FOR USE WITH:
THE PMP® EXAM
HOW TO PASS ON YOUR FIRST TRY
SIXTH EDITION PLUS AGILE
Andy Crowe, PMP

Quick
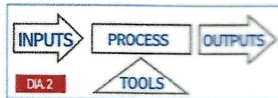## REFERENCE GUIDE

FOUNDATIONAL CONCEPTS

Project: a temporary group of related tasks undertaken to create a unique product, service, or result

Program: a group of related projects and operations coordinated together in a larger effort than a project

Portfolio: an organization's entire investment in projects and programs **(SEE DIAGRAM 1)**

DIA. 1 — PORTFOLIO / PROGRAM A, PROJECT 1, PROGRAM C / PROJECT 2, PROJECT 4, PROJECT 3, PROJECT 5
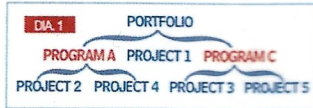
Project Management: using skills, knowledge, and resources to satisfy project requirements

DIA. 2 — INPUTS → PROCESS → OUTPUTS / TOOLS

Process: 1 of 49 packages of inputs, tools, and outputs used to produce specific output(s) for the project **(SEE DIAGRAM 2)**

Phases: groups of project activities separated by exit gates to evaluate phase deliverables

Project Life Cycle: a group of project phases specified by an organization's project management methodology

Methodology: an organization's specific implementation of project processes; a set of steps to manage a project

Triple Constraint: the concept that scope, time, and cost are interrelated; one cannot change without affecting at least one of the others; also known as the "Iron Triangle" **(SEE DIAGRAM 3)**

DIA. 3 — TIME, COST, SCOPE

Baseline (BL): the original plan plus all approved changes (scope, schedule, cost)

System: a set of formal management procedures; rules, processes, people, etc. that support an outcome

Historical Information: information from previous projects used to evaluate future project decisions

Lessons Learned: documented variances (historical information) used to avoid variances in current and future projects

Progressive Elaboration: an iterative approach where planning occurs in cycles rather than only up front

PM Skills: Leading, Communicating, Negotiating, Problem-solving, Influencing, Delegating, and being Proactive

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MANIFESTO FOR AGILE SOFTWARE DEVELOPMENT

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- Individuals and interactions *over processes and tools*
- Working software *over comprehensive documentation*
- Customer collaboration *over contract negotiation*
- Responding to change *over following a plan*

  That is, while there is value in the items on the right, we value the items on the left more

AGILE METHODOLOGIES:

Scrum: A popular methodology built upon 3 pillars of visibility, inspection, and adaptation, defining roles of Scrum Master, Product Owner and Team, practicing daily stand-up meetings. Iterations are Sprints, preceded by a planning meeting. Pull work from a prioritized backlog, and hold a retrospective at the end of each sprint.

Kanban: focuses on promoting visibility of the work-in-progress (WIP) and limiting the amount of WIP the team allows.

Lean: based on the seven principles of Eliminate Waste, Amplify Learning, Decide as Late as Possible, Deliver as Fast as Possible, Empower the Team, Build Integrity In, and See the Whole.

XP - eXtreme Programming: highly disciplined methodology that runs 1 week iterations, programmers work in pairs. XP defines roles of Coach, Customer, Programmer, Tracker, and Tester.

AGILE MANIFESTO 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.

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.
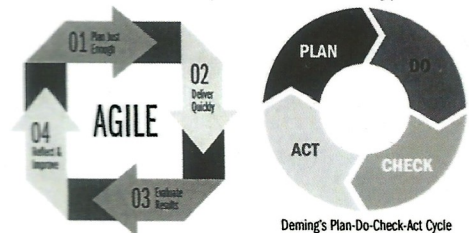
01 Plan Just Enough, 02 Deliver Quickly, 03 Evaluate Results, 04 Reflect & Improve — AGILE

PLAN, DO, CHECK, ACT — Deming's Plan-Do-Check-Act Cycle

PROJECT MANAGEMENT APPROACHES:

PREDICTIVE	HYBRID	AGILE
Waterfall / Sequential / Traditional		Adaptive / Iterative / Incremental
• Risk and cost to be controlled through planning	blend aspects of agile and predictive	• Risk and cost to be controlled through frequent small releases
• Requirements understood upfront		• Requirements evolving
• Stakeholders communicated with at major milestones		• Stakeholders deeply involved/engaged
• Change requests discouraged		• Change requests encouraged
• One big deliverable		• Frequent, small deliverables

PROJECT ROLES

Project Manager: in predictive, the person ultimately responsible for the project; authorized to spend budget and assign resources to realize project goals

Project Coordinator: a role weaker than a project manager; may assign project resources but not authorized to spend funds

Project Expediter: a role weaker than a project coordinator; reports on project progress without authority to assign resources or spend funds

Project Sponsor: responsible for funding the project; typically a senior manager; may or may not be the customer

Senior Management: a role higher in organization than the project manager; prioritize projects, authorize PM, resolve organization conflicts and issues

Stakeholder: a person or group who may influence the project or who has an interest in the project, whether positive or negative

Functional Manager: a department manager who "owns" project resources; administers human resource management responsibilities for employees

Project Office: a supporting or controlling department regarding methodologies, tools, standards, best practices, and audits

Program Manager: responsible for programs, coordinating several related projects to achieve a common goal

Product Owner: Agile role that represents the customer, users, and stakeholders; understands and advocates for feature value; maintains the product backlog; leads the first part of iteration planning meeting; 1 of 3 defined Scrum roles (1-Product Owner, 2-Team, 3-Scrum Master)

Customer: individual or organization to accept the deliverable; participates on agile team

Agile Project Manager / Coach / Team Facilitator / Team Lead: a servant leader who participates on the team in conspicuous ways: helps the team focus on and use agile principles; helps identify and remove obstacles and wasteful activities that could slow progress
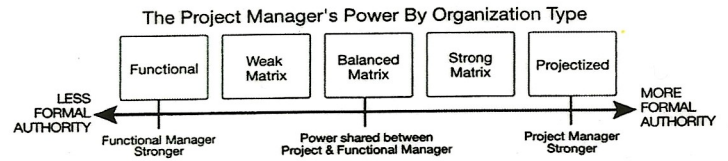
Team: group responsible for planning, executing, and monitoring and controlling the project; typically involves the sponsor; agile teams are empowered to make decisions for the project and often include the customer; 1 of 3 defined Scrum roles

Scrum Master: 1 of 3 defined Scrum roles; coach responsible for helping the team follow the Scrum process

Servant Leader: principle stating that leadership roles (e.g., Coach or Scrum Master) function best when they lead by serving the team, not asking anything of the team that they would not be willing to do themselves

Functional: team members work for a department; may be loaned to a project at times; little or no PM power

Projectized: PM is manager of projects and resources; has complete authority

Matrix: Combination with functional managers and project managers; PM has more power in Strong Matrix, equal in Balanced Matrix, and less in Weak Matrix

The Project Manager's Power By Organization Type

Functional | Weak Matrix | Balanced Matrix | Strong Matrix | Projectized

LESS FORMAL AUTHORITY ← → MORE FORMAL AUTHORITY

Functional Manager Stronger — Power shared between Project & Functional Manager — Project Manager Stronger

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PROCESS FRAMEWORK

Process groups are not project phases. Process groups are not linear; they are iterative.
Process names follow verb-noun structure (e.g., Define Scope).

PROCESSES (49):

KNOWLEDGE AREAS (10):	(# processes)	IN	PL	EX	MC	CL
Integration Management	7	1	1	2	2	1
Scope Management	6		4		2	
Schedule Management	6		5		1	
Cost Management	4		3		1	
Quality Management	3		1	1	1	
Resource Management	6		2	3	1	
Communications Management	3		1	1	1	
Risk Management	7		5	1	1	
Procurement Management	3		1	1	1	
Stakeholder Management	4	1	1	1	1	

PROCESS GROUPS (5):

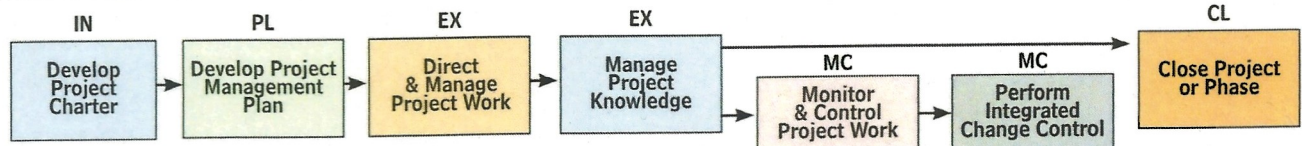|	(# processes)
INITIATING (IN)	2
PLANNING (PL)	24
EXECUTING (EX)	10
MONITORING AND CONTROLLING (MC)	12
CLOSING (CL)	1

COMMON PROCESS ITEMS:

INPUTS: Project Management Plan (PM Plan), Organizational Process Assets (OPAs), Project Documents, Enterprise Environmental Factors (EEFs), Project Charter, Agreements, Work Performance Data

TOOLS: Expert Judgment, Data Analysis, Meetings, Interpersonal & Team Skills, Data Gathering, Decision Making, Project Management Information System(PMIS), Data Representation

OUTPUTS: Updates (PM Plan, Project Documents, and OPAs), Change Requests, Work Performance Information

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INTEGRATION MANAGEMENT

	IN	PL	EX	EX	MC	MC	CL
	Develop Project Charter	Develop Project Management Plan	Direct & Manage Project Work	Manage Project Knowledge	Monitor & Control Project Work	Perform Integrated Change Control	Close Project or Phase

KEY:

INPUTS	Business Documents Agreements	Outputs from other processes	PM Plan Appr Change Reqs	Deliverables	PM Plan Work Performance Info Schedule Forecasts Cost Forecasts	Change Requests	Accepted Deliverables
TOOLS	(Common Tools)	(Common Tools)	(Common Tools)	Knowledge Mgmt Information Mgmt	(Common Tools)	(Common Tools)	(Common Tools)
OUTPUTS	Project Charter Assumption Log	PM Plan	Deliverables Work Performance Data Issue Log	Lessons Learned Reg.	Work Performance Reports	Appr Change Reqs Upd: Change Log	Final Transition Final Report Upd: Lessons Learned

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NOTES ABOUT INTEGRATION MANAGEMENT

Business Case: Market demand, business need, customer requirement, technology advance, legal requirement, ecological impact, social need

Project Selection Methods:
(Bigger is Better) Benefit-cost ratio, economic value add (Net Operating Profit After Tax - Cost of Capital), internal rate of return, present value, $(FV=PV(1+r)^{**}n)$, net present value, return on investment, return on invested capital (Net Income After Tax ÷ Invested Capital) **(Smaller is Better)** opportunity cost, payback period

Project Charter: Names & authorizes PM to expend resources to achieve project objectives (may include high-level requirements, milestones, and budget.)

PM Plan: Formal, approved document defining how project is managed, executed, and controlled **(19 components, see table at right)**

Project Management Information System (PMIS): system used to support management of the project from beginning to end, serving as a repository for information and a tool for communication and tracking

Work Authorization System: Part of the overall PMIS; ensures that project work gets done at the right time and in the right sequence; may be as informal as an email or as formal as a system to assign and log job work orders

Change Requests: Approved or rejected in Perform Integrated Change Control; PM should influence factors that cause change; PM should assess impact of changes on project and make decision

Close Project or Phase: This is the last process to be completed in each phase or in the project; finalize lessons learned, archive project documents, celebrate success, and release team

Continuous Integration: the practice of regularly checking in each team member's work and building and testing the entire system. The most rigorous methodologies do this daily with the goal of quickly catching systemic errors that may have been introduced

Daily Stand-Up Meeting: Agile projects make use of daily stand-up meetings, held each morning, so that team members can report on three general things:

1. What they have been working on since the last stand-up meeting
2. What they plan to do today
3. What obstacles they are encountering

| PM PLAN COMPONENT	PROCESS WHERE CREATED
Change Management Plan	Develop Project Management Plan
Configuration Management Plan	
Development Approach	
Performance Measurement Baseline	
Project Life Cycle Description	
Management Reviews	
Requirements Management Plan	Plan Scope Management
Scope Management Plan	
Scope Baseline	Create WBS
Schedule Management Plan	Plan Schedule Management
Schedule Baseline	Develop Schedule
Cost Management Plan	Plan Cost Management
Cost Baseline	Determine Budget
Quality Management Plan	Plan Quality Management
Resource Management Plan	Plan Resource Management
Communications Management Plan	Plan Communications Management
Risk Management Plan	Plan Risk Management
Procurement Management Plan	Plan Procurement Management
Stakeholder Engagement Plan	Plan Stakeholder Engagement

Definition of "Done:" a term that must be explicitly defined and agreed upon by the entire team. The definition of done is important so that each team member means exactly the same thing when they say that a piece of work is "done." The most common definition of done for a module is that it compiles and runs without error and passes all predefined acceptance tests and regression tests

Burndown/Burnup Charts: (Burndown Chart) in agile projects, a chart used to communicate progress during and at the end of an iteration. It shows the number of stories that have been completed and the ones that remain. The idea is that as the project progresses over time, the backlog of work will "burn down" or lessen. (Burnup Chart) The inverse of a burndown chart, showing functionality completed over time. Progress trends up as stories are completed and value is accumulated

Work-In-Progress (WIP): stories or tasks that have been started. WIP is typically openly displayed on an information radiator, and its progress is shown as it moves through the workflow

Empowerment: agile team able to make necessary decisions to add value; contrast to predictive teams asking permission or escalating decisions

Burndown Chart
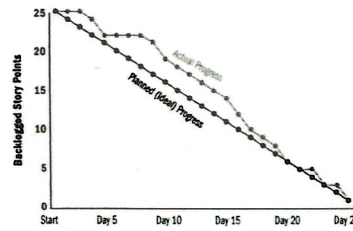
Iteration Retrospective: agile meeting after the iteration; review the process and the results and identify opportunities to improve them

Kanban Boards: display the workflow stages (e.g., Started, Designed, Coded, Tested, Done) and where the tasks are within that workflow

Spike: a quick experiment used to help the team answer a question and determine a path forward
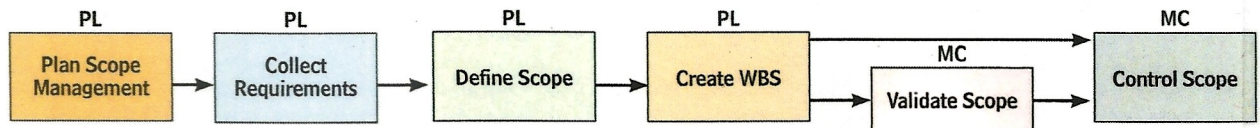
Swarming: agile collaboration technique where the entire team is focused on a single user story; may be used for the entire product backlog or simply for a single, challenging story

Test-First (Test-Driven) Development: agile-friendly dev practice where the acceptance tests for a module are defined before the module is written; code is then constructed around passing these tests so that it should only pass when it performs correctly

Timeboxing: Constraining the project or release by setting a firm delivery date; working to get as much value and functionality in the delivery as possible; also apply to agile events: Iteration Planning Meeting, Daily Stand-Up Meeting, & Iteration Retrospective

Value Stream Mapping: analyze process chain with the goal of eliminating waste; a Lean technique used to analyze the flow of materials and information through the system and to identify and eliminate waste

SCOPE MANAGEMENT

	PL	PL	PL	PL	MC	MC
	Plan Scope Management	Collect Requirements	Define Scope	Create WBS	Validate Scope	Control Scope

KEY:

INPUTS	(Common Inputs)	PM Plan	Requirements Doc.	PM Plan	Verified Deliverables	Work Perf Data
TOOLS	(Common Tools)	Decision Making Data Representation Data Gathering	Data Analysis: Alternatives Product analysis	Decomposition	Inspection	Data Analysis
OUTPUTS	Scope Management Plan Requirements Management Plan	Requirements Doc. Requirements Traceability Matrix	Project Scope Statement	Scope Baseline	Accepted Deliverables	Work Perf Info

NOTES ABOUT
SCOPE MANAGEMENT

Delphi Technique: Gathering expert opinion without participants knowing who else is being polled; prevents biasing opinions and groupthink

Nominal Group Technique: Brainstormed ideas are voted upon and ranked by priority

Decision Making: Voting (Unanimity, majority, consensus, plurality, and dictatorship)

Project Scope Statement: in predictive projects, document stating requirements by describing objectives, deliverables, boundaries, and acceptance criteria

Decomposition: Breaking down scope statement (project deliverables) into progressively smaller pieces

WBS (Work Breakdown Structure): An hierarchical decomposition of deliverables to increasingly more detail for better estimating, assignment, and tracking; each node has a unique number; Work Packages are the lowest level nodes, decomposed low enough to be estimated (cost & time) and assigned (see diagram below)

Work Breakdown Structure (WBS)
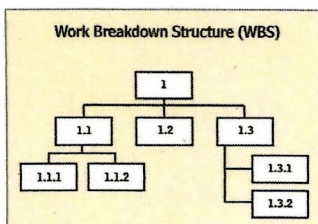
Scope Baseline: A combination of the original WBS, WBS dictionary, and project scope statement plus all approved changes

Customer Value: worth project delivers to business; adding value drives most agile team decisions; Product Owner prioritizes product backlog stories by customer value—interpreted by the Product Owner—to be delivered early and continuously

Product Vision: describes what the product will be, why it is being developed, who would use it, why someone would pay for it, and where it fits in the marketplace

Product Roadmap: (agile) overview of current and/or planned product functionality; less detail than the release plan

Product Backlog: all known features to be implemented in the agile project, regardless of planned iteration or release

DEEP: acronym describing desirable attributes of a product backlog; standing for: (D)etailed Appropriately, (E)stimable, (E)mergent, (P)rioritized

User Story: an agile concept; 1 or more business requirements that will add value to the user; relatively small in terms of implementation effort; typically captured on story cards—stated in terms of business functionality and not in technical terms, remaining negotiable even after being written: "As a ___, I need ___, So that ___."

Story Card: index card holding the user story; format limits amount of detail and advance planning by team; often with acceptance criteria / test cases on back

INVEST: acronym describing the desirable attributes of a good user story, standing for (I)ndependent, (N)egotiable, (V)aluable, (E)stimable, (S)mall, and (T)estable

Story Map: group of backlogged stories organized by user functionality to help set development priorities

Theme: main purpose or focus behind a group of stories, iteration, or release (e.g., "Reporting" or "Connectivity")

Feature: a group of stories that delivers value to the customer

Functionality: an action that a system performs that adds value to the customer or user; if the user cannot see or experience something, then it does not count as functionality

Minimal Marketable Feature (MMF): smallest deliverable that can add value to users, typically comprised of a group of user stories; allows the team to focus on small set of valuable functionality to quickly deliver

Persona, Extreme Persona: imaginary identity created by the team to model interactions with the system in order to gather requirements

Wireframe: lightweight, non-functional user interface design showing major interface elements and interaction; provides idea of how the system might function-- without the team having to write functional code

Grooming: refining the product backlog by removing, reprioritizing, disaggregating, estimating, or risk-adjusting items

Epic Story: very large story that may span iterations; disaggregate into component user stories before using at a tactical level

Disaggregation: breaking down epics or large stories into smaller user stories; similar to decomposition on predictive projects

|	PL	PL	PL	PL	PL	MC
	Plan Schedule Management	**Define Activities**	**Sequence Activities**	**Estimate Activity Durations**	**Develop Schedule**	**Control Schedule**

KEY:

INPUTS	(Common Inputs)	Schedule Mgt Plan Scope Baseline	Activity list Milestone list	Activity list Resource calendars Resource requirements	Activity list Project schedule network diagrams Duration estimates	(Common Inputs)
TOOLS	(Common Tools)	Decomposition Rolling wave planning	Precedence diagram method Dependency determination and integration Leads & Lags	Analogous (top-down) estimating Parametric estimating 3-Point estimating Bottom-up estimating	Critical path method Resource optimization Leads & Lags Schedule compression Agile release planning	Iteration Burndown Chart (Data analysis)
OUTPUTS	Schedule Mgmt Plan	Activity list Activity attributes	Project schedule network diagrams	Duration estimates	Project schedule Schedule Baseline	Work Perf Information Schedule forecasts Change requests

NOTES ABOUT:
SCHEDULE MANAGEMENT

Project Schedule Network Diagram: a diagram of the schedule activities in the order in which they must be performed.
(see diagram 4)
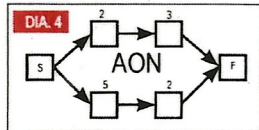
Precedence Diagramming Method (PDM): network diagram where activities are represented by the nodes and the arrows are dependencies; also called AON (Activity-On-Node)

Types of Dependencies: Mandatory (hard logic), Discretionary (preferred or soft logic), Internal (within the project's control), and External (beyond or outside of project control)

Logical Relationships: dependencies between two activities where one activity must be started or finished before another activity can be started or finished; 4 types: Finish-to-Start, Finish-to-Finish, Start-to-Finish, Start-to-Start (e.g., F-S: Task A must finish before Task B can start)

Lead: starting an activity prior to the finish of a preceding activity

Lag: delaying the start of an activity after the finish of a preceding activity

Estimating, Analogous: (also called top-down) using historical information from similar projects/activities to estimate effort, duration, or cost

Estimating, Bottom-up: estimating effort, duration, or costs at lowest levels of WBS and aggregating up to summary WBS nodes

Estimating, Parametric: estimating effort, duration, or costs using past performance information; best on scalable or linear components; unit time or cost × number of units; e.g. 4 resources are required to clear 1 acre in 1 day, therefore 16 resources could clear 4 acres in 1 day

Estimating, Three-Point: simple (triangular) or weighted (beta) average of effort, duration, or cost (beta is also called PERT estimate); Formula: (Pessimistic + 4 × Realistic + Optimistic) ÷ 6; the standard deviation of this probabilistic estimate is calculated as (Pessimistic - Optimistic) ÷ 6

Network Path: a series of schedule activities having a relationship that carries through from the project's start to finish

Agile Release Planning: adaptive projects use a product backlog to create an iterative release of features/stories

Critical Path: the path(s) of schedule activities where the delay of any one activity would delay the project finish; the path of highest schedule risk; the path of longest duration

Float (Slack): the amount of time a schedule activity could be delayed without delaying the project finish
(see diagram 5)
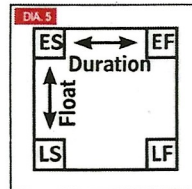
Free Float: the amount of time a schedule activity could be delayed without delaying the early start (ES) of a subsequent activity

Negative Float: the situation of a schedule activity's early finish (EF) being after a subsequent activity's early start (ES)

Critical Path Method (CPM): schedule analysis to determine the critical path, overall schedule, and each activity's float

Critical Chain Method (CCM): aggressive schedule management based on managing schedule buffers and keeping resources fully applied (Eliyahu Goldratt)

Schedule Compression: Crashing (adding resources & cost) or Fast Tracking (adjusting dependencies and increasing risk) to shorten the overall schedule

Resource Optimization: Smoothing or leveling - Adjusting resources to the level of resources available; balancing loading

Simulation: Monte Carlo analysis/simulation - compute large numbers of possible scenarios related to schedule; what are the highest risks?

What-If: Analyze the impact of events or scenarios; Is the current plan practical? What changes or reserves are appropriate?

Milestone Schedule: a high-level schedule showing only significant schedule points

Gantt Chart (bar chart): a schedule using horizontal bars to represent activities; the bar length represents activity duration; placement represents start and finish dates

Project Schedule: when activities should take place, what order, what durations, milestones, what resources.

Schedule Baseline: a formal version of the project schedule that is placed under control; the schedule baseline is a component of the project plan

Iteration: cycle of work repeated on agile projects (planning session, period of work, and retrospective). Agile principle #3 states that iterations are from 2 weeks to 2 months; XP methodology condenses them to 1 week

Sprint: iteration on a Scrum project that lasts between 1 week and 1 month

Hardening Iteration: building in an iteration prior to a significant release where no new development, functionality, or value is planned; instead, team tests functionality and integration of developed features from previous iterations to ensure solid functionality

Iteration Backlog: work that is committed in an iteration; expected to "burn down" throughout the iteration (do not confuse with product backlog)

Velocity: the number of story points that a team delivers per iteration; a measure of productivity

Release: packaged group of stable deliverables designed to be delivered to customers

Release Plan: agile non-binding expectation of what future iteration increments will be combined into releases to the customer

AGILE ESTIMATING:

Relative Sizing: estimating the size of a story based on the size of another; e.g., ordering stories from most-difficult to least-difficult without estimating effort or duration

Wideband Delphi Estimating: estimating technique where team comes together for presentation of stories and discusses challenges, estimates in private. Story estimates are plotted on chart with no names, range of points is discussed; then another round of estimates; team attempts consensus

Planning Poker: team individually estimates effort to deliver story by writing the estimate on a card; each team member simultaneously turns over card, and discussion is focused on high and low estimates for understanding; team discusses and repeats as needed until estimates are in line. Estimates may be for hours, a number of days, ideal days, affinity estimates, or points from the modified Fibonacci sequence

Fibonacci Sequence: sequence of numbers used in agile estimating; calculated by beginning with the series: 0, 1, and adding the previous two numbers together to get the next number, often simplified/modified as 0, 1, 2, 3, 5, 8, 13, 20, 40, 100

Affinity Estimating: rapidly estimate a large feature backlog–using shirt sizes, coffee cup sizes, or the Fibonacci sequence to place stories into similarly-sized groups

Ideal Time: amount of time an assignment would take with no interruptions or distractions. Some agile estimates use ideal time rather than actual time

Story Point: unit of measure to express the estimated difficulty (effort) of a story. Story points may be expressed in hours, days, as shirt sizes (XS, S, M, L, XL, XXL), or as a number of the Fibonacci sequence

COST MANAGEMENT
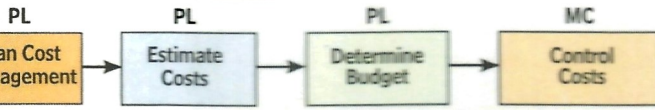
KEY:	PL	PL	PL	MC
	Plan Cost Management	Estimate Costs	Determine Budget	Control Costs
INPUTS	(Common Inputs)	(Common Inputs)	Cost estimates / Agreements	PM Plan (Cost Baseline) / Project funding requirements
TOOLS	(Common Tools)	Analogous (top-down) estimating / Parametric estimating / 3-Point estimating / Bottom-up estimating	Cost aggregation / Funding limit reconciliation	Earned value analysis (Data analysis) / To-Complete Performance Index (TCPI)
OUTPUTS	Cost Management Plan	Cost estimates	Cost Baseline / Project funding requirements	Work Performance Information / Cost forecasts

EARNED VALUE FORMULAS

BAC	Budget At Completion	Total budget
PV	Planned Value (BCWS)	Planned % Complete × BAC
EV	Earned Value (BCWP)	Actual % Complete × BAC
AC	Actual Cost (ACWP)	Sum of actual costs
CV	Cost Variance	EV - AC
SV	Schedule Variance	EV - PV
SPI	Schedule Performance Index	EV ÷ PV
CPI	Cost Performance Index	EV ÷ AC
EAC	Estimate At Completion	BAC ÷ CPI
ETC	Estimate To Completion	EAC - AC
VAC	Variance At Completion	BAC - EAC
TCPI	To-Complete Performance Index	(BAC-EV) ÷ Remaining Funds

NOTES ABOUT
COST MANAGEMENT

Life-cycle Costing: looking at total cost of ownership from purchase (creation) through operations to disposal

Value Engineering: getting the most project value in cost, quality, schedule, and benefit without sacrificing scope

Cost Aggregation: rolling up activity costs to accounting periods or the WBS node where they will be managed

Cost Baseline: what costs will be incurred in the project (the S-curve is the cumulative sum of the budgeted costs over the project life; costs start slowly, accelerate, then taper off, forming an S pattern)

Funding Limit Reconciliation: adjusting project costs and timeframes to fit within funding availability timeframes; typically funding requirements differ from the cost baseline by Management reserve

Cumulative: from the start of the project up to a point in time (e.g., CPI at the end of month 5, or total actual costs to date); sometimes notated using a superscript - e.g., (CPI^c or AC^c); Cumulative CPI: $CPI^c = EV^c ÷ AC^c$

Variance: Difference between planned and actual; target value is 0; positive is good, negative is bad

Performance Index: Ratio of planned to actual; target value is 1; greater than 1 is good, less than 1 is bad; never negative

Forecast: EAC, ETC, and VAC are all forecasted values

Periodic: opposite of cumulative; for a given period of time (e.g., CPI during month 2, or planned % complete in month 6)

Working Efficiency: SPI, schedule performance index, optimally 1

To-Complete Performance Index: spending efficiency required to meet targeted financial goals (usually greater than 1 if CPI is less than 1, or less than 1 if CPI is greater than 1); calculated (in terms of money) as remaining work (BAC-EV) divided by remaining funds (BAC-AC), when BAC is the targeted finish goal; if the targeted finish goal is EAC, then TCPI is calculated as (BAC-EV) ÷ (EAC-AC)

Variance Analysis: Measuring the difference between planned and actual (costs or durations); variances are optimally zero (on budget and/or on schedule)

Spending Efficiency: CPI, cost performance index, optimally 1
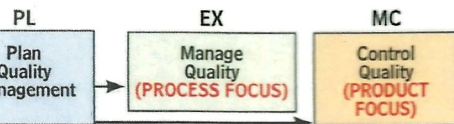
Project Budget: the cost baseline plus management reserve

Management reserve: project-level contingency for unknown unknowns (risk)

TYPE OF ESTIMATE	TYPICAL RANGE
Rough Order of Magnitude	-25% to +75%
Preliminary	-20% to +30%
Definitive	-5% to +10%

Burn Rate: rate project consumes finances—negative cash flow; often used by agile projects to budget costs for planned iterations–often calculated by adding up team cost—a meaningful metric (e.g., cost per iteration, cost per week, cost per month)

QUALITY MANAGEMENT

QUALITY: the degree to which a set of inherent characteristics fulfills requirements

KEY:	PL	EX	MC
	Plan Quality Management	Manage Quality (PROCESS FOCUS)	Control Quality (PRODUCT FOCUS)
INPUTS	(Common Inputs)	(Common Inputs)	Deliverables / Project documents
TOOLS	Data gathering / Data analysis / Decision making / Data representation / Test & inspection planning	Data analysis / Data representation / Audits / Design for X / Quality improvement methods	Inspection / Data gathering / Data representation
OUTPUTS	Quality Management Plan / Quality metrics	Quality reports / Test & evaluation documents	Verified deliverables / Quality control measurements

Data Gathering: Benchmarking, Brainstorming, Check sheets, Checklists, Interviews, Statistical sampling

Data Analysis: Alternatives analysis, Cost of quality, Cost-benefit analysis, Document analysis, Performance reviews, Process analysis

Data Representation: Affinity diagrams, Cause-and-effect diagrams, Control charts, Flowcharts, Histograms, Logical data model, Matrix diagrams, Mind mapping, Scatter diagrams

NOTES ABOUT
QUALITY MANAGEMENT

Prevention Over Inspection: current quality philosophy based on the fact that it is less expensive to prevent an error than to fix one

TQM (Total Qual Mgmt): everyone in organization is responsible for quality

Continuous improvement (Kaizen): constant process improvement; small changes

JIT (Just-In-Time): near-zero inventory; no spares on hand to waste

ISO 9000: certification that organization documents and follows processes

Six Sigma: 3.4 defects per million; 99.99966% meet specifications

Three Sigma: 2700 defects per million; 99.73% meet specifications

One Sigma: 317,500 defects per million; 68.25% meet specifications

Design for X (Excellence): where X is the top priority of the design goal; e.g., DfC - Cost

Mutually Exclusive: one choice or result excludes other possibilities

Statistical Independence: 2 outcomes are not dependent on each other

Probability Distribution: table or graph showing mathematical possibility of an event's occurring

Standard Deviation (sigma): a measure of diversity of data observations

Cost of Quality (COQ): quality planning and appraisal costs

Control Chart: graph of samples to determine if process is in control or product is in spec

Run Chart: graph of a statistic over time to depict change

Statistical Sampling: random sampling to cut costs of 100% sample

Benchmarking: comparing project quality standards to those of other projects

Flowcharting: depicting relationships of components in a process

Pareto Chart: depicting causes descendingly ranked by number of problems resulting from the respective causes; a form of histogram

Scatter Diagram: plot of data points against 2 variables to depict possible statistical correlation or dependence of the variables

Cause-and-Effect Diagram: AKA Fishbone, Ishikawa, or Root-Cause Diagram; analyzing and relating potential underlying causes to an effect or result

Audits: Project reviews to evaluate which processes should be improved and which meet quality standards; improve product acceptance and cost of quality

Quality improvement methods: two examples are Plan-Do-Check-Act and Six Sigma

Refactoring: improving the design of source code so that it is easier to test, debug, and maintain; reorganization of working code should not have noticeable effects on functionality or performance

CAUSE-AND-EFFECT DIAGRAM · CONTROL CHART · PARETO CHART (HISTOGRAM) · RUN CHART · SCATTER DIAGRAM · PROBABILITY DISTRIBUTION · FLOWCHART

RESOURCE MANAGEMENT

KEY:	PL Plan Resource Management	PL Estimate Activity Resources	EX Acquire Resources	EX Develop Team	EX Manage Team	MC Control Resources
INPUTS	(Common Inputs)	(Common Inputs)	(Common Inputs)	(Common Inputs)	Team performance assessments / Work Performance Reports	Work Performance Data
TOOLS	Org. theory / Data representation	Analogous estimating / Parametric estimating / Bottom-up estimating / Data analysis	Pre-assignment / Decision making / Virtual teams	Colocation / Virtual Teams / Recognition & rewards / Individual & team assessments / Interpers & team skills	Interpersonal & team skills	Problem solving / Data analysis
OUTPUTS	Resource Management Plan / Team Charter	Resource requirements / Resource breakdown structure	Physical resource assignments / Project team assignments / Resource calendars	Team performance assessments	Change requests	Work Performance Information

MOTIVATIONAL THEORIES

Maslow's Hierarchy of Needs: 5 categories of needs exist in an hierarchy; meeting needs in one category does not motivate unless the lower level needs are already met

Herzberg's Motivation-Hygiene: hygiene factors do not motivate but must be present for motivational factors to function
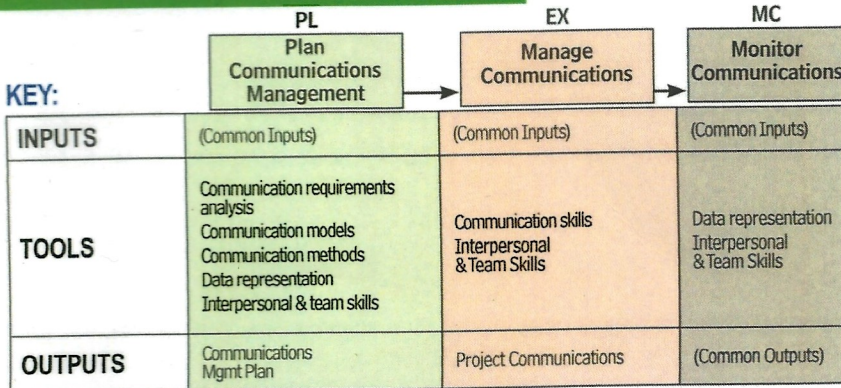
McGregor's Theory-X & Theory-Y: X-mgrs believe constant supervision is necessary; Y-mgrs believe people can be trusted to work

Fiedler's Contingency: effectiveness of a leader's style (task- or relationship-oriented) is contingent on the situation

McClelland's Theory of Needs: workers may be motivated by meeting their varying degrees of need for (1) achievement, (2) power, or (3) affiliation

Expectancy (Vroom): the realistic (believable) expectation of a reward is a motivator

Resource Management Plan: includes resource ID, acquiring resources, and staffing roles and responsibilities; includes both people and physical resources; resource histogram; release plan; training needs; rewards systems; safety; compliance

RAM (Responsibility Assignment Matrix): work packages in row headings and roles in column headings (Org Brkdn Struct); checked cells relate work to roles

RACI Chart: specific type of RAM; cells contain 'R' Responsible, 'A' Accountable, 'C' Consult, or 'I' Inform (relating role to work package)

Generalizing Specialist – "T-shaped" skills: type of team member favored on agile projects; highly interchangeable, if one team member falls behind, another can step in; usually seasoned professionals, "T-shaped" due to a depth of knowledge in a specific area plus broad skills in other areas; a specialist with deep, narrow expertise may be referred to as "i-shaped"

Self-Organizing: assembling an agile team and allowing the members to determine how their efforts would be best put to use, not heavily managed or directed; formed more organically, highly autonomous, and do not have the role of traditional project manager

Forms of Power
Reward (best)
Expert (best)
Legitimate
Referent
Punishment (worst)

Sources of Project Conflict
Schedules
Priorities
Resources

Methods of Conflict Resolution
Problem-solving* (Confrontation)*
Collaboration*
Compromise (Reconcile)
Forcing
Smoothing (Accommodating)
Withdrawal (Avoidance)
*Most effective methods

Interpersonal & Team Skills
Conflict management
Decision making
Emotional intelligence
Influencing
Leadership
Motivation
Negotiation
Team building

COMMUNICATIONS MANAGEMENT

KEY:	PL Plan Communications Management	EX Manage Communications	MC Monitor Communications
INPUTS	(Common Inputs)	(Common Inputs)	(Common Inputs)
TOOLS	Communication requirements analysis / Communication models / Communication methods / Data representation / Interpersonal & team skills	Communication skills / Interpersonal & Team Skills	Data representation / Interpersonal & Team Skills
OUTPUTS	Communications Mgmt Plan	Project Communications	(Common Outputs)

NOTES ABOUT COMMUNICATIONS MANAGEMENT

1. An effective project manager spends 90% of time communicating (50% with the team), the most important PM skill!

2. Be proactive and thorough, always in control of the process, and always distributing accurate information in a timely manner to the right audience, always deal with the problem, always communicate directly, always tell the truth

3. Communications Management Plan contains the following: Who sends and receives, What is sent, How it is sent, How often it is updated, and a Glossary of terms

No. of Communication Channels: $n(n-1) \div 2$, where n is the number of people on the project

Communication Model:
Sender: Encode, Select method, Send, Confirm reception and understanding
Receiver: Decode, Acknowledge, Respond with feedback

Communication Strategies: Interactive, Push, Pull

Communication Methods: Informal / Formal; Written / Oral

Contract-related Communications: Formal & Written

Feedback: verbal & nonverbal cues from listener to acknowledge comprehension of the message

Nonverbal Communications: body language, posture, facial expressions, hand motions; most face-to-face communication is nonverbal

Paralingual: vocal but not verbal - tone of voice, volume, pitch

Communication Skills: Feedback, Nonverbal, Presentations, Clarity of message, Negotiating, Persuasion, Motivation, Coaching

Interpersonal & Team Skills (Communications): Active listening, Conflict mgmt, Cultural awareness, Meeting mgmt, Networking, Political awareness, Observation and conversation (MBWA)

Osmotic Communications: where the team benefits from and absorbs information gleaned from other conversations
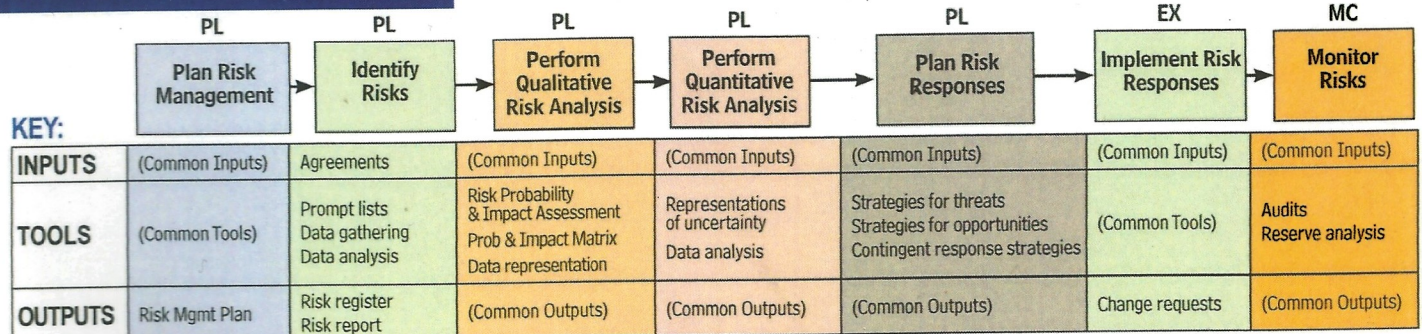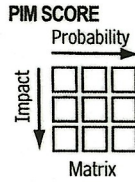
Information Radiator: group of artifacts used to communicate project status to team/stakeholders; important part of maintaining transparency and visibility of team's progress

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RISK MANAGEMENT

| KEY:	PL Plan Risk Management	PL Identify Risks	PL Perform Qualitative Risk Analysis	PL Perform Quantitative Risk Analysis	PL Plan Risk Responses	EX Implement Risk Responses	MC Monitor Risks
INPUTS	(Common Inputs)	Agreements	(Common Inputs)	(Common Inputs)	(Common Inputs)	(Common Inputs)	(Common Inputs)
TOOLS	(Common Tools)	Prompt lists / Data gathering / Data analysis	Risk Probability & Impact Assessment / Prob & Impact Matrix / Data representation	Representations of uncertainty / Data analysis	Strategies for threats / Strategies for opportunities / Contingent response strategies	(Common Tools)	Audits / Reserve analysis
OUTPUTS	Risk Mgmt Plan	Risk register / Risk report	(Common Outputs)	(Common Outputs)	(Common Outputs)	Change requests	(Common Outputs)

NOTES ABOUT
RISK MANAGEMENT

Risks: Uncertainties

Can be good or bad;

Positive (good) risks are opportunities;

Negative (bad) risks are threats

PIM SCORE

Probability

Impact

Matrix

OPPORTUNITY STRATEGIES	THREAT STRATEGIES
Escalate	Escalate
Exploit (100%)	Avoid (0%)
Share	Transfer
Enhance	Mitigate
Accept: Actively or Passively	

EXPECTED MONETARY VALUE (EMV)

Project → 70% → A ($0)

Project → 30% → B (−$1000) → 85% → C ($0)

B → 15% → D (−$500)
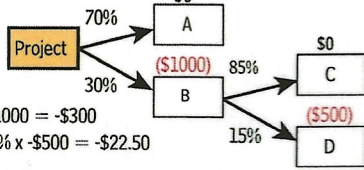
EMV(B) = 30% x -$1000 = -$300
EMV(D) = 30% x 15% x -$500 = -$22.50

Risk Parameters: urgency, proximity, dormancy, manageability, controllability, detectability, connectivity, strategic impact, propinquity

Project Risks:

Individual- uncertainty about a specific objective

Overall- uncertainty about project success

Tailored Risk Approach: adjusted to fit with the factors that influence your project

Risk Breakdown Structure: contained in Risk Mgmt Plan; categorizes risks (does not contain actual risks)

Risk Register: list of all identified risks, causes, owners, responses, categories

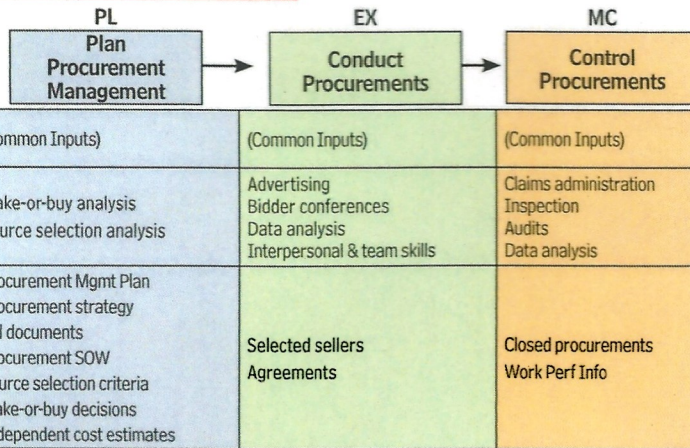**Prompt list:** question framework, e.g., TECOP (technical, environmental, commercial, operational, political)

Risk Report: summary document of factors contributing to risk and high-level information on identified risks

Data Analysis (Risk):

Alternatives analysis
Assessment of other risk parameters
Assumption & constraint analysis
Cost-benefit analysis
Decision tree analysis
Document analysis
Influence diagrams
Reserve analysis
Risk data quality assessment
Root cause analysis
Sensitivity analysis
Simulation
Stakeholder analysis
SWOT analysis
Technical performance analysis

PROCUREMENT MANAGEMENT

KEY:	PL — Plan Procurement Management	EX — Conduct Procurements	MC — Control Procurements
INPUTS	(Common Inputs)	(Common Inputs)	(Common Inputs)
TOOLS	Make-or-buy analysis, Source selection analysis	Advertising, Bidder conferences, Data analysis, Interpersonal & team skills	Claims administration, Inspection, Audits, Data analysis
OUTPUTS	Procurement Mgmt Plan, Procurement strategy, Bid documents, Procurement SOW, Source selection criteria, Make-or-buy decisions, Independent cost estimates	Selected sellers, Agreements	Closed procurements, Work Perf Info

CONTRACT TYPES	RISK
Fixed Price	
Firm Fixed Price	Seller
Fixed Price w/ Economic Price Adjustment	Seller
Fixed Price Incentive Fee	Shared
Cost Reimbursable	
Cost Plus Fixed Fee	Buyer
Cost Plus Incentive Fee	Shared
Cost Plus Award Fee	Buyer
Time & Materials	Buyer

All contracts and related change requests and communications are formal and written.

NOTES ABOUT
PROCUREMENT MANAGEMENT

Source Selection Analysis: Least cost, Qualifications only, Quality-based, Quality- and Cost-based, Sole source, Fixed budget

Statement of Work: explains scope to potential sellers so they can decide if they want to bid, or if they are qualified to bid

Bidder conference: level playing field of information to potential sellers; open, no secrets, no favored vendors

Bid documents: RFP, RFQ, IFB

ADR: Alternative Dispute Resolution, mediation or arbitration to resolve claims

Inspection: focus on the product and conformance to specifications

Closed procurements: buyer sends seller formal, written notice that contract is complete

Independent cost estimates: sanity check to ensure costs are in line

Claim: disputes between contract parties
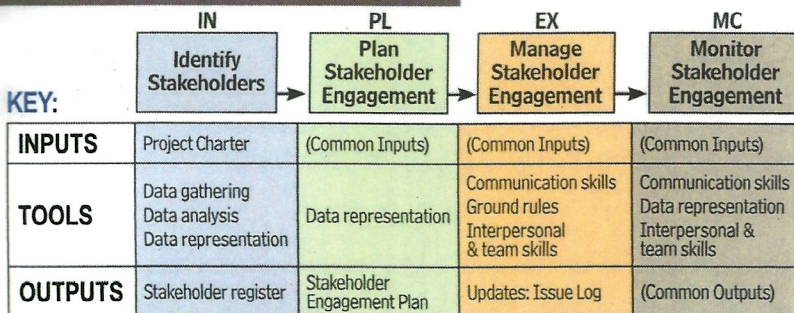
Price = Cost + Fee (or Profit)

Audits: focus on the process

Point of Total Assumption: the cost point at which the seller assumes 100% of the risk of additional cost increases

PTA = ((Ceiling Price - Target Price) ÷ Buyer's Share) + Target Cost

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STAKEHOLDER MANAGEMENT

KEY:	IN — Identify Stakeholders	PL — Plan Stakeholder Engagement	EX — Manage Stakeholder Engagement	MC — Monitor Stakeholder Engagement
INPUTS	Project Charter	(Common Inputs)	(Common Inputs)	(Common Inputs)
TOOLS	Data gathering, Data analysis, Data representation	Data representation	Communication skills, Ground rules, Interpersonal & team skills	Communication skills, Data representation, Interpersonal & team skills
OUTPUTS	Stakeholder register	Stakeholder Engagement Plan	Updates: Issue Log	(Common Outputs)

Stakeholder Analysis Grid

(Interest vs Influence grid — Low to High)
- Examine Occasionally (High Interest, Low Influence)
- Engage Heavily (High Interest, High Influence)
- Keep Informed (Low Interest, Low Influence)
- Keep Satisfied (Low Interest, High Influence)

NOTES ABOUT
STAKEHOLDER MANAGEMENT

"The creation and maintenance of relationships with the aim to satisfy needs"

Stakeholder:
(1) Anyone with an interest in the project - positive or negative
(2) Anyone who creates or causes a need, is affected by the need, or would be affected by the solution

Collaboration: Working together, sharing tools and information to create a work product or result; agile values favor customer collaboration

Agile stakeholders: not viewed as people who must be kept informed; instead, they are engaged and treated as integral parts of the overall solution
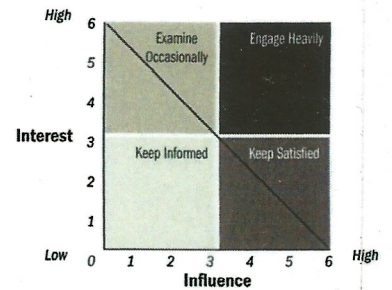
Stakeholder Engagement Assessment Matrix:
Chart the current and desired levels of engagement of each stakeholder

Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
Carla T.			Current →		→ Desired
Siva S.			Current →	→ Desired	
Ken P.	Current →			→ Desired	

For more info visit www.velociteach.com

EXAM TIPS

BEFORE THE EXAM:

1. Practice listing essential formulas (earned value, PERT and standard deviation, comm channels, and PTA) so you can list on scratch paper at the start of the exam.

2. Find the testing center the previous day to eliminate anxiety on exam day. Plan to arrive 30 minutes early.

3. Do not stay up late and cram the night before the exam; get a full night's rest.

4. Prepare a snack to bring if you need to eat something for energy during an exam break.

5. Ensure the name on your identification (2 forms, 1 government issued with photo) matches the name on your PMP® application.

6. The roles and responsibilities of the **Project Management Professional (PMP)®** are reflected in the three areas of People, Process, and Business Environment. Be familiar with this exam structure to prepare for scenario-based questions:
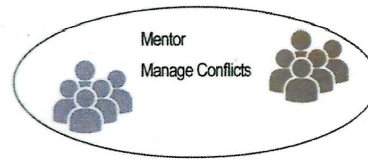
Business Environment 8%
People 42%
Process 50%
Predictive 50%
Hybrid 27%
Agile 23%
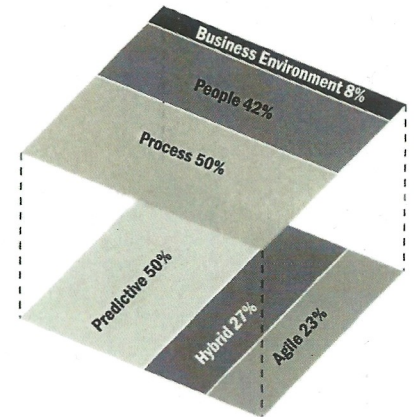
50% PROCESS

Plan approach
Establish governance
Integrate planning
Plan & Manage Scope
Plan & Manage Schedule
Plan & Manage Budget & Resources
Plan & Manage Quality
Plan & Manage Procurement
Plan & Manage Closure

Engage Stakeholders
Manage Communications
Manage Risks
Manage Issues
Manage Change
Manage Artifacts
Transfer Knowledge

Deliver business value urgently

In
Out
Tools

42% PEOPLE

Build a **TEAM**
  Sponsor ground rules
  Facilitate virtual teams
  Provide training
Lead a **TEAM**
  Support team performance
  Empower team members
  Apply emotional intelligence
  Manage obstacles

Mentor
Manage Conflicts

Collaborate with **STAKEHOLDERS**
Build understanding
Negotiate

8% BUSINESS ENVIRONMENT

Plan & manage **Compliance**
  • Requirements   • Approach
  • Categories   • Methods
  • Threats   • Measure
  • Consequences

Evaluate & deliver **Benefits & Value**
  • Identify   • Deliver
  • Agree   • Report
  • Measure

Support **Organizational Change**
  • Assess Culture
  • Assess impact of:
    • Change on Project
    • Project on Org

Evaluate & address **external business change**
  • Survey changes   • Impact on scope
  • Continual Review   • Scope changes
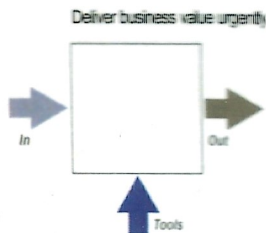
DURING THE EXAM:

CONSIDER THE PROJECT APPROACH: if the question context or terminology guides you to predictive or agile, follow the approach when selecting the best response.

ALWAYS FOLLOW THE PROCESS FRAMEWORK: Use outputs & inputs to help sequence processes correctly; don't be pressured to bypass a process.

DON'T TAKE THE EASY WAY OUT: Choose the answer that does not include shortcuts or skipping process steps. Do the work!

ACT DIRECTLY AND SAY WHAT YOU MEAN: Be proactive & timely; base decisions on current information; do not pass on the responsibility as PM.

KNOW THE PROJECT ROLES AND ORG TYPES: The predictive PM should always make the decision (do not delegate decision-making). Understand the various agile project roles.

DON'T GET STUCK: If a question will take several minutes to answer, mark it for review and come back to it later to not run out of exam time.

FORMULA SHEET: After exam begins, use 5 - 10 minutes to create a formula sheet on the scratch paper.

BUDGET YOUR TIME: Target an initial pace of 75 questions in 45 minutes; budget 45 minutes for the last 50 questions and the ones skipped.

MANAGE YOUR REVIEW: (1) Did you read the question correctly? (2) Does the answer match the question's logic? (3) Check your math.

MANAGE ANXIETY: If you begin to feel anxious, stop, take a deep breath, hold it for 6 seconds, and release it slowly. Or, take a quick break!

READ ALL FOUR ANSWERS AND CHOOSE THE BEST ONE: They may all be good answers; one is the BEST answer even if it is not the PERFECT answer.

READ THE END OF THE QUESTION FIRST: It may be a simple question, or it may provide better comprehension as the full question is read.

USE YOUR INSTINCTS TO ELIMINATE WRONG ANSWERS: Increase the probability of a correct guess by narrowing the choices.

INVESTIGATE FIRST: When facing a decision, FIRST find out, evaluate, assess, research, determine, understand, or investigate before deciding.

FOLLOW THE AGILE MANIFESTO VALUES AND PRINCIPLES: stick closely to the Values and the Principles behind the Agile Manifesto.

FOLLOW CODE OF CONDUCT GUIDELINES:
  • Be fair to everyone and respect the differences of the group.
  • Resolve stakeholder conflict in favor of the customer.
  Be open and honest about the resolution. Don't hide things from one stakeholder in order to please another.
  • Do the ethical thing in all decisions.