limit reconciliation	1. Cost baseline 2. Project funding requirements 3. Project document updates

7.4 Control costs — **Monitoring & Controlling P/G**

Monitoring the status of the project to update the project costs and managing changes to the cost baseline

Inputs	Tools & Techniques	Outputs
1. Project management plan 2. Project funding requirements 3. Work performance data 4. Organizational Process Assets	1. Earned value management - EVM 2. Forecasting 3. To-complete performance index - TCPI 4. Performance reviews 5. Project management software 6. Reserve analysis	1. Work performance information 2. Cost forecasts 3. Change requests 4. Project management plan updates 5. Project document updates 6. Organizational Process Assets Updates

8 Project Quality Management

8.1 Plan Quality Management — Planning Process Group

Identify quality requirements and/or standards for the project and its deliverables, and documenting how the project will demonstrate compliance with quality requirements and/or standards

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Cost-benefit analysis	1. Quality management plan
2. Stakeholder register	2. Cost of quality	2. Process improvement plan
3. Risk register	3. Seven basic quality tools	3. Quality metrics
4. Requirements documentation	4. Benchmarking	4. Quality checklist
5. Enterprise Environmental Factors	5. Design of experiments	5. Project document updates
6. Organizational Process Assets	6. Statistical sampling	
	7. Additional quality planning tools	
	8. Meetings	

8.2 Perform Quality Assurance — Execution Process Group

Auditing the quality requirements and the results of quality control measurements to ensure appropriate quality standards and operational definitions used

Inputs	Tools & Techniques	Outputs
1. Quality management plan	1. Quality management and control tools	1. Change Requests
2. Process Improvement plan	2. Quality Audits	2. Project management plan updates
2. Quality metrics	3. Process analysis	3. Project document updates
3. Quality control measurements		4. Organizational Process Assets
4. Project documents		

8.3 Control Quality — Monitoring & Control Process Group

Monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Cause and effect diagram	1. Quality control measurements
2. Quality metrics	2. Control charts	2. Validated changes
3. Quality checklist	3. Flowcharting	3. Validated deliverables
4. Work performance data	4. Histogram	4. Work performance information
5. Approved change requests	5. Pareto chart	5. Change requests
6. Deliverables	6. Run chart	6. Project management plan updates
7. Project documents	7. Scatter diagram	7. Project documents updates
8. Organizational Process Assets	8. Statistical sampling	8. Organizational Process Assets Updates
	9. Inspection	
	10. Approved change requests review	

9 Project Human Resource Management

9.1 Plan Human Resource Management — **Planning Process Group**

Identifying and documenting project roles, responsibilities, required skills, reporting relationships and creating staffing management plan

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Organization chart and position description	1. Human resource management plan
2. Activity resource requirements	2. Networking	
3. Enterprise Environmental Factors	3. Organizational theory	
4. Organizational Process Assets	4. Expert judgment	
	5. Meetings	

9.2 Acquire Project Team — **Execution Process Group**

Confirming Human Resource availability and obtaining the team necessary to complete project objectives

Inputs	Tools & Techniques	Outputs
1. Human resource management plan	1. Pre-assignment	1. Project staff assignments
2. Enterprise Environmental Factors	2. Negotiation	2. Resource calendars
3. Organizational Process Assets	3. Acquisition	3. Project management plan updates
	4. Virtual teams	
	5. Multi-criteria decision analysis	

9.3 Develop Project team — **Execution Process Group**

Process of improving competencies, team member interaction, and the overall team environment to enhance project performance

Inputs	Tools & Techniques	Outputs
1. Human resource management plan	1. Interpersonal skills	1. Team performance assessments
2. Project staff assignments	2. Training	2. Enterprise Environmental Factors updates
3. Resource Calendars	3. Team-building activities	
	4. Ground rules	
	5. Co-location	
	6. Recognition and rewards	
	7. Personnel assessment tools	

9.4 Manage Project Team — **Execution Process Group**

Tracking team member performance, providing feedback, resolving issues, and managing changes to optimize project performance

Inputs	Tools & Techniques	Outputs
1. Human resource management plan	1. Observation and conversation	1. Change requests
2. Project staff assignments	2. Project performance appraisals	2. Project management plan updates
3. Team performance assessments	3. Conflict management	3. Project documents update
4. Issue log	4. Interpersonal skills	4. Enterprise Environmental Factors updates
5. Work Performance reports		5. Organizational Process Assets updates
6. Organizational Process Assets		

10 Project Communications Management Overview

10.1 Plan Communication Management — **Planning Process Group**

Developing an appropriate approach and plan for project communications based on stakeholder's information needs and requirements, and available organizational assets

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Communication requirements analysis	1. Communication management plan
2. Stakeholder register	2. Communication technology	2. Project document updates
3. Enterprise Environmental Factors	3. Communication models	
4. Organizational Process Assets	4. Communication methods	
	5. Meetings	

10.2 Manage Communications — **Execution Process Group**

Creating, collecting, distributing, storing, retrieving and the ultimate disposition of project information in accordance with communication management plan

Inputs	Tools & Techniques	Outputs
1. Communication management plan	1. Communication technology	1. Project communications
2. Work performance reports	2. Communication models	2. Project management plan
3. Enterprise Environmental Factors	3. Communication methods	3. Project document updates
4. Organizational Process Assets	4. Information management systems	4. Organizational Process Assets
	5. Performance reporting	

10.3 Control Communications — **Monitoring & Control Process Group**

Monitoring and controlling communications throughout the entire project life cycle to ensure the information needs of the stakeholders are met

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Information management systems	1. Work performance information
2. Project communications	2. Expert judgement	2. Change Requests
3. Issue log	3. Meetings	3. Project management plan updates
4. Work performance data		4. Project document updates
5. Organizational Process Assets		5. Organizational Process Assets

11 Risk Management Overview

11.1 Plan Risk Management — **Planning Process Group**

.Defining how to conduct risk management activities for a project

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Analytical techniques	1. Risk management plan
2. Project charter	2. Expert judgment	
3. Stakeholder register	3. Meetings	
3. Enterprise Environmental Factors		
4. Organizational Process Assets		

11.2 Identify Risks — **Planning Process Group**

Determining what risks may affect the project and documenting their characteristics

Inputs	Tools & Techniques	Outputs
1. Risk management plan	1. Documentation reviews	1. Risk register
2. Cost management plan	2. Information gathering techniques	
3. Schedule management plan	3. Checklist analysis	
4. Quality management plan	4. Assumption analysis	
5. Human resources management plan	5. Diagramming techniques	
6. Scope baseline	6. SWOT analysis	

7. Activity cost estimates 8. Activity duration estimates 9. Stakeholder register 10. Project documents 11. Enterprise Environmental Factors 12. Organizational Process Assets	7. Expert judgement	

11.3 Perform Qualitative Risk Analysis		**Planning Process Group**
The process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact		
Inputs	**Tools & Techniques**	**Outputs**
1. Risk management plan 2. Scope baseline 3. Risk register 4. Enterprise Environmental Factors 5. Organizational Process Assets	1. Risk probability and impact assessment 2. Probability and impact assessment 3. Risk data quality assessment 4. Risk categorization 5. Risk urgency assessment 6. Expert judgement	1. Project documents updates

11.4 Perform Quantitative Risk Analysis		**Planning Process Group**
The process of numerically analyzing the effect of identified risks on overall project objectives		
Inputs	**Tools & Techniques**	**Outputs**
1. Risk management plan 2. Cost management plan 3. Schedule management plan 4. Risk register 5. Enterprise Environmental Factors 6. Organizational Process Assets	1. Data gathering and representation technique 2. Quantitative risk analysis and modeling technique 3. Expert judgement	1. Project documents updates

11.5 Plan Risk Reponses		**Planning Process Group**
Developing options and actions to enhance opportunities and reduce threats to project objectives		
Inputs	**Tools & Techniques**	**Outputs**
1. Risk management plan 2. Risk register	1. Strategies for negative risks or threats 2. Strategies for positive risks or opportunities 3. Contingent response strategies 4. Expert judgement	1. Project management plan 2. Project documents updates

11.6 Control Risks		**Monitoring & Control Process Group**
Implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk effectiveness throughout the project		
Inputs	**Tools & Techniques**	**Outputs**
1. Project management plan 2. Risk register 3. Work performance data 4. Work performance reports	1. Risk re-assessment 2. Risk audits 3. Variance and trend analysis 4. Technical performance measurement 5. Reserve analysis 6. Meetings	1. Work performance information 2. Change requests 3. Project management plan updates 4. Project documents updates 5. Organizational Process Assets updates

12 Procurement Management Overview

12.1 Plan Procurement Management — Planning Process Group

The process of documenting project procurement decisions, specifying the approach and indenting potential sellers

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Make-or-Buy analysis	1. Procurement management plan
2. Requirements documentation	2. Expert judgment	2. Procurement statement of work
3. Risk register	3. Market research	3. Procurement documents
4. Activity resource requirements	4. Meetings	4. Source selection criteria
5. Project schedule		5. Make-or-Buy decisions
6. Activity cost estimates		6. Change requests
7. Stakeholder register		7. Project document updates
8. Enterprise Environmental Factors		
9. Organizational Process Assets		

12.2 Conduct Procurement — Execution Process Group

Obtaining sellers responses, selecting a seller, and awarding a contract

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Bidder conference	1. Select sellers
2. Procurement documents	2. Proposal evaluation technique	2. Agreements
3. Source selection criteria	3. Independent estimates	3. Resource calendars
4. Seller proposals	4. Expert judgement	4. Change requests
5. Project documents	5. Advertising	5. Project management plan updates
6. Make-or-Buy decisions	6. Analytical techniques	6. Procurement documents updates
7. Procurement statement of work	7. Procurement negotiations	
8. Organizational process assets		

12.3 Control Procurement — Monitoring & Control Process Group

Managing procurement relationships, monitoring contract performance, and making changes and corrections as appropriate

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Procurement audit	1. Close procurements
2. Procurement documents	2. Procurement negotiations	2. Organizational Process Assets
	3. Records management systems	

12.4 Close Procurement — Closing Process Group

The process of completing each project procurement

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Contract change control system	1. Work performance information
2. Procurement documents	2. Procurement performance reviews	2. Change requests
3. Agreements	3. Inspections and audits	3. Project management plan
4. Approved change requests	4. Performance reporting	4. Project documents updates
5. Work performance reports	5. Payment systems	5. Organizational Process Assets
6. Work performance data	6. Claims administration	
	7. Records management system	

13 Project Stakeholder Management Overview

13.1 Identify Stakeholders — Initiating Process Group

Identifying the people, groups or organizations that could impact or be impacted by a decision, activity, or outcome of the project; analyzing and documenting relevant information regarding their interest, involvement, interdependencies, influence and potential on the project success

Inputs	Tools & Techniques	Outputs
1. Project charter	1. Stakeholder analysis	1. Stakeholder register
2. Procurement documents	2. Expert judgment	
3. Enterprise Environmental Factors	3. Meetings	
4. Organizational Process Assets		

13.2 Plan Stakeholder Management — Planning Process Group

Developing appropriate management strategies to effectively engage stakeholders throughout the project life cycle, based on the analysis of their needs, interest, and potential project success

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Expert judgement	1. Stakeholder management plan
2. Stakeholder register	2. Meetings	2. Project documents updates
3. Enterprise Environmental Factors	3. Analytical techniques	
4. Organizational process assets		

13.3 Manage Stakeholder Engagement — Execution Process Group

Communicating and working with stakeholders to meet their needs/expectations, address issues as they occur, and foster appropriate stakeholder engagement in project activities throughout the project life cycle

Inputs	Tools & Techniques	Outputs
1. Stakeholder management plan	1. Communication methods	1. Issue log
2. Communication management plan	2. Interpersonal skills	2. Change requests
3. Change log	3. Management Skills	3. Project management plan updates
4. Organizational Process Assets		4. Project documents updates
		5. Organizational Process Assets

13.4 Control Stakeholder Engagement — Monitoring & Control Process Group

Monitoring overall project stakeholder relationships and adjusting strategies and plans for engaging stakeholders

Inputs	Tools & Techniques	Outputs
1. Project management plan	1. Information management system	1. Work performance information
2. Issue log	2. Expert judgement	2. Change requests
3. Work performance data	3. Meetings	3. Project management plan updates
4. Project documents		4. Project documents updates
		5. Organizational Process Assets

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